

INDOOR-OUTDOOR NAVIGATION USING G.E.A.R (GOOGLE ENHANCED AUGMENTED REALITY) APPS

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Abstract - Augmented reality holds the promise of creating direct, automatic, and actionable links between the physical world and electronic information. It provides a simple and immediate user interface to an electronically enhanced physical world. These simple programs are really good at helping you find your way around the unfamiliar terrain and build the route to the desired point. AR assists the user walking in a multi-floor building by displaying a directional arrow under a camera view, thus freeing the user from knowing his/her position. This AR solution relies on geomagnetic positioning and north-oriented space coordinates transformation. Therefore, it can work without infrastructure and without relying on GPS. ARCore looks for clusters of feature points that appear to lie on common horizontal or vertical surfaces, like tables or walls, and makes these surfaces available to your app as planes.

1. INTRODUCTION

Indoor-Outdoor navigation is a method to reach the destination from the initial point. This can be achieved by Augmented Reality (AR). Augmented reality holds the promise of creating direct, automatic, and actionable links between the physical world and electronic information. It provides a simple and immediate user interface to an electronically enhanced physical world. All sorts of GPS navigation apps have long been popular with users. These simple programs are really good at helping you find your way around the unfamiliar terrain and build the route to the desired point. In the ordinary, "un-augmented" world, we have to ask passers-by how to get to the destination and listen to their sometimes- confusing answers. Of course, maps and geolocation apps partially solve the problem, but not fully. And then AR navigation solutions become our true salvation. Definitely, there are plenty of ideas of mobile programs focused on augmented reality with GPS-based routing. Though, in order to implement the augmented reality feature, you have to learn how to attach AR to real-world places; also, you need to work with maps as AR objects.

1.1 RELATED WORK

As explained in the previous section Indoor-Outdoor navigation apps works in the way that routes and initial-destination gps values are preprogrammed in the code. The

UI for this app is used to select the initial point, destination point and AR object. Then the AR arrows will direct the user to reach the correct destination and this uses both GPS & VPS and this makes the arrow more accurate. In gear GPSARMP app, is basically designed for contextual representation of a place or terrain. The source for this is latitude, longitude and altitude. By this we can plot any model in any place in the world.

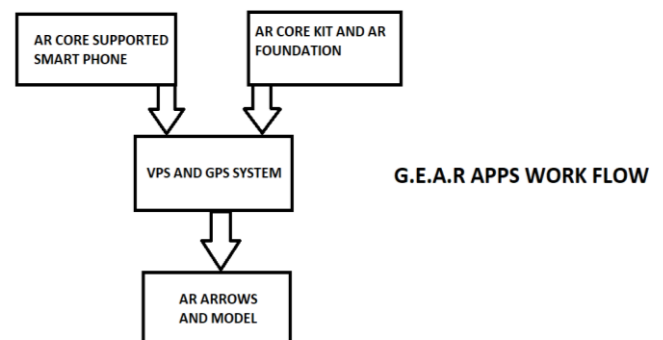


Fig-1: BASIC BLOCK DIAGRAM

2. WORKING

The gear apps are mainly designed for indoor-outdoor navigation and contextual representation which makes the user to navigate the respective destination and also by contextual representation for the place they visit. In gear ARROWS it is basically works for indoor-outdoor navigation. This apps works in a way that the user has to select the initial point and destination. The user can also change the arrow models and the option provided for it.

After selecting the initial point and destination point and model the user has to select NAVIGATE button. This leads to change the scene for the route. The route scene contains route, start, stop and delete button. By clicking the route button, the arrows will display in the order that the user can follow the arrows and to reach the destination. Additionally, the user can create their own objects which can stay in the frame. In gear GPSARMP app works in the way that to view

the contextual representation of a place or a terrain. This app works by plotting the model for any place in the world. It requires latitude, longitude and altitude which acts as a main source for this app. The user chooses the place which is mentioned in the app and to click PLACE button to place the model in the respective position. Both the gear ARROWS and GPSARMP is only designed for MSEC campus. We can also design this app for universal navigation purpose. These apps which were not available on any play store or app store instead the apps are stored in the google drive and the link has been created to a QR code. If a stranger need to navigate to the college blocks but the user does not have the knowledge to navigate through the particular block. The QR code with a link for googles drive. In the drive the gear apps are present and the user can easily pick the app and just install in the smart phone. This apps help the user to navigate through places as the user concern.

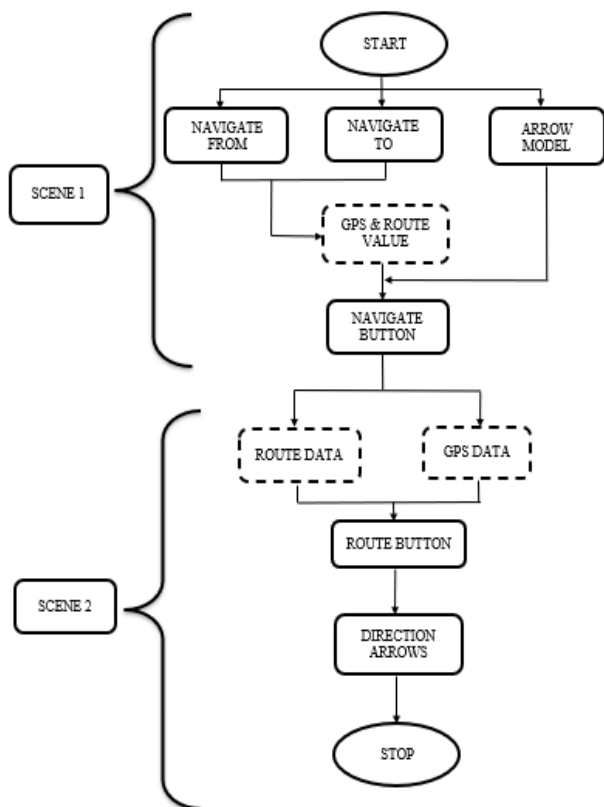


Fig-2: FLOWCHART OF G.E.A.R ARROWS

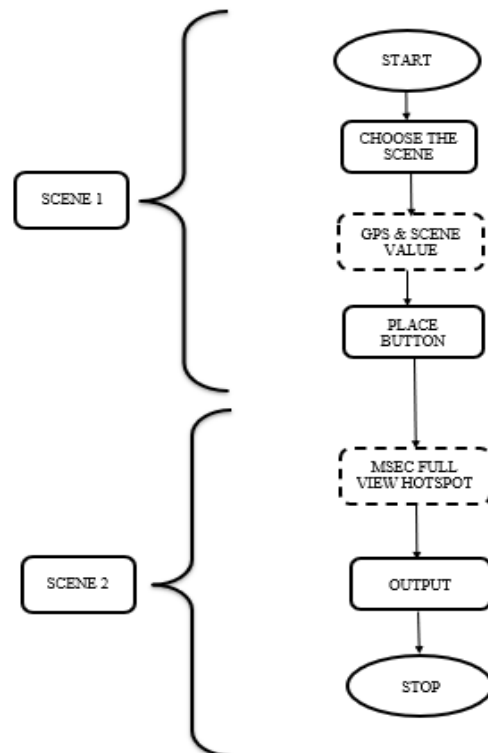


Fig-3: FLOWCHART OF G.E.A.R GPSARMP

2.1.1 PROCEDURE FOR G.E.A.R APPS

Here we discuss about procedure to handle the G.E.A.R apps. First download “MY QR CODE” app in play store. These apps available in the drive link which can be obtained to scan the QR code which is present in the college entrance. Then download G.E.A.R Arrows Indoor-Outdoor and GPSARMP. The installation steps for Arrows and GPSARMP are mentioned below.

2.1.2 INSTALLATION & HANDLING STEPS FOR G.E.A.R ARROWS OUTDOOR:

STEP 1: Download G.E.A.R Arrows indoor and outdoor apps from drive link using QR code.

STEP 2: Install the app and allow permission to access for video mode and location.

STEP 3: Choose the location where user’s current location in NAVIGATE FROM dropdown box.

STEP 4: Choose the location where the user to navigate in NAVIGATE TO dropdown box.

STEP 5: Choose the arrow model in ARROW MODEL dropdown box.

STEP 6: Press NAVIGATE button to pass to the Route scene.

STEP 7: In Route scene, the ROUTE button is to be clicked and arrows get render in the mobile phone. The user can follow the arrows to reach the respective destination.

2.1.3 INSTALLATION & HANDLING STEPS FOR G.E.A.R GPSARMP:

STEP 1: Download G.E.A.R GPSARMP from drive link using QR code.

STEP 2: Install the app and allow permission to access for video mode and location.

STEP 3: Choose the option MSEC FULL VIEW HOTSPOT.

STEP 4: After selecting the option, Press PLACE button.

STEP 5: In this scene the blocks in MSEC get represented contextually. Each block names get floats near the respective block.

2.1.4 INSTALLATION & HANDEL STEPS FOR G.E.A.R INDOOR:

STEP 1: Download G.E.A.R Arrows indoor app from drive link using QR code.

STEP 2: Install the app and allow permission to access for video mode and location.

STEP 3: Choose the location where user's current location in NAVIGATE FROM dropdown box.

STEP 4: Choose the location where the user to navigate in NAVIGATE TO dropdown box.

STEP 5: Choose the arrow model in ARROW MODEL dropdown box.

STEP 6: Press NAVIGATE button to pass to the Route scene.

STEP 7: In Route scene, the ROUTE button is to be clicked and arrows get render in the mobile phone. The user can follow the arrows to reach the respective destination.

2.1.5 FEATURES IN G.E.A.R ARROWS APP:

- The START button is used to create a manual game object in Runtime.
- The STOP button is used to end the game object session.
- The VISION button is used to hide and unhide the manually created game object.
- The DELETE button is used to destroy all game object in Runtime.
- The popup audio-dot function is used so that user can get notified with the distance between user's location and the destination.

2.2 HARDWARE/SOFTWARE DESCRIPTION

2.2.1 AR CORE SUPPORTED DEVICES

Certification is important because we want users to have a good experience with your AR application. This is primarily related to sensitive motion tracking, which is done by combining the camera image and the motion sensor input to determine how the user's device moves through the real world.

To certify each device, we check the quality of the camera, motion sensors, and the design architecture to ensure it performs as expected. Also, the device needs to have a powerful enough CPU that integrates with the hardware design to ensure good performance and effective real-time calculations.

2.2.2 FUNDAMENTAL CONCEPTS

2.2.2.1 MOTION TRACKING

As your phone moves through the world, ARCore uses a process called concurrent odometry and mapping, or COM, to understand where the phone is relative to the world around it. ARCore detects visually distinct features in the captured camera image called feature points and uses these points to compute its change in location. The visual information is combined with inertial measurements from the device's IMU to estimate the position and orientation of the camera relative to the world over time.

By aligning the pose of the virtual camera that renders your 3D content with the pose of the device's camera provided by ARCore, developers are able to render virtual content from the correct perspective. The rendered virtual image can be overlaid on top of the image obtained from the device's camera, making it appear as if the virtual content is part of the real world.

2.2.2.2 ENVIRONMENTAL UNDERSTANDING

ARCore is constantly improving its understanding of the real-world environment by detecting feature points and planes. ARCore looks for clusters of feature points that appear to lie on common horizontal or vertical surfaces, like tables or walls, and makes these surfaces available to your app as planes. ARCore can also determine each plane's boundary and make that information available to your app. You can use this information to place virtual objects resting on flat surfaces.

Because ARCore uses feature points to detect planes, flat surfaces without texture, such as a white wall, may not be detected properly.

2.2.2.3 LIGHT ESTIMATION

ARCore can detect information about the lighting of its environment and provide you with the average intensity and colour correction of a given camera image. This information lets you light your virtual objects under the same conditions as the environment around them, increasing the sense of realism.

2.2.2.4 USER INTERACTION

ARCore uses hit testing to take an (x, y) coordinate corresponding to the phone's screen (provided by a tap or whatever other interaction you want your app to support) and projects a ray into the camera's view of the world, returning any planes or feature points that the ray intersects, along with the pose of that intersection in world space. This allows users to select or otherwise interact with objects in the environment.

2.2.2.5 ORIENTED POINTS

Oriented points let you place virtual objects on angled surfaces. When you perform a hit test that returns a feature point, ARCore will look at nearby feature points and use those to attempt to estimate the angle of the surface at the given feature point. ARCore will then return a pose that takes that angle into account.

Because ARCore uses clusters of feature points to detect the surface's angle, surfaces without texture, such as a white wall, may not be detected properly.

2.2.2.6 ANCHORS AND TRACKABLE

Poses can change as ARCore improves its understanding of its own position and its environment. When you want to place a virtual object, you need to define an anchor to ensure that ARCore tracks the object's position over time. Often times you create an anchor based on the pose returned by a hit test, as described in interaction. The fact that poses can change means that ARCore may update the position of environmental objects like planes and feature points over time. Planes and points are a special type of object called a trackable. Like the name suggests, these are objects that ARCore will track over time. You can anchor virtual objects to specific trackable to ensure that the relationship between your virtual object and the trackable remains stable even as the device moves around. This means that if you place a virtual Android figurine on your desk, if ARCore later adjusts the pose of the plane associated with the desk, the Android figurine will still appear to stay on top of the table.

2.2.2.7 AR WORKS IN MOBILE

There are basically 2 types of AR which can be used in mobile apps. Each of them differs in terms of used sensors

and technologies, but the basic principle is still the same: they display virtual 3D objects on top of a camera view.

2.2.2.8 MARKER-BASED AUGMENTED REALITY

Marker-based AR is the most powerful technology. It uses image-recognition algorithms to specify the position and rotation of markers. After that it displays, for example, a 3D object in the specified place, at the beginning image recognition wasn't well developed and the marker was just a QR code. But currently there are tools that can recognize almost everything - from text to human face.

2.2.2.9 UNITY

Unity is a cross-platform game engine developed by Unity Technologies, first announced and released in June 2005 at Apple Inc.'s Worldwide Developers Conference as a Mac OS X-exclusive game engine. As of 2018, the engine had been extended to support more than 25 platforms. The engine can be used to create three-dimensional, two-dimensional, virtual reality, and augmented reality games, as well as simulations and other experiences. The engine has been adopted by industries outside video games such as film, automotive, architecture, engineering and construction.

2.2.2.10 AR CORE

ARCore (Google ARCore) is a development platform for building augmented reality apps (AR apps) for Android mobile devices. ARCore allows developers to create augmented reality apps that overlay the user's view with animated 3D content including words, objects and characters. AR scenes are persistent so that those made by one individual can be seen by others visiting the site later. ARCore is a competitor to Apples AR Kit. However, Google intends to develop the platform at its own pace.

(A) ARCore SDK for Unity

- Recommended version: v1.5.0 or later (arcore-unity-sdk-v1.5.0.unitypackage)
- Minimum version: v1.0.0

2.2.2.11 AR FOUNDATION:

AR Foundation allows you to work with augmented reality platforms in a multi-platform way within Unity. A "provider" is a concrete implementation of a subsystem. For example, the ARCore XR Plugin package contains the ARCore implementation for many of the AR subsystems. While it is up to the providers to determine how they will implement each subsystem, in general they are wrapping that platform's native SDK (e.g., AR Kit on iOS and ARCore on Android). The AR+GPS Location package brings the ability to position 3D objects in real-world geographical locations via their GPS

coordinates using Unity and Augmented-Reality. It supports both Unity's AR Foundation and Vuforia.

2.2.2.13 BLENDER:

Blender is a free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D printed models, motion graphics, interactive 3D applications, etc.

Here we used blender to create the arrow models, MSEC blocks 3D model for contextual representation and other models for G.E.A.R apps.

2.2.2.14 INKSCAPE:

The Inkscape is a free and open-source vector graphics editor. This software can be used to create or edit vector graphics such as illustrations, diagrams, line arts, charts, logos, etc. In Inkscape, 2D image is get converted to well pixeled image. By this we can process this in blender to create it to 3D model and it is used for G.E.A.R apps. AR Foundation allows you to work with augmented reality platforms in a multi-platform way within Unity. A "provider" is a concrete implementation of a subsystem. For example, the ARCore XR Plugin package contains the ARCore implementation for many of the AR subsystems. While it is up to the providers to determine how they will implement each subsystem, in general they are wrapping that platform's native SDK (e.g., AR Kit on iOS and ARCore on Android). The AR+GPS Location package brings the ability to position 3D objects in real-world geographical locations via their GPS coordinates using Unity and Augmented-Reality. It supports both Unity's AR Foundation and Vuforia.

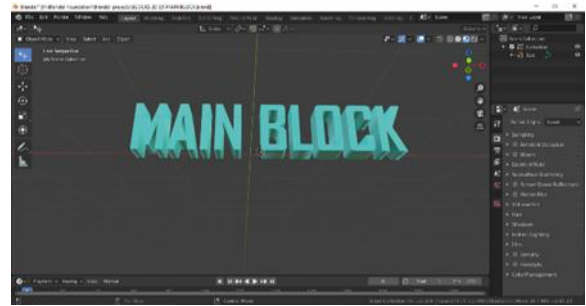


Fig-4: CREATING 3D MODEL IN BLENDER.



Fig-5: CREATING 2D ARROW IMAGE IN INKSCAPE.

2.3 OUTCOMES AND SCOPE

2.3.1 RESULT

The G.E.A.R apps help the user to navigate from initial point to destination. These apps mainly designed for MSEC campus and it works successfully. The G.E.A.R apps namely ARROWS indoor-outdoor and GPSARMP. In arrows outdoor, mainly 6 blocks of MSEC is taken as hotspot and total routes covered are 30. The hotspots are Main gate, First year block, Hostel, Canteen, Civil/mech block and Main block. In G.E.A.R Arrows Outdoor, the route is from main gate to main block, Route: 16 and 61.



Fig-6: OUTDOOR ARROWS DIRECTING THE DESTINATION

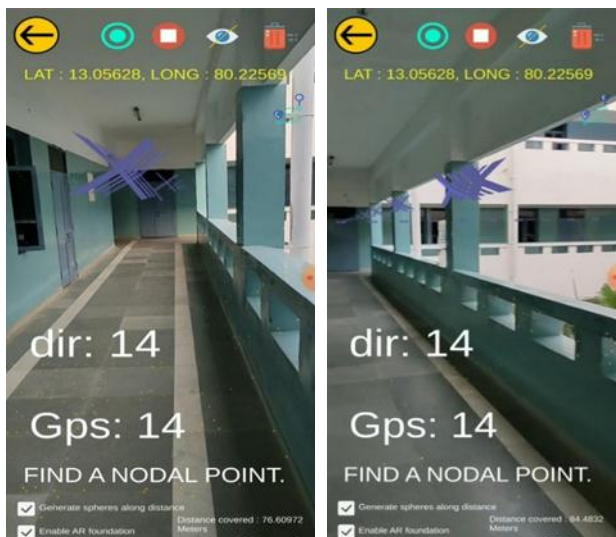


Fig-7: INDOOR ARROWS DIRECTING THE DESTINATION

The G.E.A.R Arrows indoor is designed for Main block's 1st and 2nd floor and each has 4 separate hotspot and totally 24 routes are covered. Here we see Route for 4th ECE-A class room to Restroom, Route: 14.

The G.E.A.R GPSARMP app is mainly the user to experience the contextual representation of each block in MSEC and full hotspot view of MSEC. Here we see the output:



Fig-8&9: MSEC FULL HOTSPOT VIEW AND MAIN BLOCK CONTEXTUAL VIEW





Fig-10&11: HOSTEL VIEW AND MSEC ENTRANCE CONTEXTUAL VIEW

2.3.2 APPLICATIONS

- It helps the stranger to navigate in unknown place by AR Arrows. It directs the user from initial point to destination.
- By contextual representation user can find the destination easily.
- It helps the user to navigate the indoor routes also.

2.3.3 ADVANTAGES

- The G.E.A.R apps are convenient to get it from QR code. It is easy to use and user can easily handle this app.
- AR navigation makes easy to travel the unknown places.
- User can get notification of distance from destination by popup-audio dot.
- The G.E.A.R apps is more user friendly and fun to use it.
- This can be used for universal navigation purpose.

2.3.4 FUTURE DEVELOPMENTS

The current project may be enhanced in the near future with the advancement of technology. G.E.A.R apps works in the concept of augmented reality. Google gives AR core support for the android mobile phones which makes the augmented objects are get viewed.

The G.E.A.R lens is the future development for this project and it is like Wearable gadget. The G.E.A.R lens is planned to have certain features mainly AR navigation, object recognition and collect information about it, human face detection and matching and AI based assistant.

3. CONCLUSIONS:

This work proposed an AR navigation tool. This can be largely implemented in various places like shopping malls, airport or railway stations, taking into consideration various factors such as reduction in false routes and directions. These apps require AR core supported mobile phones.

Once these apps get installed user only have to choose the initial point where the user is and to choose the destination also to choose the Arrow model. By clicking the NAVIGATE button the Route scene appears. Then user have to click ROUTE button and apps will render the AR arrows which the user has to follow the arrows to reach the destination.

This project serves to reduce the risk of false route and burden of the user more specifically it is available in mobile phone.

REFERENCES

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