INDOOR NAVIGATION SYSTEM USING AUGMENTED REALITY

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Abstract:

This project aims to create an indoor navigation system utilizing augmented reality (AR) technology to overcome the limitations of GPS signals in large buildings like airports, hospitals, and shopping malls. The system employs Simultaneous Localization and Mapping (SLAM) technology and consists of four modules: AR Core localization, QR code repositioning, Unity Navmesh navigation, and AR path visualization. Users can scan QR codes with a mobile app, select their destination, and follow AR arrows to navigate via the shortest path using the A* pathfinding algorithm.

Key Words: Augmented Reality, SLAM, AR Core, NavMesh, Indoor Positioning System, Indoor Navigation, A* Pathfinding Algorithms

1. Introduction:

The rising demand for indoor navigation systems in underground retail malls and large commercial spaces has driven the need for more effective solutions. Current indoor positioning methods, like radio wave strength, Bluetooth, magnetic repositioning, visual markers, RFID tags, and dead reckoning, often incur substantial installation costs and accuracy challenges. GPS, while excellent outdoors, struggles indoors due to limited satellite signal reception.

To meet this demand, our proposed system utilizes Unity's development environment, featuring NavMesh components for added functionality. The system consists of four core modules: AR Core-based localization, QR-code repositioning, Unity NavMesh navigation, and AR path visualization codes, strategically placed within the building, serve as reference points. Users can scan these codes, select their destination, and view the path on a minimal. Augmented reality elements, like arrows, guide users to their destination. Administrators upload the building's floor plan, define walkable paths, and mark destinations using Unity's NavMesh components. SLAM technology precisely tracks user positions on the map, directing them along the path using the A* pathfinding algorithm. The widespread availability of SLAM on modern smartphones, through technologies like Apple's ARKit and Google's AR Core, ensures broad accessibility.

2. Literature Review:

As underground retail malls and large commercial facilities have become more prevalent, there is a growing need for indoor navigation systems. Existing methods, like Bluetooth and visual markers, have limitations such as cost and accuracy. GPS, which works well outdoors, does not perform indoors due to signal issues.

To address this, our system uses Unity with NavMesh components and is divided into four parts: AR Core-based location, QR-code scanning, Unity NavMesh navigation, and AR path visualization. We rely on AR Core for indoor location, eliminating the need for extra hardware QR

codes placed around the building allow users to select their destination easily. The overall architecture diagram of the proposed system is given in Fig. 1. We use the A* algorithm for efficient pathfinding, and Unity's NavMesh components help us navigate around obstacles. Augmented reality arrows guide users along the way. Our system offers a comprehensive and user-friendly solution for indoor navigation.

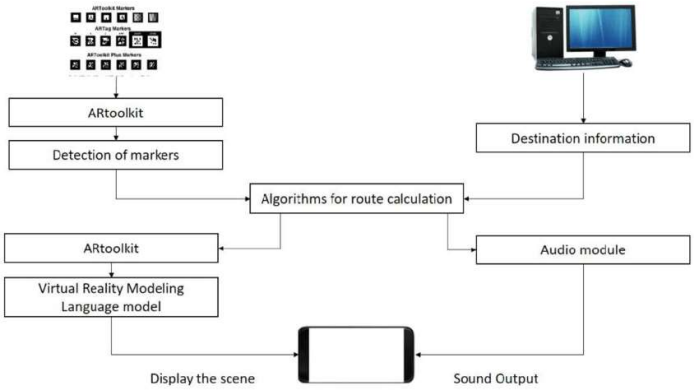

fig 1. Architecture

3. Methodology:

Our indoor navigation system is built in Unity and consists of four main components-

1. AR Core-based Location: We utilize AR Core's SLAM technology, which accurately tracks user positions indoors without requiring additional hardware. This technology relies on camera feeds and sensors.
2. QR Code Scanning: QR codes strategically placed in the building enable users to select destinations with ease. We continuously scan for QR codes during navigation to update the user's position.
3. Unity NavMesh Navigation: Unity's NavMesh components enhance pathfinding efficiency and obstacle avoidance. Administrators define walkable areas on the floor plan using NavMesh.
4. A* Pathfinding Algorithm: We employ the A* algorithm for optimal pathfinding, ensuring efficient and accurate navigation.

4. Conclusion:

In conclusion, we have successfully developed a cost-effective indoor navigation solution using AR Core's SLAM technology. We addressed the challenge of navigating around obstacles by leveraging Unity's NavMesh components, enabling the system to adapt to unforeseen obstacles not included in the floorplan. Our system offers an interactive and user-friendly way to guide individuals through complex buildings.

The integration of augmented reality features provides a simple and contactless navigation experience, particularly relevant in the context of the Covid-19 pandemic. The

mobile application is easily accessible to the public and is compatible with recent Android versions, starting from Android 8.1 with Google AR Core support.

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