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**

UNDER THE GUIDANCE OF
Mr. NIKHIL DHAVASE

"येथे बहुतांचे हित"

DEPARTMENT OF INFORMATION TECHNOLOGY

Marathwada Mitra Mandal's College of Engineering

Karvenagar, Pune-411052

Savitribai Phule Pune University

2023-24

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

VRImmersive Tech Pvt. Ltd. PUNE

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

VRImmersive Tech Pvt. Ltd. PUNE

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.

Imagine stepping into a sprawling college campus for the first time. The buildings seem to stretch out endlessly, each hallway leading to another in a maze-like fashion. You feel a sense of excitement mixed with a bit of apprehension. How will you find your way around this vast space? Traditional methods like paper maps or asking for directions might seem like the obvious choice, but they often prove to be inadequate in the complex layout of college buildings.

Even modern technology, such as GPS, sensors, and Wi-Fi, which have revolutionized outdoor navigation, struggle to provide reliable and accurate guidance indoors. The signals can be weak or non-existent inside buildings, leading to a frustrating experience. But don’t lose hope just yet. There’s a new player in town that promises to change the game - Augmented Reality (AR).

AR, in simple terms, can be thought of as a magical pair of glasses. When you put them on, the real world is transformed. It overlays digital information onto your physical surroundings, creating a rich and interactive experience. In the context of indoor navigation, this means you can see directions and points of interest right on your smartphone screen as you move around the campus.

CHAPTER 1

In this report, we dive deep into the world of AR and how it can revolutionize the way we navigate indoors, particularly within the confines of a college campus. We'll unravel the intricate workings of AR technology, its potential applications in mapping and providing directions, and the numerous benefits it can offer to students, faculty, and visitors alike.

AR has the potential to simplify life on campus in ways we've never imagined before. No more getting lost on the way to a lecture or struggling to find the library. With AR, navigating a college campus becomes as easy as taking a stroll in the park.

So, let's embark on this exciting journey and explore the magic of AR together.

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 endeavor. 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

4.1 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.

4.2 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 like a personal guide that helps you navigate indoor spaces. It's designed to make your journey more engaging and tailored to your needs. Think of it as having a friendly tour guide who knows the place inside out and can show you exactly where to go.

The magic behind this system is Augmented Reality (AR) technology. AR is like a bridge that connects the digital world with the real world. It allows us to add layers of digital information, like directions or labels, onto the actual physical surroundings you see through your smartphone camera. So, when you look at your phone, it's as if these digital elements are part of the real world.

Here's how it works: You start by pointing your smartphone at certain features indoors. These could be anything from a classroom board to a poster in a corridor. The system then takes a snapshot of what your camera sees.

This snapshot is processed using something called the Vuforia SDK. SDK stands for Software Development Kit, which is a set of tools that developers use to build software applications. Vuforia is a popular SDK used for developing AR applications. It's really good at understanding images and recognizing distinct features or points in them.

So, when you point your camera at a classroom board, for example, Vuforia analyzes the image, identifies unique points on the board, and recognizes it. This recognition process is crucial because it helps the system understand where you are and where you're looking at. With this information, the system can then guide you accurately.

In simple terms, our system is like a smart, digital compass that not only tells you which way to go but also shows you the way by adding digital signposts in your real-world view. It's designed to make indoor navigation as easy and intuitive as possible.

Architecture Diagram:

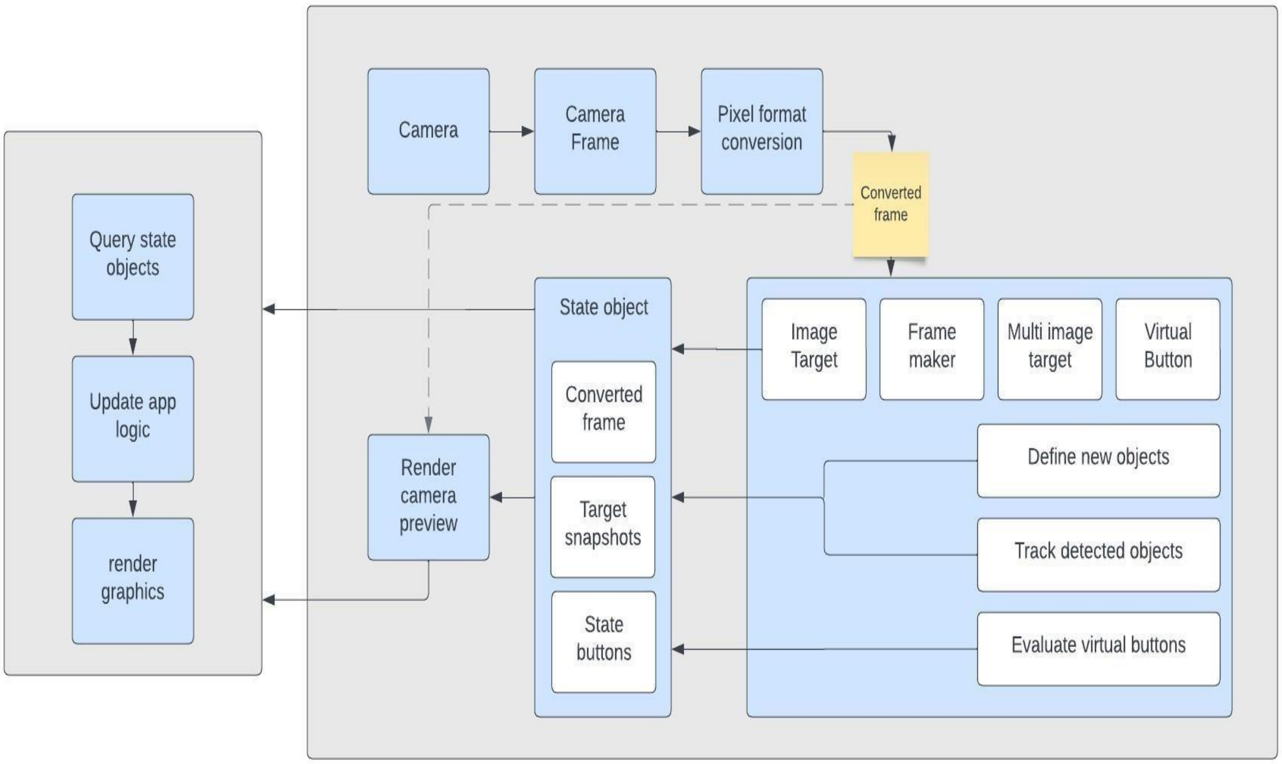

Fig 1: Architecture diagram

Explanation:

1. **Query State Objects**: The system starts by querying the state of objects in the environment.
2. **Update App Logic**: Based on the state of these objects, the application logic is updated.
3. **Render Camera Preview Graphics**: The updated state is then used to render graphics for the camera preview.
4. **Camera Frame Conversion**: The camera captures frames that are converted at the pixel level.
5. **Converted Frame Target**: The converted frames are used as targets for further processing.
6. **Image Snapshots & Target Buttons**: From the converted frame target, image snapshots can be taken and target buttons can be interacted with.
7. **Frame Maker**: Multiple images or frames are combined or processed to create new targets for interaction within the AR environment.
8. **Track Detected Objects**: Detected objects within these frames are tracked.
9. **Evaluate Virtual Buttons**: Virtual button evaluations occur as part of this process.

Class Diagram:

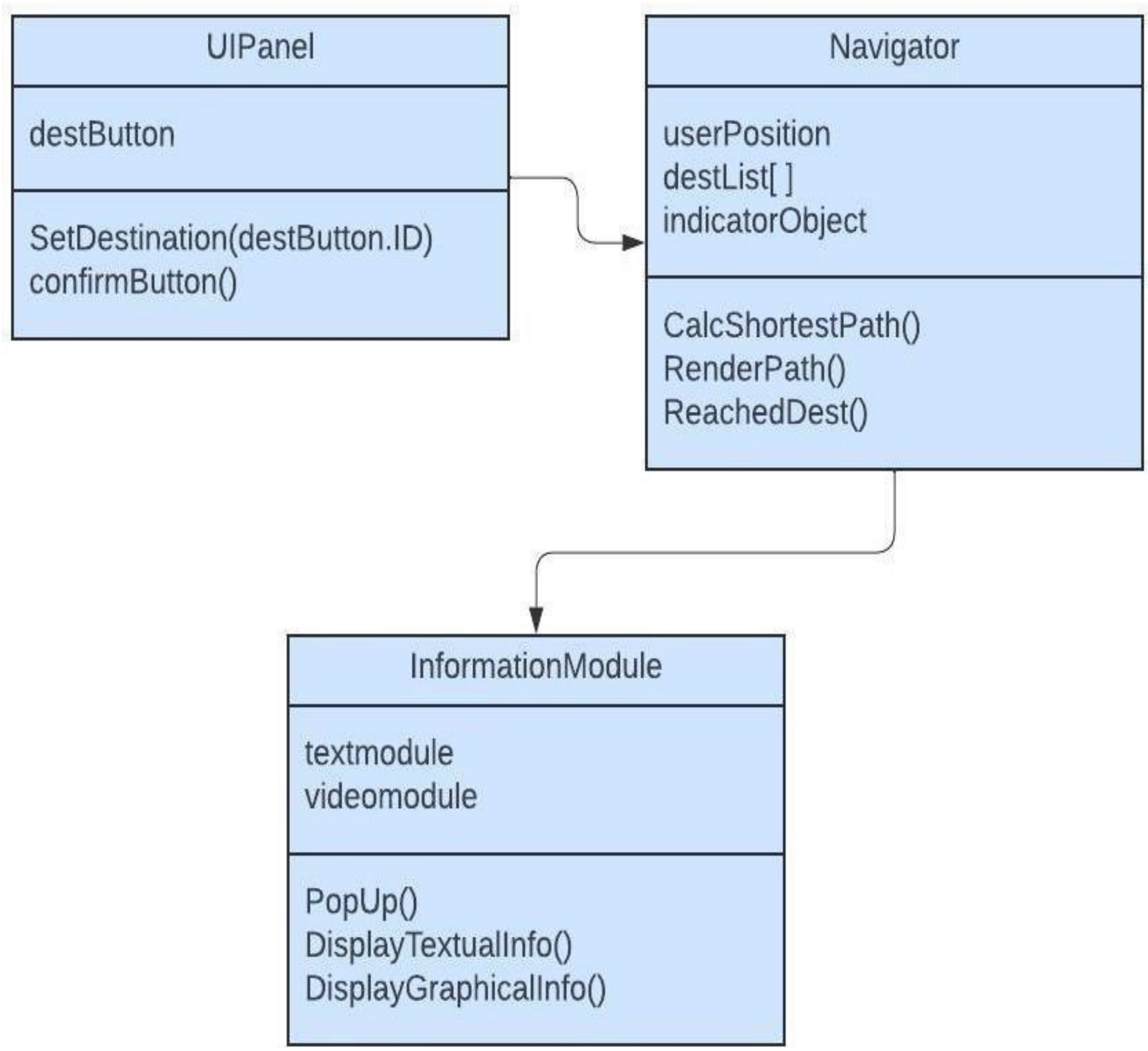

Fig 2: Class diagram

Explanation:

1. **UIPanel**: This is the user interface panel where users interact with the system. It has two main components:
   - **destButton**: This is where the user selects their destination.
   - **confirmButton()**: This function is used to confirm the user's selection.

2. **Navigator**: This is the main component that handles navigation. It has several elements:
   - **userPosition**: This represents the current position of the user.
   - **destList[]**: This is a list of possible destinations.
   - **CalcShortestPath()**: This function calculates the shortest path to the selected destination.
   - **RenderPath()**: This function renders the calculated path for the user to follow.
   - **ReachedDest()**: This function checks if the user has reached their destination.

3. **InformationModule**: This module handles the display of information and has two sub-modules:
   - **textmodule**: This module displays textual information.
   - **videomodule**: This module displays graphical or video information.
   - **PopUp()**: This function displays pop-up notifications or information.
   - **Display TextualInfo()**: This function displays textual information.
   - **DisplayGraphicalInfo()**: This function displays graphical information.

Activity Diagram:

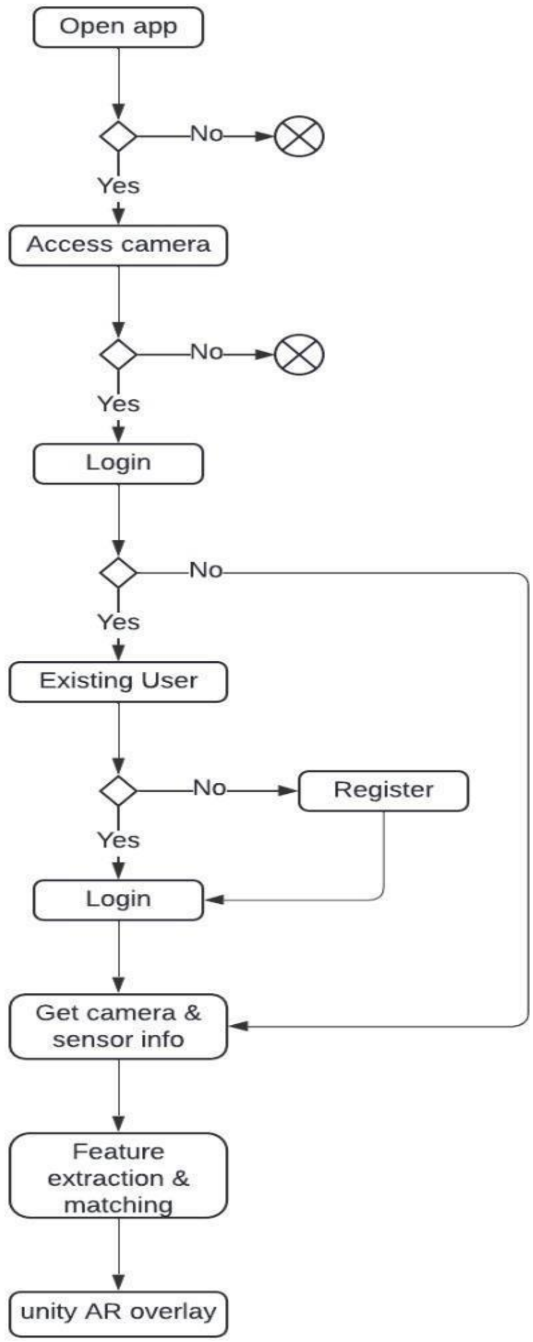

Fig 3: Activity diagram

Explanation:

1. **Open App**: The user starts by opening the application.
2. **Access Camera**: The app requests access to the device’s camera.
3. **Login**: If the user is an existing user, they can log in directly. If not, they need to register.
4. **Get Camera & Sensor Info**: The app gathers information from the camera and other sensors on the device.
5. **Feature Extraction & Matching**: The app processes the sensor data to extract relevant features and perform matching for AR purposes.
6. **Unity AR Overlay**: The final step is to overlay the AR content on the real-world view provided by the camera, creating the AR experience.

DFD level 0:

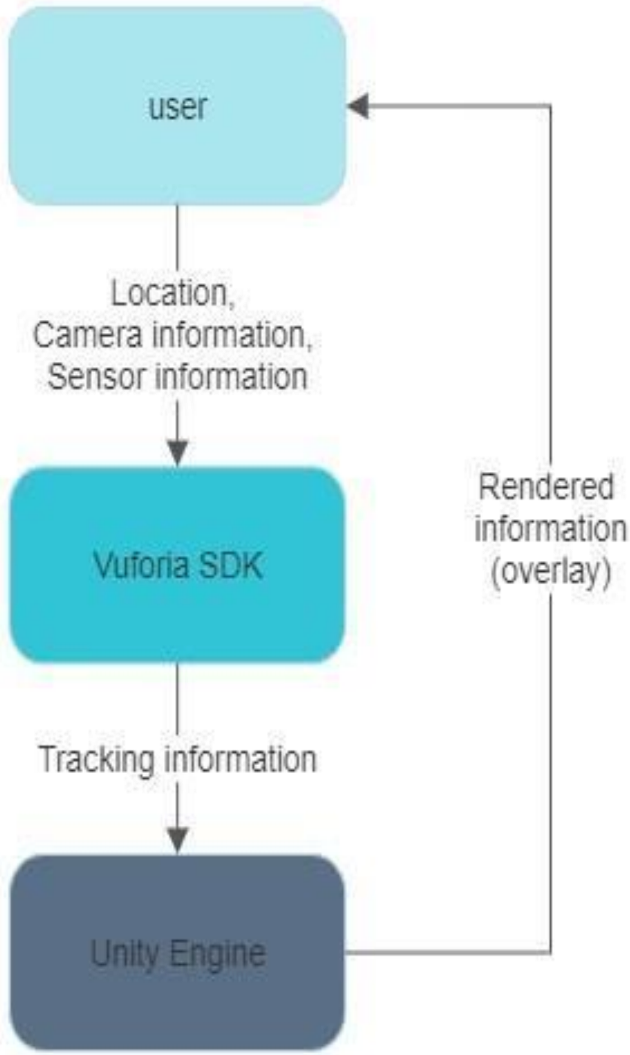

Fig 4: DFD level 0

Explanation:

1. **User**: This is the end-user who interacts with the AR application.
2. **Vuforia SDK**: This is the software development kit used for building the AR application. It receives inputs such as:
   - **Location, Sensor Information**: Data from the device's sensors, including the user's location.
   - **Tracking Information**: Data from the Unity Engine related to the tracking of objects within the AR environment.
3. **Unity Engine**: This is the game engine used to create the AR environment. It provides tracking information to the Vuforia SDK.
4. **Rendered Information (Overlay)**: The Vuforia SDK processes the sensor and tracking data to render the AR overlay, which is then presented to the user.

DFD Level 1:

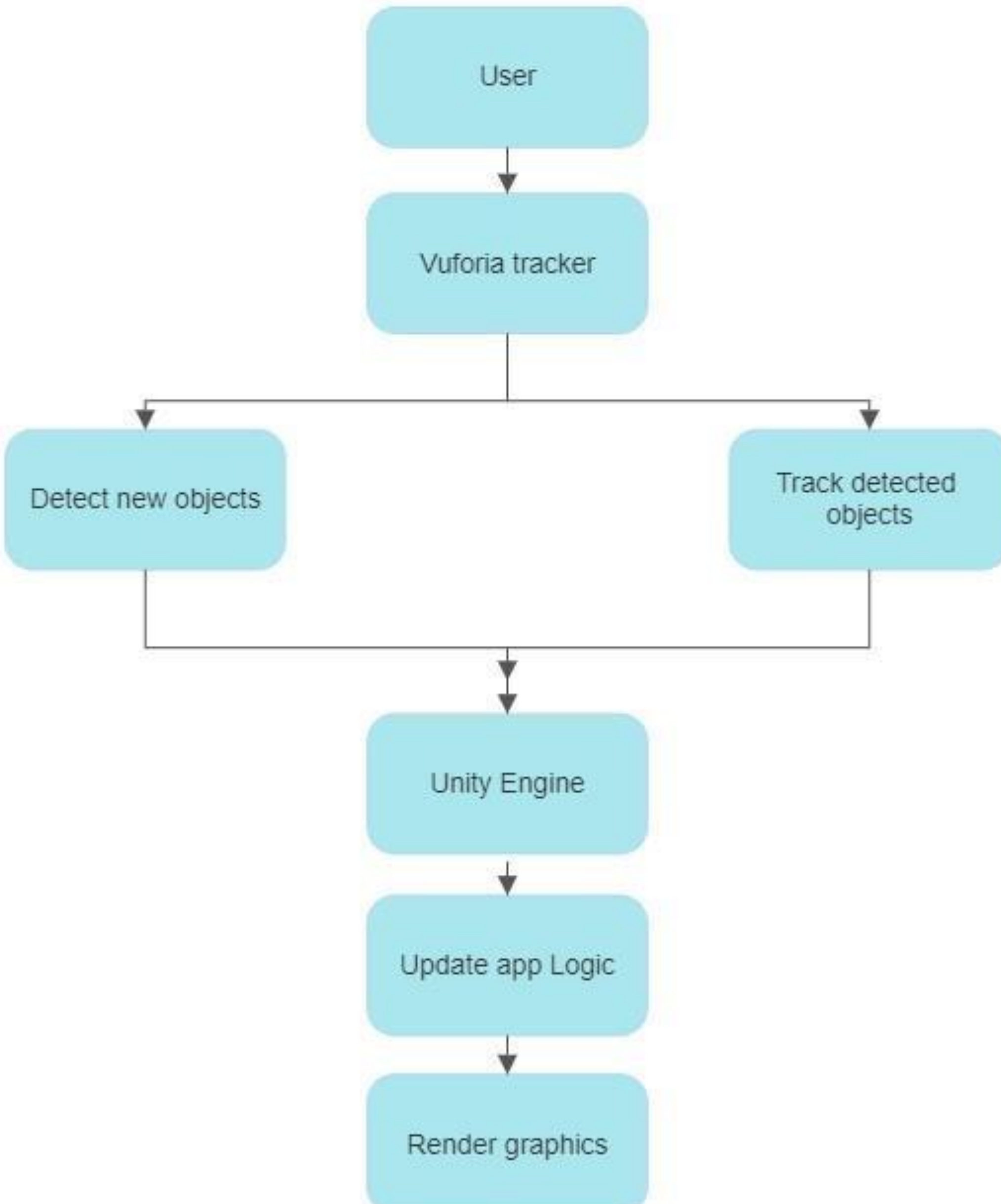

Fig 5: - Data flow diagram level 1

Explanation:

1. **User**: This is the end-user who interacts with the AR application.
2. **Vuforia Tracker**: This is the component that tracks the user’s interaction with the AR environment. It has two main functions:
   - **Detect New Objects**: This function is responsible for detecting new objects in the AR environment.
   - **Track Detected Objects**: This function tracks the objects that have been detected.
3. **Unity Engine**: This is the game engine used to create the AR environment. It interacts with the Vuforia Tracker to update the AR environment based on the user’s interaction.
4. **Update App Logic**: This is the process where the application logic is updated based on the user’s interaction and the information from the Unity Engine.
5. **Render Graphics**: The final step is to render the graphics based on the updated application logic.

CHAPTER 6

IMPLEMENTATION

The implementation of our system occurs in four phases:

1. **Environment Scanning**: This is the first step where we create a digital twin of the physical environment. We use a technology called LIDAR, which stands for Light Detection and Ranging. It's a remote sensing method that uses light in the form of a pulsed laser to measure distances. This helps us capture depth information and create a 3D representation of the environment. But how do we do it? We use an app called "Vuforia Creator" that's part of the Vuforia SDK. This app allows us to scan the environment and export 3D models. So, we walk around the space with our smartphones, scanning different features, and the app does the rest. It's like taking a 3D photograph of the space.

2. **Information Gathering**: Once we have our 3D model, we need to populate it with useful information. This is where the information gathering phase comes in. We collect all the crucial details about the space. This includes the capacity of classrooms, the timetables for different rooms, details about labs, information about faculty members, and room assignments. All this information is crucial for providing a personalized navigation experience. It's like having a digital directory of the entire space.

3. **Information Feeding**: After gathering all the necessary information, the next step is to feed this information into our system. We use the Unity engine, a powerful platform for creating 3D applications, for this purpose. We transform the gathered information into virtual objects within Unity. These virtual objects can then be overlaid on the physical environment through the user's smartphone. So, when a user points their phone at a classroom, they can see digital information about that classroom, like its capacity or timetable, right on their screen.

4. **Virtual Navigation**: The final phase is all about helping the user navigate the space. We identify points of interest, such as classrooms or labs, and mark areas where users can walk. We then create a navigation mesh, which is a fancy term for a network of interconnected paths. This mesh enables the system to generate real-time navigation paths. So, when a user selects a destination, the system calculates the best route from the user's current location to that destination and displays it on the user's screen. It's like having a personal GPS system indoors.

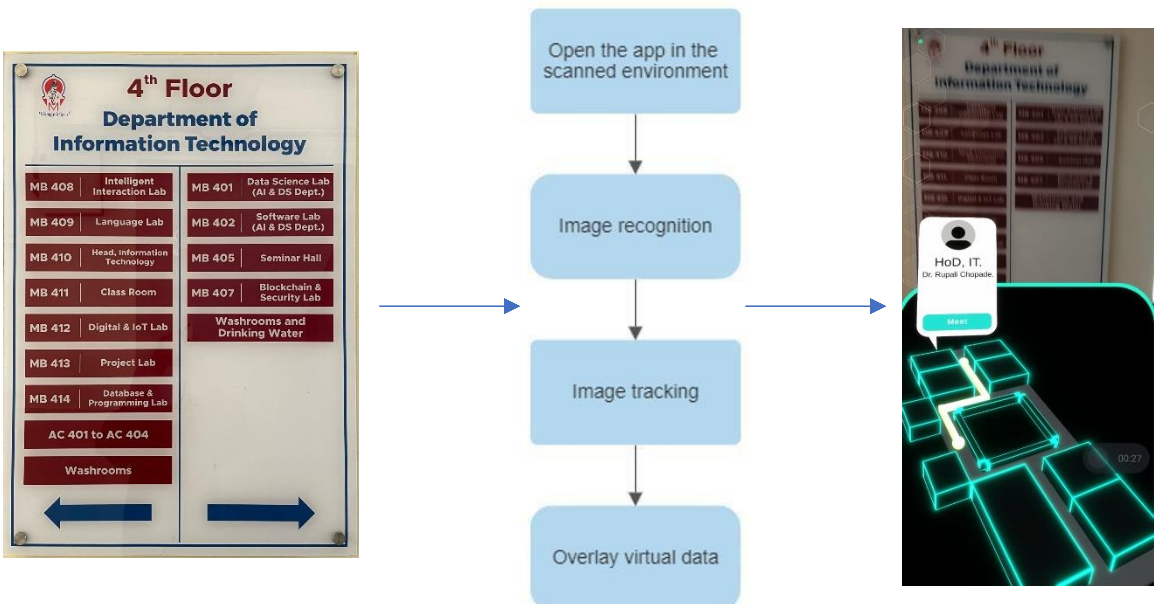

Fig 6: - Implementation Diagram

Explanation:

1. **User**: This is the end-user who interacts with the AR application.
2. **Vuforia Tracker**: This is the component that tracks the user's interaction with the AR environment. It has two main functions:
   - **Detect New Objects**: This function is responsible for detecting new objects in the AR environment.
   - **Track Detected Objects**: This function tracks the objects that have been detected.
3. **Unity Engine**: This is the game engine used to create the AR environment. It interacts with the Vuforia Tracker to update the AR environment based on the user's interaction.
4. **Update App Logic**: This is the process where the application logic is updated based on the user's interaction and the information from the Unity Engine.
5. **Render Graphics**: The final step is to render the graphics based on the updated application logic.

CHAPTER 7

Testing

Prototype 1:

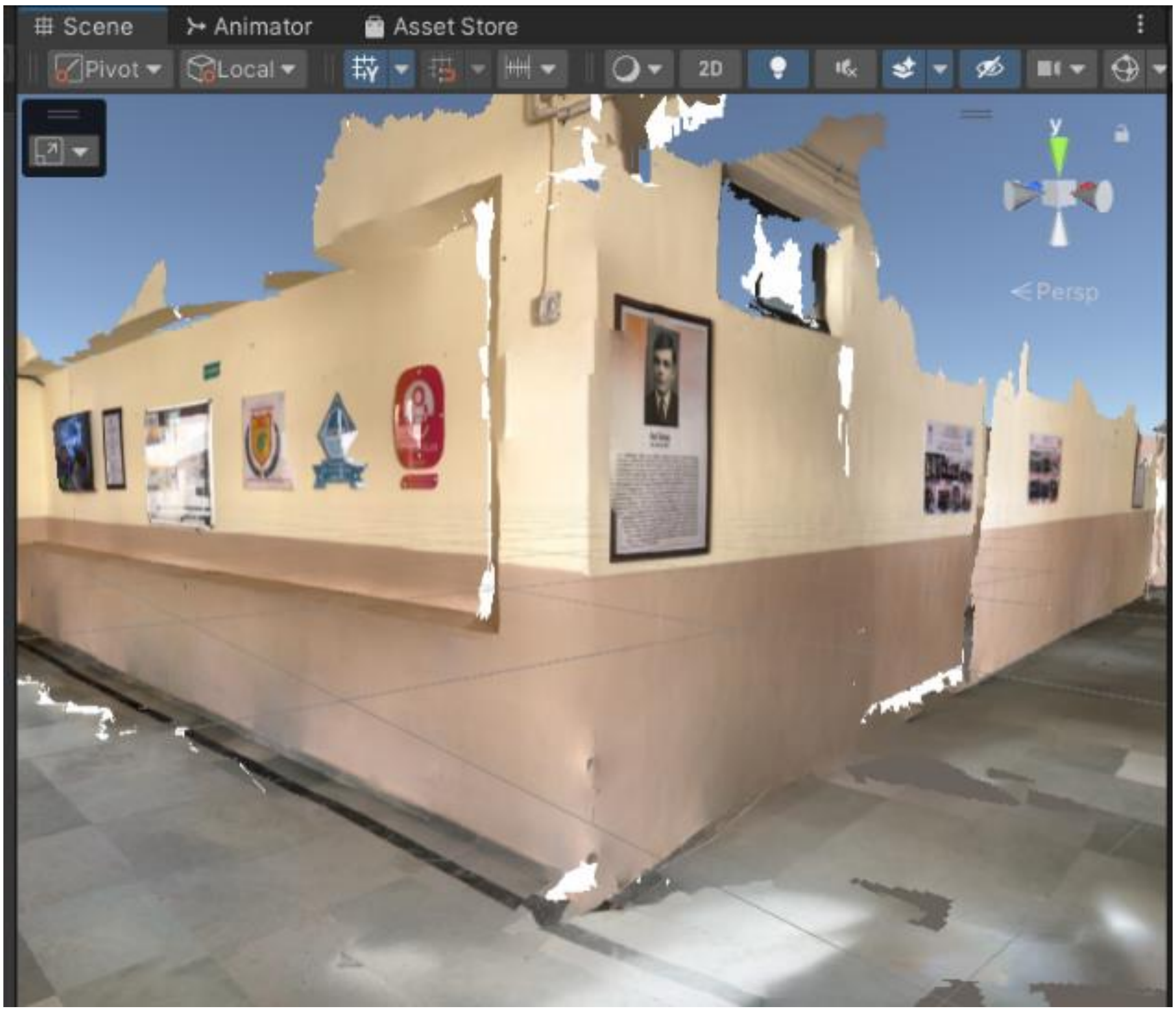

Fig 7.1:- 3D scan for prototype 1

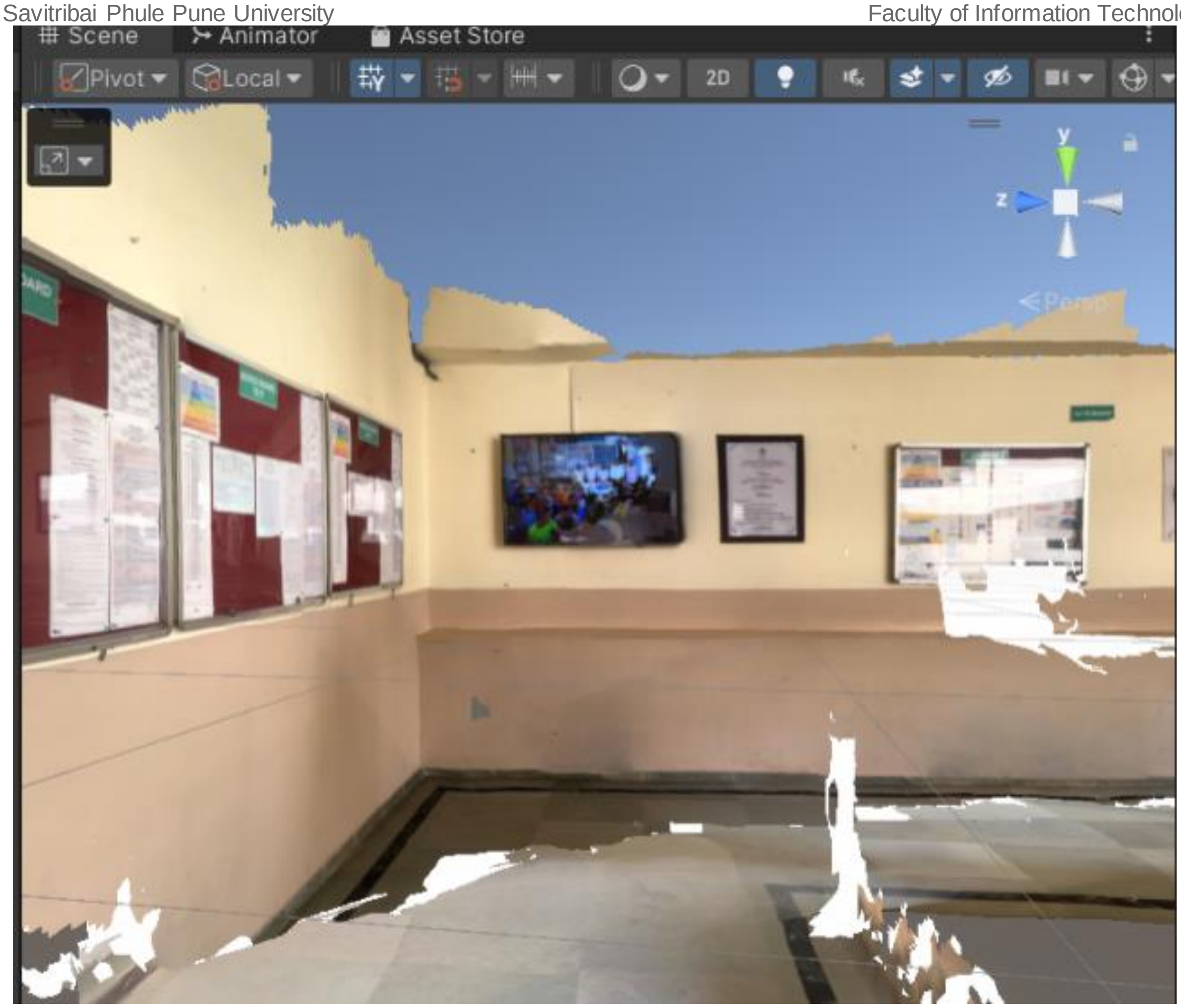

Fig 7.2: - 3D scan for prototype 1

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.

Explanation:

Our prototype involves two main processes: creating a 3D scan of the area and overlaying navigation paths onto the environment.

1. **3D Scanning**: We start by creating a 3D scan of the area. This is like taking a comprehensive digital snapshot of the space, capturing every nook and cranny in three dimensions. We use sophisticated scanning technology to map out the entire area in detail. This digital map serves as the foundation for our navigation system.

2. **Overlaying Navigation Paths**: Once we have our 3D map, we use a navigation algorithm to overlay navigation paths onto the environment. This is akin to drawing a virtual map on top of the physical space, showing users the best routes to their destinations. It's like having an invisible guide that points you in the right direction.

However, this technique has its challenges. While it's effective in some areas, providing clear and accurate guidance, it falls short in others. In certain spaces, the navigation paths may not align perfectly with the actual environment, leading to inaccuracies. This could be due to various factors, such as complex layouts or dynamic changes in the space.

Moreover, this process is processor heavy. It requires a lot of computing power to create the 3D scan and run the navigation algorithm. This means that it may not work efficiently on devices with low to medium processing power. Users with less powerful smartphones might experience lag or other performance issues, which can be frustrating and hinder the navigation experience.

We recognize these issues as problematic and undesirable. Our goal is to provide a seamless and accurate navigation experience for all users, regardless of their device's processing power. Therefore, we are actively working on optimizing our prototype to address these challenges, ensuring that it is both effective and efficient for everyone. The image provided gives a visual context to these processes, showing the potential of our prototype and the areas we are striving to improve.

Prototype 2:

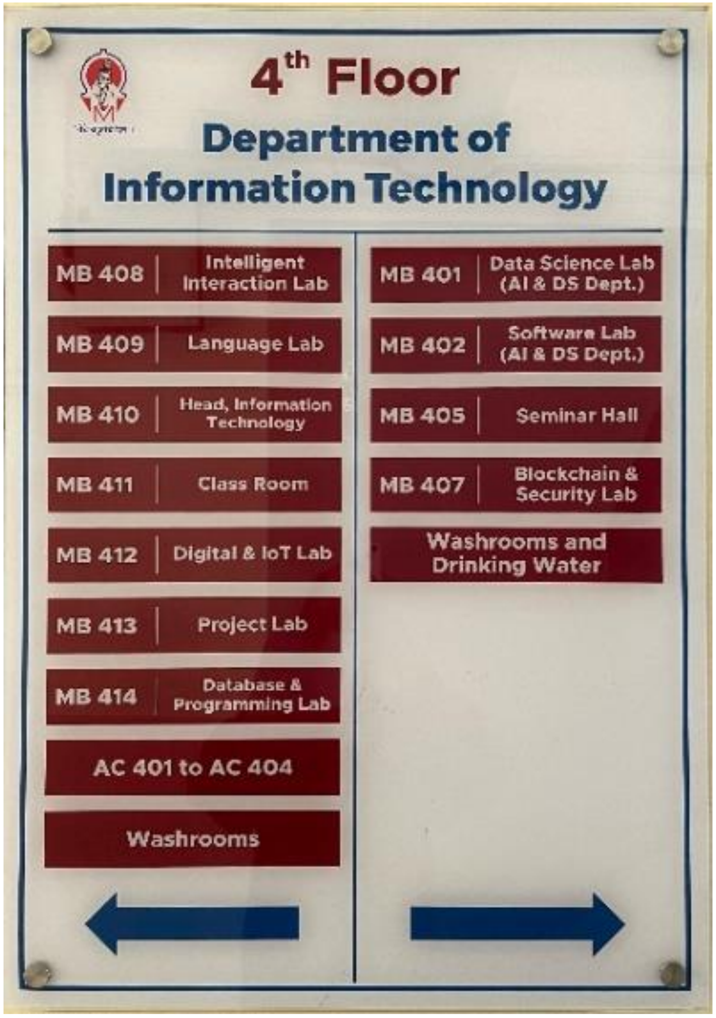

Fig 8: - Navigation Board on 4th floor

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.

Explanation:

In our second prototype, we’ve taken a different approach to enhance performance efficiency. Instead of relying on a 3D model, we use a scanned image of the environment as a reference point. Here’s a step-by-step breakdown:

1. **Scanned Image Reference**: We start by scanning an image of the environment, such as a directory sign or a distinctive feature within the space. This scanned image acts as a map that tells us where everything is located.
2. **User Positioning**: As users scan the image with their devices, our system can pinpoint their exact location in relation to the scanned image. It’s like having a “You Are Here” marker on a physical map, but in a digital format.
3. **Overlaying Virtual Data**: Once we know where the user is, we overlay virtual data onto the space. This could be anything from directional arrows to information about nearby points of interest. The tracked image serves as a reference for placing this virtual data accurately.

However, this method comes with a trade-off. By using a single scanned image as a reference, we limit the operational space of our system. It can only track the user’s position when they are in proximity to the reference image. If the user moves away from the image, the system loses the ability to track their location.

This limitation means that our navigation assistance is confined to a smaller area, but it also allows for a more streamlined and less resource-intensive experience. Users can still receive helpful guidance and information as long as they remain within the tracked area.

Our goal with this prototype is to provide a balance between performance efficiency and user convenience. We’re continuously exploring ways to expand the tracking capabilities while maintaining a smooth user experience. The image provided helps visualize the concept of using a scanned image as a reference for overlaying virtual data in a specific space.

Outcome:-

Fig 9: - Step-1

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

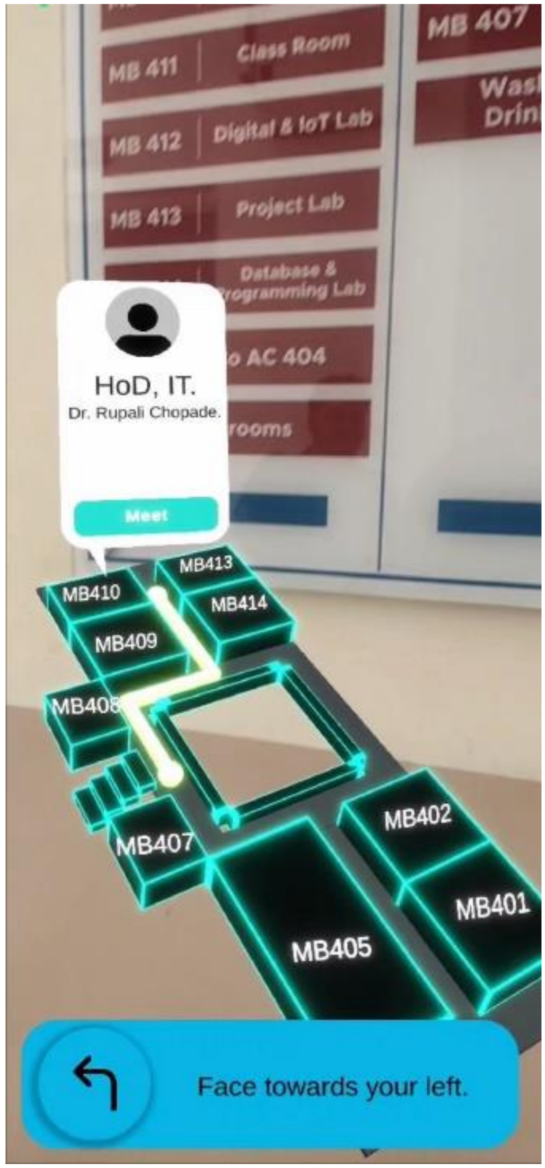

Fig 10: - Step-2

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

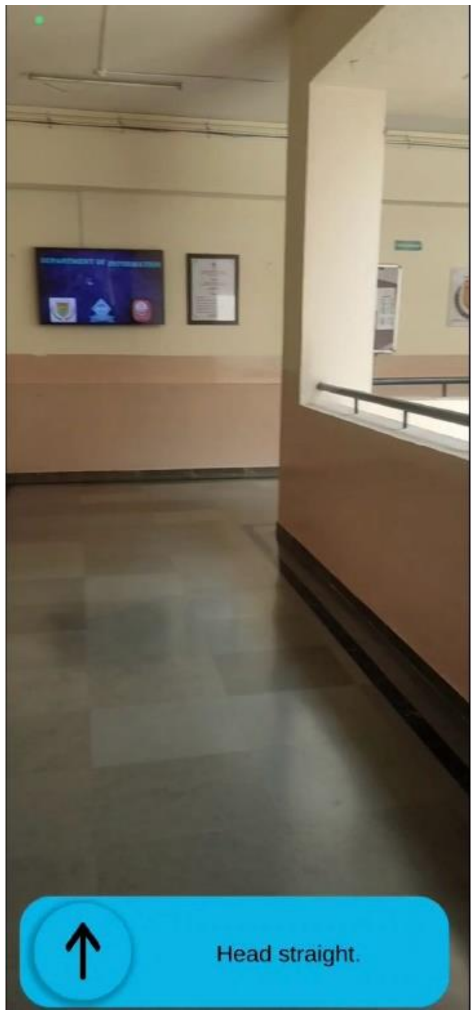

Fig 11 : - Step-1

Indication to head straight in your current direction.

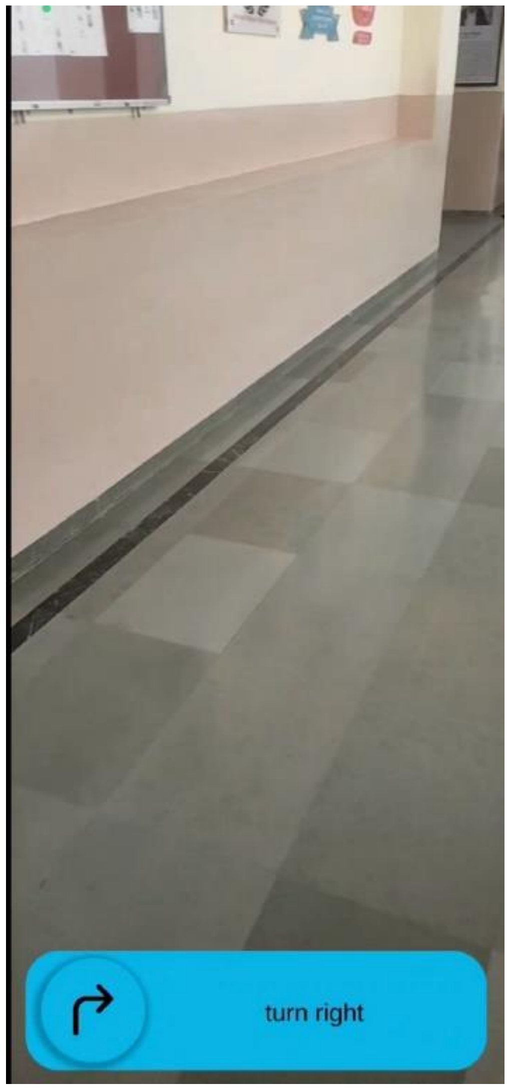

Fig 12 : - Step-2

Indication to take a right turn when nearing a corner.

Fig 13 : - Step-3

Indication to take a left turn when nearing a corner.

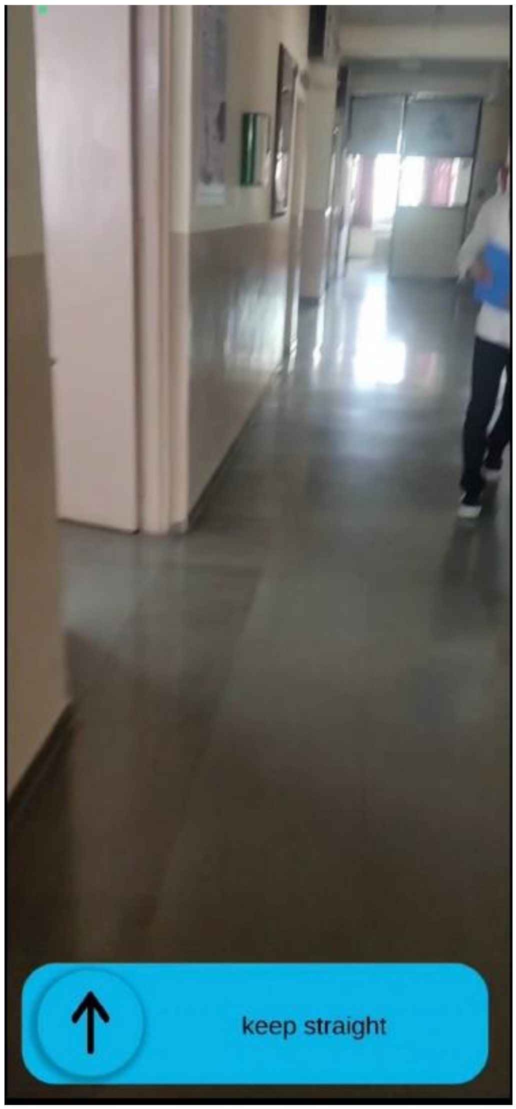

Fig 14 : - Step-4

Indication to keep heading straight until further alert.

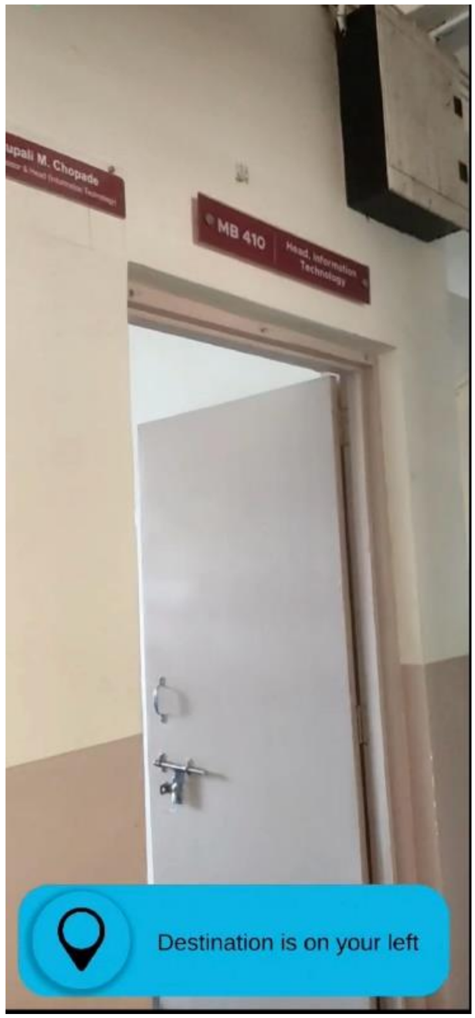

Fig 14 : - Step-4

Alert that the destination has arrived on the left.

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

1. **Department-Specific Navigation**: In the future, we could expand our system to include navigation for all departments within a college. This means that whether a student is studying arts, sciences, engineering, or any other subject, they would have a tailored navigation system that guides them to their specific classrooms, labs, and faculty offices. This would make navigating large and complex campuses much easier and more efficient.

2. **Admissions Module**: We could also develop a separate module specifically for parents and prospective students visiting the college for the admission process. This module could guide visitors to key locations such as the admissions office, auditorium for information sessions, and campus tour starting points. It could also provide information about parking, campus facilities, and nearby accommodations. This would make the admissions process smoother and more welcoming for prospective students and their families.

3. **Improved Visuals**: To enhance the user experience, we could improve the look and feel of the navigation system by adding 3D arrows and other visual elements. These enhancements would make the navigation cues more intuitive and engaging. For example, instead of just telling users to turn right, the system could display a 3D arrow pointing in the right direction. This would make following the navigation instructions a breeze.

4. **Integration with Smart Devices and IoT**: As AR technology advances, we can expect seamless integration with a variety of smart devices, including AR glasses, smartwatches, and AR headsets. This would give users the flexibility to choose the device that best suits their preferences and needs. Furthermore, integration with the Internet of Things (IoT) could provide real-time information about available study spaces, interactive digital displays, and smart building automation. This would make college campuses more connected and efficient.

5. **Personalized Navigation with AI and Machine Learning**: The application of artificial intelligence (AI) and machine learning algorithms could further enhance the navigation experience. The system could learn from users' behaviors and preferences to provide tailored recommendations and efficient routes. For example, if a student frequently visits the library after their classes, the system could automatically suggest the quickest route there.

CHAPTER 12

REFERENCES

1)Indoor Navigation using Augmented reality by Satya Kiranmai Tadepalli, Preetivardhan Ansuri Ega, Pavan Kalyan Inugurthi - IJSCSEIT

2)Indoor Navigation using Augmented reality for Mobile Application by Ramesh M S, Naveena Ramesh Vardhini J, Murugan S, Albert Mayan J -ICIRCA 2023

3)Augmented Reality Technology: Current Applications, Challenges and its Future by Jaspreet singh, Urvashi, Gurpreet Singh, Shikha Maheshwari - ICIRCA 2022

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

6)An indoor evacuation guidance system with an AR virtual agent - Zhen Liu, TingTing

7) Indoor Navigation Using Augmented Reality. - Prashant Verma, Kushal Agrawal, and V. Sarasvathi. https://doi.org/10.1145/3385378.3385387

8) A Systematic Literature Review of Virtual, Augmented, and Mixed Reality Game Applications in Healthcare. - Yu Fu, Yan Hu, and Veronica Sundstedt https://doi.org/10.1145/3472303

9) "Augmented Reality", Marketing in Customer Technology Environments - Sudharshan, D. (2020) https://doi.org/10.1108/978-1-83909-600-620201006