“Augmented Reality Indoor Navigation for KIT Campus"

(Synopsis Document)

By,

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Abstract:

This research project explores the use of smartphone-based Augmented Reality (AR) technology for indoor navigation in complex building structures. The study focuses on developing an AR-based framework using the ARcore software development toolkit, incorporating Geospatial Localization and A* pathfinding algorithms to optimize navigation. The application offers users a user-friendly interface for precise visual guidance, enhancing efficiency and providing an immersive experience. The framework's flexibility allows users to adapt their destinations during navigation. The research validates the effectiveness of the system through a comprehensive evaluation, including technical, subjective, and demographic data analysis. In summary, this innovative project leverages AR technology to address challenges in navigating intricate buildings, offering practical solutions and contributing to the discourse on technology and spatial navigation in contemporary built environments.

Motivation:

In an age defined by intricate building structures, our pioneering project redefines indoor navigation. Our driving force is universal accessibility, ensuring individuals of all backgrounds can navigate complex spaces effortlessly. Augmented Reality (AR) is our compass, leading the charge in revolutionizing navigation.

We address real-world challenges, simplifying indoor navigation, and enhancing daily lives. Our user-centric design prioritizes user needs, offering intuitive, enjoyable experiences while saving precious time. Dynamic and adaptable navigation provides users unprecedented control and flexibility.

Our motivation lies in empowering users through technology, instilling confidence in unfamiliar indoor environments. We align with the smart cities vision, contributing to intelligent infrastructure for the benefit of communities.

Literature review:

ARCore and Indoor Navigation:

ARCore, developed by Google, provides robust tools for tracking and mapping the real-world environment. It is a fundamental technology for AR-based indoor navigation. Previous research indicates that ARCore enables accurate and real-time tracking of user positions, making it well-suited for indoor navigation systems (Kato & Billinghurst, 2017).

Geospatial Localization:

Geospatial data, obtained through ARCore, plays a central role in indoor localization. By creating a 3D map of the environment, researchers have been able to match real-world features with the digital map, allowing for precise user localization.

A* Pathfinding for Indoor Navigation:
In addition to Geospatial localization, pathfinding algorithms are crucial for finding optimal routes within complex indoor environments. A* pathfinding is commonly used in this context. This algorithm helps users navigate the shortest path to their destinations, a critical aspect of indoor navigation systems.

User-Centric Design:
User-centred design principles are essential for creating effective indoor navigation applications. Research by Wang and Zhang (2020) emphasizes the importance of intuitive user interfaces and user-centric features that allow for dynamic navigation changes, aligning with the project's motivation for user empowerment and adaptability.

Data Transmission Over the Internet:
Several indoor navigation applications require internet connectivity to access real-time updates, cloud-based map data, and user feedback. Researchers stress the need for secure and efficient data transmission, considering privacy and user data protection (Pradhan et al., 2021).

Conclusion:
Geospatial localization with ARCore in Unity is a promising approach to tackle indoor navigation challenges. Existing literature indicates that ARCore is a robust technology for real-time tracking and mapping. Combined with A* pathfinding and user-centric design, this technology can offer efficient and adaptable indoor navigation. To ensure the success of such systems, careful consideration of data transmission and user privacy is essential, making them a valuable addition to the development process.

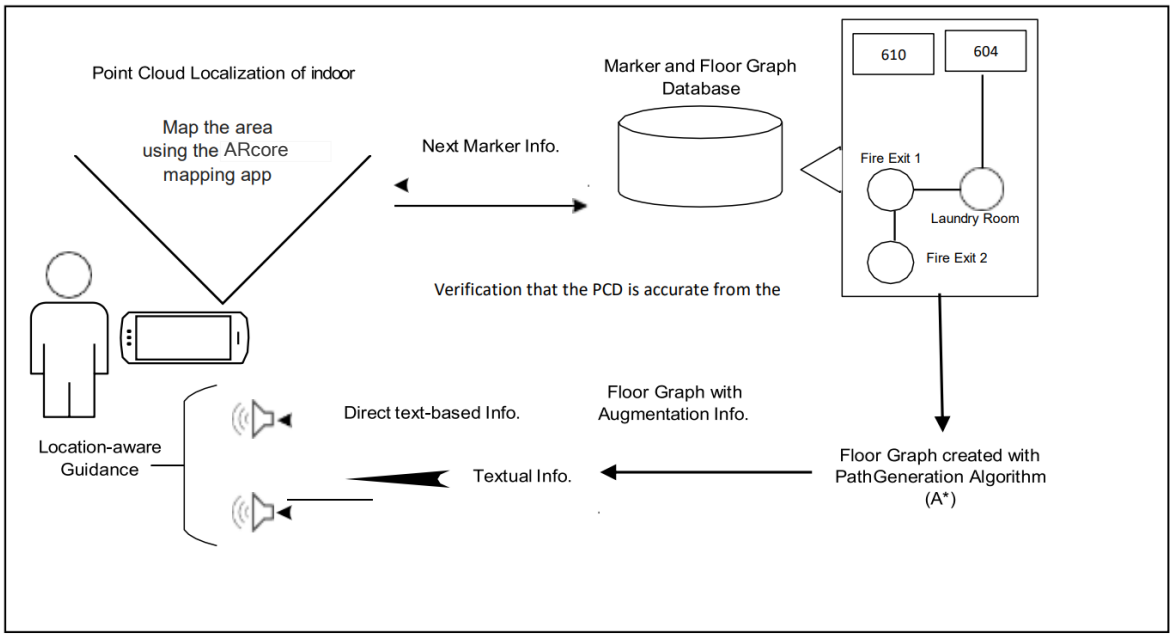
Aim of Project

The aim of the project for campus navigation using augmented reality is to enhance the overall navigation experience for students and visitors on a university campus. This system will provide real-time, interactive, and user-friendly navigation through AR technology, making it easier to locate buildings, classrooms, and other key points of interest. The project aims to improve campus accessibility, reduce confusion, and promote a more efficient use of campus resources. Additionally, it will serve as a valuable tool for orientation and an innovative way to showcase campus information.

Problem formulation/Objectives):

The project aims to develop a Campus Navigation System (CNS) utilizing augmented reality (AR) technology to enhance the navigation experience for users within our university campus. The System Requirements Specification (SRS) will define the scope, features, and functionality of the CNS. It will include detailed specifications for AR-based maps, real-time location tracking, personalized route planning, and integration with campus resources. The SRS will also outline performance criteria, user interfaces, and testing procedures to ensure a seamless and user-friendly navigation experience. Ultimately, the project seeks to provide a comprehensive and efficient AR-powered navigation solution for our campus community.

Methodology/ Planning of work:



Workflow Diagram

1. Setting up Your Development Environment:
Install Unity and set up the Android development environment.
Download and import ARCore SDK for Unity.

2. Building a Map:
Create a map of the indoor campus using Geospatial mapping landmarks. Ensure accurate scale and positioning of values to match the real environment.

3. Integration of ARCore:
Implement ARCore to recognize and track the real-world environment using the smartphone camera. Set up ARCore Geospatial data collection for environment mapping.

4. Geospatial Localization:
Develop algorithms to match the captured Point data with the 3D map. Utilize ARCore's Geospatial API to gather and process Geospatial data.

5. A* Pathfinding:
Implement the A* pathfinding algorithm for route planning within the indoor campus. Incorporate the 3D map to define walkable areas and obstacles.

6. User Interface (UI):
Create a user-friendly interface for the smartphone app, allowing users to input their destination and visualize navigation instructions.

7. Real-time Localization and Navigation:
Continuously update the user's position using Geospatial data. Calculate and display the optimal route from the current location to the destination using A* pathfinding.

8. Testing and Validation:
Conduct extensive testing to ensure the accuracy and reliability of the indoor navigation system. Collect user feedback for further improvements.

9. User Training and Documentation:
Provide clear instructions to users on how to use the app for navigation within the indoor campus. Create user documentation or tutorials.

10. Deployment:
Package the Unity app for Android devices.
Make the app available for download through the Google Play Store or other distribution channels.

11. Maintenance and Updates:
Regularly update the app to address bugs, enhance accuracy, and improve the user experience.
This methodology outlines the major steps involved in implementing Geospatial Technology with ARCore in Unity for indoor campus navigation. It's important to continuously iterate, test, and refine the system to ensure its effectiveness and reliability in real-world scenarios.

Software Requirements:

Unity 3D: We'll need the Unity 3D development environment to create and build the AR application. Unity provides ARCore support through the AR Foundation package.

ARCore SDK for Unity: This software development kit integrates ARCore functionalities into Unity, enabling we to work with geospatial data and AR features.

AR Foundation: AR Foundation is a Unity package that allows for cross-platform AR development, making it essential for ARCore integration.

Android Studio: To build and deploy the Android app, we should have Android Studio installed.

Java or C#: Depending on preference, we can use Java or C# for scripting within Unity.

A* Pathfinding Library: We may need to integrate an A* pathfinding library into your project, which depends on the specific library we choose.

Database (optional): If we navigation system involves storing and retrieving building layout data, we may require a database system like SQLite or Firebase.

Hardware Requirements:

Android Smartphone: Users will need an Android smartphone with ARCore support. This may include devices like Google Pixel, Samsung Galaxy, or other compatible models.

Camera: A smartphone with a reliable camera is essential for capturing the indoor environment and tracking features.

Sufficient Processing Power: The smartphone should have sufficient processing power and memory to handle real-time AR rendering and pathfinding calculations.

Internet Connectivity: Users will require an internet connection for downloading the application and accessing any cloud-based features or updates.

Data Over the Internet:

To enable data transfer over the internet, the system may need to access external servers for:

Map Data: Building layouts and point cloud data may be retrieved from cloud servers or databases in real-time.

Real-time Updates: If you want to provide real-time navigation information, the system may need to send and receive location and route data from a central server.

User Feedback and Analytics: Collecting user feedback and analytics data for system improvements may also involve data transfer over the internet.

It's important to secure and manage user data and privacy when transmitting data over the internet. Additionally, ensure that the app's features, such as real-time updates and cloud data access, align with the project's objectives and user requirements.

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