Augmented Reality Based Turn-by-Turn Navigation System for Mobile Devices

Aman Choudhary, Ishan Gogna, Mayuresh Deolekar, Pranav More, Rajesh Bhise

Abstract - Navigation these days has truly reached a high point of significance in our lives, its primary functionality including the ability to track and deduce routes (as many as possible) to places new to us, informing us about various institutes along the way and much more additional information. The traditional way of navigation involves the usage of a map application, which defines the route to the destination and is then followed by the user accordingly. This involves constantly having to switch attention between the phone application and the real roads and therefore safety is a vital problematic factor in this approach, due to the unpredictability on the roads. Therefore, to tackle the problems in conjunction with the traditional navigation system, implementation of Augmented Reality is a smart step in order to impose better security standards and provide an altogether better user interactive experience. The proposed model makes use of HTTP URL requests, containing the parameters: API key, origin and destination address and obtains the Navigation information in the Java script object notation (JSON) format. It makes use of the Mapbox API integrated with the functionality of Navigation SDK to successfully impose virtual arrow on real time camera module, to show the path, establishing a sense of realism while navigating It can further update the user about the nearby approaching landmarks and other important bodies along the route, be it Gas stations, hospital or even bus stops, all embedded on a camera application, ensuring high security standards, thus giving it a significant edge over the usage of traditional navigation systems.

I. INTRODUCTION

With the advent of the android system, the smartphones are under a fast-paced development, facing exponential growth on a daily basis. It has become extremely easy to access a user's location as well as track that location on a live basis. Furthermore, as the internet becomes easier to access, and extends its reach to more and more remote areas, navigation applications are becoming a must in the lives of a majority of the population. Augmented reality provides an interactive experience of computer-generated entities (including visual, haptic, auditory, etc.) superimposed with real-time-environment.

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Aman Choudhary, B.Tech (CSE) 2015-19, Amity University Mumbai, Former Vice-President a Acting President-Cell, Amity University Mumbai
Ishan Gogna, B.Tech (CSE) 2015-19, Amity University Mumbai
Mayuresh Deolekar, B.Tech (CSE) 2015-19,
Prof. Pranav More, Department of Computer Science and Engineering, Amity School of Engineering and Technology,
Prof. Rajesh Bhise, Department of Computer Science and Engineering, Amity School of Engineering and Technology,

This overlaid information can be of two forms: constructive, being additive to the natural environment or destructive, acting as a mask for the natural environment. Thus deployment of augmented reality technology on the traditional methods, takes the navigation game to the next level. It not only promotes security of the user employing the application, but also synthesizes appealing aesthetics and vast utility, overriding the traditional utility to a new extent. [1, 6] In order to integrate AR into the navigation system, this project utilizes the Mapbox API in order to obtain geological information of the user and to overlay information. [4] It makes use of Google ARCore, which is a development platform for building augmented reality applications, particularly for android based devices, analogous to ARKit provided by Apple Inc. Using ARCore allows overlaying of 3D content (characters, words etc.) over Real time environment. It performs environment Mapping via the device's camera, deducing visual features while tracking motion and the coordinates of the moving device. [3] The back end of the application involves handling of HTTP URL requests containing the source and destination parameters requested by the user, and obtaining the Java Script Object Notation (JSON), preferred over the standard XML, of the geological information, with the help of Mapbox Modules. The front end and the aesthetics is achieved through the deployment of Kotlin language, using the android studio software.

II. APPLICATION DESIGN

Since the application is structured around the integration of traditional navigation with the AR concepts, it consists of various constituents constituting the back end and front end Functionality

A.User Interface

The application supports a rather simple layout. Its initial screen consists of entries for the user to input the longitude and latitude of the destination and selecting the live location as a starting point of the trip. Furthermore, it also involves two buttons for "Start trip" and "Navigation" functionality. The "Navigate" button, when pressed results in the determination of the best possible route to the destination, on the basis of calculations, considering factors like traffic in order to deduce the least time consuming / shortest path possible for the user to transit to the destination.

The "Start Trip" button, launches the Navigation Module, which uses open GL to render blue arrow by decoding path points on top of the real-time environment(video feed), thus showing a clear direction to the destination. It depicts straight paths and also changes direction to point towards, when a turn is encountered, in accordance with the route determined.

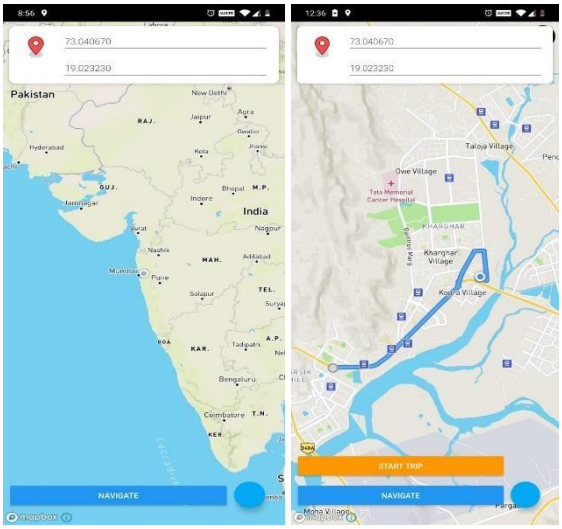

Fig (i) Navigation UI

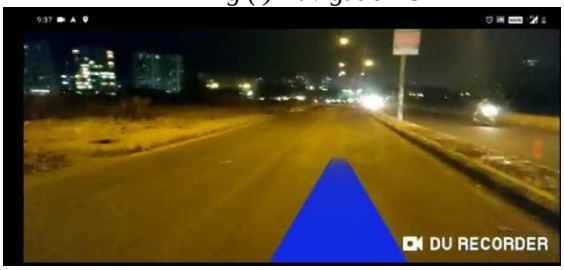

Fig (ii) On-road site navigation

Fig (iii) On-road site navigation turn indicator

B.Maps

In order to obtain navigational properties, the application makes use of the Mapbox API. Mapbox is an open source mapping platform for custom maps. It is the location data platform for various mobile and web applications, and provides the user interactive, thoroughly customizable maps in native multiple platforms, and Qt applications, powered by vector tiles and OpenGL. The Mapbox API is divided mainly into four services: Maps, directions, geocoding and accounts. The Maps service is responsible for handling datasets, fonts, maps, styles, tile queries, tile sets as well as uploads. Direction, isochrome, map matching, matrix and optimization operations are handled by direction services. Geocoding is accomplished by the search service, while the data analytics and tokens are the duties of the accounts service.

C. Augmented Reality

Augment reality is the backbone of the application. As the navigation module is launched, a vector-based rendered graphics (in our application: a blue arrow) is generated and is superimposed over the video stream, as predicted by the methods in the Navigation API. With the help of the sensors embedded in the phone, camera module, accelerometer, GPS/Network-cell-tower Location, a live real-time multimedia feed integrated with augmented reality is achieved, showing us the roads and the surroundings ahead and supplying information about the route on the screen.

D. Navigation

In order to achieve high standards of navigation, this application makes use of the navigation SDK offered by Mapbox. The former involves logic for generation routes, tracking progress, as well as receiving instructions, whereas the UI SDK organizes the data consumed from the core, into customizable UI components. The Navigation SDK has a vast functionality such as managing user location, building route requests: consisting of route generation, offline routing and custom routes. It also monitors progress tracking (with device notifications) and thus customizing the visual experience via map, localization as well as app styling. [1, 6]

III. PERFORMANCE REVIEW

A. CPU

As mentioned in the application design the application is split into two parts, the route selection and navigation. As per the tests, the average CPU utilization for application thread is 12% to 16%. During the navigation part, the CPU load increases to 30%.Throughout the AR Navigation, the CPU temperature ranges from 69 °C to 74 °C.

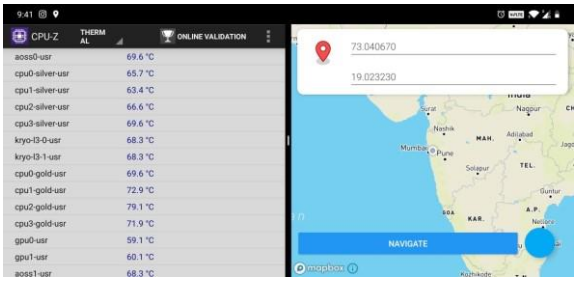

Fig (iii) CPU Performance

***B.* Memory**

Memory is a scarce resource and is limited in mobile handsets, thus optimizing the memory is a fundamental basis for good model. The average memory usage in the first part of the application is around 130 to 140mb. The memory consumption of the second part is between 380 to 400mb. Thememory is distributed among multiple segments like Code, Stack, Graphics, etc.

C. Network

The method is based on HTTP request and response protocol, the average request size is 4kb and the average response size per call is 46kb

D. Energy

The energy efficiency is in the range of low to medium, Continuous use of Camera and GPU processing takes a tool on battery life, but the energy consumption is much more similar to traditional navigation apps.

IV. FUTURE SCOPE

1) Sharing of stream data among paid Devices.

2) Live stream route using satellite images and shared data stream (ahead up to 1km).

3) Increasing the efficiency (Decreasing the Lag when location Is update)

4) Providing POI (Point Of Interest) in Real-time feed.

V. CONCLUSION

The model proposed in this paper successfully utilizes the concept of augmented reality in order to impose and improve real time driving security and convenience standards of the traditional navigation counterparts. The application deploys a clean and comprehensive User interface and achieves the navigation capabilities through integrated functionality of Navigation SDK and Mapbox API. Using latest technologies like ARCore, precise location tracking using device hardware and sensors like Compass, Accelerometer and GPS it is possible to implement a border line AR Navigation system, which utilizes backbone architecture of traditional on screen navigation.

REFERENCES

1. AR Turn-by-turn navigation in small urban areas and in1formation browsing, GianmarcoCherchi, Fabio Sorrentino, (https://pdfs.semanticscholar.org/4b/3915dea4530664b5312b2e6c23d5035c33b0.pdf)
2. MEMS Vehicle-MountedNavigation Positioning-Method(https://www.scientific.net/AMM.220-223.947)
3. SERRA A., DESSÌ T., CARBONI D., POPESCU V., ATZORI L.: Inertial navigation systems for user-centric indoor applications. Networked and Electronic Media Summit, Barcelona (2010)(https://link.springer.com/chapter/10.1007/978-3-319-47952-1_61)
4. CHEN C.-Y., CHANG B. R., HUANG P.-S.: Multimedia augmented reality information system for museum guidance.(https://www.researchgate.net/publication/227164365_Augmented_Reality_An_Overview)
5. AUGMENTED REALITY IN MOBILE DEVICES(https://www.researchgate.net/publication/320704050_AUGMENTED_REALITY_IN_MOBILE_DEVICES)
6. An emerging study in augmented reality geographical information SYSTEM(http://www.ijcte.org/vol9/1184-Q0011.pdf)

AUTHORS PROFILE

Aman Choudhary, B.Tech (CSE) 2015-19, Amity University Mumbai, Former Vice-President a Acting President-Cell, Amity University Mumbaiaman11choudhary@gmail.com

Ishan Gogna, B.Tech (CSE) 2015-19, Amity University Mumbai ishangogna10@gmail.com

Mayuresh Deolekar, B.Tech (CSE) 2015-19, mayureshdeolekar.md@gmail.com

Prof. Pranav More, Department of Computer Science and Engineering, Amity School of Engineering and Technology,pranavmore2530@gmail.com

Prof. Rajesh Bhise, Department of Computer Science and Engineering, Amity School of Engineering and Technology, rhbhise@mum.amity.edu