



# Indoor Navigation Using Augmented Reality

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## Abstract

A rapidly growing topic, indoor navigation employing augmented reality, has significant potential to improve user experiences in interior spaces users are able to effortlessly explore and find places of interest inside a building or space thanks to augmented reality technology, which superimposes digital information on the real world. With the help of this technology, people may engage with interior surroundings in a whole new way that is more intuitive and tailored to their own needs. The combine use of unity 3D and its built-in indoor navigation tools is what helps use to fuel up our project. Using Computer Vision, the user can properly scan its surrounding and navigate throughout the building with an ease. The basic principle for this system to work is by having the 3D model in Unity engine to map and add object in so that user can navigate and generate the path from their position.

**Keywords:** *Indoor navigation, Augmented Reality, Semantic Web*

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## 1 Introduction

Indoor navigation using augmented reality is a technology that allows users to navigate inside buildings using a mobile device or wearable technology equipped with an augmented reality interface. It combines the real-world environment with digital information, allowing users to see directions and information overlaid on top of their actual surroundings.

The main technology that is being used are GPS, Bluetooth Beacons, Wi-Fi in order to get user's location and their orientation dynamically for every environment. This can be easily used in places with large area and circumference such as Airport, Hospital, School and university. This app won't only solve the current problem in this world that people face in new places but also give opportunity for different new ideas to born and grow according to the need of the upcoming generation.

## 2 Related Work:

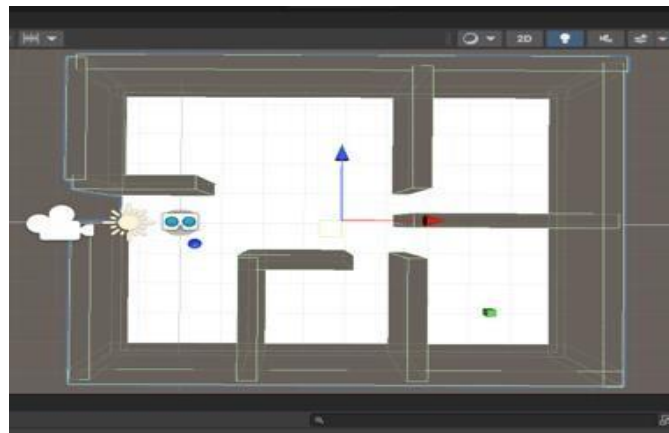
Many different works have been proposed to perform indoor navigation using augmented reality, the methods, techniques and technologies commonly used for its development mainly consist of four phases: mapping of the building where the system is used, user positioning/tracking Methods, application of wayfinding algorithms and presentation of navigation content by displaying augmented reality.

The works for indoor navigation that incorporate AR are shown in the following subsections, together with a description of the most widely used methods as per our work we will be using unity 3D game engine for building indoor navigation app for android devices with built in path finding algorithms.

### 2.1 Indoor Navigation using AR

Indoor navigation using augmented reality (AR) in Unity can be a great way to create immersive and interactive experiences for users. Here are the basic steps you can follow to implement indoor navigation using AR in Unity:

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**Fig 1:** 3D model of the Apartment

Create a 3D model of the indoor environment you want to navigate. You can use software such as SketchUp or Blender to create this model.

Design your own 3D model of your room environment in Unity.

Add markers or waypoints to the destination in 3D model where you want the user to be able to navigate. These markers can be represented by 3D objects or images that will be visible to the

user in the AR environment.

Use the Unity AR Foundation package to create an AR session and track the user's location and orientation in the indoor environment.

Implement logic to guide the user from one marker or waypoint to the next, such as displaying directional arrows or providing audio cues.

Test and refine the indoor navigation



experience until it is user-friendly and intuitive.

### 3 Methodology Design

To design the methodology for creating Indoor navigation app for navigation involves several steps. After completion of the following step the basic app can be created which can be later changed according to the need of the user or the creator themselves. The steps that are needed are as follows.

#### 3.1 Problem Definition

The problem that generally occurs when one individual goes to the new places for the first time, he/she might feel lost within the building. In such case our app will be helpful. It not only tells you where the direction to your place is but also helps you to navigate through the whole place with just an ease of tapping on screen.

#### 3.2 Choosing AR Platform

This is the most crucial part of the whole project as it defines the whole structure of your project. In

our case we choose Unity 3D engine. If comparing to other platform then even though the concept might get similar the approach will still be really different from what we did in Unity 3D engine.

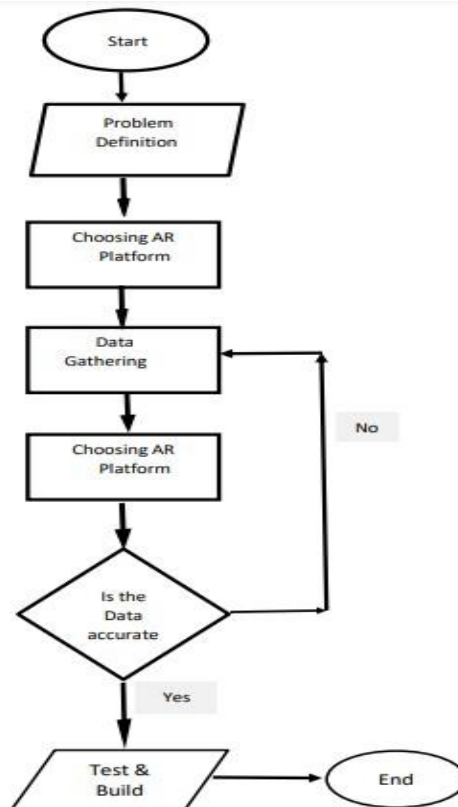
#### 3.3 Data Gathering and Preparing

This is the part where you define your project and create a base for the whole structuring of the project. In our case we created a 3D model of our apartment as our base structure and used it as reference in order to test the mapping and working of the overall system fluently and accurately. While creating a 3D model the main thing that needs to be considered is the area as we are going to map our objects as that only. The measurements that we took of our apartment was

$X\text{-axis(floor)} = 19\text{ ft}$   $Y\text{-axis(floor)} = 11\text{ ft}$   $Z\text{-axis(wall)} = 10\text{ ft approx.}$

With the help of above measurement, the whole 3D model was being created and the object and point of start were set.

Fig 2: Flowchart of the Methodology used In Indoor Navigation Using AR



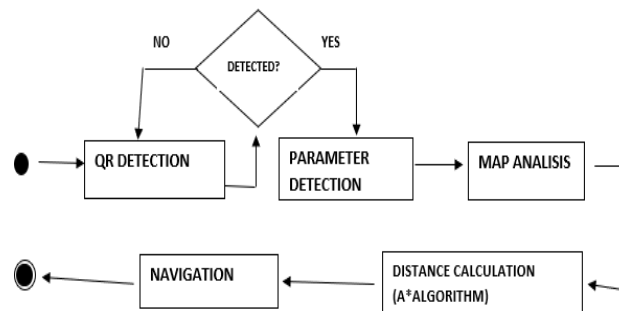
### 3.4 Test and Build

Now everything that is remaining is to add nav mesh and the script for path finding along with few touchups and creating an android app. After the app is created, we tested all the objects along with the function of the tracker and navigation that was working fine.

### 4 Methodology Implementation

In this the above proposed methodology is being implemented. This section proposes a prototype

implementation. This implementation helps user to navigate through complex building structures such as Airport, School, Universities etc. This also has other application as with little bit of more work in this field the whole visual experience might just be changed for an individual. It was created using unity 3D engine with ARCore and AR Kit. The main function for now is only navigating through indoors.



**Fig 3:** Structure Diagram of working project

#### 4.1 Positioning and Navigation

Here what we did is create a 3D model of our apartment with proper calculation and measurement and added the object in one of the rooms in order to position within the model. After That a Nav mesh was created in 3D engine using its built-in feature that enabled us to fetch the object info throughout the whole model after adjusting the Nav Mesh object to  $value \leq 1$ . Then the tracking of the object was done manually from each and every room in order to check if the positioning is correct for the object and the model. Initial Position was set at Room 1 where as the object was at Room 3.

#### 4.2 Visualization Content

Here the AR played the major role, using mobile camera's vision we were able to map the object but the initial position was still at Room 1, so in order to make it more dynamic different version of the map were created so that for every initial point the proper functioning of the positioning system. In order to create the Initial point more dynamic we used QR code to be scanned by the

user from throughout the building and get the location and start the navigation system afterwards.

After working of the QR few details such as mini map, and different buttons were also added.

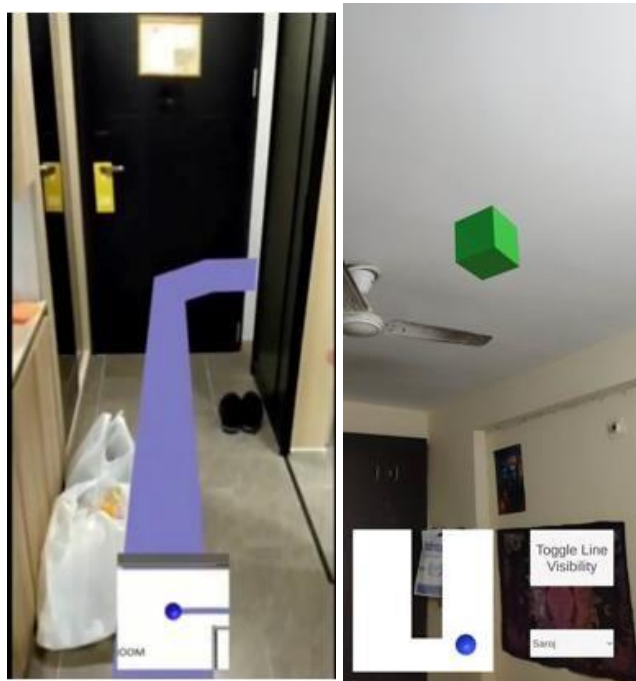
#### 4.3 Functioning of Project

After the implementation the project must function in such a way that when the user scans the QR then the location of the user must be set as the initial point or the starting point and from that starting point when the user adds an end point then the path for it must be shown in the AR view in mobile screen. After taking input parameters from the user such as initial and final point the program uses A\* search algorithm to calculate the shortest route between then and with the help of Augmented Reality it'll show the path for navigating the user to their destination.



## 5 Results

**Fig 2:** Map Navigation along and Destination object along with the MiniMap at bottom.



The first test we did is inside the compound of our building. The main objective was to see if our projects is will work as expected or not. The mobile device used to conduct the tests was POCO x3 pro global version 11.5 android version. The outcome was better than we expected, the app interface was really smooth and with the proper measurement the calculation of each room was really precise and well mapped.

## 6 Discussion

The result that we got was better than expected. The smooth functioning of the interface along with the navigating feature of the map runs in real time with every movement of the user either if they are either walking, running or stopping the map function do the same with it and also enable a user to select their destination path according to their need. Although the whole program run really fine there were still few errors and the result were not quite 100% yet, but after some work it was working fine again.

Though now this app is available for the android after all the complete testing and analyzing of the

app, however it needs to be tested for iOS as well as our priority was for it to work properly on android mobile devices

In order to achieve this result, there were other approaches as well such as instead of using Computer Vision we can also use other tech such as Bluetooth Beacons, Wi-Fi Network and Sensors or Trigger points but They do have their pros and cons as well.

## 7 Conclusions

The overall result of the program totally depends on the computer vision and the 3D model of the building, more precise the model better the result for the surrounding along with the user's movement.

This prototype version was mostly created for solely the reason of the of testing and running the Nav Mesh in unity and learning its functionality and working. In order to get this in large scale storing maps in cloud based formed will be really beneficial so that almost everyone can use this without the problem of adding the map manually for each area. The user can simply download the map from cloud and run it even offline. This really brings the Augmented Reality to be used in our daily life. So, in order large the

scale of users for this product changes are needed in order to handle large user base and large data.

The overall result will provide the insights on the AR uses in the field of navigation and also highlights the improvement that is needed in the field of Augmented Reality or its application in the field of Navigation. It will also increase the environment for the future research.

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