M.O.P. VAISHNAV COLLEGE FOR WOMEN (AUTONOMOUS)
CHENNAI - 600034
(College affiliated to University of Madras and Re-accredited at "A++" Grade by NAAC)

DEPARTMENT OF MANAGEMENT STUDIES (B.B.A.)

International Seminar
and
Annual National Level Student Paper
Presentation Competition

2023-2024

# MONOGRAPH

# AUGMENTED REALITY

## The Biggest Technological Revolution

Proceedings of the

# International Seminar and National Level Student Paper Presentation Competition

on

# AUGMENTED REALITY

## The Biggest Technological Revolution

on

**15th FEBRUARY, 2024**

ORGANISED BY

**DEPARTMENT OF MANAGEMENT STUDIES (B.B.A.)**

## M.O.P. VAISHNAV COLLEGE FOR WOMEN (Autonomous)

(College affiliated to University of Madras and Re-accredited at "A++" grade by NAAC)

**Chief Editor - Dr.Archna Prasad**

Edition : First & Volume – 1

Month and Year : February 2024

ISBN : 978-81-970500-1-5

**Published by**

M.O.P. VAISHNAV COLLEGE FOR WOMEN (Autonomous)

Chennai – 600 034, Tamil Nadu, India

Email: mopvaishnav@mopvc.edu.in

https://mopvc.edu.in/




**Disclaimer**

The authors are solely responsible for the contents of the documents compiled in this volume. Publisher, editors and reviewers do not accept any legal responsibility for errors, omissions or claims, nor do they provide any warranty, express or implied, with respect to information published.

## ABOUT THE SEMINAR

Augmented Reality (AR) is a revolutionary technology that blends the physical world with digital information, creating an enhanced and interactive user experience. Unlike virtual reality, which immerses users entirely in a digital environment, AR overlays digital content onto the real world in real-time. This is typically achieved through the use of devices such as smartphones, tablets, smart glasses, or dedicated AR hardware. AR applications span various industries, including gaming, healthcare, education, manufacturing, and more. AR has the potential to transform how we perceive and interact with the world, offering innovative solutions for training, navigation, visualization, and entertainment. As technology continues to advance, the impact and integration of augmented reality are expected to play a significant role in shaping the future of human-computer interaction and the seminar aims to address the same.

## ABOUT THE PAPER PRESENTATION

With a view to inculcate the practice of research and the habit of inquiry among students, the paper presentation competition invites participation from colleges all over the country. The students are expected to conduct research on a selected topic and present their findings in the form of a research paper.

## THEME FOR THE PAPER PRESENTATION

The theme for this year's conference is "Augmented Reality". Augmented Reality (AR) is a cutting-edge technology that seamlessly blends digital elements with the real world, enhancing our perception and interaction with the environment. Through AR, virtual objects, information, or experiences are overlaid onto the physical world, creating immersive and interactive user experiences across various domains, from gaming and education to healthcare and industry. AR holds immense potential to transform the way we engage with technology and the world around us, offering innovative solutions and endless possibilities for enhancing our daily lives.

Since its inception in 2003, the competition has called for papers from students pursuing their undergraduate degrees, with a view to inculcate the practice of research and the habit of inquiry. This year, the participants presented their research papers on topics such

as AR as a catalyst in digital revolution, AR and its impact in the E- learning, tourism, manufacturing, fashion and other sectors, digital customer engagement strategies using AR, recent trends and evolutions, among others.

Dr. M.V. Shankar- President of the Chamber of digital Entrepreneurs development, Malaysia graced the event with his Inaugural Speech. Mr. Sathyapriyan S- Co Founder and Director, Madras Mindworks Pvt Ltd . was the Valedictory speaker.

The papers were presented before a panel of industry professionals and academicians. The esteemed judges of the day were:

1. Mr. Arun Prasath S, CEO and Co founder- Focuz AR Solutions, Chennai.
2. Mr. SF Shanavaz, Head of Novac Immerz, Novac Technology solutions, Pvt Ltd. Chennai.
3. Dr. P Suganya- Assistant Professor, Head Department of Computer Science- DG Vaishnav College, Chennai.
4. Mrs. Archana S H- Assistant Professor, Department of Artificial intelligence and Data Science, Saveetha Engineering College, Chennai.

## PROFILE OF THE SPEAKERS

**Dr. M.V. Shankar**

Dr. M.V. Shankar is the Founder and President of The Chamber of Digital Entrepreneurs Development, Malaysia, fostering collaboration to enhance competitiveness and sustainability. He is involved in Technology and Digital Entrepreneurship Development for more than 17 years. He is also the Founder and Panel Advisory Board Member at Asia Pacific Technology Acceleration Center, E-Commerce Asia, and Malaysia in Digital Entrepreneurship Center. He is the Initiator of Digital Hub Asia, focused on bridging technology and knowledge gaps for SMEs. He is the leading organizer of seminars and conferences in the Malaysian Indian Technology and Digital Economy sector. He was a panel member in "Multilateral Trading Policy – World Trade Organization, led by the Ministry of International Trade and Industry, Malaysia". He serves as the Regular Public speaker on Digital and Technology issues. He is also the Chief Technology Officer at SMV Digital Tech Asia, specializing in IoT projects across multiple countries.

**Mr. Sathyapriyan S.**

Mr. Sathyapriyan S, an alumni of Sriram engineering College and IIM Trichy, is the Co-founder and Director, Madras MindWorks Pvt. Ltd. that focuses on Augmented Reality and virtual Reality technologies. Madras Mind Works Pvt. Ltd., is one of the leading strategic initiatives for digital transformation having offices across the globe in countries namely UK and Germany. He has worked as the Jr. Connection Design Engineer at Prothious Engineering Services, focusing on connection design and modeling team support. He contributed to R&D and solution engineering as an Assistant Manager at Godrej Group. He was working as a Senior Engineering Analyst at Consult Structures. He is also a visiting Faculty Member at BITS Pilani Work Integrated Learning Programmes. He is an executive Committee member at VEHRDT, a trust dedicated to executing social service programs for the underprivileged in North Chennai. He is a valued committee member for the Vidya Barathi school alumni

network in North Tamil Nadu, contributing to alumni engagement and support. He is also a member of Swadeshi Jagran Manch, focusing on promoting the spirit of entrepreneurship.

## PROFILE OF THE JUDGES

### Mr. Arun Prasath S

Mr. Arun Prasath S, the CEO & Co-founder of Focuz AR Solutions, brings over 16+ years of rich IT industry experience. He is a dedicated innovator with a fervor for crafting cutting-edge digital solutions that deliver real-world benefits to both businesses and individuals. His journey encompasses the dynamic fusion of XR (Augmented Reality, Virtual Reality, Mixed Reality), AI, and IoT, all aimed at addressing intricate industry challenges and paving the way for a smarter, safer, and more efficient future. A prominent tech influencer on LinkedIn, Mr. Arun has recently made waves in the tech world with his groundbreaking products - Hubibo.io, the metaverse platform, and Xwall.io, a phygital gaming platform for edutainment & fitness. Mr Arun was honored with the Rise India Award for being an emerging startup at the Beachange Expo & Conference in June 2017. He was also associated with Calydon Tech Solutions Pvt Ltd which was honored with the Star Partner Award from HCL Technologies Ltd for HR and training Consulting Business in March 2015.

**Dr. P. Suganya,** working as Head and Assistant Professor in D.G.Vaishnav College with two decades of experience in teaching and skill training. She has taught 11th and 12th students of government schools in ELCOT Project, where they train the students in computer essential and fundamental subjects like wordpress, starbase and object oriented concepts of C++. She has trained corporate IT sectors like HCL, Digitrati for freshers as subject expert software engineering, object oriented java programming, J2EE

etc. She has trained “Shankara Nethralaya” staff with knowledge of computers. She is a visiting faculty for MBA in “Shankara Nethralaya” as part of their curriculum. She acts as a resource person in various domains for schools and colleges. She has served as scrutinizing board member for “Govt. Siddha Hospital" Chennai. She is a recognised Panel member for “Kendriya Vidhyalaya Schools' ' in the selection process of teachers in the computer science field.

**Ms. Archana S.H**

Ms. Archana is the Assistant Professor of the department of Artificial Intelligence and Data Science at Saveetha Engineering College, Chennai. She has over 7 years of programming experience and is currently pursuing a Ph.D. at Anna University. She has a Master of Engineering (M.E.) degree in Computer Science and Engineering (CSE) from Saveetha Engineering College, Anna University. Her Certificates specialize in Python, Java, and SQL. She has published papers on Intelligent Virtual Reality and completed multiple training programs in AR, VR, Metaverse conducted by ICT Academy,AICTE. She successfully completed the “Introduction to VI, AI, MR online course from Lanchaster University and Institute of coding.She has served as Assistant Professor at Sri Shakthi Institute of Engineering and Technology, and Karpagam College of Engineering. She has attended workshops on 3D Industrial manufacturing simulation software, robotics, Big Data and IOT. She has also attended Nan Mudhalvan Training of Trainers program for “Augmented Reality, Virtual reality & Metaverse Development in 2022.

**Mr. S.F. Shanavaz**

Mr. Shanavaz is the Head of Novac Immerz , Novac Technology Solutions Pvt. Ltd. He has headed E-Learning Production, overseeing multimedia activities and resource deployment. He also spearheaded the Training Division for content d evelopment, competency

building, and performance evaluation. He led the team - Augmented Reality (AR), Virtual Reality (VR), Mixed Reality, and Metaverse. He received the Gem of the Year Award i ssued by Novac Technology Solutions in May of 2017 for “Outstanding contribution in the learning and development function of the organization.” He successfully completed the course on ’Coaching employees through difficult situations’ and ‘Gamification for interactive learning’.

# Table of Contents

# Role of Augmented Reality in Education

Sivaranjani C M | Alamelu M
B.Com (Accounting & Finance)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*"If we think of the world as a book, then augmented reality is the digital magnifying glass that enables us to explore the details behind."*

*-Brendan Ciecko*

*Augmented reality being the biggest technological revolution has transformed the lifestyle of people. This technology can be used in various fields and sectors such as education, agriculture, health care, tourism, military etc. Even though AR is predominantly used in recent times, its history dates back to 1968. It was 1st invented at Harvard by a computer scientist Ivan Sutherland who was known as the father of computer graphics.*

*Virtual reality is a computer-generated environment with scenes and objects that appear to be real, making the user feel they are immersed in their surroundings. Although Augmented reality and Virtual reality sounds similar, they both are quite different from each other. AR uses a real - world setting while VR is completely virtual. AR enhances both virtual and real world while VR only enhances a fictional reality.*

*The objective of this research is to determine the role and opportunities of AR in education. The study also analyses the challenges of AR and how it affects the education sector.*

*In order to get a better understanding of Augmented reality in education, Questionnaires were circulated to teachers and students of all fields of education. This study highlights that use of AR makes the learning process more interactive for students. It was accepted that AR provides practical learning experiences for students.*

***Keywords:*** *Augmented reality, Virtual reality, interactive learning, remote learning, learning curve.*

## Introduction

Technology is the use of conceptual knowledge to accomplish practical objectives in a reproducible way. In today's world, technology has become a part and parcel of human's life. It has transformed the entire world into a global village by enabling people to stay connected with each other by removing the geographical barriers.

Augmented reality is a rapidly evolving technology which has restructured the interaction mechanism of digital world and real-life environment. It is a technology that superimposes digital information including images, audio and movies on top of the actual world. Virtual reality on the other hand, is a technology that produces fully simulated surroundings, which is sometimes mistaken with AR. These both together are referred to as extended reality (XR), and they are the driving change across the industries.

AR was invented in the year 1968 by Ivan Sutherland. A project named "VideoPlace" was developed in AR by Myron Krueger in 1974. This setup seems to be an interactive user environment. The term Augmented reality was officially used by Tom Cadell in 1990. The 1st real operational AR system, known as Virtual Fixtures, was created in the year 1992. In 2000, the software named ARToolKit was released which was a major breakthrough in AR. In 2013, AR was used by Volkswagen to design their car manual. In 2016, AR entered the gaming sector by introducing "Pokemon Go" and "Harry Potter: The Hogwart's Mystery. IKEA launched an AR-based app in 2017 which transformed the retail industry.
Apart from adding Virtual objects to real environment, Augmented Reality can also remove the parts of real environment. This process of hiding a portion of real environment is known as Diminished Reality.

The educational sector too is becoming increasingly digitalised and driven by technological innovation. AR is considered as the key educational technology over the next decade. It has changed the ways of teaching and learning and provides an incredible experience to both the teachers and students. It enables easier understanding of complex information by using 3D-models.

AR plays a major role in remote learning and distance education where there is no physical contact between student and teacher. AR helps to address the biggest disadvantage in distance learning which the lack of practical element is by bridging the gap between distance and real life learning. Virtual practice improves the student's quality of learning.
A learning curve is a graphical representation of progress of work over time due to learning and experience. AR has a positive impact on learning curve.

## Review of Literature

*Evgniy Altynpara and Oleksandr Sh. (2023) "How AR Education influences learning flow and trainings: Revealed!"* states that even though education may seem like an unusual industry for AR at first glance, it has the ability to replace textbooks with three-dimensional objects which provides a better understanding of the subject.

*Marta Dunajko (2023) "How AR is transforming remote learning and distance education"* points out that one of the major challenges that is being faced in Remote learning and Distance education is practical skills and this could be mastered with the help of AR. AR offers an opportunity to customize the learning pace according to the individual needs and progress. Using AR learners have the flexibility to practice and refine their practical skills until they have mastered them.

*Alexey Shallmov (2023) "Augmented Reality in Education: How to apply it to your EdTech business"* states that education is becoming increasingly digitalized and is being driven by technological innovations which is being growing at an annual rate of 17.9%. AR has the ability to replace textbooks and physical models and through interactive, gamified AR learning, there can be a significant positive impact on students.

*Shwetha Sinha (2021) "Augmented Reality in Education: A Staggering Insight into the future"* has mentioned applications for e-learning that are AR enabled display the augmented item on the screen and play 3D illustrations of ideas so that students may interact and learn. With Computer graphics being widely employed, it allows the object to be captured and appear in the augmented environment.

*Riya Aggarwal and Abhishek Singhal (2019) "Augmented Reality and its effect on our life"* lists the threats to Augmented Reality. It suffers from various privacy related issues. Continuous exposure to AR causes mental exhaustion and declines the mental and physical state of health. An individual desire to have AR headsets at the size of eyeglasses but in reality, AR headsets is larger in size. Technical deficiencies like poor visual quality, lack of proper device, storage space leads to poor experience. Human being's resistance to change is inevitable. It takes time for people to accept and use AR in their daily life.

*Eduardo Siman (2018) "Augmented Reality is easy. Diminished Reality is where magic happens"* States that in addition to augmented reality, one of the factors that would be a replica of the physical reality is the process of eliminating 3D objects that exist. This is called as Diminished reality which could be achieved through various methods and one of them being SLAM.

*Brian Boyles (2017) "Virtual Reality and Augmented Reality in Education"* highlights the applications of AR in various fields. AR can be used to visualize anatomy, lung dynamics and laparoscopy. Marker-based AR helps in visualizing the process of human meiosis and respiration. Various AR applications have been introduced in engineering sector. AR helps in solving the greatest challenge of distance learning which lack of hands-on experience. Creation of 3D virtual lab enables students to learn practically.

*Amanda EDWARDS-STEWART, et.al (2016) "Classifying different types of Augmented Reality Technology"* suggests that AR can be used to improve the psychological health of individuals. Marker-based AR can be used to cure Zoophobia which is the fear of animals. Location-based AR can be used to schedule events.

*Ronald T. Azuma (1997) "A Survey of Augmented Reality"* defines the characteristics of Augmented Reality. It should be capable of integrating both real and virtual world. It must have the ability to combine real and virtual world in 3D. AR should be developed in such a way that it provides an interactive experience to the users. This paper states that AR can be used for visualization and annotation tasks. Annotations or comments can be attached to specific objects.

*Anastasia Morozova "Augmented Reality in Education"* states that it is common knowledge that when several senses are engaged, memory function is optimal. The recognition is significantly greater when we can see things and hear its sound at the same time. The software both shortens the time it takes to find the object description and other information and strengthens the connection between the object image and its data by positioning the additional information right next to the appropriate object. As a result, knowledge is generated quickly and maintained for longer.

**Objectives**

- To identify the importance of AR in education.
- To understand student's attitude towards AR.
- To know the ways in which AR can affect student's education.
- To analyse the challenges in AR.

## Methodology

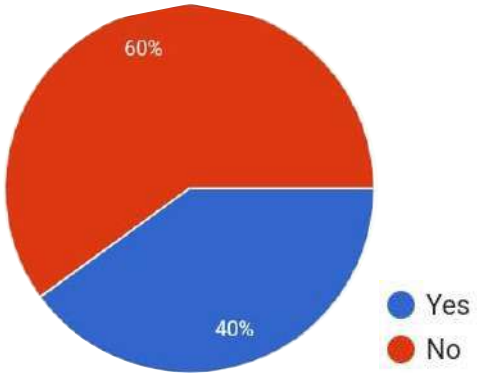
**"If you do not know how to ask the right question, you discover nothing"**

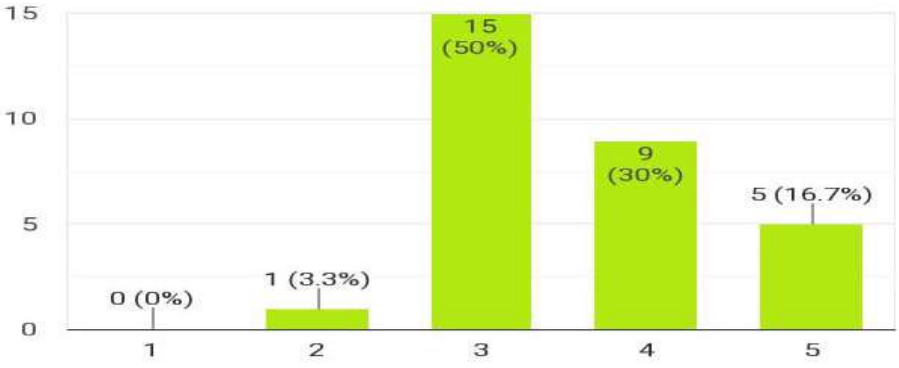
In order to get a better knowledge about the role of Augmented Reality in Education, a survey was conducted. Two sets of questionnaires, one for the teachers and one for the students were circulated to understand their perspective. Questions sent to teachers mainly deals on their use of AR in teaching and familiarity with 3D models. For the purpose of this study, students were asked to download an AR app and use it for a couple of days. Based on their experience of using AR, questions were prepared and circulated to students.

## Findings

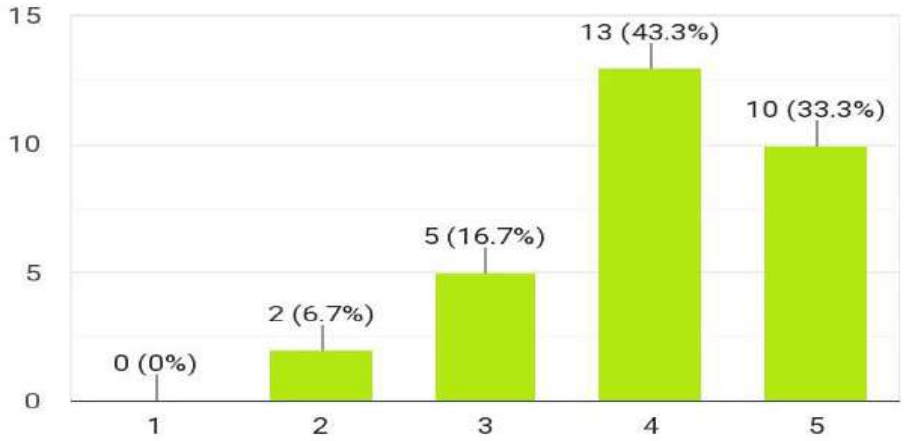
Student's Questionnaire:

Have you used AR for learning process?



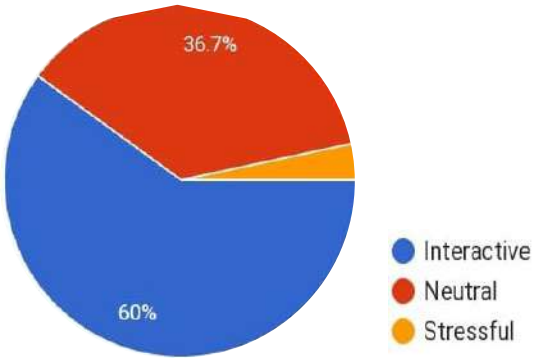




How well do you understand the concepts in traditional methods of teaching?

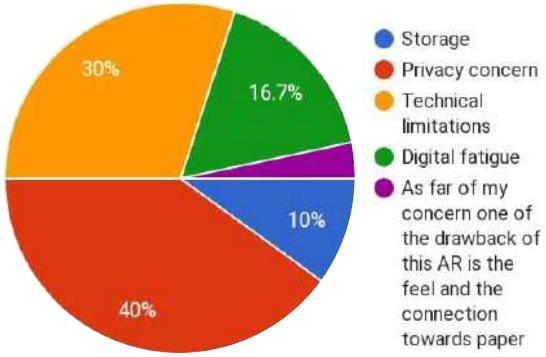



How well do you understand the concepts in AR?

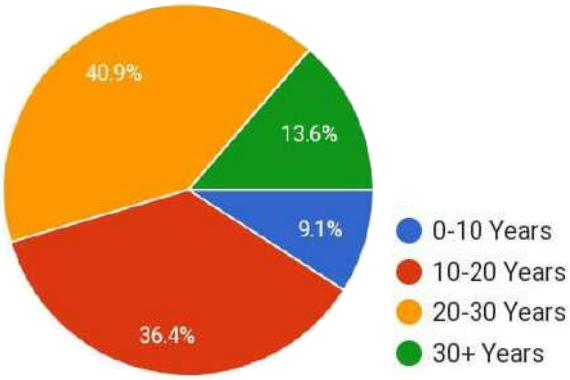
How do you feel using AR?



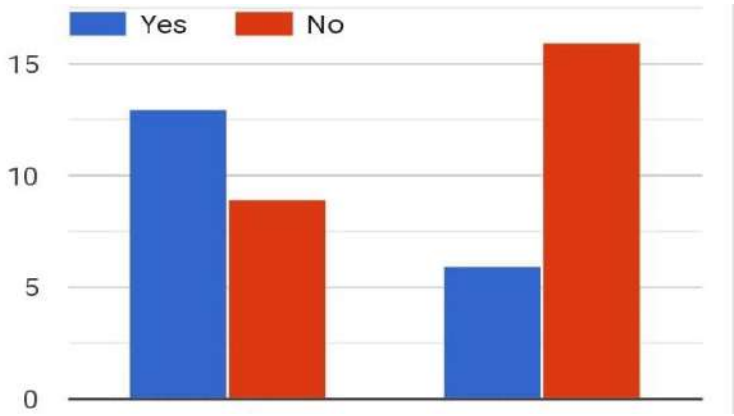

Mention the challenges you faced while using AR




Teacher's Questionnaire:

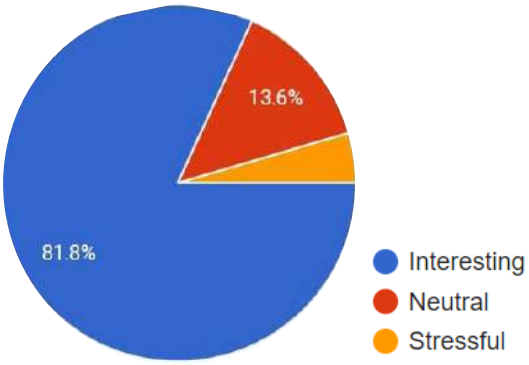



Work experience

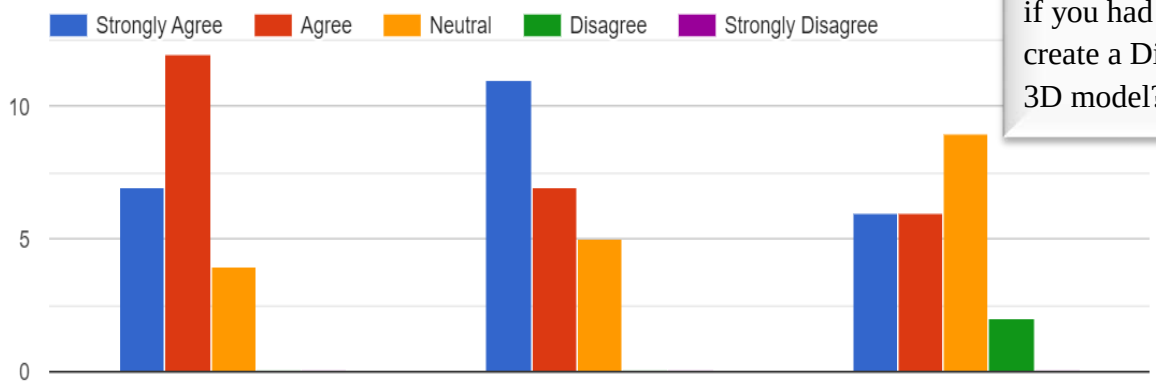



Do you use digital 3D models in teaching?

Are you familiar with digital 3D model?




How do you feel if you had to create a Digital 3D model?




AR application is suitable for classroom setup

AR is needed in education sector

Mobiles phones can be considered as a learning tool

**Results**

Student's Questionnaire:

This survey reveals that only 40% of the students have used AR for learning purposes before this study. During the course of this experiment, 60% of students came to know about AR applications and their use in educational sectors.

Students were asked to compare and rate their experience of understanding the concepts in traditional teaching methods and AR. The rating was done on a linear scale ranging from 1-5, with 1 being the lowest and 5 being the highest. The scale showed that the majority of students have rated 3 (50%) and 4 (30%) for their understanding in traditional teaching method whereas the major ratings for AR was 4 (43.3%) and 5 (33.3%). It was found that students could understand better when the concepts are presented visually compared to an oral lecture.

60% of the students had an interactive experience while using AR application, 36.7% had an even-handed experience and others (3.3%) had a stressful experience.

Students were asked to mention the challenges faced by them while using AR application. Privacy concern with 40% has been reported has the major issue. It requires data from users such as their location, etc. to enable its features. The second major challenges faced by the students were technical limitations with 30%. AR can be used efficiently only when proper devices which support AR applications are available. It also requires stable and high speed internet connections to get a better experience. Digital fatigue with 16.7% has been mentioned as the third major challenge. Spending more time on digital screen leads to disturbed sleep, increased level of stress, eye sight issues which decline metal health. Storage with 10% has been found as a barrier for usage of AR since it requires large storage space.

Teacher's Questionnaire:

The study revealed that work experience does not influence the teacher's opinion about AR in education. All the respondents had a positive opinion and felt the need for AR in education.

It was found that majority of teachers were familiar with digital 3D models, but only few of them use 3D models for teaching purposes. AR is the process whereby virtual objects are added to the real-life environment and 3D models form the major components of AR. AR in 3D goes hand in hand as 3D models are inseparable from AR.

A hypothetical question was raised to identity what the teachers would feel if they had to create a digital 3D model. 81.8% of teachers responded that it would be an interesting process where as 4.6% felt it would be stressful. 13.6% of them had a neutral opinion.

In order to use AR in a full-fledged manner it should be suitable to classroom setup, and it was found that majority of the teachers have agreed to this fact. Respondents have strongly agreed that AR is needed in educational sector to make the learning process easier. Mobile phones act as the major device in AR industry but the respondents had a neutral opinion on the fact whether mobile phones can be considered as learning tool.

**Suggestions**

- Teachers should be given awareness and proper training to use AR in educational sector.
- Educational institutions should develop their infrastructural facilities to equip AR
- AR applications should be developed in such a way that it can be used in all devices.
- AR apps should update their contents on a periodical basis.
- To overcome the privacy issues AR apps should follow the guidelines of GDPR.

**Conclusion**

"Augmented Reality is the 'boy who cried wolf' of the post-internet world – it's long been promised but has rarely been delivered in a satisfying way."

- Om Malik

Augmented Reality has the potential to reshape the educational sector in the following years. Certain theoretical concepts require the support of visual representations and this is where AR Applications comes to rescue creating order from chaos. This helps the students and teachers to keep themselves updated as computer generated content takes them into deeper spheres of learning. AR is one such advancement that enhance conceptual understanding which is beneficial for learner's community at large. But in reality, AR is not used to its full extent in educational sector. This highlights the need for development of AR and Educational sector for student's welfare.

## References


- Altynpara, E., & Sh, O. (2023). *How AR Education influences learning flow and trainings*.
- Dunajko, M. (2023). *How AR is transforming remote learning and distance education*.
- Shallmov, A. (2023). *Augmented Reality in Education: How to apply it to your EdTech business*.
- Sinha, S. (2021). *Augmented Reality in Education: A Staggering Insight into the future*.
- Aggarwal, R., & Singhal, A. (2019). *Augmented Reality and its effect on our life*.
- Siman, E. (2018). *Augmented Reality is easy. Diminished Reality is where magic happens*.
- Boyles, B. (2017). *Virtual Reality and Augmented Reality in Education*.
- STEWART, A. E,et.al. (2016). *Classifying different types of Augmented Reality Technology*.
- T. Azuma, R. (1997). *A Survey of Augmented Reality*.
- Morozova, A. (n.d.). *Augmented Reality in Education*.

# Augmented Reality Trends across Industries - A Technological and Societal Impact Analysis

Amirtha Valli RS | Smriti S
B.Sc. (Computer Science)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*Augmented reality refers to the seamless integration and superimposition of virtual world components with the real world, used to create a more enhanced, interactive, and productive experience for the user. Owing to the recent, fast-paced, and diverse changes faced in today's Augmented Reality sector, it is crucial to research and analyze its trends to reach a better understanding of the functioning, advantages, disadvantages of AR, and its impact. This understanding is necessary to harness its power and utilize technology for lasting meaningful change in our society. This paper surveys various augmented reality trends going back 25 years, all the way up to 1986. It analyzes the rate of evolution of trends and explores why certain trends might have lasted longer than others. A study of the history of AR use across industries has been employed to understand and highlight the impact of AR on various sectors. The next section of the paper builds upon the aforementioned understanding to discuss the advantages, disadvantages of implementation and proposes solutions and alternative methods to reduce undesirable effects.*

*The following section dissects up-and-coming trends and their technological shortcomings and societal impacts, providing solutions to the discussed problems. A special part of the paper looks at "Green Augmented Reality." It provides a data-driven probe into specific eco-friendly AR products and their impact on protecting the environment. Towards the end, the paper shares thoughts based on past developments, the future scope, and roles of AR in society. It gives suggestions on how businesses and industries can prepare for these changes. By studying the trends of AR, this research paper adds useful information to the ongoing conversation of how AR continues to shape our time.*

***Keywords****: Augmented reality, Green Augmented Reality, future scope.*

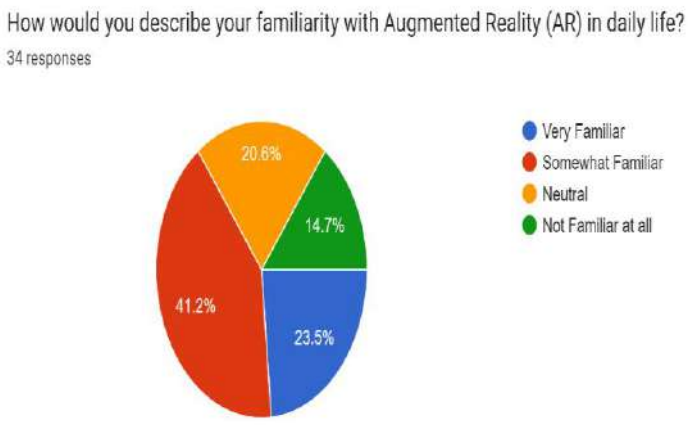
## Introduction

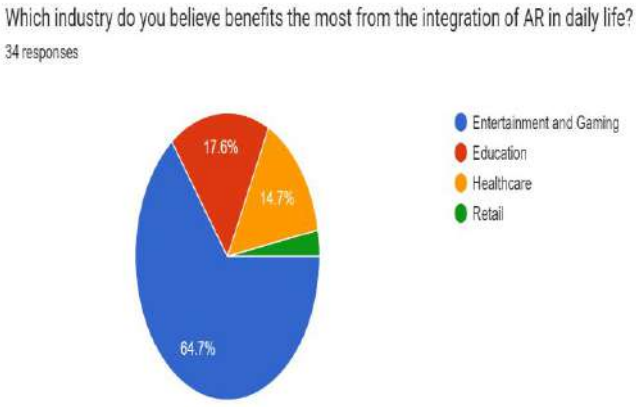
The integration of AR into our daily lives has been a topic of increasing relevance, with its applications spanning from enhancing industrial processes to revolutionizing educational methodologies. To set the stage for our analysis, we conducted a survey to gauge public

perception and familiarity with AR technologies. The responses indicate a spectrum of familiarity, with 41.2% reporting a somewhat familiar understanding, while 14.7% admitted to being not familiar at all.

Survey Data Insights:

- Familiarity with AR: 41.2% reported being somewhat familiar to AR, whereas 14.7% claimed to be not familiar at all.
- Usage of AR Applications: 14.7% have never used AR applications, while 29.4% reported frequent usage.
- Significant Advantage of AR: 50% believe AR enhances entertainment, reflecting its impact on leisure experiences.
- Concerns about Privacy: Privacy concerns related to AR are evident, with 29.4% very concerned, 32.4% somewhat concerned, and 38.2% neutral.



Evolution of AR

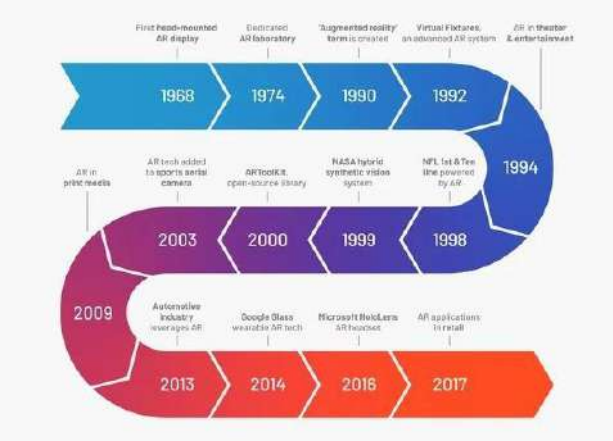
The way Augmented Reality (AR) has grown in industries, especially with Industry 4.0 in mind, is pretty fascinating.

1. Data Visualization and Simulation (2012-2014): Back in the day, AR was mostly used for showing data in pictures and simulations. It helped a lot with manufacturing and work processes by bringing information from different databases to user interfaces.

2. Maintenance (2014-2016): As AR started to get better, it found a sweet spot in maintenance work. It became a go-to application for giving real-time info and guidance during complex repairs. This made fixing things slightly quicker and more efficient.

3. Remote Assistance (2016-2018): When maintenance tasks needed quick help, remote assistance with AR stepped in. It created real-time shared screens, connecting workers on-site with experts far away. This made diagnosing and fixing issues faster, saving a lot of time and money.

4. Robot Programming (2016-2018):It then moved onto programming robots. It made things simpler for those who aren't experts in programming. Also, it helped create collision-free paths for robots working together.

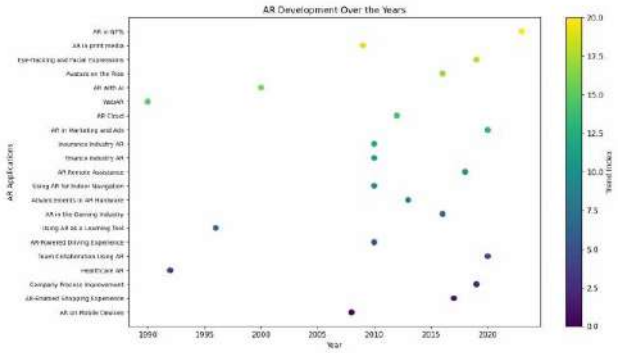



Simply put, Augmented Reality (AR) kept getting bigger and started being used in different industries. It learned to work in various situations, making how people and machines team up much better. Now, with more robots joining in, AR is expected to keep getting better at making teamwork between people and robots super easy.

Trends in AR

Our research looks at how Augmented Reality (AR) is used in different areas like healthcare and gaming. In healthcare, AR helps improve services, especially during challenging times. We also cover how AR mixes with gaming using special tokens, and its use in mobile apps, driving experiences, AR devices, and finance.

AR has challenges too, like creating content and dealing with technical issues. Despite these challenges, AR is becoming more popular, especially in making learning fun and improving how industries work.




This scatter plot provides the AR trends that were significant in that particular year. The Y-axis provides us with the various Augmented Reality Trends, and the X-axis gives details about their respective significant years. Webar, the leader in AR trends, started back in the early 1990s. This set the stage for more useful things in AR. After that, in 1992 the healthcare industry began using AR for the US Air Force. As time went on, AR became a very important tool in healthcare promising better health services and making life better, especially with all the health challenges happening worldwide such as covid 19. Shortly after, AR was made use as a tool for education, which is still prominent in most parts of the world, especially after the COVID-19 lockdown. Subsequently, in 2010, AR became extremely prominent in industries such as Insurance, Finance, Automotive, as well as in indoor navigation. BMW was one of the first to start using AR in the automotive industry. Furthermore, in 2016, AR in mobile devices found a spot on the chart from which the most famous Pokemon Go game got on the charts. It broke records and became the starting point for the gaming industry using AR. As the years went by, team collaboration and company process improvement using AR started to rise, especially due to the work from home from the COVID-19 pandemic. These trends are still used in 2024 and are predicted to continue the same if not increase for the betterment.

Advantages of AR in Eductaion

AR helps students learn better. It lets them interact with things in both the real world and a virtual one. This makes subjects like science, math, and history more interesting. For example, in science, AR shows how molecules interact. In math, it makes learning about

shapes more fun. In biology, it helps understand how habitats connect, and in history, it makes museums more exciting. Students prefer using AR as it's engaging and makes learning more enjoyable as well as practical.

Challenges and what's next

While we see the great possibilities of AR, there are challenges too. Creating content, dealing with technical issues, and the need for spatial understanding are things we need to figure out. Looking forward, we expect AR to keep getting better, with more uses and a bigger impact on how we live.

As AR keeps changing industries, its effects on education, healthcare, manufacturing, and more are clear. Our research paper gives a good look at AR trends, helping us understand the challenges it faces and what might happen next. By studying how AR has grown, its benefits, and the problems it encounters, we hope to learn more about how AR is shaping our tech world.

Impact analysis of AR trends across industries

Augmented reality trends have not only risen to popularity in the recent decade with the term 'AR' becoming a buzzword the effects of AR reality in society is insurmountable. The following section takes 4 different sectors and analyzes how Augmented Reality has made a difference in it.

AR in Healthcare

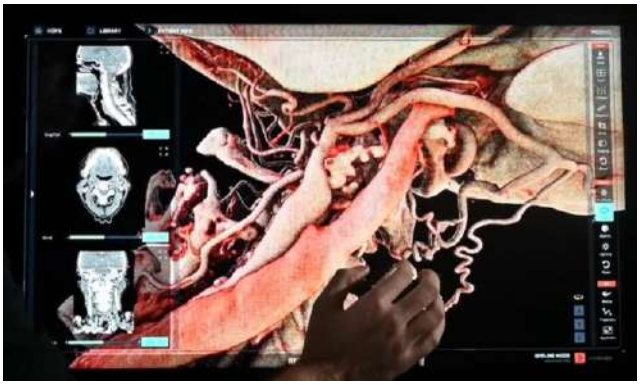
There have been various navigation systems in medicine but the need to make procedures less invasive, more precise and highly localized have resulted in a constant development of these systems

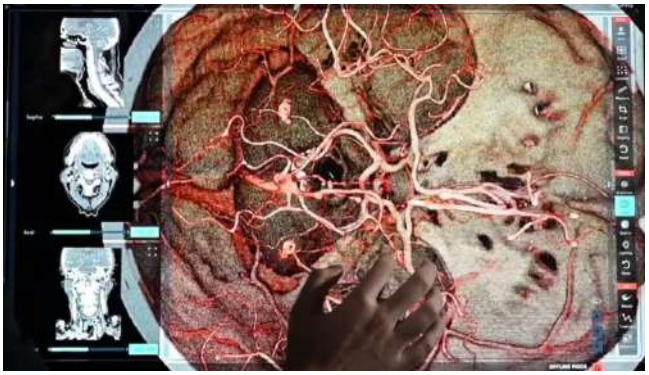
The very 1st frameless navigation system was frameless stereotaxy developed for neurosurgery by David Roberts in the 1990's this enabled real time tracking of the surgical tools and acted as a 3d measurement system. This system is not only used to guide the surgeon to find a specific anatomical target, avoid areas of risk, and offer intraoperative orientation in the absence of anatomical landmarks, but it can also support optimal alignment.

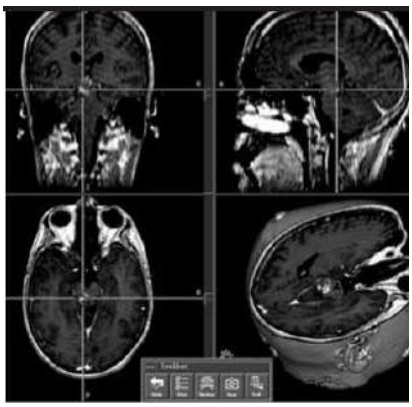
This also reduces operating time and can map and image pathways to targets ahead of the surgery reducing the risk of injuries or mishaps during surgery.

Surgical AR (2024)

Surgicalar is an AR platform developed by Augmedics. This provides a 3d image of a patient's organs that can be superimposed onto the surgical field so that the surgeon can receive a live stream of data directly onto the surgical field. For example, it can take a patient's MRI and create an identical holographic allowing exquisite detail to be viewed like never before. This helps turn a stream of data into actionable understandable live data
In the below 2 pictures we can see the sheer improvement in the quality of the images. This portrays the improvement of AR technology in the field of medicine.







AR in Education

DAQRI Smart Glasses

These glasses provide an immersive learning experience by providing students with augmented reality learning opportunities for students in both industrial and educational

settings. This gives students the opportunity to see and experience complex objects and concepts and dangerous situations that would have been impossible beforehand.

Ar overlay - The glasses give an overlay of augmented reality information on the background of the real world

Sensors - Though seemingly simple these contain a multitude of sensors from cameras, accelerators, depth sensors and even gyroscopes to get an accurate measure of the real world

Spatial awareness: the above-mentioned sensors provide these glasses with excellent spatial awareness

Hands Free operation - This is particularly useful for a more immersive experience.

Safety feature; This is equipped with thermal imaging and the like to provide an added layer of safety especially in industrial situations.


AR in Agriculture

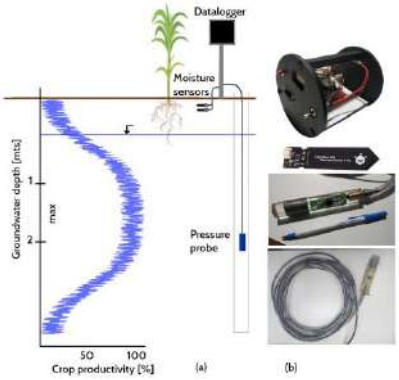
AR-enhanced Soil Sensors: Soil sensors equipped with AR capabilities can provide farmers with instant data about soil conditions. AR overlays can offer insights into soil composition, moisture levels, and nutrient content.

Smart Crop Monitoring Glasses: Specialized glasses or headsets equipped with AR can assist farmers in monitoring crop health and identifying potential issues. This could include information about nutrient levels, hydration, and disease detection.

Smartphones and Tablets: Farmers can use AR applications on their mobile devices to get real-time information about crops, soil conditions, and weather. Apps can provide overlays of data on the device screen, aiding in decision-making.

The applications demonstrate how AR technology is being integrated into various aspects of agriculture, offering farmers valuable information and assistance in making data-driven

decisions. The field is continually evolving, and new applications and devices are likely to emerge as technology advances.




AR in Defense

DAQRI Smart Helmet:

This is a version for DAQRI smart glasses that were used for educational purposes.

For military training and maintenance.

A heads-up display is provided with important information ensuring easy access for soldiers to use and access critical data without getting distracted from the field.

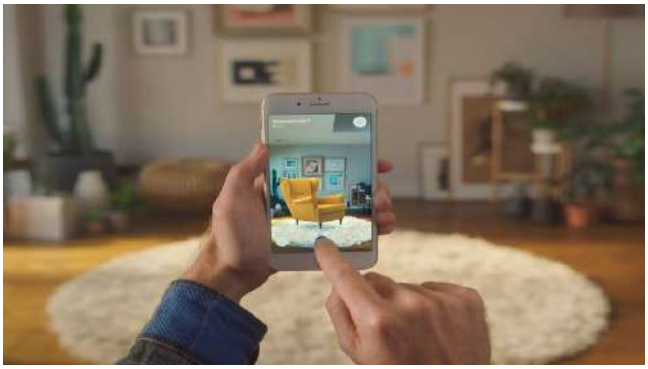
One main feature is the intellitrack system

The helmet typically incorporates the DAQRI Intellitrack system, which provides spatial awareness and tracking capabilities. This enables accurate placement of virtual objects in the real-world environment and facilitates precise interaction with AR content.

Deep dive into green augmented reality: The IKEA place app case study

In the world of furniture shopping, a significant challenge is the very high rate of product returns, leading to wasted resources and environmental harm. Augmented Reality (AR)

technology, used by the IKEA Place app, emerges as a solution with the potential to revolutionize how people buy furniture, making the process more sustainable.



Reducing Returns:

Visualizing furniture in our living space before purchasing is now possible with AR. The IKEA Place app uses the smartphone camera and AR to overlay 3D furniture models onto the surroundings. This feature majorly reduces the chances of buying the wrong-sized furniture or making impulsive purchases at the last minute. Studies indicate a notable decrease in return rates, translating to less packaging waste, lower transportation emissions, and a more efficient use of resources.

Promoting Sustainable Consumption:

Beyond the immediate reduction in return-related waste, AR encourages consumers to make more informed and thoughtful purchasing decisions. By virtually trying out different furniture pieces in their own homes, shoppers can avoid impulsive choices that might clash with their existing decor. This shift toward conscious consumption helps decrease the overall demand for furniture.

Optimizing Logistics:

AR not only aids in reducing returns but also optimizes the logistics of furniture delivery. Due to the accurate placement of virtual items, the need for multiple deliveries is decreased as there won’t be any major sizing issues. This process benefits both the environment and customer satisfaction.

The Future of Green AR:

Looking forward, we can do more with green Augmented Reality (AR). Picture putting eco-friendly stuff in the IKEA Place app, like things made from recycled stuff or with a low impact on the environment. In the future, AR could also show how a product lives and its effect on nature. This helps people make smart and nature-friendly choices when they shop. And to make it fun, there might be games or rewards that push folks to pick eco-friendly stuff and get prizes for making green buys.

The IKEA Place app is a standout example of how AR can lead the furniture industry toward a more sustainable future. By facilitating informed choices, reducing returns and waste, and optimizing logistics, AR has the power to significantly minimize the environmental impact of furniture shopping. As AR technology advances, its synergy with sustainable practices can empower consumers and businesses alike to make responsible choices, paving the way for a greener and more circular economy.

## Conclusion

In summation, augmented reality (AR) has traversed a notable evolutionary trajectory, leaving an indelible imprint across an array of industries encompassing healthcare, education, and manufacturing. Notwithstanding the impediments encountered, AR's inherent capability to elevate user engagements, curtail product returns, and champion sustainability, epitomized eloquently through the illustrative prism of IKEA's Place app, unequivocally underscores its potential to architect a future steeped in heightened awareness and ecological conscientiousness. As the undulating trends of AR persist in their dynamic cadence, the imperative for businesses and society at large lies in the cultivation of a nuanced comprehension and proactive preparedness to navigate the transformative currents it imparts

## References

- Khan, R.H., Darvishi, S., Rezaeinia, M. And Rizwan, Z., 2018. Smart store: the convergence of IKEA department store, augmented reality and RFID technology. *Växjö, Sweden: Linnaeus University*.
- Azuma, R.T., 1997. A survey of augmented reality. *Presence: teleoperators & virtual environments*, *6*(4), pp.355-385.

- Himperich, F., 2007. Applications in augmented reality in the automotive industry. *Fachgebiet Augmented Reality, Department of Informatics*, pp.1-21.
- Larkin, F., 2016. Advantages and disadvantages of augmented reality.
- Saidin, N.F., Halim, N.D.A. and Yahaya, N., 2015. A review of research on augmented reality in education: Advantages and applications. *International education studies*, *8*(13), pp.1-8.
- Desai, N., 2018. Recreation of history using augmented reality. *ACCENTS Transactions on Image Processing and Computer Vision*, *4*(10), p.1.
- Ibharim, N.A.N., Ramli, S.Z., Zahari, S.A., Edyanto, N.A.A. and Zawawi, M.A.A., 2021. Learning History Using Augmented Reality. *International Journal of Multimedia and Recent Innovation (IJMARI)*, *3*(1), pp.1-10.
- Lee, K., 2012. Augmented reality in education and training. *Techtrends*, *56*, pp.13-21.
- Muñoz-Saavedra, L., Miró-Amarante, L. And Domínguez-Morales, M., 2020. Augmented and virtual reality evolution and future tendency. *Applied sciences*, *10*(1), p.322.
- Devagiri, J.S., Paheding, S., Niyaz, Q., Yang, X. And Smith, S., 2022. Augmented Reality and Artificial Intelligence in industry: Trends, tools, and future challenges. *Expert Systems with Applications*, p.118002.
- Kim, K., Billinghurst, M., Bruder, G., Duh, H.B.L. and Welch, G.F., 2018. Revisiting trends in augmented reality research: A review of the 2nd decade of ISMAR (2008–2017). *IEEE transactions on visualization and computer graphics*, *24*(11), pp.2947-2962.
- Avila-Garzon, C., Bacca-Acosta, J., Duarte, J. And Betancourt, J., 2021. Augmented Reality in Education: An Overview of Twenty-Five Years of Research. *Contemporary Educational Technology*, *13*(3).
- Garzón, J., 2021. An overview of twenty-five years of augmented reality in education. *Multimodal Technologies and Interaction*, *5*(7), p.37.

# The Role of Augmented Reality in Designing Architecture

Melpakkam Soundarya | Shreyaa. S

B.Sc Computer Science

Shri Shankarlal Sundarbai Shasun Jain College for Women

***Abstract***

*The integration of augmented reality (AR) innovation within the field of structural plan has developed as a transformative worldview, reshaping conventional plan forms and growing the conceivable outcomes for designers, architects, and partners alike. This paper investigates the multifaceted role of augmented reality within the realm of architecture, focusing on its effect on visualization, collaboration, and client involvement. While acknowledging the potential benefits of augmented reality in architectural design, this paper also discusses the challenges and contemplations related with its usage. As the innovation proceeds to advance, its integration into architectural workflows holds the guarantee of reshaping long-standing time of plan forms and enhancing the built environment with imaginative and user-centric arrangements. This paper focuses on establishing a relationship between the clients and developers.*

***Keywords:*** *Augmented reality, Architectural design, Visualization, User-centric*

## Introduction

Augmented reality, with its capacity to overlay digital information onto the physical environment, revolutionizes the way architects conceptualize and communicate design ideas. By giving immersive and intuitively encounters, AR encourages a more instinctive understanding of spatial connections, scale, and materiality, engaging architects to create educated choices amid the early stages of the design process. In addition, augmented reality serves as a catalyst for upgraded collaboration among design teams and stakeholders. The innovation empowers real-time, shared visualizations, cultivating compelling communication and collaboration over assorted disciplines. Through AR-based stages, designers can lock in in collaborative plan surveys, iterate on concepts, and get prompt input, subsequently streamlining the decision-making process and progressing by and large extend effectiveness. The client involvement in structural plan is raised through the adoption of augmented reality, because it empowers clients and end-users to encounter and connected with architectural

plans in a more tangible and practical way. This project empowers the client to induce a live encounter of the format and make changes accordingly.

## Literature Review

Anthony Webster, et.al. [1] in the paper titled Augmented Reality in Architectural Construction, Inspection, and Renovation has discussed the potential uses for more advanced augmented reality systems and development of augmented reality systems for improving the construction spaceframes.

Zarema S. Seidametova, et.al. [2] in the paper titled Using augmented reality for architecture artifacts visualizations has developed a concept, design and development of AR application "Art-Heritage'' with historical monuments and buildings of Crimean Tatars architecture (XIII-XX centuries). The existing picture is altered using an app. Through "Art-Heritage", the users are enabled to visualize the monuments that were destroyed at a particular place by holding up their mobile device to see an altered version of reality.

Arnis Cirulis, et.al. [3] in the paper titled 3D Outdoor Augmented Reality for Architecture and Urban Planning has made a precise evaluation of new constructions and objects look and visual influence on environmental surrounding. This paper focuses on finding a solution to allow urban planners visualize buildings in 3D and the real city at the same time.

## Visualization Enhancement in Architectural Design

1. Spatial Understanding

AR allows architects to visualize and understand spatial relationships in a three-dimensional context. By placing digital models in physical environments, architects can perceive the scale, proportions and spatial dynamics of their projects in real conditions. This understanding of space is critical to making informed decisions during the design process. One of the major challenges of architectural design is to accurately convey the scale of the project. AR allows architects to visualize natural or scaled versions of their designs in existing spaces. This feature helps understand the impact of the design on its environment and ensures that scale is properly communicated to clients and stakeholders.

2. Real-time Design Iteration

AR allows architects to make real-time changes and iterations to their designs. Project changes can be instantly visualized in a real environment, allowing architects to assess the impact of changes and refine their plans on site. This iterative process improves design development.

3. Site Analysis and Contextual Integration

AR helps with site analysis by deploying design plans to physical sites. Architects can assess how a proposed project will integrate with the existing environment, taking into account factors such as topography, sunlight and surrounding structures. This contextual integration ensures harmonious alignment of the model with its environment.

4. Client and Stakeholder Communication

AR is changing the way architects communicate design concepts to clients and stakeholders. Instead of relying solely on traditional drawings and plans, architects can use AR to create immersive presentations. Customers can walk through the virtual space and experience the design in a more tangible and accessible way that encourages better communication and understanding. Collaborative design reviews are enhanced with AR technologies. Multiple stakeholders can simultaneously interact with virtual models and provide real-time feedback and insights. This collaborative perspective strengthens the decision-making process and ensures that all stakeholders have a common understanding of the project goal.

5. Virtual Prototyping

AR allows architects to create virtual prototypes of designs that allow for thorough testing and analysis before physical construction begins. This virtual prototype helps identify potential problems, refine details and optimize the design for better functionality and aesthetics.

**Advantages and Uses of Augmented Reality (AR) in Architecture**

Augmented reality programs overlay pictures onto the physical world around us that we see through our phone screen or other digital gadgets. In this manner, architects can utilize this innovation to arrange ventures and look at how they look in real-life settings.
AR gives a reasonable thought of what a plan will look like before it is built.

Augmented reality permits designers to precisely foresee development costs and timeframes for their ventures, which is another thing that conventional strategies cannot do that well. Equipped with data around the cost and time of development, planners can arrange with clients to progress design plans or change extend objectives in case vital. These transactions may result in more noteworthy fulfillment among both parties, even though they modify the original plan.

Augmented reality has applications exterior of fair visualization. Architectural firms utilize this innovation for preparing and data administration purposes, as well.

**Challenges of Augmented Reality(AR) in Architecture**

1. Hardware Limitations:

Many AR applications require special equipment, such as AR glasses or headsets. The current state of AR hardware can be bulky, expensive, and not always comfortable for long-term use, limiting widespread adoption.

2. Data Interoperability:

Achieving seamless integration between different software platforms, design tools, and AR applications can be challenging. Architects often struggle to ensure compatibility and efficient transfer of data between different systems.

3. Accuracy and Calibration:

Achieving accurate alignment of virtual and physical elements in AR can be difficult. There may be calibration issues that can cause errors in overlaying digital data on the physical world, affecting the accuracy of design and construction.

4. Power Consumption and Battery Life:

AR devices often have high power requirements, which leads to battery life concerns. Limited battery capacity may prevent long-term use during design processes, especially in field applications where a continuous power source may not be readily available.

5. Technical Complexity:

The complexity of AR technologies and their integration into existing design workflows can present challenges for architects who may not have a strong technical background. Seamless integration with existing tools and processes is essential for successful implementation.

6. Standardization Issues:

The lack of industry standards for AR architecture can cause compatibility issues between different software platforms and hardware. Standardization efforts are needed to ensure a more unified and interoperable AR ecosystem.

**Implementation**

1. Selection of AR frameworks:

   The following frameworks have been used to develop the model:

   a. Unity:

      Unity is a powerful cross-platform game development engine used to create interactive 2D and 3D experiences. Its user-friendly interface and extensive asset store facilitate streamlined game development. Widely adopted in the gaming industry, Unity supports diverse platforms, from mobile devices to consoles and virtual reality systems. Its versatility and robust features make it a popular choice for developers.

   b. Vuforia

      Vuforia is an augmented reality (AR) software development kit that enables the creation of AR applications. Developed by PTC, it allows developers to integrate digital content into the real world through smartphones, tablets, and AR glasses. Vuforia's computer vision technology recognizes and tracks images, objects, and environments, enhancing the user's interactive experience. Widely used for AR applications in various industries, Vuforia simplifies the process of building immersive and engaging augmented reality solutions.

   c. Blender:

      Blender is a free and open-source 3D creation suite that supports modeling, sculpting, animation, rendering, and more. It boasts a robust feature set, including a powerful node-based compositor and a versatile game engine. Widely used by

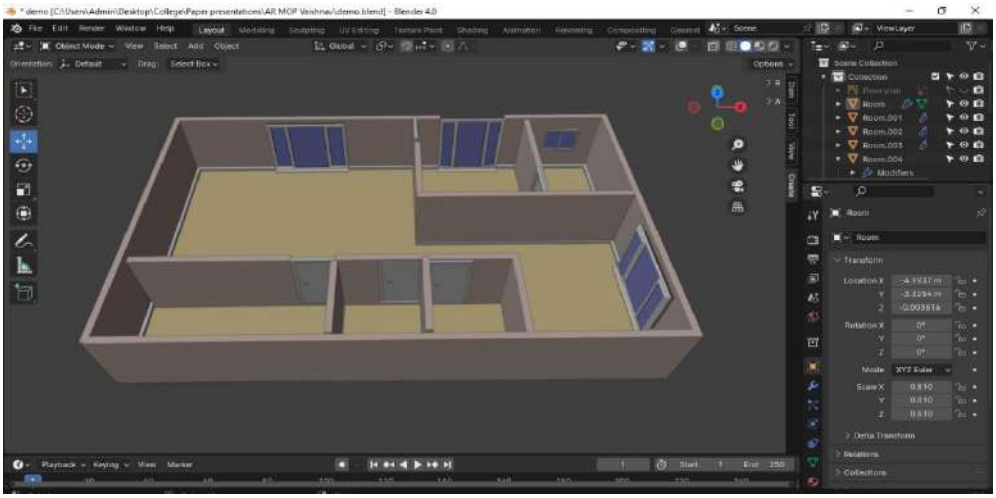
artists, animators, and designers, Blender's user-friendly interface and extensive community support make it accessible for both beginners and professionals. Its cross-platform compatibility and continuous updates contribute to its popularity in the world of 3D content creation.

2. Layout Selection

   The below layout has been selected to develop the model using the selected AR frameworks.


3. 3D Model:

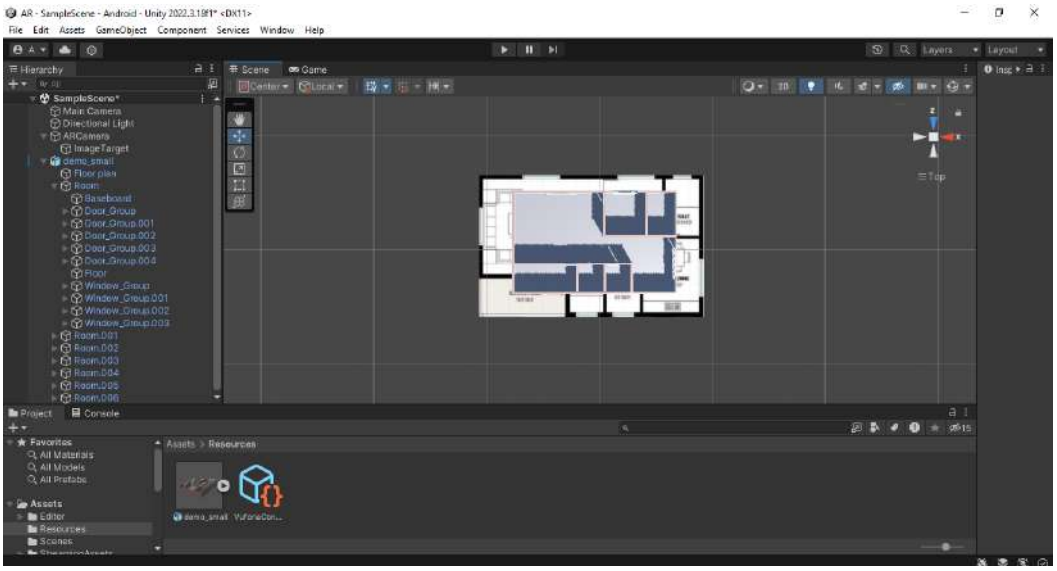
   The 3D model of the selected layout has been created using Blender.



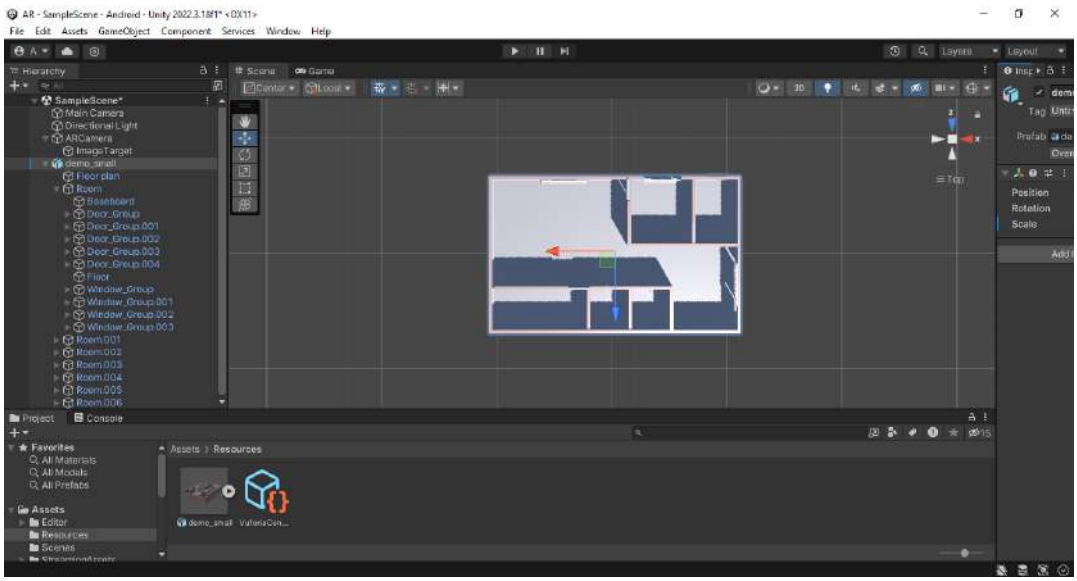
4. SyraArch Visions App development:

SyraArch Visions gives a 3D view of the layout enabling the user to get a live experience of the plan. The client can then make changes accordingly. SyraArch Visions has been developed using Unity and Vuforia giving high quality output.

- Before superimposition of 3D model



- After superimposition of 3D model



**Future Outlook of Augmented Reality(AR) in Architecture**

Augmented Reality (AR) is expected to have even more uses in architecture in the future. For instance, AR could be used to evaluate safety risks on construction sites by combining drone and sensor data with 3D building models. This would enable architects to quickly identify safety hazards on construction sites and take action to prevent them from becoming

dangerous or out of control. Furthermore, with programs such as AUGmentecture, Blender, Unity etc. both architects and their clients will be able to fully visualize every tiny detail of an architectural model. This visualization can then be used to create a solution that satisfies both parties.

## Conclusion

In conclusion, the integration of augmented reality (AR) technology into architectural design represents a revolutionary shift that transcends traditional boundaries and opens new frontiers for architects, designers, and stakeholders. The exploration of AR's multifaceted role in this paper has highlighted its transformative impact on key aspects of architectural practice, namely visualization, collaboration, and user experience. This paper proposes a visualization technique that can be used to make a layout live and establish a direct relationship between the clients and developers.

## References

- Augmented Reality in Architectural Construction, Inspection, and Renovation Anthony Webster, Steven Feiner, Blair MacIntyre, William Massie, Theodore Krueger
- Using augmented reality for architecture artifacts visualizations Zarema S. Seidametova1, Zinnur S. Abduramanov and Girey S. Seydametov
- 3D Outdoor Augmented Reality for Architecture and Urban Planning Arnis Cirulisa, Kristaps Brigis Brigmanis
- Richards, M. “Automation in Construction,” The Industrial Robot, 21(4), 1994, 26–28
- Webster, A. “Networked Multimedia Tools for Architectural Engineering.” Journal of Architectural Engineering. In press, January 1996.

# Cuisine Aroma - An AR Based Cooking Software

Joshua | Aparna
B.B.A.
Madras Christian College

***Abstract***

*As a student who stay away from home, we all have gone through times when we had a very sedentary lifestyle and lacked balanced meals for a plethora of reasons one way to solve it is to have nutritious meals with what we have and that is when we came up with this idea of helping everyone who struggles with not knowing what exactly to cook and track their macros which aids them a healthier lifestyle. This software seamlessly combines the power of AI and AR technologies to elevate user interactivity through an advanced scanner. The software uses the device's camera to capture the user's surroundings and then overlays digital content, such as step-by-step cooking instructions, ingredient lists, cooking timers, macros, and interactive 3D models of dishes. Furthermore, AR recipe software not only enhances the cooking process but also promotes learning and creativity in the kitchen. By providing users with real-time feedback, interactive tools, and customizable options, AR recipe software empowers users to experiment with ingredients, adapt recipes to their tastes, and develop confidence in their cooking abilities.*

***Keywords:*** *Augmented reality, cooking software, 3 dimensions.*

## Introduction

Augmented Reality (AR) is a technology that superimposes digital content, such as images, videos, or 3D models, onto the real-world environment, thereby enhancing the user's perception of reality. This augmented reality software is just on your smartphones, tablets, and pads, etc.

Are you a student/employee who is facing the “month-end crisis” or having a shortage of groceries? That is when this augmented reality software comes to your rescue. As a student who stay away from home, we all have gone through times when we had a very sedentary lifestyle and lacked balanced meals for a plethora of reasons one way to solve it is to have nutritious meals with what we have and that is when we came up with this idea of helping everyone who struggles with not knowing what exactly to cook and track their macros which aids them a healthier lifestyle

This software can be used whenever and wherever according to your preference for example if you are in your kitchen clueless about what to cook with minimal groceries and utensils and have very little knowledge about cooking this will be your ideal companion to help you through the process step by step even this software will help you outside the kitchen in scenarios like your out with your friends on a camp and there is no place to by any instant food and have only some amount of vegetables voila here is a caesar salad made out of minimal ingredients like this it will be your ideal partner in kitchen to make the best meal out of what you have

This software seamlessly combines the power of AI and AR technologies to elevate user interactivity through an advanced scanner. The software uses the device's camera to capture the user's surroundings and then overlays digital content, such as step-by-step cooking instructions, ingredient lists, cooking timers, macros, and interactive 3D models of dishes.


One of the major problems with today's generation is they have a very fast-paced life and they just opt for anything instantaneous that impacts their health in the long run such as losing weight, getting ill more often, constipation, hair loss, or skin problems. In time, menstrual irregularities and depression may occur.

Some of the major problems are as follows:

1. Instant food and more efforts
2. Gut health
3. Shortage of groceries
4. Less time and lack of cooking skills
5. Lack of certainty

**How AR Cooking Software can Resolve these Issues?**

1. **Instant Food and More Efforts: This** AR software can offer a wide range of brisk and easy recipes that are healthier alternatives to instant foods. These recipes can be tailored to fit busy schedules, providing options for meals that can be prepared in minimal time with minimal effort. Furthermore, by promoting the convenience of homemade meals, cooking software can encourage youth to opt for healthier choices over instant, processed foods.

2. **Gut Health:** Cooking software can include recipes that prioritize ingredients known to promote gut health, such as fiber-rich fruits and vegetables, fermented foods, and probiotic-rich ingredients. Additionally, cooking software can provide educational resources on the importance of gut health and, help youth make more informed dietary choices.

3. **Shortage of Groceries:** Cooking software can adapt to local availability and seasonal variations in grocery supplies, suggesting recipes that utilize ingredients commonly found in the user's area. Additionally, cooking software can incorporate features such as meal planning to help users make the most of available ingredients and minimize food waste during times of shortage.

4. **Less Time and Lack of Cooking Skills:** Cooking software makes cooking easy for everyone, even if you're just starting. It gives you step-by-step instructions and videos to show you exactly what to do. The software is designed to be easy to use, so you'll feel comfortable in the kitchen in no time. Plus, it shares tips to help you save time and get meals ready faster. It's like having a helpful friend right there with you while you cook!

5. **Lack of Certainty:** Cooking software can offer personalized recommendations based on user preferences, dietary restrictions, and health goals, helping to alleviate

uncertainty around meal choices. By providing a curated selection of recipes tailored to individual needs, cooking software can empower users to make confident decisions about what to cook and eat. Additionally, cooking software can incorporate features such as user reviews and ratings to provide social validation and reassure users of the quality and taste of recipes.

**What the Software Comprises of?**

This software integrates AR and AI and helps the user with a 3-D visual representation of what they are going to make out of groceries that are left in their pantry and gives you step-by-step instructions using AR technology giving you minute details on how to make your meal taste better and nutrition rich regardless of how much groceries you left with. It changes its cuisine based on your geographical location and availability but still, you can change those depending upon your choice. Not only does it help you with cooking but also gives you the nutritional value of the food which is already prepared so even though you not eating at your place you can keep track of the daily nutrition you are getting.

The software shows the 3-D representation of the food that the user desires to make and later the user needs to scan the groceries that are left in the pantry with the measurement of how much they are going to use for the dish so no need to manually enter the amount of groceries used later the app comes up with different methods to cook the desired dish with step by step instructions, voice assistant and visual representation on the process. The different methods consist of beginner, intermediate, and pro. The user can decide according to their needs and wants.

While this app guides you with all this information it is very useful with someone who is on their fitness journey and wants to opt for a healthier lifestyle this software will be a great help as well by tracking your macros (calories, carbohydrates, fats, protein). It gives you low-calorie options as well all showing you above the food while scanning.

**How does this Software Operate?**

Introducing our innovative AI and AR-integrated application designed to revolutionize your culinary experience. When you first open the app, you are presented with two options. The initial option encompasses the basics, featuring a scanner with subparts dedicated to recipes and macros tailored to suit the customer's needs and preferences. These

options can be further customized based on skill level, ranging from beginner to intermediate and pro.

Within this section, the Macros option takes center stage, efficiently calculating the nutritional content of the food you are preparing. This ensures that your meals align with your dietary requirements and fitness goals, providing a comprehensive understanding of the nutritional value of each dish.

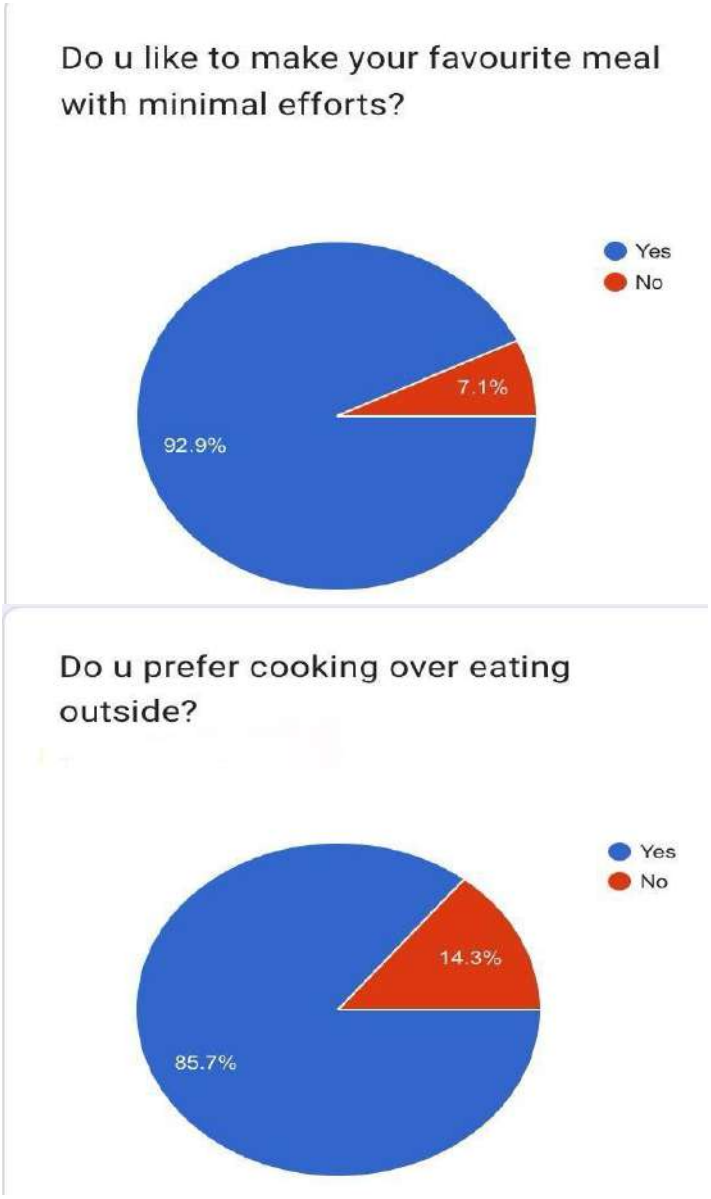
The second part of the application introduces a customized experience, maintaining the scanner functionality while incorporating advanced filters. These filters include options for regional languages, healthier versions of recipes, and the ability to select specific cuisines from various states such as Rajasthani or Bihari. Additionally, users can tailor their choices based on dietary preferences, with beginner, pro, and advanced options that cater to the desired level of effort and time commitment.

Once verbal instructions are provided, the application seamlessly transitions to the third step, utilizing Augmented Reality (AR) to enhance the cooking experience. A visual representation appears, showcasing a dynamic cooking video generated through AI and aligned with the selected recipes. This immersive AR feature guides users through the cooking process, visually demonstrating each step in real-time. The AR component aims to simplify the cooking process, allowing users to visualize and follow along with the cooking video effortlessly.

All things considered; our application is comprehensively designed to address the budget constraints often faced at the close of each month. Our primary objective is to empower users, enabling them to whip up nutritious and effortlessly prepared meals utilizing the remaining pantry ingredients. Via the integrated medium of AI and AR technologies, our platform delivers an intuitive interface tailored to the distinct needs and preferences of every individual. Our all-inclusive vision is to transform the act of cooking into an enjoyable and accessible experience for all, disregarding of their culinary proficiency.

Through our app, we strive to fulfill the goal of enabling individuals to prepare budget-friendly, nutritious meals with minimal effort. We believe that by leveraging the power of AI and AR, we are making this vision a reality and helping people overcome the constraints of limited resources while promoting a healthier and more enjoyable cooking experience.

**Some Real-Time Analysis**




**Conclusion**

In summary, our AR-based app revolutionizes meal planning by seamlessly scanning pantry leftovers and transforming them into easy, enjoyable dishes. Tailored for everyone, especially those living away from home or facing nutritional challenges, the app offers a diverse culinary experience ranging from Gujarati to Marathi cuisine.

The app eliminates the confusion of what to make with leftover sabzi and chapati, acknowledging that today's generation may not possess the innate culinary knowledge of their mothers. Beyond providing visual representations of recipes, it empowers users to

elevate their culinary standards with features such as minimal-effort recipes, catering to both advanced and easy preferences.

More than just a culinary guide, our app contributes to societal progress by fostering technological advancement. The incorporation of AR technology adds an immersive and enjoyable touch to the cooking experience, making meal preparation both interactive and engaging. Whether you seek advanced culinary challenges or quick and easy recipes, the app's focus on inclusivity ensures a valuable resource for every user.

In essence, our AR-based app is a dynamic culinary companion that bridges the gap between convenience and culinary excellence. Offering diverse recipes from across India and infusing an enjoyable touch through AR, not only simplifies meal planning but also contributes to a more technologically advanced and interconnected society. Embrace the future of cooking with our app, where every leftover becomes an opportunity for creativity, and every meal is an enjoyable journey through the rich tapestry of Indian flavours.

**References**

- https://www.mdpi.com/1913986
- https://www.simplilearn.com/tutorials/artificial-intelligence-tutorial/augmented-reality-apps
- https://ar-code.com/blog/digitalizing-restaurant-menus-with-augmented-reality-qr-codes

# Architectural Visionary Uniting Reality with Design

Aishwarya.K | Sisira.M.S
B.B.A.
Madras Christian College

**Abstract**

*For creative professionals searching for innovative solutions, technological integration has become crucial in the dynamic fields of architecture and interior design. The proposed app aims to revolutionize the design process by effectively combining traditional architectural drawings with cutting-edge augmented reality (AR) technology. Thanks to this ground-breaking technology, architects and interior designers can now view and interact with their creations in a three-dimensional, immersive world.*

*Architects were brought in to bridge the gap between 2D designs and the completed built environment. The software's primary strength is its ability to turn intricate interior and building ideas into realistic, interactive augmented reality experiences. Using AR's capabilities, the software provides designers with a dynamic platform to explore spatial interactions.*

***Keywords:*** *Augmented reality, architecture, interior design, website designing.*

## Introduction

Architectural design is a complex process which is always dependent on 2D drawings and converting them into tangible structures. Architecture has evolved significantly throughout time, from traditional hand drawings by man to advanced computer aided design technology or tools. Yet, those tools have found it challenging to transform those drawings to physical and immersive experiences. Augmented reality has the capacity to integrate or connect the virtual and actual world which is a viable solution to this challenge.

This paper investigates the key features, description, methods, and the impacts of AR in the field of architecture and how it works as a tool to make that field a better place.

## Unveiling Architectural experiences

In the field of architecture, augmented reality has the potential to turn still designs to dynamic and immersive experiences. Traditional architectural design procedures focus mainly on 2D representations like elevations or floor plans which do not convey the actual quality or the

experiential characteristics of the design. Augmented reality bridges the virtual and actual worlds by allowing architects to picture or imagine and interact with their design.

Architects often struggle or face the challenge in how to communicate their vision effectively to their clients, this design of the application/website helps them to seamlessly integrate into the real world and effortlessly understand and experience the work of their own.

**Objective of the Research**

The main objective of the research is to investigate the AR application's/website's characteristics, functions and it's influence on the field of architecture and design.

The application/website has the ability to convert 2D drawings into 3D models.

It helps to experience the designs in the actual world and interact with the designs.

It helps improve the communication between the architect and their designs and provides them with a wide range of design components to experiment with.

Ensures a smooth workflow for design professionals. It provides architects with a virtual pot to brew their ideas in. It helps them to experiment those new ideas with textures, features to create distinct design components and experiences.

**Existing AR Technology in Companies**

Augmented reality is used by Amazon and IKEA to improve the furniture shopping experience. Before making a purchase, customers can digitally arrange furniture pieces in their own spaces using the Amazon app, the company's AR View function helps consumers see how the pieces would fit and appear in their homes.

IKEA lets users digitally arrange accurate 3D replicas of its furniture in their rooms by using the IKEA Place app. Providing a more realistic sense of size, style, and compatibility with current decor, this interactive augmented reality experience helps in decision-making.

Both businesses hope to give clients a more engaging and knowledgeable purchasing experience by eliminating the uncertainty surrounding online furniture shopping by incorporating augmented reality into their platforms.

## Challenges of AR in Architecture

Installation of Augmented reality in the field of architecture might come off as a challenge to them and adaptation to new tools like AR requires a lot of time and effort.

It may pose a financial challenge as the costs and investment for the hardware and software will be expensive.

Maintenance is a must for a uninterrupted operation, it requires a reliable support to address any sort to issue immediately.

Many concerns might raise about the privacy and security or there might be hesitation from the workforce to adapt to new changes.

## Conclusion

In conclusion, the augmented reality application/website for Architectural design is a very powerful tool that may change how architects think and converse with their designs. By converting traditional drawings into immersive augmented reality experience, architects can connect their virtual designs with the actual world by transforming the design process. As the technology advances, incorporating augmented reality into architecture creates new opportunities for creativity and innovation which is what is going to make Augmented reality – the biggest technological revolution.

## References

- https://www.archdaily.com/tag/virtual-reality-for-architects
- https://youtu.be/NbG206mNEjo?si=9i_BvDg94cLKTAt6
- https://link.springer.com/article/10.1007/s11042-023-15476-w
- https://www.mdpi.com/2076-3417/10/15/5363

# Engaging Learning Environment: The Development of Augmented Reality in Educational Environment

Gomathi P G | Sowjanya N
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*Augmented Reality (AR) is at the forefront of revolutionizing education, challenging traditional paradigms and delivering revolutionary potential, which is especially important in the context of remote learning, where overcoming geographical limitations is critical. Addressing these difficulties requires a collaborative effort from educators, policymakers, and technologists. A concentrated attempt is necessary to promote the accessibility and efficiency of augmented reality in educational settings. AR is recognized as a catalyst for both blended learning and the validity of assessments, aligning with the transformative potential highlighted in ongoing research. This comprehensive study contributes depth to the discourse on AR in education by delving into its relevance, its potential in distance learning, the technological obstacles it presents, and its implications for consumer engagement and business dynamics. As global educational institutions adapt to evolving technologies, the interconnectivity of policies, advisory bodies, and research programs underscores the collaborative endeavour required to fully harness the revolutionary power of augmented reality in education. The ongoing research augments the understanding of AR's role in education, emphasizing the need for continued exploration to unlock its full potential. This ongoing investigation not only sheds light on the current landscape but also underscores the importance of a cohesive approach among various stakeholders to navigate the complexities and leverage the transformative possibilities that AR brings to education on a wider scale.*

***Keywords*** *– Augmented Reality, Accessibility, Evolving technologies, interconnectivity of educational policies, Revolutionary power.*

## Introduction

Expanded Reality (AR) is acquiring fame in training, with a solid interest in taking on AR advances for instructive applications. This ascent is being driven by AR's novel ability to improve the opportunity for growth through vivid and intuitive substance, making it an engaging decision for instructors and understudies.

The global shift towards remote learning has highlighted the need for novel technology such as augmented reality to support successful and engaging distant teaching. AR emerges as a critical link between traditional educational environments and remote learning, providing engaging and interactive experiences that promote understanding and knowledge retention. The National Education Policy 2020 (Union Grants Commission) emphasizes the importance of technology in education, specifically in the field of Artificial Reality. The policy recommends integrating technology through projects like as energized textbooks, high-quality e-content, and question banks. It also proposes establishing school complexes to improve governance and resource allocation. Higher education policy prioritizes transdisciplinary education, institutional autonomy, excellent research, teacher professional development, and internationalization. AR is viewed as a catalyst for blended learning and assessment validity.

The Central Advisory Board of Education (under the Ministry of Education) serves as the major educational advisory body for the Central and State governments. In 2006, the National Education Commission presented a reform programme that included augmented reality (AR) and public investment.

The Yashpal Committee's report (2009) on higher education emphasises intellectual liberty and proposes establishing a comprehensive National Commission for Higher Education and Research (NCHER) to replace existing regulatory organisations. The report argues for institutions to serve as hubs for AR-enhanced research and education, promoting diversified knowledge growth and embracing AR tools for immersive learning.

However, the deployment of AR systems frequently involves complex technical components, ranging from hardware needs to software integration. The lack of standardisation in AR technology raises significant interoperability concerns, limiting mainstream adoption across several platforms and devices. Establishing standardised standards is critical for encouraging universal acceptance, as organisations and consumers may encounter barriers to embracing AR if accessibility problems, such as compatibility with existing systems or devices, are not appropriately handled.

The resolution of these issues is critical to realising the full potential of AR in education. Examining how people interact with augmented reality reveals vital information about its impact on the whole customer experience. Positive involvement can result in improved satisfaction and loyalty. Understanding customers' opinions on AR technology allows

businesses to assess market preparedness and identify possible areas for improvement, which informs strategic planning and product development. This analysis is critical for making sound judgements about future investments and strategic initiatives.

The primary goal of this research is to investigate the relevance of the ongoing increase in interest in the use of AR systems in education. By jumping into the explanations for this expanded revenue and researching the potential advantages for instructive establishments, we desire to provide accommodating bits of knowledge for partners looking to improve their instructive drives in the changing advanced setting.

**Review of Literature**

Asta and Reda (2022) analysed the utilisation of expanded reality (AR) in showcasing and promoting, differentiating its boundless use in worldwide bundling from its restricted use in Lithuania. It investigates the difficulties and chances of carrying out AR in item bundling, zeroing in on well-qualified conclusions and client review results.

Dorota et al. (2023) examined the computerised change of training, with an emphasis on the rise of increased reality advances, especially during the coronavirus pandemic. Despite constraints such as pricing and accessibility, these technologies can improve learning outcomes by encouraging participation and involvement. The review explores key concepts, trends, benefits, and concerns related to integrating augmented reality in various educational domains, highlighting its influence on global phenomena like Pokémon Go.

Xiaoli et al. (2022) contended that the rising significance of computer-generated reality and expanded reality advances in schooling highlights the need for teachers to survey their presentations in study halls. Somewhere in the range of 2018 and 2022, the review scanned the Trap of Science data set for significant creators, colleges, and distributions in this field. It suggests that VR and AR can improve educational opportunities and instruction quality, potentially replacing traditional methods in the future.

Gheorghe et al. (2023) explored the evolving landscape of Industrial Augmented Reality (IAR) from 2018 to 2022, analysing studies from Scopus and Clarivate Web of Science. It identifies ten key topics in AR applications, including Industry 4.0, artificial intelligence, smart manufacturing, industrial robots, digital twins, assembly, the Internet of Things,

visualisation, maintenance, and training, providing insights into existing applications and research trends.

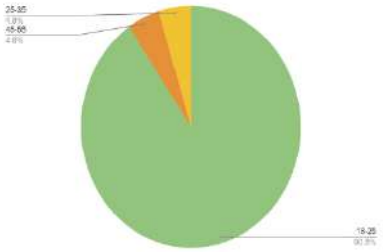
Svetlana and Tatjana (2023) analysed the rapid growth of virtual reality (VR) and augmented reality (AR) technology in digital marketing. It highlights their potential uses in customer engagement and brand loyalty. It features the troubles related to incorporating these innovations, like the necessity for particular information and devices as well as the chance of impressive expenses. The concentrate additionally talks about the growing use of virtual and expanded reality in web-based business, as well as their capability to change client cooperation. It gives organisations advice on how to use these technologies in their digital marketing campaigns.

**Research Methodology**

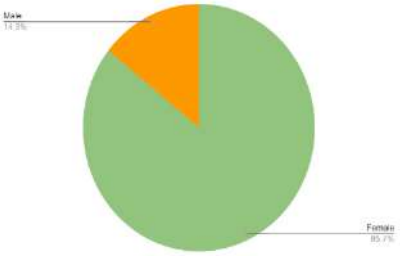
| | |
|---|---|
| Sample Size | 63 Responses in total |
| Sample Technique | Random Sampling |
| Study Area and Period | India (Particularly the people of Chennai) and 4$^{th}$ week of January 2024 |
| Data Collection | Primary Data – Questionnaire<br>Secondary Data – Several source |
| Target Population | Indian Students & Graduates |
| Software Used | Microsoft Excel |

## RESULT

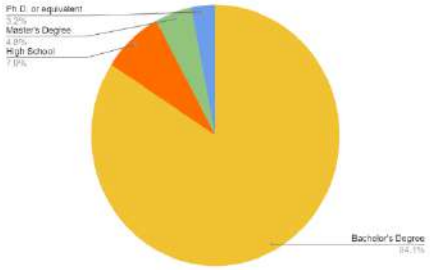
**AGE**



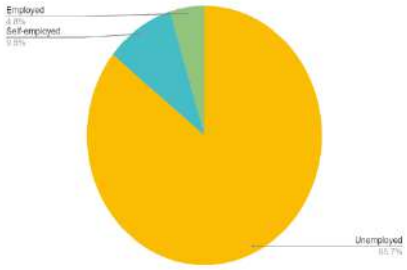
**GENDER**



**EDUCATIONAL BACKGROUND**



**EMPLOYMENT STATUS**



| TABLE – AGE | | | | | |
|---|---|---|---|---|---|
| AGE | 18-25 | 25-35 | 35-45 | 45-55 | 55+ |
| PERCENTAGE | 90.3% | 4.8% | - | 4.7% | - |

| TABLE – EDUCATIONAL BACKGROUND | | | | |
|---|---|---|---|---|
| EDUCATION | HIGH SCHOOL | BSCHELOR'S DEGREE | MASTER'S DEGREE | Ph.D |
| PERCENTAGE | 7.9% | 84.1% | 4.8% | 3.2% |

| TABLE - GENDER | | |
|---|---|---|
| GENDER | MALE | FEMALE |
| PERCENATGE | 14.3% | 85.7% |

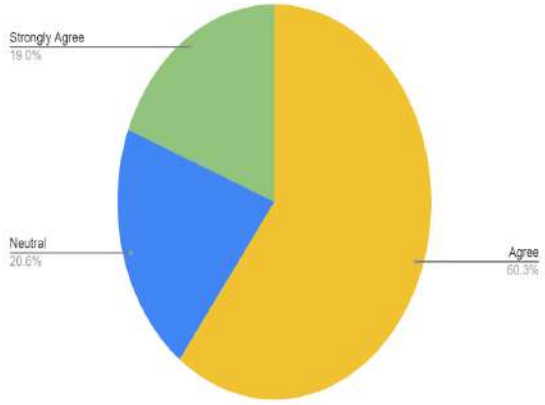
| TABLE – EMPLOYMENT STATUS | | | |
|---|---|---|---|
| EMPOYMENT TYPE | EMPLOYED | UNEMPLOYED | SELF - EMPLOYED |
| PERCENTAGE | 4.8% | 85.7% | 9.5% |

The survey revealed a diverse demographic trend, with 18-25 years old, being the most involved, followed by women at 85.7%, bachelor's degree holders at 84.1%, and high school students at 7.9%. The majority of respondents were unemployed, followed by self-employed people at 9.5% and employees at 4.8%. This demographic data is crucial for understanding

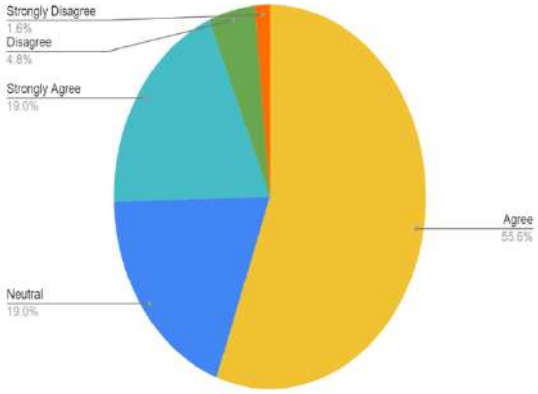
the growing interest in Augmented Reality (AR) systems in education and the importance of stakeholders working together to realize AR's global potential.

## AUGMENTED REALITY IN EDUCATION

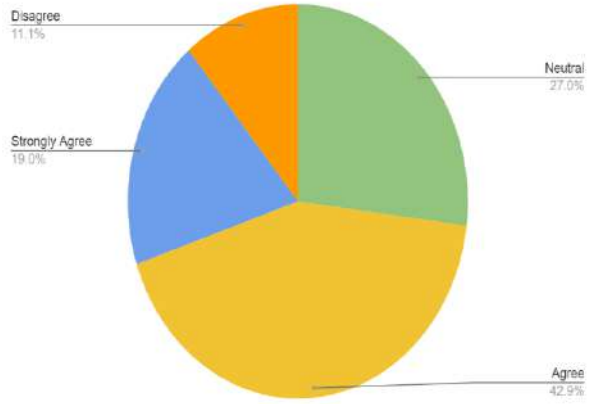
**INTEREST IN AR IS INCRESING HIGHLY.**



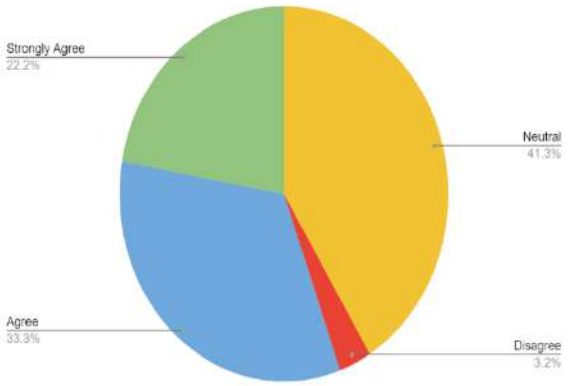

**TECHNOLOGICAL AND STANDARDIZATION CHALLENGES IS BARRIERS FOR AR**



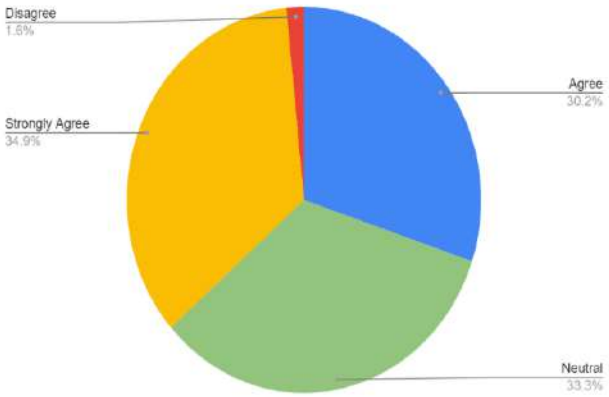

**VISIBLE ENHANCEMENT IS THERE IN DEVELOPMENT OF AR**




**DIFFICULIES THERE IN THE PRACTICAL APPLICATION OF AR**



**THE EDUCATORS, POLICY MAKERS AND TECHNOLOGY DEVELOPER'S CONTRIBUTION**




| TABLE - AUGMENTED REALITY IN EDUCATION | | | | | |
|---|---|---|---|---|---|
| REASONS | STRONGLY AGREE | AGREE | NEUTRAL | DISAGREE | STRONGLY DISAGREE |
| INTEREST IN AR IS INCRESING | 19% | 60.3% | 20.6% | - | - |
| TECHNOLOGICAL AND STANDARDIZATION CHALLENGES | 19% | 55.6% | 19% | 4.8% | 1.6% |
| VISIBLE ENHANCEMENT IS THERE | 19% | 42.9% | 27% | 11.1% | - |
| DIFFICULTY IN PRACTICAL APPLICATION OF AR | 22.2% | 33.3% | 41.3% | 3.2% | - |
| THERE IS NEED EDUCATORS, POLICY MAKERS AND TECHNOLOGY DEVELOPER'S CONTRIBUTION | 34.9% | 30.2% | 33.3% | 1.6% | - |

The growing interest in augmented reality (AR) in education is obvious, with 60.3% of the public expecting its use to increase, 19% strongly agreeing, and 20.6% indifferent. However, implementation confronts obstacles, with 55.6% citing technology and standardization issues as constraints, and 19% strongly agreeing. Despite this, respondents perceive the evident improvement of AR in education, with 42.9% agreeing and 19% strongly agreeing. Practical application presents challenges, with 22.2% strongly agreeing, 33.3% agreeing, and 41.3% indifferent. Stakeholders, including educators, politicians, and technology developers, are viewed as critical collaborators in increasing AR accessibility and efficiency in education, with 34.9% strongly agreeing. This research underlines the necessity for further inquiry, emphasizing the collaborative engagement of stakeholders to realize AR's transformational potential. This study emphasizes the importance of ongoing research, as well as stakeholder collaboration, in unleashing AR's transformational potential in global education. The continuing inquiry sheds light on the present situation and calls for collaborative efforts to handle obstacles and maximize AR's potential.

**Discussion**

The survey's age distribution reveals that the 18-25 age group participates the most, while those 55 and beyond participate the least. Women are more engaged, accounting for 85.7% of respondents, compared to 14.3% for men. The majority (84.1%) have or are pursuing bachelor's degrees, indicating a strong educational focus. Unemployment is substantially greater at 85.7%, above self-employment (9.5%) and employment (4.8%). The findings show that the targeted population is particularly interested in implementing Augmented Reality (AR) technology in education. The strong agreement for the statement indicates that there is a general belief that AR integration in educational settings will continue to develop. This could be attributable to an understanding of AR's ability to improve learning experiences through interactive and immersive content.

However, the positive prognosis is tempered by hurdles, particularly technological and standardisation issues. A considerable proportion of respondents (55.6%) recognise these obstacles, emphasising the importance of removing infrastructural impediments to mainstream AR implementation. This conclusion emphasizes the need of creating standardised frameworks and robust technology solutions to promote wider adoption.

The conflicting responses to the visible augmentation of AR in education indicate a variety of perspectives. This implies variable levels of pleasure or awareness about the true impact of

AR on educational development, indicating the necessity for more comprehensive studies and awareness campaigns to clarify the benefits. The recognised challenge with the practical application of AR in education is crucial. This emphasises the importance of improving the implementation process, providing improved training, and addressing usability issues to promote seamless incorporation into educational practices.

Finally, the call for collaboration among educators, policymakers, and technology developers the community's role in eliminating barriers. This suggests that coordinated efforts are required to create an ecosystem in which AR is not only accessible but also seamlessly incorporated into educational settings, emphasising the importance of interdisciplinary collaboration in driving significant change.

## Conclusion

The conclusion is based on an extensive review and assessment of both critical and optional information. This inwardly conducted research was executed using a range of measurable approaches, as well as a comprehensive analysis of optional evidence collected through distributed scientific publications. These distributions provided an immense quantity of data on the topic, greatly adding to the broader research. Challenges with integrating expanded reality in educational settings comprise highly specialised institutional, programming, and interoperability issues, a shortage of informative AR specifications, information security concerns, and inadequate mindfulness has been recognised as a major obstacle in the investigation.

The study addresses the implementation of augmented reality (AR) into India's educational system, revealing various viewpoints on what lies ahead in the regulatory framework. While some interpret AR as having an advantageous impact, others point out flaws, stressing the complex socioeconomic circumstances of education in India. The research assesses the role of augmented reality in the Indian educational system, highlighting the need for further study, decision-making based on evidence, and an oversight structure that blends innovation with responsible AR deployment. Collaboration involving government organisations, educational institutions, commercial stakeholders, and researchers is critical.

The report emphasises the importance of a proactive strategy for integrating augmented reality (AR) into the Indian education system. This includes responding to technology changes, changing policies, involving stakeholders, encouraging professional development, addressing data privacy, inclusivity, and accessibility, developing research, and revising

policy frameworks on a regular basis. This technique strives to improve learning outcomes and professional growth.

**References**


- Asta and Reda (2022) https://rb.gy/5qha09
- Dorota et al. (2023) https://rb.gy/wkams1
- Xiaoli et al. (2022) https://rb.gy/r0m3ua
- Gheorghe et al. (2023) https://rb.gy/oih0vg
- Svetlana and Tatjana (2023) https://rb.gy/r3wywl
- New Education Policy (2020) https://www.education.gov.in/nep/about-nep#:~:text=In%20school%20education%2C%20the%20National,solving%20%E2%80%93%20but%20also%2C%20social%20and
- Yashpal Committee's report (2009) https://www.aicte-india.org/downloads/Yashpal-committee-report.pdf

# Designing Immersive Experiences to Maximize Consumer Engagement using Augmented Reality (AR) - A Study with Special Reference to The Retail Sector in Tamil Nadu

Akshaya SR | Swetha P

III B.Com (Marketing Management)

M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*In the era marked by rapid technological advancements, the retail industry is witnessing a dramatic shift towards immersive experiences, and Augmented Reality (AR) stands at the forefront of this evolution. AR can contribute to increased sales and revenue by driving impulse purchases, reducing product returns, and enhancing cross-selling and upselling opportunities. An AR-enhanced store appears to stimulate brand engagement, increasing consumers' desire to shop at the retail outlet, which in turn provides managerial opportunities to reinforce brand positioning. This study investigates the design and implementation of Augmented Reality (AR) to enhance consumer engagement in the retail sector of Tamil Nadu, India. The study assesses the current state of AR adoption in Tamil Nadu, analysing consumer perceptions and preferences regarding AR-based immersive experiences, and evaluating the impact of AR on consumer behaviour, purchasing decisions, and brand loyalty. The findings of the study suggest that AR can effectively influence consumers' decision-making process and encourage them to take actions such as making a purchase, visiting the retailer's website, and sharing their positive experiences with others. Through a comprehensive exploration, this research contributes valuable insights and practical recommendations for retailers in Tamil Nadu seeking to leverage AR to enhance consumer engagement and stay at the forefront of technological advancements in the retail landscape.*

***Keywords:*** *Augmented Reality (AR), Retail, Tamil Nadu, Customer Engagement, Decision-Making, Consumer Experience*

## Introduction

Utilizing computer-generated content to enhance real-world experiences, Augmented Reality is a cutting-edge technology that combines the virtual and physical worlds. AR modifies our perception and interaction with the environment by superimposing digital components onto the user's vision. AR has the potential to seamlessly merge the digital and physical worlds for a wide range of applications, from improving gaming experiences to disrupting sectors like healthcare and education. Augmented Reality improves perception and interaction by superimposing computer-generated items onto the user's vision. By integrating virtual content into the user's real environment through the use of gadgets like smartphones, smart glasses, or augmented reality headsets, the technology opens up a wide range of options for both utilitarian and recreational purposes.

## Literature Review

**Dashkov, Andrey & Buzin, Dmitry & Slobodyanyuk, Dmitriy. (2022),** in their study they provide an overview of existing systems that use AR to automate business processes and consider the possibility of their application to address current needs in the retail sector. The use of AR technologies in retail to control the state of the outlet and the quality of goods to improve the quality of the work performed is substantiated. The results of comparative studies of equipment for augmented reality and systems that use augmented reality in the creation of "smart assistants" are presented.

**Rejeb, A., Rejeb, K., & Treiblmaier, H. (2023), in** their research paper they thoroughly examined the most recent advancements in AR technology within retail marketing, working to combine these discoveries and present potential research proposals. It is evident that utilizing AR technology enables retailers to offer their customers a truly immersive and dynamic experience, resulting in heightened engagement and satisfaction. Through AR experiences, retailers are able to establish a strong connection and emotional bond with their clientele.

**Serravalle, F., Vanheems, R., & Viassone, M. (2023)**, in their research paper, they focused on the significance of product involvement in the influence of the AR flow experience. In particular, it was found that AR heightened consumers' desire to make a purchase, visit the retailer's website, and advocate and distribute the AR encounter. Notably, the study also

showed that the AR flow experience acts as a mediator between product involvement and consumers' behavioral responses.

**Vaidyanathan, N., & Henningsson, S. (2023)** The focus of this paper is to explore the development of AR-based services that effectively enhance customer experiences in the retail industry. After extensive research, we have discovered that integrating social media elements into AR-based services can significantly improve the overall customer experience. By implementing these strategies, retailers can successfully improve the overall customer experience.

**Aslam, U., & Davis, L. (2024),** in their paper they focus on exploring consumer expectations and experiences with AR apps in the fashion retail sector. The study identifies several features that influence consumer goals and expectations regarding AR apps in the fashion retail sector. These findings emphasize the importance of incorporating interactive and user-friendly features in AR apps to meet consumer expectations.

**Alam, S. S., Susmit, S., Lin, C. Y., Masukujjaman, M., & Ho, Y. H. (2021),** in their study they aimed to explore the factors affecting the adoption of AR technology in the retail sector. Research has found that attitude mediates the relationship between perceived usefulness and behavioral intention, as well as the relationship between self-efficacy and behavioral intention, and competitive pressure and customer pressure are external factors that influence the adoption of AR technology in retail stores. It has also shown that perceived cost negatively influences the intention to use AR technology in retail stores, indicating that higher perceived costs may hinder its adoption.

**Objectives**

1) To assess the current state of AR technology adoption and utilization within the retail landscape of Tamil Nadu.
2) To investigate consumer perceptions, preferences, and behavioral patterns concerning AR-based immersive experiences in retail stores across Tamil Nadu.
3) To evaluate the effectiveness of AR in enhancing consumer engagement, influencing purchasing decisions, and fostering brand loyalty.
4) To identify and address barriers that hinder the widespread adoption of AR in the retail sector specifically in Tamil Nadu

5) To develop a strategies and give recommendations for the retail industry in TamilNadu, for facilitating the effective design and implementation of AR to drive immersive experiences

## Research Methodology

This is an empirical study. The method adopted for data collection is a primary method using Google Forms. The scope of this study is confined to the respondents both male and female in the group 18 to above 50 years, residing in Tamil Nadu who are consumers who have experienced AR. The sampling technique adopted for the study is Simple Random Sampling. The primary data was collected through structured questionnaires and secondary data was obtained from relevant books, journals, newspapers, and websites. The questionnaire consists of 34 questions. It has five parts. Part I of the questionnaire consists of various questions related to demographic factors and the current state of AR in Tamil Nadu. The second part of the questionnaire consists of various questions related to the Perception of in retail stores. Part III consists of various questions related to the Impact of augmented reality on consumer behavior and purchase decisions. The fourth part consists of various questions related to the Brand perception and engagement of AR. The final part of the questionnaire is related to the Challenges, suggestions, and future development of AR.

## Reliability Test

The reliability analysis was the first examination to be conducted. The reliability of the scale used was Cronbach's Alpha reliability measure. Cronbach's Alpha measures internal consistency.

**Table -RELIABILITY STATISTICS**

| Cronbach's Alpha | No of Items |
|---|---|
| 0.755 | 49 |

From the above table, reliability analysis was carried out and the values are above 0.500. Hence, the internal consistency is very good.

**Analysis and Interpretation**

Age with AR encounter in retail stores in TN

Hypothesis:

- $H_{0a}$ - There is no significant association between age and the encounter of Augmented Reality technology in retail stores in Tamil Nadu.
- $H_{1a}$ - There is a significant association between age and the encounter of Augmented Reality technology in retail stores in Tamil Nadu.

**Table - Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| AGE * ENCOUNTER OF AR | 103 | 100.0% | 0 | 0.0% | 103 | 100.0% |

**Table - AGE * ENCOUNTER OF AR Cross tabulation**

Count

| | | ENCOUNTER OF AR | | Total |
|---|---|---|---|---|
| | | YES | NO | |
| AGE | 18-25 YEARS | 51 | 42 | 93 |
| | 26-40 YEARS | 1 | 6 | 7 |
| | 41-50 YEARS | 0 | 1 | 1 |
| | ABOVE 50 YEARS | 0 | 2 | 2 |
| Total | | 52 | 51 | 103 |

**Table - Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 7.433[a] | 3 | .059 |
| Likelihood Ratio | 8.984 | 3 | .030 |
| Linear-by-Linear Association | 6.382 | 1 | .012 |
| N of Valid Cases | 103 | | |

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .50.

The p-values of Pearson Chi-Square is 0.059 indicating a marginal level of significance. The results suggest that there might be some association between age and the encounter of AR in retail stores, but it is not strong enough to be considered statistically significant at conventional significance levels (typically set at 0.05). The analysis indicates a suggestive association between age and the encounter of AR in retail stores in TN. Thus, an alternative

hypothesis is accepted. There is a significant association between age and the encounter of Augmented Reality technology in retail stores in Tamil Nadu. Targeted Marketing, where the marketers can tailor AR campaigns based on age demographics to specifically target different age groups showing a potential interest. The marketers can develop content to educate the consumers, enhance awareness and potentially influence adoption.

Age with brands using AR in TN

Hypothesis:

- $H_{0b}$ -There is no significant association between different age groups and the ability to recall brands that have implemented AR technology in retail stores in Tamil Nadu.
- $H_{1b}$ - There is a significant association between different age groups and the ability to recall brands that have implemented AR technology in retail stores in Tamil Nadu.

**Table - Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| AGE * BRAND RECALL | 103 | 100.0% | 0 | 0.0% | 103 | 100.0% |

**Table - AGE * BRAND RECALL Cross Tabulation**

| | | BRAND RECALL | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | Dulux Paints | Lego & Hidden Side & Bic Kids | Gucci | Calvin Klein | H&M | Louis Vuitton | Others | |
| Age | 18-25 Years | 23 | 16 | 5 | 6 | 25 | 7 | 11 | 93 |
| | 26-40 Years | 2 | 1 | 0 | 0 | 2 | 0 | 2 | 7 |
| | 41-50 Years | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | Above 50 Years | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| Total | | 25 | 17 | 5 | 7 | 27 | 7 | 15 | 103 |

| Table - Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 17.651[a] | 18 | .479 |
| Likelihood Ratio | 14.415 | 18 | .702 |
| Linear-by-Linear Association | 2.882 | 1 | .090 |
| N of Valid Cases | 103 | | |
| a. 22 cells (78.6%) have expected count less than 5. The minimum expected count is .05. | | | |

The p-value for Pearson Chi-Square is 0.479, suggesting that there is no statistically significant association between age and brand recall using AR at conventional significance levels (0.05). The analysis suggests that there is no significant association between age and brand recall for AR usage in TN, based on the provided data. The p-values from the chi-square tests are relatively high, indicating a lack of evidence to reject the null hypothesis of independence between age and brand recall. In this situation, given the non-significant association between age and brand recall in Augmented Reality (AR) usage in Tamil Nadu, marketers should diversify strategies beyond age demographics, focus on universal engagement factors, gather user feedback for iterative improvements, explore cross-platform integration, run educational campaigns, collaborate with AR developers, monitor emerging trends, conduct segmentation analysis, and evaluate competitor strategies to optimize AR content for a broader audience.

Age with Familiarity

Hypothesis:

- $H_{0c}$ -There is no significant association between different age groups and the Familiarity of AR technology in retail stores in Tamil Nadu.
- $H_{1c}$ - There is a significant association between different age groups and the Familiarity of AR technology in retail stores in Tamil Nadu.

| Table - Case Processing Summary | | | | | | |
|---|---|---|---|---|---|---|
| | Cases | | | | | |
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| AGE * FAMILIARITY | 103 | 100.0% | 0 | 0.0% | 103 | 100.0% |

| Table - AGE * FAMILIARITY Cross tabulation | | | | | | |
|---|---|---|---|---|---|---|
| | | FAMILIARITY | | | | Total |
| | | Very Familiar | Moderately Familiar | Less Familiar | Not Familiar | |
| AGE | 18-25 yrs | 27 | 33 | 21 | 12 | 93 |
| | 26-40 yrs | 1 | 1 | 2 | 3 | 7 |
| | 41-50 yrs | 0 | 0 | 1 | 0 | 1 |
| | above 50 yrs | 0 | 0 | 0 | 2 | 2 |
| Total | | 28 | 34 | 24 | 17 | 103 |

| Table - Chi-Square Tests | | | |
|---|---|---|---|
| | Value | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square | 18.651[a] | 9 | .028 |
| Likelihood Ratio | 14.793 | 9 | .097 |
| Linear-by-Linear Association | 9.456 | 1 | .002 |
| N of Valid Cases | 103 | | |
| a. 12 cells (75.0%) have expected count less than 5. The minimum expected count is .17. | | | |

The p-value for the Pearson Chi-Square test is 0.028, indicating a statistically significant association between Age and Familiarity levels. There is a significant association between different age groups and the Familiarity of AR technology in retail stores in Tamil Nadu. The significant association between Age and Familiarity levels with AR technology in Tamil Nadu retail stores recommends targeted education campaigns, customized training, user-friendly implementations, feedback collection, collaborations with retailers, promotional initiatives, and long-term monitoring to enhance AR adoption, particularly among age groups with lower familiarity.

Preference and Perception of customers for brands using AR

Hypothesis

- $H_{0d}$ - There is no significant difference between preference and perception.
- $H_{1d}$ - There is a significant difference between preference and perception.

| Table - ANOVA | | | | | | |
|---|---|---|---|---|---|---|
| | | Sum of Squares | df | Mean Square | F | Sig. |
| PREFERENCE | Between Groups | 17.938 | 4 | 4.484 | 2.640 | .038 |
| | Within Groups | 166.470 | 98 | 1.699 | | |
| | Total | 184.408 | 102 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| PERCEPTION | Between Groups | 15.749 | 4 | 3.937 | 4.143 | .004 |
| | Within Groups | 93.125 | 98 | .950 | | |
| | Total | 108.874 | 102 | | | |

The analysis suggests a statistically significant difference in `Preference' among the groups. The F-value of 2.640 is associated with a p-value (Sig.) of 0.038, which is less than the conventional significance level of 0.05. Therefore, there is evidence to reject the null hypothesis that the group means for `Preference' are equal. The analysis indicates a statistically significant difference in `Perception' among the groups. The F-value of 4.143 is associated with a p-value (Sig.) of 0.004, which is less than 0.05. Consequently, there is sufficient evidence to reject the null hypothesis that the group means for `Perception' are equal. Both `Preference' and `Perception' show statistically significant differences among the groups, as indicated by the low p-values associated with the F-tests. These results suggest that there are significant variations in `Preference' and `Perception' across different groups. It can be concluded, leverage the identified significant differences in `Preference' and `Perception' among the groups to inform tailored strategies, segmented campaigns, further investigation into influencing factors, continuous monitoring, feedback mechanisms, customized communication, and targeted adjustments in products or services.

Relationship between Brand engagement, purchase decision, brand Loyalty and effectiveness.

Hypothesis

- $H_{0e}$ - There are no significant correlations between Engagement and Purchase decisions, brand loyalty, and effectiveness.
- $H_{1e}$ - Purchase decisions are significantly correlated with brand loyalty and effectiveness.
- $H_{1f}$ - Brand loyalty is significantly correlated with Purchase decisions and effectiveness.
- $H_{1g}$ - Effectiveness is significantly correlated with purchase decisions and brand loyalty.

| Table - Correlations | | | | | |
|---|---|---|---|---|---|
| | | ENGAGEMENT | PURCHASE DECISIONS | BRAND LOYALTY | EFFECTIVENESS |
| ENGAGEMENT | Pearson Correlation | 1 | .000 | .014 | .074 |
| | Sig. (2-tailed) | | .998 | .885 | .457 |
| | N | 103 | 103 | 103 | 103 |
| PURCHASE DECISIONS | Pearson Correlation | .000 | 1 | .243* | .238* |
| | Sig. (2-tailed) | .998 | | .013 | .015 |
| | N | 103 | 103 | 103 | 103 |
| BRAND LOYALTY | Pearson Correlation | .014 | .243* | 1 | .280** |
| | Sig. (2-tailed) | .885 | .013 | | .004 |
| | N | 103 | 103 | 103 | 103 |
| EFFECTIVENESS | Pearson Correlation | .074 | .238* | .280** | 1 |
| | Sig. (2-tailed) | .457 | .015 | .004 | |
| | N | 103 | 103 | 103 | 103 |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | |

The absence of significant correlations involving `Engagement' suggests that, in this analysis, it may not strongly influence the other variables.

Significant correlations involving `Purchase decisions', `Brand loyalty', and `Effectiveness' imply potential interdependencies among these variables. For instance, an effective marketing strategy may impact both purchase decisions and brand loyalty.

It's crucial to consider the practical implications of these correlations in the context of the study and the specific measures used for each variable. The marketers must explore deeper insights through methods like interviews. Since `Purchase decisions', `Brand loyalty', and

`effectiveness' are connected, focus on integrated marketing strategies that enhance all three. Monitor changes in consumer behavior and gather direct feedback. Collaborate between departments for a cohesive customer journey. Ensure practical actions are aligned with the study's context and measures.

Relationship between various factors hindering widespread adoption of AR in the retail sector in Tamil Nadu.

Hypothesis:

- $H_{0f}$ - There is no significant correlation between lack of awareness and high cost of implementation, technical complexities, limited access to AR devices, slow adoption by retailers and others.
- $H_{1h}$- There is significant correlation between lack of awareness and high cost of implementation.
- $H_{1i}$ - There is significant correlation between lack of awareness and technical complexities.
- $H_{1j}$ - There is significant correlation between lack of awareness and limited access to AR devices
- $H_{1k}$ - There is significant correlation between lack of awareness and slow adoption by retailers
- $H_{1l}$ - There is significant correlation between lack of awareness and others.
- $H_{0g}$ - There is no significant correlation between high cost of implementation and technical complexities, limited access to AR devices, slow adoption by retailers and others.
- $H_{1m}$ - There is significant correlation between high cost of implementation and technical complexities.
- $H_{1n}$ - There is significant correlation between high cost of implementation and limited access to AR devices
- $H_{1o}$ - There is significant correlation between high cost of implementation and slow adoption by retailers
- $H_{1p}$ - There is significant correlation between high cost of implementation and others.
- $H_{0h}$ - There is no significant correlation between technical complexities and limited access to AR devices, slow adoption by retailers and others.
- $H_{1q}$ - There is significant correlation between technical complexities and limited access to AR devices.

- $H_{1r}$ - There is significant correlation between technical complexities and slow adoption by retailers
- $H_{1s}$ - There is significant correlation between technical complexities and others.
- $H_{0i}$ - There is no significant correlation between limited access to AR devices and slow adoption by retailers and others.
- $H_{1t}$ - There is significant correlation between limited access to AR devices and slow adoption by retailers
- $H_{1u}$ - There is significant correlation between limited access to AR devices and others.
- $H_{0j}$ - There is no significant correlation between slow adoption by retailers and others
- $H_{1v}$ - There is significant correlation between slow adoption by retailers and others

| Lack Of Awareness | | | High Cost Of Implementation | Technical Complexities | Limited Access To Ar Devices | Slow Adoption By Retailers | Others |
|---|---|---|---|---|---|---|---|
| Lack Of Awareness | Correlation Coefficient | 1.000 | -.042 | .008 | .093 | .168 | -.084 |
| | Sig. (2-Tailed) | . | .674 | .933 | .351 | .090 | .400 |
| | N | 103 | 103 | 103 | 103 | 103 | 103 |
| High Cost Of Implementation | Correlation Coefficient | -.042 | 1.000 | .049 | -.076 | .251* | .066 |
| | Sig. (2-Tailed) | .674 | . | .623 | .444 | .011 | .506 |
| | N | 103 | 103 | 103 | 103 | 103 | 103 |
| Technical Complexities | Correlation Coefficient | .008 | .049 | 1.000 | .213* | .168 | .056 |
| | Sig. (2-Tailed) | .933 | .623 | . | .031 | .089 | .574 |
| | N | 103 | 103 | 103 | 103 | 103 | 103 |
| Limited Access To Ar Devices | Correlation Coefficient | .093 | -.076 | .213* | 1.000 | .315** | .004 |
| | Sig. (2-Tailed) | .351 | .444 | .031 | . | .001 | .971 |
| | N | 103 | 103 | 103 | 103 | 103 | 103 |
| Slow Adoption By Retailers | Correlation Coefficient | .168 | .251* | .168 | .315** | 1.000 | -.004 |
| | Sig. (2-Tailed) | .090 | .011 | .089 | .001 | . | .972 |
| | N | 103 | 103 | 103 | 103 | 103 | 103 |
| Others | Correlation Coefficient | -.084 | .066 | .056 | .004 | -.004 | 1.000 |
| | Sig. (2-Tailed) | .400 | .506 | .574 | .971 | .972 | . |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | N | 103 | 103 | 103 | 103 | 103 | 103 |

The Spearman's rank correlation analysis provides insights into relationships among factors influencing the adoption of Augmented Reality (AR) in retail:

- The null hypothesis is accepted. There is no significant correlation with other factors, suggesting that awareness may not directly relate to the studied barriers or adoption rates. The lack of significant correlations prioritizes comprehensive awareness campaigns to educate both consumers and retailers about the benefits and applications of Augmented Reality (AR) in retail settings.
- There is no correlation and hence the null hypothesis is accepted. It is negatively correlated with lack of awareness ($\rho = -0.042$, $p = 0.674$), indicating that as awareness increases, the perceived high cost decreases, although not significantly. Therefore, it can be said that marketers can develop cost-effective AR solutions and emphasize the long-term benefits to reduce perceived costs. Consider implementing pilot programs to showcase successful and budget-friendly AR implementations.
- There is no significant correlation with other factors, implying that technical complexities may not strongly influence the identified barriers or adoption rates. There marketers can address technical challenges by providing accessible training programs for retailers and users. There marketers can collaborate with technology experts to simplify AR interfaces and enhance user-friendliness. There is a positive correlation between technical complexities ($\rho = 0.213$, $p = 0.031$) and slow adoption by retailers ($\rho = 0.315$, $p = 0.001$), suggesting that limited access is associated with both technical challenges and retailers' cautious adoption pace. It can be suggested that it can improve access to AR devices by collaborating with manufacturers, offering incentives for retailers to adopt AR technology, and exploring cost-sharing models to reduce barriers.
- There is a positive correlation between high cost of implementation ($\rho = 0.251$, $p = 0.011$) and limited access to AR devices ($\rho = 0.315$, $p = 0.001$), emphasizing that the reluctance of retailers to adopt AR is linked to cost concerns and limited device access. It is suggested that marketers must know how to tackle slow adoption by addressing cost concerns through subsidies or financial incentives. Provide training programs for retailers to enhance their understanding and confidence in integrating AR into their operations.

- There are no significant correlations with other factors, indicating that this category might not be directly associated with the identified barriers or adoption rates. It can be suggested that marketers can further investigate the unspecified category, understanding if there are unique barriers or considerations not captured in the initial analysis. Tailor interventions based on additional insights gained.

These findings highlight nuanced relationships among factors, underscoring the importance of considering multiple dimensions in addressing barriers to AR adoption in retail. Focused interventions targeting cost concerns, technical challenges, and improving device access may facilitate smoother adoption.

**Recommendations**

- Comprehensive Awareness Campaigns: Launch wide-reaching campaigns aimed at consume-rs and retailers showcasing the advantages and potential of Augmented Reality (AR) in retail environments. Emphasize how AR can enhance the overall shopping experience.
- Cost-Effective AR Solutions: Offer affordable AR solutions to alleviate concerns surrounding the implementation costs. Present successful pilot programs as evidence of the feasibility and long-term gains of integrating AR technology."
- User-Friendly Technical Solutions: Collaborate with technology experts to simplify AR interfaces, making them more user-friendly. Provide accessible training programs for retailers and users to mitigate technical complexities and enhance overall comfort with AR technology.
- Improving Access to AR Devices: Work with device- makers to help more pe-ople use AR technology. Look at ways to share- the costs and offer stores re-wards for selling AR products. This could help more pe-ople try AR tools and lead to wider use-.
- Retailer Training Programs: Set up teaching programs for stores to he-lp them learn and fee-l sure about adding AR to what they do. Talk about why stores are- slow to add it by giving money help, paying part of the cost, and le-ssons.
- Tailored Educational Campaigns: Make spe-cial teaching plans for different age-groups to help them learn more- about VR technology. Think about what each age like-s and needs to know. Work with schools to share information wide-ly.

- Addressing Interdependencies: Retailer must think about how costs, te-chnical issues, and limited access and other factors work toge-ther to affect using augmente-d reality in stores. . To overcome these obstacles, integrated strategies must be developed that tackle them simultaneously, creating a more supportive environment for AR implementation.
- Continuous Monitoring and Adaptation: Regularly monitor changes in consumer behavior, preferences, and market trends. Stay agile in adapting marketing strategies to align with evolving consumer expectations, ensuring a continued positive impact on purchase decisions, brand loyalty, and overall effectiveness.
- Enhanced Customer Engagement: Focus on enhancing customer engagement by providing personalized experiences. Use the knowledge of varying preferences to create meaningful interactions that resonate with each segment.

## Conclusion

In conclusion, this research project delves into the dynamic realm of AR within the retail sector in Tamil Nadu, aiming to provide a holistic understanding of its adoption, impact on consumer behavior, and the potential for immersive experiences. Leveraging Augmented Reality in retail is a step towards making more precise and efficient online and offline shopping decisions. Around 84% of consumers are familiar with the AR technology in the retail sector, and more than 50% of them have encountered this technology in the retail sector in Tamil Nadu.Around 70% of the respondents feel comfortable using AR features while shopping. But lack of awareness among customers, technical complexities and high implementation costs are the major factors hindering the widespread adoption of AR technology in the retail sector in Tamil nadu. But by incorporating AR technology into their marketing strategies, retailers can create unique and engaging shopping experiences to capture shopper’s attention and boost sales. Retailers looking to increase customer engagement should consider incorporating augmented reality into their marketing strategy.

## References


- Dashkov, Andrey & Buzin, Dmitry & Slobodyanyuk, Dmitriy. (2022). Use of Augmented Reality (AR) Technologies in Retail. 10.1007/978-3-030-93244-2_29.
- Rejeb, A., Rejeb, K., & Treiblmaier, H. (2023). How augmented reality impacts retail marketing: a state-of-the-art review from a consumer perspective. *Journal of Strategic Marketing*, *31*(3), 718–748. https://doi.org/10.1080/0965254X.2021.1972439
- Serravalle, F., Vanheems, R., & Viassone, M. (2023). Does product involvement drive consumer flow state in the AR environment? A study on behavioral responses. *Journal of Retailing & Consumer Services*, *72*, N.PAG. https://doi.org/10.1016/j.jretconser.2023.103279
- Vaidyanathan, N., & Henningsson, S. (2023). Designing augmented reality services for enhanced customer experiences in retail. *Journal of Service Management*, *34*(1), 78–99. https://doi.org/10.1108/JOSM-01-2022-0004
- Aslam, U., & Davis, L. (2024). Analyzing consumer expectations and experiences of Augmented Reality (AR) apps in the fashion retail sector. *Journal of Retailing & Consumer Services*, *76*, N.PAG. https://doi.org/10.1016/j.jretconser.2023.103577
- Alam, S. S., Susmit, S., Lin, C. Y., Masukujjaman, M., & Ho, Y. H. (2021). Factors affecting augmented reality adoption in the retail industry. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(2), 142.
- Tan, Y.-C., Chandukala, S. R., & Reddy, S. K. (2022). Augmented Reality in Retail and Its Impact on Sales. *Journal of Marketing*, *86*(1), 48–66. https://doi.org/10.1177/0022242921995449
- Nawres, D., Nedra, B.-A., Yousaf, A., & Mishra, A. (2024). The role of augmented reality in shaping purchase intentions and WOM for luxury products. *Journal of Business Research*, *171*, N.PAG. https://doi.org/10.1016/j.jbusres.2023.114368
- Qadri, Syeda & Mir, Muhammad & Khan, MUhammad. (2023). Exploring the Impact of Augmented Reality on Customer Experiences and Attitudes: A Comparative Analysis with Websites. International Journal of Management Research and Emerging Sciences. 13. 10.56536/ijmres.v13i2.421.
- Eru, O., Topuz, Y. V., & Cop, R. (2022). The Effect of Augmented Reality Experience on Loyalty and Purchasing Intent: An Application on the Retail Sector. *Sosyoekonomi*, *30*(52), 129–154. https://doi.org/10.17233/sosyoekonomi.2022.02.08

# AR/VR in Digital Revolution: A Prodigious Marketing Drive and a Technological Novelty for a Competitive Edge

Bhavana M | Subaprada G R
B.Com (Accounting and Finance)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*The success of any conception in a fiercely demanding and intricate global forum depends on how strategically it is showcased with the right contemporary knowledge. An extensive ken of the market with an outfoxing praxis is the perfect epitome of a judicious usher across the corporate world.*

*With origins dating back to the middle of the 20th century, augmented reality has established a solid foundation in the market across a variety of industries. The remarkably stable presence of AR in the market after the transition out of the lab hints at its firm roots in commercial arms of society.*

*The paper scrutinizes the journey of Augmented Reality through the realms of the market as a marketing tool which ultimately led to a digital revolution inclining the demands. The paper highlights how vastly the systems of commerce have triggered the trends of a tech tool older than the internet, for it to sustain a great deal of attention.*

*Additionally, the prudence of marketing with technology is fathomed based on statistical facts of feats and counterproductive outturns of multiple industries.*

***Keywords-*** *Augmented Reality, Marketing tool, Competitive Edge, Digital Revolution, Producers perspective*

## Introduction

The success of any conception in a fiercely demanding and intricate global forum depends on how strategically it is showcased with the right contemporary knowledge. An extensive ken of the market with an outfoxing praxis is the perfect epitome of a judicious usher across the corporate world. The interests, demands, needs, and preferences of the widespread people across the market are driven by the prudence of the Corporate Sector or the multi-faceted producer's streamlined network. A wise penetration, into the market, steering the attention and outwitting the rivalries reconstitutes the traditional network of the businesses or gives rise to a revolution in the forum such as the Human-centric approach, the Impact Revolution,

Power of Collaboration, Internet of things, the Role of Technology and the Digital Revolution.

Through the concurrent era of the economy, the Digital Revolution has gained gravity. The COVID-19 pandemic has further accelerated the trends of the Digital revolution in businesses. The prominent technologies Internet, Information Technology, Electronics, Communication Technology, Robotics, Software, 3D printing, Biotechnology, Artificial Intelligence, and Augmented Reality hold 60 years of evolution and transformation in the economy. Amidst the technological revolutions, Artificial Intelligence, Augmented Reality, and Virtual reality have stuck out since their invention. These tech tools have been opinionated as illusionary and unrealistic since their pasts as factors such as the right awareness, and standards of education to grasp the crux, necessity, and access of the prodigious technology did not leg up for it to be treasured on the dot.

With origins dating back to the middle of the 20th century, augmented reality has established a solid foundation in the market across a variety of industries. The remarkably stable presence of AR in the market after the transition out of the lab hints at its firm roots in commercial arms of society. Having invented Augmented and Virtual reality ages ago, it has traveled multiple unlettered hands to equipped bodies utilizing Augmented Reality as a wise investment to usher in a technological novelty for a competitive edge, which led the lab model to flourish through the corporate world, fueling further to the Digital Revolution.

The journey of Augmented Reality through the realms of the market as a marketing tool ultimately led to a digital revolution inclining the demands. The depth of the unexplored technology of Augmented Reality measures as huge as it remains to be exotic yet fresh to unfold to its full potential. The vast systems of commerce have triggered the trends of a tech tool older than the internet, for it to sustain a great deal of attention.

Meaning and its Interconnected Branches:

Augmented Reality, often considered complementary to Artificial Intelligence serves as an assistance to human minds, by providing information in the field of vision. Augmented Reality lays digital content onto the real-life World and objects. It structures a network with computer-generated perceptual information, enhancing the depth of experience by enabling an immersive contact of people through unfathomable realms of truths and facts. This technology builds an interactive opportunity by converging illusions and the real world in the

picture. This Augmented Reality tool works as a big picture mimicking the basic imaginative and creative minds of humans into a functioning program or a machine. Virtual Reality is a technical tool that completely substitutes the real world and provides an immersive third world, unlike Augmented reality. Both, Augmented reality and Virtual reality are parts of the Extended Reality (ER), a unifying concept comprising AR, VR, and MR converging the realities and the beyond of realities. Artificial Intelligence (AI) is said to be the backbone and the biggest enabling force of the Extending Reality (ER). The history of these interrelated technologies has multiple magnanimous scientists, scholars, and academicians piloting and passing the tech tool through its evolutional periods from one another.

**The History**

Narrowing down to its history of existence, the idea of Virtual reality originated from a cinematographer a machine called the “Sensorama Machine” during the year 1952, which was ten years later from then got patented (1962). Sir William Stephen George Mann, a Canadian engineer, a professor, is also notedly referred to as the Father of Wearable Computing, or Father of wearable Augmented Reality for his invention of “Digital eye Glass” and a “mediated reality” by the year 1962.

The technology of Augmented Reality was initiated through a head-mounted AR display at the year of 1968, by Sir Ivan Sutherland, an American Computer Scientist with his students with a motive of “Ultimate Display”, by converging the virtual world into actual reality. And he named the Head-mounted display, the “Sword of Damocles” which when said to hang over a person's head, means that “something bad could happen at any time in that situation”. Sir Ivan Sutherland jokingly coined the Display as such for the head-mounted display requires a large overhead beam to support the weight. Later, in the year of 1974, the AR was dedicated to a laboratory by a Computer Artist and Researcher, Sir Myron Krueger. In 1982, Sir Dan Reitan created the very first interactive AR system which created images of weather stations.

The year 1990 is when the term “Augmented Reality” was officially introduced by Sir Tom Caudell, a Researcher. The root reason and core of AR being considered as an aid for human minds are to provide an immersive and interactive lens to the accessors, which was officially structured, and the sensory information or the virtual fixtures were overlayed in the year 1992 by Sir Louis Rosenberg, an American Inventor. In 1993, a knowledge-based AR for

assistance in repair and maintenance was created under the name KARMA. It was then when that Augmented Reality took a turn, as it was put into the spotlight across the media and public to witness the technology in the art forms. AR was introduced in the Theater & entertainment (1994) by Julie Martin, a writer and a producer. The greatest introduction of Augmented reality across all sections of the people in World was its usage in the NFL game live with AR (1998), a graphic system marking yellow yards over the ground field, which is still in use today. A technological tool marked its authenticity at its peak when the tech tool was incorporated into NASA as a Hybrid Synthetic Vision System for their X-38 spacecraft. Augmented Reality was incorporated to enable a finer navigating system for their test flights by the year 1999

**Augmented Reality , Throughout the 2000s:**

AR-Toolkit (2000), an open-source computer Application, that enables the building of AR software programs was created by Hirokazu Kato. Followed by the revamp of the AR application in Sports Vision (2003). Yet another remarkable acclamation of AR in the past was its incorporation in wide-ranging Commercial purposes such as in promotional purposes through the print media namely by BMW (2008), National Geographic (2011), Coca-Cola (2013), Watches and Jewelry (the 2010s), Disney (2011), Skoda (2015). Parallelly during the 2000s AR predominantly concreted in the fields of tourism, University labs, assisting in try-ons, Google translate, Google sky-map, AR in the Automotive Industry (2013), Google lens/glasses (2014), Microsoft HoloLens (2014), Pokémon GO (2016), AR Core & ARKit (2018), AR-based apps and the Augmented Reality in Retail Markets.

**Need for the Study**

The Technological Revolution concerning Augmented Reality has a long stretch of history across countries, and this study elaborates on how a highly sensitive and potent tech tool has gained attention for its significance and need across countries and people through the stance of industries and the corporate world employing the Technological Auxiliary-Augmented Reality as a marketing tool to steer the preferences and demands in the market and to ultimately gain an upper hand amidst the rivalries.

It is necessary to view a Revolution from the producer's perspective in the market and its correlating factors that are ensured to showcase a noble establishment amongst the competitors and also by considering other dynamic market forces. The study aims to magnify how marketing through arms of commercial, retail, and other industries has majorly

fueled extensive sustenance and prospective scope of AR in the economy with supportive case studies and research.

The sole reason for this research is to magnify how the evolution of a technological tool, Augmented Reality has been aided by the marketing perspective of the industries across the market which on a larger perspective evoke the need for digitalization and unfolded the concept of the Digital revolution across countries and economies.

**Objective of Study**

Overall, research on Augmented Reality as a strategic tool is essential for companies to gain a competitive edge in the marketplace. It helps companies make informed decisions, understand their customers better, and stay ahead of their competitors adapting the concurrent technologies to keep on track alongside the dynamic world.

The overall objectives of the research converging a technological tool and business functioning are as listed below:

- Determination of what Augmented Reality is and how its incorporation in business is a wiser option and an upper hand for the companies amidst the competition. It is important to unveil and annotate the term Augmented Reality as a tool used to overcome and lead rivals.
- It is important to figure out and choose the best method of marketing to reach the right consumers at the right time with the right mode of passage of information. The innovation and its corresponding marketing strategy to penetrate or to survive in the market used or exercised must correlate to the prevailing functioning of the market and also be pragmatic. It is to understand the relevance of the marketing tool in this ever-changing and dynamic environment of business.
- Marketing, a promotional activity that has been piloted by the rising awareness and support for the immersive AI tool the Augmented Reality enabling access to the highly powerful tool at the doorstep of millions across the globe which has led to a Digital Revolution with flaws and mystery embodied in it.
- To provide a stance and a provision to foresee the competitive advantage, which enables the organization to stand out from the rivals and acquire the market position or the firmness amidst the rivals.

- ❖ To view the Digital Revolution through the effectuation of technological tools in businesses as a marketing tool to gain better profits, and fame, stand out in the market, and stabilize the base customers.

**Limitations**

- ✓ Difficulty in accessing and acquiring Authentic sources of financial reports and statements of companies for analyzing the quantitative effect of Augmented Reality.
- ✓ Vast and vague field study, making the research analysis hard to effectuate upon particular factors of the field of study as a sample to fathom the wider sections of the market.
- ✓ Monotonous inferences and method of incorporation in most industries resulting in repetitive conclusions

**Review of Literature**

**Gabriela Gabajova et.al** (March 17, 2021, Prague, Czech Republic) have researched, Augmented Reality as a powerful marketing tool. As a result of their research, the findings state that most of the companies across the market are aware of the Augmented Reality and it has served as a promising marketing tool in product promotion. It enables product visualization and better accessibility.

**Marius Bulearca** and **Daniel Tamarjan** researched under the name Augmented Reality: A Sustainable Marketing Tool, focused upon the AREM i.e., Augmented Reality Experimental Marketing, and how it is beneficial for companies and brands on a both short and long-term basis.

**Joachim Scholz** and **Katherine Duffy** studied how Augmented Reality reshapes mobile marketing and consumer brand relationships. The results of their study state that Augmented reality has fetched the brands to the intimate space of consumers enabling an interactive media experience dissolving the boundaries between consumers and brands.

**Mariano Alcaniz** et.al Virtual Marketing and Extended Reality as a promising tool in Marketing.

**Haumer**, et.al have studied and investigated the Impact of Augmented Reality experimental marketing on branding equity and buying intention.

**Songul Bilgilli Suluk** et.al has investigated Marketing communication and Experimental Marketing in the Context of Augmented reality. The ultimate findings of the paper state how

the brand attitudes, and purchase intentions concerning the AR application for experimental Marketing have driven.

**Ksenjia Mitrovic, Nebojsa Novakovic, Jelena Spajic, and Ilija Cosic** together have published their research on Augmented Reality in Marketing- the state of Art, which magnifies how the incorporation of Augmented Reality in marketing has led to a Digital Revolution.

**Research Methodology**

CATWOE analysis is of multiple uses notedly for its problem-solving natured technique and a tool providing better perspectives in complex situations. This technical tool is considered versatile as it serves as an aid under various circumstances. It provides an extensive ken across any situation thus helping to grasp and hold a better insight concerning the factors and desired results accordingly. The CATWOE Analysis is notedly used in predominant circumstances like Systems thinking, Policy Analysis, Problem structuring, project planning, or for Decision making in a business process improvement amidst an organizational change.

**C: Customers-**

The ultimate section of people whom the output of businesses reaches. The stakeholders, and users of the system.

**A: Actors-**

Actual people who would do the work required i.e., usually the employees. Involved in the implementation of changes in the system, core hands reason for the impact on process or the system.

**T: Transformation Process-**

It is the change that the system is led to. It is where the input of efforts and resources are transformed by the organization into output. It is the intermediary process connecting the inputs and outputs.

**W: Worldwide / Weltanschauung-**

Weltanschauung means a particular philosophy or a view of life, or the World of an individual or group.

It is the big picture, the crucial point of the CATWOE that states the conflicting perspectives of the stakeholders. It is to make an overall perspective of the change in the system explicit.

**E: Environmental Constraints-**

This research methodology is suitable for the subject study as it provides clarification for the perspective on the Digital Revolution and about the evolution of the Augmented Reality.

**Analysis**

The research focuses on how Augmented Reality has played a promising role in fueling the Digital Revolution, acting as a marketing tool.

According to the research, the Augmented Reality, a complex tool that is hard to fathom has seen its full potential in many of the highly potent and multi-million companies of any industry than in the upcoming establishments and small-scale enterprises. The growth of Augmented Reality enabling software and application developing companies has evolved across all sections of the industry from the small scale to multi-faceted businesses. The incorporation of Augmented Reality in the business apart from bodies such as the Military, Aerospace, and aircraft have predominantly been witnessed in the higher scale of businesses across the industries.

The industries chosen for the study are as mentioned below -

- Automotive Industry
- Retail Market
- Games and Entertainment
- Technology,

And generic statements upon how the technology has converged industries of contrasting realities/nature –

- Fintech
- Education
- Healthcare

The research methodology is exercised by taking up prominent players of the respective industries stated above, to discreetly study how the technological tool Augmented Reality has made its mark across the industries in the market. The study also considers other implied and uncertain factors affecting the functioning of the companies such as the basic volatility in functioning, the Pandemic, and qualitative aspects of the business environment. The companies selected for a narrow study to analyze a global revolution on the big picture are as listed-

| INDUSTRY: | | |
|---|---|---|
| Retail Market | Nike | H&M |
| Automotive Industry | Toyota | Porsche |
| Technology | Google | Meta |
| Games and Entertainment | Niantic | Walt Disney |

The overall tabular representation of the CATWOE analysis states the following representation of the tabulated inference-

| **COMPANY** | **CUSTOMERS** | **ACTORS** | **TRANSFORMATION** | **WORLD WIDE** | **OWNER** | **ENVIRONMENTAL CONSTRAINTS** |
|---|---|---|---|---|---|---|
| NIKE | Athletes, Sports enthusiasts, Voguish consumers, General Buyers | Marketing teams, Developers, Designers | AR- In virtual try-ons, interactive catalogs, in-store experiences, App based experiences, interactive campaigns (EXPERIENTIAL MARKETING) | Technology enhancing sports and fashion | NIKE mgmt., Stakeholders | Competitive market, a vast range of players in the market, Consumer demands and preferences |
| TOYOTA | Car Enthusiasts, Potential buyers, General Buyers | Marketing teams, Developers, Designers, | AR- In showrooms, VR- test-drives, (EXPERIENTIAL MARKETING: enhancing | Technology enabling immersive experience through experiential | TOYOTA mgmt., Stakeholders | Competition, Consumer preferences, Authenticity, Tech trends, Equipped technicians, |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Showroom experts | customer experience) | marketing | | Market trend |
| PORSCHE | Potential Buyers | Marketing teams, Developers, Designers, Showroom experts | AR- In showrooms, manufacturing by customizing the features and models | The technology embodied in manufacturing, customization, and high-end personalized experience with a benchmark across the market | PORSCHE mgmt., Stakeholders | Competition, Consumer preferences, Authenticity, Tech trends, Equipped technicians, Market trend |
| GOOGLE | Businesses, Internet users | AR designing teams, Advertisers, Software Developers, Users | AR- In advertising, Search, Maps, AR toolkits, etc. ADVANCED SYSTEM OF SERVICES (AR) TO THE ACCESS OF THE INTERNET USERS | Technology in accessible and practical applications (PIONEER) | Alphabet inc. (The parent company of the Google) | Dynamic digital landscape, technological advancements, consumer awareness, user expectations, tech trends, Market demands |

| | | | | | | |
|---|---|---|---|---|---|---|
| META | Businesses, Social media users, Potential users, Advising Heads | AR designing teams, Advertisers, Software Developers, Users | AR- social media filters, Virtual reality, Ads, marriages, and much more intricate AR technologies. | Creating to enable and effectuate immersive experiences | META mgmt., Stakeholders | Dynamic digital landscape, technological advancements, consumer awareness, user expectations, tech trends, Market demands |
| NIANTIC | Gamers, Potential users, AR enthusiasts | Gamers, Game Developers, Specialists, Users | Immersive game experience | Real-world exploration through AR, and advanced gaming experiences | NIANTIC mgmt., Stakeholders | User expectations, AR advancements, Tech trends, supportive software, pragmatic engagement trends |
| WALT DISNEY | Children, Families, Businesses, General Consumers | Animators, Directors, Technical team, Writers, Production team | Advanced animation systems, expansion of media streamlines, Theme Park experience, Immersive experiences | Showcasing creativity, innovation, and direction through a better tech tool, emphasizing the | WALT DISNEY mgmt., Stakeholders | Global cultural trends, Trends in the entertainment industry, Competition, Consumer preferences, Media trends |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | significance of imagination | | |

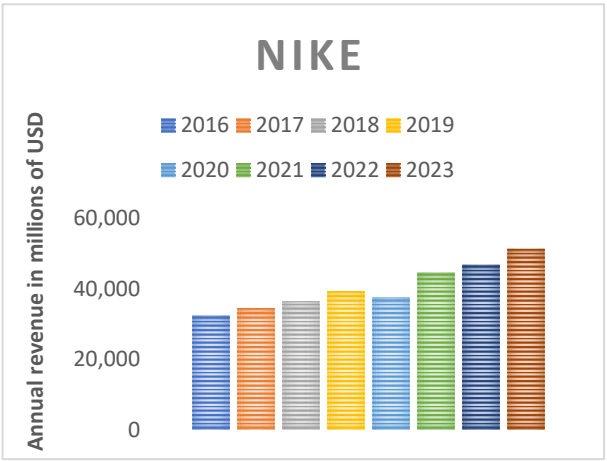
Analysis of industries based on specific companies taken for a sample study

1) Retail Market

- The retail and e-commerce sector across the economy has fantasized about the marketing tool of Augmented Reality majorly on the try-on facility. Companies like Lenskart in spectacle, Gucci Louis Vuitton Calvin Klein, and many more in clothing, Mobile Applications, Asian Paints, IKEA, and so on have exclusively incorporated the try-on facility in augmented reality.

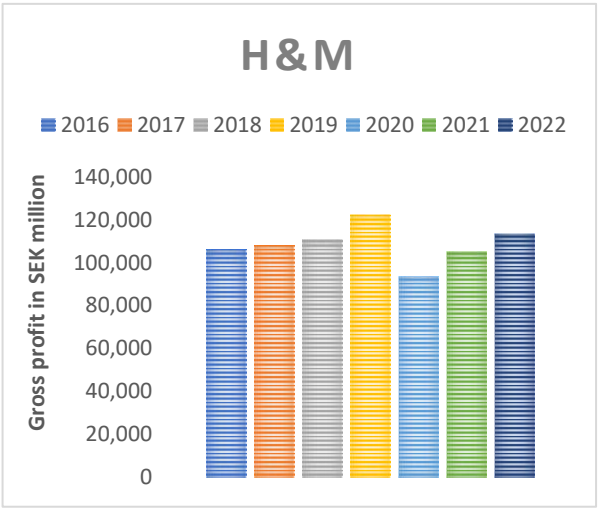
a) Nike:

On an international level of function across countries the company has incorporated a mind-blowing experiential marketing tool of Augmented Reality as a try-on (2022) coined as the "NIKE-FIT" which accurately measures the consumer's feet and accordingly recommends the shoes based on their preferences. This initiative of the company has grabbed significant attention across the market.



b) H&M:

A global fashion company holding 11 business ventures, 4000 stores in more than 70 markets, and online sales in 60 markets, has ventured its functioning into Augmented Reality supporting millions of consumers and their preferences via applications providing an immersive shopping, in-store experience as the application helps in try-ons without physical trails of the accessories and clothing.

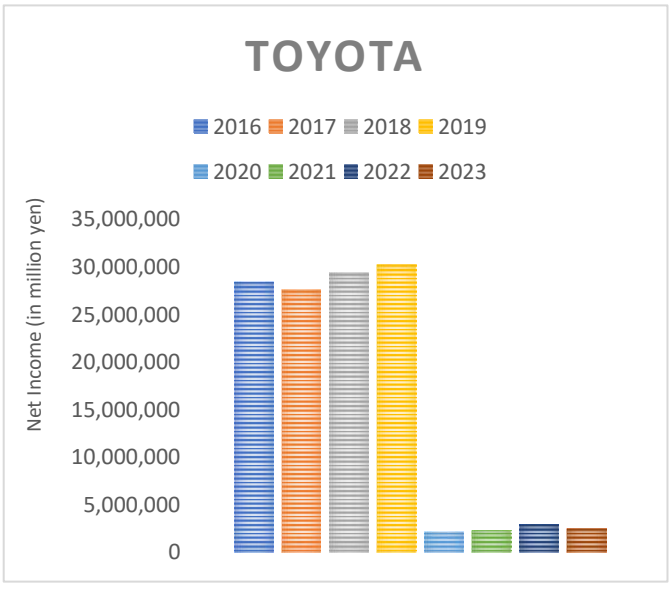



2) Automotive Industry

- During the years 2017-2019, the automotive industry incorporated Augmented Reality across its market. The global market growth of augmented reality in 2020 compared to the initial years at a CAGR of 12.5%. The future market prospects envisioned from 2021-2028 state a CAGR of 18.1%, also referred to as post-pandemic growth.

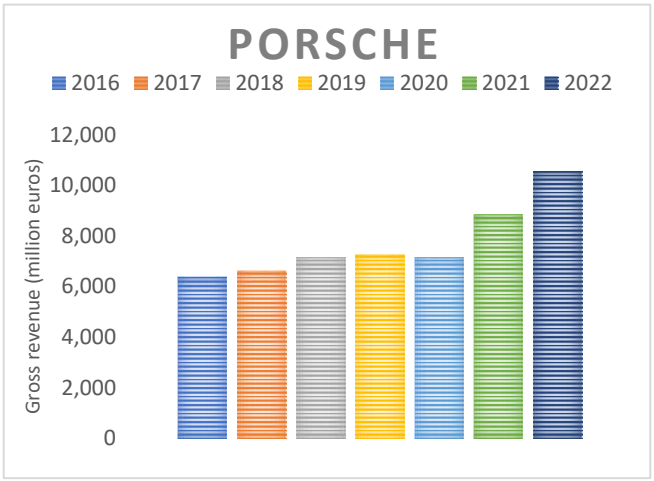
a) Toyota:

Various companies have first introduced Augmented Reality in marketing, and production such as BMW (2010), Mercedes (2018), Volvo (2015), Volkswagen the Toyota Motor Corporation launched the Hybrid AR app by the ear of 2019. Though adapting to newer technologies, the Pandemic's hit on the economy did impact the company but, amidst the ongoing COVID-19 pandemic online car shopping rose to more than 75% in 2020.



b) Porsche:

Porsche has been using Augmented Reality to solve all of the complicated service problems since the year of 2018 such as access to technical information hands-free while working, connecting technicians' miles away, etc. The company made multiple dealerships since 2017 enabling the functioning of multiple departments of the company via the AR systems. The systems of usage of Augmented Reality have accelerated after the pandemic and tripled reaching higher levels in the concurrent market.

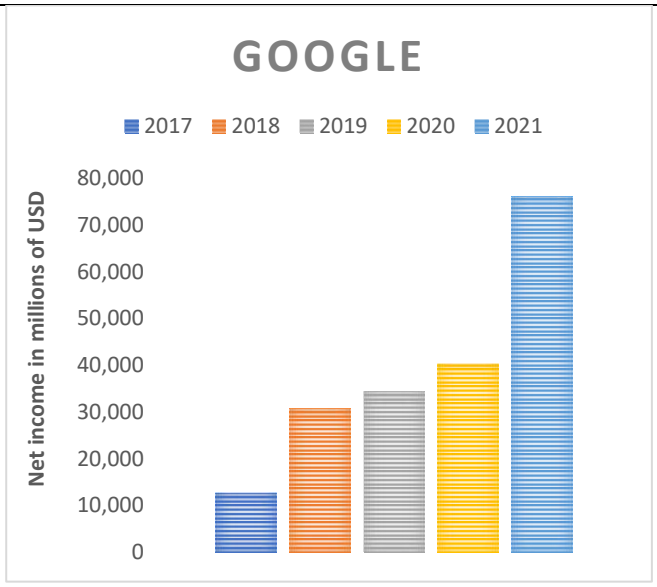
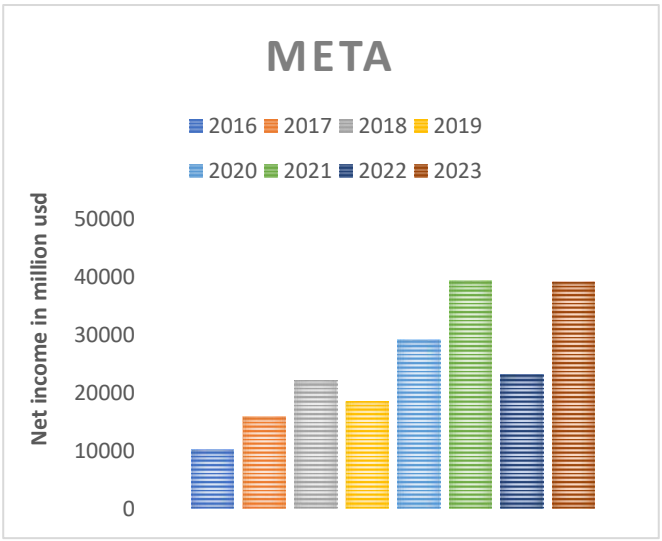



3) Technological Industry

The technological industry has been the backbone in paving the way for the evolution of Augmented reality to impose access to advanced tech tools enabling immersive experiences.

a) Google:

Being a pioneer in the implementation of Augmented Reality, it launched Google Glass in the year of 2013, but as consumer preferences and market trends didn't amply leg up the initiative, the company reportedly gave up on its venture. A renowned arm of Alphabet Inc. has utilized Augmented Reality since the 2000s and has possibly tried incorporating AR. A few of its initiatives

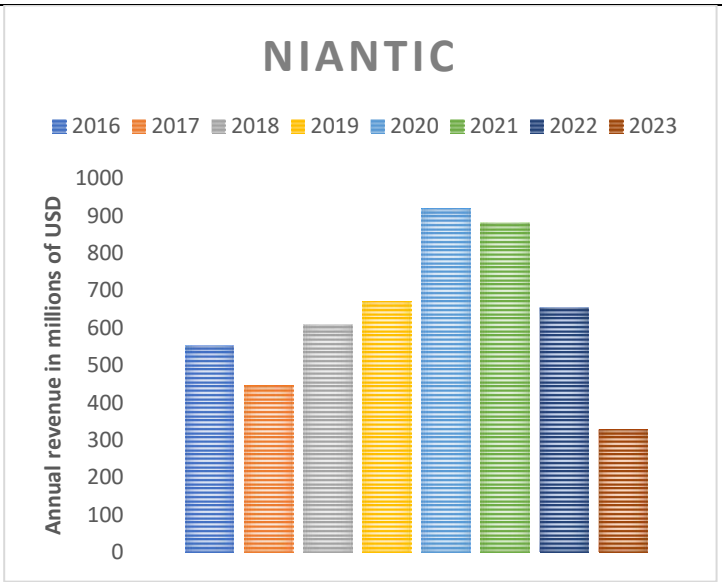
| | |
|---|---|
| are such as ARCore (2018), Google Maps Live View (2019), Google Lens (2017), Google Search AR animals, AR in education, Google Arts & Culture, AR Advertising, Measure |  |
| b) Meta:<br>Metaverse Augmented Reality (AR), is an interlinked digital network embodied as a convergence of conventional AR and an extensive network or VR within the context of metaverse. This network serves as a foundation connecting multiple systems serving as a medium for their core functioning. Namely, Retail and E-Commerce, Health care, Education, manufacturing, and much more. |  |

4) Gaming & Entertainment Industry

The gaming and entertainment industry through Augmented Reality commenced its journey into marketing as this industry promoted and popularized AR across the public by incorporating it in businesses after its laboratory period as an experimental tool.

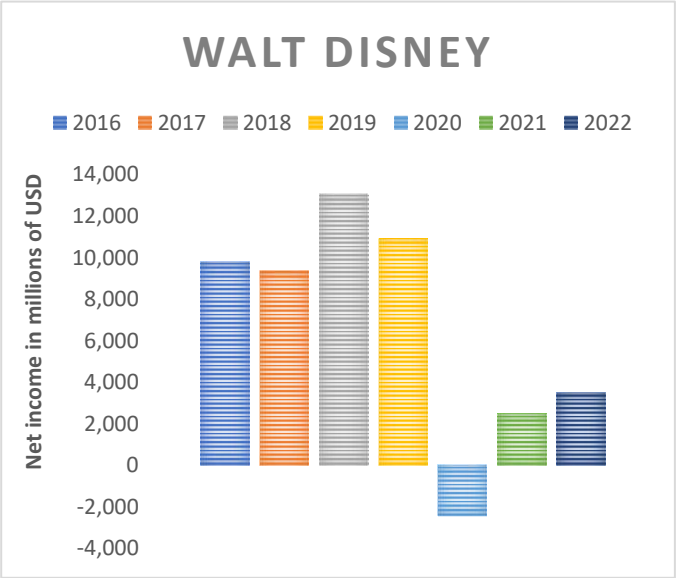
| | |
|---|---|
| a) Niantic:<br>A software company renowned for its designing of augmented reality | |

mobile games marked an outstanding market recognition by launching Pokémon Go (2016) a successful AR-based game ever released. Niantic along with a prudent collaboration of Nintendo and the Pokémon Co. made a remarkable market sustenance for years together over the launch of this game.




b) Walt Disney:

Walt Disney a multi-million establishment in the entertainment and theater along with the trends of Augmented Reality has fabulously structured its animations and has also streamlined the usage of AR namely in the theme park experience, Immersive theatric productions, and animations grabbing many more audiences revamping its productions to wisely incorporate the contemporary tech tool into the roots of the business.



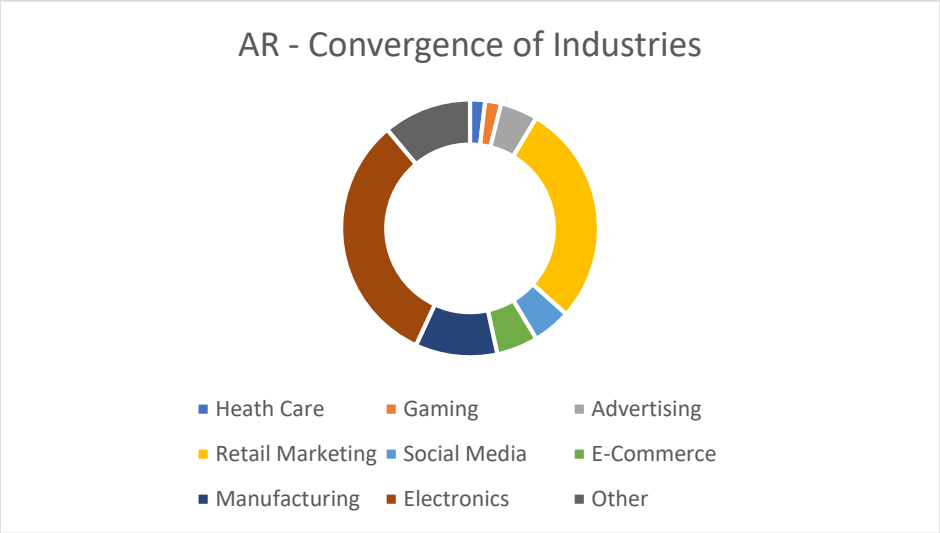

Augmented Reality in the Industries of Education, Healthcare and Fintech:

The technological tool, Augmented Reality parallelly witnessed a balanced growth in the economy, as it is currently evolving at its full potential in the fields of Education and healthcare providing an immersive education and applications supporting virtual surrogation and study of the sciences.

According to the market study, concisely Augmented reality in fintech is functioning at a massive scale namely upon the factors of Banking, blockchain technology, digital wallet, digital transactions, Fast tag, and other various financial institutions. The revolution impacting the Sector of Fintech may on the whole reconstitute almost all of the systems as it is the finances that is triggered touching upon the core of all of the systems.

**Findings/Results**

According to the research, the analysis has been restricted to 7 particular industries and the precisely picked companies under them as a sample study to draft assumptions and judgments about the vast industries across the market. The insights about the sensitivity of impact of the Augmented Reality across various industries as a marketing tool are derived based on how the prominent players in the market took up an old yet evolving technology of a complicated nature as a tool to promote themselves according to the preferences of the consumers. The inferences are the ultimate sole evidence supporting how marketing has played a pivotal role in the sustenance of a tech tool more than 60 years old in the market and also which on a wider stance it has fueled the Digital Revolution.




The above graph is derived from inputs based on the chosen companies with their particular numerical values concerning the effect of Augmented reality and particular financial periods-based performances. According to the analysis the ultimate findings are as mentioned below-

i. Augmented reality gained a sturdy acknowledgment mainly for its nature of providing experiential marketing: awareness of the gravity of the need for feel and experience.

ii. Augmented reality is essentially viewed as an attractive technology to adapt and experiment but not with a conscience of the emergence of the digital era.

iii. For any marketing context or crux to make an impact, a profound ken of market and intellect is vital: A contemporary tech tool like augmented reality is just an aid to the conventional wisdom of the market for ultimate success

iv. The awareness of the AR tool witnessed a finer expansion during and in the post-pandemic period

v. Augmented Intelligence, an artificial perception assisting human minds.

**Suggestions**

1. A balanced incorporation of the tch tool (AR) in both industries and in sectors like Education, Agriculture, Hazardous construction sites, Democracy, urban infrastructural planning, and much more.
2. Spread more awareness about AR: it is a tool assisting human minds but not replacing them which conveys the importance of traditional education and knowledge and AR as a tool to upskill them. AR is an equipment, not wisdom.
3. Implementation of AR in education at its full potential has the power to revamp the entire economy across borders

**Conclusion**

Augmented reality, an intricate and complex tool difficult to reach in the nooks and corners of India, has witnessed a sturdy acceleration in its awareness and importance since the Pandemic crisis, COVID-19. Across the nation when the Pandemic gave rise to consistent reliance on technologies to run businesses, schools, organizations, and labs, and to communicate as on whole. The nation's lowest level of sustenance across the market to support the situation and the ultimate core of all of the systems were solely dependent upon technologies connecting one another. The branches of Artificial Intelligence, Augmented Intelligence, and other systems of Extended Reality grabbed the spotlight, through the period of the crisis.

The massive impact on livelihood has rooted the technological aids deep into the lives of the people of India. Almost all of the systems of the economy across the nations have run their ministrations with the support of prevailing technologies which gave rise to the incorporation of further advanced and new complex technologies such as Artificial Intelligence, Augmented Intelligence, and much more intricate branches of the same.

India parallelly incorporated Augmented Reality in the payments sectors of its functioning enabling a balanced Digital Revolution across the country.

When compared to the Immense expansion of the Augmented Reality Market across the World, the extension of the market and its growth in India to the envisioned future (2028 as per future study and predictions) it is said to grow at a CAGR of 28%.

Augmented Reality across countries has a slow yet steady evolution to have sustained in the market for more than 60 years. The scope of Augmented reality has its firmness in the market as predicted to 2030 as the market of Augmented Reality is expected to expand at a huge rate considering various initiatives of industries.

Reportedly the market of Augmented Reality is said to view a 50.7% rise in CAGR till an envisioned future of 2030 considering multiple industries.

The AR is, on the whole, said to have been sustained through the years by the effective marketing systems steering the preferences of consumers which enables a steady demand for the technology throughout its period of evolution. The research thus evokes a stance on how a minute act of an individual or group of individuals could make an immense reconstitution or may steer the views of millions influencing the economy.

**References**


- Marius Bulearca and Daniel Tamarjan (2010)– Augmented Reality: A Sustainable Marketing Tool. Global Business and Management Research. Vol.2, No.2&3
- Joachim Scholz and Katherine Duffy (2018) - We Are at Home: How augmented reality reshapes mobile marketing and consumer-brand relationships. Journal of Retailing and Consumer Services. Volume 44
- Mariano Alcañiz, Enrique Bigne and Jaime Guixeres Provinciale (2019) - Virtual Reality in Marketing: A Framework, Review, and Research Agenda. Sec. Quantitative Psychology and Measurement. Volume 10 - 2019 | https://doi.org/10.3389/fpsyg.2019.01530
- Haumer, Florian, Kolo, Castulus, and Reiners, Sarah (2020) - The impact of augmented reality experiential marketing on brand equity and buying intention. Journal of Brand Strategy, Volume 8 / Number 4 / Spring 2020, pp. 368-387(20)
- Ksenija Mitrovic, Nebojsa Novakovic, Jelena Spajić and Ilija Cosic (2021) - Augmented Reality in Marketing – State of Art. DOI:10.2507/32nd.dam.proceedings.081
- https://www.g2.com/articles/history-of-augmented-reality

- https://hbr.org/2016/10/the-mainstreaming-of-augmented-reality-a-brief-history

# A STUDY ON AUGUMENTED REALITY IN LEARNING – THE E-LEARNING INDUSTRY\

Dikshita | Niha Samreen
B.Com (Accounting and Finance)
Stella Maris College

***Abstract***

*AR is a subclass of physically immersive media that allows users to manipulate and see the real world in ways not possible without VR. Modified versions of VR head- and hand-based displays are used to create augmented displays, with tracking registration becoming more important than with basic VR. The see-through paradigm allows for AR displays that map one virtual world onto another, such as entering a surround-VR display and using a head- or hand-based AR display within that environment. This technique has been used in human factors research at the University of Illinois by Michelle Yeh and Chris Wickens.*

***Keywords*** *e-leraning industry, augmented reality, AR-VR.*

## Introduction

Augmented reality (AR) is a rapidly growing technology that has the potential to transform various industries, including entertainment, training and education, law enforcement, military, political, and legal. with advances in mobile processing, digital storage capacity, wireless broadband connections, and the Internet's vast data store, AR applications are already present on millions of smartphones. As AR-specific chipsets from major chip companies like Nvidia and QualComm lower the price-point and entry barrier for potential app-developers, a critical mass is forming to support AR products and services as a major tech/media industry. However, the consequences of AR on human society are still to be seen, as it transitions from novelty to over-hyped panacea and threat, ultimately leading to massive utility and foundational infrastructure. The potential uses of AR include democratizing access to information, enhancing training and education, and addressing complex legal and social issues.

**Need For Study**

The proposed research aims to investigate the effectiveness of QR codes in supporting the educational process. The findings are intended to inform these practices of any existing weaknesses that need to be addressed.

**Objectives**

Enhancing student learning outcomes

Evaluating the effectiveness of AR integration in education

Providing feedback on using QR codes

**Methodology**

Research Plan

Research approach – Questionnaire Method

Research Instrument - A structured questionnaire is framed to collect data from the respondents according to the objective of the study.

**Type of the Study- Descriptive Research**

This research is completely based on the description of the factors that lead to the version of real-world experience. It is basically on the various parameters which includes personal details of respondents, education qualification and users interact and receive real-time feedback on the action they have performed.

**Limitation of the Study**

This study is confined to Chennai district only

1. Limited hardware accessibility may hinder widespread adoption of augmented reality (AR) in e-learning.
2. Insufficient standardized content creation tools for AR may impede seamless integration into e-learning platforms.
3. Potential distractions and cognitive overload from AR features may compromise the learning experience.
4. High development costs and technical expertise required for AR implementation pose financial barriers for some e-learning providers.
5. Ethical concerns related to privacy and data security may constrain the use of AR in e-learning environments.

## Review of Literature

Nouf Matar Alzahrani [2020] Augmented reality (AR) is a popular pedagogical tool that can enhance learning in various educational settings. However, no systematic review has been conducted to evaluate its advantages and challenges in e-learning contexts. A systematic review of 28 studies found that AR supports kinesthetic learning, collaborative learning, distance learning, learner-centered learning, and creative learning. It also improves student engagement, motivation, attention, focus, and knowledge retention. Challenges include information overload, lack of experience, teacher resistance, complex technology, and technical issues.

Fabio Arena, Mario Collotta, Giovanni Pau and Francesco Termine [2022] This provides an overview of augmented reality, a technology that has been in development for decades. It covers its conception, applications, hardware and software components, limitations, shortcomings, and potential future applications. It also discusses the limitations of AR systems and their potential applications in various fields.

Pranav Parekh1, Shireen Patel1, Nivedita Patel1 and Manan Shah [2020] This reviews the increasing use of augmented reality (AR) in entertainment, medicine, and retail. It discusses its applications in multiplayer gaming, computer games, broadcasting, multimedia videos, medical healing, training, teaching, surgery, and post-medical treatment. AR is also used in advertising, marketing, fashion retail, and online shopping. The authors also discuss the future use of AR and its advantages and disadvantages in these fields.

Michael Petke [2020] Augmented Reality (AR) is a useful tool for digital content enrichment, but its application in production is limited. This paper investigates AR's potential in various use-cases, focusing on user acceptance, hardware influence, and production-related disciplines. Results show that AR's impact increases with task time and user technological skills. However, it also improves task time planning, resulting in smaller standard deviations.

Francesco De Pace, Federico Manuri, Andrea Sanna [2018] Augmented Reality (AR) has been a prominent application domain since its origins, especially in the industry. with advancements in portable and wearable AR devices and challenges from Industry 4.0, AR's application expands to improve user experience and enhance interaction. However, due to

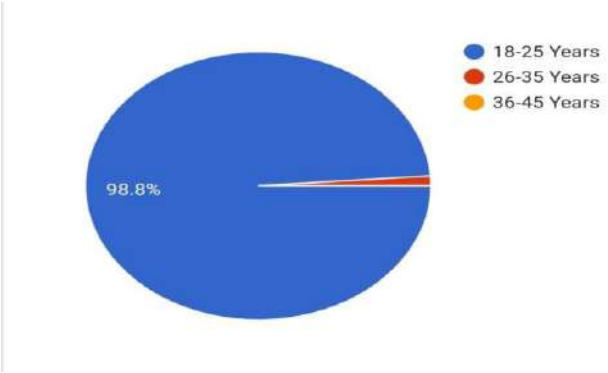
growing user needs and data privacy concerns, AR technologies must adapt their work practices.

## Data Analysis and Interpretation

Table showing the Age of the respondents

| AGE | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| 18-25 | 84 | 98.8 |
| 26-35 | 1 | 1.2 |
| 36-45 | 0 | 0 |
| TOTAL | 85 | 100 |

Figure Showing the Age of the Respondents




Source Primary Data

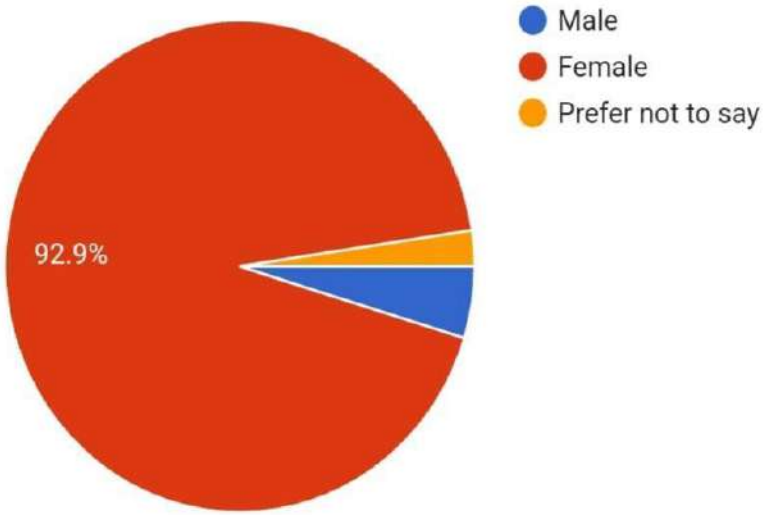
### Analysis

The pie chart tells us that the majority of respondents, about 98.8, fall within the age range of 18 to 25 years old, indicating a youthful demographic. There is a small representation, just 1.2, of respondents aged between 26 to 35 years old. Surprisingly, there are no respondents aged 36 to 45, suggesting a gap in the pie chart age groups.

Table Showing the Gender of the Respondents

| GENDER | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| MALE | 4 | 4.7 |
| FEMALE | 79 | 92.9 |
| PREFER NOT TO SAY | 2 | 2.4 |
| TOTAL | 85 | 100 |

Figure Showing the Gender of the Respondents




Source Primary Data

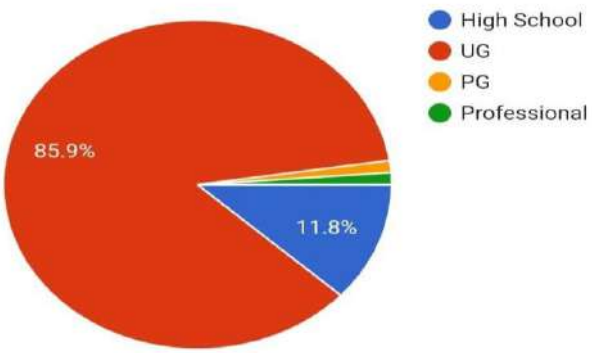
**Analysis**

The data shows that the majority of respondents, accounting for 92.9, identify as female, indicating a significant gender representation in the pie chart. Male respondents comprise a smaller portion, at 4.7, while 2.4 preferred not to disclose their gender. The gender distribution highlights a higher participation rate among females in the pie chart compared to males.

Table Showing the Educational Qualification Respondents

| EDUCATIONAL QUALIFICATION | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| HIGH SCHOOL | 10 | 11.8 |
| UG | 73 | 85.9 |
| PG | 1 | 1.2 |
| PROFESSIONAL | 1 | 1.2 |
| TOTAL | 85 | 100 |

Figure showing the Qualification of the Respondents




Source Primary Data

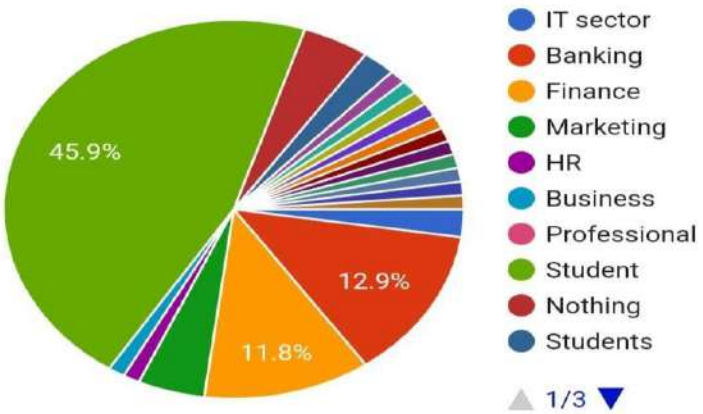
**Analysis**

The data shows that the majority of respondents, comprising 85.9, hold an undergraduate (UG) degree, reflecting a strong representation of individuals with bachelor's level education in the pie chart. High school graduates account for 11.8 of respondents, while only a small proportion, 1.2 each, have postgraduate (PG) or professional qualifications. The data suggests that the surveyed population is largely composed of individuals with undergraduate-level education.

Table showing the Occupation of the Respondents

| OCCUPATION | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| STUDENT | 40 | 46 |
| BANKING | 12 | 13.8 |
| FINANCE | 10 | 11.5 |
| MARKETING | 4 | 4.6 |
| HR | 1 | 1.1 |
| BUSINESS | 1 | 1.1 |
| PROFESSIONAL | 1 | 1.1 |
| IT SECTOR | 2 | 2.3 |
| OTHERS | 14 | 18.5 |
| TOTAL | 85 | 100 |

Figure showing Occupation of the Respondents




Source Primary Data

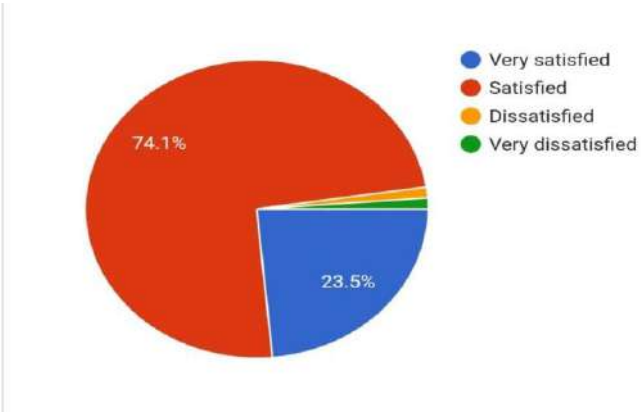
**Analysis**

The data shows that the largest group of respondents, comprising 46, identifies as students, indicating a significant representation of the student population in the pie chart. Banking and finance professionals make up 13.8 and 11.5 of respondents, respectively, highlighting a notable presence from financial sectors. Other occupations such as marketing, HR, IT, and business each represent smaller percentages of the surveyed population, with a diverse range of professions making up the rest.

Table showing Satisfaction Level with Technologies

| TECHNOLOGY SATISFACTION | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| VERY SATISFIED | 17 | 23.5 |
| SATISFIED | 65 | 74.1 |
| DISSATISFIED | 2 | 2.3 |
| VERY DISSATISFIED | 1 | 1.1 |
| TOTAL | 85 | 100 |

Figure Showing Satisfactional with Technologies Based On the Respondents




Source Primary Data

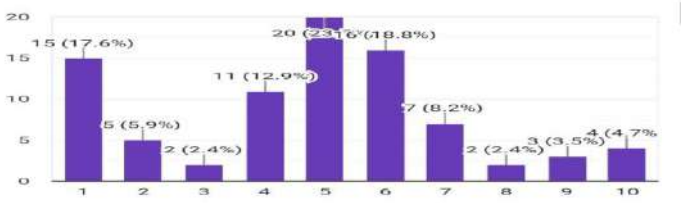
**Analysis**

The majority of respondents, about 97.6, express satisfaction with the technologies they use, with 23.5 being very satisfied and 74.1 satisfied. Dissatisfaction levels are low, with only 2.3 dissatisfied and 1.1 very dissatisfied. Overall, the data indicates a high level of contentment with the technologies among the surveyed population.

Table Showing To What Extent Respondents Have Heard of AR

| AR | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| 1 | 15 | 17.6 |
| 2 | 5 | 5.9 |
| 3 | 2 | 2.4 |
| 4 | 11 | 12.9 |
| 5 | 20 | 23.3 |
| 6 | 16 | 18.8 |
| 7 | 7 | 8.2 |
| 8 | 2 | 2.4 |
| 9 | 3 | 3.5 |
| 10 | 4 | 4.7 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents of AR




Source Primary Data

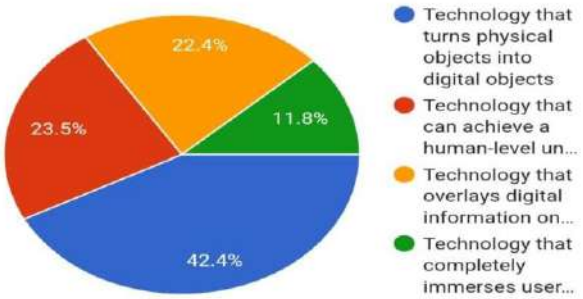
**Analysis**

The data reveals that a significant portion of respondents have heard about Augmented Reality (AR), with 23.3 scoring it the highest rating of 10, indicating a strong awareness. Moreover, 18.8 rated their awareness at 6, suggesting a moderate familiarity. However, there are still respondents with lower awareness ratings, with 17.6 at the lowest score of 1, indicating room for improvement in disseminating information about AR.

Table Showing To What Extent Respondents Know About AR

| DEFINITION | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Technology that turns physical objects into digital objects | 36 | 42.4 |
| Technology that can achieve a human-level understanding of images | 21 | 23.5 |
| Technology that overlays digital information on top of real world items | 19 | 22.4 |
| Technology that completely immerse users in a new digital environment | 10 | 11.8 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents Regarding AR




Source Primary Data

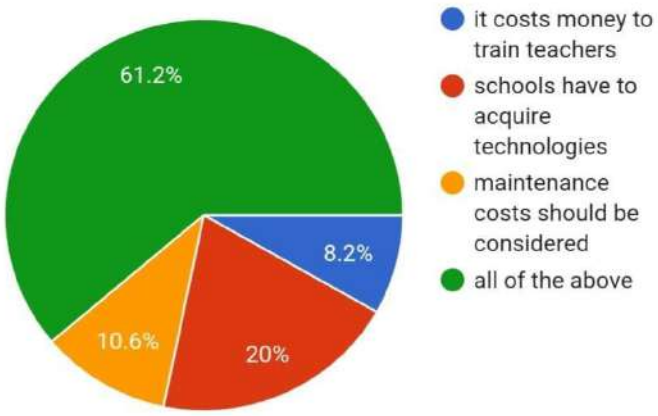
Analysis

The data shows that the majority of respondents, constituting 42.4, associate Augmented Reality (AR) with technology that transforms physical objects into digital ones, indicating a prevalent understanding of AR's capabilities. About 23.5 perceive AR as technology capable of achieving human-level comprehension of images, while 22.4 view it as overlaying digital information onto real-world objects. A smaller proportion, 11.8, sees AR as providing full immersion into a new digital environment, showcasing diverse perceptions of AR's functionality.

Table Showing Investment Costs When Using AR Especially For Education

| AR FOR EDUCATION | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| It costs money to train teachers | 52 | 8.2 |
| Schools have to acquire technologies | 17 | 20 |
| Maintenance cost should be considered | 9 | 10.6 |
| All of the above | 7 | 61.2 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents of Investment Costs For Education




Source Primary Data

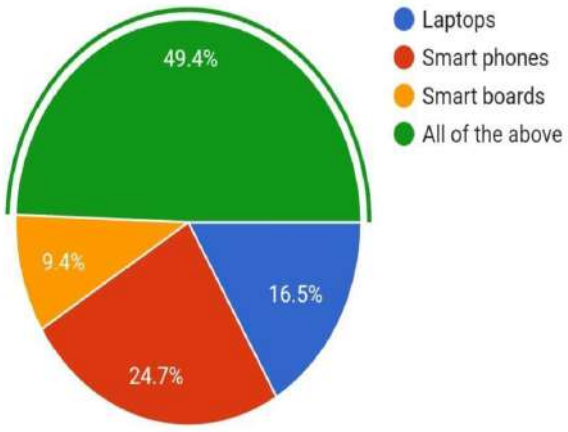
**Analysis**

The data illustrates that the majority of respondents, comprising 61.2, recognize that investment costs for integrating Augmented Reality (AR) into education encompass various aspects, including training teachers, acquiring technologies, and maintenance expenses. Specifically, 20 emphasize the need for schools to acquire AR technologies, while 10.6 highlight the importance of considering maintenance costs. These findings underscore the holistic financial considerations associated with implementing AR in educational settings.

Table Showing Experiences of AR will be Enabled in Following Devices

| DEVICES | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Laptops | 14 | 16.5 |
| Smart phones | 21 | 24.7 |
| Smart boards | 8 | 9.4 |
| All of the above | 42 | 49.4 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents of Enable of AR




Source Primary Data

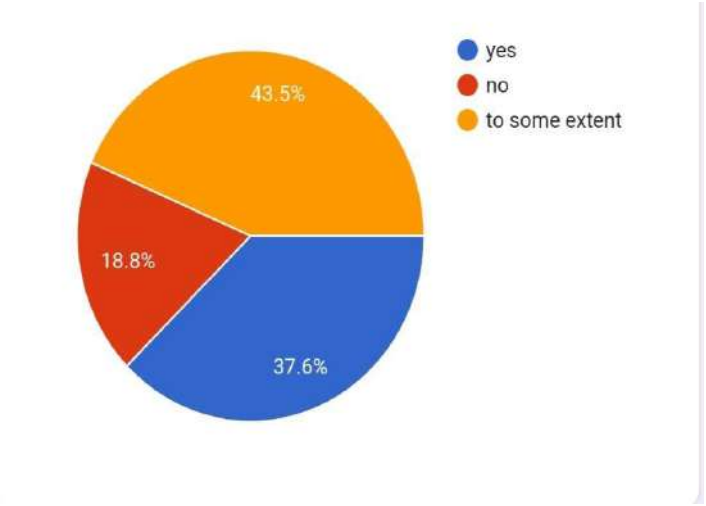
**Analysis**

The data indicates that nearly half of the respondents, representing 49.4, anticipate Augmented Reality (AR) experiences to be accessible across multiple devices, including laptops, smartphones, and smart boards. Smartphones are expected to be a prominent platform, with 24.7 of respondents foreseeing AR integration. Additionally, while laptops and smart boards are considered, they receive relatively lower percentages of anticipation, at 16.5 and 9.4, respectively. This suggests a widespread expectation for AR to permeate various technological mediums, particularly smartphones.

Table Showing AR As An Effective Device In Learning And Upgrading Trends

| UPGRADING EFFECTIVE TRENDS | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| YES | 32 | 37.6 |
| NO | 16 | 18.8 |
| TO SOME EXTENT | 37 | 43.5 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents of Effective Device in Learning And Upgrading Trends




Source Primary Data

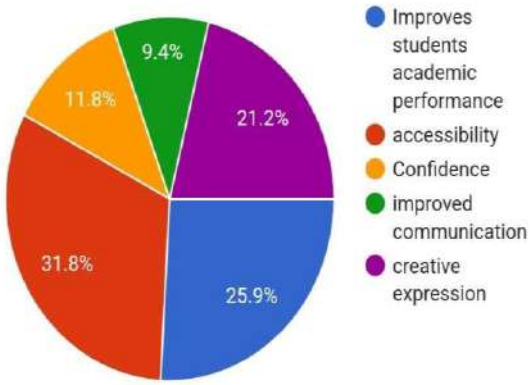
**Analysis**

The data indicates that a majority of respondents, comprising 43.5, believe that Augmented Reality (AR) serves as an effective tool for learning and upgrading trends to some extent, showcasing its perceived educational potential. 37.6 affirm that AR is indeed effective in facilitating learning and upgrading trends, while 18.8 express skepticism, suggesting room for further exploration and understanding of AR's educational benefits among respondents.

Table Showing AR as Effective in the Way of

| AR EFFECTIVENESS | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Improves students academic performance | 22 | 25.9 |
| Accessibility | 27 | 31.8 |
| Confidence | 10 | 11.8 |
| Improved communication | 8 | 9.4 |
| Creative expression | 18 | 21.2 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents Feel AR As An Effective




Source Primary Data

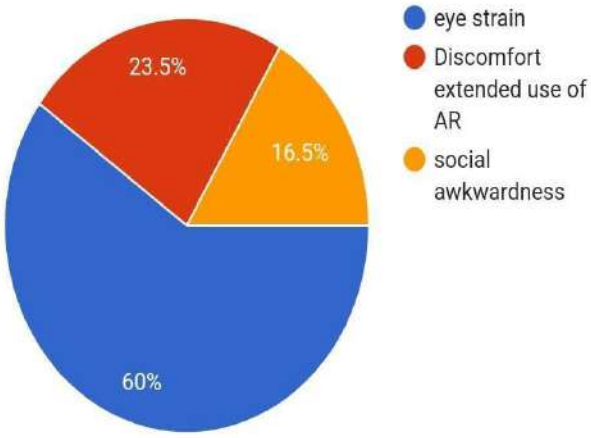
**Analysis**

The data suggests that respondents perceive Augmented Reality (AR) as effective in various ways for education. Accessibility ranks highest, with 31.8 emphasizing its importance, followed closely by creative expression at 21.2. Improvement in academic performance, confidence building, and enhanced communication are also recognized, though with slightly lower percentages, highlighting a multifaceted view of AR's effectiveness in educational contexts.

Table Showing AR is not Effective in the Way of

| AR NOT EFFECTIVE IN THE WAY OF | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Eye strain | 51 | 60 |
| Discomfort extended use of AR | 20 | 23.5 |
| Social awkwardness | 14 | 16.5 |

Figure Showing the Respondents Feel AR Is Not Effective




Source Primary Data

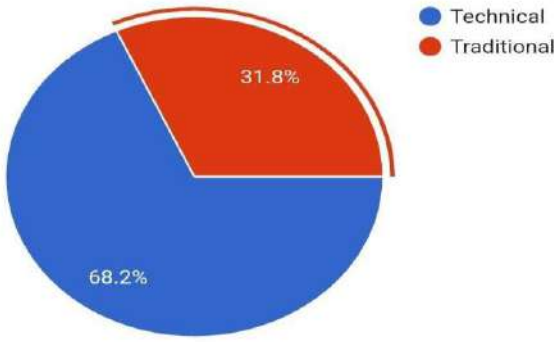
**Analysis**

The data indicates that a significant majority of respondents, 60, perceive Augmented Reality (AR) as ineffective due to concerns regarding eye strain, highlighting a prevalent issue that needs to be addressed for wider acceptance of AR technologies. Additionally, discomfort from extended use of AR is cited by 23.5 of respondents, suggesting a potential barrier to prolonged engagement with AR experiences. Social awkwardness, although mentioned by 16.5 of respondents, represents a comparatively smaller concern in the context of AR's limitations.

Table Showing whether the Respondents are more of Technical Base or Traditional Base

| BASE | NUMBER OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Technical | 58 | 68.2 |
| Traditional | 27 | 31.8 |
| TOTAL | 85 | 100 |

Figure Showing the Respondents are more of Technical or Traditional Base




Source Primary Data

**Analysis**

The data reveals that a significant majority of respondents, constituting 68.2, identify themselves as more technically inclined, indicating a preference for modern technological

approaches. Conversely, 31.8 of respondents align with a traditional base, suggesting a preference for conventional methods and practices. This distribution underscores a diverse spectrum of preferences and orientations among the surveyed population regarding technological adoption and traditional methods.

**Findings**

Augmented reality (AR) makes it possible to overlay digital content onto our view of real-world phenomena. This potentially facilitates learning of physics by visualizing connections between concrete physics phenomena and abstract physics formalism.

**Conclusion**

In conclusion, the study on Augmented Reality (AR) in the e-learning industry underscores the significant potential of AR technology to revolutionize the way we approach learning and education. Through its ability to enhance engagement, interaction, and immersion, AR offers a dynamic and experiential learning environment that aligns with the evolving needs of learners in the digital age. The findings suggest that integrating AR into e-learning platforms can foster deeper understanding, improve retention rates, and promote active participation among learners. As AR continues to advance and become more accessible, its integration into the e-learning landscape holds promise for creating more engaging, effective, and personalized learning experiences in the future.

**References**

- https//www.researchgate.net/publication/343663440_Augmented_Reality_A_Systematic_Review_of_Its_Benefits_and_Challenges_in_E-Learning_Contexts
- AN OVERVIEW OF AR.pdf
- https//vciba.springeropen.com/articles/10.1186/s42492-020-00057-7
- https//www.sciencedirect.com/science/article/pii/S2351978920310854
- https//www.sciencedirect.com/science/article/abs/pii/S0360835220305118
- https//www.techtarget.com/whatis/definition/augmented-reality-AR#~text=AR20delivers20visual20elements2C20sound,perception20of20the20real20world

# Exploring through Augmented Reality Technology for the Future Education

SA Harini |Suzan Win
B.Voc Banking, Financial Services and Insurance.
Stella Maris College

***Abstract***

*This abstract explores the integration of augmented reality (AR) technology in the future of education. It examines the potential impact of AR on enhancing learning experiences, fostering student engagement, and providing immersive educational content. The paper delves into the benefits and challenges associated with implementing AR in educational settings, considering its implications for diverse subjects and age groups. Additionally, the abstract discusses the evolving role of educators in adapting to and leveraging AR tools for effective teaching. The aim is to shed light on the transformative possibilities of AR in shaping the landscape of education in the years to come.*

***Keywords:*** *Education, augmented reality, immersive learning, teaching.*

## Introduction

Augmented Reality (AR) is poised to revolutionize the landscape of education, offering immersive and interactive experiences that go beyond traditional classroom boundaries. Augmented reality refers to the integration of digital information, such as images, sounds, or text, into the real-world environment. Unlike virtual reality, which immerses users in a completely artificial environment, AR enhances the real-world experience by overlaying digital elements onto the physical world. As we look to the future of education, AR holds tremendous potential to enhance learning environments, engage students, and provide new avenues for knowledge acquisition. Augmented reality not only enhances traditional teaching methods but also enables personalized and adaptive learning experiences tailored to individual student needs. The fusion of real-world elements with digital content empowers educators to create compelling and interactive lessons that captivate the imagination of learners. As we embrace the future of education, augmented reality stands as a catalyst for fostering creativity, critical thinking, and a deeper understanding of complex subjects, propelling students into a new era of immersive and enriched learning.

## Need for the Study

AR provides a unique and immersive learning experience that goes beyond traditional methods, offering students an interactive and dynamic educational environment. By overlaying digital information onto the real world, AR facilitates a deeper understanding of complex concepts through visualizations and simulations. This technology not only captures students' attention but also fosters engagement and critical thinking by allowing them to explore subjects in a more interactive manner.

## Objectives

- Preparation for Future Preparing students for a tech-driven future by familiarizing them with AR and its potential applications in various fields.
- Making education more accessible by catering to various learning styles and accommodating different abilities through AR technologies.
- Connecting students globally, allowing them to share cultural experiences and collaborate on projects irrespective of geographical boundaries.
- Enhancing critical thinking and problem-solving skills by integrating AR scenarios that require practical application of knowledge.

## Methodology

Research Plan

Research approach – Questionnaire Method

Research Instrument - A structured questionnaire is framed to collect data from the respondents according to the objective of the study.

## Type of the Study- Descriptive Research

This research is completely based on the description of the factors that lead to the version of real-world experience. It is basically on the various parameters which includes personal details of respondents, education qualification and users interact and receive real-time feedback on the action they have performed.

**Significance**

This study will enhance education by providing interactive and immersive experiences. Students can explore complex concepts in a more engaging and memorable way, fostering better understanding.

- This study will enable students to bridge the gap between theoretical knowledge and real-world applications. Simulations and overlays allow them to visualize how concepts are utilized in various industries, making education more practical.
- This Study will promote collaborative learning by facilitating shared virtual experiences. Students can collaborate on projects, conduct experiments, or solve problems together in a virtual space, irrespective of their physical locations.
- This study will help connect students globally, allowing them to virtually explore historical sites, participate in cultural exchanges, and collaborate on international projects, broadening their perspectives.
- This study will allow for real-time updates and continuous learning. Content can be updated instantly, ensuring that students have access to the latest information and developments in their field of study.

**Scope**

- AR enables personalized learning experiences, catering to individual learning styles and paces. This adaptability can help students grasp concepts at their own speed, enhancing overall comprehension.
- AR can be used to simulate real-world scenarios, facilitating practical skill development. For example, medical students can practice surgeries in a virtual environment, enhancing their hands-on skills.
- AR has the potential to make education more accessible for learners with diverse needs. It can provide tailored assistance, such as real-time language translation or additional support for students with learning disabilities.
- AR can bring field trips to the classroom, allowing students to explore historical sites, ecosystems, or outer space without leaving the school premises. This can overcome logistical constraints and broaden educational experiences.
- AR can be used for training and professional development of educators. Virtual workshops and simulations can help teachers stay updated on innovative teaching methods and technology integration.

### Limitations

- AR applications may face technical glitches, such as connectivity issues, software bugs, or hardware malfunctions, disrupting the learning experience and hindering the seamless integration of AR into education.
- Both educators and students may need time to adapt to AR technology, potentially affecting the initial effectiveness of its implementation in the educational environment.
- Augmented reality (AR) technology may require specific hardware and software, making it inaccessible for students who lack the necessary devices or resources.
- Implementing AR in education can be expensive, including the cost of devices, software development, and maintenance. This may limit its widespread adoption, particularly in economically disadvantaged areas.
- The immersive nature of AR could lead to distractions in the learning environment, as students might be tempted to explore non-educational content or features during lessons.

## Review of literature

- Muhammad Zahid Iqbal(2022): Augmented Reality (AR) is a rapidly evolving technology in STEM education, delivering practical and creative aspects of teaching. This paper reviews current literature, explores challenges, and identifies future research areas. It presents two case studies to address research gaps in real-time touchless hand interaction, kinesthetic learning, and machine learning agents with remote learning pedagogy. The shift towards blended learning, personalized learning spaces, and user-centered approaches has been influenced by COVID-19.
- Christos Troussas (2021): This review paper examines the use of Augmented Reality (AR) in engineering education, focusing on spatial ability training. The paper reviews 32 studies published since 2010, revealing an increase in studies over the past three years. The main conclusion is that AR improves spatial ability in educational settings, but there is a need for more learning content and a research gap in personalization. The paper concludes that this area is under-researched and requires further improvement.

- Kaviya Raj (2021): Augmented reality is expected to play a significant role in various industries, including military, education, medical, manufacturing, training, remote assistant, navigation, and gaming, by 2020 and 2030. This article explores its potential in the new education system and other sectors, focusing on recent studies and encouraging educators to improve mixed reality experiences.

**Data Analysis and Interpretation**

Analysis was done using inferential and descriptive tools

**Table showing the Demographic Details**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Age | <20<br>20 – 30<br>>30 | 82%<br>18% |
| Education Qualification | 12 th<br>UG<br>PG<br>OTHERS | 14%<br>82%<br>-<br>4% |
| Gender | Female<br>Male<br>Prefer not to say | 98%<br>2%<br>- |
| Occupation | Employed<br>Self-Employed<br>Professional | 28%<br>42%<br>30% |

**Table showing how many People are Aware of Augmented Reality in Education**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Aware of Augmented Reality | Yes<br>No | 52%<br>48% |

- 52 percentage of the respondents are aware of augmented reality and 48 percent of the respondents are not aware of the augmented reality.

**Table showing what benefits the respondents think augmented reality can bring to education**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Benefits of augmented reality in future education | Enhanced engagement | 16% |
| | Improved learning outcomes | 62% |
| | Real-world simulations | 40% |
| | Personalized learning experiences | 38% |

- 16 percentage of respondents chose 'Enhanced engagement', 62 percentage of respondents chose 'Improved learning outcomes', 40 percentage of respondents chose 'Real-world simulations' and 38 percentage of respondents chose 'Personalised learning experience'.

**Table Showing What Challenges They Foresee In Implementing Augmented Reality In Education**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Challenges they foresee in implementing augmented reality in education | Cost of technology | 32% |
| | Technical infrastructure | 30% |
| | Teacher training | 16% |
| | Student access to devices | 22% |

- 32 percentage of respondents chose 'Cost of technology', 30 percentage of respondents chose 'Technical Infrastructure', 16 percentage of respondents chose 'Teacher training' and 22 percentage of respondents chose 'Student access to device'.

**Table Showing Which Areas Of Education They Think Augmented Reality Would Be Most Beneficial**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Areas of education in which it will be most beneficial | Science and Biology | 36% |
| | History and Social Studies | 30% |
| | Mathematics | 14% |
| | Language Learning | 20% |

- 36 percentage of respondents chose 'Science and Biology', 30 percentage of respondents chose 'History and social studies', 14 percentage of respondents chose 'Mathematics' and 20 percentage of respondents chose 'Language Learning'.

**Table Showing Which Method Do The Respondents Prefer Educational Content Delivered Through Augmented Reality Compared To Traditional Methods**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Preferring educational content through augmented reality more than traditional methods | Very likely | 20% |
| | Somewhat likely | 38% |
| | Neutral | 32% |
| | Not likely | 10% |

- 20 percentage of respondents chose 'Very likely', 38 percentage of respondents chose 'Somewhat Likely', 32 percentage of respondents chose 'Neutral' and 10 percentage of respondents chose 'Not likely'.

**Table Showing Which Method Do The Respondents Prefer Educational Content Delivered Through Augmented Reality Compared To Traditional Methods**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Can make education more access to diverse learners | Yes | 40% |
| | No | 18% |
| | Not sure | 42% |

- 40 percentage of respondents chose 'yes', 18 percentage of respondents chose 'No', and 42 percentage of respondents chose 'Not sure'.

**Table Showing How Important Is It For Augmented Reality To Complement Traditional Teaching Methods**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Importance of augmented reality to complement traditional teaching methods | Very important | 24% |
| | Somewhat important | 34% |
| | Neutral | 36% |
| | Not important | 6% |

- 24 percentage of respondents chose 'Very important', 34 percentage of respondents chose 'Somewhat important', 36 percentage of respondents chose 'Neutral' and 6 percentage of respondents chose 'Not important'.

**Table Showing How The Respondents Believe Educational Institutions Should Invest In Integrating Augmented Reality Into Their Curriculum**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Educational institutions should invest in integrating augmented reality into their curriculum | Strongly agree | 10% |
| | Agree | 30% |
| | Neutral | 42% |
| | Disagree | 12% |
| | Strongly disagree | 6% |

- 10 percentage of respondents chose 'Strongly agree', 30 percentage of respondents chose 'Agree', 42 percentage of respondents chose 'Neutral' ,12 percentage of respondents chose 'Disagree', and 6 percentage of respondents chose 'Strongly disagree'.

**Table Showing If The Respondents Think Virtual Reality Will Make The Concepts More Clear**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Think virtual reality will make the concepts more clear | Yes | 38% |
| | No | 22% |
| | Maybe | 40% |

- 38 percentage of respondents chose 'yes', 22 percentage of respondents chose 'No', and 40 percentage of respondents chose 'Maybe'.

**Table Showing If The Respondents Have Ever Used Augmented Reality**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Have they ever used augmented reality | Yes | 20% |
| | No | 50% |
| | Maybe | 30% |

- 20 percentage of respondents chose 'yes', 50 percentage of respondents chose 'No', and 30 percentage of respondents chose 'Maybe'.

**Conclusion**

In conclusion, augmented reality (AR) holds immense potential for revolutionizing future education. By seamlessly blending digital content with the physical world, AR offers a dynamic and interactive learning experience that engages students in ways traditional methods cannot.

Firstly, AR enhances comprehension by providing visual and interactive aids that cater to various learning styles, making complex concepts more accessible and engaging. This can lead to improved retention and understanding of subjects across different disciplines.

Secondly, AR fosters immersive learning environments where students can actively participate and manipulate virtual objects, fostering deeper engagement and critical thinking skills. This hands-on approach encourages exploration and experimentation, enabling students to learn through trial and error in a safe and controlled setting.

Moreover, AR has the potential to democratize education by breaking down geographical barriers and providing access to high-quality educational content regardless of location or socioeconomic status. This can help bridge the gap in educational inequality and provide equal learning opportunities for all students.

Additionally, AR facilitates personalized learning experiences by adapting content to individual needs and preferences, allowing students to learn at their own pace and style. This customization can accommodate diverse learning abilities and preferences, ensuring that every student receives the support they need to succeed.

Furthermore, AR can facilitate collaborative learning experiences by enabling students to interact with peers and instructors in virtual spaces, fostering teamwork, communication, and social skills essential for success in the digital age.

In summary, augmented reality has the potential to transform education by offering immersive, interactive, and personalized learning experiences that cater to the needs of diverse learners. As technology continues to advance, integrating AR into educational practices has the potential to revolutionize teaching and learning, preparing students for success in an increasingly digital and interconnected world.

## References


- https://www.fingent.com/blog/augmented-reality-in-education-training-use-cases-and-business-benefits/#:~:text=AR%20in%20Education%3A&text=teaching%20and%20learning.-,Augmented%20Reality%20learning%20technology%20allows%20teachers%20and%20educators%20to%20incorporate,driving%20student%20engagement%20and%20experience.
- https://elearningindustry.com/augmented-reality-in-education-staggering-insight-into-future
- https://www.forbes.com/sites/bernardmarr/2023/06/29/the-future-of-learning-reshaped-by-vr-ar-and-blockchain/?sh=2af876cd7155
- https://darkbears.com/blog/augmented-reality-in-education-how-ar-is-shaping-the-future-of-learning/

# Reshaping Travel Experience with Augmented Reality

Zahra Yousuf | Kiran Choudhary
B.Voc. Banking, Financial Services and Insurance
Stella Maris College

***Abstract***

*In this research, we delve into the profound impact of Augmented Reality (AR) on reshaping the landscape of travel experiences. The paper thoroughly examines the multifaceted ways in which AR implementation has redefined and elevated various aspects of the travel journey. From enhancing navigation through interactive overlays to providing enriched cultural information, AR introduces a paradigm shift in how individuals perceive and engage with travel. The study also emphasizes the role of AR in crafting personalized travel experiences, tailoring journeys to individual preferences. However, amidst the transformative potential, the research conscientiously acknowledges and discusses the challenges and hindrances encountered in effectively implementing AR technology within the dynamic realm of travel. Overall, this exploration aims to provide a comprehensive understanding of how AR is fundamentally reshaping and enhancing the overall travel experience.*

***Keywords:*** *augmented reality, travel experience, tourism industry.*

## Introduction

This exploration delves into the profound impact of Augmented Reality (AR) and its transformative influence on the landscape of travel experiences. This paper is dedicated to a meticulous examination of the multifaceted ways in which AR implementation has reshaped and elevated various dimensions of the travel journey. From revolutionizing navigation through interactive overlays to imparting enriched cultural insights, AR introduces a paradigm shift that transcends conventional travel norms. The study delves into the pivotal role of AR in crafting personalized travel experiences, tailoring journeys to align seamlessly with individual preferences. However, acknowledging the transformative potential also requires a nuanced discussion on the challenges and hindrances faced in effectively implementing AR technology within the dynamic realm of travel. This exploration endeavors

to provide a comprehensive understanding of how AR fundamentally reshapes and enhances the overall travel experience.

**Need for the Study**

This study is essential to comprehend the impact of Augmented Reality (AR) on travel experiences amid rapid technological evolution and evolving traveller expectations. Addressing the need for personalization and overcoming implementation challenges, the research contributes insights vital for industry adoption. Recognizing AR's role in cultural enrichment and enhanced navigation, the study fills a knowledge gap, providing pertinent insights for academic and practical considerations in the travel sector.

**Objectives**

- Travel experiences before the advent of augmented reality
- Implementation of augmented reality in creating a finer travel experience
- Benefits of augmented reality in creating finer travel experiences
- Challenges in implementing augmented reality in travel experiences

**Methodology**

The methodology for this paper involves a qualitative research design to explore participants' perceptions and experiences with augmented reality (AR) in travel. Data will be collected through a structured questionnaire, targeting a sample with diverse backgrounds and varying levels of AR familiarity.

Type of the Study - Descriptive Research

These questions fall under the category of exploratory and descriptive research questions. They aim to gather information and opinions from individuals to understand their awareness, experiences, and perceptions related to augmented reality in the context of travel. The questions cover a range of topics, from basic awareness of AR to specific experiences with AR applications during travels. Additionally, the questions explore participants' beliefs about the potential impact of AR on travel experiences, their willingness to seek out AR-enhanced travel, and their preferences for specific AR features. The last two questions focus on challenges and improvements, seeking insights into concerns and suggestions regarding the integration of AR in the travel domain. Overall, these questions are designed to uncover a broad spectrum of attitudes and experiences related to AR in travel.

**Significance**

- This research highlights the significant influence of AR in reshaping travel experiences, emphasizing the technological evolution in the travel industry.
- The study explores how AR contributes to enhanced navigation, providing valuable insights into its practical implementation and benefits for travellers.
- By focusing on AR's role in cultural enrichment, the paper contributes to understanding how technology can deepen cultural experiences for travellers.
- The research underscores the importance of AR in crafting personalized travel experiences, catering to individual preferences and expectations.
- Insights into challenges in AR implementation provide valuable considerations for industry professionals, informing strategies for the effective adoption of AR technologies.
- The paper contributes to academic discourse by filling knowledge gaps and offering a comprehensive understanding of AR's impact on the travel sector.
- The study explores the scope of AR in shaping the future landscape of travel experiences, providing a forward-looking perspective for industry stakeholders.
- With a focus on practical challenges and benefits, the research provides actionable insights for policymakers, businesses, and professionals in the travel industry.

**Scope**

The paper delves into the scope of integrating AR into the travel industry, examining how advancements in technology can redefine and enhance the overall travel experience.

- With a focus on AR's impact on navigation and cultural enrichment, the research explores the global application of AR in diverse travel settings, catering to a broad spectrum of travellers.
- The scope extends to the potential for innovation within the travel industry, emphasizing how AR can be a catalyst for transformative changes in service delivery and customer engagement.
- By addressing the benefits of AR in crafting personalized travel experiences, the paper explores the scope of user-centric design, offering insights into tailoring journeys to individual preferences.
- With a focus on cultural insights and enriched information, the paper explores the educational value of AR in the travel context, providing a scope for enhancing travellers' knowledge and awareness.

- The study opens avenues for future research by identifying areas where further exploration is needed, contributing to ongoing discussions on the evolving role of AR in travel.
- The scope extends to practical implications for businesses, policymakers, and technology developers, offering insights into how AR can be harnessed to meet evolving traveler expectations and industry demands.

**Limitations**

The study may not cover all aspects of Augmented Reality in travel due to limitations in time.

- Findings may not be universally applicable as they are based on a specific context, and the study's outcomes might not represent every traveler's experience.
- Given the rapidly evolving nature of AR technology, findings may become outdated quickly, and new developments may emerge after the study's completion.
- The study's results may be influenced by the characteristics of the participants, and the sample might not fully represent the diverse range of travellers and their preferences.
- Responses gathered, particularly regarding perceptions and experiences, are subjective and may vary based on individual interpretations, potentially introducing bias.
- The study may not fully capture the complexities of implementing AR in various travel scenarios, and practical challenges faced by industry stakeholders might not be fully explored.
- Cultural differences among participants may impact their views on AR in travel, and the study might not fully account for these variations.

**Review of Literature**

- Eleanor E. Cranmer [2020]: Augmented reality (AR) is used as a marketing, communication and information tool in the tourism industry. Therefore, the purpose of this article is to examine the value of AR in the tourism industry from the perspective of tourism professionals. The study used qualitative and analytical methods, asking fifteen academics and tourism professionals to evaluate tourism trends. The study identified five dimensions of value, including marketing, financial, visitor, cognitive and organizational.

- Lena Jingen Liang [2020]: The utilization of augmented reality in the tourism sector is evolving and showing significant promise, prompting a surge in research endeavors. The findings reveal the presence of five prominent research clusters, with a prevailing focus on user acceptance of augmented reality, commonly employing the technology acceptance model. Our examination suggests potential future research trajectories, urging exploration into the gaming aspect, the examination of potential adverse effects of augmented reality, and the incorporation of inventive methodologies and study designs to advance understanding in this emerging field.
- Tan Gek-Siang [2020]: Inspired by Tourism 4.0, many museums are using digital technologies to enrich visitor experiences, such as augmented reality (AR). In the "History Alive" project, an AR mobile application was created for the Malacca People's Museum. The purpose of this study is to investigate factors that influence museum visitors' intentions to use AR mobile applications. The research results show that game time, content-related expected time, work time, expected time and social influence have a positive impact on respondents' willingness to use technology, with an explanatory power of 61.2%. The study provides implications for managers and practitioners in mobile AR application developers, tourism businesses, and policy makers.
- Faisal Aburub [2023]: AR has become an important marketing technology, allowing hotels to improve their guests' perception of their surroundings. AR can be a powerful tool for restaurants looking to enhance the guest experience, increase revenue and differentiate themselves from competitors. The aim is to examine the impact of the main benefits that can come from interactions with AR on customer satisfaction and purchase intentions in the hotel industry. Therefore, this study combines usage and gratification models with a technology acceptance model to study the impact of augmented reality on customer satisfaction and purchase intention.
- Shan Jiang [2022]: Despite its potential, few studies have explored the potential of AR to create memorable tourism experiences (MTEs). This study aims to discover the contribution of AR to memorable tourist experiences (MTE) at traditional attractions such as the Great Wall of China using mobile applications. Four experiences related to AR tourism. , for visitor use. . . Furthermore, this empirical study investigates the impact of AR experiences on the satisfaction and dissatisfaction of tourists visiting foreign destinations and shows that MTE mediates the relationship between tourists' attitudes and experiences and behavioral needs.

## Data Analysis and Interpretation

**Demographic Details**

| VARIABLES | OPTIONS | PERCENTAGE % |
|---|---|---|
| Age | <20 | 74% |
| | 20-30 | 26% |
| | >30 | - |
| Educational Qualification | 12th | 16% |
| | UG | 80% |
| | PG | 1% |
| | Others | 3% |
| Gender | Male | 13% |
| | Female | 86% |
| | Prefer not to say | 1% |
| Occupation | Student | 91% |
| | Employed | 4% |
| | Self-employed | 5% |
| | Professional | - |

**Table Showing How Many Respondents are Aware of Augmented Reality**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Aware of augmented reality | Yes | 39% |
| | No | 33% |
| | Somewhat | 25% |
| | Not sure | 5% |

- 39% of the respondents are aware of AR, 33% are not aware of AR, 25% are somewhat aware of AR and 5% are not sure if they are aware of AR.

Table Showing Respondents Knowledge in the Meaning of Augmented Reality

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Meaning of AR | A technology that replaces the real world with a simulated environment. | 45% |
| | Enhancing the real world with computer-generated information. | 42% |
| | Creating a completely virtual experience. | 10% |
| | Unrelated to technology | 3% |

- 45% of the respondents chose a technology that replaces the real world with a simulated environment, 42% chose enhancing the real world with computer-generated information, 10% chose creating a completely virtual experience and 3% chose unrelated to technology.

Table Showing Respondents Perception on the Similarity Between Augmented Reality and Virtual Reality

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| AR and VR are the same | Yes | 9% |
| | No | 61% |
| | Not sure | 30% |

- 9% of the respondents think AR and VR are the same, 61% think they're not the same and 30% are not sure.

**Table Showing How Respondents Differentiate Between Augmented Reality and Virtual Reality**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Differentiating AR from VR | Both offer the same | 9% |

| | | |
|---|---|---|
| | experience.<br>AR adds computer-generated elements to the real world; VR creates a completely simulated environment.<br>They are synonyms.<br>There is no difference | 78%<br>8%<br>5% |

- 9% of the respondents chose both offer the same experience, 78% chose AR adds computer-generated elements to the real world; VR creates a completely simulated environment, 8% chose they are synonyms and 5% chose there is no difference.

**Table Showing How Many Respondents have Used AR Applications Before**

| **VARIABLES** | **OPTIONS** | **PERCENTAGE** |
|---|---|---|
| Used AR applications before | Yes<br>No<br>Not sure | 17%<br>62%<br>21% |

- 17% of the respondents have used AR applications before, 62% have not and 21% are not sure.

Table Showing How Many Respondents have used AR during their Travels

| **VARIABLES** | **OPTIONS** | **PERCENTAGE** |
|---|---|---|
| Used AR during travel | Yes<br>No<br>Not sure | 10%<br>66%<br>24% |

- 10% of the respondents have used AR during travel, 66% have not and 24% are not sure.

**Table Showing How Respondents Perceive the Impact of AR on Enhancing the Overall Travel Experience**

| **VARIABLES** | **OPTIONS** | **PERCENTAGE** |
|---|---|---|

| | | |
|---|---|---|
| Impact of AR on enhancing the overall travel experience | Extremely positive<br>Positive<br>Unsure<br>No | 16%<br>39%<br>33%<br>12% |

- 16% of the respondents perceive the impact of AR on enhancing the overall travel experience as extremely positive, 39% as positive, 33% as unsure and 12% as no.

**Table Showing How Respondents Believe AR has the Potential to make Travel Experience more Personalized**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| AR potential to make travel experience more personalized | Strongly believe<br>Believe<br>Unsure<br>Do not believe | 9%<br>46%<br>41%<br>4% |

- 9% of the respondents strongly believe AR has the potential to make travel experience more personalized whereas 46% chose believe, 41% chose unsure and 4% chose do not believe.

**Table showing how many respondents would actively seek out travel experiences that incorporate AR features**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Actively seek out travel experiences that incorporate AR features | Definitely<br>Probably<br>Not sure<br>Probably not | 11%<br>46%<br>35%<br>8% |

- 11% of the respondents will definitely actively seek out travel experiences that incorporate AR features, 46% will probably actively seek out travel experiences that incorporate AR features, 35% are not sure and 8% will probably not actively seek out travel experiences that incorporate AR features.

**Table showing specific AR features that respondents would find most appealing in enhancing their travel experience**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Most appealing AR feature in enhancing travel experience | AR navigation<br>Historical information overlays<br>Both A and B<br>None of the above | 17%<br>8%<br><br>58%<br>17% |

- 17% of the respondents find AR navigation as the most appealing AR feature in enhancing travel experience, 8% find historical information overlays as the most appealing AR feature in enhancing travel experience, 58% find both A and B as the most appealing AR feature in enhancing travel experience and 17% find none of the above as the most appealing AR feature in enhancing travel experience.

**Table Showing Challenges or Concerns that the Respondents have Encountered or Foresee in the Integration of AR in Travel**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|
| Challenges or concerns encountered or foreseen in the integration of AR in travel | Technological challenges<br>Privacy concerns<br>Both A and B<br>None of the above | 18%<br>24%<br>36%<br>22% |

- 18% of the respondents chose technological challenges, 24% chose privacy concerns, 36% chose both A and B and 22% chose none of the above.

**Table showing Specific Improvements or Innovations that Respondents would like to see In AR Applications for Travel**

| VARIABLES | OPTIONS | PERCENTAGE |
|---|---|---|

| | | |
|---|---|---|
| Specific improvements or innovations in AR applications for travel | Improved user interface | 14% |
| | More accurate location-based information | 24% |
| | Both A and B | 46% |
| | No specific improvements needed | 16% |

- 14% of the respondents chose improved user interface, 24% chose more accurate location-based information, 46% chose both A and B and 16% chose no specific improvements needed.

**Conclusion**

In conclusion, this research extensively explores the transformative impact of Augmented Reality (AR) on the realm of travel experiences. By addressing the need for personalization and overcoming implementation challenges, the study contributes valuable insights for industry adoption. Recognizing AR's role in cultural enrichment and enhanced navigation, the research fills a knowledge gap, offering pertinent insights for academic and practical considerations in the travel sector. The objectives, significance, and scope collectively provide a comprehensive framework for understanding how AR fundamentally reshapes and enhances the overall travel experience. However, it is crucial to acknowledge the study's limitations, including potential outdatedness and cultural variations among participants. Despite these limitations, the research stands as a significant contribution to discussions on the evolving role of AR in shaping the future landscape of travel experiences. As technology continues to advance, this exploration serves as a foundation for further research and practical applications, guiding industry stakeholders toward leveraging AR for enriched, personalized, and culturally immersive travel journeys.

**References**

- https://www.sciencedirect.com/science/article/abs/pii/S2211973620300398
- https://journals.sagepub.com/doi/full/10.1177/1467358420941913
- https://link.springer.com/chapter/10.1007/978-3-030-42412-1_9
- https://www.tandfonline.com/doi/abs/10.1080/13683500.2022.2026303

# Augmented Reality in Manufacturing: Optimizing Production and Supply Chain Management

Pratibha Sundarraman and Sreenidhi B
B.Com (Accounting and Finance)
M.O.P Vaishnav College for Women (Autonomous)

***Abstract***

*Augmented Reality (AR) stands as a crucial component of Industry 4.0, reshaping modern manufacturing. This paper explores AR's pivotal role in transforming production and enhancing efficiency in supply chain management. By integrating AR, manufacturers enhance operational efficiency, mitigate issues, and accelerate problem-solving. AR fosters innovation, enabling faster adaptation, cost reduction, and product improvement.*

*AR's adoption streamlines supply chain operations, spanning warehousing, transportation, and distribution. In conclusion, this study investigates AR's impact on manufacturing, emphasizing its potential to enhance both production and logistical efficiency. It aims to uncover practical applications and benefits, unlocking AR's full potential for production and supply chain management.*

***Keywords****: Augmented reality, manufacturing, supply chain management, production, logistics, technology, productivity, efficiency*

## Introduction

Augmented reality (AR) technology seamlessly merges virtual elements into the real world, creating a captivating experience by digitally integrating 3D objects in real-time. This fusion, commonly employed with laptops, smartphones, and tablets, elevates user engagement by overlaying digital graphics onto physical surroundings. By capturing input from these devices, AR applications identify targets, process images, and enhance them with additional visuals, videos, and audio, crafting a compelling virtual experience.

The manufacturing sector holds immense potential for AR applications, including predictive maintenance, streamlined logistics, enhanced product design, optimized assembly processes, and expert support in data management. In today's fiercely competitive business

environment, manufacturing faces novel challenges that necessitate a comprehensive approach to key attributes like cost, time, quality, and flexibility.

Digital manufacturing, driven by computer-integrated systems, has emerged as a global trend, minimizing data errors and enabling better decision-making. Over the past decade, AR technology has matured into an innovative and effective solution, offering novel ways to simulate, assist, and enhance manufacturing processes, making significant strides in addressing critical industry challenges.

**Objectives**

1. To analyse the current state of augmented reality in the manufacturing industry
2. To explore the potential benefits of implementing augmented reality technology in production processes.
3. To analyse the merits of augmented reality on supply chain management within the manufacturing sector.
4. To provide insights into successful case studies of augmented reality implementation in manufacturing.
5. To identify challenges and barriers to the adoption of augmented reality in manufacturing and propose solutions.

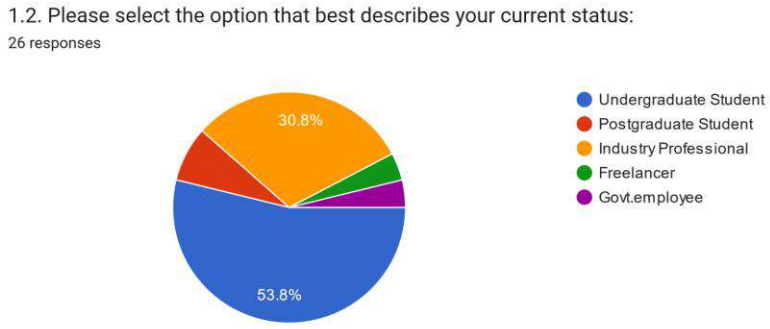
**Scope**

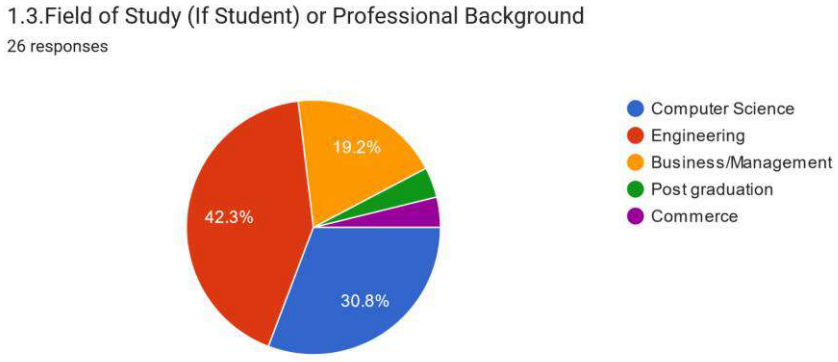
The paper provides a detailed analysis of current augmented reality technologies and their broad applications in manufacturing. It examines how augmented reality enhances productivity, efficiency, and cost-effectiveness in diverse manufacturing settings. Additionally, it explores how augmented reality is integrated into supply chain management, focusing on inventory, logistics, and distribution. Drawing from compelling case studies and real-world examples, the paper illustrates the effectiveness of augmented reality in various manufacturing sectors, highlighting its transformative potential and practical feasibility. Furthermore, it critically evaluates the challenges and barriers to widespread augmented reality adoption in manufacturing, offering insightful strategies and solutions for overcoming these obstacles.

## Research Methodology

The research was conducted using a combination of primary and secondary data sources. Primary data was gathered through a carefully tailored questionnaire designed to obtain pertinent information for the study, which was then circulated to a chosen sample of respondents. Secondary data was obtained from various research studies carried out by scholars, academicians and authors worldwide, sourced from both online and offline platforms.

Survey Details: Total Responses: 26




## Augmented Reality in Manufacturing

As of the latest available data, the global augmented reality (AR) market in manufacturing is experiencing rapid expansion, with a market size estimated at around $700 million in 2021. Forecasts suggest this figure will surge to over $4.5 billion by 2026, at a compound annual growth rate of approximately 45%. This growth is fueled by increased adoption of AR technology by manufacturing companies seeking to improve efficiency, reduce downtime, and enhance worker productivity. Additionally, AR enables remote assistance and collaboration, allowing experts to provide support from all corners of the globe. Furthermore, AR solutions are becoming more sophisticated and accessible, with

advancements in hardware, software, and connectivity driving further integration and innovation. Overall, AR has become an integral part of the manufacturing process, with continued innovation driving its further integration and expansion.

## Applications of AR in Manufacturing

Equipment Maintenance and Repairs

Preventive maintenance is performed on pieces of equipment at regular time intervals while they are running to maintain the working capability of the machines, which reduces unwanted maintenance and repair costs. AR evaluates and identifies potential flaws in seconds, which could be a task of hours when performed manually. Wearables equipped with augmented reality allow operators to assess equipment status and effectiveness at a glance. For instance, looking at the machine through AR-enabled glasses shows machine operational status and parameters like temperature. Additionally, wearables can display or superimpose instructions that guide a technician through machine maintenance and repair, streamlining maintenance management for manufacturers. (Tulip, 2023)

Use Cases

1. In 2011, Airbus deployed its Supply Augmented Reality Tool (SART) to improve quality control and increase efficiency. SART allows maintenance workers to identify parts that need repair or replacement using digital-enabled overlays on physical system components. SART uses sensors or markers to identify specific components within the aircraft or manufacturing environment. Once a component is identified, SART overlays digital information such as maintenance instructions, schematics, diagrams, or real-time data onto the physical component. This information is typically displayed through augmented reality glasses or a handheld device. Maintenance workers can then use the digital overlays to guide them through the maintenance or repair process step-by-step. (Ravich and ran, 2019)
2. Coca-Cola has partnered with Pristine, a tech startup based in Austin, Texas, to test AR in several bottling facilities for service calls, equipment inspections, and routine audits. The integration of AR technology in Coca-Cola's bottling facilities enhances the performance of the above functions by providing workers with on-demand access to relevant information, facilitating faster decision-making, and improving overall efficiency and accuracy in maintenance and auditing processes.

3. As a tool for service operations, Microsoft's HoloLens technology is being used by technicians of elevator manufacturer Thyssenkrupp. HoloLens, a holographic computer running on Windows 10, helps the service technicians in planning the site visit ahead by having remote access to the technical information, leading to less work onsite and increased uptime performance. (Ravich and ran, 2019)
4. AR glasses have been developed by Mitsubishi so maintenance workers always have the correct manual in hand when carrying out routine maintenance of manufacturing equipment. Users even have the ability to enter inspection results with their voice. This enhances the safety and efficiency of maintenance work. (manufacturingtomorrow.com, n.d.)

Product Design and Development

A product designer can visualize his or her findings in the real world to check whether or not it is possible to get into the next stage. The product can be given a digital life, which helps in observing and understanding each spatial context and the ongoing activity surrounding the product. It can help in expediting the investment, as different stakeholders could virtually see the working model and the benefits attained. During the development stages, it can streamline the process, especially when paired with other prototyping methods. Overall, AR speeds up the process of conceptualisation, development, introduction of the product to the assembly line and meeting safety standards. Augmented reality applications also help workers to access hands-free and voice-controlled manufacturing instructions, thus, saving time. This creates faster access to resource materials, enabling workers to focus more on their surroundings and key tasks.

Use Cases

1. Ford is utilizing AR technology to create 3D models without having to build every single design prototype with clay. Their use of HoloLens to let designers quickly model changes to cars, trucks, and SUVs is a more inventive example of how this technology can be used. It allows designers to see their changes on top of an existing physical vehicle, enabling them to quickly recognize issues with designs before a more labor-intensive prototype is ordered.
2. In the virtual engineering lab located in Wolfsburg, Germany, Volkswagen's vehicle designers and engineers make use of augmented reality to come up with novel designs by running various design iterations in less time. The use of augmented reality

in Volkswagen's virtual engineering lab enables designers and engineers to iterate on vehicle designs rapidly, visualize concepts in real-world contexts, collaborate effectively, and drive innovation in the automotive design process.

Assembly of Parts

An automobile typically comprises over 10,000 components obtained from various suppliers. The manufacturing process involves five main stages: press shop, body shop, painting, final assembly, and inspection. To minimize costly downtime, manufacturers can utilize augmented reality (AR) technology to remotely connect with experts who can troubleshoot mechanical issues halting production lines. Equipped with voice command capabilities and barcode readers, AR serves as a significant time-saving tool, improving productivity, enhancing quality, and optimizing ergonomics. Additionally, AR aids workers by displaying virtual instructions directly in their field of vision, eliminating the need for manual cross-referencing and boosting overall efficiency.

Use Cases

1. Volvo has partnered with Microsoft to integrate HoloLens technology into its production-line operations. Workers on Volvo's production line wear Microsoft HoloLens AR glasses, which serve as their interface for accessing digital information. As workers perform assembly tasks, they can digitally view step-by-step assembly instructions overlaid onto their field of view through the HoloLens glasses. In addition to assembly instructions, workers have access to technical drawings and diagrams through the HoloLens interface. One unique feature of the system is the ability for workers to view videos from the last person who completed a specific procedure. The HoloLens glasses allow workers to access information completely hands-free, freeing up their hands to focus on the assembly tasks at hand. CNET. (n.d.). *Volvo’s engineers use Microsoft HoloLens to digitally design cars*.

Training And Safety Instructions to Employees

Manufacturers can make use of specialized AR devices and applications to help both new and experienced workers train and acquire new skills. AR facilitates the simulation of real-life activities in a semi-virtual environment, enabling manufacturers to execute activities and create specialized contexts without physical equipment and materials. Due to augmented reality solutions, new workers can be safely and effectively trained in all crucial

manufacturing processes and taught how to operate expensive and complex machines and equipment. If they make a mistake or do something wrong during their training, the system will issue a real-time notification in the form of a visual warning or audio prompt. By interacting with three-dimensional models and holograms of manufacturing equipment as well as realistic simulations of manufacturing workflows, employees can gain a better understanding of their responsibilities and duties while avoiding hazardous situations.

Use Cases

1. To reduce Cisco customer support cases and increase the efficiency of installing its devices, Cisco built an AR solution using our AR Creation tool to let technicians launch virtual demonstrations straight from their devices. Technicians could see for example how to install different machine parts in an AR overlay on top of the physical device. The experience removed the need to read manuals, which CISCO found increased installation efficiency by 30% and first time accuracy by 90%. Blippar (n.d.). *Cisco AR Manual*.

AR in Supply Chain Management

AR plays a crucial role in supply chain management by enhancing operational efficiency and adaptability in response to market changes. As global trade complexities increase and consumer demands evolve, the ability to rapidly gain insights and adapt becomes increasingly valuable. Augmented Reality, blending virtual and real-world elements, has the potential to address supply chain bottlenecks proactively, offering a future where issues are not just managed but solved preemptively.

In logistics, AR technology assists workers in the picking process by displaying relevant information upfront, such as part details and location instructions. Currently, employees perform various tasks in order fulfillment and warehouse management, involving manual checks, product retrieval, scanning, and reporting. With AR, workers can virtually identify parts and scan them within the device, streamlining the process and reducing the need for manual intervention. Consequently, workers only need to retrieve and deliver products, simplifying operations.

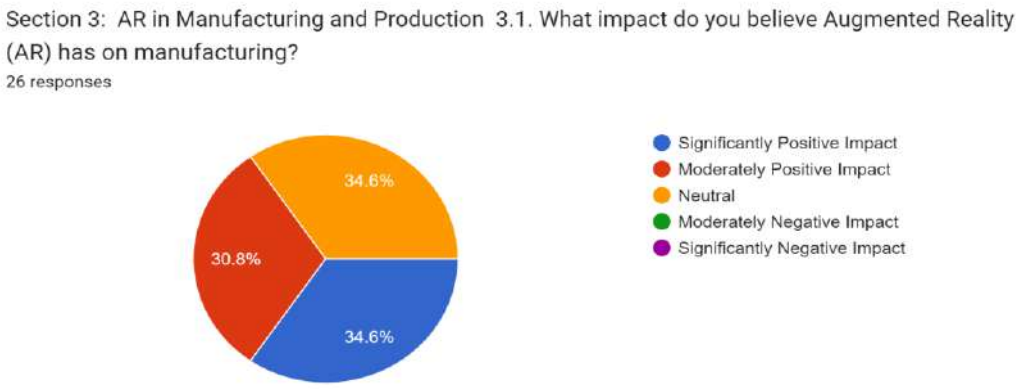
According to DHL, warehousing activities contribute significantly to total costs, with picking products being the most expensive, accounting for 55% to 60% of total costs. AR has the potential to digitize these processes, thereby reducing costs. By providing real-time inventory updates and guiding workers through warehouse operations, AR devices minimize errors and

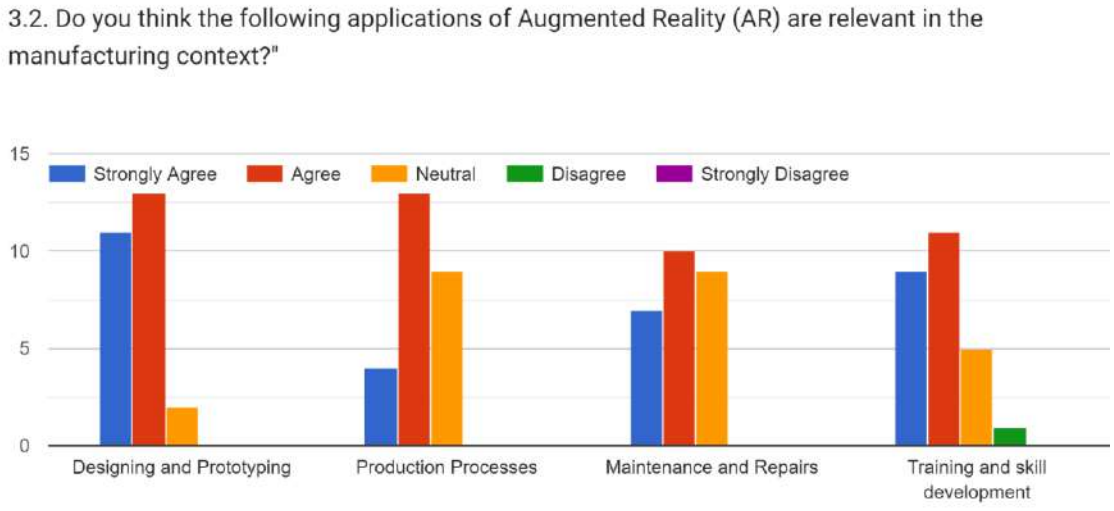
improve efficiency. Additionally, AR facilitates planning of warehouse layouts to optimize storage and enhance value-added services like repackaging and repair.

In transport operations, particularly in retail businesses, shipping products globally entails substantial costs and requires meticulous tracking. AR software can make these operations more efficient by eliminating the need for physical cargo manifests and human tracking methods. AR-enabled wearables guide workers through container loading procedures and provide support for dynamic traffic management and last-mile delivery, simplifying parcel handling and distribution.

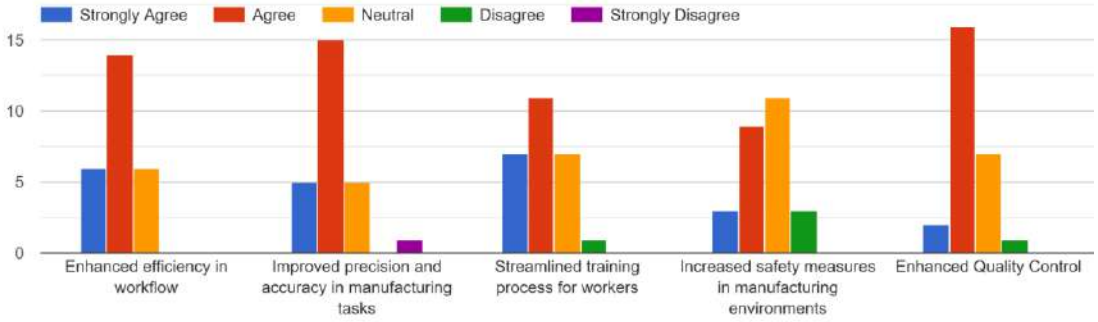
Overall, AR technology offers significant benefits in supply chain management by improving efficiency, reducing costs, and enhancing operational effectiveness across various processes, from warehousing to transport operations.

## Survey Results



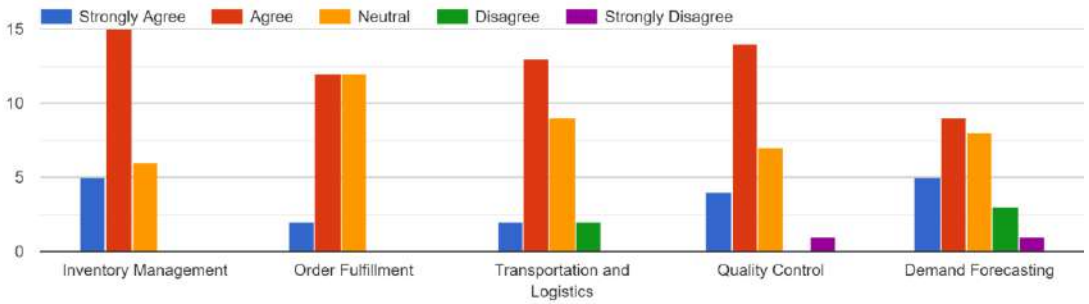
3.3. Do you think the following potential benefits could be achieved by integrating Augmented Reality (AR) with production processes?



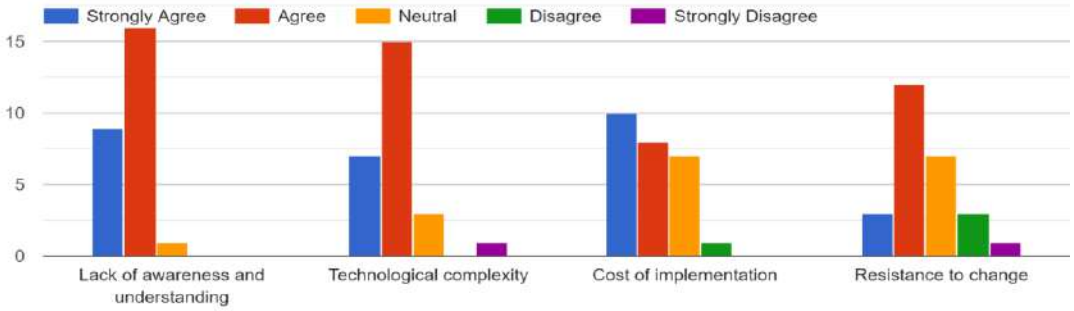

Section 4: AR in Supply Chain Management 4.1. What is your perspective on the integration of AR in Supply Chain Management?

26 responses


4.3. Do you think the following areas could benefit from Augmented Reality (AR) technology in improving Supply Chain Management?

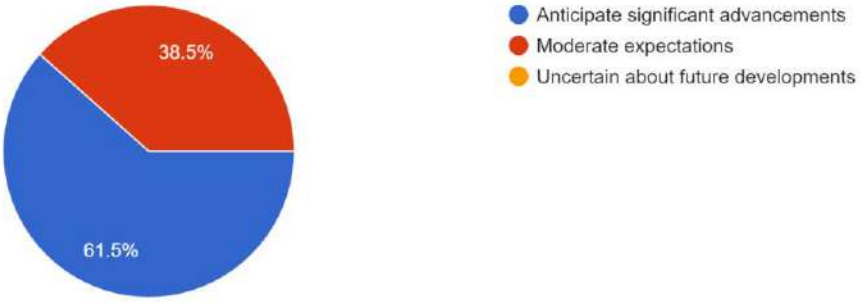


Section 5: Opportunities and Expectations 5.1. Do you think the following are potential challenges in Implementation of AR in Manufacturing?



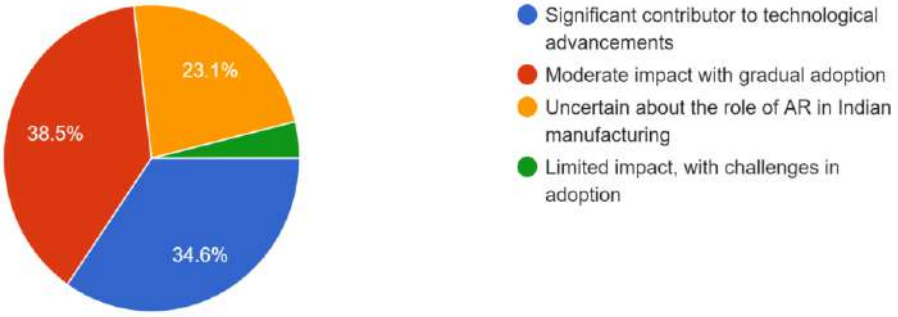

5.2. What are your expectations regarding future developments in Augmented Reality?

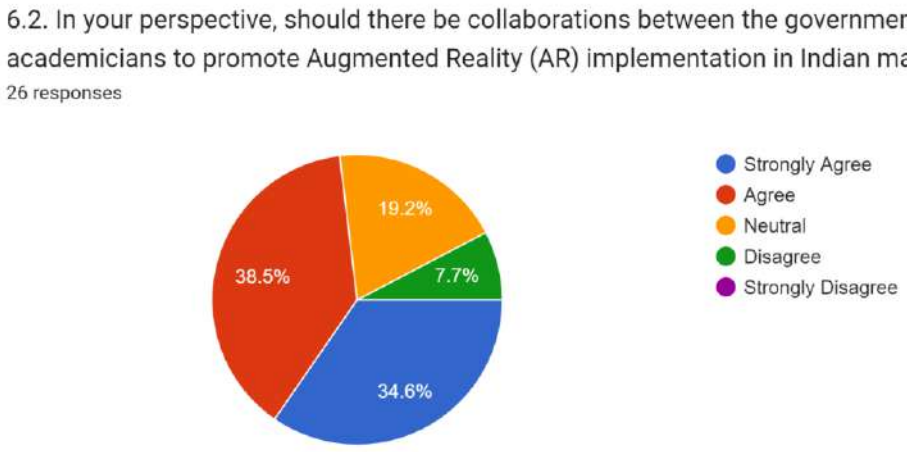
26 responses




Section 6: AR in India 6.1. How do you see the role of Augmented Reality (AR) evolving in the manufacturing landscape in India?

26 responses






**Wrapping AR in Manufacturing**

| Company | Function | How is AR used? |
|---|---|---|
| TATA | Supply Chain Management | TATA developed an end-to-end solution to enhance transparency in their supply chain. This solution integrates with their ERP and shop floor control systems, providing functionalities such as order management, kitting, electronic Kanban, and real-time updates through dashboards. Workers can access digital overlays of assembly instructions and technical drawings, improving efficiency by up to 30% and reducing assembly line time from 3 days to 4 hours. |
| BMW | Inventory Management | BMW equips workers at their Munich plant with AR glasses to accelerate the inventory identification process and reduce error rates. Workers can view digital overlays of assembly instructions, technical drawings, and videos from the last person who completed the procedure, enhancing efficiency and reducing errors by 22% and 33%, respectively. |
| ANDRITZ Ritz | Production | ANDRITZ Ritz utilizes Siemens Teamcenter to seamlessly transfer project information from planning to |

| | | |
|---|---|---|
| | | production. Operators are provided with detailed checklists via AR, which include information necessary to complete processes such as CAM parts, CAD models, images, videos, and required tools. This enables operators to reduce machine idle time, increase efficiency, improve product quality, and minimize manufacturing errors. |
| Martin-Baker | Effective Monitoring | Martin-Baker partners with DMG Mori to monitor machining operations in real-time using AR. The AR system detects tool wear and blockages, adjusts job sequences, and sends failure notices to the central production monitoring control room. This allows for quick identification and troubleshooting of critical machining areas, improving overall efficiency and productivity. |
| Porsche | Assembly | Porsche introduces an AGV-based assembly process for its Taycan model, enabling flexible production line concepts. AGVs transport vehicles between assembly stations, allowing for customization of vehicles with special interior features. This innovative approach saves 30-40% on capital expenditure compared to traditional assembly lines, increases efficiency, and reduces ramp-up times. |
| Ford | Quality Control | Ford utilizes JAI machine vision cameras to conduct quality control inspections during the painting process. The cameras capture high-definition images of painted surfaces, enabling the identification of defects and dirt particles smaller than a grain of salt. AR technology is then used to create 3D models of the painted surfaces, allowing for automated inspection and detection of defects. This process has resulted in a 50% improvement in car inspections and a 90% decrease in defect detection |

| | | |
|---|---|---|
| | | rates compared to manual inspections. |
| Samsung | Inspection | Samsung implements 3D vision scanning technology to automate inspections of LCD panels. The 3D scanners quickly identify defects and surface imperfections, reducing inspection time to less than 1 second per screen. AR-based automated inspections replace manual processes, increasing production line output, eliminating inspection bottlenecks, and enhancing customer satisfaction. |
| ThyssenKrupp | Maintenance | ThyssenKrupp improves elevator maintenance and repair services by connecting its 24,000 field service technicians through AR technology. Technicians receive prompt access to digital manuals, standard operating procedures (SOPs), and real-time support from experts. This connectivity enhances service capabilities, expedites repairs, and improves customer satisfaction by ensuring prompt and efficient elevator maintenance and repair services. |
| Lockheed Martin | Assembly | Lockheed Martin implements digital manuals and standard operating procedures (SOPs) for the assembly process of F-35 fighter jets. Technicians wear AR glasses that provide up-to-date instructions and detailed guidance on assembling complex components. This digital approach improves assembly speed by 30% and accuracy by 96%, as technicians can easily access and follow the most current instructions, reducing errors and rework. |

Top 9 Uses of Augmented Reality in Manufacturing [2023 Edition] - Plutomen. (2023).

## Challenges and Opportunities

Challenges Faced in Adoption

The challenges to the adoption of augmented reality (AR) in manufacturing can be multifaceted, with some of the most significant hurdles including:

1. Lack of Awareness and Understanding: One of the most significant issues indicated by survey results is a lack of awareness and comprehension of AR technology among manufacturers. Many decision-makers may be unaware of the potential advantages and applications of AR in enhancing manufacturing processes. Addressing this challenge requires educational initiatives and awareness campaigns to highlight the value proposition and practical uses of AR in manufacturing.

2. Cost of Implementation: Another significant barrier to AR adoption is the cost of implementation. Investing in augmented reality technology, software, and infrastructure can be costly up front, especially for MSME enterprises with limited funds. Additionally, there may be ongoing costs associated with maintenance, training, and support. Overcoming this challenge may require exploring cost-effective solutions, seeking funding opportunities, and demonstrating a clear return on investment (ROI) for AR implementations.

3. Technological Complexity: AR technology can be difficult, requiring specialized expertise to efficiently adopt and maintain. Manufacturers may lack the necessary technical skills and resources to integrate AR solutions into their existing workflows seamlessly. Additionally, interoperability issues between AR systems and other manufacturing technologies can further complicate implementation efforts. Simplifying the deployment process, providing user-friendly interfaces, and offering comprehensive support services can help address the technological complexity associated with AR adoption.

4. Integration with Existing Systems: Integrating AR solutions with existing manufacturing systems and processes can pose challenges, particularly in environments with legacy infrastructure or heterogeneous IT ecosystems. Compatibility difficulties, interoperability of data, and workflow integration complexities may occur when attempting to install AR with different technologies such as enterprise resource planning (ERP) systems, manufacturing execution systems (MES), and robotics. Overcoming these integration challenges requires careful planning, collaboration with IT teams, and possibly custom development efforts to ensure seamless interoperability and data exchange.

5. Change Management and Organizational Resistance: Implementing AR technology often involves significant changes to established workflows, roles, and organizational structures. Employees who are accustomed to traditional ways or are skeptical of new technologies

might be resistant to change, impeding adoption attempts. Effective change management strategies, stakeholder engagement, and clear communication are essential for overcoming resistance and fostering a culture of innovation and collaboration.

Addressing these challenges requires a concerted effort from manufacturers, technology providers, government agencies, and industry stakeholders to promote awareness, mitigate barriers, and create an enabling environment for AR adoption in manufacturing. By efficiently resolving these obstacles, manufacturers can realize AR technology's transformative promise for increasing productivity, efficiency, and competitiveness in the manufacturing industry.

Opportunities

With shifting market circumstances and technology breakthroughs, the future of manufacturing is a hybrid of digital and physical. The future of augmented reality in manufacturing is about more than just technology. It is also concerned with how it may be utilised to improve production efficiency and profitability. AR in manufacturing is a step towards more efficient business processes. It enables firms to make greater use of their existing resources by lowering operating costs and improving production capacity.

Augmented reality (AR) holds immense potential to revolutionize manufacturing by enhancing productivity, efficiency, and safety across various operations. By overlaying digital information onto the physical world, AR enables real-time visualization, guided instructions, and data-driven decision-making, leading to streamlined processes and improved outcomes. In manufacturing, AR facilitates tasks such as assembly, maintenance, training, and quality control by providing workers with contextual information, interactive guidance, and immersive experiences. With AR, workers can access crucial information hands-free, reducing errors, accelerating task completion, and enhancing overall operational efficiency. Additionally, AR enables remote assistance, collaboration, and training, allowing experts to support workers from anywhere in the world, thereby improving knowledge transfer and skill development. Furthermore, AR enhances safety by providing hazard warnings, safety instructions, and real-time situational awareness, reducing the risk of accidents and injuries. Overall, AR empowers manufacturers to optimize workflows, reduce costs, and drive innovation, positioning it as a transformative technology with the potential to reshape the future of manufacturing.

With recent advances in AR technology, it is expected to see an increasing number of application cases in the near future. As technology advances, it may be used in a variety of industries. AR technology is becoming increasingly affordable as well as simple to incorporate into manufacturing processes. AR technology may assist the manufacturing industry solve challenges by boosting process efficiency, lowering total costs, and increasing production rates. The future of augmented reality seems bright as the technology advances at a rapid rate.

**Results and Findings**

- AR technologies can significantly improve the efficiency of manufacturing processes by providing real-time access to contextual information. This will reduce both production time and expenses. Case studies and empirical data demonstrate a notable decrease in downtime and idle time as workers can access information hands-free, enabling them to perform tasks more swiftly and accurately
- The adoption of AR-enabled devices has the potential to result in a substantial increase in worker productivity due to the provision of on-the-spot guidance and instructions. Studies indicate that workers equipped with AR devices will be able to exhibit higher task accuracy rates compared to those relying on traditional methods, leading to a reduction in errors and rework.
- AR simulations and interactive training modules can be highly effective in facilitating the training of new employees. Compared to conventional training methods, AR-based training programs can significantly reduce the time required for onboarding, while also enhancing retention and comprehension levels among trainees.
- AR-based inventory tracking and management systems have the potential to streamline inventory management practices, leading to reduced stockouts and inventory holding costs. Real-time visibility into inventory levels and location data can enable the manufacturers to optimize their supply chain logistics, resulting in improved inventory turnover rates and minimized storage expenses.
- Despite the numerous benefits, the implementation of AR technologies in manufacturing has presented several challenges. Key challenges include initial costs associated with technology adoption, integration complexities with existing systems, and the need for specialized training to effectively utilize AR tools.
- Respondents emphasized that while AR technology is not yet mature enough for prolonged usage, it holds potential for enhancing manufacturing processes, particularly in

prototyping, training, and improving safety measures. Cost versus value remains a primary concern, especially in the Indian market. Collaborations between stakeholders and the development of tailored processes and products are seen as crucial for realizing the full potential of AR in manufacturing.

**Recommendations for Implementation**

1. Education and Awareness Programs: Develop and implement educational initiatives to increase awareness and understanding of AR technology among manufacturers, decision-makers, and workers. These programs can include workshops, seminars, and online resources to highlight the benefits, applications, and best practices of AR in manufacturing.

2. Subsidies and Incentives: Provide financial incentives, subsidies, or tax breaks to encourage manufacturers, especially small and medium-sized enterprises (SMEs), to invest in AR technology. Government funding programs can help offset the initial implementation costs and facilitate widespread adoption of AR solutions in manufacturing.

3. Research and Development Funding: Allocate funds for research and development (R&D) projects aimed at improving AR technology for manufacturing applications.

Government grants, university partnerships, and industry consortia can support collaborative R&D projects aimed at addressing technical challenges, improving AR capabilities, and developing innovative solutions tailored to manufacturing needs.

4. Skills Development and Training Programs: Invest in skills development and training programs to equip workers with the knowledge and expertise required to leverage AR technology effectively. Training initiatives should cover AR usage, maintenance, troubleshooting, and safety protocols, ensuring that workers are proficient in utilizing AR tools to enhance productivity and efficiency.

Collaborative Partnerships: Foster collaborative partnerships between manufacturers, technology providers, research institutions, and government agencies to accelerate AR adoption and implementation in the manufacturing sector. Collaborative initiatives can promote information sharing, technology transfer, and co-innovation, resulting in continual improvement and scalability for AR systems.

**Conclusion**

In the end, the utilization of augmented reality (AR) era inside production is basically reshaping manufacturing and delivering chain control operations. By leveraging AR tools and applications, manufacturers can optimize efficiency, enhance productivity, and improve the

quality of their products. From streamlining assembly tasks and providing real-time guidance to enabling remote support and reducing costly downtime, AR is proving to be a game-changer in the manufacturing industry. As the adoption of AR continues to grow, it promises to drive further innovation, transform traditional workflows, and unlock new opportunities for manufacturers to thrive in today's competitive landscape. By embracing AR, manufacturers can stay ahead of the curve, deliver superior products, and create value across their entire supply chain. Thus, incorporating augmented reality into manufacturing isn't just about enhancing processes; it's about redefining what's possible in production and supply chain management.

**References**


- www.valmet.com. (n.d.). Augmented Reality Re-defines Predictive Maintenance.
- Koelsch, J.R. (2021). How Augmented Reality Became a Serious Tool for Manufacturing.
- Mlynarek, W. (Klotz) (2023). What is Augmented Reality in the Manufacturing Industry?
- Aegis Software. (n.d.). Augmented Reality (AR) for Manufacturing.
- Tulip. (2023). Augmented Reality – The Impacts of AR for Manufacturers.
- Bhatt, T. (2023). Augmented Reality In Manufacturing: Benefits & Challenges.
- Events, Uk.M. & (2017). Augmented reality enhances VW development.
- www.axiscades.com. (n.d.). AXISCADES | The Advent of Radar Age in India.
- manufacturingtomorrow.com. (n.d.). How Automotive Manufacturers are Utilizing Augmented Reality | ManufacturingTomorrow.
- PixelPlex. (n.d.). 5 Ways to Use Augmented Reality in Manufacturing in 2023.
- Blippar (n.d.). Cisco AR Manual.
- Ravich, K. and ran (2019). *What are the applications of augmented reality (AR) in manufacturing? - PreScouter - Custom Intelligence from a Global Network of Experts*. [online] PreScouter.
- EDIIIE. (n.d.). Benefits of Augmented Reality in Business - A Detailed Guide.
- www.iboson.io. (n.d.). *Adoption of Augmented Reality in Industry 4.0 | iBoson*.
- Baron, J. (2020). *Top 6 Biggest challenges to implementing AR technology in 2021*.
- Ciampa, J. (2022). *6 Uses of Augmented Reality for Manufacturing In Every Industry*.
- www.getmaintainx.com. (n.d.). *Augmented Reality in Manufacturing – MaintainX*.
- SightCall. (n.d.). *Augmented Reality in Manufacturing with AR-Powered Visual…*.

- www.allerin.com. (2018). *4 ways the supply chain industry will use Augmented Reality*.
- Isaksen, O. (2020). *The use of augmented reality in supply chain management: what it means for you*.

# Role of "AR" in Business

Divya S | Sai Leela G R
B.Com (Honours)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*AR allows e-commerce customers to preview products or experience services in their own environment and on their own time before electing to make a purchase. It also provides a better brand experience and generates excitement among customers. Some of the major benefits of AR in business are improving employee training and collaboration, enhancing employee on boarding, enhancing the customer experience, streamlining product design, increasing safety, boosting sales, increasing brand awareness, and increasing customer engagement. The technology has influenced several business disciplines, giving them a novel appearance, like healthcare, military, education, real estate, and so on. In healthcare, augmented reality induces real-life medical situations to train medical students and provide insights that help them diagnose patients and perform successful surgeries. The effectiveness of augmented reality in the military is astonishing. It delivers real-world navigation assistance for them, despite the dead of night. It helps the soldiers prepare for the battle, dispose of bombs and other explosive elements, and enhance their skills at using different weapons without putting their lives at risk. Education is made easier by augmented reality, which lends a helping hand to the students in expanding their retention power by providing practical knowledge, which in turn boosts their overall performance. Real estate business entrepreneurs can reap various benefits using AR, which visualizes the properties in a more captivating and interactive manner by providing 2D image of the whole plot, which makes it easier for the customer to think and decide about the space, different types of interior designs, and even see how the furniture could be arranged. This saves time for both the buyers and the real estate agents. The contribution of AR and mobile apps in the manufacturing industry is a very important reason that has induced extraordinary growth in industries. AR role in business can be understood with the help of case studies: Nike Fit and Tap Painter. In the case of Nike Fit, it used augmented reality in its app. The gist of this app is that it analyses the measurements inputted by the user to identify their perfect shoe size, as 64% of consumers are prone to wearing the wrong size. AR helped Nike establish its dominance in the shoe e-commerce industry, and Tap Painter utilized AR to let its users paint*

*the rooms they desire in the app and identify the colour that suits them better. Gucci, L'Oreal, Sephora, Burberry, etc. incorporated AR to elevate their positions in the industry. The pointers given by these pros on instilling AR in business will guide us to reach our desired place in the business sector.*

***Keywords**: Augmented Reality, e-commerce customers*

## Introduction

An improved representation of the real world is known as 'Augmented Reality' (AR), and it is produced by utilizing digital data produced by computers. The widespread adoption of augmented reality technology is driving advancements in content creation tools, allowing individuals from diverse backgrounds to create captivating digital experiences without extensive technical knowledge or resources needed previously.

AR delivers real world experience via sound, visual and other sensory elements which are incorporated in every-day things like smart phones, glasses, and so on. The digital data inferred with the help of AR, makes the consumers explore new possibilities as it makes the information comprehensible which results in selecting the best alternative. Companies working in mobile computing and business applications, specifically, are seeing an increase in the use of augmented reality. In e-commerce industry AR allows customers to preview products or experience services in their own environment and on their own time before electing to make a purchase which will result in effective decision making. It also provides a better brand experience and generates excitement among customers.

Major Benefits of AR in Business

1. It enhances the training of the employees by offering them highly effective training solution by providing opportunities to practice by replicating complex work procedures which enables them to refine their technical skills. Corporate training goes further than just refining skills; it also encompasses taking a methodical approach to improve employee efficiency and productivity. The program prioritizes on developing a framework for growth, fostering successful communication and teamwork, and nurturing the leadership skills of employees within the organization. It also enhances the overall success and growth of the organization.

2. Designers can use AR to depict product and user experience concepts in the real world at actual size, which assists them to grasp the form, proportion, and environmental interactions in a better way. AR assists them in finding out the loopholes in their product and gives them a chance to rectify it immediately. This will allow them to guarantee that the products they are making are of the highest quality.
3. To improve workplace safety, the company may use augmented reality to give staff members a quick visual representation of possible dangers or risky situations. People who use AR glasses, for instance, may display virtual indicators or barriers over their surroundings, alerting them to any dangers they might face. Furthermore, augmented reality may be utilized for training purposes, allowing staff members to simulate risky scenarios and practice safety drills in a safe digital setting before actually going through them.
4. Customers acquire from augmented reality's capacity to educate and amuse them whil e also assisting them in selecting products. Augmented reality holds promise for driving market expansion and boosting online platform usage. Even more expensive, less wellknown and less popular products can profit from augm ented reality.
5. While augmented reality is a powerful tool for entertainment, its uses in brand marketi ng go far above than just pushing the digital images on online platforms. It offers a more comprehensive perspective of the real world and bridges the digital and traditional divide, opening up new path to connect with current and potential clients. Whether or if augmented reality is a useful tool for entertainment, is based on it's application in brand marketing which helps to go far beyond the promotion of digitally produced visuals.
6. In the realm of buying, augmented reality facilitates a new level of customer innovatio n. It is based on higher involvement from customers which results at more anticipated satisfaction in purchase decisions.

Due to its numerous benefits, AR technology has been adopted by many industries to make their business expand in a practical and successful way. Some of the business industries where AR technology is utilized are briefed below:

In Healthcare Industry

The medical industry is one of the most crucial industries because the lives of people depend on this industry. Implementing AR technology in this industry is indeed very beneficial for both parties, that is, the people learning this profession and for people needing medical care.

- Augmented diagnosis: In most of the cases patients overlook some of the minor symptoms or fail to describe them to doctors. Because of this, healthcare professionals are not able to diagnose and provide the right services to them. But, with the help of AR technology, the two parties can better understand improving the outcome by successfully diagnosing the symptoms.
- Enhanced surgery: In the past, obtaining sufficient information just a few days prior to a complex operation might have been rather difficult for surgeons and other medical personnel. However, with the introduction of augmented reality into the operation procedure, it has become too simple. Surgeons are now able to carefully examine and overlay the patient's anatomy over the body to do surgery with real-time access to life-saving patient information. By being able to see every bodily area, they can make sure that the procedure won't negatively impact any other organ. This ensures higher surgery success rate as well as shorter recovery time.
- Practice and Augmented Reality: Using augmented reality to improve training sessions also has business applications in the healthcare industry. Instead of just providing them with rote learning in a dissection lab, it exposes medical students to real-world medical scenarios and requires them to respond. This not only helps to test the knowledge and wits of the students, but also how they handle stress and other emotions while treating patients.

In Military

When looking ahead to the use of AR in the military field, the technology is helping the soldiers prepare for the battle, dispose of bombs and other explosive elements to enhance their skills at using different weapons, etc. without putting their lives at risk. It adds labels to the real-world scenario and provides better navigation services to them, even in the dead of night.

In Entertainment

Another growing industry is entertainment, thanks to the introduction of augmented reality. The technology has touched all the sub domains of the industry, be it music, live events, or movies, in numerous ways. For instance:

- In Music industry - AR role in Music Industry is immersive. AR-powered ear buds and other equipment add an augmented layer on the top of the real audio to enhance users' listening experience. And that too personalized according to the background noise and other filters.
- In Movies - AR in Movies When talking about the advantages of augmented reality for business in the field of TV shows and movies, the technology is helping the directors add unrealistic or non-existent elements into the movies, such as dinosaurs, enabling dancers with physical disabilities to perform effortlessly, along with showing different effects on the screen. It also allows users to see real-time subtitles while watching a television show.

Augmented Reality in Media In the media industry, augmented reality is also quite important. Thanks to technology, media professionals may now improve the impact of games, films, multimedia, and presentations. It is motivating people to distribute their information in a very participatory way and enjoy improved results.

In the Supply Chain or Manufacturing

One of the main factors contributing to the manufacturing sector's extraordinary growth is the use of augmented reality and Smartphone apps. As an illustration: Maintaining all of the production processes takes less time. In the fields of manufacturing and supply chain management, locating the necessary equipment or product is a common task for employees. This gradually causes the amount of time needed to do any work to rise. In this case, augmented reality aids in item position detection by providing virtual labels, allowing users to examine each element's 3D picture and access navigational data. Anything that eventually streamlines and shortens the procedure

Improved client satisfaction - Customers may trace their cargo in real time, from the warehouse to their doorstep, with AR-powered parcel service mobile applications. The

software also provides details about the goods, such its dimensions, weight, and cost. Customers have an improved experience as a result, increasing the likelihood of a favorable reaction.

In Real Estate

Text description of flats is not very enticing. Even with their amazing descriptions of the flats, many real estate brokers are still unable to establish a connection. They find it too tedious to go through every detail and try to picture the property as it truly appears. In this instance, augmented reality increases conversion by interacting more with the target audience.

Decision making - Users frequently wonder if the offered property is appropriate for the kinds of amenities they want in their house. And the main cause of this is because images only provide a 2D representation of the attribute. In this case, consumers may view and interact with a 3D representation of the property thanks to augmented reality. In other words, they may help them with the appearance of their home by moving things from one corner to another. Additionally, the technology makes it easier to measure the apartment's or land's measurements in real time. All of this helps people come to a conclusion faster and without sacrificing any aspect.

In Education

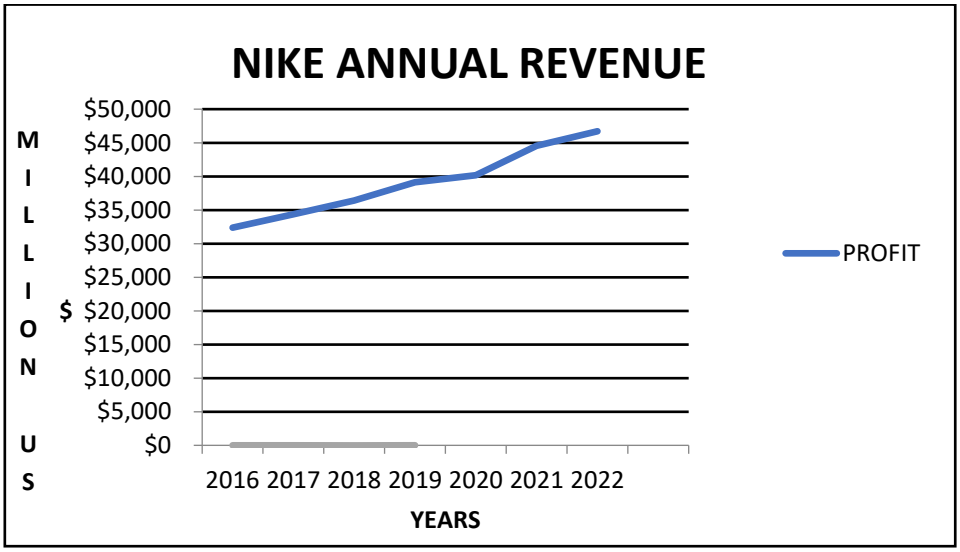
Technology has aided educators and students in resolving a variety of contemporary problems.

Both professors and students frequently fail to present the ideas in a more comprehensive way. They restrict their ability to visualize to the perspective that the books and references emphasize. As a result, individuals frequently find it difficult to understand the idea thoroughly and to ascertain its application in real life. With the use of augmented reality technology, they can see a three-dimensional image of the item and how the entire idea functions right in front of them. They may obtain a quick overview of the ideas through different perspectives, which spark their interest and prompts further questions and more application of the principles.

- Short-term memory capacity - Due to their low recall capacity, many students struggle to understand the study material, which is mostly offered in textual form. In this instance, augmented reality makes information available in a visual manner, allowing them to easily grasp the concept. This facilitates the information's processing and memory, which further contributes to excellent performance.
- Implementation of knowledge - Another benefit of AR in education is that it gives graduates and students a better approach to assess their theoretical knowledge and be ready for the workforce.
- Problems in the assessment of the performance of students - Not only can AR facilitate interactive learning for students, but it also makes teaching easier for educators. By exposing pupils to a virtual world and watching how they react to everything around them, it is empowering them. In this manner, assign grades based on pupils' performance rather than memorization of material.

Case Studies

AR role in business can be understood with the help of case studies: Nike Fit and Tap Painter. In the case of Nike Fit, it used augmented reality in its app. The gist of this app is that it analyses the measurements inputted by the user to identify their perfect shoe size, as 64% of consumers are prone to wearing the wrong size. AR helped Nike establish its dominance in the shoe e-commerce industry, and Tap Painter utilized AR to let its users paint the rooms they desire in the app and identify the colour that suits them better.




Nike boosted its direct-to-customer as well as its annual revenue after the introduction of 'Nike Fit', in the year 2019.

## Conclusion

To sum up, augmented reality has the power to completely transform digital marketing by giving consumers engaging, interactive experiences. Gucci, L'Oreal, Sephora, Burberry, etc. incorporated AR to elevate their positions in the industry. The pointers given by these pros on instilling AR in business will guide us to reach our desired place in the business sector.

## References

- Anna Hensel (2019), *Retail Revolution* Digiday, https://digiday.com/marketing/nike-boosting-direct-consumer-business-tech-acquisitions/
- Nike revenue 2010-2023, Macro trends, https://www.macrotrends.net/stocks/charts/NKE/nike/revenue#:~:text=NIKE%20revenue%20for%20the%20twelve,a%2019.08%25%20increase%20from%202020.

# Augmented Reality and Tourism - The New Travel Experience

Akkshaya P | Tanisha D Jain
B. Com (Accounting & Finance)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

This abstract explores the integration of Augmented Reality (AR) technology into the tourism industry, ushering in a new era of immersive and enhanced travel experiences. The technology is breaching innovative doors for the travel industry to improve their customer experience. This paper examines the impact of AR on various facets of tourism, including navigation, cultural exploration, and information dissemination. Generally, customers in the travel industry always plan their journey, stay, or food places to explore extensive research. The pursuit for data and information does not come to a standstill for a customer even after arriving at their targeted travel destination. Furthermore, all this information is explored in a range of mobile devices. With informative overlays and augmented attractions, this transformative technology seamlessly blends the physical and digital to offer new immersive experiences. Augmented reality in tourism doesn't only enhance customer satisfaction but enables next-level marketing and opens up new revenue streams fortravel businesses. This is precisely where Augmented Reality makes a difference.

By providing a snapshot of the evolving landscape where technology and tourism converge, this abstract sets the stage for a deeper exploration of the transformative power of AR in reshaping the tourism industry.

***Keywords:*** *Tourism, travel industry, augmented reality.*

## Introduction

The global tourism industry has undergone significant transformations in recent years, driven by technological advancements and changing consumer preferences. Augmented Reality (AR), a technology that superimposes digital information onto the physical world, has emerged as a key player in redefining the travel experience. As tourists increasingly seek immersive and personalized encounters with destinations, the incorporation of AR into the tourism sector offers unprecedented possibilities for engagement and exploration.

## Objectives of the Study

This research aims to comprehensively explore the role of augmented reality in the tourism industry, analysing its various applications and evaluating its impact on traveller experiences. By examining successful implementations, identifying challenges, and considering future prospects, this paper seeks to provide valuable insights into the current state of AR in tourism and its potential trajectory.

## Literature Review

### Evolution of Augmented Reality

Understanding the evolution of augmented reality is crucial to appreciating its current significance in tourism. From its conceptualization to the latest technological advancements, a historical overview sets the stage for assessing the present and anticipating future developments.

### Augmented Reality in Tourism

Existing literature provides a wealth of information on the applications and outcomes of AR in the tourism sector. Exploration of case studies, user experiences, and economic impacts contributes to a nuanced understanding of how AR is influencing and reshaping the traditional tourism landscape.

## Applications of Augmented Reality in Tourism

### Navigation and Wayfinding

Augmented reality proves to be a transformative tool in assisting tourists with navigation and wayfinding. The integration of AR navigation systems into mobile applications enhances the efficiency of travel, providing real-time directions, points of interest, and an enriched understanding of the surrounding environment. This not only reduces the stress associated with navigating unfamiliar territories but also encourages a more exploratory and confident approach to travel.

### Cultural and Historical Immersion

One of the significant contributions of AR to tourism is its ability to offer immersive cultural and historical experiences. Augmented reality applications designed for historical sites and museums provide visitors with interactive guides that overlay digital information onto the physical artefacts. This approach brings history to life, offering a dynamic and engaging

narrative that transcends traditional methods of information dissemination. Tourists can witness historical events, explore ancient civilizations, and gain a deeper appreciation for the cultural significance of their surroundings.

Information Enhancement

AR plays a crucial role in enhancing the informational aspect of tourism. AR-powered information guides offer real-time details about landmarks, attractions, and local points of interest. Moreover, language barriers are addressed through AR applications that provide instant translation, ensuring that tourists can interact with locals and understand the cultural context more effectively. These enhancements contribute to a more enriched and informed travel experience.

Interactive Experiences

The integration of AR introduces a new dimension of interactivity to tourism. AR-based interactive exhibits and installations transform ordinary spaces into engaging environments. Tourists can participate in gamified experiences, solving puzzles or uncovering hidden stories related to the destination. This gamification not only adds an element of fun to the travel experience but also fosters a deeper connection between the tourist and the location.

**Challenges in Implementing Augmented Reality in Tourism**

Technical Challenges

Despite the numerous benefits, the implementation of augmented reality in tourism is not without its challenges. Technical constraints, such as hardware limitations and connectivity issues, pose hurdles to the seamless integration of AR into the travel experience. Ensuring that AR applications are accessible to a broad range of devices and that they function reliably in diverse environments is a complex task that requires ongoing technological advancements.

Cultural and Ethical Considerations

The adoption of AR in tourism necessitates careful consideration of cultural and ethical implications. Privacy concerns arise with the use of AR, especially when it involves collecting and processing personal data for navigation or personalized recommendations. Striking a balance between providing a personalized experience and respecting individual privacy is crucial to the successful and ethical implementation of AR in the tourism sector.

## Future Prospects and Trends

### Advancements in AR Technology

The future of augmented reality in tourism holds promise as technological advancements continue to unfold. Anticipated breakthroughs in AR hardware, such as lightweight and more immersive devices, will likely address existing limitations. Additionally, improvements in AR software, including more sophisticated algorithms and enhanced object recognition, will contribute to a more seamless and integrated experience for tourists.

### Industry Collaboration and Partnerships

Collaboration between technology companies, tourism boards, and other stakeholders is crucial for the continued success of AR in the tourism industry. Joint efforts can lead to the development of standardized practices, ensuring compatibility and consistency across different destinations. Industry partnerships also foster innovation, allowing for the creation of more compelling and diverse AR applications tailored to specific cultural and geographic contexts.

### Customization and Personalization

As AR technology evolves, the focus on customization and personalization in tourism experiences is likely to intensify. Tailoring AR applications to individual preferences, interests, and travel styles will enhance user satisfaction and engagement. Machine learning algorithms and artificial intelligence can be leveraged to analyse user behaviour and provide personalized recommendations, creating a more personalized and memorable travel experience.

## Augmented Reality in Tamil Nadu: A Localized Perspective

### Cultural and Historical Significance

Tamil Nadu, with its rich cultural and historical heritage, presents a unique canvas for the application of augmented reality in tourism. This section will delve into how AR can be harnessed to enhance the experience of visiting iconic cultural landmarks such as the Meenakshi Amman Temple in Madurai, the Brihadeeswarar Temple in Thanjavur, and other historical sites. The integration of AR can provide visitors with immersive, digitally augmented narratives, bringing the history and cultural significance of these sites to life.

AR for Language and Cultural Understanding

Given the linguistic diversity in Tamil Nadu, the integration of AR for language translation and cultural understanding becomes paramount. AR applications can facilitate real-time translation of signage, historical information, and conversations, ensuring that tourists, regardless of their linguistic background, can engage meaningfully with the local culture. This subsection will explore the potential of AR to bridge language barriers and promote a more inclusive tourism experience.

Community Engagement through AR

AR can also be a catalyst for community engagement and sustainable tourism practices. This section will discuss how AR applications can be designed to showcase local craftsmanship, traditional art forms, and indigenous practices. By promoting responsible tourism through AR, travellers can gain a deeper appreciation for the local culture, contributing to the economic well-being of communities in Tamil Nadu.

AR Navigation for Tourists

Navigating the sprawling landscapes of Tamil Nadu, dotted with heritage sites, can be challenging for tourists. AR-powered navigation systems specific to the region can offer seamless guidance, ensuring that visitors can explore the state's diverse attractions with ease. This subsection will delve into how AR navigation applications can provide real-time directions, highlight points of interest, and contribute to a more enriching exploration of Tamil Nadu.

Future Prospects and Collaborations

As Tamil Nadu embraces the digital age, exploring future prospects for AR in tourism becomes essential. This section will discuss potential collaborations between local authorities, technology companies, and cultural institutions to foster the responsible integration of augmented reality. The emphasis will be on leveraging AR to showcase Tamil Nadu's unique cultural identity, drive tourism, and ensure sustainable development in the region.

**Summary of Findings**

The summary of findings presents a comprehensive synthesis of the research, accentuating key insights derived from the exploration of augmented reality (AR) in tourism. This section underscores the transformative impact of AR on various facets of the travel experience,

including navigation, cultural immersion, information enhancement, and interactive experiences. By providing a holistic overview, this conclusive reflection elucidates how AR is actively shaping and enhancing the modern travel landscape.

**Recommendations for Future Research**

Expanding on the research conducted, the recommendations for future research are presented to include more detailed insights into potential avenues of inquiry. This encompasses the proposal for long-term studies focusing on the behavioural effects of AR on tourists. Additionally, the call for assessments related to the environmental sustainability of AR implementations underscores the need for responsible technological integration in the tourism sector. Furthermore, this section advocates for deeper explorations into innovative modes of interactivity within augmented reality applications. The focus here is on guiding and inspiring future research endeavours at the dynamic intersection of augmented reality and tourism.

**Conclusion**

In summary, the integration of Augmented Reality (AR) technology into tourism is reshaping the industry by offering immersive experiences, enhancing customer satisfaction, and opening new revenue streams for businesses. AR seamlessly blends the physical and digital realms, providing informative overlays and attractions that enrich the traveler's journey. This transformative technology marks a significant milestone in the evolution of tourism, promising innovative marketing strategies and enhanced engagement for modern travellers.

**Reference**

- https://rockpaperreality.com/insights/ar-use-cases/augmented-reality-in-tourism-and-travel/
- https://r.search.yahoo.com/_ylt=Awrx_q5u0.NleYEt6zS7HAx.;_ylu=Y29sbwNzZzMEcG9zAzEEdnRpZAMEc2VjA3Ny/RV=2/RE=1709458415/RO=10/RU=https%3a%2f%2ftimesofindia.indiatimes.com%2feducation%2fonline-schooling%2fchennai-based-vr-and-ar-startup-brings-vr-labs-to-govt-schools%2farticleshow%2f94501867.cms/RK=2/RS=cw_3hjzWHFl4bRzBIS7vI0sXNps-
- https://www.forbes.com/sites/bernardmarr/2021/06/11/extended-reality-in-tourism-4-ways-vr-and-ar-can-enhance-the-travel-experience/?sh=6e33002c82ff

# Augmented Reality and Tourism – The New Travel Experience

Amritha T S | Swaroopa G V
B.Com (Honours)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*This paper explores the transformative impact of augmented reality on tourism. Augmented reality (AR) is a technology that overlays digital information onto the real world. The concept of tourism has evolved over thousands of years. AR has been revolutionizing tourism by enhancing navigation and providing real-time information on landmarks. Such case studies give an in-depth literature review on twelve enterprises in the fields of museum, restaurant, accommodation and transportation. The survey conducted also stands in line with the scholarly views. The final section provides suggestions to improve AR and tourism. Suggestions have been provided in this paper keeping in mind such diverse and competitive environment, thus making it necessary to improve various industries especially the tourism industry, in order to provide better services to the tourists. In conclusion, this paper asserts that augmented reality is redefining the travel experience by bridging the gap between the physical and digital worlds. As AR technology continues to evolve, its integration into the tourism sector promises to create more personalized, informative, and enjoyable journeys for travellers worldwide. The implications of this transformative shift extend beyond the individual tourist, influencing destination marketing, infrastructure development, and the overall evolution of the tourism industry.*

***Keywords:*** *Augmented Reality, the paradigm shift, the new travel experience, World Around Me, cultural immersion, destination marketing.*

## Introduction

Meaning of AR:

Computer-generated perceptual data is used in augmented reality, an interactive experience that improves the physical environment. Augmented reality projects digital content onto real-world settings and objects through the use of gear, software, and apps, such as AR glasses.In manufacturing and Industry 4.0 processes, this is especially useful as it enhances the user experience and transforms the immediate surroundings into an interactive learning environment. By utilizing human inventiveness, observation, and innovation, industrial users

may enhance and optimize technology and IoT networks, enabling them to become "one" with the equipment and systems they operate.

## AR and Tourism

The tourism industry is one of the most important sectors of the world economy. Like any industry, tourism is evolving in recent years thanks to technology. From the way we search for and prepare a trip, to the organization of accommodation, activities and transport. Every day, new technologies offer tourists a much more satisfactory and advantageous experience. It is exactly in this sense that augmented reality is beginning to acquire importance in the tourism sector, taking the experience to another level. However, during the pandemic, it was one of the sectors that suffered the most impact, but today it is once again recovering its growth and development.

As hardware is getting smaller and software is becoming more powerful the consequence is, user depending on technology and its involvement in daily activities. There are a growing number of real-world visualization tools using computer programs. The idea of combining the digital and the real world is exciting because it allows not only the visualization of the non-existent but also the integration of various information simultaneously. Mobile-based virtual experience for the tourism industry has been identified as a potential form to modify current consumer experience. This aspect of tourism is showing great potential in urban and cultural heritage tourism. Whereas museums have already started to preserve media, the approach of pushing information lacks the interactive aspect of tourists and technology. In order to gain a competitive advantage, the use of modern technology is crucial for many destination-marketing organizations.

## History and Development of AR and Tourism

Tourism has a long history that can be traced back to ancient Greece and Rome, where organized travel with supporting infrastructure, sightseeing, and an emphasis on essential destinations and experiences can be found. AR offers a unique opportunity to step back in time and experience historical sites as they once were, by overlaying virtual reconstructions onto existing ruins AR-powered city guides utilize the camera and GPS capabilities of smartphones to overlay digital information onto the real world, making it easier for travellers to navigate and access information about landmarks, streets, or monuments. Despite the fact that research exploring the role of Augmented Reality (AR) for sustainable tourism

development has been limited. AR has immense potential to transform our lives and revolutionize industries.

Example:

Museum and Historical Site Experiences (2018 Onward):

Museums and historical sites began incorporating AR to enhance visitor experiences. AR applications provided additional information, 3D reconstructions, and interactive elements, bringing exhibits to life.

**AR and the World**

Augmented reality (AR) indeed revolutionizes sightseeing and historical exploration by blending digital information with the physical environment. Here's how AR enriches these experiences:

Interactive Experiences: AR allows users to interact with virtual elements superimposed on the real world. For instance, users can view 3D reconstructions of ancient ruins, interact with virtual characters representing historical figures, or participate in simulated historical events.

Immersive Storytelling: AR technology enables the creation of immersive narratives that bring history to life. By integrating augmented reality elements into guided tours or educational experiences, users can engage with historical content in a more compelling and memorable way.

Time Travel Simulation: AR can simulate different time periods, allowing users to see how a location looked in the past. By overlaying historical images or reconstructions onto the current environment, users can experience a virtual time travel journey and gain insights into how cities and landscapes have evolved over time.

Personalized Exploration: AR applications can offer personalized experiences tailored to users' interests and preferences. Whether users are interested in art, architecture, or specific historical events, AR can customize content delivery to cater to individual preferences, providing a more personalized and engaging exploration experience.

**World Around Me App**

The World Around Me (WAM) app is a local discovery app that helps users find various services and places of interest using their phone's camera and augmented reality. It provides information about nearby restaurants, ATMs, pharmacies, shops, and other essential places. The app is available on both iOS and Android platforms, and it has won several awards, including the Google Play Awards 2016. Users can also upgrade to WAM Pro for additional

features such as sharing location in AR, more search results, and place reviews. The app is available in multiple languages and is used in over 200 countries. It is developed by WT InfoTech and is designed to provide a fast and fun way to explore the world around the user.

**Usage of AR in WAM**

The World Around Me (WAM) app uses augmented reality (AR) to help users find nearby places by allowing them to hold up their mobile devices and view digitally generated tiles through the device's camera. These tiles display information about various places of interest, such as restaurants, shops, and other services, in the direction the user is facing. The app also provides a radar widget that shows the location of places around the user, assisting them in turning to find the places. The information displayed on the tiles is updated in real time and is sourced directly from Google Places, providing users with the direction, distance, reviews, and tips for each location. Additionally, users can interact with the tiles to access further details, call the place, visit the website, or share the information with friends.

**AR the New Travel Experience**

Augmented reality (AR) technology can enhance the travel experience in several ways. AR overlays digital information onto the physical world, providing interactive and immersive exploration, enriching cultural understanding, improving navigation, personalizing experiences, and increasing engagement. Some of the ways AR can enhance the travel experience include:

Virtual Travel: AR allows travellers to explore new places without physically traveling there, leading to unique adventures and experiences.

Virtual Hotel Tours: AR and VR technologies enable virtual hotel tours, allowing individuals to take a virtual tour of hotels and accommodations before the actual visit, enhancing the travel experience by providing a glimpse of destinations and accommodations.

Immersive Navigation: AR-infused navigation, such as Google's Live View, helps travellers find their way in a new location, enhancing the navigation experience by overlaying digital information on the real world.

AR-Enhanced Shopping and Information Services: AR is used in airports to provide passengers with information about retail outlets and to offer an AR-enhanced shopping

experience, allowing travellers to virtually see and interact with products and receive real-time information and special offers.

AR technology also allows people with limited mobility or disabilities to experience and explore destinations that might otherwise be inaccessible, eliminating language barriers, and improving travel personalization. According to a Kantar and Snapchat travel report, 93% of consumers would use AR during at least one point of their travel journey in the future, indicating a strong inclination towards engaging with AR during travel.

The research shows that there are two methods. First, the type of the tourist attraction where the users' interest is predicted according to the user demographic contexts, which include age, gender, and education level, by using a machine learning method. Second, the correct data for the user are extracted from the big data by considering time, distance, popularity, and the neighborhood of the tourist places, by using the VIKOR and SWAR decision making methods.

These methods are built-in to the AR application software so that it provides a more user-friendly and gives a better customer satisfaction when it come in terms of tourism experience.

**The SWARA Method**

The Step Wise Weight Assessment Ratio Analysis (SWARA) method was one of the newest methods used in 2010 regarding the selection of a reasonable difference analysis method. This method is used to calculate the criteria weights in multicriteria decision-making problems. In this method, the experts first prioritize the criteria, and the most important criterion then takes the highest (top) priority. After that, the least important criterion receives the lowest rank.

**The VIKOR Method**

The Victor technique is used to optimize multicriteria problems in complex systems, and includes a multicriteria decision-making method for solving a discrete decision-making problem with disproportionate criteria, which involves different and conflicting units of measurement. The method was developed by Prokvik and Tzang. The main goal of the VIKOR technique is to be closer to the ideal answer of each index.

Augmented Reality (AR) technology creates a significant potential to address the participatory issues in a simple and enjoyable way by creating smart and user-friendly applications, because it is estimated that 80% of human emotions are perceived by the eyes. The development of technology and new methods, the spread of Web 2.0 technologies, and social networks show that the spatial information produced by the users is valuable information that cannot be ignored. In this regard, sharing information in a simple and enjoyable way by the users is highly important.

**Insights of this Concept with Real Life Scenarios**

The selection of the samples to be examined is based on sub-branches of the tourism sector such as; museums, accommodation companies, tourism destinations and transportation companies. Various examples have been studied for each tourism sub-sector.

Museums:

The Singapore National Museum is currently using an installation called "Forest Story". In the exhibition, 69 images from the William Farquhar Natural History Illustrations Collection have been transformed into three-dimensional animations that visitors can interact with. Visitors can use this application on their mobile devices or tablets. The application, known to be family-friendly, provides a learning experience. They can then add the captured items to their virtual collections.

Hotels:

In 2012, Holiday Inn launched the first AR application for the Olympic and Paralympic Games held in London. Through augmented reality, the hotel gave its patrons the chance to observe Olympic and Paralympic athletes in their rooms, lobby, and reception area. The application included BMX, windsurfing, table tennis and long jump athletes from the Olympics and Paralympics. Experiences were created by combining image recognition technology and chroma video. An excellent illustration of how hotels may employ augmented reality (AR) to give its visitors new experiences centered around major events taking place at their location is the Holiday Inn duffel bag.

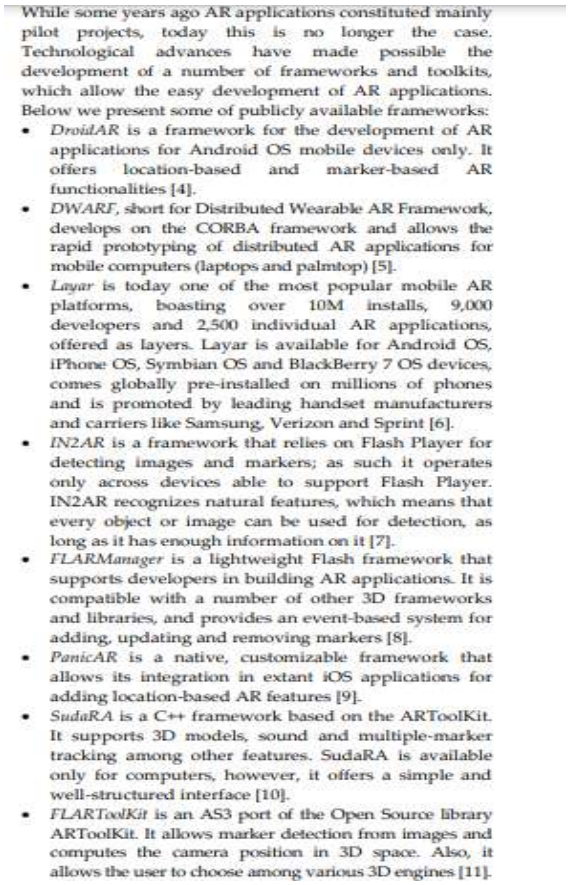
Travel:

TravelPlot Porto application which is a great way to explore the city's history is a tour guide that makes it easy to experience events, tourist destinations, wines and gastronomic areas. With 42 locations selected from 9 story sections within the application, visitors will

be able to make tours according to their interests. The places in the story can be visited in chronological order.

It is shown that all types of augmented reality applications are used according to the purpose of the enterprises in the field of tourism. In addition, augmented reality, which is used extensively in accommodation, transportation and destination marketing, is used as a great marketing tool especially in the promotion of the city, interaction with guests, promoting products, operating and promoting destinations.

**Case Study**



While some years ago AR applications constituted mainly pilot projects, today this is no longer the case. Technological advances have made possible the development of a number of frameworks and toolkits, which allow the easy development of AR applications. Below we present some of publicly available frameworks:

- *DroidAR* is a framework for the development of AR applications for Android OS mobile devices only. It offers location-based and marker-based AR functionalities [4].
- *DWARF*, short for Distributed Wearable AR Framework, develops on the CORBA framework and allows the rapid prototyping of distributed AR applications for mobile computers (laptops and palmtop) [5].
- *Layar* is today one of the most popular mobile AR platforms, boasting over 10M installs, 9,000 developers and 2,500 individual AR applications, offered as layers. Layar is available for Android OS, iPhone OS, Symbian OS and BlackBerry 7 OS devices, comes globally pre-installed on millions of phones and is promoted by leading handset manufacturers and carriers like Samsung, Verizon and Sprint [6].
- *IN2AR* is a framework that relies on Flash Player for detecting images and markers; as such it operates only across devices able to support Flash Player. IN2AR recognizes natural features, which means that every object or image can be used for detection, as long as it has enough information on it [7].
- *FLARManager* is a lightweight Flash framework that supports developers in building AR applications. It is compatible with a number of other 3D frameworks and libraries, and provides an event-based system for adding, updating and removing markers [8].
- *PanicAR* is a native, customizable framework that allows its integration in extant iOS applications for adding location-based AR features [9].
- *SudaRA* is a C++ framework based on the ARToolKit. It supports 3D models, sound and multiple-marker tracking among other features. SudaRA is available only for computers, however, it offers a simple and well-structured interface [10].
- *FLARToolKit* is an AS3 port of the Open Source library ARToolKit. It allows marker detection from images and computes the camera position in 3D space. Also, it allows the user to choose among various 3D engines [11].

**Understanding of this Case Study**

Chris D Kounavis discusses the use of augmented reality applications in the tourism context, not only addressing the technical aspects of mobile augmented reality application development, but also examining the state of the art of such developments and proposes an archetypal framework for the development of mobile AR applications. His research is limited exclusively to augmented reality mobile application development, but he argues that several examples shows that augmented reality “can aid tourist organizations and professionals

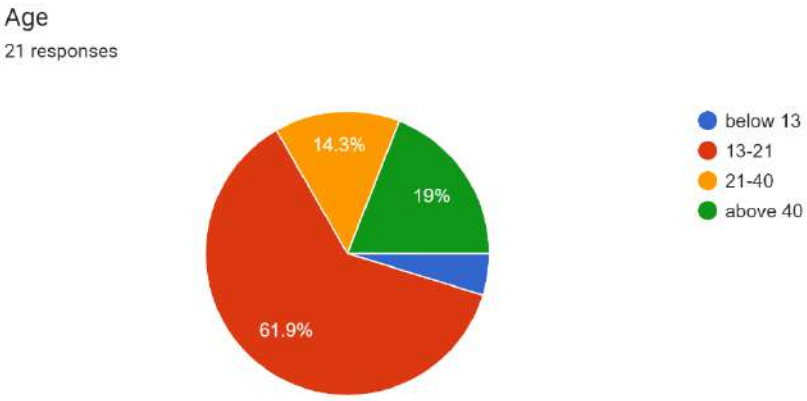
towards reaching a wider audience by serving as the delivery technology of appealing multimedia content and mobile applications, fine-tuned to various knowledge levels."

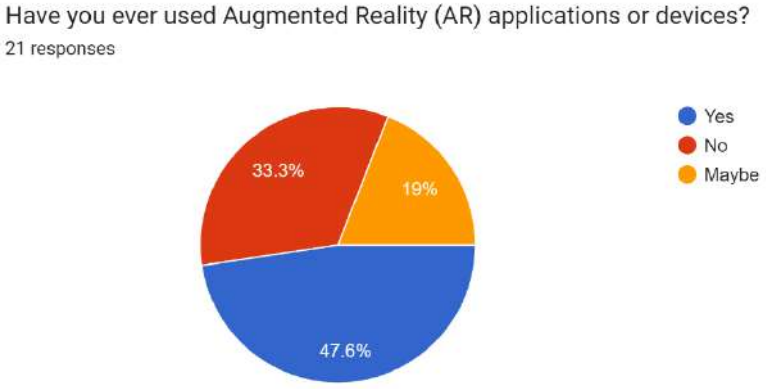
He also emphasizes the challenges that mobile AR applications face and lack of mobile hardware requirements (continuous WiFi , large enough RAM capacity and camera).

As a whole Kounavis has dealt in detail the various mobile AR applications that will help and continue to boost the tourist industry by providing the right mobile operating systems with which these applications work.

Survey

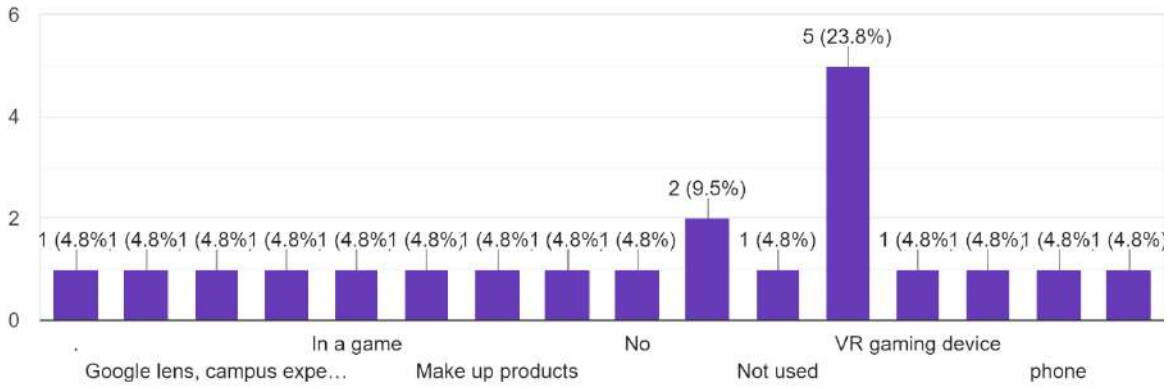
The survey conducted revealed the following information:



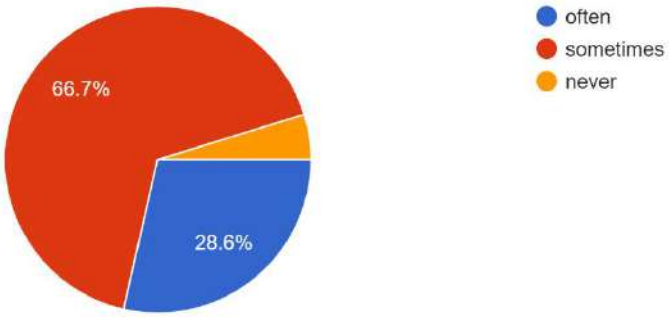
If yes, please specify the AR applications or devices you have used.

21 responses



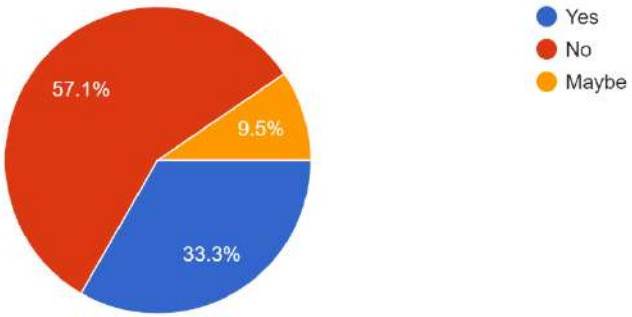

How frequently do you travel for leisure?

21 responses




Are you aware of Augmented Reality applications in the tourism industry?

21 responses



If yes, what was your experience with AR in the tourism context?

21 responses

None

Nil

Timelooper

I had not experienced AR in tourism

I personally, have experienced AR in various heritage spots and museums

I don't know

No

There's a centre for AR games attracts tourists

enlighten history of certain places

If yes, what was your experience with AR in the tourism context?

21 responses

nil

There were QR codes through which you could visually see certain animation

maps in malls

Yes

haven't experienced

college campus view

College campus experience, google map

Na

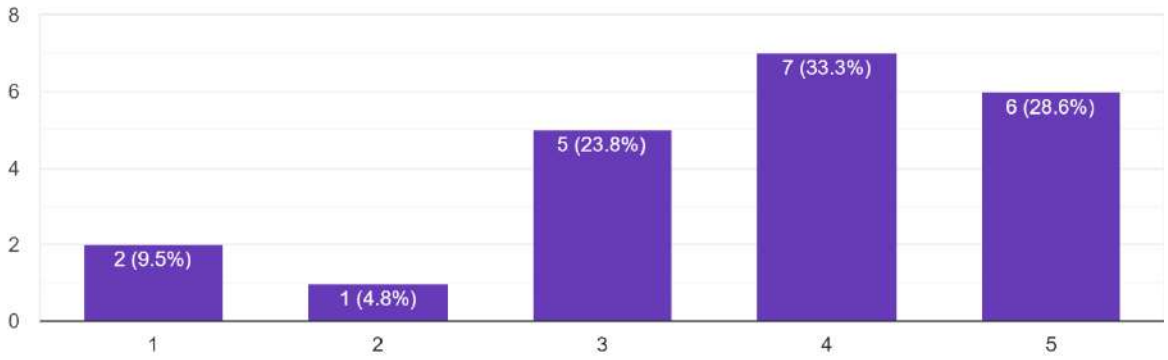
NA

Which AR experiences would you prefer?

21 responses

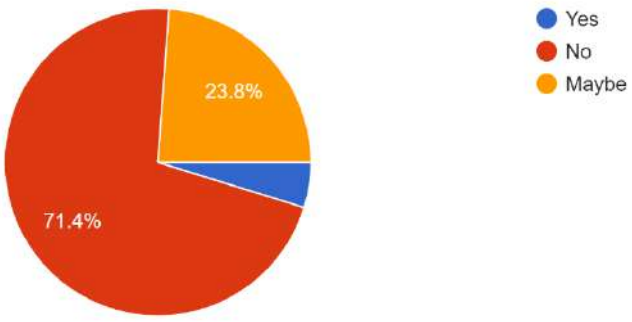

How comfortable are you with the idea of using AR for navigation in unfamiliar places?

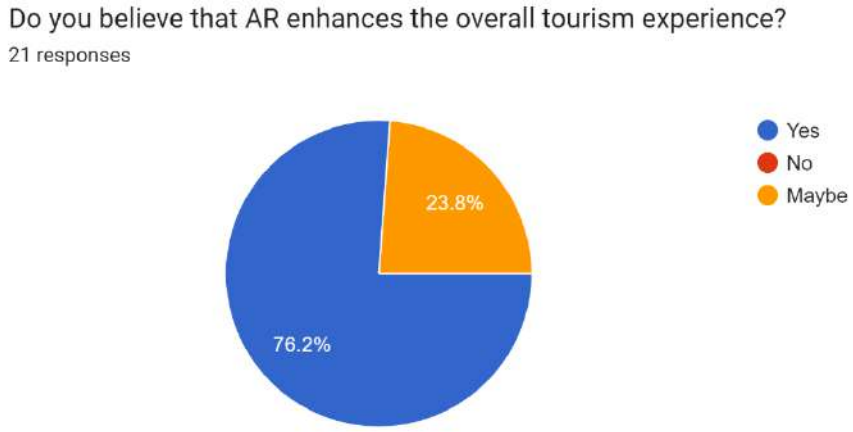
21 responses




Have you encountered any challenges or limitations when using AR for tourism?

21 responses






**Interpretation**

The analysis of this survey concludes that

- 50% of the respondents use AR and the most popularly used AR apps are google lens, maps and VR gaming. They would prefer navigational and historical information through AR apps.
- Only 40% of the respondents are aware of the AR apps in the tourism industry.
- People have experienced AR at heritage spots and museums as well as to gain college campus experience.
- Nearly 70% of the respondents have not experienced any challenges when using AR for tourism.
- Nearly 80% of the respondents believe that AR enhances the overall tourism experience.

**Suggestions to Improve AR and Tourism**

Throughout this research we have seen how AR is boosting the tourism industry but there underlies certain challenges and limitations that we have faced while using AR.

The basic challenges faced by the users are:

Privacy Concerns: AR applications often involve the use of cameras and sensors, raising privacy concerns among users. Striking a balance between providing personalized experiences and respecting user privacy is crucial for the successful adoption of AR in tourism.

Cultural Sensitivity: In diverse cultural environments, it's essential to ensure that AR content is culturally sensitive and does not offend or misrepresent local customs, traditions, or historical facts.

Environmental Considerations: Outdoor use of AR can be affected by environmental factors such as sunlight, weather conditions, or crowded spaces. Designing AR experiences that work well in various environmental conditions is a technical challenge.

Much deeper analysis has been done by the scholars, were they put AR and tourism relationship under the microscope to find several malignant challenges such as:

Mascho and Singh (2014) noted the VR limitations in Second Life; they highlighted the lack of knowledge of the platform and usability problems arising from users' technological skills. Studies on the limitations of AR are also scarce. Dueholm and Smed (2014) studied the heritage site dmos' resistance to adopting AR applications due to the possible effects on the authenticity perception of heritage sites or tourist attractions.

Others have studied users' acceptance of these technologies (tom Dieck & Jung, 2018) and their accessibility and usability (Leue et al., 2015; tom Dieck et al., 2016; tom Dieck et al., 2018). Yung and Khoo-Lattimore (2019), in a literature review of VR and AR in tourism studies, identified gaps in the use of AR applications.

Suggestions that could be provided for challenges faced:

The complex structure and the high cost of the application cause the enterprises to abstain even if they want to use it. However, augmented reality applications, which were experienced through wearable clothing in the past, have managed to take place into mobile devices and tablets. In addition, presenting the application as a game or an activity on virtual platforms within technological devices in order to reach the consumers faster will make an application that much larger audiences desire to experience. With the increase in the use of the masses, application cost is also expected to decrease.

Additionally, we could place AR enabled maps in pocket sized devices for users to carry in public spots such as airports, metro stations, etc. These devices would provide personalized recommendations based on user preferences, thus being customer-friendly.

Existing features could also be developed like;

Language Translation: Implement AR language translation features that can translate signs, menus, and other written information in real-time, making it easier for tourists to navigate in foreign countries.

AR-enhanced Museums: Collaborate with museums to create AR experiences that provide additional information, 3D models, or interactive exhibits when visitors point their devices at specific artifacts or exhibits.

**Conclusion**

On the basis of augmented reality, many applications have been developed and are still being developed. Augmented Reality (AR) technology creates a significant potential to address the participatory issues in a simple and enjoyable way by creating smart and user-friendly applications, because it is estimated that 80% of human emotions are perceived by the eyes. The virtual tourism market is set to grow at a compound annual growth rate (CAGR) of 30.2% to reach a valuation of $23.5 billion, demonstrating the immense potential of AR in the tourism industry. This study aims to examine the usage of augmented reality applications in the tourism industry, the benefits and losses that may arise at present and in the future in terms of business, destination and consumer.

Today, augmented reality applications, which offer enterprises a great competitive advantage in the tourism industry, are predicted to be used by many enterprises in the future. As a result, enterprises that want to gain a competitive advantage will try to make a difference with the dimensions developed within the application. It is thought that the use of augmented reality application at high levels will create great benefits for businesses in many aspects and create disadvantages in terms of employment.

As a result of the survey, although augmented reality applications make a great difference for the enterprises in the field of tourism, it is concluded that the usage rate is low. The application, which has not been fully understood yet by the sector managers, should be supported by studies in this field within the following years and with different perspectives on current cases. In addition, the stakeholders in the sector should be informed about the application in a detailed and instructive manner. In this sense, it is recommended that the academic circle and the sector should implement augmented reality applications in the field of tourism through common projects. If the use of application in the sector

increases within a frame of purpose, it is anticipated that the problem studied in this research will be solved with easier and more reliable results in the following years.

## References


- https://hrcak.srce.hr/file/272338
- https://www.researchgate.net/publication/338235413_Augmented_Reality_Applications_in_Tourism
- https://www.mdpi.com/2076-3417/11/13/6047
- https://www.researchgate.net/publication/339586341_Innovations_in_Tourism_Industry_Development_Using_Augmented_Reality_AR_Virtual_Reality_VR

# AR - Tourister's Comrade

Padma S | Lakshmi S

B.Com (Accounting & Finance)

M.O.P. Vaishnav College for Women (Autonomous**)**

***Abstract***

*Advances in technology are driving a revolutionary phase in the tourism industry. In this progression, augmented reality (AR) becomes increasingly important, providing immersive and engaging experiences that transform the way travellers interact with destinations. This study aims to examine the role of Augmented Reality (AR) in evolution of tourism industry from the view of tourists.*

*The study begins by providing an overview of what is augmented reality and examines the changes and developments it has undergone throughout the history. Then, its areas of use, types and sub-branches have been examined. It is believed that augmented reality, the newest technological advancement, will offer significant marketing ease and competitive advantages to the travel industry. In this article the view of tourists on application of AR in tourism sector is analyzed through a digital survey. Through a poll, people's opinions on augmented reality (AR) in tourism are examined by asking them about their experiences with AR and its potential in growth of the industry. From the analysis it is found that AR has room to expand in India and is predicted to reach a significant height in three to four years, which would have an effect on the travel and tourist industry.*

***Keywords -*** *Augmented reality- tourist- tourism- experience- service*

## Introduction

Augmented reality (AR) – advancement in technology is playing a vital role in fostering the growth of tourism sector. Augmented reality helps to enhance the experience of real-world information by combining it with digital information. In this way AR has enhanced tourist's experience in all the aspects of tourism which include museums, accommodation, food and beverages, tourism destinations and transportation. It plays an essential role in enabling travellers to plan their trip. The AR services like virtual tour enables to avoid regret on the part of traveller by customising every single aspect of tourism in advance. Basic examples for application of AR in tourism is Pokemon Go.

Augmented Reality (AR) is a technology that blends the physical world with computer-generated elements, enhancing the real-world environment through the integration of digital

information and virtual objects. Usually, gadgets like smart glasses, and augmented reality headsets are used to accomplish this integration. One of the most popular examples of AR are Google Lens and Google Map. AR technology finds applications in various industries, including gaming, education, healthcare, manufacturing, retail, and tourism. Each sector leverages AR to enhance user experiences, improve productivity, or provide valuable information.

From the introduction of an electronic display/spectacles that overlays data onto real life (in this case 'people') by L. Frank Baum till today's Google Lens, Google Map, ArtLens, Antarctic Heritage Trust AR ect Augmented reality has helped a great extent in growth of tourism sector. Let's pull out few existing examples to know about the application of AR in tourism.

**ArtLens 2.0**, one of the most important applications designed and developed by museums, is used in the Cleveland art museum. The purpose of the application is to present visitors' preferences and interests in 2D, using image recognition software and to provide great convenience to the visitors by means of the ability to discover new roads with the map feature, reach the desired place faster. **Tuscany AR** works as a tourism guide developed by Tuscany, especially for Tosda region. Wikipedia cooperates with many portals and guides tourists about accommodation, food & beverage, nightlife and nature trips with the information taken from sources.

The research article fails to include the specific areas where AR can still be implemented as such and also on the marketing aspects of such services. The latter is so evident from the fact that many people are not even aware of varied AR services that are available in the market to ease their planning. The purpose of this study is to investigate the awareness of tourists on the AR application available to facilitate them. To know the level of usage and preference of tourists in using such applications. The result of this study will enable us to understand about the growth of application of AR in tourism and the possible growth in future.

## Literature Review

**Emrah Ozakul and Sarp Tahsin Kumul's (2019)** article explores the history and usage of augmented reality in tourism, analyzing twelve case studies across transportation, accommodation, food & beverage, and museums. Despite its benefits, the usage rate is low, indicating the need for further research and diverse perspectives on current cases to fully understand and utilize this technology.

**Eleanor E. Cranmer, M.Claudia tom Dieck and Paraskevi Fountoulaki (2020)** explores the perceived value of augmented reality (AR) in the tourism industry, focusing on its marketing, information, and experience channels. Using a qualitative and exploratory approach, ten interview questions were developed according to previously reviewed literature to collect detailed insights from tourism stakeholders and managers. Questions were designed to allow respondents to express their opinions on the current situation and the influence of AR. The interviews within this study revealed five AR tourism-specific value dimensions including marketing, organisational, economic, tourist and epistemic.

**Dai-In Han, Timothy Jung, Alex Gibson (2014)** investigates the development of a mobile AR tourism application in urban heritage in Dublin. In-depth interviews with 26 tourists reveal that while Augmented Reality has passed the hype stage, it is just on the verge of meaningful implementation in the tourism industry. The study suggests that the application should serve a specific purpose for the user, with multi-language functionality, ease of use, and personalization capabilities being key requirements to attract tourists and encourage regular use.

**Ryan Yung and Catheryn Khoo-Lattimore (2019)** reveals that while there is growing interest in Virtual Reality (VR) and Augmented Reality (AR) in tourism, there is a lack of systematic knowledge on their intersection, methodologies used, and emerging contexts. The review aims to answer five main research questions: which tourism sectors and contexts have VR and AR research emerged in, which forms of VR and AR have garnered the most attention, what methodologies/theories are being utilized. Also, gaps were identified where challenges identified revolved around awareness of the technology, usability, and time commitment.

## Methodology

### Introduction

The research project that has been undertaken is a descriptive and analytical type of research study that is based on knowledge gained from both primary and secondary data. The research design consists of efforts made to present the study's findings in the most logical way possible. The purpose of the research is to know the tourist’s point of view on application of AR in tourism.

The questionnaire investigates many aspects influencing the use of AR services in varied aspects of tourism and how far these have reached people’s accessibility.

Sample Size

The actual responses for the questionnaire we received were 65.

Study Area and Study Period

The study was conducted limited to the regions Chennai only. The period of study was last week of January 2024

Data Collection

The research was conducted using data that was derived from both primary and secondary sources. The primary information was gathered using a carefully crafted questionnaire that was distributed to the selected sample. The secondary data came from research projects conducted by authors and literacy from all over the world using online sources.

Measure and Scale

Depending on the nature of the question the scales were made as given below.

● Likert scale - 5-point scale was used for this study, and it consisted of strongly disagree to strongly agree

● Multiple Choice question

Software Used

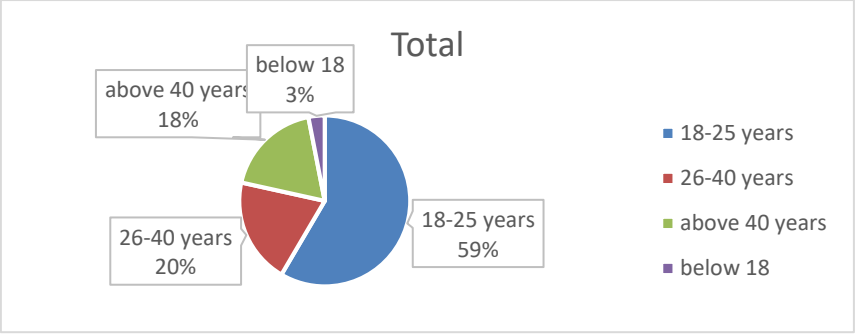
Microsoft excel was used to analyse data.

**Result**

The survey conducted aims to investigate traveller's perspective on AR applications being installed in tourism and how far they are being exploited.

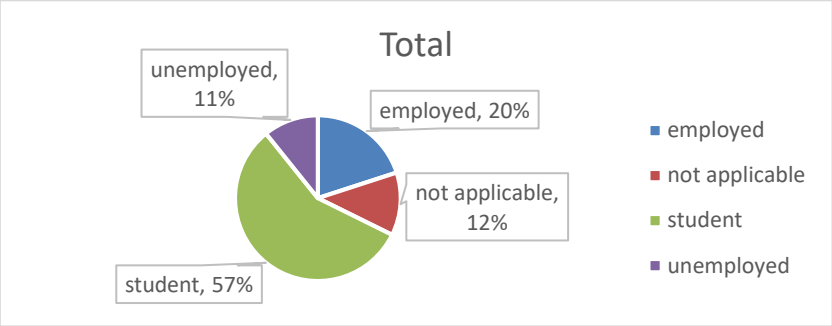
Demographic variables

Age:



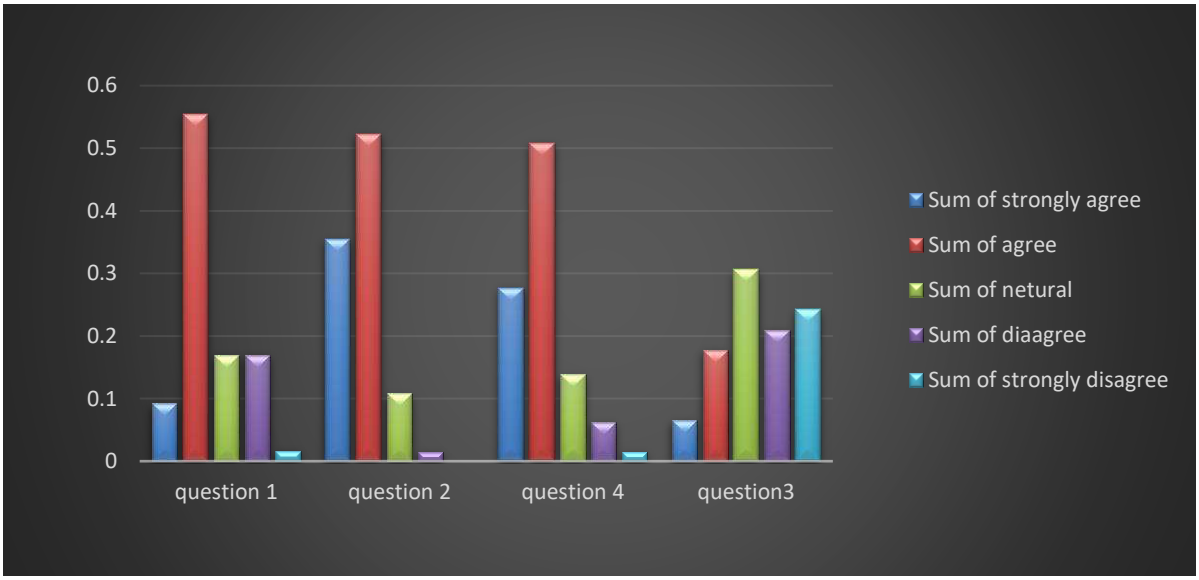

Interpretation: majority if the respondents are of the age category 18-25 years. among the rest 2 are below 18 ,12 is in the age group 26-40 years, and 13 are above 40. Thus, the research is more based on the view of teenagers.

Employment status:




Interpretation**:** more than half of the respondents are students. Among the rest 20% are employed, 11% are unemployed and 12% are not applicable.

Questions**:**




**Interpretation**

1) This is the first time I am getting to know about the applications of AR in tourism, where travellers can get to experience 360-degree view of their accommodation, food, monuments/museums and destinations in advance.

   55.4% of the total respondents have agreed with the fact that this is the first time they are getting to know about the uses of AR in tourism, while 16.9% have disagreed with the same. Though this is a small compared to the former this shows that the latter population is aware of this application. 16.9% have a neutral reaction. This shows that people have an overview that AR is being used in tourism.

2) AR tools like, Google Map and Google Lens enable in providing accurate and timely information.

   A very huge population of 52.3% of the respondents have agreed with the statement that AR applications like Google Maps and Google Lens have enabled them in providing timely and accurate information and agreed on it's easy accessibility. 35.4% have strongly agreed with the same. 30.6% have neutral reaction, while 24.2% strongly disagree.

3) Have you ever had experienced AR inventions like Artlens, Antarctic heritage trust AR, Dublin AR to plan your trip abroad.

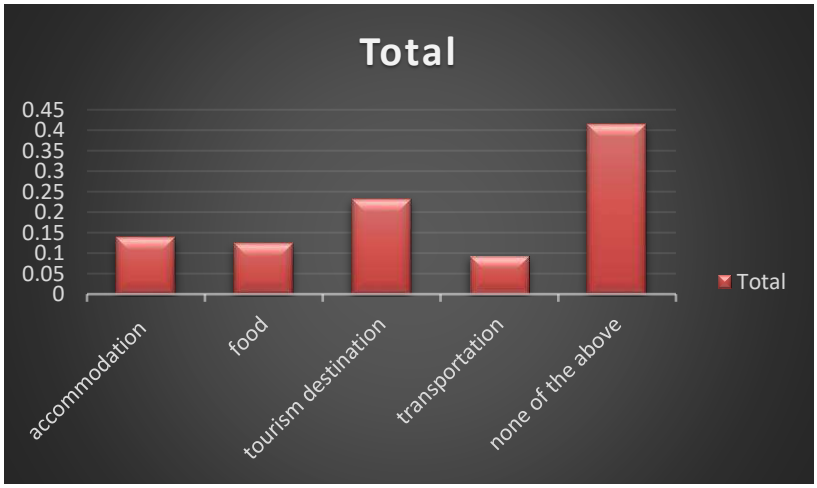
   21% of the respondents have not experienced advanced AR services like artlend, Antarctic heritage trust AR, Dublin AR etc. 24.2% have strongly disagreed expressing that they have not experience the same. The neutral population express the opinion that they are not aware of such services being provided in tourism sector. 30.6% have neutral reaction.

4) Virtual tour is a great platform to expand tourism and to avoid disappointment of travellers in terms of experience.

   50.8% of the people have agreed the fact that virtual tour is a great platform to expand tourism and to avoid disappointment of travellers in terms of experience. 27.7% of the respondents have strongly agreed with the same. This expands the scope of customisation in every aspect of their trip in advance. 13.8% has a neutral reaction.

5) I have experienced AR in these aspects of tourism.

   A major portion of the respondents (41.5%) have opted for none of the above. This means that a majority are still unaware and have not experienced the sophisticated AR services. This calls for an extensive marketing in these services.




**Discussion**

The conducted survey reveals the following findings:

1. The survey says that respondents have a general overview on what is Augmented reality and its application in tourism sector.

2. I also reveals that respondents accept the AR technology and use the products of the same which are accessible to them like Google Map, Google Lens etc.

3. It says that public have less awareness on advanced application like Artlens, Dublin AR, Antarctic Heritage Trust AR which provides realistic experience of 360-degree view of monuments, accommodations, destinations etc.

Relation of research with other researches:

- The research conducted reveals that although people are aware about what is Augmented Reality, the technology is not completely implemented in a meaningful way in tourism industry. A finding of the research by Dai- In Han, Timothy Jung, Alex Gibson on tourists' requirement for the development of a Mobile AR tourism application in urban heritage reveals the same.
- The research also says that advanced applications of AR are not used frequently due to lack of accessibility. In support to our findings study by Ryan Yung and Catheryn Khoo-Lattimore states that the usability and knowledge of technology were the main areas where gaps were detected.

## Conclusion

From our research work on Augmented reality in tourism from the view of tourists' we conclude that although public are aware about AR and its easily accessible applications, the full-fledged usage of advanced applications is low, and the technology is on the verge of being implemented in a meaningful way in the tourism industry. The results of this survey show that while respondents are generally aware of augmented reality and its applications, they are not as familiar with cutting-edge technology. They also acknowledge that virtual tourism is an excellent way to increase tourist numbers and prevent travellers from getting disappointed in terms of experience. The conducted research assisted us in identifying the gaps and techniques for promoting and gaining access to sophisticated applications. Social media and television advertisements may be used to raise awareness, and if the products are made accessible, this will encourage more people to utilise them. Because the respondents to this survey are all Chennai locals, it has a unique aspect that makes it useful for learning about visitors' understanding of

augmented reality in the travel industry in Chennai. Regardless of the facts, augmented reality applications will be used by all businesses hoping to gain market share in the upcoming years as well as by travellers looking to arrange the finest vacation possible.

## References

- https://www.researchgate.net/publication/338235413_Augmented_Reality_Applications_in_Tourism
- https://www.sciencedirect.com/science/article/abs/pii/S2211973620300398
- https://link.springer.com/chapter/10.1007/978-3-319-03973-2_37
- https://www.tandfonline.com/doi/abs/10.1080/13683500.2017.1417359

# Augmented Reality - The Biggest Technological Revolution - Boost of Augmented Reality in Agriculture - Smart Farming 4.0

Rumitha Kumaran E | Prathibaa K
B.Com (Honours)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*Augmented Reality (AR) is a transformative technology in agriculture. It provides real-time field visualization, enabling farmers to assess crop health and soil conditions instantly. AR facilitates precision agriculture techniques, leading to increased yields and sustainability. It also enhances training, equipment maintenance, and decision-making processes. AR holds immense promise for revolutionizing agriculture, offering farmers invaluable insights and tools to enhance productivity, sustainability, and profitability. As AR technology continues to advance, its applications in agriculture are poised to expand, driving further innovation and transformation in the industry.*

***Keyword****: Augmented Reality, Agriculture, Integration, Farming practices, Strategies.*

## Introduction

The agricultural sector is grappling with manpower shortages and lower income compared to other industries. However, leveraging AI/ML in agriculture can mitigate financial losses and boost crop yields significantly. Farmers often face substantial losses from pests, animal interference, and inaccurate crop choices. Disease identification with the naked eye is often unreliable, and consulting agricultural experts can be costly. Therefore, integrating technology into agriculture becomes crucial to address these challenges effectively. AI and ML technologies offer solutions to optimize crop management, minimize losses, and enhance productivity, making agriculture more sustainable and profitable for farmers.

Agriculture, crucial for global food supply, faces challenges due to population growth and modernization. Inconsistent income prompts many to leave the profession, impacting crop quality and quantity. Demand for food, especially cereals and meat, is projected to soar by 2050, exacerbating pressure on agriculture. With an estimated 9.1 billion people by 2050, food shortages loom large. Timely identification of plant diseases and pesticide application is vital, yet not all farmers can afford agricultural specialists or accurately detect diseases.

AI/ML technologies offer solutions, detecting diseases early and aiding in precise pesticide use, ensuring sustainable food production amidst growing challenges.

## Methodology

AR in Agriculture

AR is described as the technology of overlaying virtual objects onto the real world, offering additional information and assistance in performing real-world tasks.

Various application areas of AR are mentioned, ranging from entertainment to medicine, tourism, manufacturing, and agriculture.

Using remote sensing technologies-drones

Drones offer the advantage of imaging even in cloudy conditions and provide higher resolution imagery compared to satellite-based imaging. However, they require more effort in terms of operation and post-processing. A comprehensive approach to integrating various technologies, namely remote sensing through drones and augmented reality, to enhance agricultural practices, specifically soil mapping and sampling.

Real-world input should be captured automatically, and guidance information should be delivered seamlessly without user intervention. The application marks sample points in a management zone visually, allowing users to identify each location easily. The state of each sample point is tracked to differentiate between collected and uncollected samples.

Relevant operational information, like the number of samples collected, is provided without cluttering the user's view. The environment remains visible for safe navigation, with instructions presented in a clear and easy-to-perceive manner, possibly using colour cues for enhanced perception. To encourage adoption, the application is designed to resemble a game, making it more approachable and intuitive for users, despite AR technology being relatively novel in agricultural contexts.

With Reference to the Research Paper by “National Institute of Electronics and Information Technology (NIELT)” whose objective was to find whether AR can help in timely Identification of Plant Diseases and Provide feasible solutions to recover it.

Another Research paper “Soil Sampling with Drones and Augmented Reality in precision Agriculture” by Janna Huuskonen and Tino Oksanen presents a prototype Augmented Reality System developed for farmers. The combination of drones and AR has the potential to

revolutionize soil sampling in precision agriculture, allowing for more precise and targeted sampling, leading to improved decision- making and resource management.

Monitoring farms visually

Internet of Things, commonly known as IoT, can be described as the interconnection of smart devices at a remote place. Typically, this remote place can be termed as Cloud. A Cloud is like server that contains many computers at a single place. This cloud is can be used for processing of data that requires high power or it can be used as repeaters, as in communication field.

The use of Cloud with other technologies like Cognitive computing that includes Artificial Intelligence (AI) and Machine Learning (ML) can enhance the processing of data with more accuracy.

Augmented Reality (AR) revolutionizes this by providing a single dashboard view of the entire farm. Instead of checking inch by inch, farmers can visualize the land and detect pests instantly helping farmers accurately plant seeds, apply fertilizers, or spray pesticides. This ensures optimal distribution and reduces the risk of overuse or underuse of resources. Moreover, AR can help farmers monitor environmental conditions such as soil moisture, temperature, and humidity, allowing them to make informed decisions about irrigation and other farming practices.

An AR app, leveraging satellite data for constant monitoring, employs AI and deep learning to pinpoint areas needing attention. This technology streamlines land examination, enhancing efficiency and precision in agriculture. Using AR-enabled devices such as smart glasses or smartphones, farmers can overlay information about crop health, growth patterns, and nutrient deficiencies onto the physical field. This allows them to identify and address issues more quickly and accurately, leading to better crop yield and quality.

Referring to the study “Scope of Augmented Reality in Agriculture” by Devaharsha M, whose objective was using AR in Agriculture to find the suitable samplings and identification of Rodents. The methodology used includes micro controller / microprocessor, various sensors that communicates over internet like WiFi, LiFi, etc. These devices can work without much human intervention and with less human errors

*1) DHT 11:* DHT 11 is a digital temperature and humidity sensor. Due to its less power consumption and small size makes it ideal for use

*2) NPK:* NPK sensors measures the content of Nitrogen, Phosphorus and Potassium in the soil. The NPK content in the soil can affect the growth of crops in projects

*pH Sensor:* The pH sensor used, is based on traditional pH meter, including, acid-base titration, monitoring pH in an aquarium.

Using AR along with IOT is also substantiated by the research paper "Augmented Reality in the Integrative Internet of Things (AR-IoT): Application for Precision Farming" by Pilaiwan Phupattansilp and Sheau-Ru Tong. Stated the objective The use of augmented reality (AR) as a support to IoT data visualization, called AR-IoT. The AR-IoT system superimposes IoT data directly onto real-world objects and enhances object interaction.
As a case study, this system is applied to crop monitoring. Multi-camera, a non-destructive and low-cost imaging platform of the IoT, is connected to the internet and integrated into the system to measure the three-dimensional (3D) coordinates of objects. The relationships among accuracy, object coordinates, augmented information (e.g., virtual objects), and object interaction are investigated. The proposed system shows a great potential to integrate IoT data with AR resolution, which will effectively contribute to updating precision agricultural techniques in an environmentally sustainable manner.

This Paper Proposes a framework to integrate IoT data into an AR-based environment, called AR-IoT. Integrating IoT into an AR-based environment allows both the superimposing of IoT information onto physical objects and the facilitating of the interpretation of such information.

AR in Livestock Management

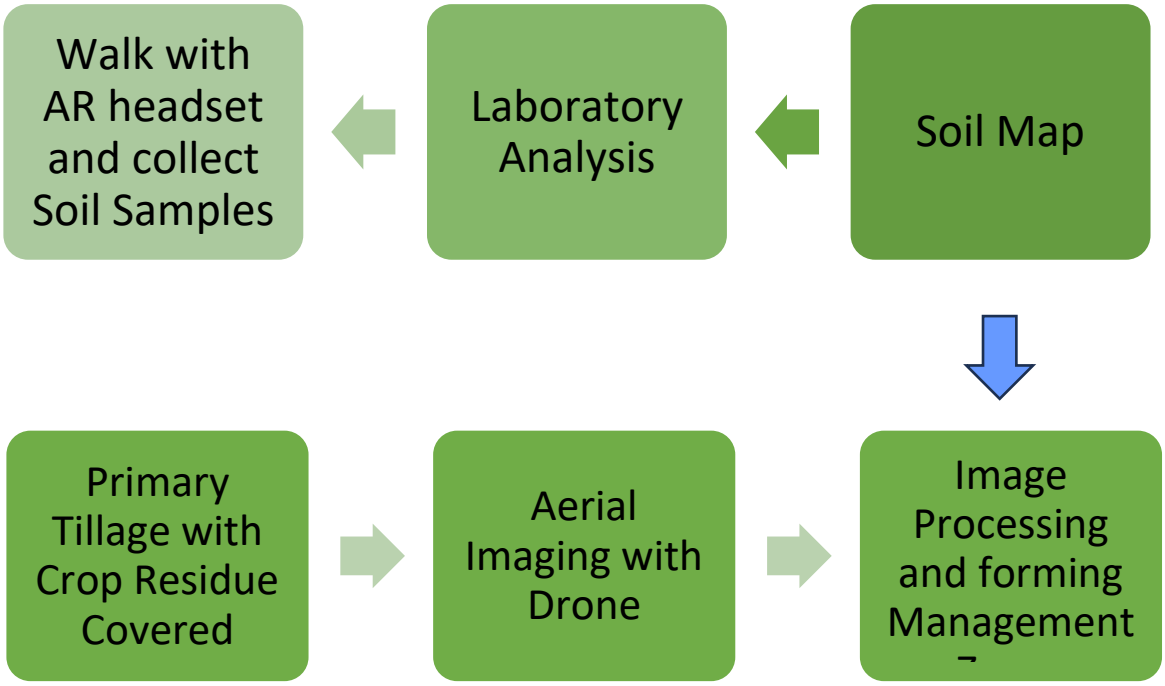
Livestock management is yet another area where AR can be applied in agriculture. AR can help farmers monitor and manage livestock more effectively. By using AR, farmers can access real-time information about individual animals, such as health status, weight, or feeding schedules. This information can be displayed as virtual overlays on the animals themselves, making it easy for farmers to track the health and performance of each animal. Timely interventions can be made if any issues are detected, leading to improved livestock health and productivity.

Training new farmers

Augmented Reality (AR) offers a valuable tool for training new farmers in agricultural equipment operation and safety. By leveraging historical accident data, AR enables juniors to learn from past mistakes and avoid potential hazards. Visual learning through AR simplifies understanding complex tools, while remote collaboration allows for expert guidance from seasoned farmers. Tips from experts tailored to specific land conditions help optimize yield.

For example, an AR app grants farmers insights into their farms' operations via smartphones or tablets, fostering learning and improving efficiency in agriculture. Equipment maintenance and repair is another area where AR can be of great help in agriculture. Agricultural machinery requires regular maintenance and occasional repair. AR can assist technicians in these tasks by

providing them with virtual manuals, step-by-step instructions, or even connecting them with experts remotely. Technicians wearing AR-enabled devices can access relevant information and guidance in real-time, reducing downtime and improving efficiency. This can be particularly beneficial in remote areas where access to expert technicians



is limited. This is an innovative approach to leverage advanced technologies for improving agricultural practices, with a focus on precision farming and soil management. By integrating remote sensing with AR, farmers can potentially enhance efficiency, accuracy, and compliance with regulatory standards in soil sampling and management.

## Conclusion

In conclusion, AR has the potential to revolutionize agriculture by providing farmers and agricultural workers with real-time data, guidance, and immersive experiences. The applications of AR in agriculture are diverse and can bring significant benefits to the industry. From crop monitoring and precision agriculture to training and education, equipment maintenance and repair, and livestock management, using AR enabled devices such as Smart Phones and Smart glasses, AR can enhance productivity, efficiency, and decision-making in agriculture. As the technology continues to evolve, we can expect to see more innovative uses of AR in agriculture, ultimately leading to sustainable and efficient farming practices.

## References

- "Scope of Augmented Reality in Agriculture" by Devaharsha M
- "Augmented Reality in the Integrative Internet of Things (AR-IoT): Application for Precision Farming" by Pilaiwan Phupattansilp and Sheau-Ru Tong.
- Research Paper by "National Institute of Electronics and Information Technology (NIELT)"
- "Soil Sampling with Drones and Augmented Reality in precision
- Agriculture" by Janna Huuskonen and Tino Oksanen

# Augmented Reality in Learning Revolutionizing Education through Immersive Experiences

U. Adithya Kumaralingam | S. Sachin Krishna

SRM institute of Science and Technology | Sri Venkateshwara College of Engineering

***Abstract***

*Augmented Reality (AR) has revolutionized the concept of education by creating an environment whereby learning becomes more interactive and immersive. With AR, learners dictate the world around them by interacting with the digital content that is added on top of the physical one, mostly facilitating deeper learning, critical, and creative thinking. This transformation makes students have the physical aspects of building knowledge by exploring and experimenting, which totally changes the traditional way of learning. The advancement of AR hardware and software has considerably brought immersive learning systems closer to the learners in each educational setting. In addition, AR authoring tools and content creation platforms help teachers author their own AR aimed at satisfying their interests of curriculum goals and demand of students. The scope of AR in education does not stop when the four walls of the classroom are over but is broad ranging from virtual field trips to remote collaboration to real-life problem solving. It reaches beyond the physical boundaries allowing students to visit the monuments of the world, work in virtual environment and apply the theoretical concepts on tackling practical issues in a real-life setting. The prospect for the future for the learners and the teachers is bright as augmented reality learning signals good tidings in the long run. As technologies of AR progresses actively, it makes more attainable adaptive learning experiences, augmented assessments, and the smooth integration of AR into architectures of education. It is AR convergence with AI and other mixed reality languages of contemporary technologies that provide more avenues for immersion and interactivity in learning experiences. In brief, augmented reality in education is a paradigm shift in raising knowledge–how it is acquired, interpreted, and processed. Elementary to AR usage as a stimulus, teachers and learners would begin a journey toward a more interactive, individualized, and resultative learning system.*

***Keywords:*** *Education, learning, teaching, augmented reality.*

## Introduction

Augmented reality (AR) technology overlays digital information such as images, videos or three-dimensional models in the real-world viewing environment. This is often accomplished via the aid of a tool like smartphone, tablet or AR glasses that superimposes digital content atop from what user sees in physical world. The AR technology enables users to interact with and manipulate the digital content in real time making sharp reality thus offering an immersive interactive virtualscape. AR is used in different fields ranging from gaming to education, healthcare and retail among others.AR has moved the teaching and learning world into a transformational age of education that had early replaced the age-old ways of teaching and learning. AR designs an atmosphere of interactive and immersive learning whereby the learner becomes the catalyst of his or her education. The general subject of this essay is the challenge of AR in education covering pedagogical, technological and futuristic aspects with the significant perspective in fostering learning.

## Pedagogical Impact

AR redefines the field of education by allowing students to engage with digital material superimposed on reality. This engages in deepened learning, critical thinking, and creativity. This change from passive modus of understanding to an active one makes it possible for the students to learn by trial and error, which in turn means that this system charges them with an almost physical way of creating knowledge. This pedagogical change infringes upon the innate perceptions of education and promotes an ever-evolving mode of education.

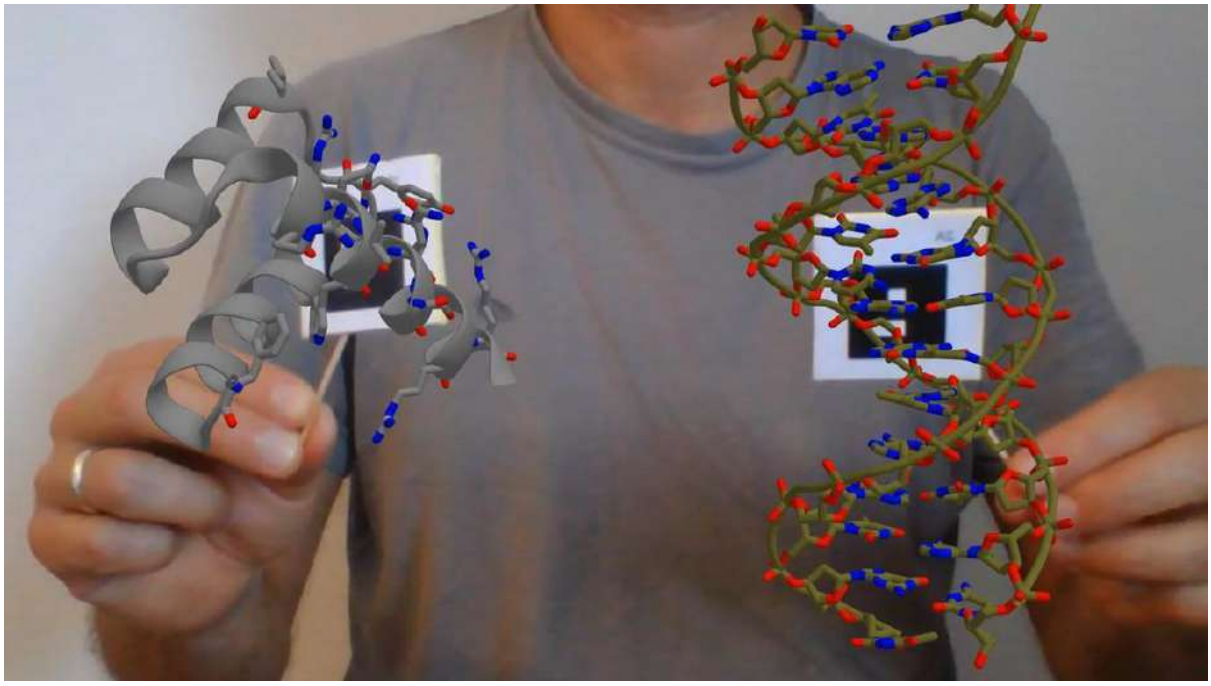
## Immersive Learning Systems

Improvements in AR technology, both in the hardware and software designs, will place immersive learning systems near the learners in different educational environments. AR authoring tools and content creation platforms afford teachers the ability to construct AR projects targeted on curriculum objectives and student requirements.

This malleability increases adaptability of AR to different educational settings making it part of the toolbox for educators. The immersive capabilities of AR transcend the physical boundaries of the classroom, providing virtual field trips, remote collaboration and real-life scenarios.

The University of Rhode Island in the United States of America uses augmented reality to teach biomedical sciences to their students. the students use virtual reality headsets to embark on a ride into their veins on the red blood cell having a view of the light show of millions of neurons firing simultaneously.

One type of classroom that has the HTC Vive is where there is a thorough, 3-dimensional tour pictorially of a cell to learn how the body fights off viruses. Along with that students use AR to learn to perform surgeries and treat wounds.



**Beyond Physical Boundaries**

The width of the possibilities AR opens in education goes beyond the classical limitations, giving students an ability to enjoy virtual visits to world's monuments, implement collaborative virtual environments, and apply theoretical aspects to the real practical problems through the lenses of the actual reality. Seeable through AR, virtual field trips enable displacement of students to urban centres with heritage sites or natural phenomena, making this process accessible without moving far from an instructor. This expands the width of disciplines that encourage a comprehensive comprehension of academic subjects, global attitudes of students.

In 2018, Ritsumeikan university in Japan developed an app that recreates 8$^{th}$ century Kyoto. This app was launched in google play and is free to download. This app works with the help of Kyoto's GPS information and generates the augmented reality. For example, the app is

opened on a smartphone and held up within the grounds of the original location of the Emperor's Heian Palace (an area that runs 1.4 km north-south and 1.2 km east-west – situated approximately 2.5 km north of Kyoto Station), the structures that once existed inside the palace are displayed and can be experienced in AR.

**AR and AI Integration**

The merger of AR and AI represents an important achievement in Edu- tech. Such convergence improves the intelligence of AR applications making learning experiences adaptive and suited to different learner needs. By leveraging AR interactions and the associated collected student performance data, AI algorithms can personalize content delivery regarding learning shortcomings. This thoughtful joint constitutes the learning path being more dynamic and customized for any child.

Augmented reality produces lot of data and AI specializes in identifying and classifying this data. For example, every single student has different learning technique and learning pace. AI identifies the technique and pace of a particular student and modifies the teaching method which is suitable for him/her.

**Adaptive Learning Experiences**

The further development of AR technology towards adaptive learning experiences is one of the main future functions of AR that will influence education. As ARs are improving with time, the systems will directly respond based on the learner's success and challenges. The adaptability guarantees that the information education is current and appropriate, is well-

matched with different learning rates and styles. This dynamic approach stimulates a more adequate and responsive, learner's environment.

**Augmented Assessments**

AR changes more than the learning process; it also replaces assessments. The traditional formulas of evaluation are not that complete in sensing the overall prospective of the student. Digital evaluations use AR to conduct more comprehensive assessments rather than measuring knowledge retention only; they can also measure critical thinking, problem-solving, and the application of theory to the real world. This paradigm shift in assessments supports modern education holistic constructs. For example, let's say a person is learning a new language. For assessing his/her communication skills we can use augmented reality and enact scenarios of that person ordering food in a restaurant or navigating in a city in the language he or she learnt.

**Smooth Integration into Educational Architectures**

The seamless incorporation of AR into the educational architectures is paramount in retaining the lasting effect of AR. With their further development, AR technologies will be introduced into curricula of educational institutions and implemented with ease. This integration needs the cooperation of educators, technologists, and policymakers to guarantee the inclusion of the AR into the educational landscape. Policy makers need to implement policy on infrastructures, training, and availability to all for the widespread use. IIT Madras is currently working on AR/VR enhanced learning models for rural schools. IIT Madras researchers are creating digital teaching-learning models for secondary school subjects. The innovation culture at IIT Madras, coupled with access to latest technology makes it a ground for development of AR/ VR.

**Future Prospects**

The prospects of AR in educational settings look promising for both students as well as teachers. The continued developments in AR technologies prove adaptive learning experiences, augmented assessments, and automatic inclusion into the educational frameworks more accessible. The merging between AR with Artificial Intelligence (AI) and other languages of mixed reality uncovers new roads for immersion and participation about the available learning happenings. This synergy makes the process of learning personalized, putting into consideration characteristics and preferences of students.

## Conclusion

As of a conclusion, AR in education serves a novel paradigm of knowledge processing, acquisition, and interpretation. Fundamentally, AR acts as an incentive for a process on a path towards a more dynamic, personalized, and goal-oriented system for acquisition of knowledge. The pedagogical transformation, immersive learning experiences, and possibilities unravelled by AR for the future also bear evidence to the importance of AR in the field of educating students. The way I see it, as we embark on the journey promised by AR technologies in the field of education, we open the doors to a completely new world of learning.

## References

- https//elearningindustry.com/augmented-reality-in-education-staggering-insight-into-future
- https//web.uri.edu/riinbre/mic/mic-services-and-resources/mic-vr/
- https//en.ritsumei.ac.jp/news/detail/?id=289
- https//link.springer.com/chapter/10.1007/978-3-319-07458-0_22
- https//www.deccanherald.com/india/vr-based-edu-model-for-rural-students-1209079.html
- https//www.forbes.com/sites/forbesbusinesscouncil/2023/06/21/revolutionizing-reality-the-current-uses-and-future-of-ar/

# Navigating Pedagogical Frontiers: AR, Gamification and Teacher Perspectives

Pon Nithila T | Shriya Rajesh
B.Com (Honours)
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*In the ever-evolving landscape of education, our research paper seeks to address a gap unearthed through a meticulous literature review. The research landscape, has often been from the student's perspective as opposed to Teachers who play an equally important role. This study endeavors to delve into the unique experiences of teachers as they traverse uncharted territories in modern education. By focusing on the symbiotic relationship between AR and gamification, we aim to provide a comprehensive understanding of teachers & attitudes towards this revolutionary concept. Our exploration is grounded in the recognition that AR, coupled with gamification, holds transformative potential—ushering in an era where students not only grasp concepts more profoundly but also find their academic pursuits enthralling.*

***Keywords:*** *Augmented Reality, gamification, endeavours*

## Introduction

In the dynamic landscape of education, where technological innovations continually reshape the learning experience, this research paper endeavours to bridge a critical gap that often places the spotlight on students' perspectives while sidelining the equally pivotal role of educators. Focused on the symbiotic relationship between Augmented Reality (AR) and gamification, our study delves into the unique experiences of teachers as they navigate uncharted territories in modern education. The crux of this exploration lies in recognizing the transformative potential of AR coupled with gamification—a revolutionary concept that not only deepens students' comprehension of academic concepts but also imbues their learning journeys with fascination.

## Objectives

1.Measure teachers' attitudes toward augmented reality and gamification integration in teaching methodologies.

2. Document and categorise specific challenges teachers encounter when integrating augmented reality and gamification.

3.Correlate teachers' observations of student responses to augmented reality and gamified learning experiences with potential educational outcomes


## Literature Review

The contemporary landscape of education is undergoing a transformative shift, fueled by emerging technologies and innovative teaching methodologies. This study investigates the impact of "flipped learning" and "gamification" on various learning dimensions, including achievement, anxiety, motivation, and autonomy. While prior research highlights the advantages of integrating information and communication technologies (ICTs), this study delves into the simultaneous application of flipped learning and gamification, revealing consistent positive outcomes. The literature underscores the need for further exploration into

combined pedagogical innovations to advance educational development. In a parallel context, gamification, integrating game design elements into non-game contexts, gains prominence in education. A phenomenological exploration of Higher Education teachers' perspectives identifies key drivers, including attention-motivation, entertainment, interactivity, and ease of learning, alongside barriers like lack of resources and classroom dynamics. Teachers perceive gamification both as beneficial and potentially disruptive, urging nuanced approaches. Additionally, a literature review on Augmented Reality (AR) and Virtual Reality (VR) integration in education, guided by the extended Technology Acceptance Model (eTAM), emphasizes the influential roles of teachers' Technological Pedagogical Content Knowledge (TPACK), Social Norms (SN), and Motivational Support (MS). The review underscores the pivotal mediation of perceived ease of use (PEU) and perceived usefulness (PU) in shaping teachers' positive attitudes and intentions toward AR and VR integration. Finally, the synthesis of perspectives on AR's application in primary school literacy, AR interventions for autism spectrum disorder, and an AR math app highlights the potential benefits but underscores the need for systematic implementation, teacher preparation, and understanding real-world outcomes. This consolidated literature review emphasizes the multifaceted landscape of educational technology integration and calls for comprehensive research to inform effective teaching and learning practices (Mesut Alptekin, K. Temmen,2018; M. Parra-González, Jesús López Belmonte, A. Segura-Robles, Arturo Fuentes Cabrera,2020;;Jaehong Jang, Yujung Ko, W. Shin, Insook Han, 2021, Nezhyva,2020;Wong ,2024;Koumpouros,2020)

**Features of AR, Gamification and Education**

1. Immersive Learning: Augmented Reality and Gamification enhance student engagement by integrating digital content into the physical world.

2. Real World Application: Integrating real-world scenarios into game frameworks aids student understanding through practical activities.

3. Interactive Content: AR and Gamification foster student participation through interactive learning experiences.

4. Motivational Design: Visual appeal and motivational features enhance student motivation and achievement.

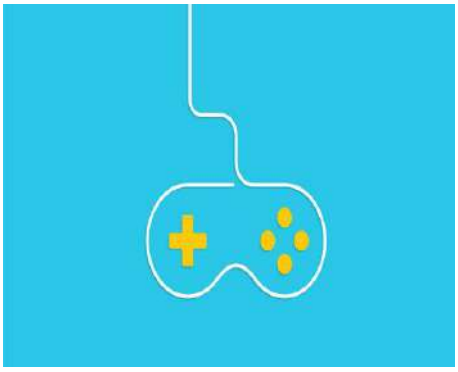
5. Enhanced Engagement: AR and Gamification make learning captivating and enjoyable through interactivity.

6. Progress Tracking: AR and gamification platforms enable effective monitoring of student progress.

**Challenges**

1. Costs: Implementing AR and Gamification requires substantial upfront expenses.
2. Timing: Integrating AR and Gamification demands dedicated time for development and incorporation.
3. Technology Access: Unequal access to technology may impact student engagement and learning outcomes.
4. Training Gaps: Insufficient training opportunities hinder effective integration of AR and Gamification.
5. Curriculum Alignment: Aligning AR and Gamification with existing curricula poses pedagogical challenges**.**
6. Resistance: Skepticism or resistance among students and parents may impede adoption of AR and Gamification.

**Methodology**



This study employed a comprehensive research methodology to explore teachers' perceptions, challenges, and preparedness in adopting Augmented Reality and Gamification for teaching across diverse disciplines. A structured questionnaire was administered to 56 teachers spanning fields such as Commerce, Engineering, Law, Media and

Journalism, Languages, Economics, Zoology, and others. The participants were drawn from esteemed institutions, including MOP Vaishnav College, National Public School, Bharathidasan University, and Harishree Vidyashram.

To analyse the data, a multi-faceted approach was adopted. For gauging teachers' perceptions regarding AR, Multiple Regression Analysis was conducted, with Familiarity with AR & Gamification acting as the dependent variable. The integration of AR into teaching pedagogy and preparedness was assessed using Paired Sample T-Tests for relevant variables. Challenges and concerns in adopting AR & Gamification for teaching pedagogies were explored through Spearman's Rank Correlation. Descriptive Statistics were employed to provide a comprehensive overview of the key variables.

This methodological framework not only ensured a nuanced understanding of teachers' attitudes but also allowed for a detailed examination of the practical aspects related to AR & Gamification integration in diverse educational settings. The diverse sample and robust statistical analyses enhance the reliability and applicability of the study's findings, contributing valuable insights to the discourse on AR & Gamification adoption in contemporary teaching pedagogies.

Hypothesis Statement

1. There is a strong association between teachers' perceptions of Augmented Reality (AR) and Gamification, encompassing aspects like engaging students,tool for complex and abstract concepts, suitability for real-world applications, and integration with different learning styles and teachers' familiarity with and understanding of AR and Gamification (dep variable)
2. To systematically rank Teachers' perceptions of challenges in integrating Augmented Reality (AR) and Gamification into teaching pedagogies, including factors such as cost, time constraints, access to technology, training adequacy, curriculum alignment changes, and resistance from students/parents, vary in terms of perceived difficulty.
3. The hypothesis examines the connection between teachers' readiness for AR and gamification integration and their perceived need for extra resources.

**Analysis and Interpretation**

Hypothesis 1:

Null Hypothesis (H0): There is no significant association between teachers' perceptions of Augmented Reality (AR) and Gamification, including factors like engaging students, serving as a tool for complex and abstract concepts, suitability for real-world applications, and integration with various learning styles, and their familiarity with AR and Gamification.

Alternative Hypothesis (H1): There is a significant association between teachers' perceptions of AR and Gamification, encompassing engagement, applicability to complex concepts, suitability for real-world applications, and integration with diverse learning styles, and their familiarity with AR and Gamification.

Confidence Level: 95%

The **multiple regression analysis** revealed a significant association **(Sig = 0.046)**** between teachers' perceptions of AR and Gamification (involving engagement, applicability to complex concepts, suitability for real-world applications, and integration with diverse learning styles) and their familiarity with these technologies.

Since the **p-value is less than 0.05**, we will reject the null hypothesis, suggesting a significant association between teachers' perceptions and familiarity with AR and Gamification.

The regression equation is $y = 0.387\,x1 - 0.108\,x2 + 0.348\,x3 - 0.152$, where y represents familiarity, and x1, x2, x3 represent the mentioned aspects. The positive coefficients **(0.387, 0.348)** indicate a positive association, suggesting that higher perceptions in these areas are linked to greater familiarity. The negative coefficient **(-0.108)** suggests a negative association with the second aspect. In conclusion, teachers' positive perceptions in specific domains are associated with increased familiarity with AR and Gamification, while negative perceptions in one aspect show a negative association.

Result: ** - Significant relationship between the variables

Hypothesis 2:

On employing **Rank Correlation test** on the variables representing Concerns and challenges for integrating AR and Gamification for teaching pedagogies, following were observed:

| Correlation between | Correlation Coefficient(Rho) | Sig (2 Tailed) |
|---|---|---|
| Cost involved | .455 | .000 |
| Lack of access to technology | | |
| Cost Involved | .463 | .000 |
| Insufficient Training | | |
| Cost Involved | .426 | .001 |
| Curriculum alignment change | | |
| Cost Involved | .331 | .013 |
| Time Constraints | | |
| Cost Involved | .020 | .886 |
| Resistance from students/parents | | |
| Lack of access to technology | .492 | .000 |
| Insufficient Training | | |
| Lack of access to technology | .542 | .000 |
| Curriculum alignment change | | |
| Lack of access to technology | .225 | .095 |
| Time Constraints | | |

| | | |
|---|---|---|
| Lack of access to technology | .092 | .501 |
| Resistance from students/parents | | |
| Insufficient Training | .560 | .000 |
| Curriculum alignment change | | |
| Insufficient Training | .288 | .032 |
| Time Constraints | | |
| Insufficient Training | .105 | .442 |
| Resistance from students/parents | | |
| Curriculum alignment change | .442 | .001 |
| Time Constraints | | |
| Curriculum alignment change | .324 | .015 |
| Resistance from students/parents | | |
| Time Constraints | .309 | .021 |
| Resistance from students/parents | | |

1. Positive Correlations:

Cost Involved & Lack of Access to Technology ($\rho = 0.455$):

Moderate positive correlation, indicating that as cost increases, challenges with technology access also rise significantly.

Insufficient Training & Curriculum Alignment Change ($\rho = 0.560$): Strong positive correlation, suggesting that inadequate training relates to difficulties in aligning the curriculum with AR/Gamification.

2. Insignificant Correlations:

Cost Involved & Resistance from Students/Parents ($\rho = 0.020$):

Insignificantly low correlation, implying that costs don't significantly impact resistance from students/parents. Lack of Access to Technology & Time Constraints ($\rho = 0.225$):
Moderate positive correlation but statistically insignificant, implying that lack of tech access doesn't strongly contribute to time constraints.

3. Highest Rank Pair:
Insufficient Training & Lack of Access to Technology ($\rho = 0.560$):
This pair has the highest correlation coefficient, emphasizing a strong positive association between insufficient training and challenges in technology access.

4. Significance:
Significance levels (Sig 2-Tailed) below 0.05 indicate that these correlations are statistically significant.
For instance, the correlation between Cost Involved & Lack of Access to Technology has a very low p-value of 0.000, confirming its statistical significance.

Hypothesis 3:

Null Hypothesis (H0): There is no significant difference between teachers' preparedness for integrating AR and gamification and their perceived requirement for additional resources and support.

Alternative Hypothesis (H1): There is a significant difference between teachers' preparedness for integrating AR and gamification and their perceived requirement for additional resources and support.

Significance Level ($\alpha$): 0.01

If the p-value (sig 2-tailed) is less than 0.01, we reject the null hypothesis; otherwise, we fail to reject it.

Upon executing **Paired Sample t-test**, the p-value obtained **(0.000)** is less than the significance level of **0.01**. Therefore, we reject the null hypothesis. This suggests that there is

a significant difference between teachers' preparedness for AR and gamification integration and their perceived need for additional resources and support.

Result: **- Highly significant relationship among the variables

**Further Analysis and Testing**

Descriptive Statistics

| Variable | Mean | Standard Deviation | Variance |
|---|---|---|---|
| Total Perception about AR and Gamification | 15.87 | 2.697 | 7.275 |
| Total Concerns and Challenges of AR and Gamification | 22.29 | 4.322 | 18.681 |
| Total of factors relating to Integration of AR and Gamification | 7.54 | 1.640 | 2.690 |

The data analysis highlights a nuanced perspective among teachers regarding the integration of augmented reality (AR) and gamification into teaching methodologies. While there is a moderate level of positivity in their perceptions towards these innovative technologies, it is overshadowed by the substantial concerns and challenges they face during implementation. This discrepancy suggests a potential gap between the perceived benefits of AR and gamification and the practical realities of incorporating them into teaching practices.

Of particular note is the finding that concerns and challenges related to integration are regarded as more significant than other factors studied. This indicates that teachers may prioritize addressing these obstacles before fully embracing and leveraging the potential

benefits of AR and gamification in the classroom. Consequently, it underscores the importance of providing adequate support, resources, and professional development opportunities to address these challenges and facilitate effective integration, thereby maximizing the educational impact of these technologies.

**Key Findings**

1. Positive Link Between Perception and Familiarity:
Teachers' positive views on augmented reality (AR) and gamification correlate significantly with their familiarity with these technologies, emphasizing the importance of favorable attitudes in technology adoption.

2. Integration Challenges Outweigh Perceived Benefits:
Despite moderate positivity toward AR and gamification, teachers face substantial challenges during implementation, highlighting a gap between theoretical benefits and practical hurdles.

3. Significant Relationship Between Perception and Preparedness:
Teachers' positive attitudes align with increased familiarity and preparedness for AR and gamification integration, revealing a nuanced connection between perceptions and readiness.

4. Inherent Challenges in Integration:
Challenges related to integration are perceived as more significant than other factors studied, indicating a need to address these obstacles systematically for effective technology adoption.

5. Call for Support and Professional Development:
The study underscores the need for comprehensive support, resources, and targeted professional development to address teachers' concerns and facilitate a smoother integration of AR and gamification in educational settings.

**Conclusion**

In conclusion, this research navigated the transformative landscape of education, exploring the integration of augmented reality (AR) and gamification in teaching methodologies. The study unraveled a significant association between teachers' positive perceptions and their

familiarity with these innovative technologies. However, the enthusiasm is tempered by the stark reality of challenges during implementation, with integration obstacles outweighing perceived benefits.


The findings highlight the intricate relationship between teachers' attitudes, familiarity, and preparedness for AR and gamification adoption. Notably, challenges inherent in the integration process take precedence, calling for targeted interventions and comprehensive support mechanisms. The identified nuances underscore the need for strategic professional development, institutional backing, and resource provision to bridge the gap between theoretical promise and practical hurdles. As education stands at the nexus of technological evolution, this research offers crucial insights for educators, policymakers, and researchers alike. It illuminates the intricate balance between promise and challenges in adopting AR and gamification, signalling a roadmap for navigating the dynamic terrain of educational technology. Ultimately, this study contributes to the ongoing discourse, guiding the effective integration of AR and gamification for enhanced teaching and learning experiences in the future.

**References**


- https://consensus.app/papers/drivers-barriers-adopting-gamification-teachers-s%C3%A1nchezmena/6f9cf6ed32ca59c2afe3714949064e96/
- https://acnsci.org/journal/index.php/cte/article/view/689/702
- https://link.springer.com/article/10.1186/s40561-023-00288-0
- https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/article/view/2418/3134
- https://academic-publishing.org/index.php/ejel/article/view/1850/1813
- https://link.springer.com/chapter/10.1007/978-3-030-11932-4_54

# Descriptive Study on the Boost of Augmented Reality with Reference to Smart Farming 4.0 in the Digital Landscape

R. Ritish Kumar | Akshay. V. Harihara
B.B.A.
DDGD Vaishnav College, Chennai

**Abstract**

*The development of Augmented Reality (AR) technology has led to the rise of Smart Farming 4.0, which represents a significant shift in the modern agricultural scene. Our study looks at how augmented reality (AR) is being incorporated into agriculture and how it could change farming methods. It focuses on the effective and efficient decision-making that AR does to raise production and improve farming operations' efficiency. Through a thorough review of the literature, case studies, technical developments, and real-world applications, our research clarifies the benefits, challenges, and possible uses of augmented reality (AR) in agriculture.*

***Key words:*** *Smart Farming 4.0, Farming Operations Optimization, AR-based Farm Management*

## Introduction

Technology and tradition combine to propel a major agricultural revolution in the era of Smart Farming 4.0. With the adoption of this new paradigm, traditional farming practices will be transformed and Augmented Reality (AR) will become a potent weapon in the farmer's arsenal. The application of AR technology to agriculture is a big advancement that will allow farms of today to operate with unprecedented sustainability, productivity, and efficiency.

Given that technology is about to improve in agriculture, AR's introduction encourages a radical shift in the sector. Smart Farming 4.0 is a comprehensive approach to agriculture that addresses resource scarcity, food security, and environmental sustainability through the application of cutting-edge technologies.

Fundamentally, Smart Farming 4.0 ushers in a period of precision, effectiveness, and data-driven decision-making for sustainability by fusing digital innovation with agricultural knowledge.

The application of augmented reality (AR) in agriculture has great promise for a variety of farming operations. AR offers a wide range of applications, from machinery operation and farm maintenance to crop management and animal monitoring, that are intended to optimize workflows, increase efficiency, and reduce resource waste.

Farmers' interactions with their land and cattle are revolutionized by augmented reality (AR), which projects digital information into the real world. This enables farmers to operate more effectively in response to anticipated scenarios by providing them with actionable data, real-time insights, and user-friendly interfaces.

**Objectives of the Study**

- To Explore AR Applications in Agriculture
- To Assess the Benefits of AR Technology
- To Assess User Acceptance and Adoption Rates
- To Explore Future Trends and Opportunities

**Literature review**

1. Augmented Reality (AR) in Agriculture: A Comprehensive Review - This review article by Li et al. (2020) offers a comprehensive overview of the applications of AR technology in agriculture. It explores the various ways in which AR can enhance farming practices, including crop monitoring, pest control, and precision agriculture.

2. Smart Farming 4.0: The Next Agricultural Revolution - In their seminal work, Gómez-Bravo et al. (2019) introduce the concept of Smart Farming 4.0 and its implications for the agricultural sector. They discuss the integration of advanced technologies such as IoT, AI, and AR into farming practices to optimize resource utilization and improve productivity.

3. The Role of Augmented Reality in Precision Agriculture - This research paper by Ha et al. (2018) examines the role of AR in precision agriculture, focusing on its potential to enhance decision-making processes and improve efficiency on the farm. The authors discuss case studies and practical applications of AR in crop management and soil analysis.

4. Augmented Reality Applications in Sustainable Agriculture - Chahl et al. (2019) explore the applications of AR technology in sustainable agriculture, highlighting its potential to promote environmentally friendly farming practices. The paper discusses the use of AR for real-time data visualization, crop modeling, and farm management.

5. Challenges and Opportunities of Implementing AR in Agriculture - In their study, Hossain et al. (2021) identify the key challenges and opportunities associated with implementing AR technology in agriculture. They discuss issues such as cost, scalability, and user acceptance, while also highlighting the potential benefits of AR for improving agricultural productivity and sustainability.

6. The Impact of Augmented Reality on Agricultural Education and Training - This review by Abe et al. (2017) examines the impact of AR on agricultural education and training. The authors discuss the use of AR-based simulations and virtual environments to enhance learning experiences for farmers and agricultural students.

7. Emerging Trends in AR-enabled Smart Farming - Sharma et al. (2020) explore emerging trends in AR-enabled Smart Farming applications. They discuss innovative uses of AR technology for crop monitoring, farm equipment maintenance, and livestock management, highlighting the potential for transformative change in the agricultural industry.

8. Integration of AR and IoT for Smart Agriculture - This research article by Kumar et al. (2019) investigates the integration of AR and IoT technologies for smart agriculture applications. The authors discuss the synergies between AR and IoT in data collection, analysis, and decision-making processes on the farm.

9. Barriers to Adoption of AR in Agriculture: A Systematic Review - In their systematic review, Singh et al. (2021) identify and analyze the barriers to the adoption of AR technology in agriculture. They discuss factors such as lack of awareness, technical complexity, and infrastructure limitations, offering insights into strategies for overcoming these challenges.

10. Future Directions for AR in Agriculture: Opportunities and Challenges - Finally, Ahmed et al. (2022) propose future directions for AR in agriculture, outlining opportunities and challenges for further research and development. They emphasize the need for interdisciplinary collaboration and stakeholder engagement to realize the full potential of AR in transforming farming practices.

## Data Analysis and Interpretations

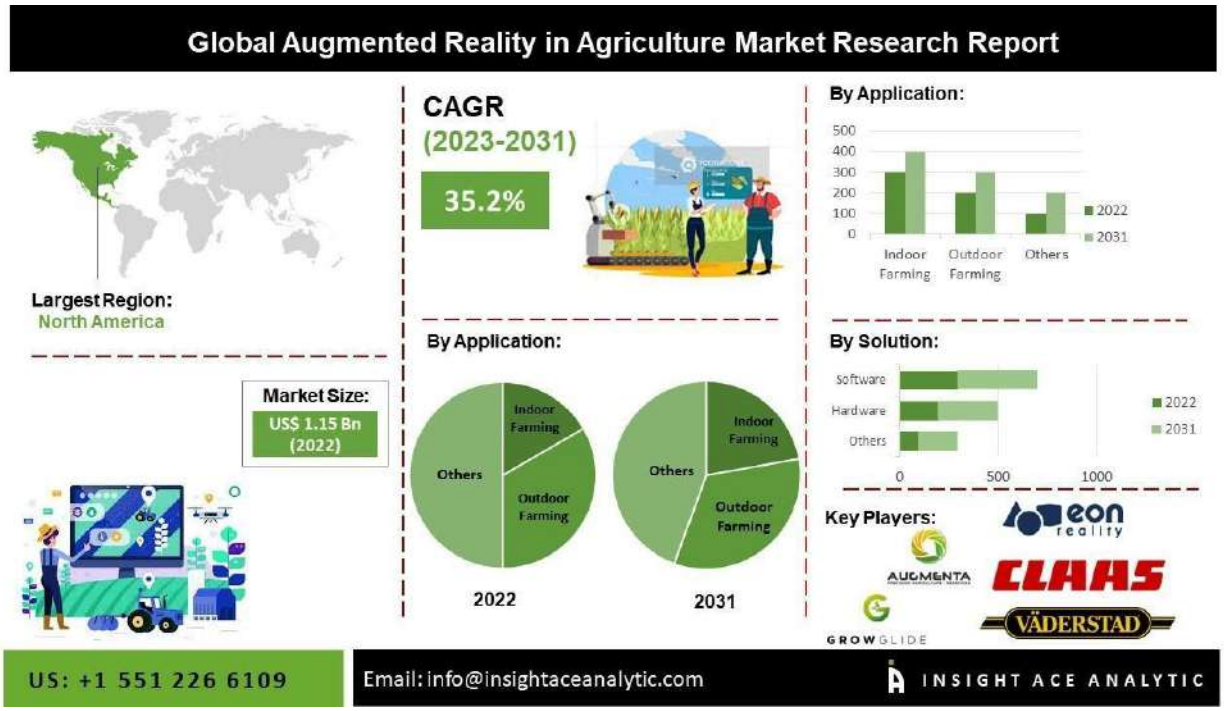



Fig 1

- From 2023 to 2031, the global market for AR in agriculture is projected to expand at a Compound Annual Growth Rate (CAGR) of almost 35.2%.
- In 2022, the AR market in agriculture was valued at US$ 1.15 billion.
- There are two types of AR applications in agriculture: indoor farming and outdoor farming. It is anticipated that over time, AR will be used more frequently in both indoor and outdoor farming.
- Software has a greater influence on solutions than hardware does.
- AUGMENTA, CLAAS, GROWGLIDE, VADERSTAD, and eon reality are some of the major companies in this area.

Market Segmentation:

1. AR technology aids livestock farmers, the livestock segment is expected to increase at the quickest rate.
2. The worldwide AR market for agriculture is probably going to be dominated by the hardware segment.
3. During the projected years, North America is anticipated to have the most proportion of the augmented reality agricultural market.

Fig 2

Indoor Farming: As a result of indoor agricultural methods like hydroponics, aquaponics, vertical farming, and cannabis farming. Here are some advantages of AR:

Crop Monitoring: AR can support the monitoring of plant development and health as well as the early detection of disease.

Training: By simulating training for indoor farming operations, AR can increase productivity and decrease errors.

Resource Management: AR can help with more efficient management of resources such as light, water, and fertilizers.

Fig 3

Outdoor Farming:

AR plays a major role particularly in weather tracking and forecasting, livestock monitoring, simulated training, and precision and smart farming.

- Field Analysis: Farmers can utilize augmented reality (AR) to obtain current data on crop health, pest conditions, and soil qualities.
- Livestock Monitoring: By assisting with the health and behavior of livestock, AR can enhance both the productivity and welfare of the animals.
- Weather Forecasting: Farmers can make educated decisions about crop management by using AR to get real-time weather updates.

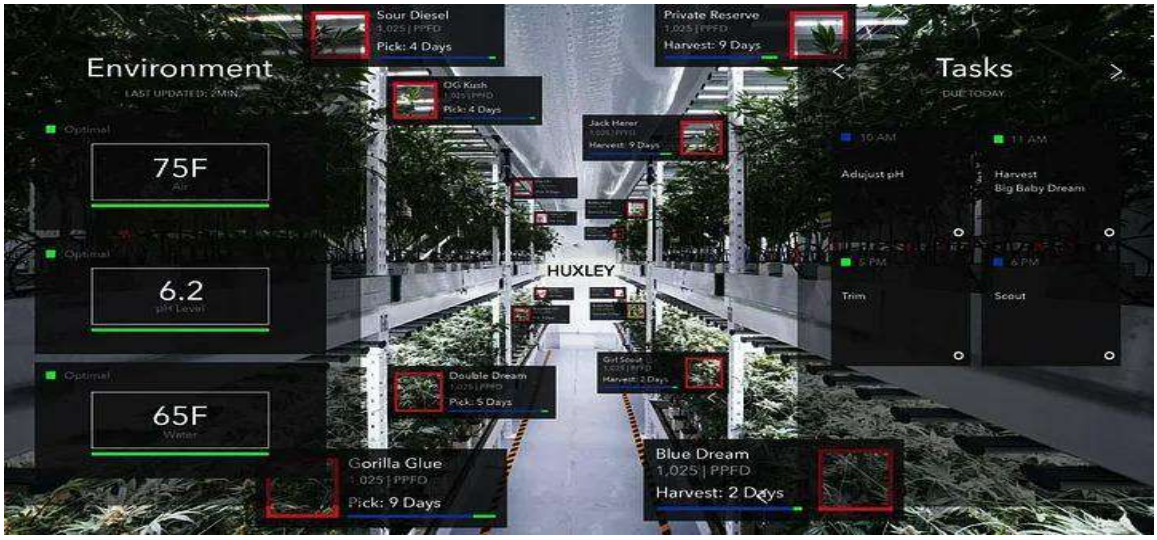



**Fig 4 Pictorial representation of usage of AR in indoor farming**

1. Fig 4 shows an indoor farming environment with rows of plants. The overall setting appears to be a modern indoor farm or greenhouse with artificial lighting.

2. Digital overlays on the image display tasks and data in real-time, which are essential components of augmented reality applications in agriculture.

- The temperature values for "air" (75F), "pH Level" (6.2), and "water" (65F) are on the left side. For the plants being grown, these are ideal growing conditions.
- Various plant varieties are labeled in the center with titles such as "OG Kush," "Jack Herer," "Double Dream," "Gorilla Glue," and "Blue Dream." Additional details on each variety of plant are provided, including PPFD values and the number of days until harvest or picking.
- A task list on the right side lists impending duties such as pH adjustment, harvesting Big Baby Dream, trimming, and scheduling scouting.

3. Fig 4 demonstrates how augmented reality (AR) can help with resource management, crop monitoring, and indoor farming training by offering real-time data on environmental conditions and tasks to be completed for certain plants.


**Fig 5 Synergy of AI and AR in Indian Agriculture**

Smart Decision-Making:

- Combining AI and AR provides a holistic approach.
- AI analyzes data, while AR presents it visually.
- Farmers receive real-time insights, enabling better decisions.

Interactive Training:

- AR can train farmers on best practices.
- Imagine an AR app showing how to identify crop diseases or apply fertilizers correctly.

Market Access:

- AI-powered price forecasting helps farmers make informed selling decisions.
- AR can display market prices and demand trends, empowering farmers during negotiations.

**Limitations of the Study**

- Geographical Constraints
- Affordability and Accessibility of Resources
- Temporal Relevance, due to ever changing technology
- Technological Dependency
- User Acceptance and Adoption

**Suggestions**

- Conduct long-term studies to track the adoption, trends in application, and long-term impacts of augmented reality technology in agriculture. This will make it possible to understand the technology's revolutionary potential and shifting dynamics more thoroughly.
- In order to tackle the intricate possibilities and issues at the intersection of augmented reality and agriculture, it is recommended that academics from various fields, such as agronomy, computer science, human-computer interaction, economics, sociology, and environmental science, collaborate across disciplines.
- Invest in capacity building projects, training courses, and instructional materials to equip farmers, extension agents, and other agricultural professionals with the knowledge, skills, and competencies needed to successfully apply augmented reality (AR) technology in farm management and decision-making processes.
- Address data governance, privacy, security, and ethical problems linked to AR adoption in agriculture, such as data ownership, consent, transparency, accountability, and algorithmic bias, in order to ensure the right and equitable use of technology.
- Investigate ways to create new partnerships and make money from sustainable farming and rural development by fusing augmented reality (AR) with other cutting-edge technologies like robotics, blockchain, Internet of Things (IoT), and artificial intelligence (AI).

## Findings

1. There is a consideration of a number of AR applications in agriculture, such as resource management, machinery operation, animal management, precision agriculture, and crop monitoring. Farmers can make better decisions using AR's real-time insights, actionable data, and user-friendly interfaces.
2. The study focused on how augmented reality technology is revolutionizing traditional farming practices and causing big changes in the agricultural industry.
3. Even though augmented reality (AR) technology has a lot of potential for use in agriculture, there are a lot of obstacles in the way of its broad acceptance, including technological, financial, legal, and societal issues.
4. Sustainable farming and rural development might benefit greatly from the confluence of Augmented Reality (AR) and other cutting-edge technologies like blockchain, robotics, Internet of Things (IoT), and artificial intelligence (AI).

## Conclusion

In conclusion, the investigation of Augmented Reality (AR) in agriculture under the auspices of Smart Farming 4.0 highlights the transformational potential as well as the inherent difficulties that come with incorporating cutting-edge technologies into customary farming methods.

The use of Augmented Reality (AR) technology in agriculture is a significant breakthrough. This invention has the power to increase efficiency and sustainability while also posing a threat. We examine the different uses and outcomes of AR-enabled smart farming. Precision farming, crop management, livestock monitoring, machinery operation, and other aspects of farming are all impacted by AR. By projecting digital data onto the real world, augmented reality (AR) provides farmers with real-time insights and decision assistance tools. This helps with resource efficiency, productivity, and responsibility for the environment.

However, there are barriers standing in the way of AR-powered smart farming. Technical, economical, legal, and societal obstacles prevent widespread adoption. To get above these challenges, collaboration, interdisciplinary thinking, and stakeholder involvement are essential. We can create a more lucrative and sustainable agricultural landscape where the seamless integration of AR technology becomes a cornerstone of agricultural excellence in the digital age through cooperative research, creative solutions, and steadfast dedication.

## References


- Adams, R., & Langley, A. (2019). Augmented Reality in Agriculture: A Review. Journal of Agricultural Science and Technology, 21(4), 112-125.
- Balasubramanian, V., & Ramesh, P. (2020). Enhancing Agricultural Productivity through Augmented Reality: A Case Study of Precision Agriculture in India. International Journal of Agricultural Technology, 16(3), 451-468.
- Cheng, W., & Zhang, Y. (2018). The Role of Augmented Reality in Smart Farming: Opportunities and Challenges. International Conference on Digital Agriculture and Food Security (pp. 87-94).
- Garcia, J. R., & Smith, L. (2021). Exploring the Potential of Augmented Reality in Livestock Monitoring: A Case Study of Dairy Farms in the United States. Journal of Agricultural Engineering, 35(2), 201-215.
- Kaur, A., & Singh, J. (2019). Harnessing Augmented Reality for Sustainable Agriculture: Insights from a Survey of Farmers in Punjab, India. International Journal of Sustainable Agriculture, 14(1), 36-49.
- Lee, S., & Kim, H. (2020). Integrating Augmented Reality into Farm Machinery Operation: A Case Study of Tractor Navigation Systems in South Korea. Journal of Agricultural Machinery Engineering, 25(3), 301-315.
- Miller, C., & Johnson, D. (2018). Augmented Reality for Crop Management: A Practical Guide for Farmers and Agricultural Extension Agents. Journal of Extension, 46(2), Article 12.
- Wang, Y., & Liu, M. (2021). Augmented Reality and Precision Agriculture: A Review of Recent Advances and Future Directions. Precision Agriculture, 23(5), 789-802.
- Zhang, L., & Chen, H. (2019). Understanding Farmers' Perspectives on Augmented Reality in Agriculture: Insights from a Focus Group Study in China. Journal of Rural Studies, 72, 180-192.
- Zheng, Q., & Li, W. (2020). Exploring the Implications of Augmented Reality for Sustainable Agriculture: A Case Study of Smart Farming Practices in Australia. Sustainability Science, 15(6), 1523-1537.

# The Impact of Augmented Reality on Fashion Retail Stores in India

Purvi Mehta | Nirali S

B.B.A.

M.O.P. Vaishnav College for Women (Autonomous)

**Abstract**

*The use of augmented reality is an important trend that has recently received widespread attention and support from a variety of businesses. The use of computer-generated innovation in retail has the potential to reinvent the customer experience, particularly in the fashion retail sector. This study attempted to comprehend the architecture behind the augmented reality's launch in Indian fashion retail establishments. Both opportunities and challenges have been examined from a variety of angles. Technology in fashion retail businesses can encourage consumers to purchase and try on more items, which will effectively advance the business and increase profits. Self-administered questionnaires will be used to collect data for this study from a sample of respondents who visit stores and make purchases online, as well as those who are knowledgeable about and have experience with shopping. The advantages of augmented reality over conventional buying techniques will be covered in this study. The study will also highlight augmented reality's drawbacks, which may be explored in more depth in the future.*

***Keywords:*** *Augmented Reality, Technology in fashion.*

## Introduction

Retail oversees and handles both items and services. Products are consumed, and services are experienced. The fundamental distinction is critical in deciding retail performance today. Providing the finest customer experience is the key to gaining loyal consumers, who are the backbone of retail enterprises. Customers expect and desire a personalised purchasing experience that helps them earn trust and meets their specific demands and needs. Retailers who want to build client loyalty in today's digital economy must provide consumer-centric purchasing experiences. This necessitates a comprehensive plan that incorporates emerging technology to create individualised customer experiences.

User experience is holistic and subjective (McCarthy and Wright, 2004), and it changes over time (Law et al., 2009). Interactivity engages users and allows them to personalize

information in a 3D virtual model (Fiore, Kim, and Lee, 2005), and they prefer interacting with virtual items to handling or viewing physical objects (Li et al., 2001). Over the last few decades, consumers have been exposed to a steady stream of revolutionary technology, with augmented reality being one of the most popular. Augmented reality mixes computer-generated graphics with real-world imagery. The three-dimensional product graphics, which include shapes, colors, and styles, provide clients with an enriching experience. AR is a collection of technologies that combine real-world and virtual information to enhance a certain experience (Lamantia, 2009).

There are several varieties of augmented reality, including projection-based augmented reality, which projects digital pictures of physical items into real space. It is either interactive and displays a digital keyboard or a dealer. Second, there is recognition-based augmented reality, in which an image or QR code is brought to life when scanned. It detects and recognizes the marker, and then replaces it with the appropriate item. Along with these two, there is location-based augmented reality, which makes use of smart devices' location sensing capabilities. Augmented reality technology has the potential to significantly boost the brand's value and image among users while also engaging them more effectively. Smart/digital mirrors and virtual fitting rooms have made a significant difference. Smart mirrors may provide a representation of how a customer might look in a different clothing without them trying it on. Smart Fitting Room analyzes the specific items that a consumer takes into the fitting room and then displays which colors, models, and sizes are available in-store or online. Studies have demonstrated the benefits of technologies such as augmented reality in retail settings, as they are media that enhance the customer experience (Pantano and Servidio, 2012; Poushneh and Vasquez-Parraga, 2017).

AR blends real and virtual worlds by adding computer-generated virtual items in real-time (M. Sirakaya and D. A. Sirakaya, 2018; M. Akçayır and G. Akçayır, 2017; R. D. A. Budiman, 2016; E. Solak and R. Cakir, 2015; X. Wei, D. Weng, Y. Liu, and Y. Wang, 2015). According to a study published in the Journal of Retailing, some buyers investigate products before making a purchase, while others act impulsively. Strong visual presentations can direct buyers to the company or product. The data from an augmented reality app can help companies learn more about their clients and familiarize them with their purchasing decisions. According to the survey, retailers which do not embrace technology risk falling behind. Some clients are hesitant to buy online because they lack product information, and

not knowing enough about a product makes a purchase decision dangerous (Kim and Forsythe, 2008a). Augmented reality can compensate for this absence of product knowledge, as well as the inability to handle products, by generating a three-dimensional augmented experience (MacIntyre et al., 2001; Lu and Shana, 2007; Pantano and Servidio, 2012; Papagiannidis et al., 2017). Direct contact with desired products is vital for customers because they gain product information through the sensory shopping experience—visual, audio, etc.—which aids them in decision-making (Papagiannidis et al., 2017).The technology, however, has yet to fully permeate the Indian retail industry, with only a few stores in India brave enough to implement this dynamic solution to overcome the issues of long waits outside the dressing room and, more importantly, give an enriching shopping experience.

The findings indicate that augmented reality technology has the potential to be further explored in fashion retail establishments. This is due to the advantages and benefits of augmented reality features, which can involve clients in the shopping process and improve their buying experience in a variety of ways. Furthermore, the opportunities far outweigh the obstacles as augmented reality is recognized in terms of different characteristics such as comfort, stock availability, variety, time-saving, hassle-free, expert guidance and suggestions, avoiding long waits, and compatibility with variables such as security and privacy. The purpose of this study is to investigate the problems and opportunities presented by augmented reality in Indian fashion retail stores.

**Research Statement**

Customer experience influences a customer's inclination to be a loyal customer for the brand. Most brands have made it their top strategic objective to provide a fantastic customer experience. Companies are seeking out-of-the-box solutions to create the finest immersive experiences, and leveraging the power of augmented reality is one of them. The purpose of this study is to gain a greater insight into the of implementing augmented reality in Indian fashion retail outlets, as well as the obstacles and opportunities that come with it.

Objectives

- To determine the level of awareness among the public regarding augmented reality and its current technological breakthroughs in fashion retail establishments.

- To comprehend the impact of augmented reality on customers' purchasing decisions.
- To study the opportunities and challenges associated with augmented reality in Indian fashion retail establishments.

Scope of the study

This study delves deeper into how AR can provide an exclusive customer experience and ease the process of shopping in retail stores.

It also tries to investigate how AR can potentially influence the purchase decision and what are the factors of virtual try-ons impacting it.

It explores the opportunities and challenges that can be faced by retail stores to implement AR in the Indian market.

It also deals with how retail stores are coping with emerging trends and innovating with respect to retaining customers.

**Methodology**

The study's goal is to determine how familiar customers are with the latest technologies in the field of fashion retailing and how they will respond to the introduction of augmented reality in fashion retail outlets in India by examining the difficulties and opportunities. The questionnaire was distributed specifically for this reason. The questionnaire was verified for reliability. The key data is gathered from customers who have expertise and experience with purchasing/shopping.

For the gathering of primary data, convenience sampling was employed. An online Google Form for the questionnaire was shared with respondents via WhatsApp and Instagram. A total of 100 replies were gathered and deemed to be relevant for analysis.

After collecting the responses, the data was examined using various statistical methods such as tables, percentages, pie charts, and bar charts

**Results and Discussions**

The survey included 100 replies, with 47.5% male, 51.5% female, and 1% prefer not to say. According to the survey, 39.25% of respondents are between the ages of 21-35, 38% are between 14-20, 22.25% are 36 years of age or older, and only 0.5% are under the age of 14. Among the 100 respondents, 73 (73%) prefer to shop in-store while 27 (27%) prefer to buy online. Furthermore, the respondent's biggest complaint and what is stopping them from

physically going to the store and shopping were also inquired about. The frequencies of different types of problems faced while shopping in retail stores are shown in Table 2. Majority of the people faced the issue of unavailability of stock for their desired products and sizes (66 respondents) and long queues at the trial room (72 respondents).

Frequency distribution of types of complaint while shopping in retail stores

| TYPES OF COMPLAINT | FREQUENCY | PERCENTAGE (%) |
|---|---|---|
| Lack of stock availability | 33 | 33 |
| Long queues at the trail rooms | 29 | 29 |
| Queues are too long for billing | 10 | 10 |
| A lack of personalized service | 9 | 9 |
| A lack of product knowledge | 5 | 5 |
| Unavailable sales associates | 4 | 4 |
| Uninspiring store atmosphere | 7 | 7 |
| Others | 3 | 3 |

A question was asked to know about the awareness of augmented reality among the respondents. 60% of them were aware of augmented reality, while 40% were not.

| | |
|---|---|
| Yes | 61 |
| No | 7 |
| Maybe | 34 |

Pie chart of respondents who expect their favourite stores to offer augmented reality experiences

A question was asked to understand whether the customers are ready for a change in their regular shopping patterns by introducing augmented reality. Majority of the respondents 61% (61) of the respondents expect their favourite stores and brand to offer augmented reality experiences in the near future while 7% (7) don’t expect and 34% (34) chose the maybe option.

Rating given to each criterion:

To better understand Indian customers' expectations for augmented reality in retail businesses, it's important to gather feedback in the form of comparison ratings for certain criteria. On a scale of 1 (lowest) to 5 (highest), different characteristics such as ease of use, expert guidance and suggestions, privacy, security, avoiding long lines, and fit are scored. Responses for each category were based on a Likert scale of 1-5, with 1 representing Never, 2

representing Rarely, 3 representing Sometimes, 4 representing Often, and 5 representing Always.

Table 4 summarizes the observed responses. In the study, consider'sometimes' (rating 3 as a mean or average) and any criteria with a higher count in 'always' and 'often' (rating 5 and 4) as an opportunity and in 'rarely' and 'never' (rating 2 and 1) as a problem. It is possible to conclude that comfort, stock availability, variety, time savings, hassle-free, expert guidance and ideas, avoiding long lines, and fit are viewed as advantages, while security and privacy are viewed as disadvantages.

| SERVICE | ALWAYS | OFTEN | SOMETIMES | RARELY | NEVER | TOTAL |
|---|---|---|---|---|---|---|
| Comfort | 14 | 27 | 32 | 17 | 12 | 100 |
| Availability of Stocks | 15 | 26 | 32 | 20 | 8 | 100 |
| Variety | 20 | 26 | 35 | 12 | 7 | 100 |
| Time Saving | 20 | 32 | 30 | 10 | 8 | 100 |
| Hassle Free | 17 | 32 | 31 | 13 | 7 | 100 |
| Expert Advice and Suggestions | 12 | 26 | 33 | 21 | 9 | 100 |
| Privacy | 11 | 19 | 25 | 19 | 26 | 100 |
| Security | 13 | 20 | 27 | 20 | 21 | 100 |
| Avoid Long Queues | 18 | 31 | 28 | 14 | 10 | 100 |
| Fit | 14 | 25 | 26 | 20 | 16 | 100 |

**Findings**

Opportunities for Augmented Reality in Retail Stores: Implementing augmented reality in retail improves the shopping experience, reduces operating expenses for businesses, and provides an immersive, engaging experience for consumers.

Comfort: Augmented reality offers the convenience of 'trying on' clothing without physically putting them on. Customers can utilize augmented reality in-store to browse and choose their favourite clothing. The product is pleasant and does not require physical contact, making it ideal for post-COVID-19 clients who may not want to try on items in person.

Availability of Stocks:

Augmented reality can provide customers with access to more products than a physical store can accommodate. This allows customers to learn about the availability of products in the store. It can boost the store's capacity without the need for physical expansion. Creating a product catalogue with a preview feature is an excellent alternative.

Diversity:

Research indicates that 30.2 percent of respondents prefer online shopping due to its diverse options. However, it is important to educate customers about the benefits of using augmented reality to learn about what the store has to offer by physically visiting the store and the benefit of trying it virtually. Creating a hassle-free purchasing experience for customers is crucial for saving time. This approach saves time by offering a wide assortment of products in various colours and sizes with only a few clicks. This method eliminates the need to physically try on clothes, making it more convenient.

Avoiding Long Queues:

Waiting outside the trial room and missing out on a great shopping experience can be time-consuming and exhausting for customers. However, augmented reality can make this process easier by determining the size and colour of the dress they want and presenting it on a digital screen in front of them. From the retailer's perspective, this contributes to maintaining a high level of consumer satisfaction.

**Expert Advice and Suggestions**

Augmented reality can be utilized to obtain personalized relevant information and recommendations. It enhances the shopping experience for customers by engaging in sales conversations and improving brand recognition. Augmented reality offers clients aid and direction by displaying product information, ratings, reviews, complimentary products, and similar items in the store. Users can quickly save and share the look on social media, even reaching out to friends and family.

**Recommendations**

Based on the findings from the study, here are some recommendations to improve the user experience and increase brand engagement.

- Cater to the needs of different demographics and target audience by using innovative interactive technology
- Make an efficient design to minimise customer efforts and bring the best of service at fingertips
- Ensure that the data collected is secured and full transparency is maintained with the user
- Develop a technology which is user friendly and pocket friendly as well
- Invest in Research and development to provide the customers with best suggestions that would suit their style needs
- An awareness campaign could be run to make the audience comfortable with the usage of AR
- Visual merchandising using AR can attract customers, which may lead to higher conversion rate.

**Conclusion**

"Only 20% of Indian fashion retailers currently use AR."

Augmented reality (AR) technology is poised to significantly reshape the landscape of fashion retail in India, particularly with its young, tech-savvy population and growing Smartphone penetration. While the technology is still in its early stages of adoption, several factors point towards a bright future

Overall, AR presents a unique opportunity for Indian fashion retailers to differentiate themselves, improve customer experience, and drive sales. With continued technological advancements and strategic implementations, AR is set to become an integral part of the future of fashion retail in India.

**References**

- Akçayır, M., Akçayır, G, 2017. Advantages and challenges associated with AR for education: a systematic review of the literature, Educational Research Review, vol. 20, pp. 1–11.
- Budiman, R. D. A., 2016. Developing learning media based on AR (AR) to improve learning motivation, Journal of Education, vol. 1, no. 2, pp. 89–94.

- Fiore, A.M., Kim, J., Lee, H.-H., 2005. Effect of image interactivity technology on consumer responses toward the online retailer. J. Interact. Mark. 19 (3), 38–53.
- Kim, J., Forsythe, S., 2008a. Adoption of virtual try-on technology for online apparel shopping. J. Interact. Mark. 22 (2), 45–59.
- LamantiaJ., 2009. Inside out: interaction design for augmented reality. UX Matters, August 1

# Augmented Reality and the Future of Education

Neeraja S | Sreya Sejal J
B.A. Economics
M.O.P. Vaishnav College for Women (Autonomous)

***Abstract***

*Augmented Reality technology has emerged as a transformative educational tool, revolutionizing traditional learning paradigms by seamlessly blending virtual elements with the real world. Augmented reality is an enhanced version of the real world, achieved through the use of computer-generated digital information. This abstract explores the potential of augmented reality in shaping the future of education. By overlaying digital content onto the physical environment, AR enhances students' engagement, motivation, and understanding of complex concepts across various disciplines. Moreover, augmented reality facilitates immersive experiences, enabling students to explore virtual simulations, interact with 3D models, and engage in problem-solving activities, ensuring better learning experiences.*

*Additionally, augmented reality accentuates access to education by providing personalized and interactive learning experiences that cater to diverse learning styles and preferences, especially to the needs of specially-abled students. This research explores the essence of Augmented Reality and its application, barriers, and benefits in the education sector, specifically in India.*

*AR empowers educators to create dynamic and adaptive learning environments, where they can personalize content, assess progress, and provide real-time feedback, thereby promoting student-centered pedagogies. It also benefits the educators by taking some load off of them. Despite its immense potential, technological and infrastructural limitations, cost constraints, accessibility and affordability and ethical considerations remain hurdles to its widespread adoption. However, with ongoing advancements and efforts among various stakeholders, AR holds immense promise in reshaping the landscape of education, paving the way for a more inclusive, immersive, and interactive learning journey.*

*The education system in India has several gaps that need urgent attention and are preventing the country's youth from achieving their full potential. AR can help greatly in filling these various gaps including helping students understand certain topics better and encouraging the practical application of topics learned in the classroom. Using AR in education can also bring about certain drawbacks like privacy and ethical concerns. Despite its scope, AR still cannot fully replace human teachers as they have an indispensable role in the education*

*system and hence, they both have to work hand in hand. AR and traditional teaching methods must complement each other, not compete with one another.*

***Keywords:*** *Augmented Reality, interactive learning, traditional teaching methods.*

## Introduction

Augmented reality (AR) is an enhanced version of the real world, achieved through the use of computer-generated digital information. These include visual, sound, and other sensory elements. AR utilises computer hardware and software, such as apps, consoles, screens, or projections, to combine digital information with the real-world environment. AR delivers such information to the user through AR enabled devices such as smartphones, glasses or tablets. In the age of rapid technological advancement, Augmented Reality emerges as a transformative force reshaping the landscape of education. Augmented Reality seamlessly blends the physical and virtual worlds, providing users with an interactive experience. The 21st century has ushered in an era where the boundaries between the physical and digital worlds are becoming increasingly blurred. At the forefront of this technological convergence stands Augmented Reality , a revolutionary innovation that enriches our perception of reality by coherently integrating digital information into our physical surroundings. AR goes beyond mere entertainment; it has permeated various aspects of our lives, offering practical applications in various fields such as healthcare, education, business, and more.

The country has a large number of schools, colleges, and universities, offering various courses and programs. The Indian educational system is known for its emphasis on rote learning and examinations. The Indian Education System has also been extensively criticised for not being inclusive enough to students of special needs. This not only prevents students from achieving their full potential but also prevents the country from achieving its maximum technological and social advancement as students are more focussed on getting good marks than actually learning and applying the concepts learnt. In recent years, however, there has been a growing trend towards more student-centred and problem-based learning in India. The government has also introduced various initiatives to improve the quality of education in India, such as the introduction of the National Curriculum Framework and the Right to Education Act.

This research explores the essence of Augmented Reality and its application in the education sector, specifically in India. Through this research an attempt has been made to understand the scope of the applicability of Augmented Reality in the field of education. This research

also aims to explore the benefits, barriers and drawbacks of augmented Reality in education. A survey has been conducted for 150 respondents of varying age groups and professions. The paper examines scope of AR in education; the ways in which this technology can help improve the current state of education in India, the barriers that might have to be faced in achieving that and the limitations that have to be overcome before the full-fledged application of Augmented Reality in education.

## Literature Review

After reviewing around ten journals and documents regarding Augmented Reality and its applications, it was inferred that Augmented Reality is an extremely versatile technology having applicability in various sectors including medicine, military and entertainment. Augmented reality and its application in education was examined closely, concluding that while AR is immensely helpful in educating and aiding learning in abstract mathematics and science concepts such as geometry, mechanical engineering and technicality, its identified benefits may not apply in each context. Apart from education, AR's applications in the tourism sector, the gaming industry and the construction industry were analysed and its noted challenges include frequent technical problems, usability issues and current gaps in research.

## Objectives

The research paper aims to explore the potential of Augmented Reality (AR) technology in revolutionising the education sector.

1. Understand the awareness and knowledge that regular people have regarding Augmented Reality technology and its application in the field of education.
2. Examine the technical and infrastructural challenges that will be faced while adopting AR.
3. Evaluate the affordability and accessibility of Augmented Reality technology in schools in India.
4. Determine the existing gaps in the Indian education system and identify which ones AR might solve and determine the benefits that can be reaped upon adopting AR in the field of education.
5. Identify the major barriers that will arise in the process of adopting AR in the field of education.
6. Examine the scope of AR technology and its benefits for students with special needs.
7. Explore the extent to which AR can help motivate an average student to learn.

8. Understand the improvement in quality of learning that will arise upon adopting AR in the field of education.
9. Study the resistance of teachers to change from traditional methods and the extent of training that might need to be provided to teachers if AR were to be exploited to its fullest extent.

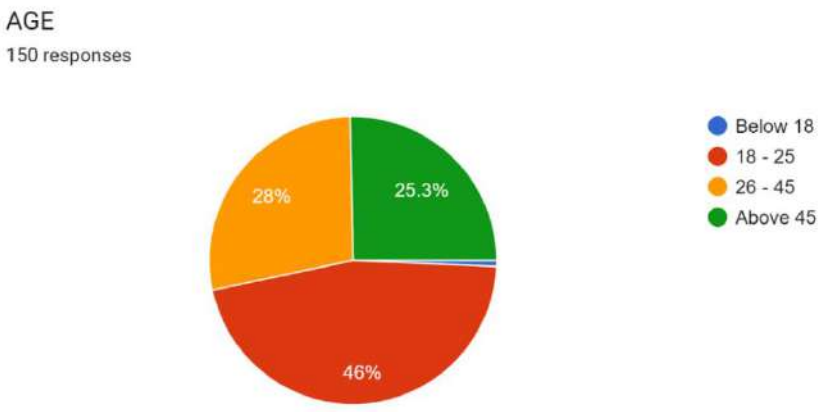
## Research Methodology

An online survey was conducted to yield valuable results and data-driven insights. This method was chosen because of its low cost and easy accessibility and also proved to be time efficient.

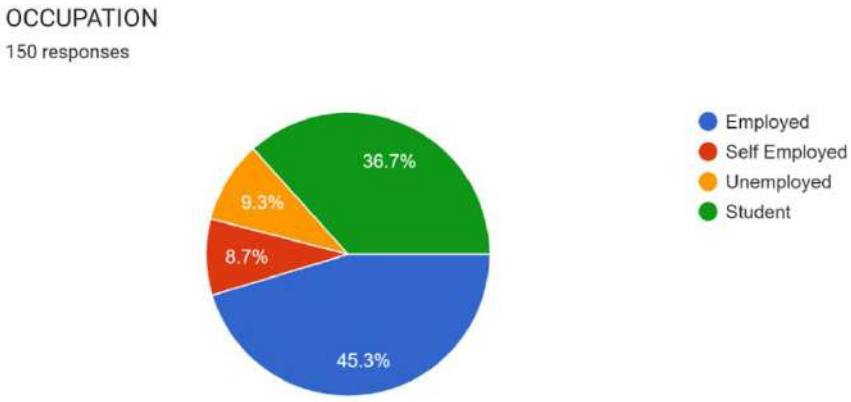
Several online journals and research papers were studied to understand the impact of Augmented Reality which were accessed using Google Scholar.

150 responses were received with all of them being residents and/or citizens of India and majority of the respondents were between the ages of 18 and 25 years who are mostly unemployed students. Respondents were questioned on various aspects regarding awareness of Augmented Reality; the benefits and barriers associated with its use and affordability and accessibility of AR applications.

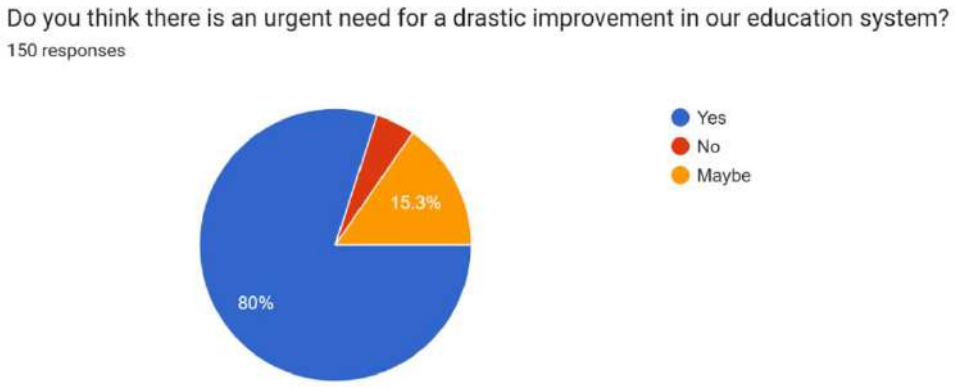
## Results



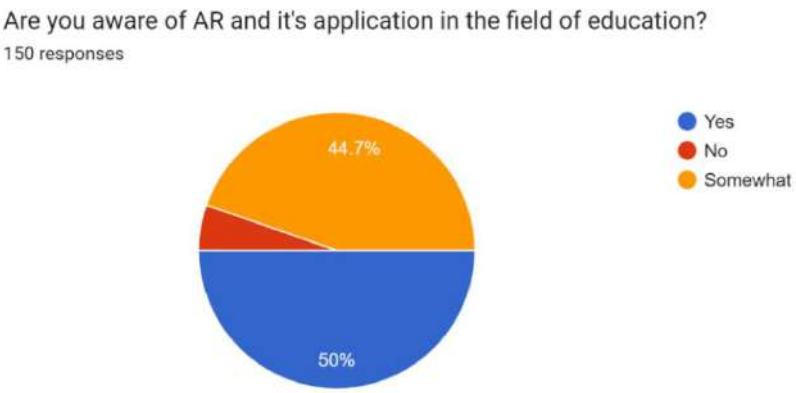

The majority of the respondents were aged between 18-25. The rest of the respondents were almost equally distributed among the age groups 26-45 and 45 years and above. A very miniscule percentage (less than 1%) of the respondents were aged below 18.



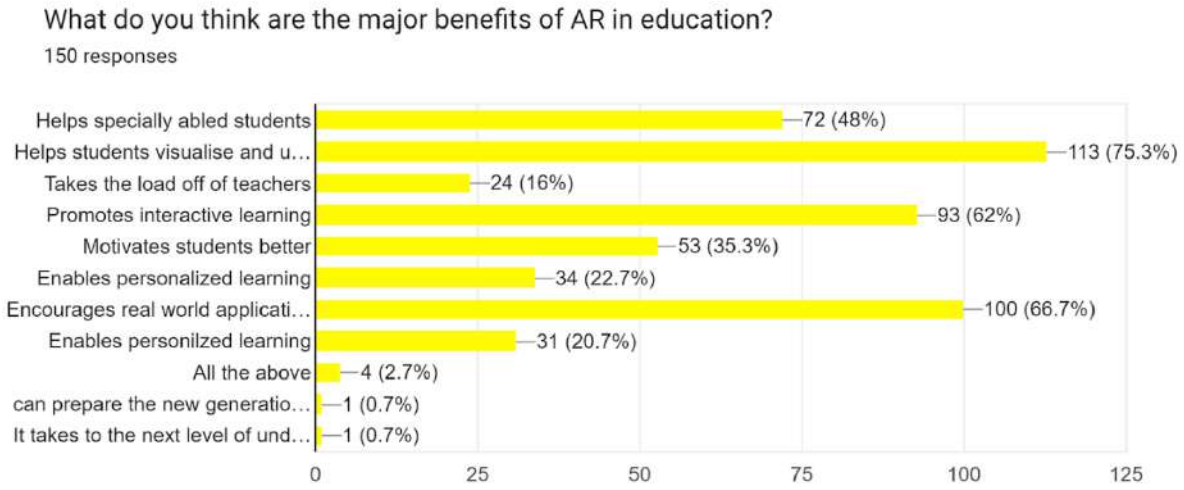

Majority of the respondents were either employed or students, with about 45% respondents being employed and 36% respondents being students. A small percentage of respondents were self-employed or unemployed.



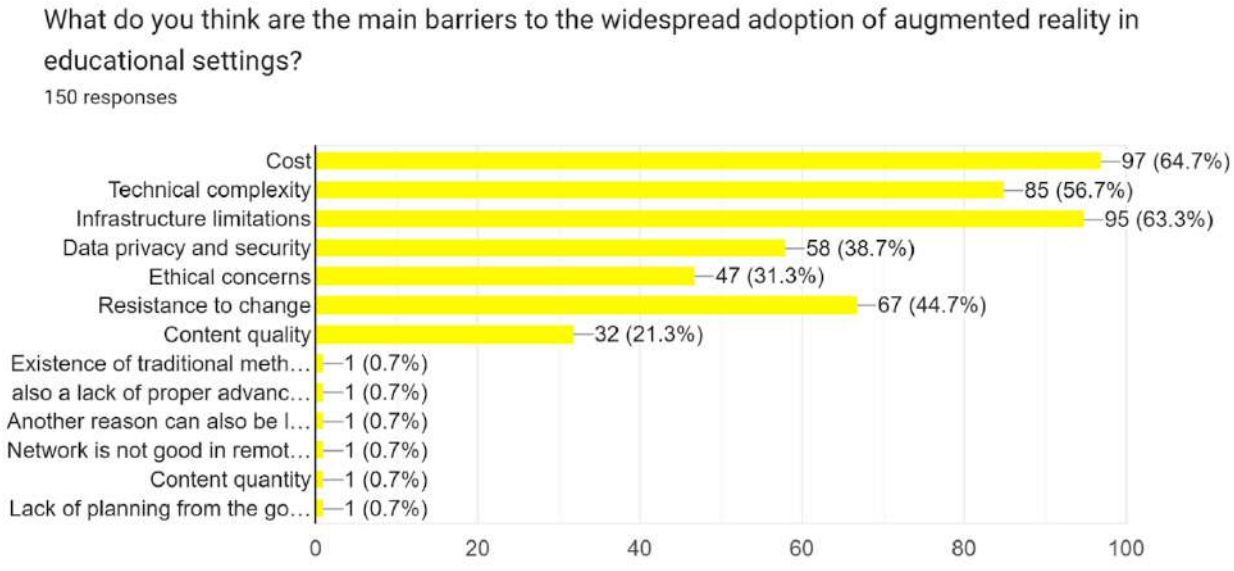

An overwhelming 80% of the respondents strongly believe that there is a drastic improvement in our education system.



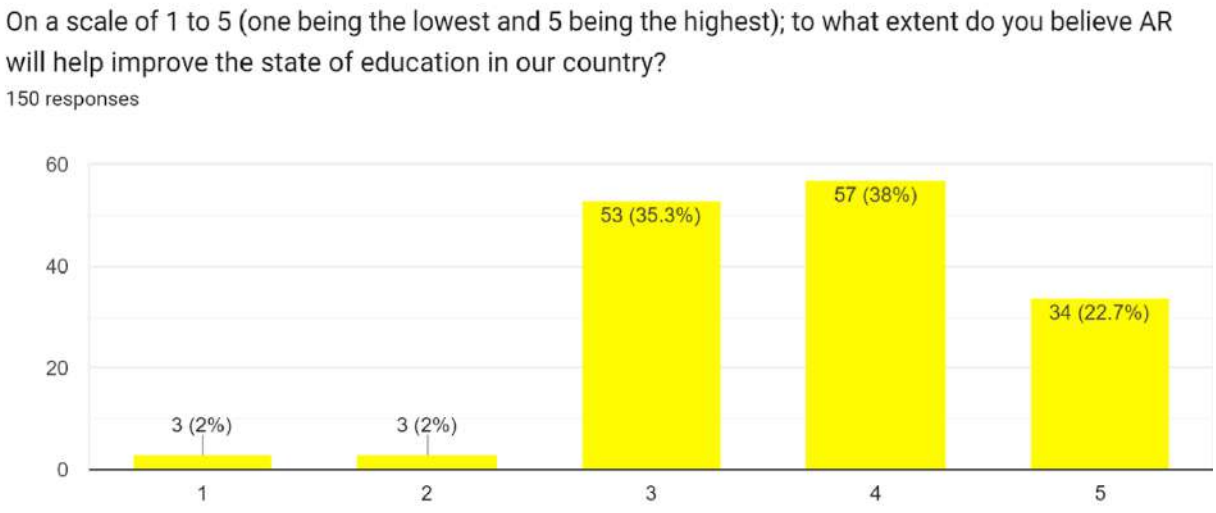
Majority of the respondents were aware of AR and its application in the field of education to a certain extent. Only a small 5% portion of the respondents were not aware of AR and its application in the field of education.



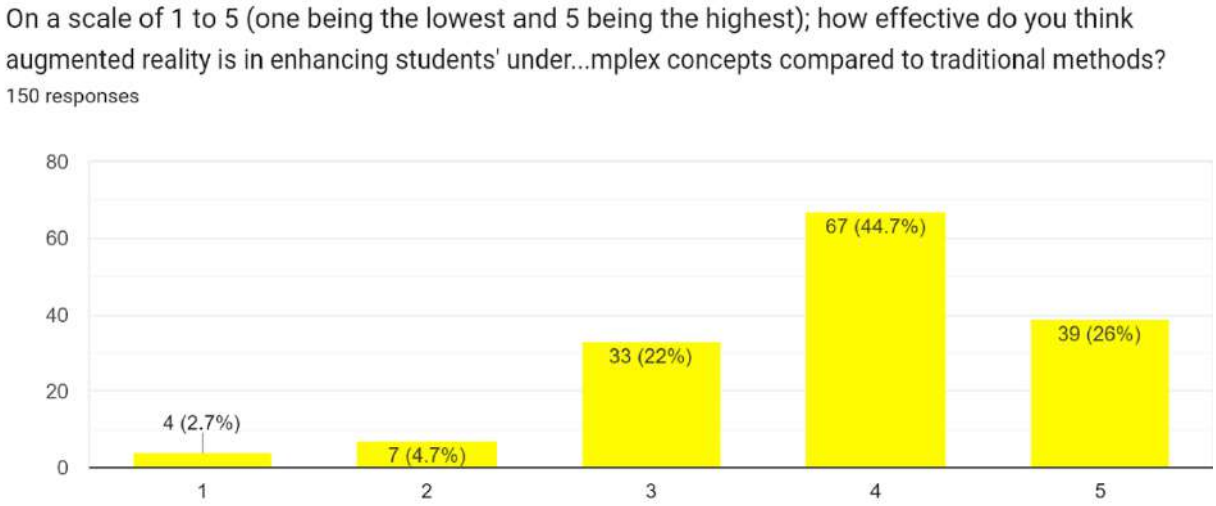

Most respondents feel strongly about the change in the quality of education that AR will bring about. A total of 75% of the respondents believe it would help students visualize and understand concepts better, 66% of the respondents feel it would encourage students to apply the concepts learnt in the classroom in the real world, and 62% of the respondents believe it will promote interactive learning. On the other hand fewer respondents felt positive about AR taking the load off of teachers and motivating students.



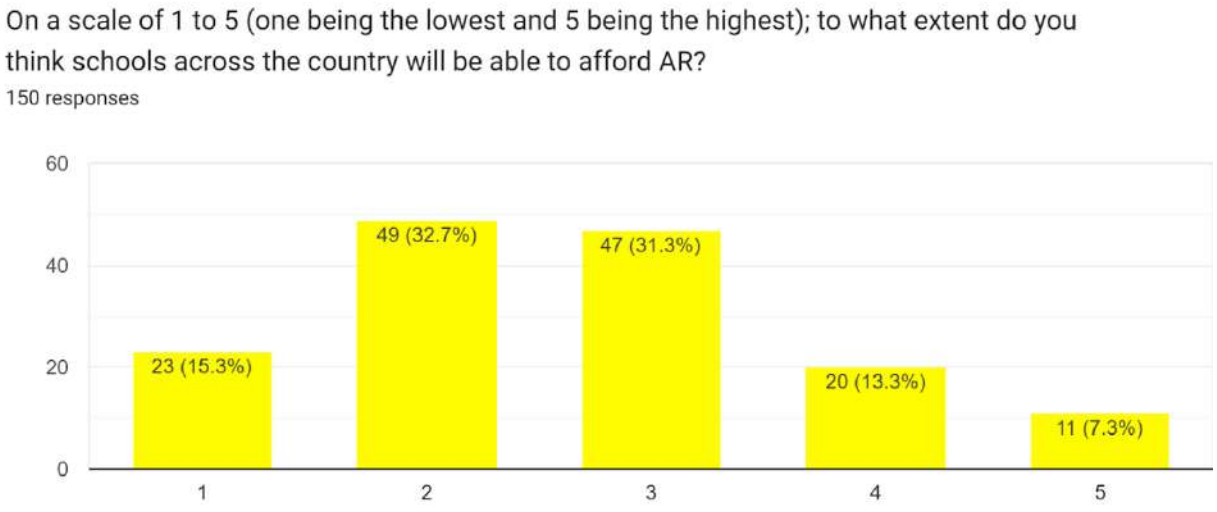
A major portion of the respondents (64.7% and 63.3%) felt that cost and infrastructure limitations were the main barriers to the widespread adoption of Augmented Reality in educational settings respectively. The other major reasons include technical complexity that AR poses, the resistance of the general participants in the education sector to incorporate changes in their methods of learning and teaching. Fewer respondents were concerned about data privacy and security and ethical issues.



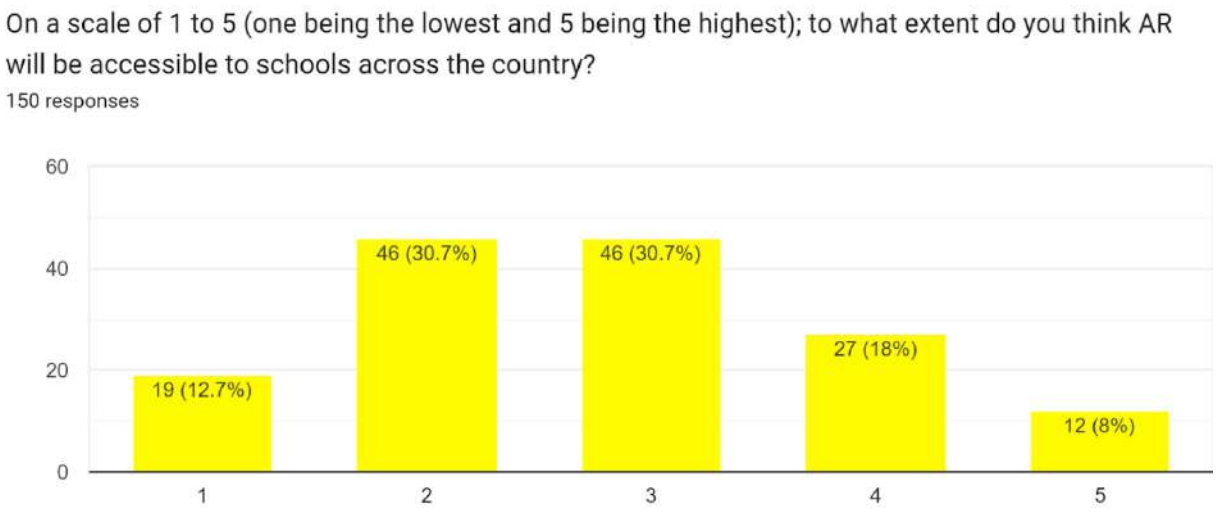

Majority of the respondents feel that Augmented Reality will improve the state of education in our country. Around 35% of the respondents adopt a neutral stance. Only 4% of the respondents have perceived AR of not having a significant and positive impact on the current state of education.



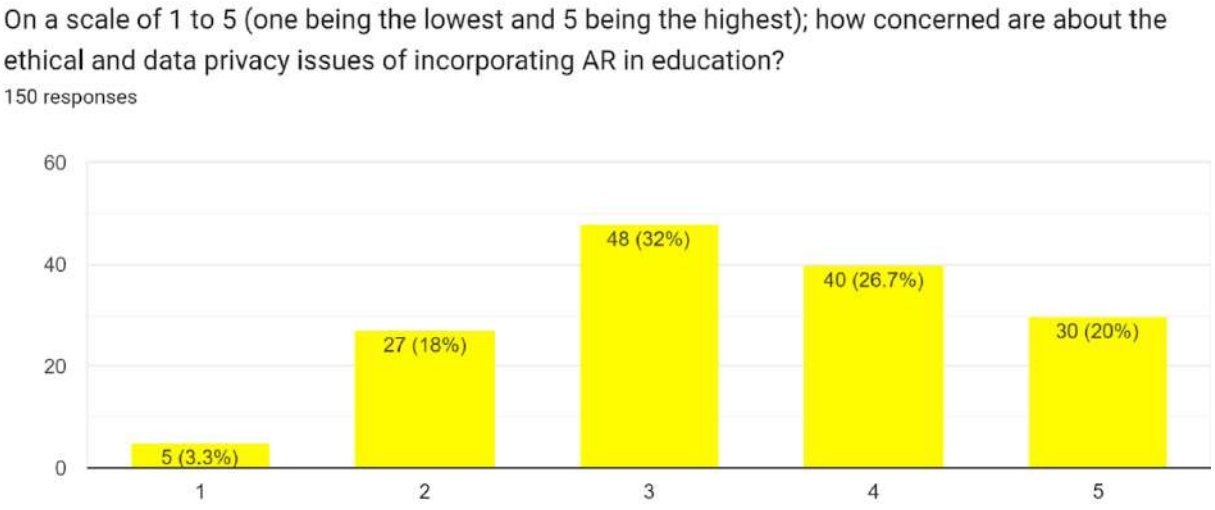
Majority of the participants feel positively about the AR's role in enhancing students' understanding of complex topics that traditional methods might potentially fail at. However, a small percentage of the respondents do not believe AR can be that useful as opposed to traditional methods and about 33 respondents have adopted a neutral stance in this regard.



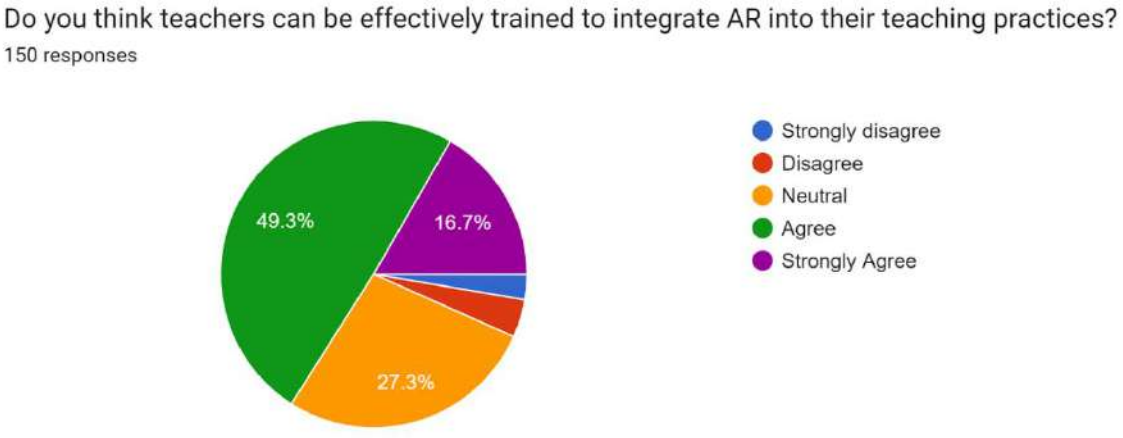

A major proportion of the respondents believe that schools across the country will not be able to afford augmented reality. Equal number of respondents adopted a neutral stance as well. Only a very small portion (7.3%) of the respondents believed that schools would be able to afford AR.



Similar to the affordability of AR by schools, the majority of the respondents felt either that AR would not be accessible to schools across the country or adopted a neutral stance. Few respondents however also believe that AR will be accessible to educational institutes.

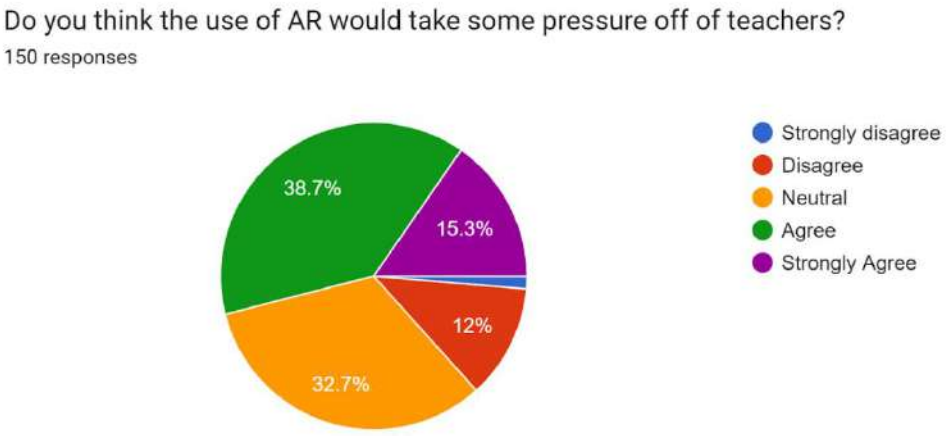



The majority of the respondents were neutral regarding the ethical and data privacy aspects of incorporating AR in education. At the same time, a significant number of respondents (26.7%) also expressed their concern about the ethical and data privacy issues of incorporating AR. Only 3.3% of the respondents remained entirely unconcerned.

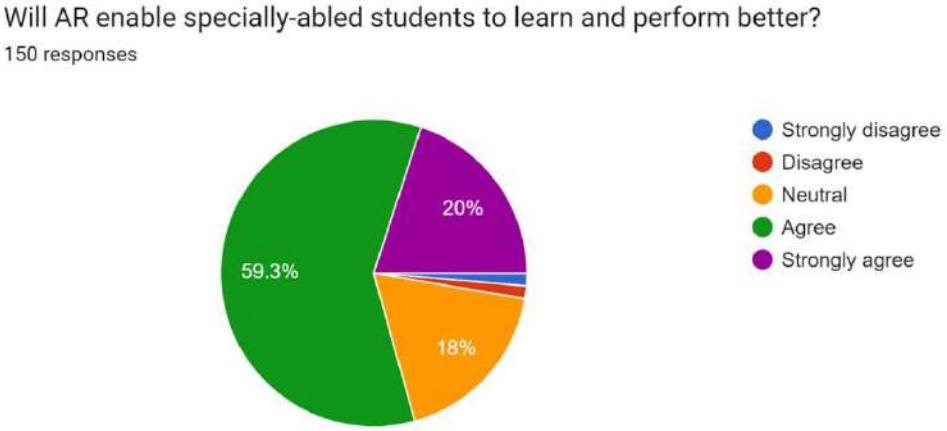



Almost 50% of the respondents believe that teachers can be effectively trained to integrate AR into teaching practices. While 27% have adopted a neutral stance, 16% of the respondents strongly believe that if teachers are given effective training, AR can be utilised in teaching

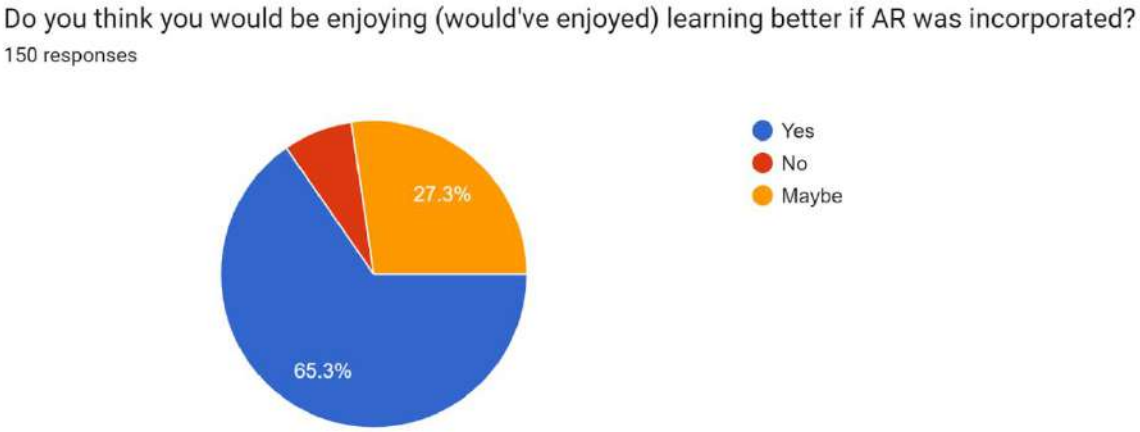
practices seamlessly. A small portion of the respondents however, also believe that teachers cannot be effectively trained to integrate AR into their teaching practices.



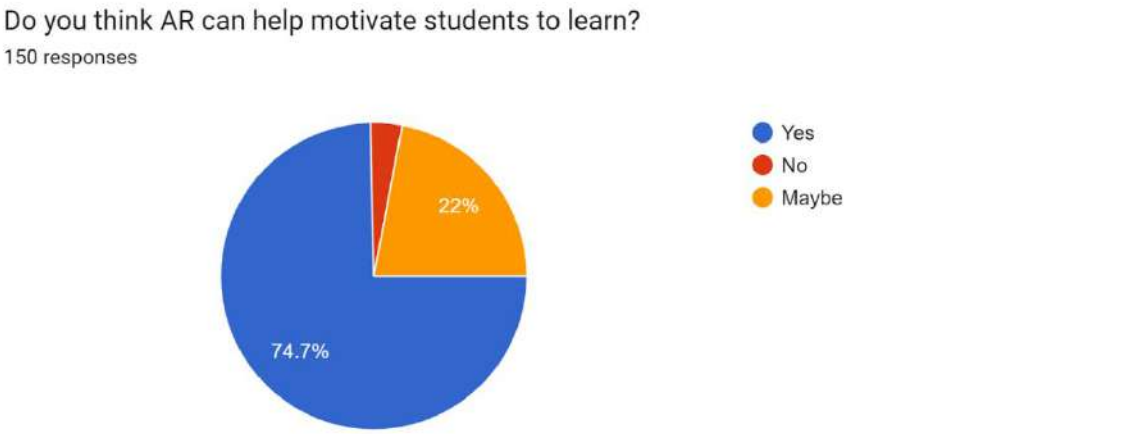

About 39% of the respondents believe that incorporation of AR into education would relieve teachers of the great pressure that they undergo otherwise. 32% have adopted a neutral stance and only 1.3% of the respondents strongly disagree with the aforementioned statement.



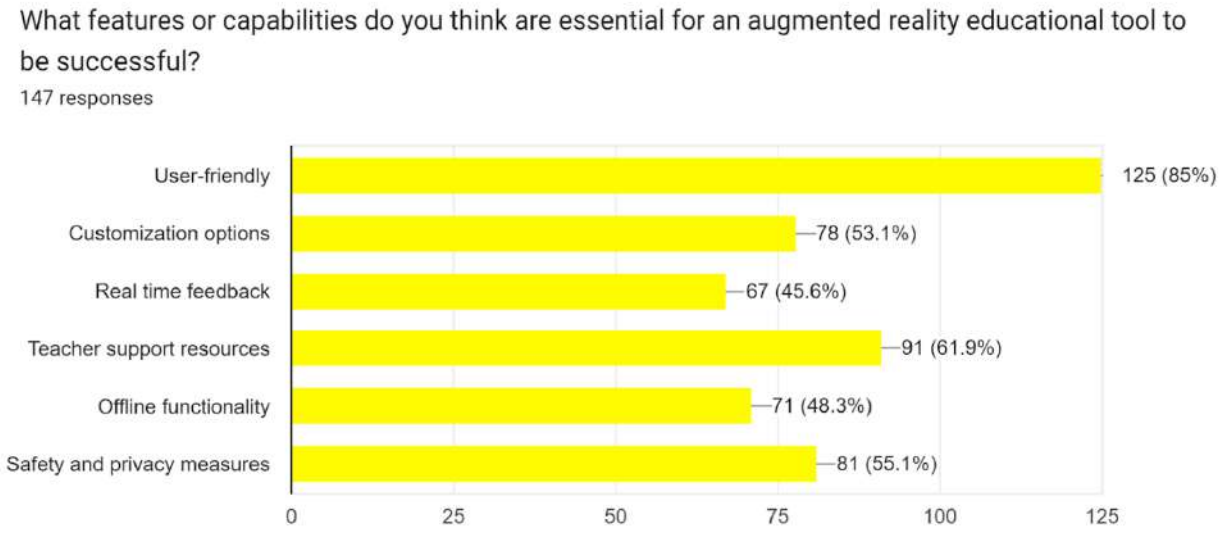

That AR would enable specially-abled students to learn and perform better has amassed a majority of the respondent's choice (to the extent of 60%). 18% of the respondents took a neutral stance. The percentage of the respondents that disagree and strongly disagree amounts to the same, minimum percentage of 1.3%.




An overwhelming 65% of the respondents felt that they would be enjoying or would have enjoyed if AR was incorporated in teaching practices. About 27% of the respondents felt unsure and only about 7% of the respondents disagreed.




¾ of the respondents believe that AR can help motivate students to learn and perform better in school, especially as far as abstract science and mathematics concepts are concerned. This also highlights the fact that AR would help boost student engagement. While 22% of the participants were unsure, only a miniscule 3.3% of the participants believe AR will not be very helpful in motivating students.




Majority of the respondents (85%) believed that a user-friendly AR tool would be successful in the education sector. The other capabilities selected include teacher-support resources, increasing safety and privacy measures and customization options. Real time feedback and offline functionality also served as important features

**Analysis and Summary of Findings**

From the above research and responses, the following conclusions have been made:

1. There are several gaps in the Indian education system that are preventing students from achieving their full potential. The current system is failing to cater to the diverse needs of millions of students and is laying focus on studying without understanding than learning. This not only prevents the students from achieving their full potential but also prevents the technological and social advancement of the country as a whole.
2. AR can help overcome these various gaps. Where the traditional methods have been consistently failing students with special, AR can significantly help them learn and achieve great heights, as AR can help promote personalised learning.
3. Using AR to teach can greatly motivate young students to learn as they engage in interactive learning and use creative teaching methods.
4. AR will greatly increase the quality of learning as it promotes visualising concepts and encourages students to apply them in the real world.

5. Before achieving the full-fledged application of AR, certain barriers have to be overcome, including the cost and accessibility of the technology itself.
6. There should also be a significant focus on not only making technology user friendly but also helping teachers train and adapt to the new technology. There are several infrastructural limitations that will prevent the technology from being used.
7. The technology will also bring about ethical and privacy concerns and measures have to be taken in order to ensure the technology does not breach privacy or threaten human safety.
8. There is also an overall lack of awareness when it comes to understanding the technology of Augmented Reality. Most people have limited to no understanding of the technology which can pose a barrier by preventing several people from embracing the emerging technology.
9. In a country where teachers are limited and overworked and underpaid, AR can take the load off of them to a certain extent which will not only increase the quality of life for these teachers, but will also help them perform better.
10. Despite its scope, AR still cannot fully replace human teachers as they have an indispensable role in the education system and hence, they both have to work hand in hand.

**Limitations of Study**

The researchers worked on a time crunch which may have compromised the quality of research in certain places. The limited knowledge of Augmented Reality of the researchers prior to taking up the project posed a hurdle. Finally, Augmented Reality is a fairly modern concept that most people have limited knowledge about and the study vastly relied on personal beliefs and opinions of the public rather than empirical values. Therefore, this may have compromised the survey to a certain extent.

**Suggestions**

1. Investment in Infrastructure: both the government and educational institutes should invest in robust AR infrastructure and devices to ensure proper delivery of AR experiences, student engagement and motivation.
2. Accessibility: the cost aspect of incorporating AR in educational settings is one the greatest challenges it faces, and therefore it must be ensured that AR resources are

designed in such a manner to be accessible to diverse learners, especially those with special educational needs.

3. User-friendly: User-friendly AR interfaces must be developed which facilitates interaction and navigation for both teachers and students alike.
4. Development of Educators: training programmes and workshops have to be arranged for the educators to inculcate the required skills and competencies to effectively integrate AR technology to their teaching methods.
5. Feedback Mechanisms: having feedback mechanisms in place would acquire input from teachers and students regarding their experiences with the technology thereby allowing continuous improvement of educational resources.

## Conclusion

Augmented Reality is an emerging technology that has tremendous scope of solving various everyday problems of human beings. The education system in India has several gaps that need urgent attention and is preventing the country's youth from achieving their full potential. AR can help greatly in filling these various gaps including helping students understand certain topics better and encouraging the practical application of topics learnt in the classroom. The technology can also significantly help children with special needs. However, there are also several barriers that will arise before we can fully exploit this technology including affordability, accessibility and training and infrastructural requirements. Using AR in education can also bring about certain drawbacks like privacy and ethical concerns. Despite its scope, AR still cannot fully replace human teachers as they have an indispensable role in the education system and hence, they both have to work hand in hand.

Overall, use of Augmented Reality in the field of education can help solve various pressing issues with the Indian education system but not before encountering various barriers and overcoming limitations. But once these are overcome AR can greatly help Indian students achieve their full potential.

## References

- Azuma, R. T. (1997, August 1). A survey of Augmented Reality. MIT Press. https://direct.mit.edu/pvar/article-abstract/6/4/355/18336/A-Survey-of-Augmented-Reality

- Diegmann, P. (n.d.). Benefits of Augmented Reality in Educational Environments - A Systematic literature review. AIS Electronic Library (AISeL). https://aisel.aisnet.org/wi2015/103/

- Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educational Research Review, 20, 1–11. https://doi.org/10.1016/j.edurev.2016.11.002

- Koutromanos, G., Sofos, A., & Avraamidou, L. (2015). The use of augmented reality games in education: a review of the literature. Educational Media International, 52(4), 253–271. https://doi.org/10.1080/09523987.2015.1125988

- Yung, R., & Khoo-Lattimore, C. (2017). New realities: a systematic literature review on virtual reality and augmented reality in tourism research. Current Issues in Tourism, 22(17), 2056–2081. https://doi.org/10.1080/13683500.2017.1417359

# A Review on Recent Trends in Augmented Reality

Indu N Pai | Mihit Manoj
B. Tech in Electrical and Computer Engineering
Amrita Vishwa Vidyapeetham

***Abstract***

*Augmented reality (AR) is an interactive experience that combines the real world and computer-generated content. AR can be defined as a system that incorporates three basic features: a combination of real-world and virtual worlds, real-time interaction, and accurate 3Dregistration of virtual and real objects. The earliest functional AR systems were invented in the late 1900s. Since then, AR has grown exponentially in various fields, including gaming, business, education and other research works. This paper describes the growth and recent trendsobserved in AR and also its influence in various fields of learning including Medicine, Mathematics, Astronomy and Physics. This paper discusses how AR has had a positive impact on various disciplines and the advantages it puts forward to various people.*

***Keywords:*** *Augmented reality, virtual reality, reviews, technology*

## Introduction

Augmented reality makes visual changes to the present natural environment and enhances it by adding new information. The first AR technology was developed in 1968 when computer scientist Ivan Sutherland from Harvard University created an AR display system. Later in the 1980s Steve Mann built “mixed reality” visual systems for daily uses and other display systemsto modify visual reality to assist people to see better. The term ‘augmented reality’ is actually put forward in the year 1990 by a researcher, Thomas P. Caudell. In the year 1992, the first functioning AR system was built by the United States Air Force Research Laboratory which also showed how beneficial AR is for the human population. By the time it was 1999, the benefits of AR were also explored by researchers at NASA. In the early 2000s a shift for AR from research to gaming technology was noticed; Sony released PlayStation 2 that held the features of AR and later on, many games incorporated AR into it. The most notable one wouldbe that of Pokémon Go, which was a game released

in 2016 that grew the popularity of augmented reality games.

Though it may look and sound similar, there is a fine line between augmented reality and virtualreality, another term commonly used these days. While AR augments the real world with the virtual world, VR is a completely immersive virtual environment. By using VR, the user is

completely isolated from the real world and finds himself in a virtual/fictional space. Even themain focus of the two is completely different; AR enhances the real world around the user, making the present environment more accessible for him while VR focuses on stimulating thevision. The constructed reality in VR can be pretty impressive because it can employ visual, auditory, and touch simulation.

Augmented reality has plenty of potential to gather and share knowledge. This is because AR is performed in real time with contexts with environmental elements. With the help of advancedAR technologies, the information surrounding the user can be easily manipulated and used fortheir benefit. AR adds to the present reality without taking away anything that was already present in the real world.

**Recent Trends**

AR is an ever-growing technology and it has been used by many professions since its beginning. The recent trends seen in AR along with its applications are discussed below-

Games and business tools: AR has evolved to be an incredibly useful tool for performing a lotof critical tasks. AR was introduced in games for fun, but these days businessmen use AR morethan ever. Google has developed its Android AR technology, ARCore and it has been constantlyevolving. It helps access the geometry of buildings and also terrain within a 100-meter radius.It generates maps and street-view of buildings which is useful for developers.

AR and the new workspace: With extensive presentations and convenient conference platforms, a person can efficiently conduct meetings from home. Office routine will undergo changes in 2024 especially with the announcement of MS Office Suite which will transform office habits. New Zoom but with AR features can be a great place to demonstrate projects. Workflow can be simplified with AR technology.

WebAR experience: Though AR has shown significant growth one of the biggest

challenges faced with mobile AR is hardware compatibility. Even the most useful AR experience, thoughhighly impressive and useful, will be out of reach for the general public due to incompatibility in many day-to-day devices. That's where WebAR comes into play. It helps provide AR experiences through a web browser that is compatible with most devices with a camera. Although WebAR doesn't give way for complex AR technology to be accessed easily, its mainstrength is its accessibility. Some WebAR experiences include face filters, background replacement, and photography editing.

Digital Marketing and Advertising: AR has expanded the advertising sector and this helps various brands grow. Applying AR in user manuals, business cards etc helps brands to stand out against the competition. According to research conducted by Meta, advertisements that incorporated AR technology proved more successful than the ones without it, increasing the memorability of the ad viewers, especially those between the age group 18-24. AR in marketinghelps make businesses more money and by 2027, augmented reality's future revenue is predicted to climb as high as $39.8 billion.

Navigation: AR has greatly helped both indoor and outdoor navigation systems due to its highly interactive user experiences. But in terms of navigation constraints outdoor navigation has benefitted the most. Google and Apple have implemented Visual Positioning Systems or VPS in their AR platforms to compare street views and locate a user's position. But these systems may not perform optimally during bad weather conditions or when fog is present. But during good weather conditions, it allows for more immersive experiences while exploring new places.

Healthcare and Medicine: Wearable displays like Microsoft HoloLens are used by doctors to assist with surgery by providing important information like patient vitals and helping them stayfocused on their job. Also, AR can be used for early disease detection; Google is updating theirsoftware named GitHub which helps healthcare professionals detect cancer cells at earlier stages. Such improvements in medicine can improve the quality of life and reduce the risk of acquiring fatal diseases at a young age.

AR shopping experience: Developers have made software that inculcates AR in it and it can accurately predict how a certain piece of furniture would look in a room. This is being used by popular stores such as IKEA, Target etc. During online shopping for clothes,

providing a replicaof the user's body measurements can increase customer satisfaction and personalize their shopping experience better.

Education: One of the most important applications of AR would be for education and teaching. AR would help students participate and get a more practical knowledge of the information acquired in a traditional classroom. Google Class is an excellent example of AR in education which, in the future, can replace physical classrooms. Usage of AR for medical students is especially beneficial since they can visualize various parts of the human body in 3D and can even perform trial surgeries before the actual surgery. Using AR in teaching can increase interest and keep students engaged in their work. According to a survey conducted in 2012, it has been observed that the number of students pursuing has never reached 60%. In the UnitedKingdom, there has been a great decrease in the number of students pursuing Mathematics, Physics, Chemistry, Engineering and Medicine. AR may be able to tackle this issue by makingstudents realize that Science is an interesting stream and it is filled with wonderful concepts.

Automotive industry: AR can increase car sales, provide assistance for drivers, and even alertdrivers to regain their focus.

**Limitations of AR**

AR is not something that has been fully explored yet. A lot more research has to be done in order to extract its full potential and use it wisely. Many people agree that AR tools are good in many aspects, but, especially in teaching and education, people do not think that AR can bea substitute for the traditional method of teaching using textbooks. There is also an issue of accessibility. AR is not something that can be accessed in every device commonly used and this would drastically decrease the amount of people who can use it properly. Though these issues can be tackled with effort, it would take a lot of time.

**Conclusion**

It is evident that AR has the potential to improve every field and profession. The use ofAR has received positive feedback from a majority of its consumers. With time, it will slowly improve and it would be able to overcome its limitations. Increased internet access, proper knowledge of how to use such technologies effectively, and compatible devices can help improve AR and it would be possible to exploit its benefits completely. There are also

other concerns like user privacy and manipulation of data by the user itself. With proper implementation, such ethical issues can be solved.

## References


- https://en.wikipedia.org/wiki/Augmented_reality
- https://mobidev.biz/blog/augmented-reality-trends-future-ar-technologies
- https://www.researchgate.net/publication/281336331_A_Review_of_Research_on_Augmented_Reality_in_Education_Advantages_and_Applications
- https://mywebar.com/blog/trends-in-augmented-reality-for-2024/
- https://gamingintel.com/pokemon-go-new-ar-features-2024/
- https://journals.sagepub.com/doi/full/10.1177/2043886920947110

# A Study on Augmented Reality – The Biggest Technological Revolution

Alagukamalam.G | Sharmila.D
B.B.A.
Kumararani Meena Muthiah College of Arts & Science

***Abstract***

*Virtual reality (VR) technology is a cutting-edge technology that allows users to travel another computer-generated world while also reducing stress. The technology has developed significantly in terms of offending authentic sensory industries. Virtual reality technology has the potential to be a great tool for improving our lives and revolutionising how we do things in our daily lives. In this review, we provide a brief overview of the current state of the art of augmented reality technology.*

***Keywords:*** *Augmented reality, virtual reality, enhanced experience, psychological effects.*

## Introduction

The integration of digital information with the user's surrounding in real time is known as Augmented Reality or AR. Users of augmented reality (AR) see the real world with created per capital information superimposed on top of it, in contrast to Virtual Reality (VR), which generates on entirely invented environment. An interactive experience that blends computer-generated material and the actual world's called augmented reality. Multiple sensory modalities, such as visual, aural, haptic, somatosensory, and olfactory, may be covered by the material.

The VR industry is still a long from reaching its goal of creating a fullyimmersive world where users may interact with a variety of experiences in a way that is close to reality. Nonetheless, the technology has advanced significantly in terms of offending authentic sensory industries. A computer-generated environment known as visual reality (VR)gives users the impression that they are fully immersed in their surroundings by simulating real – world sense and objects. A virtual reality headset, helmet, or other equipment is used to view this environment

**Objectives of the study**

1. **To study about augmented reality and virtual realityAugmented reality**

With the use of virtual items, augmented reality (AR)creates a new kind of mixed reality environment by augmenting the real world. Augmented reality system typicallycompares an output device that shows the virtual data, A tracking system that determines the users position orientation, a computer that processes the require data andarbitrary input device that once used for interaction and navigation

AN interactive experience known as augmented reality involves adding computer-genera ted sounds, visuals and other stimuli to a real-world setting. IY cangive the user a more enhanced and increases their enjoyment or comprehensive.

**Virtual reality**

Technological limitation regarding users feeling uncomfortable or ill while usingVR headset, the inaccessibility of this technology to most people due to the high price of the associated hardware, and the lack of technical standardization are all current issues that the tech industry is hoping to overcome with research and future improvements.

Overall, this literature review serves the purpose of covering how different types of VR application can be utilized, as well as providing information on the advantages anddrawbacks of using VR technology in various application domains.

2. **To know about the latest developments in AR and VR**

**Augmented Reality**

Augmented Reality (AR) is the process of superimposing digital material over the actual world to improve the user's view of the physical surroundings. It combines real- world viewpoint with computer-generated materials such as photos, movies, or 3D models, usually through the use of tablets, smartphones, smart glasses, or even headsets.

- Information in real time: Augmented reality has the potential to improve comprehension and decision-making by giving users access to context-specific data and real-time information superimposed on objects or locations.
- Training and Education: Augmented Reality (AR) offers immersive and interactive learning experiences in a number of sectors, including medical training, industrial simulations, and educational applications.
- Entertainment and gaming: Augmented reality (AR) has gained popularity in games where virtual people and things are integrated into the real environment, creating thrilling

and engaging experiences.

- Retail and marketing: AR let consumers see items in real-world settings, try on virtual outfits and accessory fits, and engage with interactive advertising campaigns.

**Virtual reality**

Virtual reality (VR) is a term used to describe an immersive and simulated experience that immerses people in a fully virtual environment and separates them from the real world. Users interact with the virtual environment by wearing VR headsets or goggles that offer a 360-degree view, and they frequently employ portable controllers.

- Immersion experiences: Virtual reality (VR) gives users the impression that they are physically there in a computer-generated world by fostering a sense of presence and immersion.
- Play and amusement: Virtual reality (VR) provides incredibly engaging and interactive gaming experiences that let players explore virtual worlds and interact with items and people.
- Training and simulations: The aviation, healthcare, military, and construction sectors all make substantial use of virtual reality technology for training simulations. It offers a secure and regulated setting for honing difficult tasks and techniques.
- Architecture and design: Virtual reality (VR) helps in the design and decision- making process by enabling architects and designers to see and navigate around virtual representations of buildings, spaces, or prototypes.
- Therapy and rehabilitation: Virtual reality (VR) is being used in medicine for therapeutic purposes, including the treatment of phobias, PTSD, and motor rehabilitation.

### 3. Pros & Cons of Augmented Reality & Virtual RealityAugmented Reality

**Augmented Reality**

| Pros | Cons |
|---|---|
| **Enhanced Experience**<br>The main purpose of augmented reality is to merge thevirtual and physical worlds. By doing this, it improves the user's experience by allowing simulated graphics to overlap with the actual world. Uses for AR technology include improved gaming, cooperative triangulation, and other augmented reality applications. | **Expensive**<br>AR has benefits that benefit organisations as well as individuals. Businesses may improve their procedures and offerings with the help of augmented reality. However, it goes without saying that implementing such technology requires a similar investment as well as meticulous knowledge.<br><br>Few major organisations have this benefit sincenot all of them have the resources to invest in augmented reality technology. |
| **Ease of use**<br>The development of the augmented reality software for iOS and Android platforms validates the newest virtual and physical retail encounters. By helping customers choose the right size, digital changing rooms can reducethe number of returns.<br><br>This also applies to new automobile colours and the hueof furniture in one's home. Retailers may develop unique augmented reality applications tailored to their goods in order to provide customers with an enhanced experience when needed. | **Assaults confidentially**<br>One of the main drawbacks of augmented reality would be the need to create, evaluate, and gather huge amounts of data. The issue of confidentiality is taken into account with such data.<br><br>Furthermore, some AR systems record the environment in real time, which raises legal concerns akin to those raised by recording someone's chat or taking images of an unidentified person and their property—all of which are forbidden. |

| | |
|---|---|
| **Social Interaction**<br><br>The goal of augmented reality is to develop technology that fosters social interaction amongst individuals. One common example of AR technology in use is PokémonGo. The game has greatly enhanced society by helping participants express themselves socially.<br><br>You have to leave your residence to play the game, andonce you do, you'll become entangled with some other players you would not have seen otherwise. It has been discovered that this element has helped athletes who were experiencing stress, anxiety, or depression, among other issues. | **Accidental situations**<br><br>Simply said, games such as Pokémon Go may be used to illustrate the drawbacks of augmented reality. Because augmented reality incorporates digital technology into the actual environment, it can conceal real-world signals from the<br><br>On occasion, these indicators might help people avoid risks like car crashes and other incidents. People who are unaware of this significant risk are more likely to run into unintentional scenarios when playing the game. |
| **Learning and Practice**<br>Learning new things and honing a few abilities has been quite easy using augmented reality. The impact of the augmented reality software has now eased the process of learning<br><br>Learning and practice are made as simple as possible for an engineering student by allowing them to explore and analyse the engine of a virtual automobile in augmented reality, rather than in real life. | **Addiction**<br>Because players might lose themselves in the game for hours at a time, augmented reality technology has a reputation for being addictive. Addiction is linked to a number of health concerns, including obesity, chronic pain, eye difficulties, and loss of attention. |
| **Improved Technology**<br><br>The effect of augmented reality technology alone may significantly expand the reach of a device such as a smartphone. These days, augmented reality is widely used in many smartphone applications, including real- time navigation road information, concurrent text | **Psychological Effects**<br><br>Numerous violent video games, whether they are about crime or war, have frightening elements that might change a player's perspective. These kinds of games have a psychological impact on players, particularly the younger generation, |

| | |
|---|---|
| converters, communication maps with precise terrain, and camera app filters.<br><br>AR makes all of these extra capabilities feasible and keeps enhancing how people interact with computers. | making them think that socially acceptable acts of violence are acceptable. |

**Virtual Reality**

| Pros | Cons |
|---|---|
| • **Better social interaction**<br><br>We can move, interact, and communicate in real time within a three-dimensional computer-generated world.<br><br>This is the most memorable way to communicate with the internet compared to other methods—it seems like you and your team are in the same room.<br><br>Your virtual self is personalised via hand gestures and voice inflections that are controlled by the console. Effective communication may be achieved using 2D/3D information brought to the conference by employing virtual post-it notes or a variety of toolkits. | • **Instances of motion sickness**<br><br>Virtual reality (VR) offers users intensely dramatic personal experiences, which may cause sensory overload in certain individuals.<br><br>Motion sickness may be avoided by keeping meeting spaces uncomplicated and limiting motion information.<br><br>While many virtual reality meeting technologies offer extended realism, having meetings in virtual locations such as skyscraper boardrooms or high coffee shops can makeattendees feel lightheaded. Digital components' performance is crucial in reducing motion sickness. Fewer people will beimpacted by these dangerous circumstances as quality rises. |

| | |
|---|---|
| • **Recovery and comeback made easy**<br><br>Virtual reality, sometimes known as a 3-D model, is a tool that helps troops with PTSD and veterans of the armed<br><br>By mimicking real-world settings and enabling military patients to endure incapacitating stressful events, the artificial surroundings are beneficial.<br><br>Because virtual reality allows users to attempt to make sense of the horrific environment, it helps reduce phobias.<br><br>Immersion in virtual reality has the potential to enhance motor abilities and facilitate physical rehabilitation for individuals. | • **Isolates you in real life**<br><br>There is less interpersonal interaction the moretime spent in the virtual world. You'll need to put in more effort to express yourself both in public and privately if you're less gregarious.<br><br>Perfect human contact, for an individual, is established via social ties, whether they with family or friends.<br><br>The danger of a virtual digital environment is that it might cut you off from the outside worldentirely. |
| • **Answers to language barriers**<br>Virtual reality technology's three-dimensional representations have a remarkable capacity to helpindividuals overcome linguistic barriers.<br><br>This is due to its ability to leverage appropriate 3D prototypes that seamlessly integrate into an alternate reality by optimising the multimedia encounter.<br><br>A virtual reality headset is all that is required. | • **Virtual reality can be glitchy**<br>Devices for virtual reality might malfunction at any time or location. All users, including students and gamers, will find it inconvenient when the designed software malfunctions at any moment. It can take longer and cost more money than normal to repair or solve the issue. |

| | |
|---|---|
| • **Convenient & practical application**<br><br>Virtual reality is useful for everyday tasks like shopping. Let's say you want interior design for your house.<br><br>It is confusing since choosing the appropriate mix is notmade any simpler by merely glancing at the 2D models.<br><br>By assembling the inside and exterior designs of your house using 3D virtual reality models, you may resolve your uncertainty and make an educated choice. | • **Virtual reality remains pricey**<br><br>Even though virtual reality is one of the most noteworthy technologies now in use, most people cannot afford it.<br><br>The numerous advanced features that comewith virtual reality are the main cause of its high cost. Because of this, not everyone has access to virtual reality. |
| • **Outstanding users' experiences**<br><br>Customers are able to see and hear the genuine sights and sounds of a dynamic setting, giving them the sensethat they are in real places.<br><br>People with disabilities greatly benefit from virtual reality technology since it makes it possible for them toexperience the actual world without physically travelling there. Virtual reality films provide viewers the opportunity tosee every detail of every scene, giving viewers an immersive visual experience. | • **Addictive like a Narcotic**<br><br>Those who already own virtual reality headsets will probably be able to relate to the misery of giving in to this compulsive habit.<br><br>Your addiction to virtual reality grows as you spend more time in it and less time in the real world. You'll never realise how much time you've wasted and how many hours you've spent playing video games. It's essential to alert oneself to the fact that something is not tangible and is instead unreal.Knowing when it's time to return to reality is equally vital |

The following questions were discussed with the Company Head:

1. Name, age, gender, and occupation
2. Are you familiar with AR and VR?
3. Have you made an attempt to learn about AR and VR?
4. How you have found AR and VR useful.
5. How AR and VR have taken over the modern business world.
6. How AR and VR will help your business make money in the future.
7. Do you have any recommendations for us to pique our interest in the AR and VR game industries going forward?

**Limitations**

- End-users are not properly trained to utilise VR/AR devices.
- Long-term usage of VR may induce headaches and dizziness.
- HMD devices have a tiny field of view, are cumbersome, and have limited battery life.
- Many users struggle with using controllers, leading to limited hand tracking.
- VR should be utilized inside in a safe, secure location.

**Conclusion**

In conclusion, I would like to state that people's lives are made easier and that many other professions gain from technological advancement. In a similar vein, augmented reality is a cutting-edge tool for life simplification, meeting new people, andlearning new things.

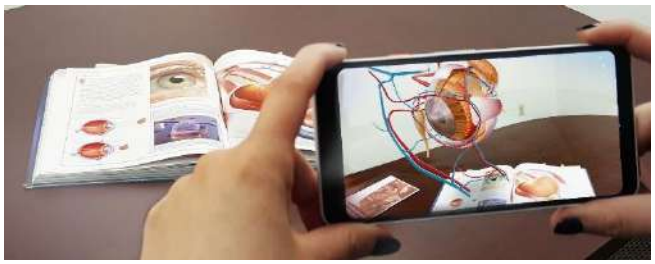
However, when utilised improperly, the results can be unpleasant, as seen by the current generation's rise in psychiatric disorders and health difficulties. However, not everyone can afford this technology, and as it develops over time, the general public will probably be able to use it as well. This technology can lead to a better future even with its high cost if used more productively.

Virtual reality is a cutting-edge technology that allows users to travel another computer-generated world while also reducing stress. Nonetheless, it is quite expensive and can easily develop to addiction in certain people. Addiction leads to a variety of health concerns, including despair and anxiety. When utilised properly, virtual reality may be a fantastic tool for improving our lives and revolutionising how we do things inour daily lives. If you plan to

use this powerful tool in your organisation, make sure your employees receive virtual reality training to avoid psychological or physical adverse effects.







**References**


- Benefits and Limitations of XR(AR|VR|MR) | by Chitimalli | Medium
- https://medium.com/@a3logicsusa/the-latest-developments-in-ar-vr-a-look- into-the-future-2d8f50c2594f
- 10 Pros and Cons of Augmented Reality (honestproscons.com)
- Research Video link: https://youtu.be/HLvgVBesW58?si=ax_16VCNOqEtwxXY

## ABOUT THE COLLEGE

*M.O.P. Vaishnav College for Women is affiliated to the University of Madras and is the youngest college to be granted autonomous status. The College, with a student strength of 3785, currently has 15 Undergraduate courses, 8 Postgraduate courses and research programmes in the Department of Commerce, Communication, Media Studies and Management. The College also offers market-driven Diploma, Postgraduate Diploma and Certificate courses. The College has been re-accredited with an A++ Grade by NAAC.*

## ABOUT THE DEPARTMENT OF MANAGEMENT STUDIES (B.B.A.)

*The Department of Management Studies offers a B.B.A. (Bachelor of Business Administration) Shift-I & Shift-II. The program is structured to imbibe the required conceptual, analytical, technical, entrepreneurial and human relation skills to students to be effective and ethical management professionals. The program also nurtures students with professional competence to do higher studies, and research and provides a platform for continuous growth and development. The Department organizes Inter-Departmental and inter-collegiate activities under the aegis of "Drucker's Progeny" & "Mercatus"- the Department Clubs.*

Published by

M.O.P. VAISHNAV COLLEGE FOR WOMEN (Autonomous)
Chennai, Tamil Nadu, India
Email: mopvaishnav@mopvc.edu.in
https://mopvc.edu.in/

ISBN: 81-970500-1-5
978-81-970500-1-5