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Augmented Reality in Indoor Navigation

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Abstract - AR-based indoor navigation is a promising technology that enables users to quickly navigate through challenging indoor environments. Augmented reality (AR) enhances the user's perception of the physical world and makes for a more natural and enjoyable navigation experience by superimposing digital data on the actual surroundings. This research examines the state-of-the-art AR-based indoor navigation, the underlying technology, and the challenges that must be overcome to realize its maximum potential. We provide a summary of the plane detection, route marking, and path following problems.

1.INTRODUCTION

For many people, indoor navigation can be difficult, especially in complicated and foreign contexts like malls, airports, and medical facilities. In these situations, conventional navigation techniques like paper maps and static signage frequently fall short. Yet, technological advancements have made it possible to create indoor navigational solutions that use augmented reality (AR) to improve the navigational experience for consumers.

A technology known as augmented reality (AR) enables the superimposition of digital data such as 3D models, text, and photographs onto the physical world. AR creates an engaging and immersive experience that improves users' perception of their environment by fusing real-world sensory input with computer-generated data.

Users are guided through intricate indoor surroundings using AR-based indoor navigation systems, which leverage this technology to give them real-time directions and context-sensitive information.

The application of AR to indoor navigation can fundamentally alter how individuals move about indoor areas by making it simpler and more natural. The current state of AR-based indoor navigation, including the underlying technology, applications, and research obstacles, will be examined in this study.

2. Implementation

The base for an Augmented Reality (AR) application is AR Foundation framework that supports plane detection, placing 3-D objects in the virtual environment, cloud anchoring and many other AR based features.

AR Foundation: A cross-platform development framework called AR Foundation is used to create augmented reality (AR) applications for both iOS and Android devices. The AR Foundation, created by Unity, offers a standard API for building AR experiences using several AR technologies, including ARKit and ARCore.

By offering a uniform API that abstracts the differences between distinct AR technologies, AR Foundation streamlines the development process by enabling developers to code once and distribute to numerous platforms. As a result, less platform-specific code needs to be developed, cutting down on development time.

To allow AR experiences, the AR Foundation offers a variety of features, including:

World tracking: The AR Foundation gives developers the ability to track the location and orientation of the device in the actual world, allowing for the placement and anchoring of virtual objects.

Plane detection: The AR Foundation can identify flat surfaces like floors and tables and provide details about their dimensions and location, enabling the placement of virtual objects on actual surfaces.

Object tracking: AR Foundation has object tracking capabilities that let virtual things interact with actual objects by following their position and motion.

Face tracking: it enables AR experiences to react to facial expressions and movements by tracking facial features like the mouth and eyes.

Also, the AR Foundation supports a variety of devices, including ARKit-compatible iOS devices, ARCore-compatible Android devices, as well as popular AR capabilities like light estimation, and occlusion.

The implementation strategy has three key concepts involved :-

- Plane Detection
- Path Marking
- Path Following

2.1 Plane Detection

A key component of augmented reality (AR) applications is plane recognition, which permits the precise positioning of virtual items on real-world surfaces. Plane detection in augmented reality (AR) is the process of locating horizontal, flat surfaces like walls, tables, and floors. The AR experience can be made more realistic and immersive by anchoring virtual things to the plane once it has been identified.

Using depth sensors is an additional strategy. One such device is the time-of-flight (TOF) sensor, which produces light and time how long it takes for it to reflect off surfaces. In addition to being able to detect planes in real-time, this technique offers more precise depth information than visual feature detection.

For plane detection in AR, machine learning algorithms like neural networks can also be used. These algorithms are capable of learning to identify planes based on their visual characteristics and can be trained on enormous datasets of photos.

After the plane is discovered, it can be used in the AR scene as a reference point for virtual items. Techniques like projection, in which the virtual object is projected onto the plane, or occlusion, in which the virtual object is concealed by real-world objects, can be used to anchor the virtual objects to the plane.

In conclusion, plane recognition is essential to AR applications because it makes it possible to precisely put virtual items on real-world surfaces. The technology utilized for plane identification in AR might vary according to the requirements of the application, including computer vision, depth sensors, and machine learning algorithms.

Fig 1 : Plane Detection

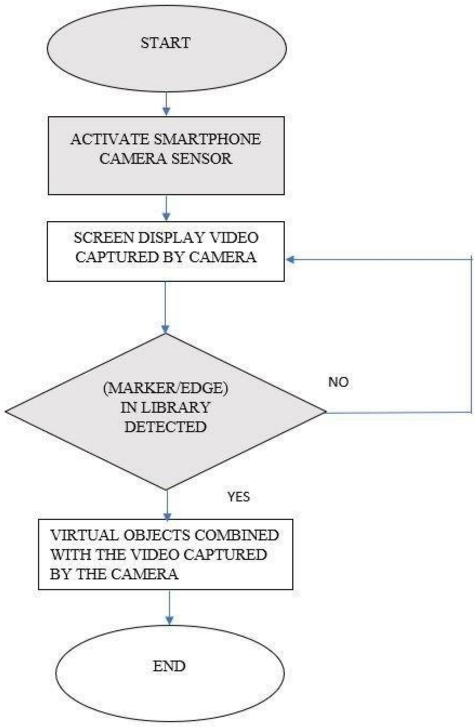

Fig -2: Plane Detection and Marking Flowchart

2.2 Path Marking

The technique of visually indicating a certain route or path for a user to follow in a real-world environment is known as path marking in augmented reality (AR). When customers need to be led through challenging or unfamiliar interior or outdoor areas, this capability can be especially helpful in navigation and wayfinding applications.

In AR, path marking can be done using a variety of techniques, such as:

- Line drawing: This technique involves sketching a line or path on the AR display to indicate the user's intended path. The line may follow an easy 2D course or a more challenging 3D path that mimics the features of the surrounding landscape.
- Arrow Pointing: Displaying arrows that point in the direction the user should travel to get there is one way to employ this technique. The arrows might be straightforward 2D arrows or more intricate 3D arrows that change their orientation according to the user's position and motion.
- Colour Coding: Using different colours to highlight distinct sections of the route or journey is one way to use colour coding. For instance, green can represent a safe path, whereas red might represent a dangerous location that the user should avoid.
- Virtual signage : it is used in path marking to show virtual labels or symbols that direct users through the surroundings. These signs may include details about landmarks, sites of interest, or destination directions.

Computer vision, GPS, and sensor data are just a few of the methods that can be used to identify paths in augmented reality. The technique selected is determined by the application needs and the resources—hardware and software—that are at hand.

In general, path marking in augmented reality is a potent feature that can enhance wayfinding and navigation in challenging or unfamiliar surroundings. It can provide users with a more dynamic and intuitive experience, which will make it simpler for them to go where they're going.

Fig -3: Path Marking

2.3 Path Following

In augmented reality (AR), the term "path following" refers to the application of AR technology to direct people along a predetermined path or route in the actual world. The system overlays digital information, such as visual cues, arrows, or other indications, onto the user's perspective of the surrounding area to show them the right path to take.

There are various processes involved in the path following process in AR. First, a camera and computer vision algorithms are used to track the user's position and motion. Then the AR system aligns the digital information with the real world by superimposing it on top of the user's perspective of the surroundings.

The AR system continuously refreshes the visual signals to keep the user on course as they proceed down the path. The AR system might overlay an arrow to show the user which way to turn, for instance, if they need to turn right.

Path following in augmented reality has a wide range of uses, including navigation in public places like museums or airports and training in professions like construction or emergency

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services. Without the assistance of conventional navigational tools like maps or GPS units, it can assist users in staying on course and getting there more quickly and correctly.

Path following in this application was achieved using the AR rabbit that was designed using Unity. Which follows the path saved.

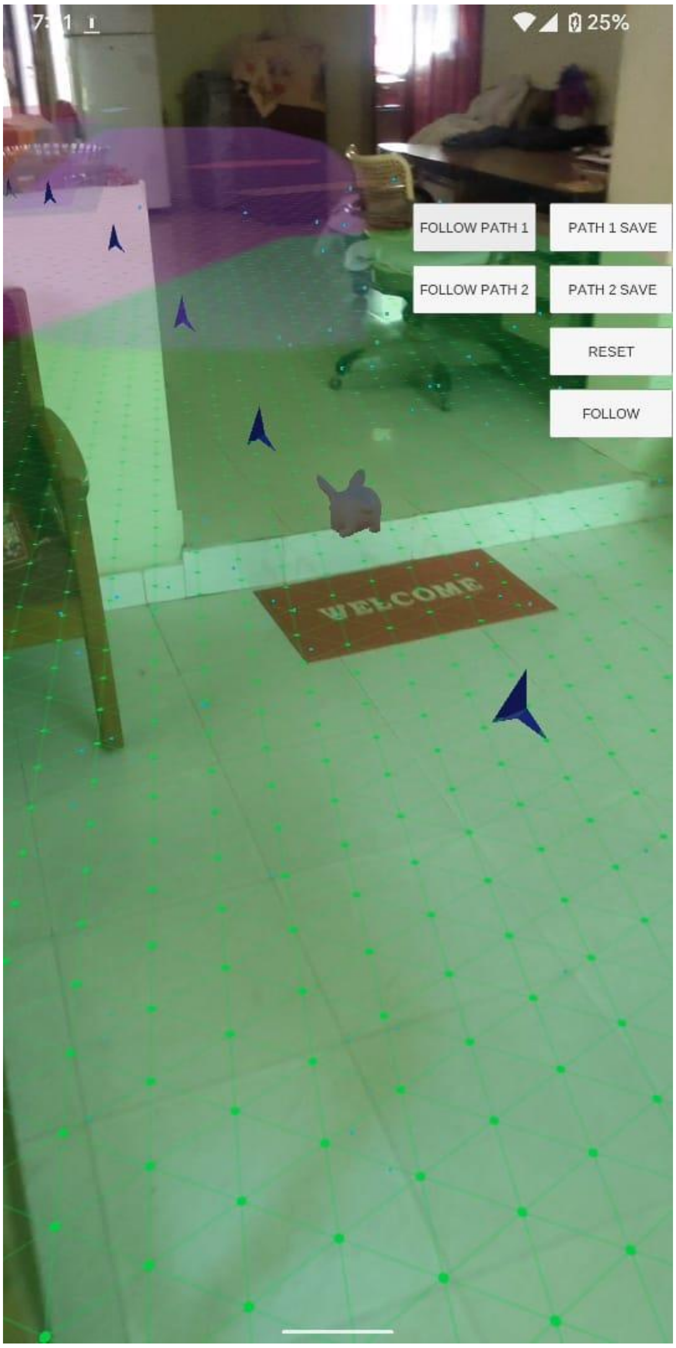

Fig -4: Path Following

3. CONCLUSION

Personalized and context-sensitive information is one of the main benefits of AR interior navigation. Directions, places of interest, and other pertinent information may be included in this to aid users in navigating indoor areas more effectively and efficiently.

Additionally, those who are vocally impaired may benefit the most from AR interior navigation as asking for directions can be avoided completely. AR can increase their accessibility by assisting them in navigating challenging indoor settings visual cues.

Before AR indoor navigation can be extensively used, there are still a few issues that need to be solved. These encompass technological constraints like those related to accuracy and dependability as well as privacy worries and potential ethical dilemmas.

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