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Augmented Reality Based Indoor Navigation System

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Abstract - The system that displays the route to the user's destination on the camera screen. QR codes should be placed at specific destinations within the building, recognizing that each destination may be a starting point for the user. The user must scan their QR code and select a destination. Google AR Core takes a live feed from the user's camera and simultaneously performs localization and mapping to update the user's position. Using augmented reality, the user's camera screen shows directions to their destination. The application was developed from scratch in Unity with important plugins such as Google ARCore. Our goal is to develop the front end as simple as possible so that users can easily reach their destination by opening the camera and the directions are animated around them.

Key Words: Augmented Reality; ARCore; AR Foundation; indoor navigation system; points of interest (POI).

1.INTRODUCTION

As the world has been navigating its way through development, indoor navigation has become increasingly important, enabling individuals to efficiently navigate large infrastructure spaces such as shopping malls, hospitals, and airports. Using old methods such as maps and signposts can be challenging without the proper knowledge and understanding to navigate these dynamic environments. To address this challenge, Augmented Reality(AR) has revolutionized the way to navigate, interact and explore indoor spaces. Augmented Reality based indoor navigation systems enable users to experience an intuitive and immersive way to navigate by overlaying digital information such as directions, points of interest (POI), and contextual data on top of real-time worldly objects.

The actual purpose of this research work is to analyze the functions and workings of AR-based indoor navigation systems. This paper will search into the technologies and techniques used in these systems, such as sensor technologies, computer vision, and various algorithms and search techniques. It will also explore the various AR systems used for indoor navigating, such as marker-based, marker less, projection-based, and wearable AR devices (AR Glasses). Additionally, this research focuses on the application of AR-based indoor navigation. From malls and airports to educational institutions, and medical facilities, AR navigation systems have the potential to enhance the user's experiences to navigate and explore more accurately in indoor environments.

However, despite the progress made in this field, several challenges remain. This paper will identify and discuss these challenges, such as the accuracy of indoor positioning of the spatial model, occlusion and environmental constraints, and integration with emerging technologies like the Internet of Things (IoT). Furthermore, it will explore future directions and potential opportunities for AR-based indoor navigation. By giving an overview of the current state-of-the-art, challenges, and future points of view of AR-based indoor navigation systems, this research paper aims to contribute to the existing body of information within the field and serve as a valuable resource for analysts, practitioners, and developers involved in the design, development, and management of AR-based indoor navigation systems.

2. METHOD AND MATERIAL

2.1 Requirements

i. Unity

ii. Google AR Core

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released as a Mac OS X game engine at the Apple Worldwide Developers Conference in June 2005. This engine can be used to create three-dimensional (3D) games and two-dimensional (2D) games, as well as interactive simulations and other experiences. The engine is also used in industries other than video games, such as film, automotive, architecture, engineering, and construction.

Google AR Core is a plugin that integrates AR functionality. To provide augmented reality, the device needs to understand augmented reality. AR Core provides various tools for understanding real-world objects. These tools include environmental analysis, which allows the device to detect horizontal and vertical surfaces and planes. It also includes motion tracking, allowing your phone to understand and track your position relative to the world. As AR Core continues to improve and expand, it will improve your contextual and semantic understanding of people, places, and things.

3. METHODOLOGY

Google ARCore
AR Core is Google's platform for creating augmented reality experiences. Google AR Core includes various APIs used to capture the environment, understand, and interact with the world using the smartphone's RGB camera. Google AR Core provides a feature called Simultaneous Localization and Mapping (SLAM), considering key features such as motion tracking, environment awareness, depth perception, light estimation, and user interaction.
SLAM (Simultaneous Localization and Mapping) is the concept of creating or updating a map of a simulated environment while tracking the user's real-time location within

that environment. We used this to track the user's movements, reproduce them in his 3D model of the building, and also use it to update the path to the destination.

Nav Mesh
In Unity, a NavMesh represents an area where the user object's center can move. The object here is either a point or a circle of size, both are equivalent. In our application, the NavMesh is based on the building blueprint and contains all walls, doors, and other objects that the user cannot pass through. This allows estimating only the area that the user can walk.

System Overview
As Figure 1 shows, this system starts by detection of the QR code which sets the starting point of the user and the environment, and the user can choose the preferred destination and the app visualises the path on the physical camera of the user`s handheld device or AR glasses and navigate through the indoor spaces using Augmented Reality.

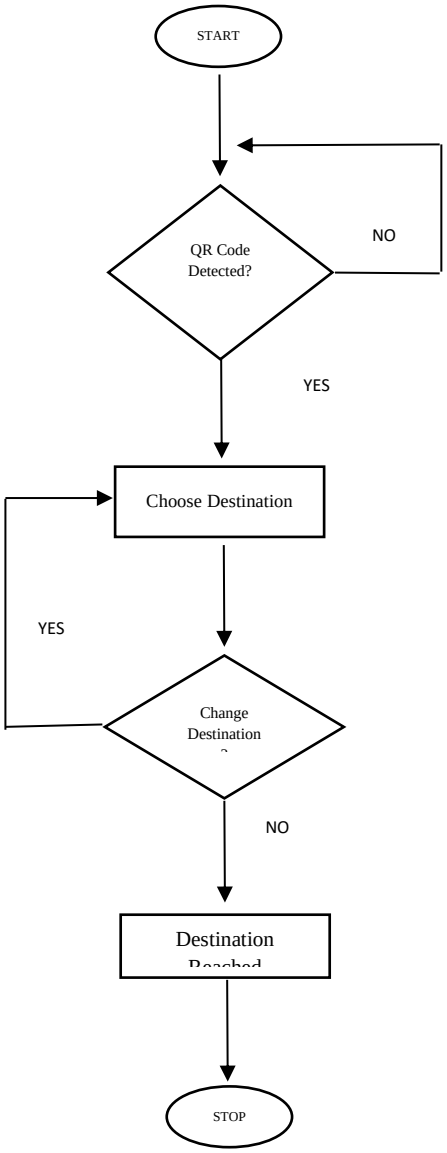

Figure 1. Flowchart for AR Based Indoor Navigation System

Area mapping
The first step is to create a map or model of the internal environment in which the navigation system will be used. This can be done using various techniques such as B. Manual surveying and planning, use of laser scanning equipment, or use of SLAM (simultaneous localization and mapping) technology. ARCore provides the following tools and APIs to help you map your environment: B. Feature point detection and face detection.

Localization
Once the environment is mapped, the next step is to locate the user within that environment. ARCore uses a technique called visual-inertial odometry to track the device's position and orientation in real-time. This includes analysing the device's camera feed and accelerometer/gyroscope data to estimate device motion and position.

Unity's navigation system uses NavMesh to create objects that can intelligently navigate through the game world. A built-in A* algorithm is used for pathfinding.

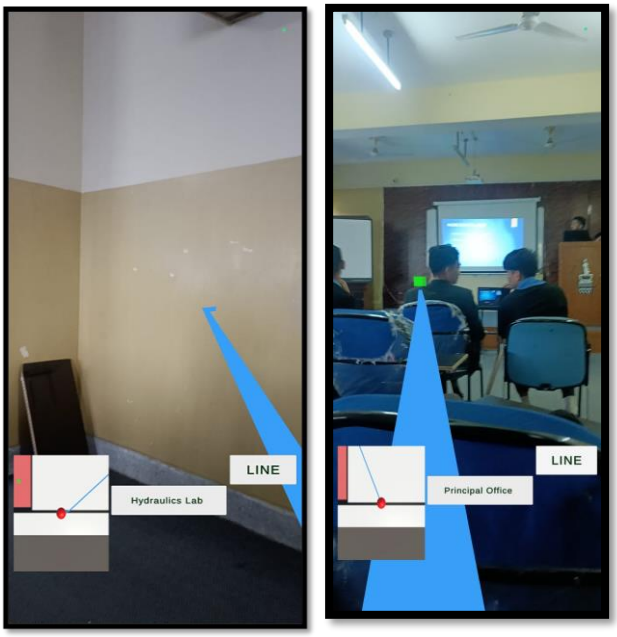

Figure 2: Result Screenshots of the AR view displaying the route to destination, and a green cube indicating the destination.

Abbreviations
AR- Augmented Reality
SLAM- Simultaneous Localisation and Mapping
API- Android package Installer
POI- Points of Interest
QR- Quick Response

4. CONCLUSIONS

This application can be installed on an android smartphone that supports Google play service for AR Core. The major steps to achieve this are as follows:

i. Creating 3D map of the building
ii. QR-code based positioning of user.
iii. Google ARCore based simultaneous localization and mapping
iv. Navigation on the AR view.

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