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AR Indoor Navigation System

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Abstract:** Nowadays, the field of abstract- augmented reality is starting to boom. In business, education, and now in the navigation of enormous multi-complexes, augmented reality is utilized. With its many capabilities and fewer hardware requirements at the same time, augmented reality makes work simpler and more exciting. When utilized for navigation, augmented reality can give a person additional directions from where they are now to where they want to go in an unknown environment. The purpose ofour research is to investigate every technology that is practical for indoor navigation and to propose a simple prototype as a remedy. Augmented Reality employs its inherent properties toassess a person's position and provide the appropriate navigational guidance in the case of indoor navigation.
***Keywords:** ARCore, Unity, Navmesh, QR code*

I. INTRODUCTION

The market for augmented reality has recently begun to expand. In business, education, and nowin the navigation of enormous multi-complexes, augmented reality is utilized. With its many capabilities and fewer hardware requirements at the same time, augmented reality makes work simpler and more exciting. When utilized fornavigation, augmented reality can offer users augmented directions from their current location to their desired location, even in an unknown environment. Campuses, malls, multiplexes, workplaces, etc. are just a few examples of large indoor spaces where indoor navigation can be used to find a certain location. Due to the fact that many new tourists who are unfamiliar with the area access these locations, they spend a lot of time looking around the area looking for their ideal site. That is the issue that AR's Indoor Navigation addresses by giving these visitors crucial AR directions and pop-ups to their preferred locations along the way. The problem that occurs here is that the cost of these systems ispredicted to be too expensive and if even one of the components fails then the entire system calibration will be ruined. Wi-Fi routers, Bluetooth beacons, or even Place Note SDKs canall be used to develop these AR systems indoors.

The purpose of our research is to investigate everytechnology that is practical for indoor navigationand to propose a simple prototype as a remedy. Augmented Reality employs its inherent properties to assess a person's position and provide the appropriate navigational guidance in the case of indoor navigation. The project's prototype is set on a sizable campus, which wouldgive students and visitors usability benefits and location-finding tools inside the institution, particularly in the area where the target is located.

This project uses tools like Unity, ARCore, Navmesh, and others. Our prototype uses Google's ARCORE and Unity to provide a quick,accurate, simple, and affordable solution for sucha system. Because of its sensors that follow the actual scene, ARCORE is frequently used.Simultaneous Localization and Mapping is a feature of ARCORE that is accessible through.

II. RELATED WORKS

An Indoor Navigation Robot Using Augmented Reality [1] by Austin , Jian Zhang and Irgen-Gioro in their research paper discussed AR navigation in a phone to help direct the JAQLrobot. This was implemented using AR Core's cloud anchor in which an anchor is placed in the room with the coordinates and surrounding features. Using which they are able to map the area and use the coordinates to determine therobot's current location and plan out the directionsfor the robot to reach its desired location. ARCore along with path finding and simultaneous scanning was used in the approach.

Indoor Navigation Systems Using Annotated Maps in Mobile Augmented Reality [2] by Ullah, Yin Bee, Amalia, and Shu End explain how annotated mapping is used in AR navigation in their research article. A digital map known as an annotated map combines the standard paper map with annotations that provide coordinate information and other location details. Using ARcore, the mapping was completed. The device overlays 3D maps and location information, suchas the corresponding navigation path, 3D objects,and text-based visual information, onto the AR camera feed. As the user moves through environments, an estimation of the camera and a 3D model reconstruction are made. The results showed that the platform provided by the systemprovides a dependable means of showing locationdata without the need for hardware installation ora strong wireless connection.

A novel campus navigation app with augmented reality and deep learning based on the development of research and the state of application of navigation and localization technology, C. Lin, Y. Chung, B. Chou, H. Chen,and C.

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Tsai [3] combine visual inertial odometrywith ARCore-based virtual and real fusiontechnology. The system's development platform is Unity. It may develop a wide range of human- computer interaction capabilities in accordance with various scenarios and user requirements by writing appropriate scripts. Through the database,the system may offer users a variety of augmentedreality content, including 3D text, sound, video, and other data, allowing users to feel participatorywhile navigating.

AR Navigation Application based on iOS Platform proposed by X. Wang and R. Zhang [4],a Location Approximate method and a Position Convert method which are used to generate a navigation route in AR scene and overlay this route on a real world background. The Approximate method can convert the GCJ-02 coordinate and WGS-84 coordinate to each other. The Position Convert method can convert a geographic coordinate to a 3D position.With these modules, the a application can provide a more intuitionistic, vivid and imaginary navigation experience.

Markerless in-door/outdoor augmented realitynavigation device based on orb-visual- odometry positioning proposed by Chian C. Ho, Ming-Che Ho, and Chuan-Yu Chang [5]. This work suggests ORB-visual-odometry positioning estimate and wall-floor boundary image registration to enhance the accuracy,dependability, and speed of ARN. Experimental results show that wall-floor-boundary image registration and ORB-visual-odometry positioning estimations outperform more established, well-known positioning estimation and image registration strategies for ARN in terms of accuracy and response times. The two proposed solutions, on the other hand, may be easily tested to work on a portable indoor/outdooraugmented reality navigation device and are easily implemented on a portable Android embedded platform.

Using Augmented Reality Technology in pathfinding put up by Faris Abuhashish and Hoshang Kolivand [6] , a database with GPS is used. In the directory, the GPS navigate is recorded for appropriate positioning. Scanning isdone of the GPS coordinates of the selected area stored in the database. The guidance is measuredusing GPS coordinates and renders the point of interest of the current inclination of the mobile device. To calibrate or adjust the camera, the usermust specify the venue by directing the camera only to the required places or by providing the location radius that the person wants to travel.

Augmented-Reality-Based Indoor Navigation Outdoor Navigation with HandheldAugmented Reality proposed by L. Wu and X. Yu [9], GPS and inertial measurement unit (IMU)is used.The system proposed basically achieves AR navigation by using Baidu map, Unity3D, etc. But there are still some drawbacks in this system. For example, the problem that the model sometimes turns around when turning at the corner directly affects the user experience of navigation. Another problem is that the smartphone screen shakes badly when the user is walking, and how to reduce the poor user experience caused by the screen jitter is also a concern. In addition to these two problems, it is impossible to judge whether the user is moving intime.

Campus Navigation using Augmented Reality proposed by Chirag Gupta, Prof. V M. introduce a system where they used Android SDK, SDK and Eclipse IDE for development [11]. The concept of Mobile Augmented Reality (MAR) was used. For creating that responsive environment, MAR would combine AR with wireless communication and location or position-based computing services (LBS). The position was obtained from the compass, gyroscopes, accelerometers and GPS data. For this work, network connection was needed whenever used. Augmented Reality can be widely incorporated in various platforms to develop any augmented prototype. Hence, along with these comes their dependencies, that might act as a drawback or limitation to the existing projects.

Positioning Technology	Indoor Positioning Accuracy Range	Robustness
GPS	>40m	Weak signal strength indoors
Wi-Fi	30-40m	Multipath effect Time consuming for fingerprinting
BLE Beacon	10-20m	Multipath effect Time consuming for fingerprinting

Magnetic Field	2-6m	Metal elements interference Time consuming for fingerprinting
Visible Marker	Unreliable	Line of sight requirement Light source interference
Markerless Vision Recognition	Unreliable	Light source interference High computational and memory resources requirement
Fusion (Wi-Fi + Magnetic Field)	1.2m	Time consuming for fingerprinting

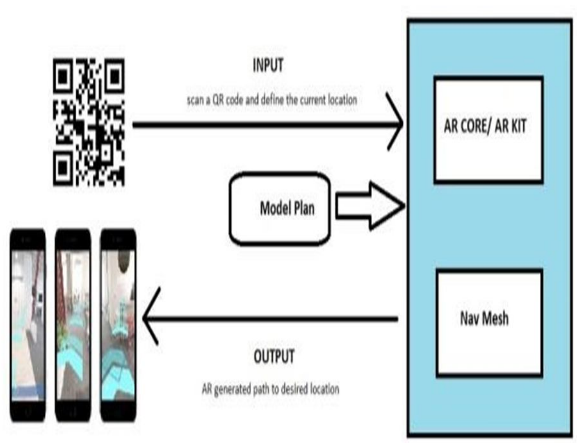
III. PROPOSED METHODOLOGY

Navmesh is a technology that can be used with Unity; it simply allows the developer to establish walkable regions throughout the virtual world.

This makes it ideal for interior navigation, which entails many ill-defined obstacles spread throughout the virtual map. Walk in an environment.In order to specify these restricted zones and transform our simple virtual map into a 3D annotated map, we need a mesh.

For instance, using nav mesh in a virtualenvironment, we can designate the principal's office as a restricted region while designating thewalls and other objects, along with the corridors and pathway, as walkable areas on the map. A pathfinding method that will assist us in guiding the user to his or her intended place can likewise be implemented using navmesh.This aids the system's definition of the user's space as well as the boundaries and other prohibited locations.Theuser can specify a destination and choose a routefrom one spot to another by creating a plane as a 3D annotated map with data.

The map can be used to offer the AR Directions after generating the virtual environment (3D annotated map). Using NavMesh's pathfinding, we choose a route that leads to the desired location. With the help of this module, we can now use augmented reality to show the user the directions. The idea behind this component is that when a destination is chosen, an arrow will spawn in front of the user and point in the right direction. The arrow is surrounded by a collider, and each time it exits it, the previous arrow is erased and a new one with the right placement angleemerges in front of the user.This is done using the AR Core SDKwhich enables us to project AR objectson the camera screen.Using this an AR generated path to the destination is created.



IV. TECHNOLOGIES USED

A. Unity

Unity is much more than just the best real-time development platform in the world; it also has a strong ecosystem created to support your success.It is one among the most popular software for augmented/virtual reality content development in2019 . With the aid of the programme Unity, youmay carry out various tasks linked to the creationof video games. Video game makers have accessto a 2D and 3D platformer with Unity. The gameengine supports several different AR tools,making it a valid option for approaching the technology from different directions and with different motivations . Surrounding Unity is a vast ecosystem of information in the form of tutorials, forum posts and developer guides that acted as an important resource during the development process of this software. In its core, it is a component-based system that also provides an editor which acts as an interface to show therelation between GameObjects. These are the foundation of the engine and act as containers fordifferent components or scripts. For example, to form a cube, components with information aboutits position, rotation and size are added to a GameO> the cube should move by its own, a script can be added that regularly changes the position value of the corresponding component. Unity also provides a physics engine that can translate a speed value to a change in position over time. It tracks physical boundaries of objectsso that walls or floors can be created that other objects can't pass through. 2D UI elements are usually rendered on a canvas, which is a representation of the phone display. The position and size of these elements are also determined bycomponents. To display AR elements, ARCore provides a virtual camera that moves within the Unity world coordinate system based on the smartphone movements. Its virtual properties aresimilar to the phone's camera so that GameObjects that are placed in front of it can be directly rendered onto the camera feed.

B. Unity Navmesh

A navigation mesh, or navmesh, is an abstract data structure used in artificial intelligenceapplications to aid agents in pathfinding through complicated spaces.

The approach chosen in this work is using NavMesh to generate path data and display it as acontinuous line on the ground. NavMesh is a toolfound within Unity to calculate a navigation meshbased on a 3D model. This mesh can be queried for information such as the path from a usertowards their goal or which terrain the user is currently in. Using a continuous line as the navigation display method allows for an overviewof the whole path and provides some feedback ofthe tracking state by showing the difference in rotation between the line and the orientation of theaisle.The current tracking technique is not accurate enough to provide an accurate navigation path. Using lines, this small accuracy can be manually adjusted. This approach is not an ideal approach but provides enough information to evaluate ARCore and analyze the impact of an inaccurate tracking technique on the navigation system.

C. AR Core

A software development kit called ARCore, commonly referred to as Google Play Services forAR, was created by Google to enable the development of augmented reality applications.

To combine virtual content with the real world asseen through a smartphone or tablet camera, ARCore makes use of three main technologies:

Six degrees of freedom enable the phone to comprehend and track its position in relation to the outside world, while environmental comprehension and light estimation enable it to identify the size and placement of flat horizontal objects like the ground or a coffee table.

D. AR Core Tracking

ARCore provides an inside-out tracking system through concurrent odometry and mapping (COM). Using inertial measurements units (IMUs), such as gyroscopes, magnetometers, andaccelerometers to calculate the motion of the smartphone and combining that with feature points which were extracted from the camerafeed, allows for a tracking method that can correctthe registration error of these sensors. A virtual map is generated that combines all the knowledgeprovided by the COM and places the phone withinthat map. For each set of feature points that createa representation of the surrounding world, a new map is created and if several of these maps overlap, they combine into a bigger one30 . This approach works best in smaller environments andcan introduce problems when used in larger ones,especially when they don't provide a significant amount of unique feature points. During the development of this application, there have been several occasions where the tracking suddenly jumped locations. This is most likely due to the repetitiveness of aisles within the building. Whencalculating feature points for these aisles, it is possible that there can be a match between two different sections of the building, resulting in a false pose correction.

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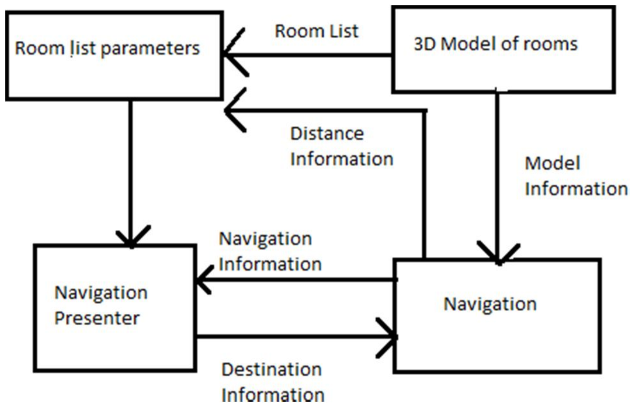
E. Android SDK

Android SDK, or Android Software DevelopmentKit, is a tool created by Google for the Android operating system.A collection of libraries andsoftware development tools called the Android SDK is necessary for creating Android applications.A relevant SDK is always released alongside a new version or update of the Androidsoftware by Google.Some additional features notpresent in the prior version of the SDK are now included in the updated or new version.Sometools that are part of the Android SDK are crucialfor creating Android applications.These tools provide a seamless transition between developing and debugging.Windows, Linux, macOS, and other operating systems are all compatible with the Android SDK.

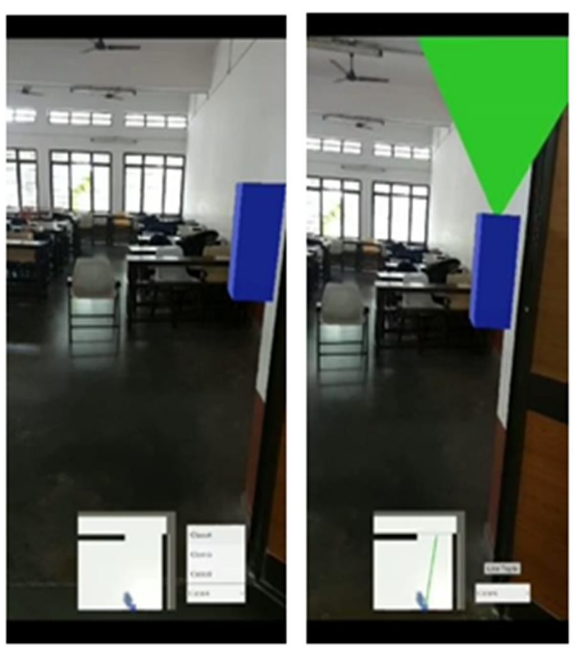
V. ARCHITECTURE

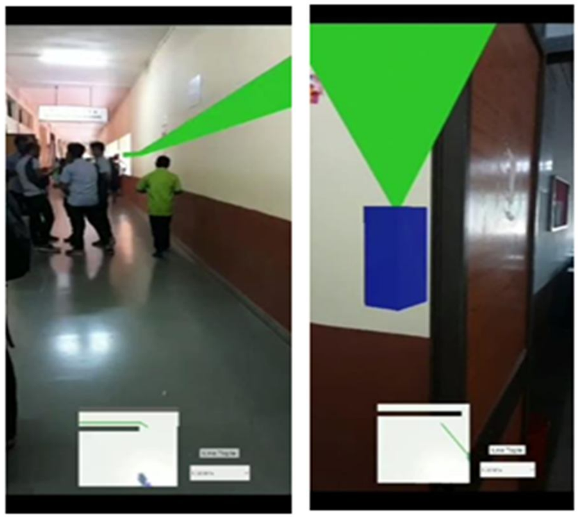


Navigation system

The structure has mainly two portions, that are the navigation part and a sectioncontaining room list and 3D models . The 3Dmodels are built with the parameters extracted from the map of the building , which is used to create a list of rooms to provide in the menu displayed in UI.This information is passed on to the navigation section where we are building virtual environment matching to the real world
.Now through the UI user will choose adestination from the room list .This will be send to the navigation section where using proper parameters , it will display the virtualpath to the user via the navigation presenter.

VI. RESULT





VII. CONCLUSION

This work provided a potential solution for an augmented reality indoor navigation system. Using ARCore and Unity to implement a software architecture which can be used to analyzeARCore and the impact of low tracking accuracyon such an indoor pedestrian navigationapplication.

The tracking has been split into two phases: Userlocalization and continuous tracking. The formerdeals with the problem of tracking absolute coordinates of users within the building. The latter to keep track of the user device's movementmore frequently. In order to overlay digital information on the video feed, the exact motions of the device have to be tracked. ARCore uses these motions in combination with feature point detection methods to identify objects, including walls and floors, that can serve as an anchor for the AR elements

VIII. ACKNOWLEDGEMENT

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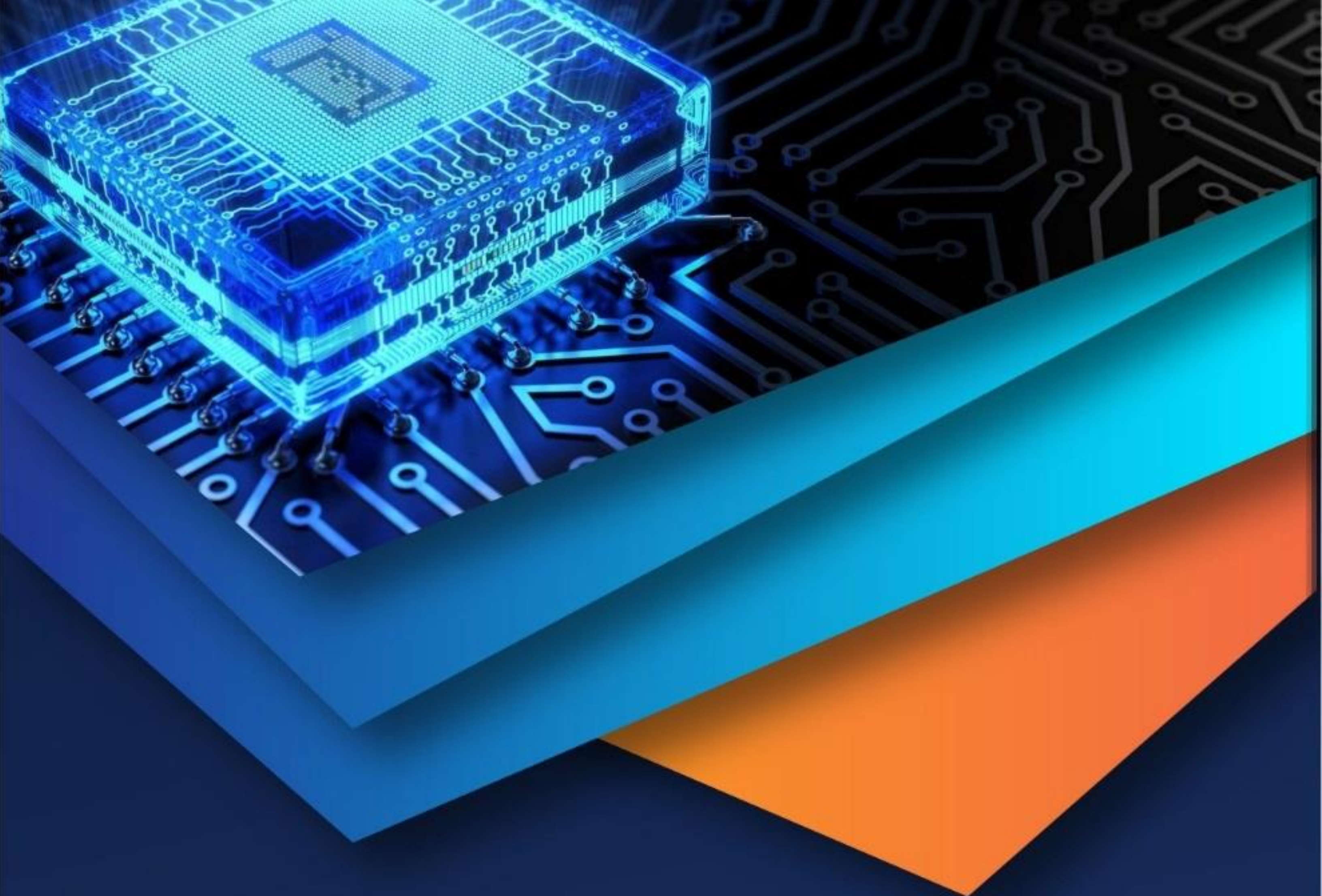

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