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A PROJECT REPORT ON

"Indoor Navigation in Colleges Using AR"

SUBMITTED TO SAVITRIBAI PHULE PUNE UNIVERSITY,

IN THE PARTIAL FULFILLMENT FOR THE AWARD OF THE DEGREE

OF

BACHELOR OF ENGINEERING IN INFORMATION TECHNOLOGY BY

Koustubh Wayfalkar	**B190458579**
Vedant Purandar	**B190458560**
Toyieb Naseer	**B190458571**
Pranita Pawar	**B190458558**

DEPARTMENT OF INFORMATION TECHNOLOGY

MARATHWADA MITRA MANDAL'S COLLEGE OF ENGINEERING

KARVE NAGAR, PUNE-411052, MAHARASHTRA, INDIA

CERTIFICATE

This is to certify that the Project Report entitled

DEPARTMENT NAVIGATION USING AUGMENTED REALITY

Submitted by

KOSTUBH WAYFALKAR	**B190458579**
VEDANT PURANDARE	**B190458560**
TOYIEB NASEER	**B190458571**
PRANITA PAWAR	**B190458558**

This is a bonafide work carried out by them under the supervision of **Mr. Nikhil Dhavase** and it is approved by the partial fulfillment of the requirement of Savitribai Phule Pune University for the award of the Degree of Bachelor of Engineering (Information Technology)

This project report has not been submitted to any other Institute or University for the award of any degree or diploma.

Mr. Nikhil Dhavase
Internal Guide
Department of Information Technology

Dr. Rupali Chopade
Head of Department Department of Information Technology

Mr. Vineith Kaul
External sponsor
VRImmersive Pvt. Ltd.

Dr. V. N. Gohokar
Principal
Marathwada Mitra Mandal's College of Engineering

External examiner
Sign:

ACKNOWLEDGEMENT

It is our proud privilege and duty to acknowledge the kind of help and guidance received from several people in the preparation of this report. It would not have been possible to prepare this report, in this report and in this form without their valuable help, co-operation and guidance.

Our sincere thanks to **Dr. Rupali Chopade**, Head Department of Information Technology, for her valuable suggestions and guidance throughout the preparation of this report.

We express our sincere gratitude to our guide, **Mr. Nikhil Dhavase** for guiding us in the investigation of this project and in carrying out experimental work. We hold him in esteem for the guidance, encouragement and inspiration received from him.

Last but not least we wish to thank our parents for financing our studies and helping us throughout our life for achieving perfection and excellence. Their personal help in making this report and project presentation is gratefully acknowledged.

Koustubh Wayfalkar B190458579

Vedant Purandare B190458560

Toyieb Naseer B190458571

Pranita Pawar B190458558

Sponsorship Letter

VRimmersive Tech Private Limited
Tower F104, 10th Floor, Kalptaru,Jade Recidency,
Baner Pune,
Pune Maharashtra 412101
vineith@vrimmersivetech.com

Date:-15/09/2023

To,

The HOD (Information Technology),

Marathwada Mitra Mandal's College of Engineering, Pune, 52

Subject: Letter for Academic Project Sponsorship for the below stated students.

Respected Mam,

This letter is for the sponsorship of B.E. project of below mentioned students at our company "VRImmersive pvt. ltd.". The students are working on project titled

"Indoor navigation for colleges" in the Augmented Reality domain.

The below mentioned students have been sponsored with the project at our company during the academic year 2023-2024 till the time of completion.

Names of the Students:

1. Mr. Koustubh Wayfalkar
2. Mr. Vedant Purandare
3. Mr. Toyieb Naseer
4. Ms. Pranita Pawar

We wish them good luck.

Thanks & Regards,

Kirti Solanki,

HR,

VRImmersive pvt. Ltd

Completion Certificate

VRimmersive Tech Private Limited
Tower F104, 10th Floor, Kalptaru,Jade Recidency,
Baner Pune,
Pune Maharashtra 412101 vineith@vrimmersivetech.com

Date:-03/04/2024

To,

The HOD (Information Technology),
Marathwada Mitra Mandal's College of Engineering, Pune, 52

Subject: Letter for Project Completion.

Respected Mam,

This letter is to inform you that the project titled "**Indoor Navigation for Colleges**" in Augmented Reality domain was sponsored by VRimmersive Tech Private Limited during the academic year 2023-2024. The students mentioned bellow have successfully completed the project as per the guidelines.

Names of the Students:

1. Mr. Koustubh Wayfalkar
2. Mr. Vedant Purandare
3. Mr. Toyieb Naseer
4. Ms. Pranita Pawar

We wish them good luck.

Thanks & Regards,

Kirti Solanki,

HR,

VRImmersive pvt. Ltd

ABSTRACT

In today's bustling college environments, navigating the intricate network of buildings and facilities can be a daunting task for students, faculty, and visitors alike. Traditional methods of using paper maps or seeking guidance from fellow campusgoers often fall short within the labyrinthine halls and corridors. To address this challenge, our research explores the innovative integration of augmented reality (AR) technology, harnessed through smartphones, as a pioneering solution for enhancing indoor navigation. By seamlessly overlaying digital information onto the physical surroundings, AR offers a dynamic and real-time guidance system, promising to simplify the navigation process within college campuses.This report takes on added significance in the context of colleges, where the academic landscape is characterized by an ever-changing dynamic, with schedules, locations, and information in constant flux. In this context, the conventional methods of navigation can prove inadequate. However, the convergence of augmented reality and smartphones offers not only practical advantages but also aligns with the digital preferences of the younger generation. Today's students are inherently tethered to their smartphones, utilizing them for a myriad of daily activities. Therefore, leveraging this technology for indoor navigation mirrors their existing habits and holds the potential to enhance their overall campus experience.

CONTENTS

INDEX

CHAPTER 1

INTRODUCTION

Navigating through vast college campuses can often pose a daunting challenge, especially for new students and visitors. Traditional methods, such as paper maps or asking for directions, may fall short within the labyrinth of college buildings. Modern technology, including GPS, sensors, and Wi-Fi, though promising, can be unreliable and inaccurate in indoor settings. However, there's a beacon of hope in the form of augmented reality (AR), which can be likened to a pair of magical glasses, transforming the way we find our way within these educational institutions. AR technology overlays a layer of digital information onto the physical world, creating a seamless and intuitive navigation experience through smartphones. In this report, we delve into how AR technology can revolutionize indoor navigation in college campuses, simplifying the lives of students, faculty, and visitors. We will explore the intricate workings of AR, its potential applications in mapping and directions, and the numerous benefits it can bring to academic communities.

CHAPTER 2

LITERATURE SURVEY

STUDY OF LITERATURE PAPER

Sr. no	Paper Title	Publication & Year	Authors	Summary
1.	Indoor Navigation using Augmented reality	IEEE - 21 June 2022	Satya Kiranmai Tadepalli, Preetivardhan Ansuri Ega, Pavan Kalyan Inugurth	This research paper explores the development of an indoor navigation system using augmented reality (AR).
2.	Indoor Navigation using Augmented reality for Mobile Application	IEEE - 04 September 2018	Ramesh M S, Naveena Ramesh Vardhini J, Murugan S, Albert Mayan J	The study addresses the challenges of navigating complex indoor spaces where traditional outdoor navigation systems like GPS may not be effective.
3.	Augmented Reality Technology: Current Applications, Challenges and its Future	IEEE - 20 April 2021	Jaspreet singh, Urvashi, Gurpreet Singh, Shikha Maheshwari	The research paper explores Augmented Reality (AR), covering its working principles, applications in marketing, education, health sciences, gaming, and more. It discusses challenges like public acceptability and device accessibility and proposes solutions.

4.	Augmented Reality and its effect on our life	IEEE - 17 May 2021	Riya Aggarwal and Abhishek Singhal	The authors discuss the advantages and disadvantages of AR, presenting real-world examples and applications. They explore the threats to AR's success, including legal and privacy concerns, digital fatigue, miniaturization issues, and social rejection.
5.	Augmented-RealityBased Indoor Navigation: A Comparative Analysis of Handheld Devices Versus Google Glass.	IEEE – 09 September 2020	Umair Rehman and Shi Cao	The research explores augmented reality-based indoor navigation, comparing wearable devices like Google Glass with handheld devices such as smartphones and paper maps. The study involves technical assessments and human factors evaluations.
6.	An indoor evacuation guidance system with an AR virtual agent		Zhen Liu, TingTing Liu,Yanjie Chai	The paper discusses an indoor evacuation guidance system that evacuates AR technology and virtual agents to help people quickly and safely evacuate large buildings during emergencies.

CHAPTER 3

BACKGROUND

In the context of modern college campuses, the complexities of indoor navigation pose a significant challenge for students, faculty, and visitors. Navigating the labyrinthine network of buildings, classrooms, offices, and facilities can be a perplexing endeavour. Traditional navigation methods, relying on physical maps or verbal directions from peers, often fall short within the dynamic academic landscape where schedules, locations, and information frequently undergo changes. It's within this context that the need for an innovative solution emerges. Augmented reality (AR) technology, coupled with the ubiquitous presence of smartphones, has emerged as a pioneering answer to these challenges. AR, in its essence, seamlessly blends digital information with the physical environment. By leveraging the camera and screen of a smartphone, AR technology has the potential to provide dynamic, real-time guidance. This research explores the application of AR to college campuses, where the need for improved indoor navigation is pivotal. The integration of AR and smartphones not only promises practical benefits but also caters to the digital preferences of the tech-savvy younger generation. As students increasingly rely on smartphones for various aspects of their daily lives, harnessing this technology for indoor navigation aligns seamlessly with their existing habits, promising to elevate their overall campus experience.

CHAPTER 4

REQUIREMENT AND ANALYSIS

Requirements:

Defining the functional and non-functional requirements of our indoor navigation system for college campuses is a pivotal step in ensuring its effectiveness. Functionally, the system must provide seamless, real-time navigation for users within the campus. This entails delivering precise step-by-step directions, highlighting crucial points of interest, and offering multiple route options tailored to user preferences. The accuracy of location tracking is paramount, as even minor inaccuracies could lead to confusion and frustration. Users should be able to create and manage profiles, personalizing their navigation experience and setting preferences, including accessibility options and designated frequently visited destinations. An essential component of our system is a robust feedback mechanism, allowing users to report issues and provide valuable insights for continuous improvement.

On the non-functional front, the system's performance must be exemplary, ensuring swift response times and minimal latency to guarantee a seamless and uninterrupted user experience. Usability is of paramount importance, as the system's user interface must be intuitive, accessible, and straightforward, catering to a diverse user base, including students, faculty, and visitors. Reliability is a cornerstone requirement; the system must operate consistently with minimal downtime or disruptions. Security considerations are paramount to safeguard user data and location information, ensuring privacy and protection from unauthorized access. Lastly, the system should be designed with scalability in mind, allowing it to accommodate a growing user base and potential expansion to cover the entire campus.

Analysis:

The analysis phase is an integral part of our research, beginning with user surveys and data collection to gain profound insights into the indoor navigation needs of students, faculty, and visitors within a college campus. These surveys serve as a window into common challenges and pain points experienced by users during their daily navigation on campus. By understanding user needs and preferences, we can tailor our system to address specific pain points. Additionally, usability testing plays a crucial role in the analysis. It enables potential users to provide direct feedback on the system's interface, functionality, and overall user-friendliness. This hands-on approach ensures that the system is designed with the end-user in mind, delivering a seamless and intuitive navigation experience.

Lastly, a feasibility study is an essential component of the analysis phase. It assesses the practicality and viability of implementing our AR-based navigation system within the college campus. Factors considered in this study include the availability of AR technology, the readiness of the college environment for AR integration, and the financial implications of the project. This thorough analysis ensures that our system not only meets but exceeds the specific requirements of our college campus, providing an efficient, user-friendly, and reliable indoor navigation solution that enhances the overall campus experience.

CHAPTER 5

DESIGN

Our system is designed to provide an immersive and personalized navigation experience. It utilizes AR technology to overlay digital information on the user's physical environment. The application workflow involves users pointing their smartphones at indoor features such as classroom boards or corridor posters. Images captured are then processed using the Vuforia SDK for feature point extraction and recognition.

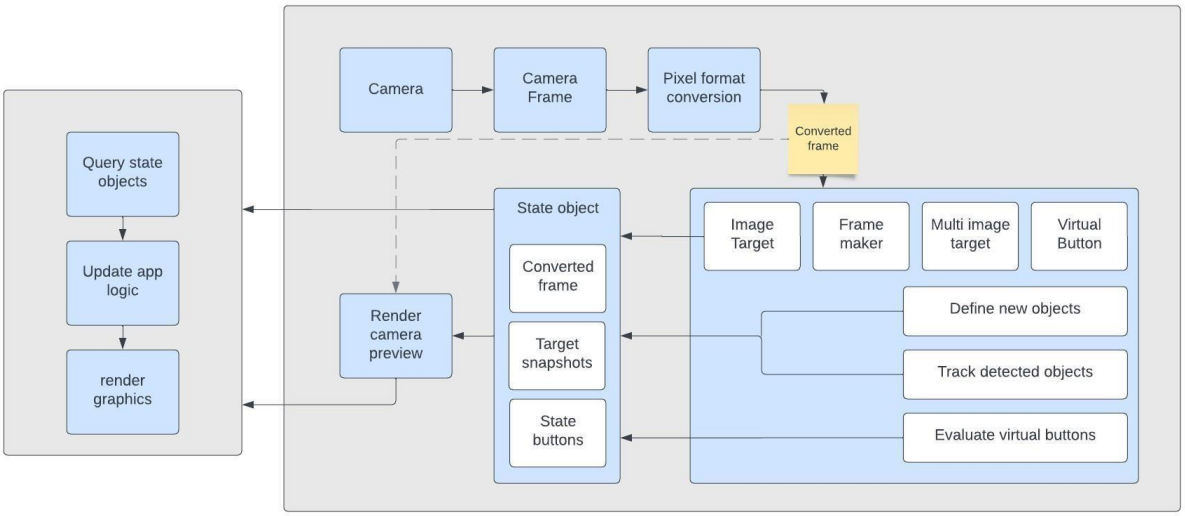

Fig 1: Architecture diagram

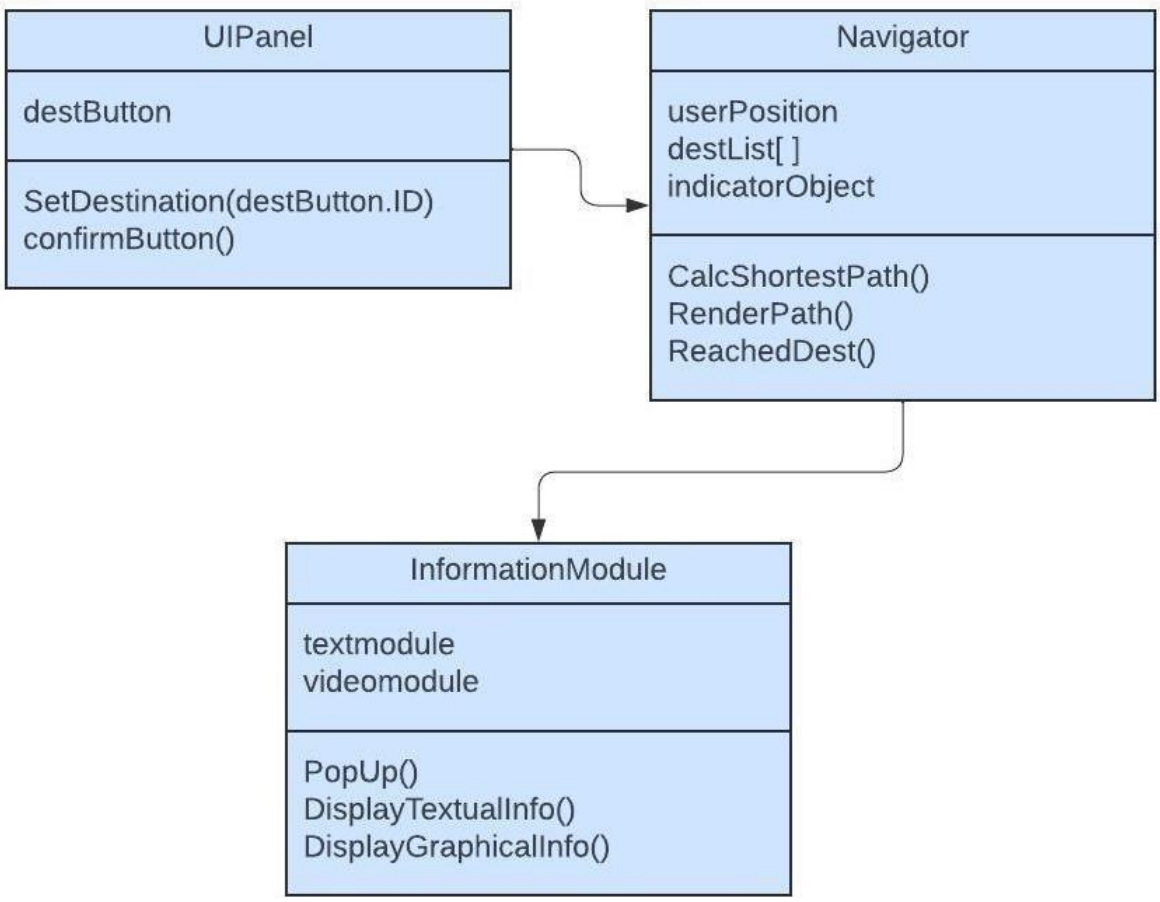

Fig 2: Class diagram

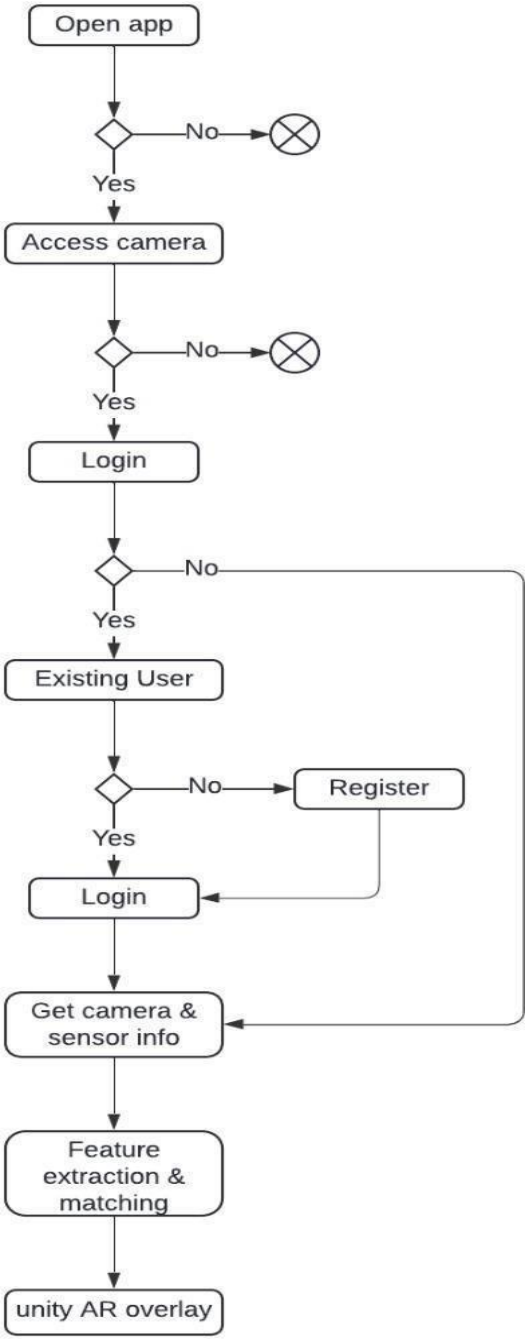

Fig 2: Activity diagram

DFD level 0:

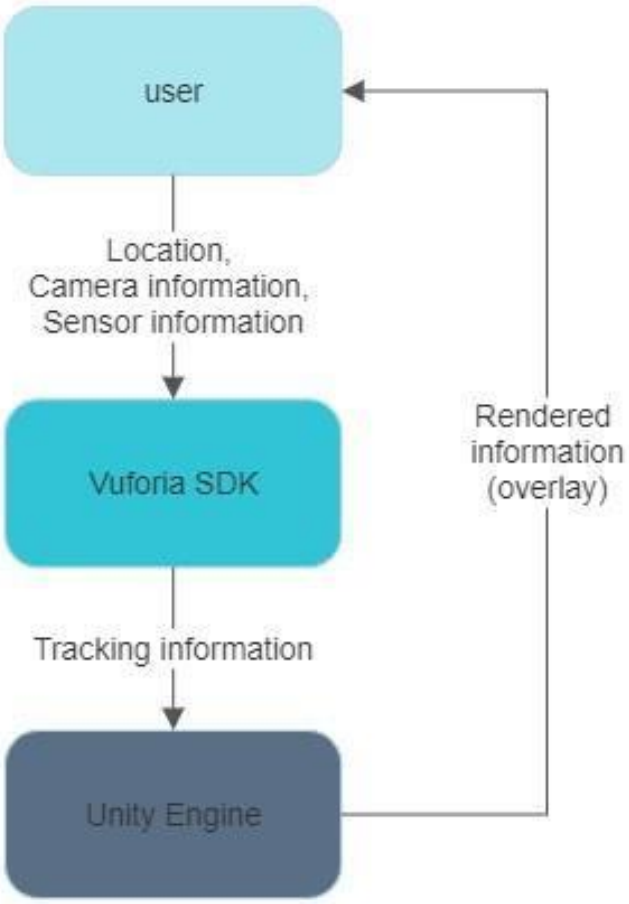

Fig 2: - Data flow diagram level 0

DFD Level 1:

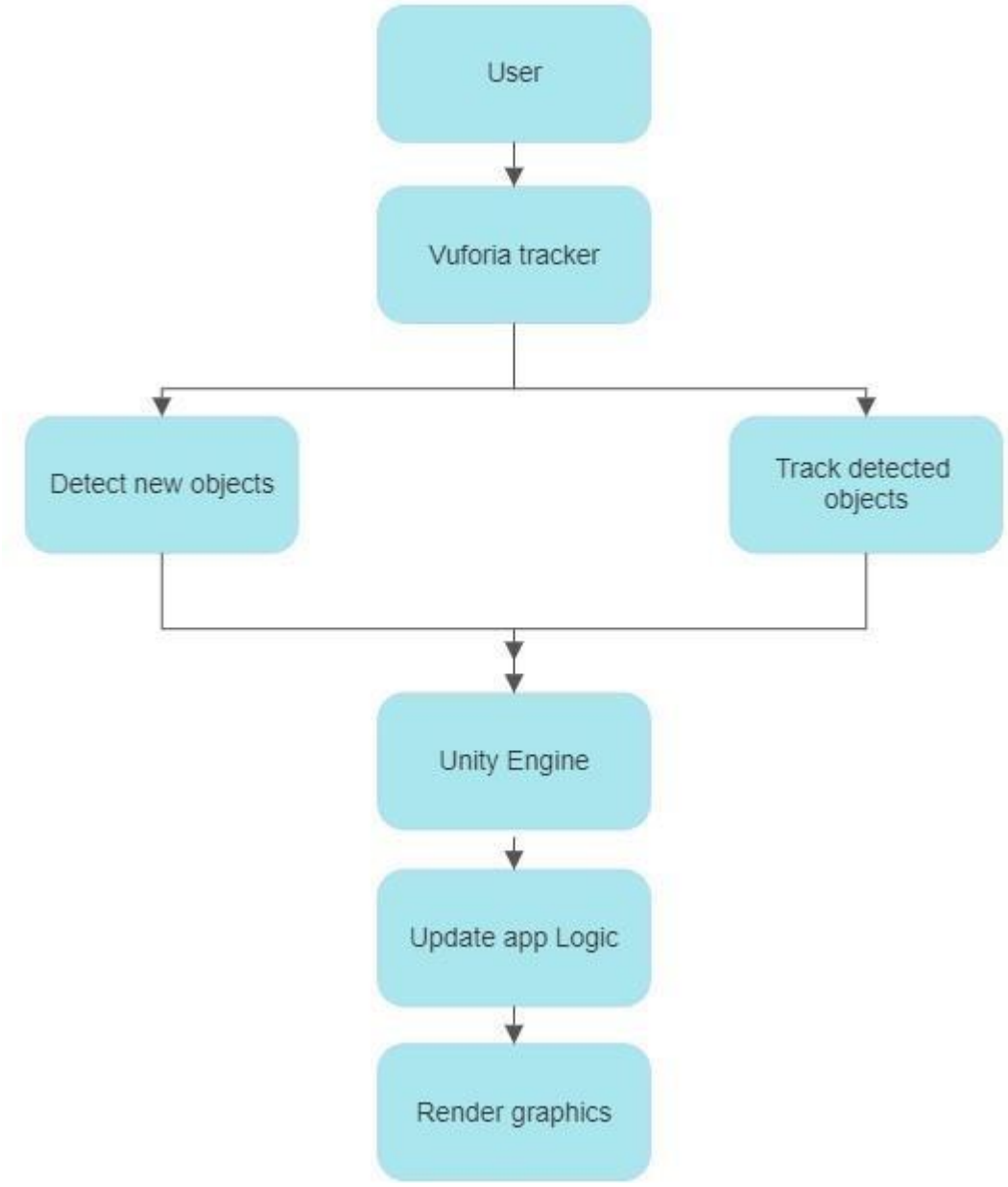

Fig 3: - Data flow diagram level 1

CHAPTER 6

IMPLEMENTATION

The implementation of our system occurs in four phases:

- Environment Scanning: We use LIDAR technology to capture depth information, and the Vuforia SDK's "Vuforia Creator" app to scan and export 3D models of the environment.
- Information Gathering: We collect crucial information, including classroom capacity, timetables, lab details, faculty information, and room assignments.
- Information Feeding: The gathered information is transformed into virtual objects within the Unity engine, allowing it to be overlaid on the physical environment.
- Virtual Navigation: We identify points of interest, mark walkable areas, and create a navigation mesh, enabling the system to generate real-time navigation paths based on the user's current location and the selected destination.

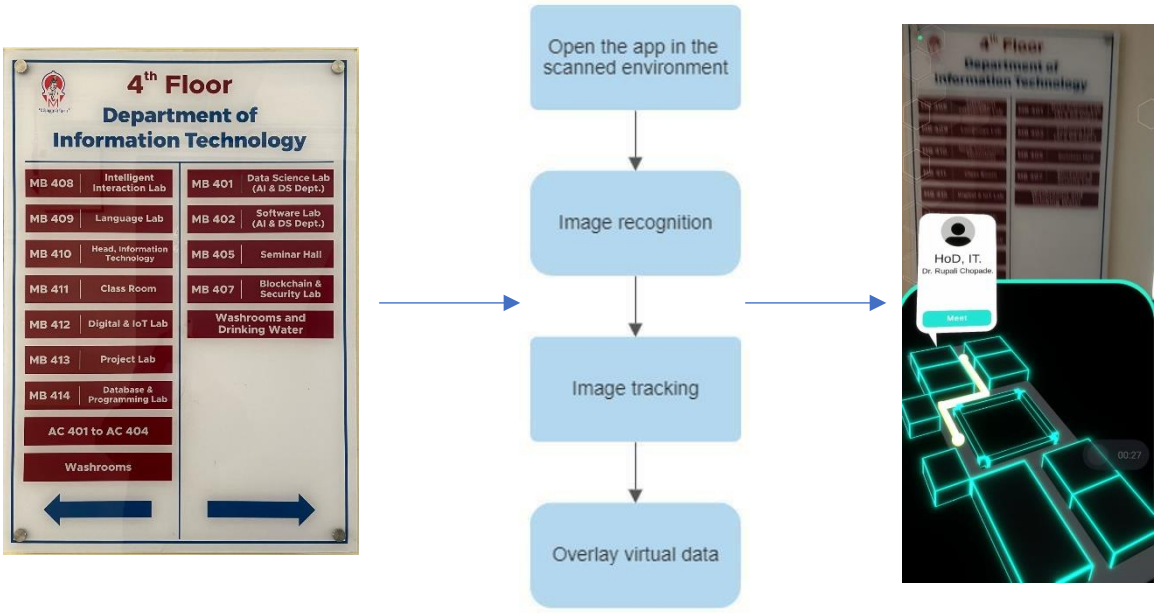

Fig 4: - Implementation Diagram

CHAPTER 7

Testing

Prototype 1:

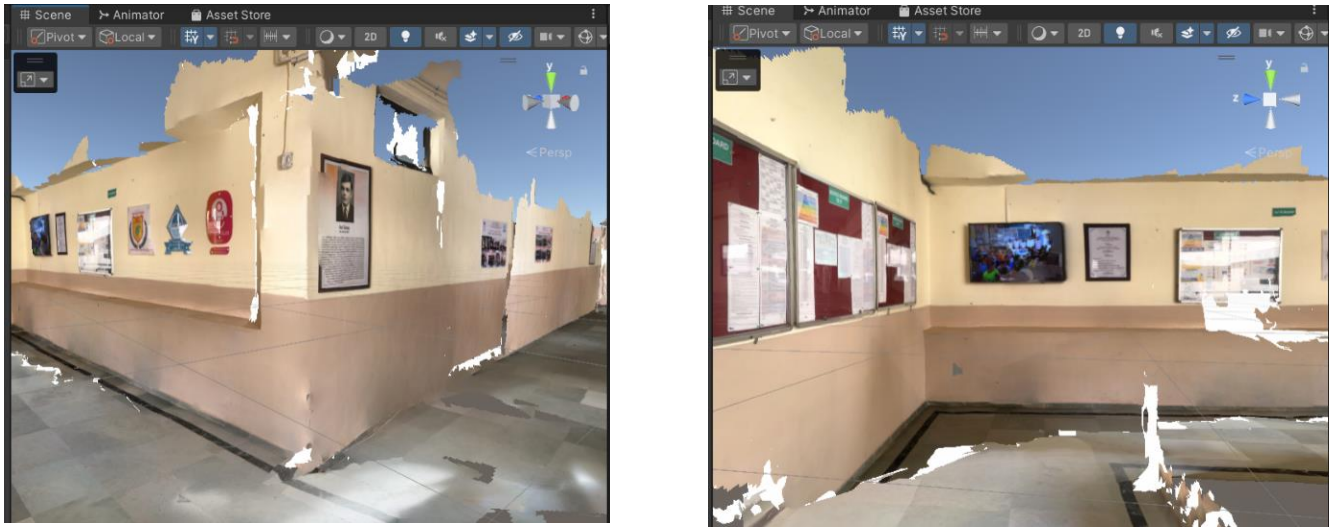

Fig 5,6: - 3D scan for prototype 1

Creating a 3D scan of the area and overlaying navigation paths onto the environment using the navigation algorithm. This technique proves effective in some areas but is inaccurate in others. It also is processor heavy and may not work efficiently on devices with low to medium processing power. We found this problematic and undesirable.

Prototype 2:

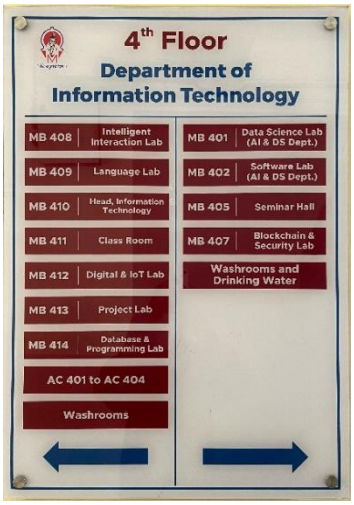

Fig 7: - Navigation Board on 4th floor

To improve on performance efficiency, in this prototype we removed the 3D model and used the above scanned image instead. Due to this, we would know the exact position of the users as they scan the image. After the current position is determined, we overlay virtual data in the space using the tracked image as a reference.

This approach limits the space we have available to work, as now we can only track the user's position while the user is near the above reference image.

Outcome:-

Fig 8: - Step-1

You can click on any room to visit.
Click on the **"meet"** button to start the navigation.

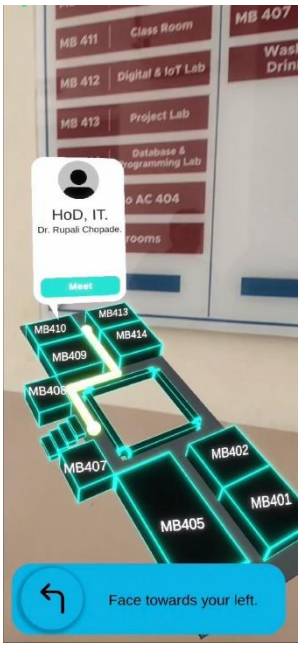

Fig 9: - Step-2

Then the complete route will be visualized in the 3D model.
Also, navigation instructions will appear at the bottom of the screen, follow then to reach the destination.

CHAPTER 9

Experimental Results

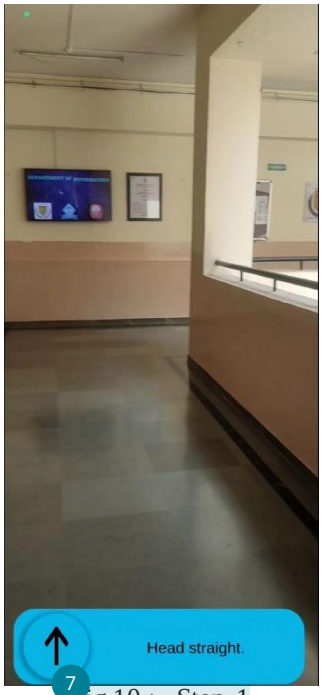

Fig 10 : - Step-1

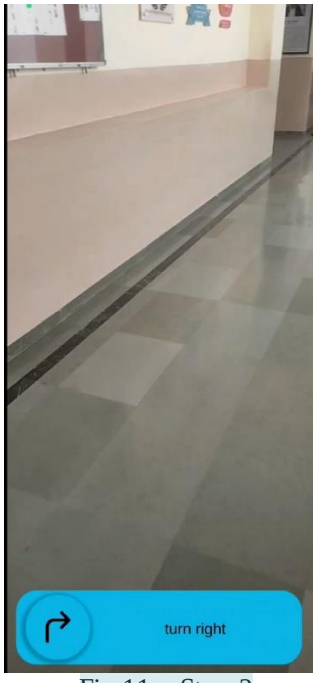

Fig 11: - Step-2

Fig 12: - Step-3

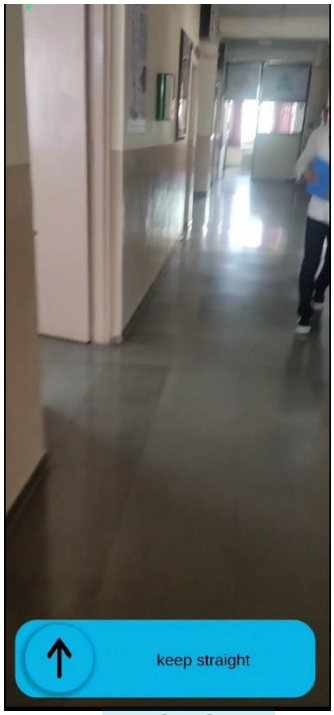

Fig 13: - Step-4

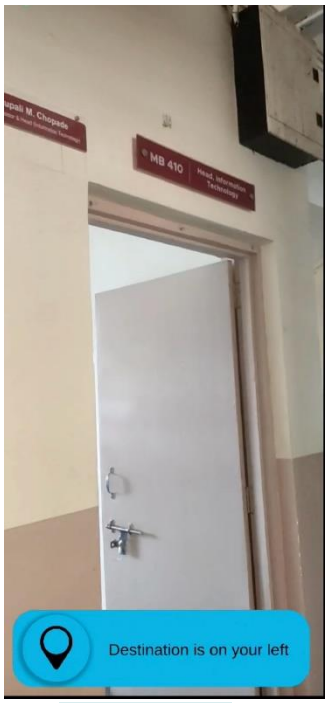

Fig 14: - Step-5

CHAPTER 10

CONCLUSION

In conclusion, our report explores the potential of AR technology to revolutionize indoor navigation within college campuses. By implementing an AR-based navigation system designed to meet the specific requirements of academic institutions, we have taken a significant step toward improving campus accessibility and enhancing the overall experience for students, faculty, and visitors.

Also, it is crucial to address the practical aspects of integrating AR technology into existing campus infrastructure. This involves collaborating with IT departments, facility management, and other relevant stakeholders to ensure a seamless implementation. Additionally, user feedback and testing should be incorporated into the refinement process to optimize the navigation system's accuracy and userfriendliness. As we embark on the next phase of this project, we must also consider potential challenges, such as cost implications and the need for ongoing technical support. By addressing these elements, we can further solidify the role of AR in shaping the future of campus navigation and contribute to the advancement of technology-driven solutions in educational environments.

CHAPTER 11

FUTURE SCOPE AND APPLICATIONS

Looking ahead, the future scope of our indoor navigation system for colleges using augmented reality holds great promise. As technology continues its rapid evolution, we can anticipate significant advancements in indoor navigation within college campuses. Augmented reality (AR) technology is expected to become even more precise and responsive, offering an improved and more immersive real-time navigation experience. Potential future developments may include 3D indoor mapping, enabling users to interact with their environment on a deeper level. Furthermore, the integration of AR navigation with an array of smart devices, including AR glasses, smartwatches, and AR headsets, is likely to expand, giving users more options to choose the devices that best suit their preferences and requirements. The future of indoor navigation systems may also see seamless integration with the Internet of Things (IoT), enabling users to access real-time information about available study spaces, interactive digital displays, and even smart building automation, making college campuses more connected and efficient. Additionally, the application of artificial intelligence and machine learning algorithms could personalize navigation further, learning from users' behaviours and preferences to provide tailored recommendations and efficient routes.

CHAPTER 12

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4) Augmented Reality and its effect on our life by Riya Aggarwal and Abhishek Singhal -

5) Augmented-Reality-Based Indoor Navigation: A Comparative Analysis of Handheld Devices Versus Google Glass- Umir Rehman and Shi Cao

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