

CAMPUS AR NAVIGATION SYSTEM

Shrushti N¹, Megha N², Sunitha J³, Shivani Kumari⁴, Prof. Anjini L⁵

^{1,2,3,4} Student, Dept. of Computer Science Engineering, Bangalore Institute of Technology, Karnataka, India

⁵Assistant Professor, Dept. of Computer Science Engineering, Bangalore Institute of Technology, Karnataka, India

Abstract— The interior architecture of many buildings such as hospital, university campuses with a lot of departments it's so tough and confusing to direct people inside a closed infrastructure who are in it for the first time. With a lot of technologies using GPS to direct you to your destination there are a little or fewer technologies which direct you inside a closed architecture. This paper explores augmented reality and navigation technologies and allows us to do campus internal navigation on a mobile phone. Inside our campus, one can find the exact position and details of every classrooms and departments that can be obtained by using the augmented reality technology. The navigation system merged with augmented reality makes campus navigation technique in the application more accurate, realistic and easy to use and understand.

Keywords---augmented reality; campus navigation; interior architecture; mobile device

1. INTRODUCTION

A campus is a complex infrastructure. Especially with new students joining every year and people who are visiting it for the first time have a hard time to reach their destinations by themselves and find places. Our campus consists of more than one building thus has many different buildings. Most of the buildings are connected to each other, some of them even are located within walkable distance and also consist of separates canteen and different departments in different floors and buildings usually students are always asked to shift from one class to another after every period the time consumed to shift takes more time when group of students who are in it for the first time and most likely to take more time to find class this app helps to monitor and direct them to correct class on time. Even if there are sign boards at every step on the campus, users do not have continuous help to get to their destination. They can try to figure out a way to get to their destination by asking someone in the campus or by searching it in the static maps, but as soon as they start walking in the target direction they have no help any more.

help freshmen and other inexperienced people orientate themselves in the campus and support them finding places on campus with the use of modern techniques. Our BIT Campus AR Navigation system application enables users to see routes that are much more detailed than an existing commercial application can provide. Our implementation of a navigator application calls for much greater complexity than the simplest version of this type of application. At its core, a simple navigation application would not be difficult to create. The campus would be represented as a Graph structure, with locations (buildings, parking lots, etc.) on campus stored as vertices of the Graph and transitions between the locations (roads, sidewalks, etc.) stored as edges between the vertices. This application directs the user from his current location to the exact location he searches in the campus. It reduces the effort of the user to walk all over the campus

2. LITERATURE SURVEY

Li Zhigang et al. [1] In the application of a visitor visiting the campus with a smartphone, the location and pose of the smartphone is retrieved by its GPS and IMU data and then the registration in 3D is realized by tracking the viewpoint of the phone or the visitor accurately based on result data. Then, the multi-sensor fusion approaches are used for the spatial

registration, and a combination of the real and virtual world appears in the eyes of the visitor, which helps the visitor not only understand the campus style, but also deeply understands the history, tradition and culture of the campus. Eman Yaser Daraghmi [2] In this paper, CAMA, a context-aware mobile application for a university campus is presented which provides users the most rewarding environments for users seeking personalized context-aware information and navigation service in a University campus. Here, the system allows users to locate classrooms, teachers and friends. The user profile retrieved from the university database is used to notify both students and teachers of their next classroom. The app provides all the information that the user needs to know what inside a closed classroom without interrupting

the teacher while giving the lecture. And also, the mobile application includes additional features, such as providing the shortest path via the navigation service, detecting more than one object simultaneously, location sharing, personal context-aware, recommendation, and voice-commanded search. Joseph T. Chao et al. [3] developed a Campus Event App which is based on the client-server model. The mobile

as a central point which is implemented so that clients based on different platforms can access information in an easy way via restful web services and a prototype for the Android platform was developed which connects to these data sources and supports users on the campus with routing features and other information. Vaibhav Anpat et al. [5], presents a campus spatial information service system application which provides guidance and navigation service with a custom map simple and converts public map onto custom map in graphic format. The custom map may be in Kml format, this kml files loaded onto the application to show navigation on custom maps. When the visitor is interested in the POI (Point of Interest), then he/she may activate the guiding service and mainly implemented a map navigation system for travelling salesman problem on android using Google map and Google Geo-Coder API. The System is mainly the combination of Google Maps and MySQL database and provides facility of interactive information such as the picture, description, link and zoom out, zoom in, pan, eagle.

3. SYSTEM FRAMEWORK

Here first the start of the process will take place then user will select the navigation button and enters the premises that is the destination location and checks for the condition, if the entered address is not available then Navigation to that location cannot be performed and directly goes to termination state. If the entered address is available then that point of location is captured. If the captured location is invalid it will repeat the process until it captures a valid location, once it is valid, the location will be scanned and Identified and then goes to the termination state.

4. IMPLEMENTATION

A. Location

This app considers users location inside the campus by taking the latitude and longitude which is done by unity. This latitude and longitude is registered in the system. This API supports the digital map navigation, the location latitude and longitude can be obtaining by the satellite view or one can also use mapping from one building to another or from one classroom to another what exactly mapping does is it collects all the coordinate points in a closed space allows the database to store different viewpoints from the already existing points which makes

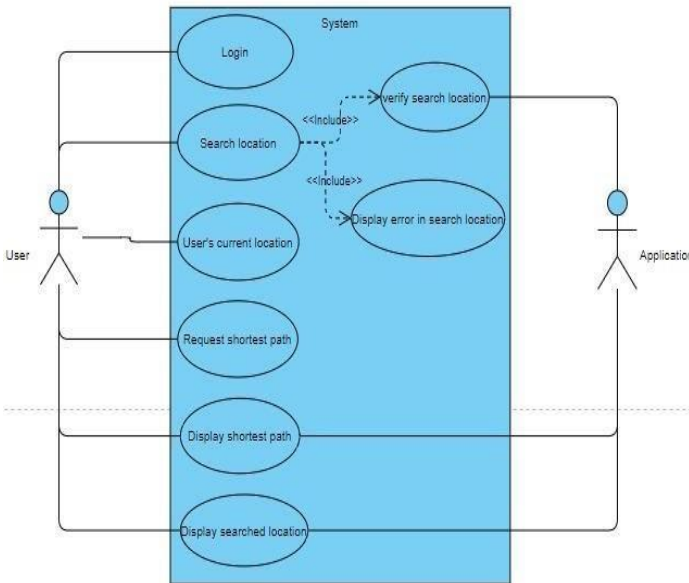


Figure 1. Interaction between User and System

phone app acts as the client, and an App acts as the Server, which is both a server and the server-side software that retrieves event data from the university calendar, stores it in a database, and later the user can retrieve when the client device requests it. The LLA coordinates are generated by the app server obtaining all of the event information, such as addresses, event name, event description, event time, and event links, from the university calendar which sends the physical addresses of all the events to Google Geocoding. Finally, the Campus Event App on the client device sends a request for data and the App Server processes the request, fetches the desired event data from the database, and sends that data in JavaScript Object Notation (JSON) format to the mobile phone. Benjamin Lautenschläger et al. [4] This paper recognizes planar images and also complex 3D objects regardless of their size and geometry. This paper aims to create a mobile application which helps people on the campus of the University of Calgary to orientate themselves and find their destination. Here, server acts

each points unique these points can be named in the way one needs to search. Once the list of all the destination is marked in the map we draw a virtual map showing directions inside the unity considering each view point as user's destination on the system interface. According to the users destination the localization attempt takes place once the camera is scanned in the user's search place a holographic arrows direct the user an optimal route in the navigation interface.

B. Storing and Registration

To precisely direct the user to their destination we first locate all the buildings in the campus, a marker is drawn in the virtual system on the maps. A floor maps is done for each floor of the building in order to locate all the rooms in one floor and each rooms view point is recorded by mapping. This is obtained in the following steps.

Step 1: All the individual points in the room is recorded in the video of the camera. This shows the edge points in each room to consider a unique identity.

Step 2: Once the points of each room is recorded we name each room in the same way we have built the floor map in this floor map must be beforehand uploaded in the system and we match the recorded points of reach room with their respective room number on the map.

Step 3: Now all the data is stored and marked. We make a virtual map for the user each destination is marked with a red symbol and a navigation from search place to destination according to the map database. The mapping of the world coordinate to image plane coordinate system is then calculated by the user's phone camera capacity. Transformation process is implemented by this.

$$\begin{bmatrix} u \\ v \\ l \end{bmatrix} \equiv \lambda.M \begin{bmatrix} p_1 & p_2 & p_3 & t \\ x \\ y \\ z \\ 1 \end{bmatrix} \quad \dots(1)$$

Where (u, v) is point on imagination plane; (x, y, z) is a coordinate system; M and [p₁ p₂ p₃ t] are internal and external parameter of camera matrix accordingly; λ is the scaling factor of the mapping phone.

For the marker with this coordinate system, using this camera parameters can be solved using a homographic matrix H which is created in the mapping process. Identifying and calculating these homographs needs four or more view points in the recorder version, more the coordinates higher rate for accurate distance to the destination. In this paper we use four point pairs for the vertex on the map to conclude the homographs.

Hence, equation (1) is modified to (2).

$$\begin{bmatrix} u \\ v \\ l \end{bmatrix} = H \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = [h_1 \ h_2 \ h_3] \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} \quad \dots(2)$$

According to (1) and (2), equation (3) and (4) are obtained as the following

$$H = [h_1 \ h_2 \ h_3] = \lambda.M [p_1 \ p_2 \ p_3 \ t] \quad \dots(3)$$

$$\begin{aligned} p_1 &= \lambda M^{-1} p_1. \\ p_2 &= \lambda M^{-1} p_2. \\ p_3 &= p_1 \times p_2. \\ t &= \lambda M^{-1} p_3. \end{aligned} \quad \dots(4)$$

Scale factor λ is determined using orthogonal points, i.e. λ = 1/|M⁻¹h|. Thus the camera point is obtained by 3:3 homographic points.

Step 4: Destination once selected by the user from his location the scene around the user is done by OpenGL for the camera image processing. The destination is symbol is drawn using the OpenGL API and the external parameters of camera.

Once the system is loaded with the database the system tracks and registers by visual- based technology, location is tracked in the next step and the exact data of destination that is the step count and estimated time to reach is displayed on the screen.

C. Image and Display

Image stored in the system contains the stored guide markers and data of each building in the campus. The map is capable to store images on the wall and also display it to the user. A built in camera and display of an android phone is the requirement that is completely equipped. To easily obtain various functions provided by the system, the operation interface are designed by the button and drop-down list options which gives the user details of each building and floors they want to visit.

5. SYSTEM ARCHITECTURE

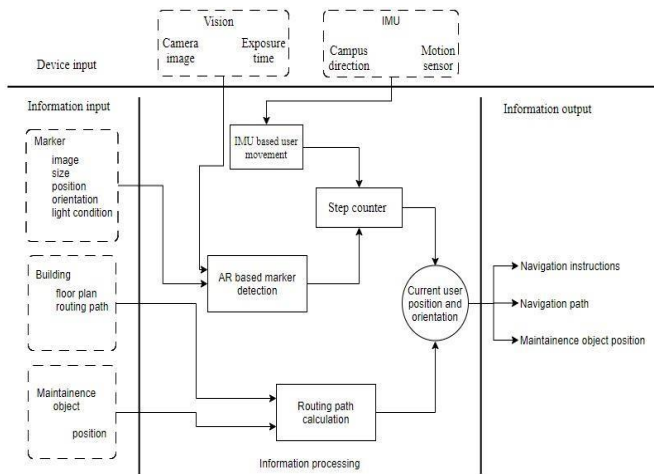


Figure 2. Template Markers [1]

The architecture of BIT AR Navigation system. It consists of four blocks namely information input, information processing, device input and information output. It takes input from the marker and sends it to AR based marker detection where we find the close continuous on the input image and unwrap the image inside it to a rectangle and the check this against our Marker model.

Building and maintenance object are the components of information input where floor number and position can be obtained for routing path calculation which is done under information processing block, after calculating it forwards the path to the current location and displays it in the Information output. IMU based user movement takes the input from device input and calculates force of body, angular rate as well as the direction of the body, which can be achieved by using a blend of sensors. Step counter then takes the calculated movements and generates the number of steps required to reach the destination. The Information output displays three details such as navigation instructions, navigation path and maintenance object position on the user's smart phone application.

6. EXPERIMENTAL RESULTS

When the user scans the QR code from an android version above 8.5 the localization attempt takes place when the camera is scanned anywhere in the campus giving a list of places one can visit or want to visit this is stored in the database. Each localization attempt is recorded on the screen, a distance estimation and time is also displayed on the screen where the distance tells the user how long the

destination is in meters and time tells the user in how many seconds the destination can be reached. Localization button is in the bottom and user can use it every time one needs to change the destination there will be no need to scan the QR code twice. Navigation is done using augmented reality where a holographic arrows lead the user to the destination.

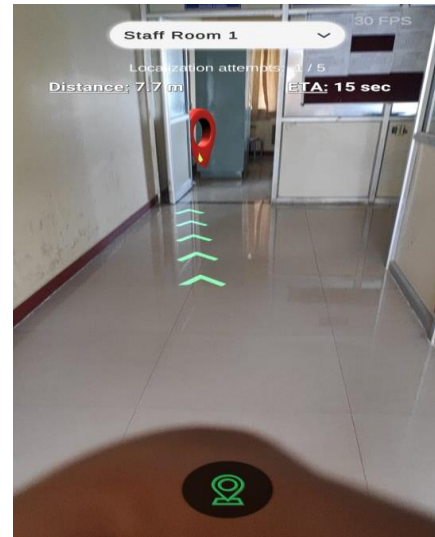


Figure 3. Augmented Reality Result

7. APPLICATION

1. Campus- the exact position and detail location of every block can be obtained by using the augmented reality technology.
2. Hospital and other infrastructure- indoor navigation.
3. E-commerce and Retail- augmented reality app development is about to reshape on- and off-line shopping.
4. Interior Design, Landscaping & Urban Planning apps- like IKEA Place helps to measure objects, walls etc.
5. Games, Leisure, and Entertainment- the viral Pokémon GO is still the first AR app that comes to most people's mind when they think of AR.

8. FUTURE ENHANCEMENT

The proposed system has very a vast scope in future. This project has been designed with the combination of both technical requirements and user requirements which is needed in future. The results of the system provides an addition feature which helps the user in visualizing the

desired location path. The highlighting factor of the project is that it keeps track of the user's current position and orientation using step counter which makes the system more efficient to future work.

9. CONCLUSION

The paper goes through all aspects of augmented reality, navigation and image processing technology, and unites them to develop a system which navigates campus. Through the experiments, the system can help users to visit different locations in the campus, gather more precise information about the hospital. This helps understanding the architecture better. This system can be further used to navigate similar applications, such as big factories, IT centers and large malls.

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