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AUGMENTED REALITY FOR EDUCATION

A report submitted for the Research Project(7th Semester)

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Abstract

Augmented Reality (AR) is a transformative technology that augments real-world environments by overlaying digital content enhancing user experiences across diverse domains. It adds virtual things to the actual environment in real-time throughout the user's experience. In the last few years, augmented reality has grabbed the curiosity of researchers, investors, and the common public due to its versatile application in education, healthcare, entertainment, sports, and tourism. However, AR implementation faces challenges like real-time rendering, accurate object recognition, and seamless integration. In this project, our main contribution will be to explore the augmented reality application in education. For this, we will prepare a marker-based dataset and create visual aids for early childhood learning. Researchers have observed that visual-aid learning (images, videos, and animations) presented over conventional learning and teaching techniques encourages children to remain focused and makes learning simpler to comprehend. The visual aids in our project will be in the form of 3D virtual objects to be projected on the markers. This setup will provide the school kids with a seamless and engaging learning experience.

Keywords: *Augmented Reality, Virtual learning, Deep learning*

1 Introduction

1.1 Augmented Reality

The term “Augmented Reality”,refers to a technology that enables the real-time integration of information from the real world with computer generated content through appropriate computer interfaces. Integrated information technology is augmented reality. [1] that combines digital image processing, computer graphics, machine learning, and other areas. By using VR techniques augmented reality is introduced to create a real-world scenario around you.

Ivan Sutherlsnd created the first head-mounted display device (HMD) in 1968, introducing the concept of augmented reality. However, the term "augmented reality" wasn't used until 1990 by Boeing researcher Tim Caudell. There are already a growing number of applications for augmented reality thanks to tremendous technological advancement. Earlier definitions of augmented reality (AR) called on the usage of head-mounted displays (HMDs) [2]; however, newer definitions advocated the following qualities to avoid restricting AR: 1) Real-life and virtual world integration; 2) real-time tracking; and 3) 3-D display. This definition attempts to open the door for the advancement of additional technologies, such mobile technology [3].

1.2 AR and VR and MR

Imaginary or virtual worlds that exist only on computers and in our imaginations are referred to as "virtual reality" in this context. Virtual reality is defined as a man-made environment that is experienced through sensory input provided by a computer (such as sights and sounds), in which one's actions partially influence the environment, according to [4].According to the author of [5], "Mixed Reality" creates a space in which both real and virtual elements coexist, enabling simple interaction between the two, blurring the lines between environments, and creating one enormous space where components from both worlds (physical and logical) can communicate in real-time.

1.3 Types Of AR

1.3.1 Marker Based AR:

The phrase "marker-based AR" refers to augmented reality that relies on identifying and following specific markers or patterns in the real world to overlay virtual objects on top of them. These markers could be pictures, QR codes, icons, or anything else that the AR system can quickly identify. The key steps of a marker-based augmented reality application, according to [6], are (i) detecting markers from various camera angles, (ii) identifying the marker, (iii) estimating the marker's pose, and (iv) superimposing 3D virtual content over the marker in a live video stream.

1.3.2 Markerless AR:

Markerless Augmented Reality (AR) stands at the forefront of AR technology, representing a significant advancement in the field. Unlike Marker-Based AR, it relies on cutting-edge computer vision algorithms to identify objects and surfaces in the physical environment, eliminating the need for predefined markers or QR codes. By harnessing the power of cameras, Markerless AR seamlessly integrates digital content with the real world. This technology offers users a more natural and immersive experience, as it can recognize a wide range of objects, such as landmarks, everyday objects, and even complex scenes. It finds applications in various domains, including gaming, navigation, education, and industrial training, revolutionizing how we interact with and perceive our surroundings.

1.4 Applicatons of AR

Augmented reality has its applications in many fields(such as [7–11]). Some of the important applications are as follows

1.4.1 Medical

In medical sector,medical information and the patient at the same location as provided, augmented reality is utilized in medicine.Real-time viewing is necessary since the data is not homogeneous. Three-dimensional augmented reality (3D-AR) is a developing technology, according to the author of [12] and it has the ability to provide clinicians with particular guidance during clinical trials. The most well-known applications of 3D-AR involve the patient being shown surgical or anatomical models.

1.4.2 Education

It is acknowledged that the advantages of teaching and learning produce favorable outcomes. Since there are both physical and virtual worlds, students can gain essential skills to design learning environments while also visualizing and comprehending complex concepts and abstract ideas that communicate with two- and three-dimensional things. When using ARtoolkits, the author of [7] discusses how to overlay 3D material from a-z when viewed from a laptop webcam, a mobile camera, or a tablet. It will display some 3D material for each letter to help children learn and understand concepts more quickly. Due to these educational advantages, augmented reality (AR) is one of the most rapidly expanding educational technologies [8].

1.4.3 Sports and Games:

In the sports sector, augmented reality has been used to build games and to make key game elements more visible. With the use of a camera and video recording software, it is simple to recognize and prepare different sporting and gaming venues, such as football fields and cricket grounds. In [9] pitch marking is done easily by AR technologies with help of reference images .

In [10]the first step for players is to locate the bomb in the real world using GPS mapping. Players locate the prescribed image target and then activate the analysis screen, which causes an augmented reality bomb model to emerge on top of the target. The task is to defuse the bomb in the 10 to 60 seconds that are arbitrarily given to you. Success necessitates a methodical process for removing virtual fuses. In the event that all bombs are successfully defused or an explosion occurs at the end of the game, players earn points for any time that remains. Players can then publish their results to a Hall of Fame website, encouraging rivalry and score comparisons among competitors.

1.4.4 Tourism

The Archiouguide, an artistic heritage effort based on augmented reality, was advertised as providing visitors with archaeological knowledge about historical cultural locations [11]. In order to approach the development of AR interfaces for guided tours (seeing historical sites), multimedia designs were used. For tourists, augmented reality (AR) technology have improved museum visits, exhibits, and museum guides, respectively [13].

1.4.5 Marketing

The marketed automobile was projected in 3D on the screen after webcams automatically recognized the markings [14]. The QR code, a black-and-white graphic that can be scanned by a computer or mobile device to reveal additional information, is a simple example of augmented reality. [15]. Virtually trying on spects (used by LENSKART) is an illustration of more advanced augmented reality. The user puts on eyeglasses, then sees himself or herself in front of a camera and sees a picture of himself wearing the selected eyeglasses. The user may quickly find the most attractive pairs of eyeglasses thanks to the quick changes in model, color, and accessories.

2 Literature Review

In [16],The prototype system displays encouraging results for identifying pests. Future objectives include integrating GappaGoshtiTM for field tests and potential application in drug detection via barcode or QR code analysis, boosting user safety and collaboration.We may use a feedback mechanism to make the program even better and update as necessary .

In [17],line detection for 2D pitch models is promising for AR applications. Recognization of limitations, propose solutions, and plan testing and performance analysis for further improvements.It can be improved by using advanced Computer Vision.

In [18]the game combines with AR, brings a novel interactive game experience of AR to children. At the same time, it also exercises the children's reactivity and concentration.It can be further improved by increasing custom modes of the game. float longtable

Sl No	Paper name	Year	Publisher	Platform /langau -age used	Method	Marker / Markerless	used Application

1	Current Challenges and Future Research Directions in Augmented Reality for Education	2022	MDPI	Unity	Machine Learn -ing	Markerless	Colaboravtive Learning
2	Registration Techniques for Clinical Applications of Three-Dimensional Augmented Reality Devices	2020	IEEE	Microsoft Hololens	Image processing	AruCo Marker	Patient-specif -ic 3D-printed registration guide
3	Research and Development of Augmented Reality Children's Puzzle Game Based on Vuforia	2019	IEEE	UNITY 3D ,Vuforia	Image processing	Marker	Puzzle Game for Childen
4	Augmented reality using Vuforia for marketing residence	2016	IEEE	Vuforia	Computer Vision	Markerless	E-marketing and advertisement
5	Mobile augmented reality on web-based for the tourism using HTML5	2018	IEEE	HTML5 ,JAVA -SCRIPT	Computer Vision	Marker	Tourism
6	Designing of marker-based augmented reality learning environment for kids using convolutional neural network architecture	2018	Elsevier	Python Keras	Deep Learning	Marker	Education
7	Augmented Reality in the Classroom	2012	IEEE	BuildAR	Computer Vision	Marker	Education
8	Augmented Reality in education – cases, places and potentials	2014	researchget .net			Markerless	
9	Augmented Reality in agriculture	2011	IEEE	QCAR SDK	Image Processing	Markerless	Agriculture

10	Augmented Reality Education Tool for Children with Learning Disabilities	2015	researchget .net	Vuforia ,SDK	Image Processing	Marker	Education
11	Augmented Reality in Visual Learning	2020	researchget .net	Vuforia	Machine Learning	Marker	
12	Design and Development of an Augmented Reality Tracing Application for Kindergarten Students	2019	IEEE	Vuforia	Machine Learning	Marker	Education
13	An Augmented Reality Application with Leap and Android	2015	amazonaws .com	snapdragon	Image Processing	Marker	
14	Augmented Reality as a New Marketing Strategy	2018	Springer	Unity,Arkit		MarkerLess	Marketing
15	Application and scope analysis of Augmented Reality in marketing using image processing technique	2016	IEEE	Argon	Image processing	Markerless	Marketing
16	Localisation for Augmented Reality at Sport Events	2019	IEEE	Open CV	Deep Learning	Marker	Sports
17	Using Unity 3D to facilitate mobile augmented reality game development	2014	IEEE	Unity 3D	Image processing	Marker Based	Mobile Games
18	Error Detection using Augmented Reality in the Subtractive Manufacturing Process	2020	IEEE	Open CV ,python	Computer Vision	Marker	Error Detection

19	Web AR: A Promising Future for Mobile Augmented Reality—State of the Art, Challenges, and Insights	2019	IEEE	Html,Java -script	Computer Vision	Marker	Web AR
20	Web based Augmented Reality for Human Body Anatomy Learning	2018	Science Direct	Action Script 3.0	Image processing	Marker	Medical Education
21	MagicHand: Interact with IoT Devices in Augmented Reality Environment	2019	IEEE		Deep Learning	Marker	Detection of IOT devices

3 Research Problem:

In the research project the following challenges will be dealing:

1 **.Marker:**It is used detect the location to superimpose the computer generated content over it.

2 **.Depth:**The camera enabled device should able to detect markers from any possible depth. Distance between camera and the markers

3 **.Orientation:**From different view point of camera markers should be easily detectible.

4 **.Light:**The camera should detect the marker in any light condition.

4 Objective of the project:

1. **Marker Based:**Creating markers(from A-Z) will be used to super imposed the 3d Content.
2. **Using image processing:**After image processing of a marker(affected by light,different viewpoint and depth)we should be able to detect the marker .
3. **Project 3D objects in the detected markers:**The 3D content generated by computer or any cameras should superimpose over the marker perfectly.
4. **Real-Time tracking and Interaction:** Enable responsive tracking of markers and interactive capabilities, allowing users to manipulate and engage with augmented 3D content fluidly.

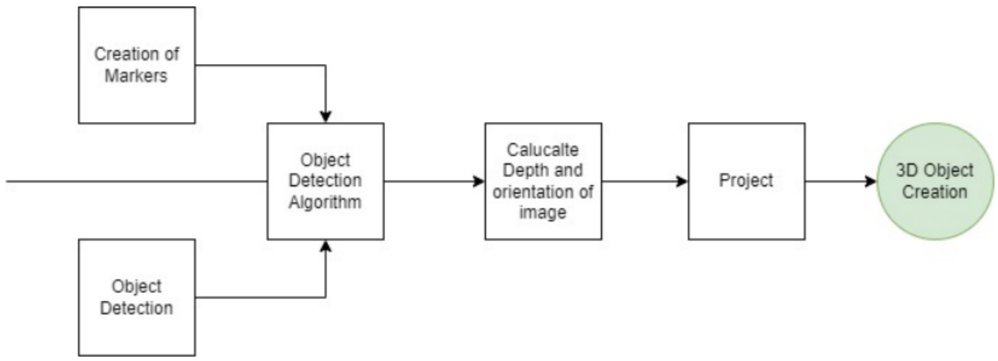

Figure 1: 6(a) Proposed-approach

5 Methodology:

5.1 Marker Based AR:

Marker-based AR relies on physical markers or fiducial markers, such as QR codes or specific patterns, to superimpose the digital content when detected by a camera-equipped device.This approach is often used in AR marketing campaigns, educational apps, and interactive installations.

Fig a) Sample Markers, b)Detected markers boundary with the help of camera ,c)Extracted segment from the whole frame.

One of the famous marker is Aruco marker typically appears as a grid of white and black squares. The arrangement of these squares forms a binary matrix, where the white squares represent 0s, and the black squares represent 1s. This binary matrix is unique for each Aruco marker, enabling precise identification and tracking. When the camera-equipped device detects an Aruco marker, it matches the observed binary matrix with pre-defined templates to determine the marker's identity and orientation.

Fig (a) Sample Aruco Marker

6 Proposed Approach:

Fig 6(a) Depicts that how we will be proceeding from creation of markers to 3D object creatioin

7 Expected Contribution

1. **Object Detection Algorithm:** A computer program that can recognize and locate objects in the real world using OpenCV. This will help the augmented reality system understand where to place virtual objects accurately.

2. **3D Object Acquisation:**3D Object Acquisition: 3D digital objects are to be aquired so that it can be used in the augmented reality experience. Thus seems to be a part of real world.

3. **According to Depth and Orientatio:** it will accurately recognize markers and display 3D objects no matter how close or far you are or from what direction you're looking at them

8 Resources and Budget

1. **GPU based computer (for effective tracking of object detection algorithm):**A high-performance computer with a Graphics Processing Unit (GPU) for better execution of object detection algorithms, ensuring real-time processing
2. **A camera to capture the object:**A digital camera or webcam used to capture real-world objects, providing input for the object detection and augmented reality system
3. **Application and Software:**
   (a) **Open CV:**Open-source computer vision library in Python, vital for image processing, marker detection, and object tracking
   (b) **Python:** Programming language for developing the augmented reality application and integrating various components

9 RoadMap

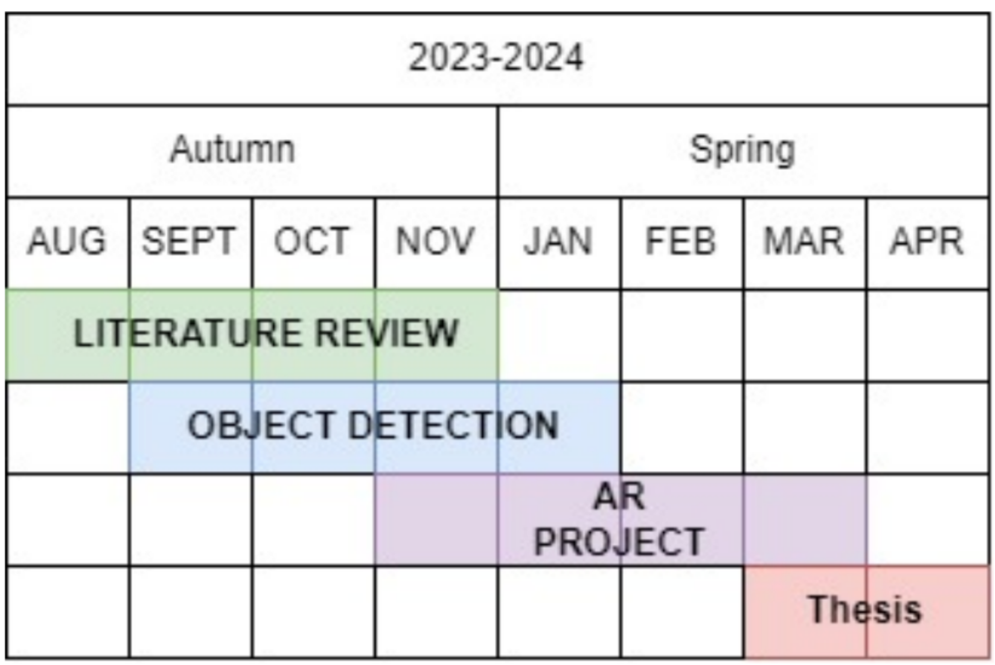

Figure 2: Road Map

10 Conclusion:

In conclusion, this research project explores the application of Augmented Reality (AR) in education, focusing on marker-based AR. The primary objective is to create a marker-based dataset and develop visual aids in the form of 3D virtual objects for early childhood learning. AR has many applications in various domains, including education, and can enhance the learning experience. Challenges such as marker detection, depth recognition, orientation, and lighting conditions are addressed. The expected contributions include the development of object detection algorithms and the superimposition of 3D content over markers. This project aims to provide school children with an engaging and seamless learning experience using AR technology.

References

[1] Dhiraj Amin and Sharvari Govilkar. Comparative study of augmented reality sdks. *International Journal on Computational Science & Applications*, 5(1):11–26, 2015.

[2] Anton Fuhrmann, Dieter Schmalstieg, and Werner Purgathofer. Fast calibration for augmented reality. In *Proceedings of the ACM symposium on Virtual reality software and technology*, pages 166–167, 1999.

[3] V Meenakshi Sundaram, Shriram K Vasudevan, C Santhosh, RGKB Kumar, and G Deepak Kumar. An augmented reality application with leap and android. *Indian J. Sci. Technol*, 8(7):678–682, 2015.

[4] Fakhreddine Ababsa. Augmented reality application in manufacturing industry: Maintenance and non-destructive testing (ndt) use cases. In *Augmented Reality, Virtual Reality, and Computer Graphics: 7th International Conference, AVR 2020, Lecce, Italy, September 7–10, 2020, Proceedings, Part II 7*, pages 333–344. Springer, 2020.

[5] Wolfgang Hoenig, Christina Milanes, Lisa Scaria, Thai Phan, Mark Bolas, and Nora Ayanian. Mixed reality for robotics. In *2015 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pages 5382–5387. IEEE, 2015.

[6] Ajaya Kumar Dash, Santosh Kumar Behera, Debi Prosad Dogra, and Partha Pratim Roy. Designing of marker-based augmented reality learning environment for kids using convolutional neural network architecture. *Displays*, 55:46–54, 2018.

[7] Ajaya Kumar Dash, Santosh Kumar Behera, Debi Prosad Dogra, and Partha Pratim Roy. Designing of marker-based augmented reality learning environment for kids using convolutional neural network architecture. *Displays*, 55:46–54, 2018.

[8] Laurence F Johnson, Alan Levine, Rachel S Smith, and Keene Haywood. Key emerging technologies for elementary and secondary education. *The Education Digest*, 76(1):36, 2010.

[9] Patrick Skinner and Stefanie Zollmann. Localisation for augmented reality at sport events. In *2019 International Conference on Image and Vision Computing New Zealand (IVCNZ)*, pages 1–6. IEEE, 2019.

[10] Vassilios Vlahakis, M Ioannidis, John Karigiannis, Manolis Tsotros, Michael Gounaris, Didier Stricker, Tim Gleue, Patrick Daehne, and Luis Almeida. Archeoguide: an augmented reality guide for archaeological sites. *IEEE Computer Graphics and Applications*, 22(5):52–60, 2002.

[11] Fabian Fritz, Ana Susperregui, and Maria Teresa Linaza. Enhancing cultural tourism experiences with augmented reality technologies. 6th International Symposium on Virtual Reality, Archaeology and Cultural ..., 2005.

[12] Christopher M Andrews, Alexander B Henry, Ignacio M Soriano, Michael K Southworth, and Jonathan R Silva. Registration techniques for clinical applications of three-dimensional augmented reality devices. *IEEE journal of translational engineering in health and medicine*, 9:1–14, 2020.

[13] Margarita Martínez and Guadalupe Muñoz. Designing augmented interfaces for guided tours using multimedia sketches. In *MIXER*. Citeseer, 2004.

[14] Roland Spies, Markus Ablaßmeier, Heiner Bubb, and Werner Hamberger. Augmented interaction and visualization in the automotive domain. In *Human-Computer Interaction. Ambient, Ubiquitous and Intelligent Interaction: 13th International Conference, HCI International 2009, San Diego, CA, USA, July 19-24, 2009, Proceedings, Part III 13*, pages 211–220. Springer, 2009.

[15] Ji-Hong Chen, Wen-Yuan Chen, and Chin-Hsing Chen. Identification recovery scheme using quick response (qr) code and watermarking technique. *Applied Mathematics & Information Sciences*, 8(2):585, 2014.

[16] Apurv Nigam, Priyanka Kabra, and Pankaj Doke. Augmented reality in agriculture. In *2011 IEEE 7th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob)*, pages 445–448. IEEE, 2011.

[17] Patrick Skinner and Stefanie Zollmann. Localisation for augmented reality at sport events. In *2019 International Conference on Image and Vision Computing New Zealand (IVCNZ)*, pages 1–6. IEEE, 2019.

[18] Guoli Wu, Ming Qiu, Yankun Zhang, and Yuhui Zheng. Research and development of augmented reality children's puzzle game based on vuforia. In *2019 14th International Conference on Computer Science & Education (ICCSE)*, pages 354–359. IEEE, 2019.

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FINAL GRADE

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GENERAL COMMENTS

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