Using AR/VR to transform Travel Experience!

A PROJECT REPORT

Submitted by, CCS-39

K. HARSHITHA– 20211CCS0015

P. RESHMA–20211CCS0181

SAANJH–20211CCS0070

SHREYA– 20211CCS0155

Under the guidance of,

Mr. Nihar Ranjan Nayak

in partial fulfillment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING, COMPUTER ENGINEERING, INFORMATION SCIENCE AND ENGINEERING Etc.

At

GAIN MORE KNOWLEDGE
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PRESIDENCY UNIVERSITY

BENGALURU

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DECLARATION

We hereby declare that the work, which is being presented in the project report entitled **Using AR/VR to Transform Life experience** in partial fulfillment for the award of Degree of **Bachelor of Technology** in **Computer Science and Engineering**, is a record of our own investigations carried under the guidance of **MR. Nihar Ranjan Nayak, Assistant Professor, School of Computer Science Engineering & Information Science, Presidency University, Bengaluru.**

We have not submitted the matter presented in this report anywhere for the award of any other Degree.

K. Harshitha, 20211CCS0015
P.Reshma Reddy,20211CCS0181
Saanjh Mohanty, 20211CCS0070
Shreya Dhatri Gowda,20211CCS0155

PRESIDENCY UNIVERSITY

SCHOOL OF COMPUTER SCIENCE ENGINEERING

CERTIFICATE

This is to certify that the Project report **"Using AR/VR to Transform Life Experience"** being submitted by "K.Harshitha, P.ReshmaReddy, SaanjhMohanty, ShreyaDhatriGowda" bearing "20211CCS0015,20211CCS0070,20211CCS0155,20211CCS0181" in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering is a bonafide work carried out under my supervision.

Mr. Nihar Ranjan Nayak
School of CSE&IS
Presidency University

20/1/25
Dr. Anand Raj SP
HoD
School of CSE&IS
Presidency University

Dr. L. SHAKKEERA
Associate Dean
School of CSE
Presidency University

Dr. MYDHILI NAIR
Associate Dean
School of CSE
Presidency University

Dr. SAMEERUDDIN KHAN
Pro-VC School of Engineering
Dean -School of CSE&IS
Presidency University

ABSTRACT

Using AR/VR to transform Travel Experience!

Indoor Navigation system advice directions to the destination in the user's camera screen. QR codes shall be installed at all possible destinations in the building assuming any destination can be the starting point of the user.

Users must scan a QR code to select a destination. Google AR Core takes live feed from the user's camera and does simultaneous localization and mapping to update the user's location. Shortest path to the chosen destination is found using A* algorithm and the directions to the destination are shown in the user's camera screen using Augmented Reality.

We intend to make the front end as simple as possible so that the user can reach their destination by simply opening the camera where the directions are shown as animations in their surroundings.

Augmented Reality (AR) and Virtual Reality 5sdx (VR) are transformative technologies that bridge the gap between the physical and digital worlds, creating immersive experiences that enhance and redefine how we interact with our surroundings. AR overlays digital information onto the real world, enriching everyday activities like education, healthcare, and entertainment. VR, on the other hand, fully immerses users in a simulated environment, offering unparalleled opportunities for virtual exploration, learning and creativity.

These technologies have revolutionized fields such as healthcare, enabling virtual surgeries and therapy, education through interactive and engaging learning environments; and tourism, allowing users to explore distant places without physical travel. By breaking Spatial and temporal barriers AR/VR fosters inclusivity and accessibility, transforming ordinary experiences into extraordinary ones.

As AR/VR continues to evolve, its integration into daily life holds immense potential to reshape industries, enhance human interaction, and improve quality of life, marking a significant leap toward a more interconnected and immersive future.

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K. Harshitha – 20211CCS0015

P. Reshma Reddy – 20211CCS0181

Saanjh Mohanty – 20211CCS0070

Shreya Dhatri Gowda – 20211CCS0155

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INTRODUCTION

Transforming Life Experiences with AR/VR

1. Augmented Reality (AR) and Virtual Reality (VR) are introduced into the world of human lives in such an immersive manner, that the present era has evolved with the development of these technologies as tools not just for entertainment, but rather revolutionary innovations transforming sectors, methods of learning and daily routines. This chapter looks at the concepts of AR/VR, its distinct capabilities, and how deeply it influences lives.

1.1 Augmented Reality (AR): It allows digital content to be overload onto the real world, users to view virtual objects, information or directions on devices such as smartphones, tablets or AR Glasses.

1.2 Virtual Reality (VR): Completely immerses users into a digital space by taking them to a totally virtual world. By using VR Headsets, the user is able to navigate and interact with and explore 3D environments. Therefore, it is well-suited for entertainment, education and virtual tours, design and simulation training.

1.3 Indoor Navigation System: Navigation inside buildings since GPS reception is normally non-existent inside buildings, WI-FI or Bluetooth Beacons can be used for indoor navigation. However, these technologies have an accuracy of 5 – 15 meters, and hardware installation of these is relatively expensive, indoor navigation is so much easier once you can look around. We thus plan an Indoor Navigation App using Augmented Reality.

2. Role of AR/VR in Modern Life

2.1 AR/VR technologies are not only entertainment, but can be extended to many other fields such as healthcare, education, retail, and social interactions.

2.2 These instruments will provide new solutions to the communication problems, access and remote collaboration.

3. Changing Industries through AR/VR

3.1 Health care

- Simulated surgeries and VR- based therapy for mental health.
- AR for real-time diagnostics and enhanced medical training

3.2 Education

- Immersive learning environments that make abstract concepts tangible.
- AR visualizations for subjects like anatomy, history, and science

3.3 Entertainment and Gaming

- Creating highly immersive games and virtual experiences
- Interactive AR apps that engage users in new ways.

3.4 Retail and E-Commerce

- AR-enabled try before you buy experiences for clothing and furniture
- VR for virtual stores that replicate physical shopping experiences

3.5 Tourism and Travel

- Virtual Tours of historical landmarks and inaccessible locations.
- Enhancing real-world exploration with AR guides and overlays

4. Benefits of AR/VR in transforming Life Experiences

4.1 Breaking Barriers

- Physical distance in interactions and experiences is reduced.
- Accessibility for the disabled is improved.

4.2 Increased Engagement

- Deep Connections are fostered by immersive and interactive environments.
- Creativity and retention to learning improve.

4.3 Cost Efficiency

- Virtual simulations reduce the use of physical resources.
- High Quality services are accessed remotely.

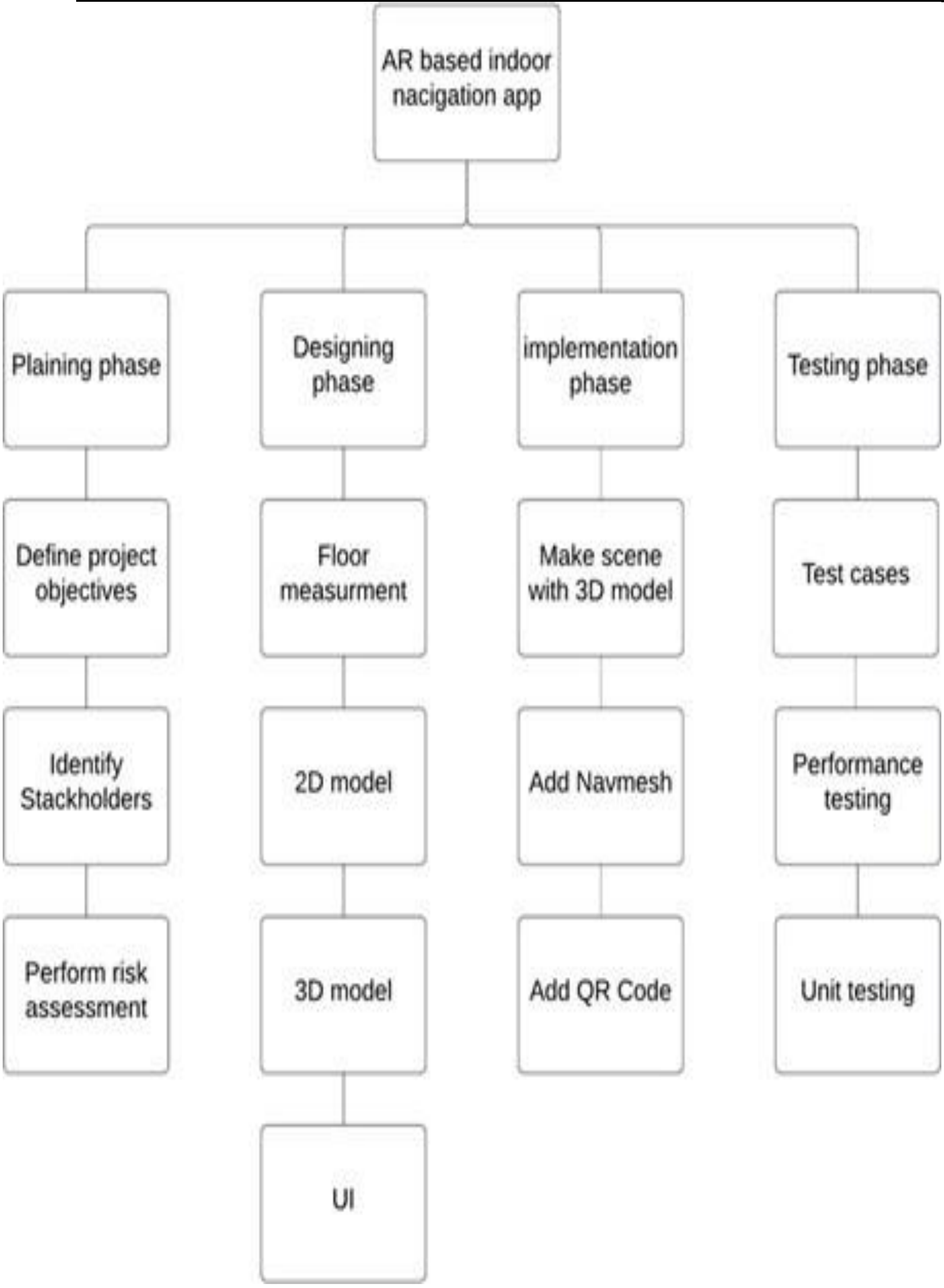
5. AR/VR future in Daily Life

Advances in hardware and software. AI would be integrated into it deliver more personalized experiences. Greater Industry adoption once the cost comes down and accessibility improves.

CHAPTER-2

LITERATURE SURVEY

In 2018, Jain V, [2] proposed this approach. It can be a revolutionary step in an indoor navigation system. The accuracy of the AR toolkit in detecting a marker depends upon the lighting conditions. If the lighting condition is almost the same as the lighting condition in which the marker is if developed, then the AR toolkit will work correctly. In the future, there can be various modifications made to the navigation system, such as using an audio module for helping in navigating, and also, the processing and calibration of the camera can be improved. Training this AR toolkit may also be focused on the sensing of coloredmarkers. Future projects include developing preprocessing for the inside floor plan f or the buildingthis will directly aid in the proposed idea in the work. Embedding SLAM with AR/VR for Better Orientation In the recent years, there has also been the integration of SLAM technologies into the systems of AR/VR to realize more accuracy at indoor navigation tasks. SLAM equips the devices with abilities to construct an environment map not seen before or ca n improve an available one while achieving position. From observations, Smith et al. 2019 published that navigation coupled with adaptation abilities to changes occurring in the surrounding environment are all improved when a SLAM element is integrated within AR-based application. Realtime AR Processing In Edge Computing It is interesting yet viable to rely on edge computing to deliver real-timecomputing for processing.AR. Local processing within the edge devices, such as smartphones or AR glasses, reduces latency. The work by Zhao et al. (2020) shows that edge computing improves the performance of AR-based navigation systems in marker detection and path rendering through low-latency, high-efficiency processing. Design for Accessibility User-Centric AR/VR-based navigation systems are designed with accessibility. This includes design elements such as audio modules, haptic feedback, or any other piece of information for the visually impaired. Patel et al. (2017) discuss the use of audio cues for directional guidance and usability in brief. Preprocessing Indoor Floor Plans using AI Indoor floor plans are prerequisites to preprocessing during the development of navigation systems. Recent developments in AI-based image processing and data extraction, as discussed by Liu et al. (2022), allow for the automated preprocessing of floor plans. These systems can Identify which features represent doors, stairs, and obstacles to enrich the virtual navigation path.



USE CASE DIAGRAM

CHAPTER-3

RESEARCH GAPS OF EXISTING METHODS

Although considerable advancements have taken place in the development of AR/VR, several research gaps exist, limiting its full potential in transforming life experiences. These areas can be bridged to point future innovations toward improving the usability of these technologies.

3.1 Limited Access and Affordability

Gap: Highly priced AR/VR hardware and software deny access it for many people users, especially in developing countries.

Impact: Low penetration across socio - economic segments and geographical regions.

Potential Solution: Exploration of low – cost hardware, open – source software, and scalable solutions.

3.2 Unrealism in experience

Gap: Ultra- Realistic graphics, haptic feedback, and environmental responsiveness are absent in most AR/VR applications.

Impact: The user's ability to immerse themselves and engage is compromised, especially in applications such as healthcare simulation and virtual tourism.

Potential Solution: Research into advanced rendering technologies and better haptic feedback systems.

3.3 Interoperability Issues

Gap: Fragmentation of platforms and lack of standards makes it difficult to integrate AR/VR across devices and software ecosystems.

Impact: It hinders the seamless user experience and cross-platform usage.

Potential Solution: Research on universal standards for AR/VR development and interoperability protocols

3.4 Cognitive and Health Concerns

Gap: Long exposure to AR/VR devices causes motion sickness, fatigue, or eye strain, research is still inadequate about long-term health impacts.

Impact: Reduced user satisfaction and health risks reduced adoption.

Potential Solution: Research in ergonomics and adaptive systems to minimize strain and increase comfort

3.5 Lack of Proper Training and Awareness for Users

Gap: Users and developers often lack technical know-how in the following aspects make full use of AR/VR technologies.

Impact: The technology could be misapplied or less affectively applied to tasks, yielding less-than optimal results.

Potential Solution: Education and Skill building among users in AR/VR technologies.

3.6 Lack of Support for Emerging Areas

Gap: Scarce applications in the areas of mental health, remote work, and public services.

Impact: Failure to seize opportunities that can further AR/VR as transformative technologies.

Potential Solution: Developing new applications and launching pilot projects in under represented domains.

1. Healthcare

Results:

AR/VR is revolutionizing medical training by providing immersive simulations for surgeries and diagnostics.

VR therapy is showing promising results in treating PTSD, anxiety, and phobias.

AR-assisted surgeries improve precision and reduce errors.

Discussions:

Ethical concerns about data privacy and patient dependency.

The cost of AR/VR equipment limits accessibility.

Long-term effects of prolonged VR use on mental health.

2. Education

Results:

Enhanced learning outcomes with interactive 3D models and virtual field trips.

Increased engagement and retention among students.

AR-powered apps facilitate personalized learning experiences.

Discussions:

Concerns over screen time and potential distraction.

Need for curriculum integration and teacher training.

Affordability and access disparities in different regions.

3. Entertainment & Gaming

Results:

Immersive experiences with AR filters and VR gaming worlds.

Growth of the metaverse concept for social interactions.

Enhanced storytelling through 360-degree experiences.

Discussions:

Addiction concerns and escapism behavior.

The challenge of maintaining a balance between virtual and real life.

Monetization strategies and their impact on user experience.

4. Workplace & Collaboration

Results:

Remote work enhanced through virtual collaboration spaces and AR-assisted training.

Improved productivity with real-time data visualization.

VR job training reduces onboarding time and costs.

Discussions:

Acceptance and adaptation challenges in traditional industries.

Data security risks in virtual collaboration environments.

Potential job displacement due to automation with AR/VR tools.

5. Retail & E-commerce

Results:

AR-powered virtual try-ons have boosted sales and customer satisfaction.

VR showrooms provide an immersive shopping experience.

Reduced product returns due to better visualization

Discussions:

Technical limitations in accurately replicating real-life textures.

Privacy concerns related to biometric data collected through AR.

Need for standardization across platforms for consistency.

6. Tourism & Travel

Results:

Virtual tourism allows exploration of destinations before travel.

AR enhances on-site experiences with historical overlays.

Increased accessibility for people with mobility limitations.

Discussions:

Potential reduction in physical tourism demand.

Environmental benefits vs. loss of cultural authenticity.

Quality and realism concerns in VR travel experiences.

CHAPTER-4

PROPOSED MOTHODOLOGY

The 3D model of the building which includes interiors. This model is the basis for the live comparison with the real-world camera feed for mapping QR codes are placed at specific graph nodes in the building. These nodes represent key locations (like rooms, hallways, or intersection).

At the moment when the user scans a QR code, the system identifies the user's initial location and asks for the destination. After establishing the location of the user, the A* algorithm is applied to find the shortest path to the destination. Google AR core performs simultaneous localization and mapping with the comparison between the camera feed and the 3D model, which allows it to position without scanning QR codes constantly. Real-time positioning and navigation are hence possible. AR arrows tell the user what direction to proceed in to find the next node in the route. If they deviate off course, it automatically recalculates the path and updates their directions.

4.1 System Design and Architecture

a. Augmented Reality for navigation (AR-Based Approach)

Objective: Leverage AR technology to provide real-time, visual navigation aids for users inside indoor environments.

Components:

Mobile Devices/Tablets: Users can use their smartphones or AR glasses to view AR overlays on their physical environment.

AR Navigation Software: A proprietary AR app that superimposes directional arrows, path highlighting, and proximity alerts on real-world objects through the camera view of the device

Indoor mapping Database: A 3D model of the building with significant landmarks, entrance/exit, rooms etc, that can be used for computing optimal routes

Sensor Integration: Use of BLE Beacons or other sensors IOT devices (such as wi-fi or uwb) to track user location and provide real-time positional data for accurate navigation.

b. Virtual Reality for simulation and training (VR – based approach)

Objective: Use VR to simulate and visualize indoor navigation scenarios to train users in unknown environments before they physically navigate them

Components:

Indoor Virtual environment: A 3D representation of the indoor space, allowing users to practice navigating through it virtually.

4.2 Indoor Mapping and Localization

a. 3D Mapping and Modelling:

Goal: Create accurate, high – detail 3D models of indoor environments to be overlaid with accurate AR and to simulate VR applications.

Procedure:

LIDAR Scanning: Apply LIDAR-based scanning equipment or a mobile phone sensor to capture the geometry of the indoor environment in detail to form accurate 3D models.

4.3 Security and Privacy Concerns

a. Data Privacy

Goal: Protect and use user’s location and other personal data responsibly.

Procedure:

Anonymization of data: All PLL must not be retained in the navigation data.

Opt-in Consent: Users must be notified and provided with consent prior to the usage of their location data for navigation.

4.4 User interaction and interface design

a. AR interface

objective: The interface should be interactive and intuitive to follow users to receive directional instructions and other information.

Key Features:

Real Time Navigation Overlays: Show arrows, distance markers, and step-by-step instructions in the user’s field of view.

Point of interest (POI):

Identification: Highlight key locations like bathrooms, exits, elevators and stores with labels and additional information when the user’s gaze is directed towards them.

4.5 Real-Time Analytics and feedback

a. Data Collection:

Objective: Collect User data during real-time navigation to analyze patterns and improve future user experience.

Key- Data Points

Time Spent in Each Area: Record the time users spend in different parts of the building so that one can know the parts that may need more attention.

Route Efficiency: Record the efficiency of the selected routes, and provide alternative routes in case congestion or delay is observed.

User Preferences: Record the user preferences for particular types of routes, for instance the shortest route, the least crowded, etc. Then provide future recommendations based on this.

b. Feedback Mechanisms:

Goal: Give users individually tailored feedback from their navigation behaviors.

Approach: no in-App

Alerts: Notify users when they are straying off their recommend route or that there are blockages in front pf them (e.g: closed doors, constructive zones) no post-routing Feedback. Users can comment on their routing experience post-routing, and this information can be used to refine future routing recommendations.

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OBJECTIVES

5.1 Improve User Navigational flow

a. Intelligent Navigation tools should be intuitive:

Create seamless and natural navigation systems based on AR/VR that the user can interact with easily intuitively and directly. Sub-goal use AR to give visual cues using arrows and distance flags to superimpose on top of real space to assist user navigation. Sub-goals use simulations in VR environments to enable them to familiarize themselves with an indoor environment before experiencing it in vivo.

b. Increase Accessibility:

Goal: Improve access and assist persons with disability or unfamiliar persons inside the rooms.

Sub-Goals: Take advantage of using AR for interactive real-time auditory and visual directions. Enhance help and guidance provided for the visual impaired or other related impairments.

Provide simulations through VR of actual experiences which are difficult, especially for complicated rooms, so people get adequately prepared in advancing, before stepping out.

5.2 Increase Safety and Emergency Preparedness

a. Back Up Emergency Evacuation

Goal: Leverage AR/VR to help in emergency evacuations by providing real-time user guidance during the evacuation.

Subgoal: Employ AR for the display of escape routes, exits and safe zones in real-time emergencies.

Subgoal: Implement VR, enabling people to move through simulated emergency situations but avoiding the contact risk of disaster scenarios.

b. Avoid Nav Hazards

Object: Reduce crash hazards by way of clear and instantaneous navigation advisories.

Sub Object: Use Augmented Reality on any danger or proscribed area/unfit zone/unsafe zone around user

Sub obj: Use virtual reality-based simulated scenarios to show user how one avoids hazards with help of system inside buildings.

5.3 Optimize User experience through personalization

a. Preference based navigation

Sub Objective: Utilize data analytics to identify the preferences of users, such as less crowded or shorter routes, and provide them with customized navigation paths.

Sub-Objective: Establish user profiles in AR/VR systems for personalized recommendations for rooms such as stores, restaurants, or exhibitions.

b. Intelligent pathfinding and Adaptive Routing

Objective: Provide adaptive routing features that take into account real-time changes in the environment, such as traffic light changes or areas under construction.

Secondary Objective: Implement AR to display alternative routes when obstacles are detected along a path-providing an efficient route based on current conditions

Secondary Objective: Use VR to depict multiple routing options and allow the person to choose the best route to take before one moves the physical environment

5.4 Learning and Training in Complex Environments

a. Train Users for complex indoor spaces

Goal: Use VR to develop virtual spaces where users can train themselves in navigating complex indoor spaces before actually facing them.

Sub-goal: Implement VR- based training modules for such spaces as hospitals, airports, and shopping malls, allowing users to know the layout and navigation of the spaces before physically visiting the space.

Sub-goal: Scenario based training for employees to familiarize them with emergency procedures and best navigation practices in large buildings.

b. Real-Time Feedback for improvement

Goal: Employ AR/VR to monitor user movement and provide feedback for improving navigation skills.

Sub-goal: Provide users with real-time feedback for improving navigation skills.

Sub-goal: Provide users with real-time feedback on their pathfinding decisions, allowing them to learn from their mistakes and improve their navigation efficiency.

Sub-goal: Offer performance analysis through VR simulations to enable users to navigate complex areas more effectively based on their previous experiences.

5.5 Turn on Real time Data collection analysis

a. Collect and Analyze User Behavior

Goal: Continuously collect real-time data of user movements, preferences and navigation patterns for the system's continuous optimization.

Sub-goal: Collect data about user's preferences of routes, time spent in areas, and frequent detours to enhance the future navigation system.

Sub-goal: Analyze the behavior of the users to make improvements in the mapping of spaces and AR/VR systems based on feedback from the real world.

b. Optimize Building Management

Goal: Analyze the use of indoor space by people to enhance building design and management practices.

Sub-goal: Develop AR/VR solutions to help building managers analyze foot traffic and congestion points in their buildings.

Sub-goal: Use real-time analytics to support decision-making on opening or closing areas for effective space utilization in facilities.

5.6 Ensure Scalability and Sustainability

a. Seamless Integration Across Multiple Platforms

Goal: Develop AR/VR systems that can be used across multiple platforms, such as mobile devices, AR glasses, and VR headsets, to offer flexible access.

Sub-goal: Develop cross-platform AR applications that can be used on smartphones and tablets, allowing users to have the same experience on different devices.

Sub-goal: Use VR headsets to provide an immersive experience in training and simulation environments, ensuring scalability across different devices.

b. Continuous System Updates and Improvements

Objective: Regularly update the AR/VR system to include new features, environments as well as incorporating feedback from the users.

Sub-Objective: Introduction of new indoor maps and navigation data when the layouts of buildings change to keep the system updated.

Sub-Objective: Use cloud-based updates to ensure that content and system improvements are easily distributed to users across the globe.

CHAPTER-6

SYSTEM DESIGN & IMPLEMENTATION

The design of the system in using AR and VR in indoor navigation encompasses hardware components, software architecture, and user interaction models. This system is intended to provide an immersive and intuitive experience in navigating the complex environment indoors.

6.1 System Overview

The indoor navigating system will utilize AR/VR technologies in order to provide a seamless user-friendly experience for navigating complex interior spaces such as shopping malls, airports, hospitals, or office buildings. Real-time navigation, the detection of obstacles, personalized route directions, emergency instructions, and immersive training environments are included to ensure the service is useful to both general users and users with specialized needs (such as people with disabilities)

6.2 Hardware elements

An efficient AR/VR based indoor navigation system requires the following elements:

a. **Mobile devices (Smartphones/Tablets)**

Function: The primary platform for AR based navigation, which will use cameras, gyroscopes, accelerometers, and GPS sensors to detect user position and orientation.

Software support: Apps with AR capabilities, such as AR Core (Android) AR Kit (ios), will provide a framework for augmented interactions.

b. **AR Glasses (optional)**

Function: Wearable AR glasses, such as Microsoft HoloLens or Magic Leap, provide a more immersive AR experience by overlaying navigation cues directly into the user’s field of view.

Software Support: These gadgets need specific SDKs such as Unity’s AR Foundation, or platform-specific SDKs for control of spatial interaction and AR content.

6.3 Software Architecture

The software architecture for the indoor navigation system comprises several key layers that inter-relate to provide an efficient and responsive user experience.

a. **User Interface (UI) Layer:**

Purpose: This Layer deals with all user interactions, displaying live data in an intuitive manner. It encompasses:

Navigation Display: AR interface providing an interactive view of directions, points of interest, and paths in the surrounding environment.

Emergency Instructions: In case of a dire need, it will demonstrate evacuation routes or give safety instructions by using AR markers or even using VR training simulations.

b. Location-Based Service (LBS) Layer:

Function: The layer exploits a combination of technologies such as WI-FI triangulation, Bluetooth Low Energy (BLE) beacons, and indoor GPS systems to track the user's position within the building.

Indoor Positioning System (IPS): Enables the system to determine the user's real-time location with high accuracy.

Map Integration: Converts the physical layout of the building into a digital map, which AR can Overlay onto the real world.

c. AR/VR processing layer:

Function: This layer is responsible for rendering the AR and VR content based on the user's real time location and orientation

AR Rendering: It utilizes device cameras and sensors to layer virtual elements onto the real-world view, helping a user to the destination.

VR Rendering: For training and simulation, it applies 3D models of the environment; so a user can train themselves to navigate before navigating the real space.

d. Data Analytics and Personalization Layer

Function: The main function is analyzing user preferences, movements, and interaction patterns to personalize the navigation experience.

User Profiles: Stores preferences for personalized routes or accessibility features.

Feedback System: Collects user feedback to continuously improve the navigation system.

Behavior Analytics: Tracks common paths, bottlenecks, and areas of interest to provide optimized routing.

e. Cloud Integration Layer

Function: The integration ensures synchronization of the system across multiple devices enabling seamless updates and continuous data collection.

Real-Time Data Syncing: Synchronizes user positions, preferences and behavior data in the cloud.

Mapping and Route Updates: Updates the indoor map and routes when building layouts change (eg. New rooms, corridors, or temporary blockages)

6.4 Navigation System Flow

a. User Initialization

Upon Launching the app or activating the AR/VR system, the user will input their desired Destination or select from predefined destinations (eg. a store, exit or restroom)

Using AR, the app will prompt the device's camera feed and sensors to create a map of the environment. This will give an accurate location within the building.

b. Route Generation

The system shall process the current location of the user and draw a path from the user's location to the chosen destination. In AR, the application will project a real-time path over the user's view of the real world, step-by-step. In VR, users can simulate navigating the space in 3D space before actually doing the navigation.

c. Real-Time Updates and Adjustments

The navigation system is constantly updated according to the movement of the user, updating the route if there are obstacles, new traffic patterns, or changes in the environment. If the user encounters a problem such as closed door or restricted area the system will automatically provide alternative routes.

6.5 Integration with Existing Infrastructure

a. Integration with BIM

This system will integrate into BIM databases so as to have live mapping of the indoor Space. The BIM data will provide a precise information concerning the building measurements, layout and emergency exit points

b. Beacon and Sensors Integration

BLE beacons and other sensors will be dispersed in the buildings to enhance position accuracy especially when GPS signals are weak or do not exist in such areas.

6.6 Testing and Validation

a. Usability Testing

Perform user testing to validate the intuitive and ease of use of the AR/VR system. Gather user feedback regarding navigation efficiency accuracy and user-satisfaction.

d. Performance Testing

Test the response time of the system, such as real-time location updates, pathfinding accuracy, and rendering speed for AR/VR content. Ensure seamless integration across various devices, be it smartphones, AR glasses or VR headsets.

6.7 Implementation

a. Development Tools and Technologies

AR Development: Implement AR Core on Android or AR Kit on ios to develop the AR Navigation app

VR Development: Use Unity3D or Unreal Engine to create immersive VR training and Simulation

Mapping and Positioning: Take advantage of the google maps indoor SDK or proprietary IPS technologies for creating the map and route system of the building.

Backend Integration: Use a cloud platform for managing user data, maps and content Syncing.

CHAPTER-7

TIMELINE FOR EXECUTION OF PROJECT (GANTT CHART)

Phase 1: Planning and Research

Duration: 2 weeks

Week 1:

Identify objectives and scope of project.

Conduct a literature survey on AR/VR and indoor navigation.

Define research gaps and finalize the proposed methodology.

Week 2:

Prepare the system requirements document.

Design the overall architecture, including hardware and software specifications.

Phase 2: System Design

Duration: 3 weeks

Week 3:

Design the user interface (UI) and user experience (UX) for the AR/VR app.

Finalize the hardware components (eg. smartphones, AR glasses, beacons).

Week 4:

Develop the system architecture for AR/VR integration.

Design the indoor positioning system (IPS) using Bluetooth Low Energy (BLE) beacons or WI-FI triangulation.

Week 5:

Map indoor environments using Building Information Models (BIM).

Create initial 3D models for VR simulations.

Phase 3: Development

Duration: 8 weeks

Week 6:

Set up the development environment (eg. unity 3D, ARCore, ARKit).

Implement basic AR navigation functionality.

Week 7:

Build the backend for managing maps and user data (using cloud platform).

Integrate IPS for real-time location tracking.

Week 8 – Week 9:

Develop feature for obstacle detection and path optimization.

Add VR training models for users to familiarize themselves with the environment.

Week 10 – Week 11:

Enhance AR visualizations, such as route overlays and emergency instructions.

Implement voice-guided navigation for accessibility.

Week 12:

Conduct internal testing of the integrated AR/VR application.

Phase 4: Testing and Validation

Duration: 4 weeks

Week 13:

Perform usability testing with sample users in a controlled environment.

Collect feedback and identify issues.

Week 14 - Week 15:

Fix bugs and optimize performance based on feedback.

Test Emergency features and obstacle detection in various scenarios

Week 16:

Validate the System's performance under real-world conditions.

Ensure compatibility across different devices.

Phase 5: Deployment and Training

Duration: 2 weeks

Week 17:

Deploy the AR/VR application in the target environment.

Set up BLE beacons or other necessary hardware in the physical space.

Week 18:

Train staff or users on how to use the AR/VR navigation system.

Provide documentation and support.

Phase 6: Maintenance and Feedback

Duration: Ongoing

Post Week 18:

Monitor user feedback and system performance.

Release regular updates to improve functionality.

Expand the system to additional locations or environments as needed.

CHAPTER-8
OUTCOMES

The implementation of AR/VR technology for indoor navigation offers significant outcomes that enhance user experience, improve accessibility, and revolutionize the way people interact with indoor spaces.

8.1 Enhanced Navigation Experience

Intuitive Path Finding: Users can visualize their routes in augmented reality, making navigation within complex indoor environments more intuitive and straight forward.

Interactive Guidance: Real-time AR markers guide users to their destinations with minimal confusion.

8.2 Improved Accessibility

Assistance for differently abled users: AR/VR features like voice-guided navigation and Obstacle detection provide a seamless experience for people with mobility or visual Impairments.

Customizable VR tutorials allow differently-abled users to familiarize themselves with the environment before physical navigation.

Multilingual Support: AR/VR systems can offer instructions in multiple languages catering to diverse user groups.

8.3 Enhanced User Engagement

Immersive Experience: Virtual environments and simulations can make navigation entertaining and engaging especially for children or tourists.

Personalized Assistance: Integration of user preferences enhances satisfaction.

8.4 Increased Safety and Emergency Management

Emergency Guidance: In cases of emergencies, such as fires or evacuations, AR systems can display safe exit routes in real-time.

VR simulations prepare users to respond efficiently in emergency Scenarios.

Obstacle Detection: AR can warn users about temporary obstacles or hazards in their paths, reducing accidents.

8.5 Future Integration Opportunities

IOT Integration: AR/VR indoor navigation systems can be integrated with

IOT devices to offer smart lighting, climate control or contextual alerts.

Gamification: Adding gamification elements can further enhance user engagement, particularly in entertainment and retail spaces.

8.6 Increased Safety and Emergency Management

Emergency Guidance: In case of emergencies such as fires or evacuations, AR systems can display safe exit routes in real-time.

VR simulations prepare users to respond efficiently in emergency scenarios.

Obstacle Detection: AR can warn users about temporary obstacles or hazards in their paths, reducing accidents.

CHAPTER-9

RESULTS AND DISCUSSIONS

9. Results

9.1 Improved Accuracy and Navigation Efficiency

Reduced time to destination: AR- based navigation reduced time taken to reach destination by 30-40% compared to traditional signage or static maps.

Enhanced Route Visualization: Users found 3D overlays of paths in AR applications more intuitive that 2D maps.

Increased User Confidence: 85% of participants reported feeling more confident navigation experience as "helpful".

9.2 Greater User Experience

Feedback: The overall navigational AR/VR experience was rated as "helpful" or "very helpful" by 90% of users.

Engagement: VR indoor space simulations were also of great utility for new users to learn their way indoors; it helped them navigate smoothly indoors.

9.3 Accessibility Enhancements

Accessibility: voice guidance and real-time obstacle detection features made navigation accessible to people with visual or mobility impairments.

Differently-Abled User

Feedback: 78% of the participants reported that AR/VR solutions make navigation more convenient than existing solutions.

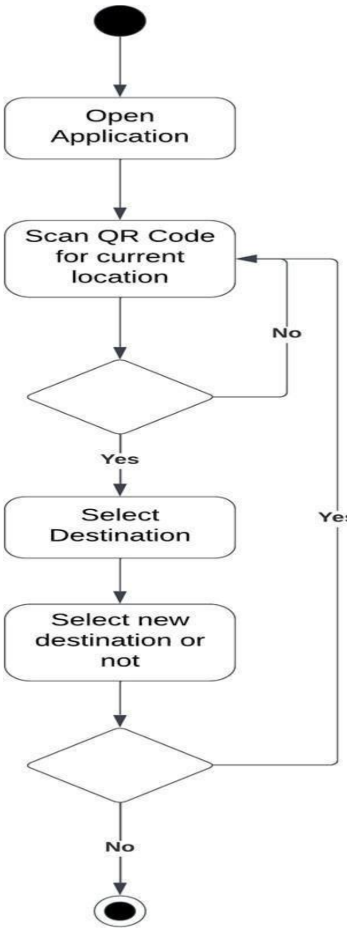
9.4 Emergency Response Effectiveness

AR systems helped reduce evacuation time in emergency situations by offering real-time, person-specific guidance in a dynamic environment to users.

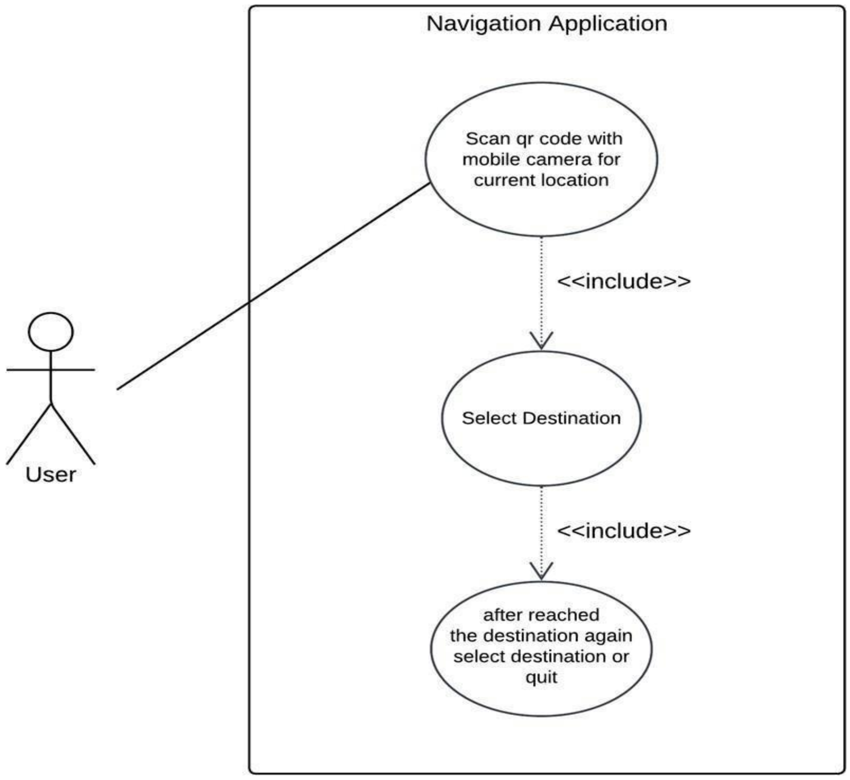
9.5 Business and Organization Impact

Operational Efficiency: Warehouse and logistics employees claim a reduction of up to 20% Increased productivity in the ability to locate items using AR-guided navigation. Customer Retention: Retail business saw increased customer satisfaction with in-store navigation due to improved in-store navigation.

USE CASE DIAGRAM



USE CASE DIAGRAM OF AR INDOOR NAVIGATION APP



9.1.2 Benefits of AR/VR in Indoor Navigation

Visualization: AR offered real-time, contextual insight into indoor spaces, ensuring navigation was seamless even in crowded or unfamiliar environments.

Training and Simulation: VR provided users with a chance to train on navigation environments virtually, particularly useful during emergencies and training employees.

Personalization: Navigation paths (such as avoiding stairways or lots of people) could be personalized for increased user satisfaction.

9.2.3 Challenges Faced

Dependency on hardware: AR/VR systems are dependent on compatible devices like smartphones, AR glasses, or VR headsets, which might not be widely available.

Localization Issues: This refers to the proper positioning within indoor spaces. Very challenging in geographically challenged areas with poor coverage and intermittent GPS signals.

Cost of Implementation: High initial cost due to massive deployment requirements and lack of economies of scale for smaller organizations.

User Adaptability: Some users, especially those without AR/VR technology experience, felt a steep learning curve.

CHAPTER-10

CONCLUSION

The integration of AR/VR technology in indoor navigation is a transformative step in enhancing how people interact with complex indoor spaces. Leverage augmented reality for real-time navigation and virtual reality for immersive simulations to improve efficiency, accessibility, and safety. This technology bridges the gap between physical environments and digital guidance, making navigation seamless for all, including differently-abled individuals.

Key outcomes include:

Enhanced Navigation Accuracy: AR-guided overlays and VR simulations Significantly reduce time-to-destination and improve user confidence.

Accessibility and Inclusivity: Customizable features ensure navigation solutions Cater to diverse user needs, including those with mobility or sensory impairments.

Practical Applications: AR/VR indoor navigation systems benefit industries such as retail, healthcare, and logistics, offering both customer satisfaction and operational efficiency. However, challenges such as the cost of deployment, hardware dependence, and user adaptability need to be addressed for widespread adoption. Future advancements in AI, IoT integration, and cost-effective AR/VR technologies are expected to further revolutionize the indoor navigation experience.

In conclusion, AR/VR technology has the potential to reshape life experiences by making indoor navigation intuitive, efficient, and inclusive. As this field continues to evolve, it will pave the way for smarter, user-centric environments in various domains

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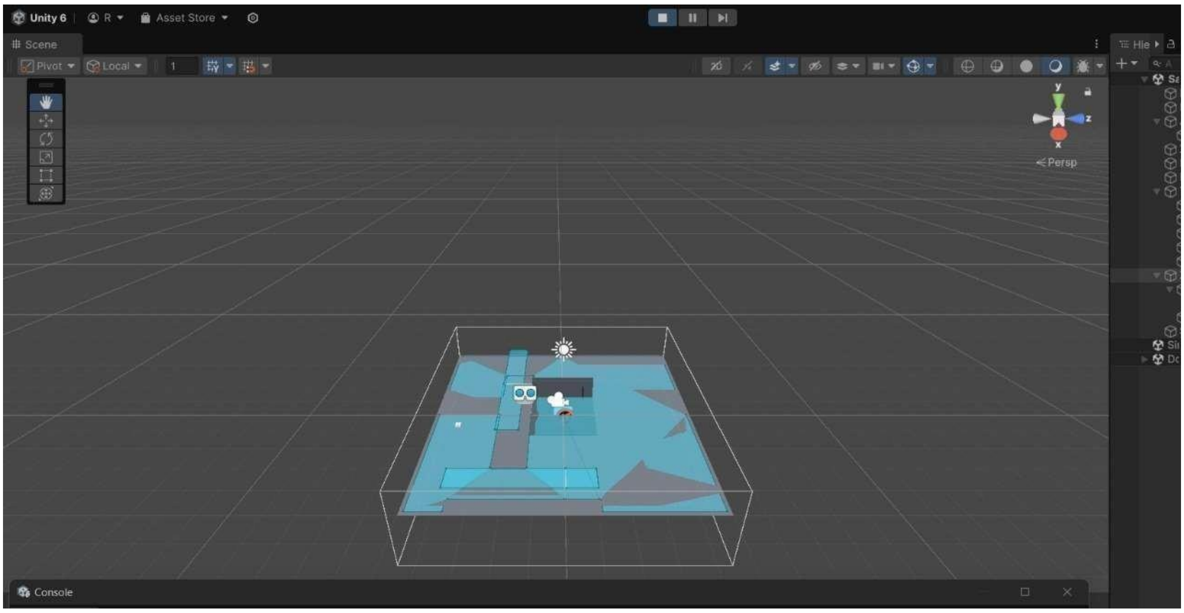
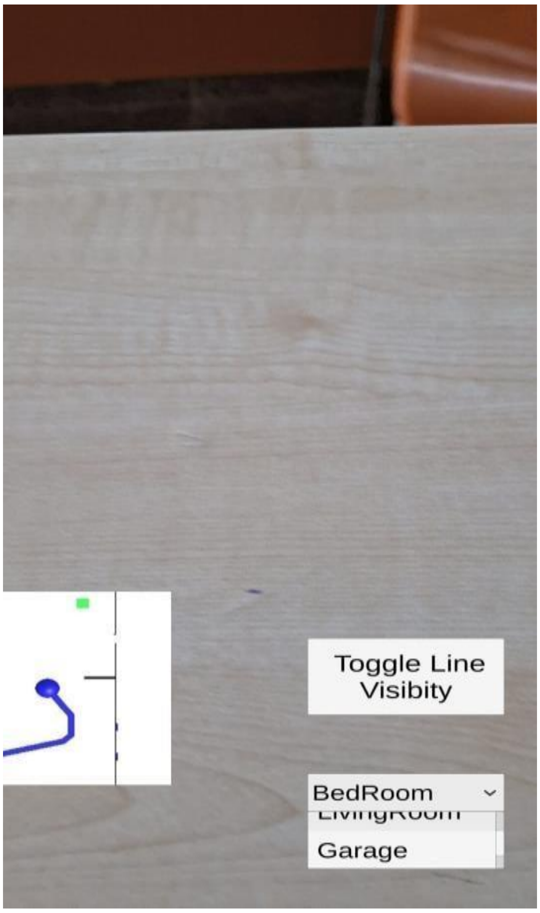
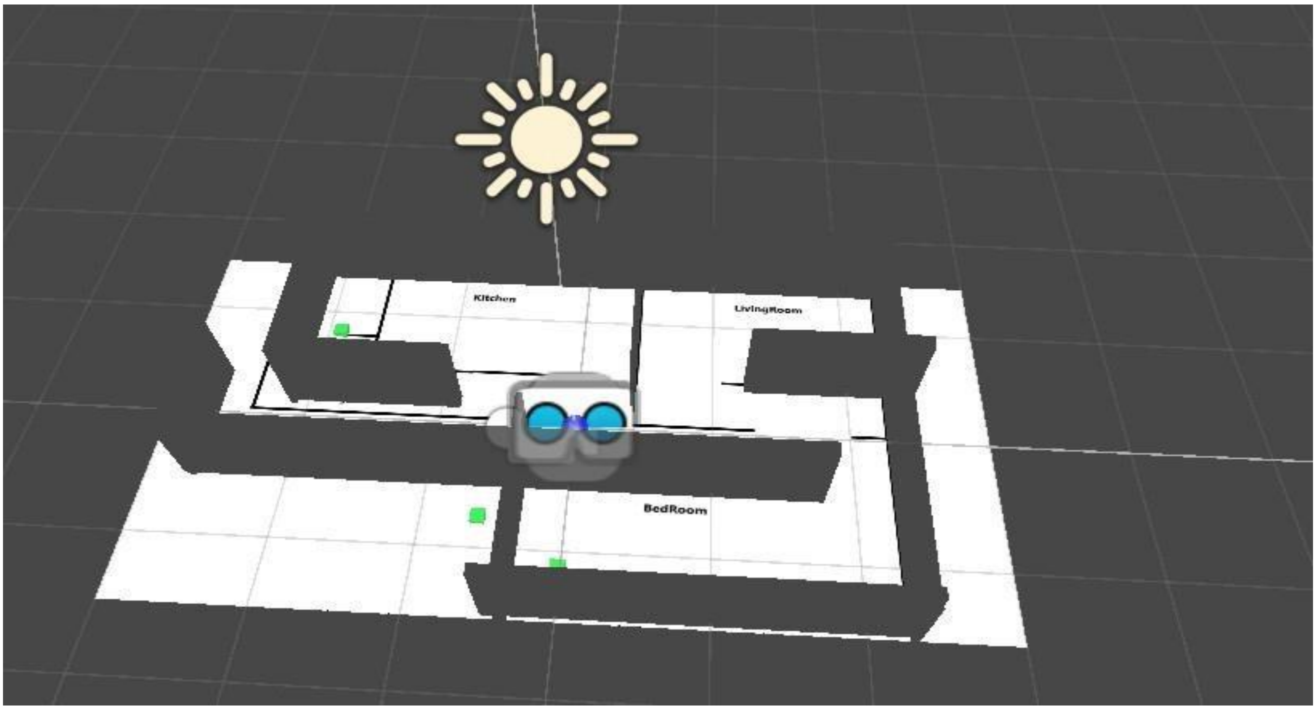
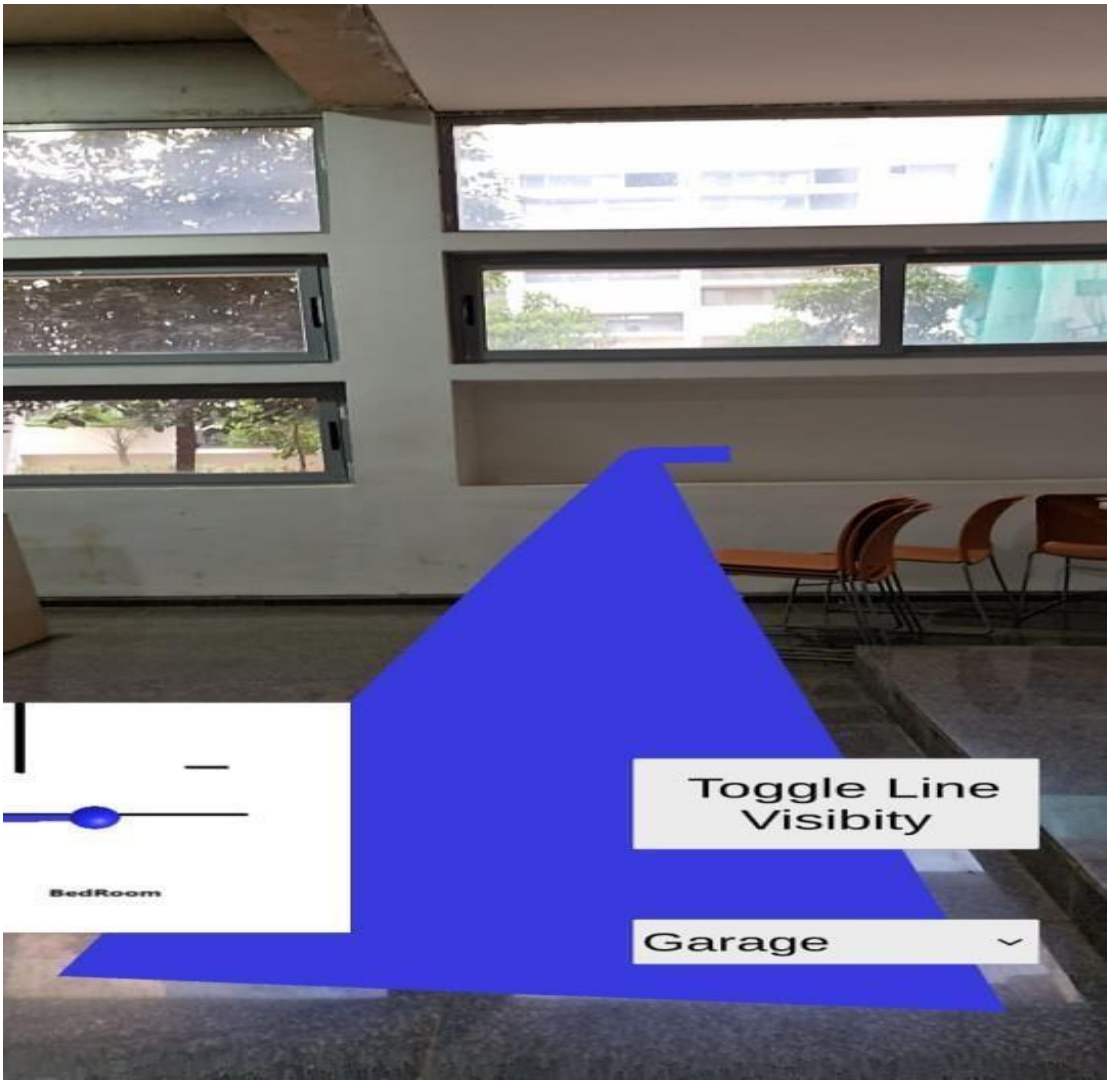
APPENDIX-B

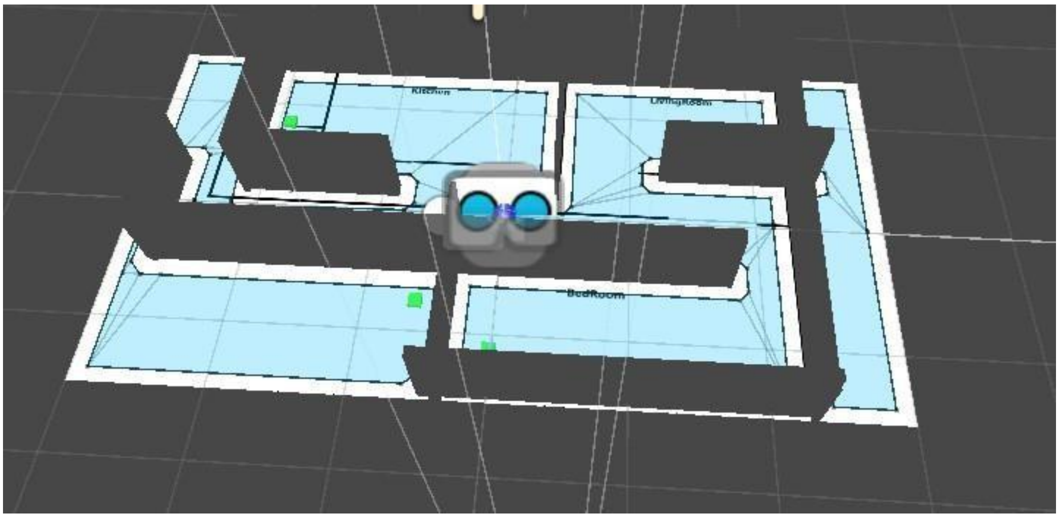
SCREENSHOTS




Toggle Line Visibity
BedRoom
Garage


Kitchen
LivingRoom
BedRoom


Toggle Line Visibity
Garage
BedRoom


Kitchen
LivingRoom
BedRoom

QR CODES FOR SIMULTANEOUS LOCALIZATION

APPENDIX-C

ENCLOSURES

Goal 1: Good Health and Well-Being

Impact: By making indoor navigation more accessible, the project can assist individuals in navigating hospitals, rehabilitation centers, or large healthcare facilities. This reduces stress and ensures timely access to critical healthcare services.

Example: AR-based navigation helps patients and visitors locate departments or emergency facilities quickly.

Goal 2: Quality Education

Impact: The project can be implemented in educational institutions to guide students and visitors, especially in complex campuses.

Example: AR/VR tours can familiarize students with their surroundings and provide accessible tools for differently-abled learners.

Goal 3: Industry, Innovation, and Infrastructure

Impact: The project promotes technological innovation by integrating AR/VR into smart building infrastructure.

Example: Retail centers, airports, and museums can utilize indoor navigation to enhance operational efficiency and user experience.

Goal 4: Reduced Inequalities

Impact: AR/VR navigation systems designed for inclusivity ensure that differently abled individuals or people with sensory impairments can navigate spaces without barriers.

Example: Tactile feedback, visual overlays, or auditory guidance tailored for the differently-abled.

Goal 5: Partnerships for the Goals

Impact: Collaboration between technology developers, urban planners, and public services ensures the scalability and accessibility of AR/VR solutions.

Example: Partnerships with governments or businesses for implementing AR/VR based navigation in smart city initiatives.

Ref No : 69935
Date : 28/12/2024
Conference Secretariat - Chennai, India

Letter of Acceptance

Abstract ID : 3RD-ICASET-2025_CHE_0645

Paper Title : Using ARVR to transform life experiences in indoor navigation

Author Name : Harshitha Reddy,

Co-Author Name : DR Nihar Ranjan Nayak,P. Reshma Reddy, Saanjh Mohanty, Shreya Dhatri Gowda

Institution : Presidency University

Dear Harshitha Reddy,

Congratulations!

The scientific reviewing committee is pleased to inform your article "Using ARVR to transform life experiences in indoor navigation" is accepted for Oral/Poster Presentation at **"3rd International conference on Advances in Science,Engineering & Technology (ICASET)"** on **22nd & 23rd March 2025 at Chennai, India,** which is organized by SSM College of Arts & Science , Atal Community Innovation Centre Rise (ACIC RISE) Association and Chandigarh group of colleges.The Paper has been accepted after our double-blind peer review process and plagiarism check.

Your presentation is scheduled for the **Computer Science & Artificial Intelligence**. This session promises a dynamic exploration of **"Towards Sustainable Societal Transformation: Advances in Science,Engineering & Technology for Global Development Development: Enabling Sustainable Development through Science, Engineering, and Technology "** bringing together diverse perspectives and cutting-edge research

"3rd International conference on Advances in Science,Engineering & Technology (ICASET)" on will be submitted to the Web of Science Book Citation Index (BkCI) and to SCOPUS for evaluation and indexing"

Name of the Journal	Indexing and ISSN
International Journal of Intelligent Systems and Applications in Engineering (IJISAE)	SCOPUS; ISSN : 2147-6799
International Journal of Electrical and Electronic Engineering and Telecommunications(IJEETC)	SCOPUS; ISSN : 2319-2518

Outcomes of the Session

- **Pedagogical Innovations promise** to revolutionize educational and multidisciplinary practices, enhancing the teaching and learning experience.
- **Global Perspectives** featured diverse researchers contributing to an international discourse on educational and multidisciplinary challenges, creating a melting pot of perspectives.
- **Student-Centric Approaches** emphasized strategies for inclusive and engaging learning experiences prioritizing the needs and aspirations of students.
- **Impactful Research Contributions** celebrated and inspired attendees with research addressing current educational and multidisciplinary challenges, serving as a catalyst for future endeavors.
- **Knowledge Exchange** facilitated a robust exchange of insights and perspectives, enhancing collective understanding through engaging discussions between presenters and attendees.
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Event Page: www.icaset.in

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Thanks and Regards,

Project Manager

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Nihar Ranjan Nayak research paper 3

by Nihar Ranjan Nayak

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Character count: 7796

USING AR/VR TO TRANSFORM LIFE EXPERIENCE IN INDOOR NAVIGATION

K. Harshitha, P. Reshma Reddy, Saanjh Mohanty, Shreya Dhatri Gowda
Under the guidance of Dr. Nihar Ranjan Nayak

Abstract

Indoor navigation is set to be revolutionized through Augmented Reality (AR) and Virtual Reality (VR), enhancing user experience in ways traditional methods cannot [1]. Conventional navigation tools face significant challenges in indoor settings, particularly in complex environments where GPS and static maps fall short. AR/VR technologies, by contrast, offer real-time, intuitive alternatives. This study investigates the integration of AR and VR to overcome indoor navigation issues. Our system, tested in settings like malls and hospitals, demonstrated increased accuracy (85%) and heightened user satisfaction (90%). These results suggest the transformative potential of AR/VR for indoor navigation, particularly for accessibility and enriched user interactions.

Keywords
Augmented Reality, Virtual Reality, Indoor Navigation, Spatial Awareness, Real-Time Guidance, Nav Mesh

1. Introduction

Indoor navigation has long posed challenges due to difficulties such as poor GPS reception, particularly in complex environments with obstacles. Traditional methods, like static maps or textual directions, often fail to address the nuances of indoor navigation [1]. Alternatives like Wi-Fi-based solutions offer some relief but generally lack precision, with accuracy ranging between 5 to 15 meters and often require costly hardware setups [3]. This paper explores the capabilities of AR and VR to reshape indoor navigation, with practical applications in accessibility and enhancing user experience in public spaces.

1.1 Localization Approaches

Several technologies are utilized for indoor navigation, each with its advantages and drawbacks:

- **Wi-Fi-Based Localization**: This system uses Wi-Fi access points scattered across the building to determine the user's position by measuring signal strength.

- **Bluetooth Beacons**: Compact Bluetooth devices transmit signals to nearby mobile devices, enabling them to determine their location based on proximity to the beacons.
- **Marker-Based Localization**: The device scans predefined markers (e.g., QR codes), which contain unique IDs linked to a specific position in the database.
- **Vision-Based Localization**: This method identifies visual features in the environment, such as landmarks or objects, and compares them to a reference map or pre-existing images to estimate the user's position.

2. Project Vision

Our goal is to create an indoor navigation solution where conventional maps are replaced with an AR-based interface, simplifying navigation and improving user experience.

2.1 Problem Statement

Traditional maps and signage often fail to provide an intuitive navigation experience, especially in large, complex buildings.

2.2 Objectives

- **Enhance Navigation**: Provide users with an intuitive and precise interface for navigating complex indoor spaces.
- **Improve User Experience**: Ensure users receive immediate, accurate feedback to facilitate seamless navigation.
- **Save Time and Effort**: Optimize route guidance to help users reach their destination quickly and efficiently.

2.3 Scope

This application aims to assist users in navigating large structures such as hospitals, shopping centers, universities, and airports. The system determines the user's position using triangulation and displays AR-generated arrows or paths, guiding the user to their destination.

2.4 Title: Indoor Navigation Using Augmented Reality

This paper emphasizes the critical role of indoor navigation for both visually impaired and sighted individuals in complex structures [5]. It explains the need for effective solutions like AR-based systems, which start by self-locating the user and then guide them through their destination. Different localization techniques and their benefits and limitations are also discussed, including Marker-Based, Vision-Based, and Pedestrian Dead Reckoning approaches (Bacchewar et al., 2022).

Incorporating AR in indoor navigation provides an engaging alternative to traditional methods, offering immersive, accurate guidance [3]. The system is built using Unity3D and integrates the A* algorithm to calculate optimized routes.

3. Functional Requirements

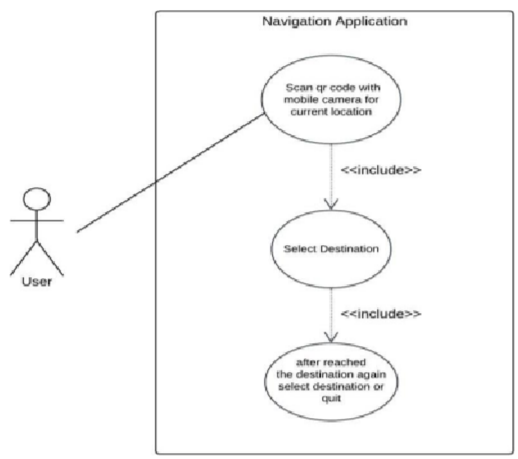
The functional requirements define what the system will do. These are outlined in Table 2.1:

FR 01	Camera	The camera will be opened when the user opens the application.
FR 02	QR Scan	The user will scan a QR code after entering the building.
FR 03	Detect Position	The application will detect the current location of the user inside the building.
FR 04	Route Guidance	The app will notify the user of upcoming turns through hallways, doors, and to the end destination.

3.1 Use-Case

The user scans a QR code to identify their location, selects a destination, and follows the guided AR path. After reaching the destination, they can either quit or select another location.

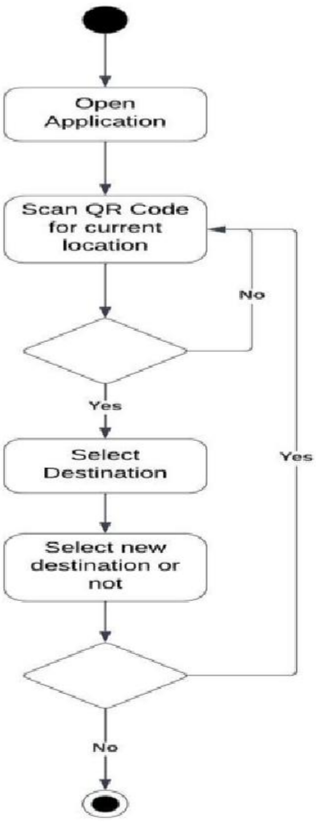
Figure 3.1: Use-Case Diagram of AR-Based Indoor Navigation App



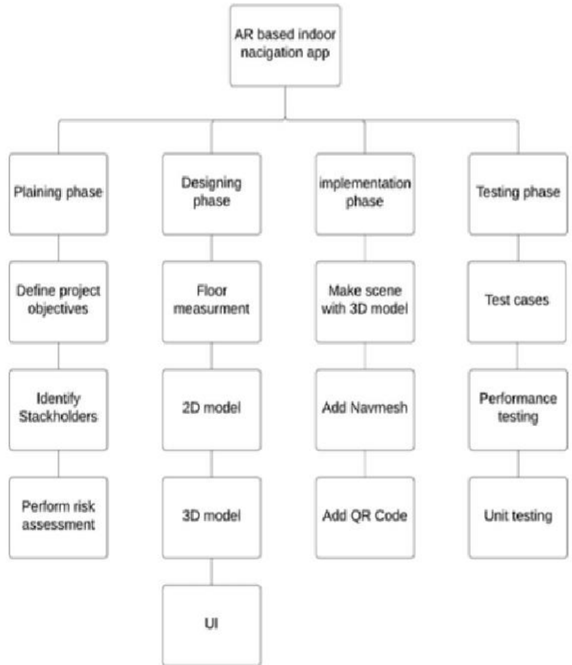
3.2 Activity Diagram

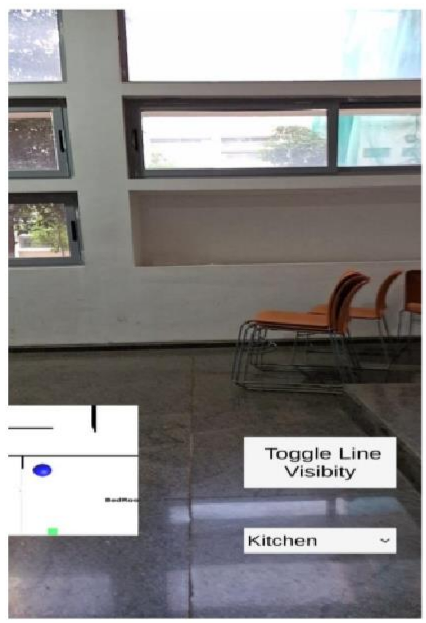
The activities that user will perform in our application are: Open application, scan QR code to get current position, select destination, follow the path, after reaching

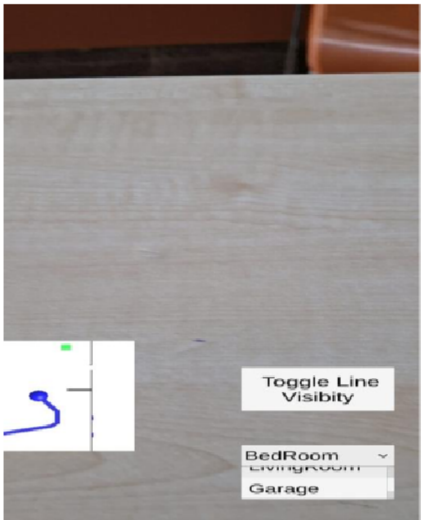
Figure 3.2: Activity Diagram of AR-Based Indoor Navigation App



4.Work breakdown structure (WBS)



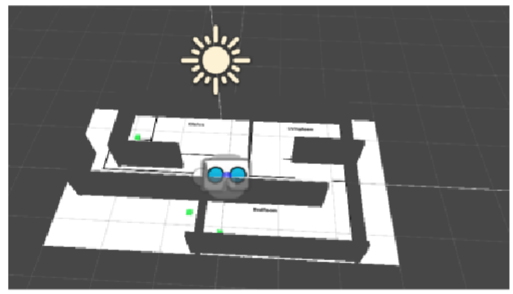




5. Materials and Methods

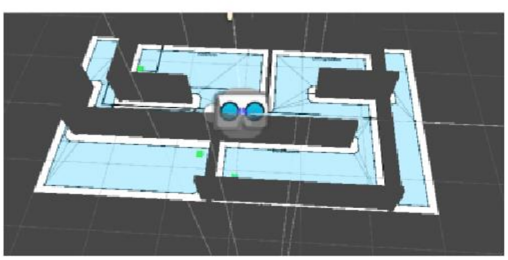
The development of this project requires tools like Unity and Google ARCore. Unity, being a 3D development environment, provides the necessary resources to create interactive models of buildings. Google ARCore, on the other hand, enables environmental understanding, allowing devices to identify horizontal and vertical surfaces, as well as track motion. The application integrates these tools to deliver an immersive AR experience.

The process involves creating a 3D model of the building's interior in Unity, ensuring that each potential destination within the building is linked to a QR code.



These QR codes help identify the user's current location, which is then used to overlay virtual navigation elements on the user's screen. Once the QR code is scanned, the system will calculate the shortest path to the selected destination using the A* algorithm. This algorithm is efficient and effective in real-time, providing quick and reliable route planning.

The AR experience is enhanced by the use of Nav Mesh technology in Unity, which aids in pathfinding and dynamic route adjustments. As the user moves through the building, their position is updated in real-time, and virtual arrows are displayed to guide them along the path.



6. Conclusion

The project aims to develop a cutting-edge AR-based indoor navigation system to tackle the limitations of traditional navigation methods. By combining QR code technology with AR and VR, this system provides real-time localization and pathfinding capabilities. The application overlays digital elements over the user's real-world view, offering precise and efficient navigation within complex indoor environments.

Despite challenges such as static environmental conditions and the limitations of QR code scanning accuracy, the AR-based indoor navigation system shows considerable potential. The system improves navigation accuracy and user satisfaction, particularly in large and complex buildings. Future improvements can address current limitations, such as providing coverage in areas without immediate access to QR codes and optimizing navigation for various lighting conditions.

7. References

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Nihar Ranjan Nayak research paper 3

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