## AR EDUCATIONAL APP FOR ELEMENTARY EDUCATION

## Literature review

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**IN**

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**1.The History of AR**

**Early Conceptualizations (1960s-1970s):** The origins of AR can be traced back to the 1960s, with pioneering work by computer scientist Ivan Sutherland, who developed the first head-mounted display system known as the "Sword of Damocles." In the following decades, researchers like Myron Krueger explored the concept of "Artificial Reality," laying the groundwork for AR.

**Emergence of Terminology (1980s):** The term "Augmented Reality" was first coined in the late 1980s by Boeing researcher Tom Caudell, who used it to describe a digital display system that assisted aircraft assembly workers. This period saw initial experiments and prototypes, but AR remained primarily within the domain of research labs.

**Technological Advancements (1990s**): The 1990s witnessed significant progress in AR technology, driven by advancements in computer vision, graphics rendering, and wearable computing. Research institutions and universities worldwide, such as MIT's Media Lab and the University of North Carolina, played pivotal roles in pushing the boundaries of AR capabilities.

**Commercialization Efforts (Early 2000s):** Despite ongoing research, AR remained largely confined to academic circles until the early 2000s. Companies like BMW and Volkswagen began experimenting with AR applications for vehicle design and maintenance. However, widespread commercial adoption remained elusive due to limitations in hardware and infrastructure.

**Mobile AR Revolution (Late 2000s-2010s):** The proliferation of smartphones equipped with cameras, GPS, and powerful processors laid the foundation for a new era of AR. In 2008, the release of the ARToolkit, an open-source software library, democratized AR development and sparked a wave of innovation. In 2016, the launch of Pokémon GO brought AR to the mainstream, captivating millions of users worldwide and demonstrating the technology's potential for gaming and entertainment.

**Expansion Across Industries (2010s-Present):** In the following years, AR expanded beyond gaming into various sectors, including education, healthcare, retail, and manufacturing. Major tech companies such as Apple, Google, and Microsoft invested heavily in AR development, introducing platforms like ARKit, ARCore, and HoloLens. Industries embraced AR for training, visualization, marketing, and remote assistance, among other applications.

**Advancements and Future Prospects:** As of the 2020s, AR continues to evolve rapidly, driven by advancements in hardware, software, and AI. Technologies such as spatial mapping, object recognition, and immersive displays are enhancing the user experience and unlocking new possibilities for AR applications. The future of AR holds promise for even more seamless integration into everyday life, with potential applications ranging from navigation and communication to healthcare and beyond.

**2. Existing Solutions**

**Here are some existing products that are developed by other companies:**

**1. IKEA Place**

First released in 2013, IKEA’s approach to augmented reality stemmed from the need to solve an existing problem. IKEA’s solution is, in many ways, revolutionary. In particular, IKEA addresses the difficulties related to buying furniture by allowing customers to go through their furniture catalogue, select items of interest, and place computer-generated versions of their favourite pieces in their homes. The digital furniture is true-to-scale. This helps users make well-informed purchases, eliminating the risk of buying something that will be too big or that might not match the rest of their decor.

**2. Sephora Virtual Artist**

Sephora is another brand using AR technology to remove uncertainty from their customers’ shopping experience. Sephora’s Virtual Artist makes use of smartphones’ facial recognition capabilities to allow users to try on virtual makeup. Customers no longer have to wonder if a certain lipstick colour will look good on them, or whether a specific eyeliner shade will be flattering. With Sephora’s Virtual Artist, buyers can try on makeup from the comfort of their homes.

**3. Pepsi Max’s AR Entertainment Campaign**

A few years ago, Pepsi used augmented reality to entertain UK commuters via a window-like screen connected to a camera in a bus stop in London. The screen displayed a live feed of the street they were on, but computer-generated graphics such as aliens, tigers, and giant robots were added to the scene to surprise and delight the audience. The campaign video went viral, contributing to a notable increase in sales.

**4. Pokémon Go**

It’s hard to talk about augmented reality without bringing up AR games and the groundbreaking success of Pokémon Go. This mobile phenomenon combines location-based technology with AR, encouraging users to physically explore their surroundings while searching for Pokémon to capture. Pokémon Go was released in 2016. Since then, it has been downloaded more than 500M times and grossed over $2.01B worldwide**.**

**5. Brain Power**

Brain Power brings neuroscience, wearable technology, and augmented reality together to create meaningful, life-changing products intended to improve the lives of people on the autism spectrum. Through computerized glasses, users can receive coaching that helps them better understand the world that surrounds them. As a result, they learn to go through their daily routine in a more self-sufficient way.

**6. Holo Anatomy**

Holo Anatomy is an award-winning application intended for use with Microsoft’s HoloLens. This technology drastically changes the way medical students learn by allowing them to view and analyse 3-dimensional holograms of the human body. Students can look at the human body as a whole, select and examine individual organs in great detail, and even see how certain physical processes happen. The tool has the power to fundamentally change the medical and educational industries by providing its users with never-seen-before assets**.**

**7. GAP Virtual Dressing Room**

GAP is another well-known brand looking to revolutionize the way customers shop. Through the power of augmented reality, this worldwide retailer allows users to select clothes from their catalogue, pick one of the five body types available in the application, and “try on” items they’re interested in purchasing. If consumers like what they see, they can complete purchases right from the application. They don’t even need to go to the store.

**3. Bibliometric analysis**

So, by summarizing our topic here are some key features of AR app

**Interactive Learning:** AR apps can offer interactive and engaging learning experiences where students can manipulate virtual objects, explore concepts in 3D, and actively participate in educational activities.

**Visualizations:** AR enables visualizations of abstract concepts, making them more concrete and understandable for young learners. For example, students can explore the solar system by placing virtual planets in their classroom or visualize the anatomy of the human body in a hands-on manner.

**Contextual Learning:** AR apps can provide contextual information relevant to the learning objectives, such as historical facts overlaid onto historical sites or labels appearing on objects to reinforce vocabulary acquisition.

**Personalization:** AR apps can adapt content to individual learning styles and abilities, providing personalized feedback and challenges to students based on their progress and performance.

**Engagement:** By leveraging gamification elements, storytelling, and interactive features, AR apps can capture students' attention and sustain their interest in learning, leading to higher levels of engagement and motivation.

**Enhanced Learning Outcomes:** AR apps have the potential to improve learning outcomes by providing immersive and experiential learning experiences that cater to different learning styles and preferences.

**Increased Retention:** By offering interactive and memorable experiences, AR apps can enhance retention of knowledge and concepts, as students are more likely to remember information they have actively engaged with.

**Foster Collaboration:** AR apps can promote collaboration and teamwork among students, as they work together to solve problems, explore virtual environments, and complete educational tasks.

**Real-world Application:** AR apps can bridge the gap between classroom learning and real-world application by allowing students to apply their knowledge in authentic contexts, fostering deeper understanding and transferable skills.

**Positive Attitudes Towards Learning:** Engaging with AR technology in the classroom can cultivate positive attitudes towards learning, as students perceive it as fun, exciting, and relevant to their lives.

But along with this there are some drawbacks also which are listed below:

**Cost and Accessibility:** The development and implementation of AR apps may require significant financial investment, and not all schools may have access to the necessary technology and resources.

**Technical Limitations:** AR apps may face technical challenges such as hardware compatibility issues, network connectivity problems, and software bugs, which can disrupt the learning experience and frustrate users.

**Content Quality:** The quality and accuracy of content in AR apps may vary, leading to inconsistencies in learning experiences and potential misconceptions among students.

**Teacher Training:** Teachers may require training and support to effectively integrate AR technology into their teaching practices, including understanding how to use the apps, align them with curriculum standards, and manage classroom dynamics during AR activities.

**Distraction:** While AR apps can enhance engagement, they may also introduce distractions in the classroom if not used appropriately, leading to off-task behavior and reduced focus on learning objectives.

**4. Review summary:**

Here is the summary of some research papers that we have found related to our project

These research papers collectively explore the diverse applications of augmented reality (AR) in education, revealing its potential to enhance learning experiences across various subjects and age groups. They address the benefits of AR, such as improved engagement and understanding, while also acknowledging challenges like cost, technical requirements, and the need for teacher training. Despite these obstacles, the papers suggest that AR holds promise for transforming traditional educational methods and creating more interactive and effective learning environments. Overall, they provide valuable insights into the current state and future potential of AR in education, encouraging further exploration and development in this rapidly evolving field.

**[1] Topic: Augmented Reality and Its Application in Education: A Systematic Survey**

The research paper dives in various types of AR technology, its uses and software/technology used to achieve the AR world. The research paper states that AR is a system in which virtual world is laid over real world and it is interactable in Realtime. There are three types of Augmented Reality - a.) Marker based, b.) Markerless and c.) Geographical. In Marker based augmented reality, the virtual object is placed on a pre-determined marker that is in real world and this gives a very positionally accurate augmented reality. In Marker less augmented reality, the position of the virtual object is determined through sensor inputs like camera, gyro etc, this method is not as positionally accurate as the marker-based method. In Geographical augumented reality, the virtual object is placed using the data from gps, camera and other sensors. The various places where AR can be used in teaching are Electronic Learning, Mobile Learning and Ubiquitious learning. Electronic learning is studying using internet and technology. Mobile learning is studying through smartphones and Ubiuitous learning is studying from anywhere at any time. The various tools that can be used to create AR based application are ARCore, ARkit, Vuforia, Wikitude and Kudanl. Augumented reality can also be used in HMD(Headset mounted Devices), projectors, and iot based devices. The various limitaions of AR based application as listed in the research paper are:

1. AR based gadgets like HMDs, google glasses are very expensice and are not affordable by an average student.

2. Special guidance should be provided to teachers and students who are not in the computer science field to use the AR application

3. The AR based application require a good and stable internet connection to work properly

4. AR based application are expensive to make and hard to maintain

**[2] Topic: Augumented Reality - an Application for Kid's Education**

The research paper gives an example of the use of AR technology to teach kids. It used tools like unity, vuforia and sketchup 3d. Unity is a software used to develop 3d games and other things like AR application. Vuforia is a great AR Sdk that provides with great tracking and realtime 3d object processing. Sketchup 3d is a software used to create and modify 3d objects.The paper divesin creating a app that can be installed on handheld devices like smartphone and tablet. The application is used to teach the 26 alphabets to children using the augumented reality. The application uses marker in real world to track position in real life then place the 3d object in the real world.

Reference – IEEE Xplorer

**[3] Augmented Reality Applications in Education: Teachers Point of View**

As reported in this paper the author describes the view of teacher that what they think of AR as teachers are the common elements in every educational system and plays a key role in integration and acceptance of technology in education in this the author states about that what is AR and how it can be beneficial in many areas like – education, culture field etc. In education it can helps to provide the interface to the student as it connects the real and virtual world and also have special effects like sound etc, and it also decrease the teacher load as the student are learning practically The author also told us about the limitation of AR that children find it difficult to use AR apps and also because of some technical problem, cost, lack of proper tools and many more, it also discuss the issues like: (a) diffusion of AR technology; (b) the need for continuous training; (c) 3D modelling; and (d) teachers’ and students’ involvement in AR applications development. the author has also written about the AR survey conducted with 20 teachers and its outcomes the author concludes that only a small teachers knows about this technology and only few teachers have used the AR apps and without knowing they were AR apps and conclude that the AR apps need to have user friendly interface which teacher of every designation can use whether He/she is using that app first time or not and also it should not bound the students to “pre – packaging” learning experience as knowledge is built through interaction and we should make more advancement in AR technology and it is not feasible to use it in Cultural Heritage

**[4] The application of augmented reality in elementary school education**

In this paper the author reported that how Augmented reality is important in the educational centre and has become the attraction of stake holders to improve the quality of education and tells its advantage that how it improves student confidence and enhance their abilities and how can help certain objects and natural phenomena that are difficult to obtain in real world and will provide a valuable learning experience and also its limitations, affordability, features, uses and challenges it face, some challenges are like these apps mostly operate on mobile and we need to make the app more attractive so that children do not get distracted while learning as using mobile can also harm children and they can become lazy also so it need to be attractive and educative that children love to learn from that app the author concluded this paper by saying that the Augmented reality apps can both have a positive and negative impact and the use of AR apps still has to consider the needs and readiness of students as well as existing readiness such as facilities and teachers ability .

**[5] Implementation of Augmented Reality (AR) as A Teaching Media in English Language Learning in Elementary School**

In this research paper the author tells us about AR as a learning medium in English subject in elementary schools, and how there is a increase in the learning outcome before and after use and teacher and student feel more fun in leaning the author tells us about Medan and how English it teached there from grade 1 to grade 6 and not everyone can grasp the significance of learning and dominating English it tells us about marker base and non-marker basedAR and how AR media stand out for understudies and make learning exercise more viable this paper tells us about the technological developed in making AR and information related to implementation of AR the author also shows the result of pretest and post-test and shows a positive result in increase in student vocabulary he took a total of 22 students and see that 19 student got their vocabulary improved drastically with the help of AR app and it also receive a positive response from the parents because of AR app the children increasing like to learn English and the author end it by concluding that there is an increase in learning outcome by the use of AR app and the use of AR app for learning English is appropriate and according to teachers and student, it is very useful if applied in elementary schools.

**[6] Learning the chemical elements through an augmented reality application for elementary school children**

In this the author tells us that how AR technology will provide multiple advantages in learning chemistryas its often seen as boring course amongstudents due to use of static non-dynamic material and how AR will help as it will allow students to interact with virtual element in real world author also tells us that how Covid-19 has made significance change in our learning as it makes most of our study online and making opportunities for companies to come online and also a step close to AR education, also AR has the potential to improve the quality and fluency of teaching learning, Learning chemistry with this technology allows students to complement the study of various topics, favouring the understanding of chemical elements and the formation of chemical compounds. Here the author tells us about the “Atomik-3D” app which can be used in mobile also and helps to study elements and how this app was developed and all those processes required to make that app and also shows its test result that how it performs the concludes it by sayingthat how successful the app was and how it can become more useful in near future.

**[7] An Educational Augmented Reality App To Facilitate Learning Experience**

In This research paper talked about an AR app to enhance our learning experience and students experience the magical transformation of 2D pictures to 3D perspective with the help of an AR app. Augmented Reality (AR) is making big waves in education, especially among young tech-savvy learners. It's like a magic tool that brings learning to life, sparking curiosity, creativity, and a love for learning. By layering digital elements onto the real world, AR adds a whole new dimension to teaching and learning. Researchers have been exploring AR's potential in education, and the results are promising. Students are grasping complex concepts better, whether it's understanding Geography or diving into Engineering topics. AR is flexible too, fitting seamlessly into different subjects and teaching styles. Teachers are embracing AR as a way to engage students of all ages and abilities. Studies show that AR apps, featuring games and simulations, have improved understanding, motivation, and classroom participation. From elementary to university levels, AR is making learning more enjoyable and effective and Interactive AR systems are also enhancing collaboration in learning environments, offering multimedia resources like videos, audio, and 3D models. Reviews of AR in education highlight its many benefits and foresee a bright future for its integration into classrooms. Recent developments, like Microsoft's AR viewer built into Windows 10, and partnerships with educational publishers like Pearson Education, are pushing AR even further. These innovations promise immersive 3D experiences that will revolutionize learning at all levels. So AR is not just a fad; it's transforming education as we know it. With its ability to make the impossible possible, AR is paving the way for the next evolution of learning.

**[8] An augmented reality app for therapeutic education and suitable for mobile devices with different features**

This research paper talks about using Augmented Reality (AR) to help kids with diabetes learn about how much carbohydrates are in different foods. They made an AR app for this purpose. In the app, virtual food appears on a real plate, so kids can see it like it's actually there. They tested the app on 66 kids with diabetes. These kids were split into three groups, each using a different mobile device. The only differences between the devices were the quality of the camera and the size of the screen. They used two tablets with different camera qualities (one had a 2-megapixel camera and the other had an 8-megapixel camera), and a Smartphone with a smaller screen size compared to the tablets but also with an 8-megapixel Camera. The results showed that the kids learned about estimating carbohydrates using the app. Interestingly, there weren't any big differences in how much the kids learned or how much they liked using the app, no matter which device they used. This means that the AR app worked well for teaching, regardless of the device's features.

**[9] Meta-Review of Augmented Reality in Education**

This paper looks at previous research on AR in education to see what's been found so far. It examines both the good and bad sides of using AR in learning. One key focus is on how AR apps are designed and how users interact with them, especially in terms of teaching methods and user engagement .The paper suggests that there's a lot of potential in AR for education, but there's still more research needed. It highlights the importance of considering how AR can make learning more comfortable for students and easier for teachers to manage content .In the future, the paper suggests exploring other factors that might affect learning with AR, like how it can help teachers deliver lessons and how it affects students' cognitive and spatial skills. It also suggests looking into what kinds of content work best with AR and using personalization or recommendation systems to tailor the learning experience to each user's needs. Overall, the paper shows that while AR holds promise for education, there's still work to be done to fully realize its benefits. Augmented reality (AR) has been around for a long time, but it's only recently become widely available to people, thanks to affordable Smartphones. While studies have shown that AR can help students learn better, we're still not sure exactly how it compares to other ways of teaching.

**[10] The Feasibility Study of Augmented Reality Technology in Early Childhood Education**

This paper talks about using a cool technology called augmented reality (AR) in early childhood education. AR can make learning more fun for kids by creating virtual stuff in real life. By analyzing AR in early childhood education, the paper suggests that AR can recreate learning scenes and materials, making learning more engaging and effective for young children. It highlights that AR has solid theoretical backing and technical support for use in early childhood education, and predicts that it will be widely used in kindergarten classrooms. The paper finds that using AR in teaching young children can boost their excitement for learning and help them learn faster and better. Overall, it suggests that AR has great potential to improve early childhood education and make learning more enjoyable for kids.

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**4. Problem Definition**

The problem at hand involves developing an Augmented Reality (AR) app. The objective is to create an application that overlays digital content onto the user's view of the real world through their device's camera. This digital content can include 3D models, text, images, animations, or any other virtual elements.

**So here are the things that need to be done to over this problem:**

**Conceptualization**: We have to define the purpose and functionality of the AR app. Determine what digital content will be overlaid onto the real world and how users will interact with it.

**Development**: Then we have to design and develop the AR app using appropriate programming languages and frameworks (e.g., Unity for 3D content, ARKit for iOS, AR Core for Android).

**User Interface (UI) Design**: We have to create an intuitive user interface that allows users to navigate the AR experience seamlessly.

**Integration**: Also, we have to integrate computer vision algorithms or AR SDKs to accurately detect and track real-world objects or surfaces for precise placement of digital content.

**Testing**: Now we should conduct the testing to ensure the app functions correctly across different devices and in various environments.

**Optimization**: We also have to optimize the app's performance to minimize battery consumption and ensure smooth rendering of AR content.

**Deployment**: The last step is to Publish the app to the appropriate app stores (e.g., Apple App Store, Google Play Store) for distribution to users.

**But there are some things that is not to be done like:**

**Overcomplicate**: We should avoid adding unnecessary features that may overwhelm users or compromise the app's performance.

**Neglect User Experience**: Also don’t neglect the importance of intuitive UI/UX design. The app should be easy to navigate and understand.

**Lack of Testing**: Other things are skipping thorough testing can lead to bugs and glitches, diminishing the overall user experience.

**Disregard for Privacy**: We also have to ensure that the app respects user privacy and does not collect or misuse sensitive data without permission.

**Ignore Performance**: Neglecting optimization can result in sluggish performance and poor user reviews.

**Violate Platform Guidelines**: Adhere to the guidelines provided by the app stores to prevent rejection during the review process.

**Forget Maintenance**: After deployment, continue to maintain and update the app to fix bugs, add new features, and ensure compatibility with the latest devices and operating systems.

**5. Goals**

Our goal is to provide the children of elementary classes a new vision of learning as it the building stage of every concept and most children find it boring to learn so with the help of interactive designs and models in AR app the children will be able to concentrate more on studies and can understand everything easily.

And to achieve this goal we have to do certain tasks like we have to gather the content and for this we have to read research papers and try to find what are the present apps lacking and what we can improve in it and we also have to gather the syllabus of students of elementary classes so to check which of them can be developed as 3D models

Then the next step is model development once we have gathered the content now, we can start making models and we can make them by using AR developing apps like – Blender etc.

Now once the models are made now, we will use Figma a designing app to design the prototype of the app that how our app will look, how its interface will look like and how will it work

Then the app development will start and for this we will use the flutter app for app development and the coding language will be dart, and once the app development will finish we will test the app and in the end we will fix some bugs that are left and ensure that the app is working smoothly.