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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

A PROJECT PHASE-2 REPORT (20CSE84A)

on

"AR: A Visual Aid for Classrooms"

Submitted in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

by

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It is hereby certified that the Project work entitled "**AR: A Visual Aid for Classrooms**" is a bonafide work carried out by MEGHNA ASUTI (1NH19CS102), SALONI BELLIAPPA B (1NH19CS225) and ATHARVA VISHAL KAPADNIS (1NH19CS230) in partial fulfilment for the award of Bachelor of Engineering in COMPUTER SCIENCE AND ENGINEERING of New Horizon College of Engineering during the year 2022-2023. The project report has been approved as it satisfies the academic requirements in respect of the project work prescribed for the said Degree.

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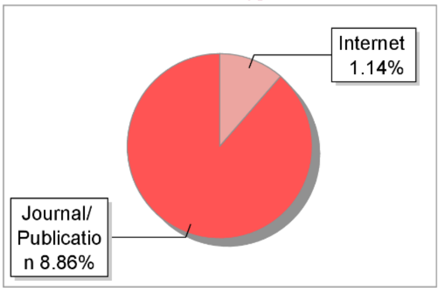

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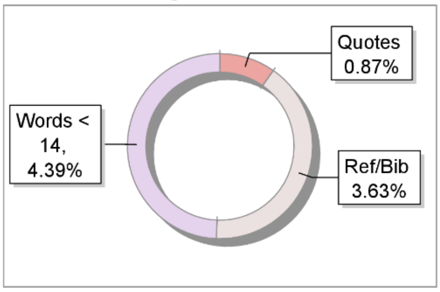

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ABSTRACT

The conventional methods of education as we previously knew them are becoming obsolete. They are getting more and more digital and are impacted by technological improvements. There are numerous applications for augmented reality in the classroom. It facilitates the students' learning, comprehension, and retention of information. AR also increases the enjoyment and engagement of learning itself. Among the benefits include a learning process that is quicker and more efficient, enhanced teamwork skills, and practical learning that is relevant worldwide. When and where they are needed, accessible learning resources are available and do not require any special tools. The goal is to create a computer vision application that uses the idea of augmented reality to show a 3D representation of the image that the user of the software has scanned. One of the impressive implicit properties of Augmented reality is its ability to blend reality with virtual data. In most fields, augmented reality is employed as a system to help people execute activities. Particularly in the fields of surgery and aero plane manufacturing, AR has shown to be helpful in improving task efficiency and accuracy. In the event of surgery, it can be used as a tool to create 3D models of the patient's operated organ or body part, which can assist doctors in performing procedures with the least amount of risk and difficulty. AR also increases the enjoyment and engagement of learning itself. always Having access to educational resources and locations without the need for specialized equipment is only one benefit. Any level of education or training can benefit from practical learning, which can boost student interest and involvement.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 DOMAIN INTRODUCTION

AUGUMENTED REALITY: Digital visual elements, audio, or other sensory cues transmitted through technology are used to create augmented reality (AR), which is a more enriched version of the real world. Businesses specifically engaged in mobile computing and business applications are noticing a growing trend in this direction. As data gathering and analysis become more prevalent, one of augmented reality's main objectives is to draw attention to certain aspects of the real world, deepen understanding of those aspects, and generate clever, approachable insight that can be used in practical contexts.

The use of augmented reality is expanding and becoming increasingly common across a diverse variety of applications. For instance, several early adopters in the retail industry have created technologies that are intended to improve the shopping experience for customers. Apps for catalogues that use augmented reality enable retailers to show customers how various products might seem in various settings. When customers point the camera toward the proper room and select furniture, the item shows up in the foreground.

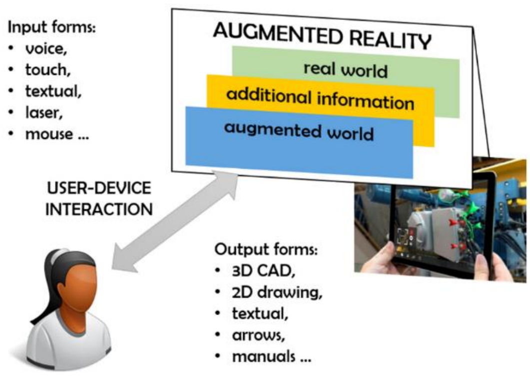

Fig. 1.1: Augmented Reality

COMPUTER VISION: Artificial intelligence abilities of computer vision enables computers and systems to extract useful information from digital photos, videos, and other visual inputs and to conduct actions or offer recommendations in response to that information. If AI gives computers the ability to think, computer vision gives them the ability to see, observe, and comprehend.

Human vision has an advantage over computer vision in that it has been around longer. With a lifetime of context, human sight has the advantage of learning how to distinguish between things, determine their distance from the viewer, determine whether they are moving, and determine whether an image is correct.

With cameras, data, and algorithms instead of retinas, optic nerves, and a visual cortex, computer vision teaches computers to execute similar tasks in a much less time. A system trained to inspect items or monitor a production asset can swiftly outperform humans since it can examine thousands of products or processes per minute while spotting imperceptible flaws or problems.

Applications of computer vision are as follows:

- Computer vision is used in the development of self-driving cars to interpret the visual data from a car's cameras and other sensors. Identification of other vehicles, traffic signs, lane markings, bicycles, pedestrians, and all other visual elements encountered on the road is crucial.
- By pointing a smartphone camera at a sign in another language, users can use Google Translate to get a translation of the sign in their favorite language practically instantly.
- In order to deliver sophisticated AI to the edge and assist automobile makers in identifying quality flaws before a vehicle leaves the factory, IBM is implementing computer vision technologies with partners like Verizon.

On a following note, here are a few tasks that are already being achieved with the help of computer vision:

- When an image is seen, image classification can classify it. More specifically, it can correctly guess which class a given image belongs to. A social network corporation would want to utilize it, for instance, to automatically recognize and sort out offensive photographs shared by users.

- In order to identify a specific class of image and then recognize and tabulate its existence in an image or video, object detection can employ image classification. Detecting damage on an assembly line or locating equipment that needs maintenance are a couple of examples.

- After an object is found, it is followed or tracked. This operation is frequently carried out using real-time video streams or a series of sequentially taken pictures. For instance, autonomous vehicles must track moving things like pedestrians, other vehicles, and road infrastructure in addition to classifying and detecting them in order to avoid crashes and follow traffic regulations.

- Instead of focusing on the metadata tags that are attached to the photos, content-based image retrieval employs computer vision to browse, search, and retrieve images from massive data repositories. Automatic picture annotation can be used in place of manual image tagging for this activity. These tasks can be used to digital asset management systems to improve search and retrieval precision.

1.2 PROBLEM DEFINITION

Augmented reality (AR) has many potential uses and is the subject of extensive research. It has entered a number of commercial sectors, most notably the healthcare and educational technology sectors. With the aid of apps that allow users to view in-depth, 3D representations of bodily systems or even assist surgeons in practicing on an augmented reality model of the patient before major surgery, it might play a significantly larger role.

The conventional methods of education as we previously knew them are becoming obsolete. They are getting more and more digital and are impacted by technological improvements. There are numerous applications for augmented reality in the classroom. It facilitates the students' learning, comprehension, and retention of the information.

AR also increases the enjoyment and engagement of learning itself. Having access to educational resources at all times and locations without the need for specialized equipment is only one benefit. Any level of education or training can benefit from practical learning, which can boost student interest and involvement as well as their capacity for teamwork.

In actuality, the so-called education technology business is projected to increase at a rate of 17.9% per year to reach $680.1 billion by 2027. A leader among the most important EdTech trends, augmented reality is deserving of this distinction. With the value of AR in edtech expected to hit $5.3 billion by 2023, there will undoubtedly be new opportunities for corporations and educational institutions.

The proposed system aims at creating high quality 3D video manuals using AR. Fiducial markers (Image Targets) are tracked using a camera and the 3D models are mapped to the marker. These 3D models are representations of a product or concept that the user can see on his screen. The user will be interacting actively with these 3D models and observing the animations to understand the mechanisms, workings and details of a certain product or concept.

1.3 OBJECTIVES

The major goal of this project was to create an application that would support the teachings already being taught in the aforementioned classes while adhering to certain limitations, such as technology and budget. Lessons were to be preloaded into the application and a very simple modeling and scripting approach was to be used to accomplish this.

The exact objectives we sought to accomplish were:

- Excellent Visualization
- Readily available applications and lessons
- Ease of use
- Helpful for students as well as teachers
- Cost effective
- Better classroom engagement

Social Outcomes:

With this initiative, we sought to provide the following societal outcomes:

- Providing educational assistance, to even the less privileged.
- Equal learning opportunities for everyone.
- Easier to use for children with special needs.

1.4 SCOPE OF THE PROJECT

Since a long time ago, businesses have been developing augmented reality (AR) devices, with applications in everything from healthcare to media and entertainment to eCommerce. The significant development of AR devices has boosted the potential for portable application development, enabling application development companies to produce more versatile applications for a wider range of devices.

The use of augmented reality has transformed how businesses operate. By enabling customers to evaluate the objects more creatively, it has especially helped eCommerce fill the reliability gap in products.

Many industries are utilizing the advantages of augmented reality, including healthcare, design, manufacturing, gaming, and entertainment. People can now view objects better than they ever could have imagined and communicate with business suppliers more successfully thanks to mobile devices.

Virtual reality, which is often used to refer to augmented reality, is not augmented reality. Unlike VR, AR typically calls for a headset like the Oculus Rift. Application engineers and businesses are now more empowered to integrate cutting-edge data in reality in a variety of applications.

We'll create a system that uses augmented reality (AR) technology to enhance product learning and comprehension for users of electronic goods. Many nations continue to use the tried-and-true "chalk and black-board" method of teaching, which, while requiring less initial investment, is outdated and ineffective when used by students for learning.

However, if AR is used as a teaching strategy in the aforementioned classrooms, learning rates dramatically rise due to its distinct position as a combinational or multi-mode audio-visual teaching strategy. The way the human mind processes information makes it more likely that it will be retained than if it is only presented verbally or visually. This very idea would underpin the use of AR in classrooms to raise the standard of instruction.

CHAPTER 2

LITERATURE REVIEW

2.1 TECHNOLOGIES USED

The usage of AR in education is one of the main issues it faces. By enhancing their interactivity, augmented reality may significantly improve the look and feel of any smartphone application. The kids' learning experience, which has greatly enhanced, can be said to be similar. These AR apps have been used in the past to introduce young children to the English alphabet, shapes, and numeracy while also fostering group activities.

Numerous capabilities of AR are made available in order to create the aforementioned collaborative sessions. Among these features are plane detection, movement tracking, and image recognition. Several evergreen AR algorithms have been tested on handheld devices. These techniques, including simultaneous localization, concurrent odometry, and mapping, have shown to be appropriate for such devices.

Users can interact with AR games using their fingertips or gestures. In order for the user to engage with the aforementioned items or alphabets, this makes use of the interaction event that is expressly built into AR technology. This opens up the possibility of a touchless method, which was discovered by displaying a communication gesture game in an "open" environment on two wearable devices, i.e., a framework that the user can put on, with the first device, or the visor, mounted on their head for viewing and the other device on their wrist for limbic motion tracking.

Advantages: Applications for augmented reality can be found in many different industries and offer a variety of advantages. By enabling users to see the digital world in their physical environment, it enhances their overall experience. Since smartphones have advanced, anyone can now use it, and developers can now create AR applications and games for the price of a typical smartphone. As demonstrated with Pokémon Go, a game based on the AR system for some aspects of gameplay, it has proven to be an enjoyable and lucrative experience.

Disadvantages: Even while technology has advanced, there is still plenty that can be done to make the experience easier to use and more seamless. In comparison to VR, more resources and research are put into VR, whereas AR has taken a backseat.

2.2 EXISTING SYSTEMS

According to BBC experts, the global value of augmented reality might reach $162 billion by 2024. The creation of portable applications is being aided by the growing interest in AR devices. As Android phones dominate the market, it is expected that Android app development companies will profit.

AR has already started to influence global application development. Many industries are asking for the development of extended reality mobile applications that can aid them in their internal activities, including land, money, and medical services.

Additionally, it is obvious that the AR application will need cross-stage upgrading to expand its usage scope given that the majority of the world's population uses Android and iOS smartphones. IKEA is a well-known furniture manufacturing company that has released an augmented reality mobile application that enables its customers to gradually see IKEA's products through smartphones.

When the attention turns to the classroom, augmented reality has previously been used in a variety of use cases, however they are restricted to either higher education levels or educational institutions with significant capital commitments. These are a few examples of use case scenarios that are regularly seen in classrooms:

- **Business presentations:** The difficulty with ideas presented in the form of PowerPoints and 2D charts is the viewers' poor comprehension and the extreme disconnect in the message delivery. This can be remediated by including the audience in presentations and showcasing concepts in 3D, as in the case of architectural models and renovations.

- **Prototyping:** Digital tools like CAD and the physical processes of sketching and engineering drawing are used to envision the dimensions and create a replica of the project results that we are aiming for. Although there are other approaches, such as 3D printing, they are more expensive and difficult to utilize because of the equipment and supplies needed. Instead, AR enables designers to make changes to models as they work, reducing time spent sketching or money spent on 3D printing for each iteration. Users may even contrast the current model with the prior one.

- **Research and development (R&D):** If the handling and transportation of physical models can be completely replaced by the sharing of AR 8 simulations of research in the middle of completion, it will be possible to collaborate on a global scale with little to no delays, which is essential for time-sensitive or degradation-prone samples and experiments.

- **Training and learning:** The stages of the cardiac cycle or the operation of an internal combustion engine and its four-stroke cycle are just a few examples of modules that are difficult to memorize and may take a long time to fully comprehend if AR is used in their place. AR explains life and machine mechanisms not only as they appear in stasis but also as they function and move.

With the rise in popularity of apps like PokemonGo, the technology that we use every day started to be adapted for the needs of AR displays. However, it's arguable that the hardware in AR glasses like Google Glass, Dream Glass, and Vuzix Blade is more practical for bringing AR to users.

2.3 BASE PAPER

The base paper chosen for this project was written by Cristian Pamparău and Radu-Daniel Vatavu and is called "FlexiSee: flexible configuration, customization, and control of mediated and augmented vision for users of smart eyewear devices" published in Springer Science and Business Media, LLC, part of Springer Nature 2021.

The study outlines a novel method for creating smart eyewear that enables variable configuration, personalization, and control of mediated and augmented vision. The method, known as FlexiSee, is built on a modular architecture that enables users to select and combine various visualization kinds, manage the look and behavior of visual elements, and customize the device to their specific requirements and preferences.

The article examines FlexiSee's potential uses in industries like healthcare, education, and entertainment while showcasing a prototype implementation of it. According to the authors, FlexiSee is a key step toward the creation of smart eyewear products that can offer a more customized and flexible user experience.

Fig. 2.1: AR glasses utilizing a framework similar to FlexiSee

According to the authors of FlexiSee, there is a need for flexibility in the configuration and personalization of the aspects that current frameworks present to their clients. They generally use a web-based interface and overload visual channels like color shadings, part highlighting, and correlation change through to reach a predefined model.

Using this web-based interface, which is conveniently accessible from smartphones, smart watches, and other devices with internet connectivity, authorized clients can choose and apply customary boundaries for the optical channels being used. A 3D design environment with client classes, supervise format elements, augmentation and mediation, as well as a design environment for FlexiSee-related projects that outlines an expansion of FlexiSee-related frameworks, are also demonstrated.

2.4 SUMMARY OF LITERATURE REVIEW

The related papers that were investigated for this study are summarized in a table in this section. The table includes a serial number for the paper, the names of its authors, the year of publication (paper), the name of the journal, the title of the paper and a section on each paper's key findings.

Table 2.1: Literature review

Sl No.	Authors	Year of Pub.	Journal	Title	Key Findings
1	Hasan Köse& Nevin Güner-Yildiz	2020	Springer Science + Business Media, LLC	Augmented reality (AR) as a learning material in special needs education	• AR technology is on the rise to become an important learning tool. • Vast Majority of research on AR use in education has focused on individuals with typical development and especially on STEM education. • High potential for special needs education and can be used to overcome the barriers faced by individuals with special needs.

2	Castellanos A, Pe´rez C	2017	Ariso JM (ed) Augmented reality: reflections on its contribution to knowledge formation. De Gruyter, Berlin, pp 273– 293	New challenge in education: Enhancing student's knowledge through augmented reality	• AR not initially designed with educational purposes, its applications on education are getting further relevance. • AR provides a blended learning experience that enriches reality with digital technology. • Students able to develop a deeper understanding through AR and deeper knowledge, but also become acquainted with their future works.
3	Huang Y, Li H, Fong R	2016	Early Child Dev Care 186:879–894	Using augmented reality in early art education: a case study in Hong Kong kindergarten	• The aim of this study is to explore the feasibility of integrating AR technology into art education in a Chinese kindergarten in Hong Kong. • Stakeholders showed big interests and high acceptance after a series of AR-based art activities. • Children's responses and performances jointly proved that AR could be an engaging and attractive teaching tool in ECE.

4	Akcayir M, Alccarr G	2017	Educ Res Rev. 2017; 20:1- 11.	Advantages and challenges associated with augmented reality for education: a systematic review of the literature	• While some studies reported that AR decreases cognitive load, others reported that it causes cognitive overload. • Whether there is a real usability issue and, whether that stems from inadequate technology experience, interface design errors, technical problems, or the teacher's lack of technology experience still needs to be clarified. • Hardware constraints may still need to be overcome.
5	Safar AH, Al-Jafar AA, Al-Yousefi ZH	2017	Eurasia J Math Sci Technol Educ 13:417–440	The effectiveness of using augmented reality apps in teaching the English alphabet to kindergarten children: a case study in the state of Kuwait.	• A total of 42 students (equally divided) enrolled in the public educational system participated in this study in the 2015-2016 academic year. • Statistically significant differences between the control group and the experimental group in their degrees of interaction with the English alphabet lesson in favor of the experimental group.

6	Tomi AB, Rambli DRA	2013	Procedia Comput Sci 25:123–130	An interactive mobile augmented reality magical playbook: learning number with the thirsty crow.	• Based on observational study on the prototype, this playbook turns reading old folklore story from traditional book into a new joyful, interactive and engaging learning experience. • Based on encouraging response from observational study, it motivates the development of the AR playbook series for preschool education as future work.
7	Bujak KR, Radu I, Catramb one R, MacIntyr e B, Zheng R	2013	Comput Educ 68:536–544	A psychological perspective on augmented reality in the mathe- matics classroom.	• Physical objects afford more natural interactions compared to traditional computer input devices (e.g., keyboards, mice), potentially resulting in memory encoding that is strengthened through motor actions. • Additional information can be presented with these physical objects in the virtual space, helping students make connections between the physical and abstract.

8	Matt Dunleavy , Chris Dede, Rebecca Mitchell	2009	J Sci Educ Technol (2009) 18:7-22 DOI 10.1007/ s100956-008-91199-1	Affordances and Limitations of Immersive Participatory Augmented Reality Simulations for Teaching and Learning	• Scalability of AR curricula, the challenges of managing and debugging the equipment are significant. • The data supports these findings that teachers who rely on a lecture-practice style of instruction are uncomfortable relinquishing control of the learning to their students. • Some of these teachers led their students step-by-step through tasks in a way that diminished their cognitive value.
9	Pamparău, Cristian, Vatavu, Radu Daniel	2021	Springer Science + Business Media, LLC, part of Springer Nature 2021	FlexiSee: flexible configuration, customization, and control of mediated and augmented vision for users of smart eyewear devices	• Addresses a gap in the scientific literature, where previous systems for vision augmentation were designed with little flexibility in terms of customizing their features and functionality. • Evaluation showed good usability and perception regarding the concept and implementation, and very good added value of our system idea in the landscape of mobile and wearable devices.

10	Savita Yadav, Pinaki Chakraborty, Gurtej Kochar, Deeheem Ansari	2020	Springer Nature	Interaction of children with an augmented reality smartphone app	• Children aged between two to six were attracted to the application but were overwhelmed with the application at hand and lacked the motor skills to interact with the app. • Alternatively, the seven- and eight-year-old children were able to comprehend the scene and act accordingly. These children in their concrete operational stage were able to use inductive reasoning to find the virtual butterflies in the three-dimensional space around them.
11	S. S. Priya, R. P and D. Chellani	2022	International Conference on Smart Systems and Inventive Technology (ICSSIT), 2022, pp. 1703-1708	Augmented Reality and Speech Control from Automobile Showcasing	• This paper provided an insight on the consumers' perception of and engagement with the brand that use augmented reality and voice commands for marketing and retail. • A detailed review of the AR apps, along with speech recognition can be used in shopping and retail by providing the consumer with a straight forward way to shop for products from the comfort of their own home.

12	Sivabalan N, Samridhi Gupta, Stuti	2022	Journal of Positive School Psychology 2022, Vol. 6, No. 5, 5520–5523	ForwARd – An Augmented Reality Application to Assist in Visualization	• The support provided by famous video game engines such as Vuforia and Unity and being aided by AR Core, offered by Google, is helping developers enhance applications for AR. This execution has the degree and ability of having the option to be utilized by thousands and millions of understudies, liberated from cost. • The research done can be prolonged to be completely incorporated within the instructional plan of middle schools.
13	Kamarulzaman Ab Aziz, Nor Azlina Ab Aziz, Anuar Mohd Yusof, Avijit Paul	2012	Procedia Engineering	Potential for Providing Augmented Reality Elements in Special Education via Cloud Computing	• This paper observes two technological trends, namely cloud computing and augmented reality within the context of the Malaysian special education delivery. • It is recognized that augmented reality offers significant benefits to the learning process. This paper draws attention to the synergistic possibility of providing AR enhanced education for the special needs students in Malaysia via cloud computing.

14	Danakorn Nincarean, Mohamad Bilal Alia, Noor Dayana Abdul Halim, Mohd Hishamuddin Abdul Rahman	2013	Procedia – Social and Behavioral Sciences	Mobile Augmented Reality: The Potential for Education	• Augmented Reality (AR) is one of the latest technologies that offer a new way to educate. Due to the rising popularity of mobile devices globally, the widespread use of AR on mobile devices such as smartphones and tablets has become a growing phenomenon. • Therefore, this paper reviews several literatures concerning the information about mobile augmented reality and exemplify the potentials for education.
15	Srividhya G, Dr Selvan C, Atharva Vishal Kapadnis, Saloni Belliappa B, Meghna Asuti	2022	43rd WCASET Goa	AR: A VISUAL AID FOR CLASSROOMS	• The paper aims to develop a computer vision application that utilizes AR to provide a 3D visual and enhance learning effectiveness and engagement. • System aims to create 3D video manuals using AR. These models are representations of a concept. The user will be interacting with these models and observing the animations to understand the mechanisms, workings and details.

2.5 RESULTS OF LITERATURE REVIEW

One of the main difficulties is the usage of AR in education. To create collaborative sessions, augmented reality offers features like photo identification, plane detection, movement tracking, and more. For augmented reality on mobile devices, mapping, simultaneous localization, and concurrent odometry and mapping have all shown to be evergreen techniques.

As we learn more about augmented reality, we also learn more about how innovative curriculum analysts who are willing to integrate augmented reality in the classroom may benefit from it. The use of augmented reality (AR) as a teaching aid for pupils with special needs is also explored in the study. One of the related types of research examined the feasibility of teaching four persons with developmental disabilities how to find things using paper maps, Google Maps, and AR route programming as a preprofessional skill.

The poll results demonstrated that using AR route programming was significantly better than the other two options. In a different study from 2020, sixty children between the ages of 8 and 10 interacted with an augmented reality smartphone app that was created in C#. They performed a priority test to determine whether there might be any additional reasons for the kids to use the app, and an ability test to determine whether the kids might benefit from the claimed use.

A study that looks at the application of AR and VR in engineering design, industrial technology, and protection engineering. The usage of AR and VR in engineering education is anticipated to lower the cost of astronomically high lab equipment and instructional aids. Applications with somewhat similar layout features were dependent on virtual data disclosure techniques to access information via computerized components.

Using research on effective and commanding outcomes, the test included a substantial component that assessed how AR innovation affected students' conceptual comprehension.

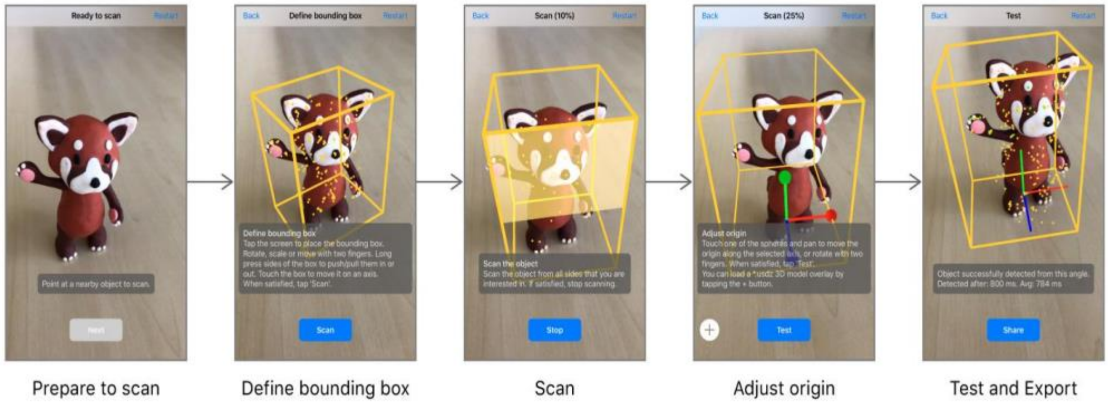

Fig. 2.2: Recognition with the use of AR markers

Users interact with augmented reality video games by moving their fingers or feet in front of the camera, which triggers an interaction event that allows them to communicate with the digital object in the image. The articles that have been evaluated claim that three simple augmented reality games with 11 active gestures are progressed based on the provided technology for contact-much less engagement. At its core, an evaluation assessment focuses on the work evaluation, consumer satisfaction, and an adaptable wearable framework to highlight the social acceptability and value of the touch-less technique.

Numerous video games need pointing and touching inputs, however issues with occlusion and fat fingers arise. Through touchless interaction, this is resolved. By demonstrating an "in-an-open" environment communication gesture game on two wearable devices, such as a hybrid wearable framework for smart phones, where users mount the head wearable vision device and the second device on their wrist or knees, we were able to see the potential of the touch-less approach while reading the paper.

Another study from 2020 looked at how sixty children aged between and eight years interacted with an augmented reality smartphone app that was built in C#. They conducted a priority test to look into and determine the children's potential interest in using the program as well as an aptitude test to determine the children's ability to use it.

They discovered that 5 percent of young children (aged 2 and 3), 25 percent of children (aged 4-6), and 55 children (aged 7 and 8) were fascinated by using the application.

In a few study publications, it is projected that the use of AR and VR technologies in engineering education will reduce the cost of exorbitantly expensive lab equipment and training devices.

A 2018 study was conducted, In order to consume facts through the exchange with computerized factors, the applications under evaluation introduced some of the same layout functions depending on virtual data disclosure systems. A significant component of the test measured the effects of AR innovation on developing students' conceptual mastery, followed by employing those that used research on efficient and commanding outcomes. Future projects must have a meta-cognitive platform and a test guide to assist students develop their talents. Experts seek configuration elements that let undergraduates acquire key skills relevant to STEM courses.

Finally, it would be worthwhile to look into how combined academic processes like the flipped classroom might benefit from AR learning methodologies. An innovative multi homography-based fully feature monitoring method that is effective and environmentally friendly for quick motion and stable rotation is supported by a study. On the basis of it, we suggest a real-time local map enlargement strategy to immediately triangulate the discovered 3-D points. The motion prior constraints between subsequent frames are imposed using simulated or real IMU information via a sliding-window based fully digital cam pose optimization method that is developed.

The efficiency of the suggested method is demonstrated through qualitative and quantitative comparisons with contemporary tactics and an AR app for mobile devices. The report identifies two cutting-edge trends in the delivery of special education in Malaysia, namely augmented reality and cloud computing. It is believed that AR offers the educational system important benefits. Additionally, it is true that Malaysia's government has started building the nation's cloud computing infrastructure. This study highlights the potential for cloud computing to improve AR teaching for Malaysian children with special needs.

A survey on augmented reality was published by researchers (AR). By providing expert examples of the recent advancements, they aimed to supplement the actual survey rather than replace it. We refer readers to the comprehensive survey for descriptions of potential packages (such as scientific visualization, renovation and repair of complex devices, annotation, and path planning); summaries of AR device characteristics (such as the advantages and disadvantages of optical and video procedures to blending virtual and real, problems in display attention and contrast, and device portability); and an introduction to the crucial problem of registration, which is the process of identifying the location of an object in space.

CHAPTER 3

REQUIREMENT ANALYSIS

Since it lays the foundation for the system's design and development, the requirement analysis phase must be included in every software project. This section outlines the many techniques utilized to accomplish the project's objectives, including the development of the Android application and the generation and rendering of 3D visualizations. We looked at the project's requirements from both a technical and a functional perspective. The augmented reality application's capabilities and features were covered by the functional requirements, whereas the hardware and software specifications were covered by the technical requirements. This project on its own is very hardware intensive. It takes special hardware to run some of the softwares that were absolute necessities for this project. Some of the applications/ softwares, mentioned in the later parts of this section require the usage of high-power graphics cards as the models would first need to be created in 3D software as a 3D image and the rendered into models that would be then used in the Unity AR engine.

3.1 HARDWARE REQUIREMENTS

Firstly, the hardware requirements were identified. These would depend upon the complexity of the models that were being rendered onto the display using the object markers, but for our purposes the basic requirements are as follows:

- **Processor:** Any processor above 1 GHz

The project's processor was an Intel7 10^{th} generation processor. The generation does significant because newer models have faster rendering capabilities for some applications. Older processor generations might render game components very slowly, which would hypothetically make it very challenging to construct the game in the allotted period. Therefore, a modern processor with a clock speed of at least 1 GHz is essential for this process.

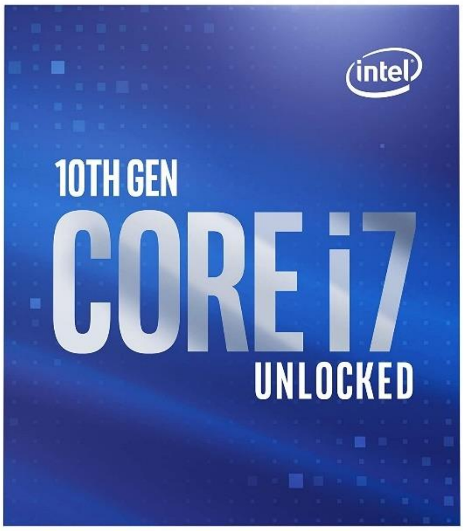

Fig. 3.1: Processor

- **RAM:** 8 GB Minimum

Although 8GB of RAM is the minimum requirement, anything more than that helps to make the development phase less difficult to complete. 32GB of RAM was used for this project. Therefore, 16GB is the minimum recommended requirement, though anything equivalent or greater than 8GB will also work.

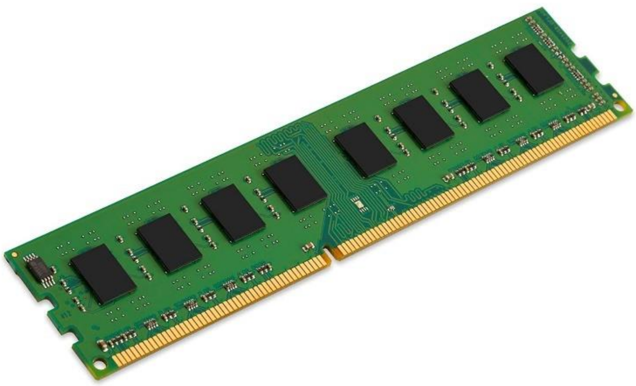

Fig. 3.2: RAM

- **HDD:** 30GB

The applications being utilized to create the game are quite storage hungry, which is why the hard disk need is relatively large. Due to their high power and many features, the amount of storage needed quickly increases. Additionally, game elements like game objects can significantly increase the amount of storage needed, so it's critical to have a lot of storage space so the developer can work without concern that they might run out. The best option would be a Solid-State Drive (SSD), which has higher read and write speeds and would also cut down on the time required for some tasks, but it is easy to create one using simply any regular hard drive designed for desktops or laptops.

Fig. 3.3: Hard Disk

- **INPUT DEVICE:** The bare minimum for the development phase's input devices would be a mouse and any standard keyboard to access the computer system.

  Since even phone games can technically be played using controllers, it is essential for game developers to have a joystick controller as it enables them to test their game using various forms of control. A good developer ensures that the gamer will also have a smooth experience while using other forms of input devices.

Fig. 3.4: Console Controller

- **Output device:** High-Resolution Monitor/ Mobile Device

The output devices required would mainly comprise of a monitor to visually work using the computer or the laptop screen which would readily be available with the laptop.

Fig. 3.5: Monitor

The second output device that we would require would be a smartphone, since in the end the application is being developed for handheld devices that would ensure portability of the said course material. The device would need to have Depth sensing cameras or a LiDAR system.

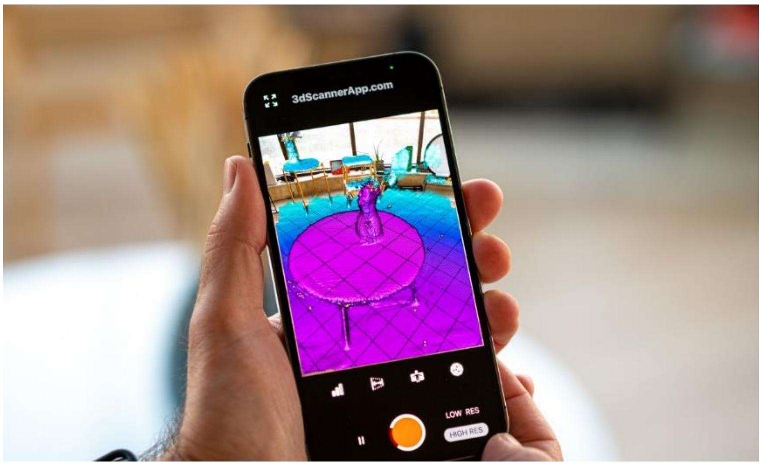

Fig. 3.6: Smartphone with LiDAR

3.2 SOFTWARE REQUIREMENTS

- **Operating System:** The most recent iteration of the Windows operating system line is Windows 11, which was unveiled by Microsoft. Since Windows is the most widely used operating system worldwide and almost all independent or innovative applications can run on it, it is the best option for the software requirements to develop the application. Additionally, Windows offers developers greater user control flexibility than any other operating system.

Fig. 3.7: Windows OS

- **IDE:** Visual Studio 2019

An extremely well-known integrated development environment is Visual Studio. It supports a variety of plugins and may run various languages. It is quite potent and useful for scripting the game in this circumstance because it can be set as the default IDE for Unity scripting. Additionally, it includes IntelliJ Sense, which makes the task of scripting much simpler and more practical.

Fig. 3.8: Visual Studio 2019

- **Game Engine:** Unity 3D

Unity 3D is really easy to use and incredibly strong. It contains an extensive library of online documentation and tutorials. It makes it incredibly easy to create AR applications and can be linked with Google's ARCore for AR development. Additionally, Unity allows for cross-platform development, which is very helpful when creating games because it allows the developer to easily export the game to different hardware and operating systems without having to rewrite a single line of code.

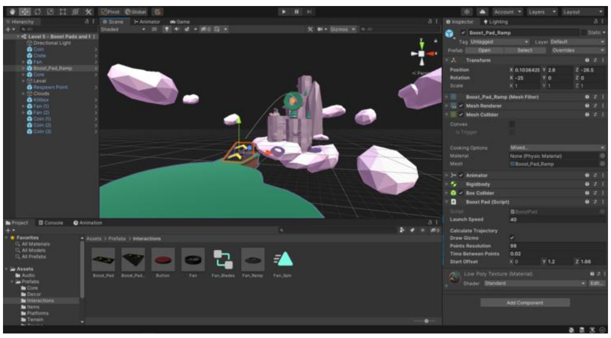

Fig. 3.9: Unity 3D

- **3D Computer Graphics Software:** Blender

Another 3D modeling software that may be used to create video games is Blender. However, because of its sophisticated features, Blender is more frequently used to create 3D models. Additionally open source and simple to use, Blender is available to everyone.

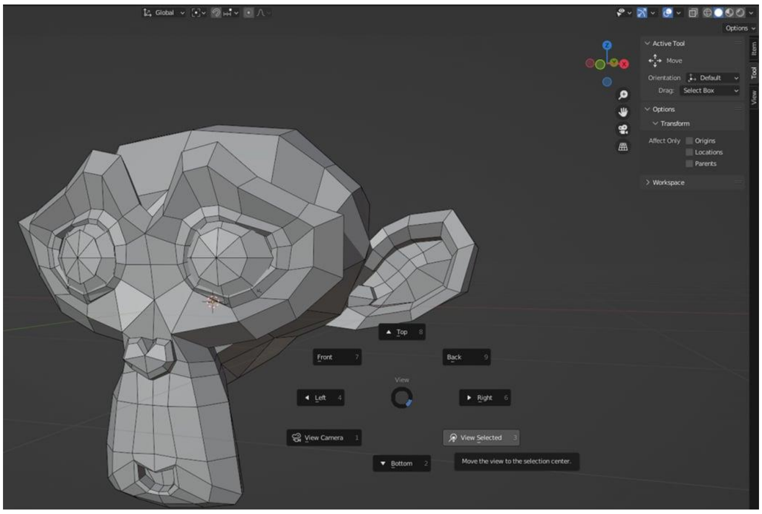

Fig. 3.10: 3D model in Blender

- **AR Engine:** Vuforia Engine

The Vuforia Engine is an engine mostly used for augmented reality development. It is restricted to being utilized for AR development alone, unlike the above stated engines. Fortunately, Unity allows for integration with Vuforia, making it very easy to use since Vuforia is more capable of carrying out specific AR tasks like planar detection and image tracking.

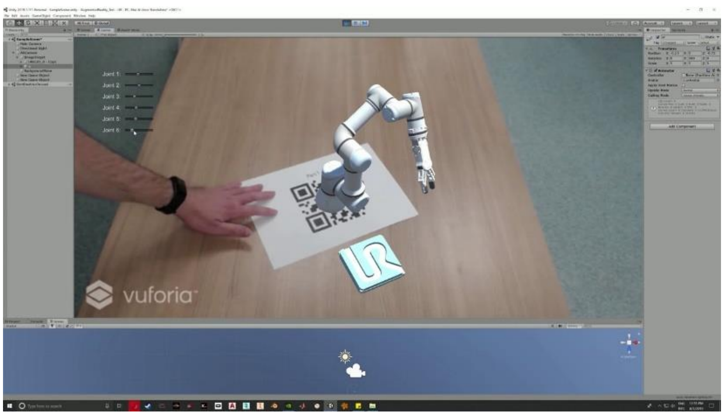

Fig. 3.11: Vuforia integrated with Unity

3.3 FUNCTIONAL REQUIREMENTS

A functional requirement in software engineering identifies the purpose of a software system or one of its parts. A set of inputs, behavior, and outputs are used to describe a function. Functional requirements specify what a system should be able to do through computations, technological details, data processing, and other specialized capabilities. Use cases provide all of the behavioral requirements explaining how the system will use the functional requirements.

Here, the system has to perform the following tasks:

- Make sure that the scenes, modules, and their behaviors are correctly loaded and displayed in the Android app.
- To render the models in augmented space in real time, use the device's camera.
- Be interactive and properly display all of the information cards if the individual model so requires.

3.4 NON-FUNCTIONAL REQUIREMENTS

A non-functional requirement is one that, rather than describing specific behaviors, sets criteria that can be used to assess how well a system performs in systems engineering and requirements engineering. Functional requirements, on the other hand, specify particular behaviors or functions. The system design includes a thorough plan for putting functional requirements into practice. The system architecture provides specifics on how non-functional requirements will be implemented.

3.4.1 ACCESSIBILITY

When something is as available as feasible to the widest possible audience, it is said to be "accessible" in a general sense. The user interface is straightforward, effective, and simple to use.

3.4.2 MAINTAINABILITY

Maintainability in software engineering refers to how easily a software product may be changed to:

- Correct defects
- Meet new requirements

By simply adding the necessary files to an existing project in one of several different programming languages, new functionalities can be introduced in accordance with customer needs. Because the programming is so basic, it is simpler to identify errors, fix them, and modify the project.

3.4.3 SCALABILITY

When resources (typically hardware) are added, the system can handle an increase in total throughput under a heavier load. The system can function normally in circumstances like poor bandwidth and a high user count.

3.4.4 PORTABILITY

One of the fundamental ideas in high-level programming is portability. When migrating software from one environment to another, the ability to reuse the existing code rather than writing new code is known as portability. As long as the project meets its minimum requirements, it can be carried out under various operating conditions. In such a setup, just system files and dependent assemblies would require configuration.

CHAPTER 4

DESIGN/ OVERALL SYSTEM ARCHITECTURE

4.1 DESIGN GOALS

4.1.1 MARKER BASED APPLICATIONS

This kind of augmented reality, also known as recognition-based augmented reality or image recognition, depends on the recognition of markers or user-defined images to work. In marker-based AR, an augmentation must be activated by a marker. Markers can be tangible things found in the real world or paper-based patterns that are easily recognized and processed by cameras. Markers are visually independent of their surroundings.

Maker-based AR functions by scanning a marker, which causes an augmented experience to show on the device (which might be an object, text, video, or animation). To scan markers from a device utilizing its camera feed, it typically requires software in the form of an app.

4.1.2 MARKER LESS APPLICATIONS

- **LOCATION BASED AR:**

Location-based AR uses data from a device's camera, GPS, digital compass, and accelerometer while predicting where the user is focusing as a trigger to pair dynamic location with points of interest in order to provide pertinent data or information. This is possible thanks to smartphone features that provide location detection. Location-based AR ties augmentation to a specific place. When a user's device data matches the location, information and virtual objects are mapped on specified areas and then shown.

Since marker-based AR requires an image or object cue to deploy, marker-less AR is more adaptable because it relies on positional data gathered from a device's camera, GPS, digital compass, and accelerometer.

- **PROJECTION BASED AR:**

A technique for conveying digital information in a static environment is projection augmented reality, often known as spatial augmented reality. Its primary objective is to render virtual things in or on a user's actual physical space. One of the simplest types of augmented reality involves light being projected onto a surface. By physically touching the projected surface, the interaction takes place.

Users and target objects can move around the environment within a designated zone, in which both the fixed projector and supporting camera for tracking are placed, in projection augmented reality (AR). Virtual objects are integrated directly into the environment, so the user is not restricted to any particular device. To generate illusions about the depth, location, and orientation of an object, projection-based AR techniques may be used.

- **SUPERIMPOSITION BASED AR**

When using superimposition AR, an augmented view of the same object replaces all or part of the original view of the object. Because an app cannot replace an original object with an augmented one if it cannot identify the original object, object recognition is essential in this type of AR. By applying filters, social media sites like Instagram, Facebook, and Instagram have helped to make this kind of AR more widely known.

- **USER DEFINED MARKER LESS AR**

Non-mainstream apps created by developers to address issues in their personal life or those of their customers are what define these experiences. Typically, the content is unique and has user-defined points of interaction. To create various visualizations and interactions, it makes use of existing technologies and AR frameworks.

4.2 DATA FLOW

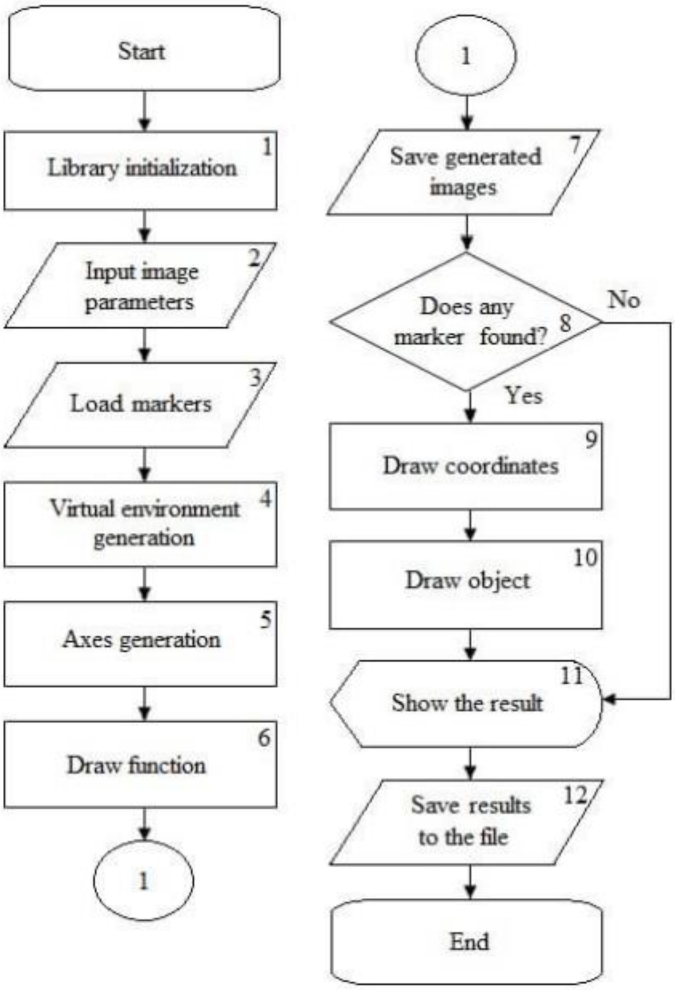

Fig. 4.1: Workflow of marker-based AR application

The basic workflow of the steps that must be taken to successfully construct an augmented reality application is shown in the flowchart above. On the user's device, each of the mentioned actions takes place. First, the model libraries are loaded with their appropriate markers. Following this, the draw function is initialized and the axes on the virtual plane are generated, making the models in the space in front of the user visible. After this procedure is finished, users can interact with the model and learn more. This interaction's outcome is recorded in the application logs.

4.3 DEVELOPMENT OF THE APP

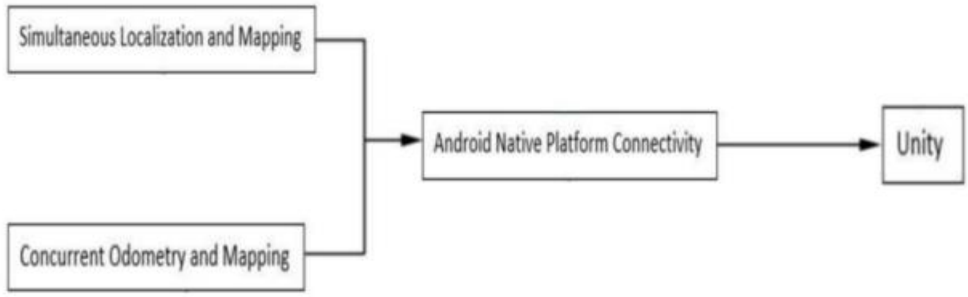

Fig. 4.2: Unity and Android

The application combines ARCore and SLAM (Simultaneous Localization and Mapping) (Concurrent Odometry and Mapping). Unity is used to merge these two, each with their own special functions, so they can cooperate with the native Android platform.

- **Simultaneous Localization and Mapping:** The computational challenge of creating or updating a map of an uncharted area while tracking an agent's position inside it is known as SLAM. Despite the fact that this initially seems to be a chicken or the egg problem, numerous algorithms are known to be able to resolve it in, at the very least roughly, tractable time for specific contexts.

  The particle filter, extended Kalman filter, covariance intersection, and GraphSLAM are examples of popular approximation techniques. Robot navigation, robotic mapping, and odometry for virtual reality or augmented reality all make use of SLAM algorithms, which are based on ideas in computational geometry and computer vision.

  The goal of SLAM algorithms is operational compliance rather than perfection and they are adapted to the resources that are available. Self-driving cars, unmanned aerial vehicles, autonomous underwater vehicles, planetary rovers, more recent domestic robots, and even inside the human body use published methods.

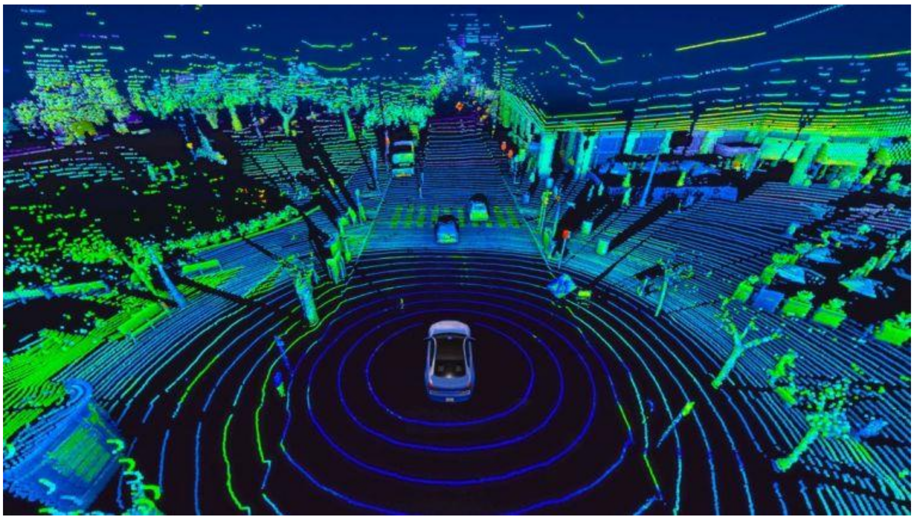

Fig. 4.3: SLAM used to provide 360° view

- **Concurrent Odometry and Mapping:** ARCore employs a technique known as simultaneous localization and mapping, or SLAM, to determine where your phone is in relation to the environment as it moves through it. In order to determine its change in location, ARCore uses feature points—visually distinct features—that it finds in the camera-captured image.

  To estimate the pose (position and orientation) of the camera with respect to the environment over time, the visual data is coupled with inertial measurements from the device's IMU. Developers can generate virtual content from the appropriate perspective by matching the pose of the device's camera provided by ARCore with the pose of the virtual camera that renders your 3D content. To give the impression that the virtual content is a part of the actual environment, the produced virtual image might be superimposed on top of the image captured by the device's camera.

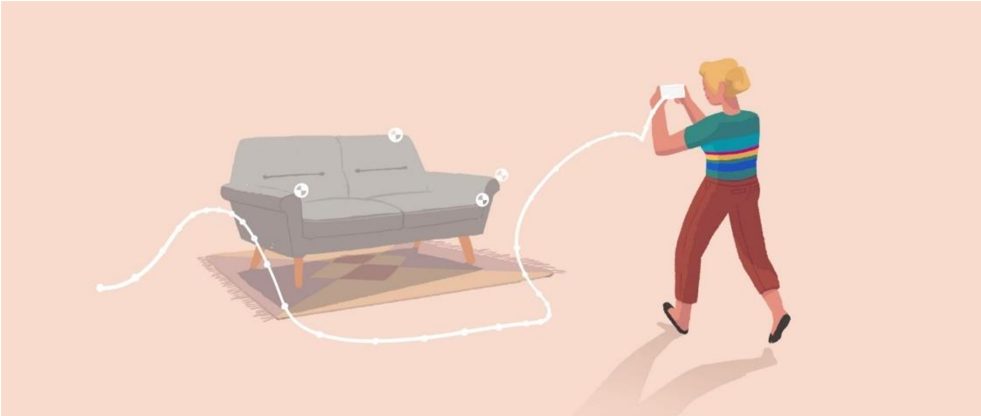

Fig. 4.4: Marker Detection using Concurrent Odometry and Mapping

4.4 WORKING OF THE APP

- The relevant course modules must be chosen in advance, and a thorough survey of the subjects the students need to learn must be conducted.
- The models must be produced as 3D visuals in a 3D modeling program, in this example blender, when the survey has been completed.
- Then, using a render pipeline, these models must be rendered into Unity.
- Once these models have been properly imported into Unity, they can be called into scenes as objects, and their behavior can be described and altered as necessary by the user.
- Using in-app navigation buttons, these scenes are combined and connected to one another to create a fully interactive app.
- The app is signed, exported to an android device, and the permissions and needs for Android are defined.

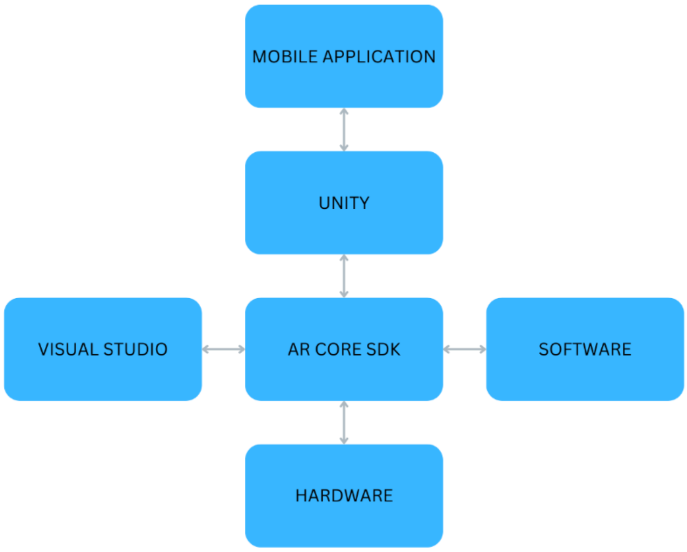

Fig. 4.5: Working of the App

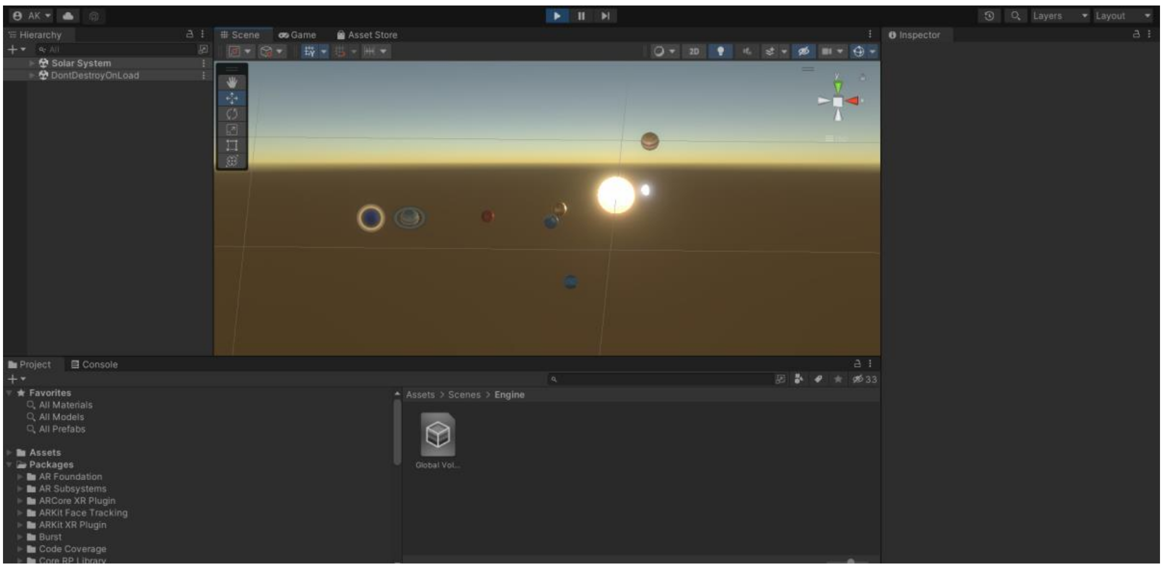

Fig. 4.6: Example scene

CHAPTER 5

IMPLEMENTATION

The application is divided into four primary elements. These four scenes are the data structures scene, the main menu scene, the physics scene, and the astronomical scene. The user can engage with various aspects in each of these scenarios.

- **Main Menu Scene:** The three currently offered learning modules in the application are shown in the main menu scene. These three fields are physics, astronomy, and data structures.

  Both of these can be clicked to display the models that are relevant to that topic.

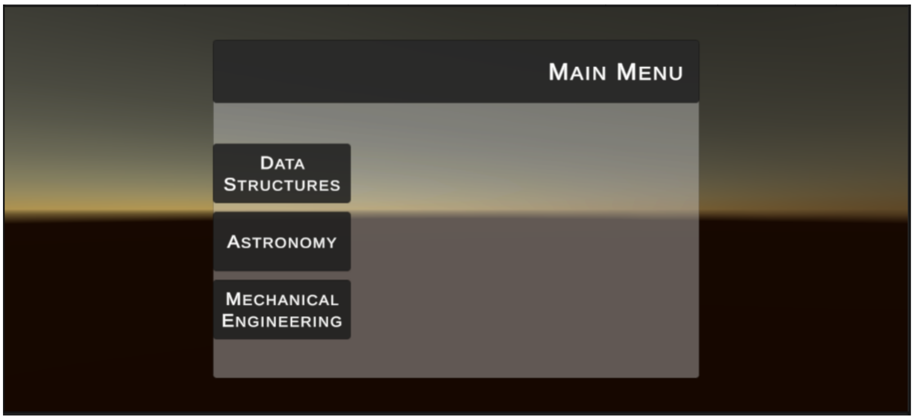

Fig. 5.1: Main Menu scene

- **Data Structures Scene:** This is an example of learning modules available in the application. We have a model to replicate the behaviour of a stack and queue. These models are based on the marker-based applications of augmented reality. When either of these learning modules are selected, the camera on the smartphone is utilized to create markers to appropriately place the stack or the queue in the space visible in front of them. The models for these, i.e., are created in blender as simple cubes and then imported into unity, while their behaviour is modeled using a set of coded instructions.

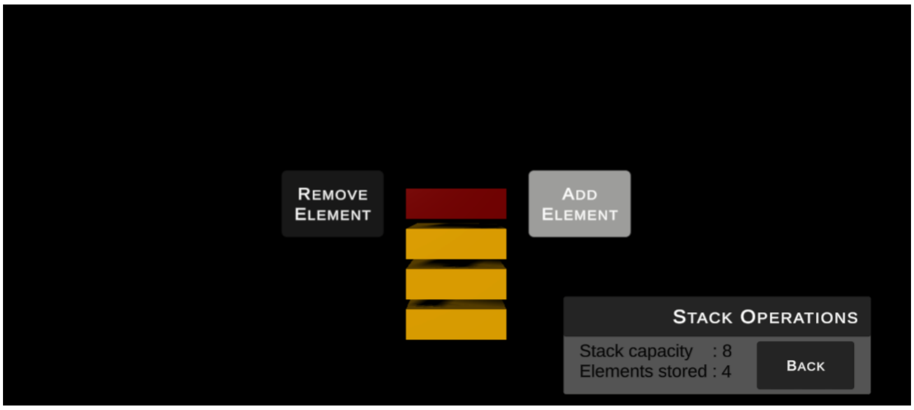

Fig. 5.2: Stack Operation

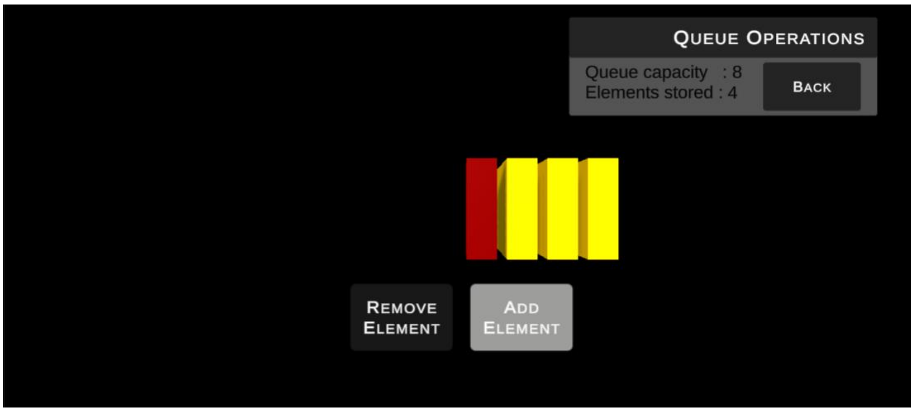

Fig. 5.3: Queue Operation

- **Astronomy Scene:** The sun is employed as a system point in this particular picture to make the instructional model of the solar system a little bit more manageable. A complete three-dimensional reproduction of our solar system is available to the user, complete with interactive cards that display details about the individual heavenly bodies. These planets also exhibit a degree of realism in that they spin on their own axes and circle around the point of reference.

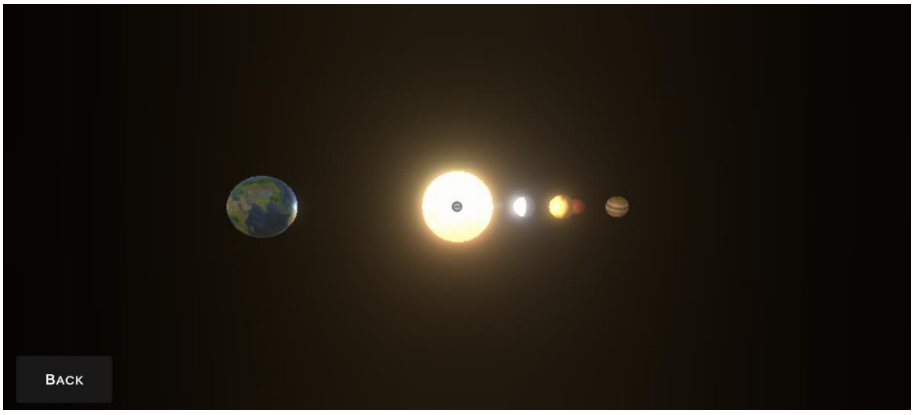

Fig. 5.4: Astronomy Scene

- **Physics Scene:** This scene resembles a four-stroke engine and its behavior while also including extra interactive features like the engine's movement speed and the visibility of its outside components. With precise visualizations of the piston bore, we can determine the phase the engine is in using intricate mathematical formulas. A four-stroke engine has four phases: intake, compression, combustion, and exhaust.

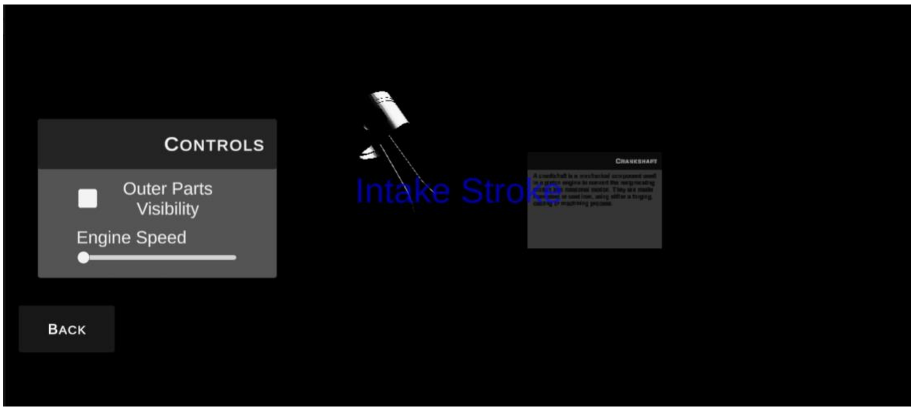

Fig. 5.5: Physics Implementation

CHAPTER 6

RESULTS AND DISCUSSION

The project report's results and discussion part provides a summary of the experimentation and evaluation of the performance of the suggested solution. In this section, we'll look at how effectively a certain group of students handled their coursework with the aid of the AR application. We will also discuss the accuracy, efficiency, and dependability of the proposed system.

6.1 CASE STUDY

Setting Test Parameters: The goal of the Case Study was to get a sense of the effectiveness of a fully functional semi-realistic rendered AR model against more traditional methods of importing education- in this instance, dense text assembled into paragraphs describing the working of a Four Stroke Engine Cycle. The test was done in a controlled environment with set time limits and strict invigilation and a complete lack of access to the internet, extra reading material or any crosstalk between the participants.

The penultimate question was:
“Are there statistically significant differences between the AR group and the traditional group in their test scores?”

The control group used the standard course materials from a textbook and received sufficient information to respond to questions. The study was likely to show that students who use the application as a supplement to their classroom materials will have a deeper understanding of the concepts in general and will be able to perform better on exams when compared to their peers. The experimental group, on the other hand, was given access to both the traditional materials and the application.

Parts of the Engine:

Piston- In an engine, a piston transfers the expanding forces of gas to the mechanical rotation of the crankshaft through a connecting rod. Crankshaft- A crankshaft is a part that converts the reciprocating motion to rotational motion. Connecting Rod- It transfers motion from a piston to a crankshaft, acting as a lever arm Spark Plug- It is a device that delivers electric current to the combustion chamber, which ignites the air-fuel mixture leading to the abrupt gas expansion.

Four Stroke Engine Cycle

Suction/Intake Stroke- Intake stroke occurs when the air-fuel mixture is introduced to the combustion chamber. In this stroke, the piston moves from TDC (Top Dead Center – the farthest position of the piston to the crankshaft) to BDC (Bottom Dead Center – the nearest position of the piston to the crankshaft.) The movement of the piston towards the BDC creates a low-pressure area in the cylinder.

Compression Stroke-In compression stroke, the trapped air-fuel mixture is compressed inside the cylinder. During the stroke, the piston moves from BDC to TDC, compressing the air-fuel mixture. Compressing the air-fuel mixture allows more energy to be released when the charge is ignited. The charge is the volume of compressed air-fuel mixture trapped inside the combustion chamber ready for ignition..

Power/Combustion Stroke- The power stroke occurs when the compressed air-fuel mixture is ignited with the help of a spark plug. Ignition or Combustion is the rapid, oxidizing chemical reaction in which a fuel chemically combines with oxygen in the atmosphere and releases energy in the form of heat. The hot expanding gases force the piston head away from the cylinder head.

Exhaust Stroke- As the piston reaches BDC during the power stroke, combustion is complete, and the cylinder is filled with exhaust gases. The exhaust valves open during this stroke, and the inertia of the flywheel and other moving parts push the piston back to TDC, forcing the exhaust gases through the open exhaust valve. At the end of the exhaust stroke, the piston is at TDC, and one operating cycle has been completed.

Fig. 6.1: Control Group Study Material

Fig. 6.2: 4-stroke engine main components

Fig. 6.3: Exhaust stroke without the visibility of external parts

Fig. 6.4: Combustion stroke without the visibility of external parts

Fig. 6.5: Compression stroke without the visibility of external parts

Fig. 6.6: Intake stroke without the visibility of external parts

Sample Requirements:

- Two random and independent samples required. We used a test group consisting of 84 students aged between 18- 21 students on each side on a completely random allotment basis into two groups of 42. The subjects were studying at 1st year level in Engineering from the same institute. They belonged to different streams and had near equal distribution of Gender, with diver socio-economic backgrounds and all ranges of academic performance.
- The data is continuous – in other words, it must, in principle, be possible to distinguish between values at the nth decimal place.
- Scale of measurement should be ordinal, interval or ratio, we used ordinal data.
- For maximum accuracy, there should be no ties through this test – like others – has a way to handle ties.

Null Hypothesis: The null hypothesis asserts that the medians of the two samples are identical.

Data Analysis: The recordings of the two groups were judged by MCQ based tests covering the topics from the concept illustrated in both the methods. The paper was set (prior to the Learning, Observation and Response Collection phases) and undisclosed in pattern and format. The grading was done an Associate Professor of Mechanical Engineering (domain expert) without any knowledge of name or group of the student being tested i.e.; blinded study as opposed to open label.

The data points were recorded and processed in comma separated and delimited format to process in python algorithm for Mann-Whitney U Test

Sample 1 (Control Group):

4,5,3,6,5,2,4,5,4,4,3,5,6,5,1,3,4,7,5,5,3,6,4,5,3,4,5,4,5,8,3,4,2,5,7,5,4,10,4,5,4,3

Sample 2 (Experimental Group):

7,6,8,8,9,7,8,8,7,7,10,7,8,8,9,6,10,9,7,8,6,6,8,7,6,9,9,7,8,7,6,3,8,7,8,5,7,8,6,7,9

Table 6.1: Study Data

S1 Values	S1 Ranks	S2 Values	S2 Ranks
1	1	1	7.5
2	2.5	2.5	30.5
2	2.5	2.5	42.5
3	7.5	7.5	42.5
3	7.5	7.5	42.5
3	7.5	7.5	42.5
3	7.5	7.5	42.5
3	7.5	7.5	42.5
3	7.5	7.5	42.5
3	7.5	7.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	54.5
4	17.5	17.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	68
5	30.5	30.5	77.5
5	30.5	30.5	77.5
6	42.5	42.5	77.5
6	42.5	42.5	77.5
6	42.5	42.5	77.5
7	54.5	54.5	77.5
7	54.5	54.5	82
8	68	68	82
10	82	82	7.5

The significance level assumed: 0.05

Hypothesis was Two-tailed.

Equation:

$$U = NM + \frac{N(N+1)}{2} - \sum_{x_i} Rank(x_i)$$

Fig. 6.7: Mann-Whitney U test Equation

Result:

In general, one can say about the effect strength:

- Effect Size r less than 0.3 → small effect.
- Effect Size r between 0.3 and 0.5 → medium effect.
- Effect Size r greater than 0.5 → large effect.

In this scenario, upon calculation we get:

Table 6.2: Sample Analysis

Sample 1	Sample 2	Sample 1 and 2 combined
Sum of ranks: 1051.5	Sum of ranks: 2434.5	Sum of ranks: 3486
Mean of ranks: 25.04	Mean of ranks: 59.38	Mean of ranks:42
Expected sum of ranks: 1764	Expected sum of ranks: 1722	Std. Dev: 109.7907
Expected mean of ranks: 42	Expected mean of ranks: 42	
U-value: 1573.5	U-value: 148.5	
Expected U-value: 861	Expected U-value: 861	

The value of U is 148.5

The z-score is -6.48507

The p value is $< .00001$

The result is **significant** at $p < 0.5$

We have found that when AR is used as a visual aid, there is a noticeably higher understanding rate when compared to difficult process-based concepts through the examination of a relevant target group. The development of modules for higher education institutions can benefit from more study in the disciplines.

It is possible to continue the research so that it is fully included in middle school lesson plans. The program will include a virtual assistant and a number of other interesting features for students that were created using IBM's open-source Watson Software Development Kit.

The suggested technology seeks to use augmented reality to produce high-quality 3D video instructions. The 3D models are mapped to fiducial markers (ImageTargets), which are tracked using a camera. These 3D models serve as the user's screen-based representation of a certain product or idea. By actively interacting with these 3D models and watching the animations, the user will be able to comprehend the inner workings and specifics of a given product or idea.

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

The section on conclusions and future scope provides an overview of the study's key findings and contributions. This section also outlines the flaws in the planned fix and makes suggestions for further research and advancement. In this chapter, we examine the project's limitations, the implications of our findings, and potential future research trajectories.

7.1 CONCLUSION

As a result, we used various AR and computer vision-based technologies to construct an Android application that is based on augmented reality. According to the case study that was conducted, it is safe to state that this application was able to dramatically boost the students' learning ability, knowledge retention, and classroom participation.

Through the study of a suitable target population, we have established that there is a significantly higher rate of understanding vis a vis complicated processes-based concepts when AR is utilized as a visual aid. Augmented reality has a couple of use instances, and the most convincing one is its application in the educational region.

The support provided by famous video game engines such as Vuforia and Unity and being aided by AR Core, offered by Google, is helping developers enhance applications for AR. This execution has the degree and ability of having the option to be utilized by thousands and millions of understudies, liberated from cost.

We believe that developing the aforementioned curricula and their corresponding model using more potent systems and adding additional modules, features, fulfilling software deliverables, improving quality of life, and other improvements will result in a completely new generation of educational systems. Additionally, we want to maintain this project open-source so that anyone may contribute and share ideas while still making the application accessible to everyone.

7.2 FUTURE SCOPE

The development of modules for higher education institutions can benefit from more study in the disciplines. It is possible to continue the research so that it is fully included in middle school lesson plans.

The program will include a virtual assistant and a number of other interesting features for students that were created using IBM's open-source Watson Software Development Kit. Offering information about the object and performing immediate recognition of photographs now in the camera flow are further potential improvement points, while this feature may also have uses outside the realm of education.

The scientific community has closely studied smart eyeglasses and augmented reality technologies to provide vision rehabilitation to people with visual impairments as well as augmented vision to those with and without visual impairments for various application scenarios and contexts of use. Less than 10% of schools use the existing AR technology intended for education since it would take a significant initial capital expenditure to address technical breakthroughs on this scale. In addition to the lack of funding, AR technology is cumbersome, frequently necessitates specialist hardware in order to visualize the imaging, is time-consuming to install, and requires specialized training for personnel in order to operate.

Among the benefits include a learning process that is quicker and more efficient, enhanced teamwork skills, and practical learning that is relevant worldwide. When and where they are needed, accessible learning resources are available and don't require any special tools. The project's goal is to create a computer vision application that uses the idea of augmented reality to show a 3D representation of the image scanned by the user of the software.

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