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AR Assistant for Indoor Navigation

Prof.Saranya.C
Assistant Professor,
Department of CSE,
Sri Sairam College of Engineering, Anekal, Bangalore
Akhila.R,Chethan.A,Deepa.S
UG Scholars, Department of CSE,
Sri Sairam College of Engineering, Anekal, Bangalore

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Abstract: In this study, we discuss the problem of indoor autonomous robotic navigation. By using an Android smartphone and the JAQL robot, a system is created dedicated for indoor navigation based on AR is developed. We want to learn more about how augmented reality can now be implemented to solve the problems of navigating without GPS. We created a smartphone application that serves as the system's eyes and brain at the same time using Google's AR core. We emphasize AR core's features and describe how they were used in all of our tasks. Assessment of the performance of the whole architecture is done and a report of the findings from a series of tests conducted under various conditions in a real-world setting is made. We finish by examining the system's advantages and disadvantages as well as potential future developments.
Keywords: indoor navigation robot, smartphone, Q learning, AR core, Arduino, and augmented reality.

Our vision of our surroundings is altered by augmented reality (AR), which can improve our natural surroundings and give us more insightful information about our environment. Wikitude, ARkit, ARcore, and Vuforia, among others, have greatly increased developers' access to AR and allowed this technology to be used in a variety of industries. Most people have access to smartphones, and augmented reality technology transforms our smartphones into potent environmental sensors. Smart phones can easily lower system costs if they can take the place of expensive hardware like light detection and ranging (LiDAR) sensors or supplementary hardware like beacons.

INTRODUCTION

We create a system that can by effectively used for indoor navigation with a very low cost and reduced complexity which will enable us to reproduce the system quite easily and efficiently. We want to study the current potential of AR. The remaining portions of the essay are structured as follows: The framework of google AR core is covered in Section 2. The system architecture is given in Section 3. The solution to navigate indoors is described by using ARcore in Section4. 4. The findings are explained in Section 5, along with a discussion of the advantages and disadvantages of the proposed system. The ability to manipulate this environmental data digitally makes it useful for many different tasks, including item detection or recognition, motion tracking, and environmental comprehension.

System Architecture

An indoor path-finding system that enables us to sketch both the intended trajectory and learn about the surrounding area using Q-learning. By using theoretical metric system the navigation was found to be around 65 percent of the time, the navigation was successful and accurate as long as the map was correct with the correct ratios of the surrounding. Developers can use the information provided by environment comprehension to estimate the automation required. The phone has some features that enables it to understand its surroundings and also perform motion tracking to find its position in relation to the surroundings, and perform light estimation to gauge the lighting levels at the moment. By the means of visual identification of some points called feature points and processing the data from the inertial sensors of mobile. The camera's location and orientation in relation to its surroundings can be tracked via the ARcore motion tracking technology. This approach is referred to as visual-inertial (VIO) Odometry. VIO is specifically employed to ascertain the attitude of the mobile's visual sensor. An orientation defines the coordinates from an object's local scope to the global scope, from one space to another. As a result, both the feature points' distance from the phone and their relative placement are continuously monitored.

They can also be observed as a point cloud in the camera frame. ARcore evaluates feature points that are positioned on a common surface in order to present them as planes. Anchors may be drawn and tracked digitally while the phone is moving. Anchors serve as placeholders for permanent places and directions in the region. Cloud anchors may be created, saved to a remote server, and then tracked by the phone as time passes. Feature points are used to monitor the camera's posture and anchoring in the global space. ARCore's benefits make it an intriguing choice for our project. ARCore makes use of hardware that is already available in the vast majority of smart phones, giving it a terrific potential toolbox for effectively and economically reaching the greatest number of people. There is no need for additional sensors. ARCore is compatible with any smartphones running iOS 11.0 or Android 7.0 and later.

This applies to 89% of iOS users and 50% of Android users. The JAQL system aspires to provide a framework wholly controlled by augmented reality on a mobile device. Our platform is basically composed of a Google Pixel 2 smartphone and a JAQL robot. The mobile smartphone acts as both the controller and the sensor for the robot. As a result, the robot will be completely reliant on the device's camera.

B. The Design of the Q-Learning Component
The Qteam is in charge of putting the Q-learning component into action. For navigation, we use a floor plan from a 2-D building layout. The 4 by 4 pixel square states of this blueprint are converted into a pdf file. Using a generic Qlearning software, a routing Q-table containing the identified shortest routes to various destinations is then built.

C. Design of mobile applications
Application: 1)The programme was developed for Android 7.0 using the Android Studio SDK, and then using the Kotlin-written OpenGL library and the ARcore SDK. SQLite was used to store our route data, while Firebase was used to store our cloud anchors. The highest view shows the ARcore scene perspective. This will render every ARcore feature using OpenGL over the phone's camera view. The map view is in the centre of the screen. A blue print of our surroundings is seen above the robot's location in this image. This view allows you to pan and zoom in. The map view's primary function is to show the robot's location within the environment. More information will be supplied on these points of view. in the sections that follow. Using the list view at the bottom of the screen, the user may select which robot or Bluetooth device the phone should connect to.

IV JAQL ROBOT APPROACH

When building the JAQL system and investigating the possibilities of AR for interior navigation, we focused on three major aspects of autonomous navigation: routing, localisation, and object identification. Our approach envisions a robot guiding a human to a specific point within a building. We just used the single floor of the current JAQL system for our needs. The user's starting location is commonly assumed to be their home base. The user will then be directed by the robot to their destination without encountering any impediments along the way. Path-planning A In order to route the user to the intended location, the software must select the optimal path from the lobby to the destination. The best potential path was planned using a Q-learning algorithm. Establish J and Mr.'s first-state rewards. Set MQ to 0 for all possible starting states. Choose a random beginning state in the absence of the desired state. Choose a random action from all possible options for the current condition. First, consider Q-learning. Q-learning, a reinforcement learning algorithm, can determine the optimal pathways from one state to another. The algorithm learns the optimum course of action by taking random pathways from random start states to the ultimate destination states. Using an image parser, a floor layout was deconstructed into an adjacency list of states. Each state is represented by a 4 by 4 pixel rectangle in the blueprint. There were a total of 25,217 states. Any nations with walls were removed from the list. Islands-designated states were also removed. In this sense, islands are states that are not connected to the rest of the map.The initial state incentives were set up so that all other states were set to zero, but the goal state received a reward equal to the total number of states. Once the Q-learning algorithm has converged, each state-action pair is assigned a value in a Q-table. The optimal path is chosen. Using an image parser, a floor layout was deconstructed into an adjacency list of states. Each state is represented by a 4 by 4 pixel rectangle in the blueprint. There were a total of 25,217 states. Any nations with walls were removed from the list. Islands-designated states were also removed. In this sense, islands are states that are not connected to the rest of the map. The initial state incentives were set up so that all other states were set to zero, but the goal state received a reward equal to the total number of states. Once the Q learning algorithm has converged, each state action pair is assigned a value in a Q-table. The optimal path is chosen.mera. to learn. B. Localization Accurate localization is a significant problem with indoor navigation. For indoor conditions, GPS technology lacks the essential precision. Additionally, problems with signal strength may affect localisation as well. Our method for indoor localization uses a scaled model of the area as well as the ARcore system.

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Results

ARcore's plane detection proved out to be a remarkable asset and was considerably more dependable in our setting. The moment the phone could recognize horizontal planes, navigation using anchors could be rendered.

Conclusion

Router Algorithm: In the beginning, a fixed point which acts as an anchor is placed.This point/anchor is used as a reference point. Once the start point and the placement of mobile is aligned ,the robot is ready to navigate.By adding Vorigin to the frame's view matrix (Mv), projection matrix (Mp), and other relevant matrices,as shown in (2). The screen coordinates were changed once the NDC coordinates had been established. In (3) and (4), this conversion is illustrated.

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