Campus Navigation Using Augmented Reality

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Abstract— Navigation is a technique which basically focuses on process of monitoring and controlling the movement of person or vehicle or craft from one place to another e.g.: Aeronautic Navigation, Land navigation, Marine Navigation, etc. The campus navigator is the android mobile application which is basically used for navigating routes inside any campus premises e.g.: College, Hospital, Mall, etc. Mobile phones are nowadays far more than merely devices to communicate with. Especially, Smartphones are products that help to make our work and everyday life easier. Along with the advanced technology and popularity of these devices, the use of mobile applications has increased enormously in the last few years. Based on new techniques like GPS, sensors, compass and accelerometer that can be used to determine the orientation of the device, location-based applications coupled with augmented reality views are also possible. There are several commercial navigation applications - such as Google Maps, Yahoo Maps and Mapquest that provide users with directions from one place to another. However, these applications must search along existing roads; they are not able to provide routes that are as precise as an on-campus path would require.

Index Terms— Administation module, Android, Augmented Reality, Campus Navigation, Campus Navigator Application, Indoor Navigation module, Mobile Augmented Reality, Outdoor Navigation module, Smart Phone Application.

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1 INTRODUCTION

A campus is a complex infrastructure. Especially new students and people who are on it for the first time have a hard time to orientate themselves and find places. The campus occupies more than two square kilometers and thus is even larger than that. The campus has many different buildings. Most of the buildings are connected to each other, some of them even by underground walkways. Even if there are maps at some points 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 target on these static maps, but as soon as they start walking in the target direction they have no help any more. Whereas it is very common to use navigation systems in cars to reach designated locations, systems for pedestrian navigation are quite hard to find. So, how is it possible to help freshmen and other inexperienced people orientate themselves in the campus and support them finding places on campus with the help of modern techniques. The answer to this question is "CAMPUS NAVIGATOR". Our Campus Navigator application enables users to obtain 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.

1.1 Goals

The main purpose of this system is to give a mobile based solution, in a manageable way to students and guardians while they travel around the campus premises. Also, the goal is to reduce the wastage of time, dissatisfaction and to gain efficiency, accuracy, application friendliness, and speed, of the application for a small campus environment. With the proposed system it is expected to serve as a useful and informative navigate helper for both students and visitors of the campus.

1.2 Objective

Provide a useful, informative, mobile based solution for navigation inside a campus, which will contain all the necessary details, to make sure that it is easy, accurate navigation and identification of various buildings, departments and help the students and visitors to reach their desired location without any trouble.

1.3 Scope

The scope of the project is determined by the allocated time, resources and the client's requirements. The scope of the system is limited and can expand in a modularized manner. Users can navigate through the campus via guidance given by the AR browser. They can browse buildings, locations etc. or search for locations.

1.4 Problem Statement

Universities around the world are expanding structurally at a rapid rate especially when the number of students gets greater and greater with every enrollment period. As a result of being tremendous in size there is a great chance that some students would not be able to find their way around the campus with parents and newly enrolled students being the ones greatly

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affected.

1.5 Overview

In this modern age, effective navigation has become increasingly vital as cities develop and began to grow with skyscrapers and large buildings continuously erected. Due to this need, technologies such as the Global Positioning System, GPS are developed to aid navigation. However, indoor navigation is still a hassle as there is no such technology which is accurate, effective and inexpensive to cater the need.

This project aims to use augmented reality to develop a prototype which aids indoor navigation. Augmented reality is the view of the real world augmented with another layer of computer generated sensory inputs such as sound or graphics. This application is built for smartphones as almost all smartphones today are equipped with a camera and decent processing power which enables the rendering of some graphics. This application is built using Android SDK and Vuforia Augmented Reality SDK formerly known as QCAR.

2 SIMILAR SYSTEM

2.1 Arizona Mobile

Arizona Mobile is the first official app and one-touch experience for all things for University of Arizona including a navigation system. Not only does Arizona Mobile make life easier for current students, but past/ present students around the world can stay up to date with features like event calendars and video tours that make every user feel like they're on campus – no matter where they are.

Features -

Some of the main features included in this system are Maps, Phonebook and campus directory, Course listings, UAccess Student, UAnews, Event listings, Social Media, Videos, Library, Tours, Photos, Alumni, Emergency contacts

Review and Comparison -

There are few unique features residing with this mobile application. For example, the users' social interaction function is a new addiction. Pupils could be in updated with collage news and headlines via this system. But the map is not well working with upper versions of Android mobiles because there are less utility and information given. Would suggest integrating University Access into the app rather than directing to a browser for the mobile site.

2.2 Oregon State University Mobile

The application comes in both iPhone version and Android supportive platforms. The description for the application system developed by the University of Oregon is as described below.

Features -

- Offers an optimized experience for a variety of web phones and devices.

- Can access this site from any mobile web browser, with real-time data.
- Can find buildings on campus or track down phone numbers just using your thumb: the auto-populating people finder will even complete user typing, saving time in a crunch.

Review and Comparison -

It is more of iOS rather than Android. Still uses outdated iOS UI elements. Quick functionality of finding buildings and phone numbers. Could work on the add contacts. Would add the email to the wrong contact on user phone. If could link towards the online services, this app would be phenomenal. Would be able to check class schedules, add/drop courses, etc.

3 SYSTEM ANALYSIS AND DESIGN

Analysis is very important procedure for a project's success. The main processes of this phase include domain understanding, requirements collection, classification, structuring, prioritization and validation. Suitable collective methods and procedures were engaged to carry out the analysis phase in an effective way.

3.1 Analysis

It is useful to discover the existing systems and traditional methods to develop a new system. Some of the current systems are expensive to maintain and do not fulfil what the user really wants. There was not 100% fulfilled system currently. Most of them are not fit enough with user requirements. Here are some traditional manual systems that are currently exists.

- Displaying a map covering the whole campus at the entrance.
- Showing arrows as directions.
- Naming departments and pasting banners inside the building

Displaying a map covering the whole campus at the entrance-

In front of the entrance, there is big campus plan to find ways to university visitors. It is very hard to keep the path in memory. Most of the places are currently changed and some of them do presently not exist. So, the information of the map is not far enough to find the destination. As the result of renovation of the department, some buildings are removed, or some of them are changed with other department. So, the map is static, it is impossible to change. If it is, it would very expensive or sometimes it is beneficial to create new map rather than updating the existing one.

Showing arrows as directions -

There are banners and arrows that direct the user saying the correct path. Sometimes it is easier to go in other way rather than keeping focus with the arrows. Problem is it is not a long-term solution to find out the buildings, because of some arrows may get old and ruined, some fall. So, they are not certifying the stability. On the other hand, it has effects on envi-

ronmental pollution and it ruins the beauty of the natural environment.

Naming departments and pasting banners inside the building -

Buildings are named by pasting banners on the walls. If the user is far away from the building, the banner in the wall cannot be seen by the new comer. Those banners are not a solution for long tern period. As they face the rain and get damaged.

3.2 System Design

The system of Mobile Campus Navigation with Augmented Reality is to assist the user to identify the buildings/departments inside the campus and mainly focuses on finding location and details of officials easily. Mainly five modules have been used to implement the application in order to make the development and comprehension easier. The modules are as follows,

1. Outdoor navigation module
2. Indoor navigation module
3. Official availability module
4. Official's login module
5. Administration module

The way this application work is by guiding the user to his/her desired destination using augmented arrows or texts. Upon opening the application, the possible locations are listed out for the user to select. Below is the screenshot of the list of destinations.
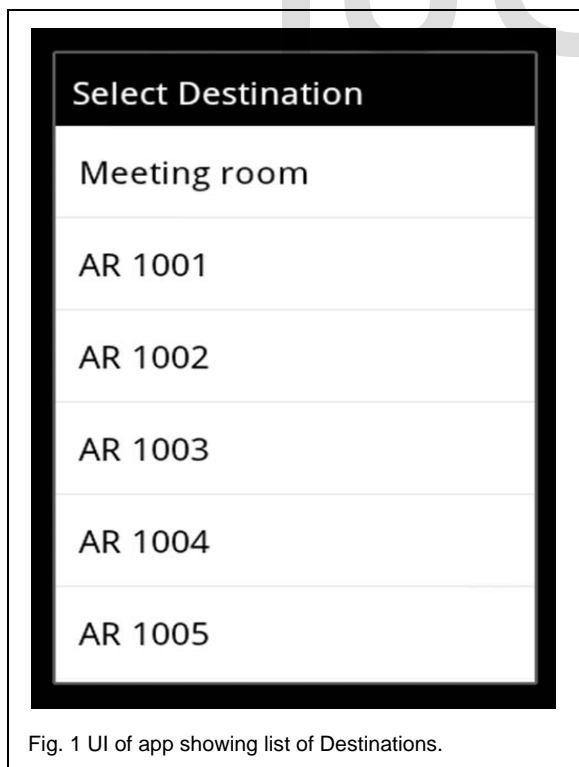

Fig. 1 UI of app showing list of Destinations.

After selecting the desired destination, the application changes to navigation view which displays live feed from the camera.

The user then holds the phone in front as he/she is walking around the area. The application will automatically detect the user's location by comparing input from the camera with previously stored data. Following that, the application will calculate and generate the shortest path from the user's current location to the desired destination and display augmented arrows on the screen to lead the user to the destination. Below is a screenshot during navigation. Anytime during navigation, the user can choose to change the destination or view a map of the area complete with the generated route.
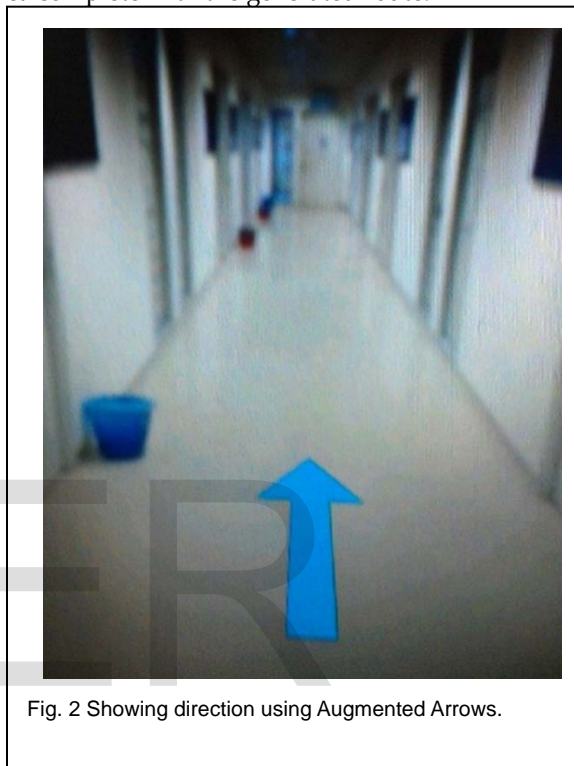

Fig. 2 Showing direction using Augmented Arrows.

4 METHODOLOGY

To develop a successful system, choosing an appropriate methodology is important. Methodology provides the basic guidelines that will guide the developer to accomplish the project task. In this section, what is the best methodology need to be applied on this project will discuss.

This project involves heavy user interaction thus is more suitable to use prototyping approach. A prototype will be developed based on the known requirements of the system, so that with the prototype the client have a basic idea of how the completed product will look like. The interactions with the client can have a better understanding the requirements of the desired system. Normally, the prototype is not a complete system and there are some of the features that are not built in the prototype. The objective of the prototype is to deliver a system that can provide basic functionality.

4.1 Tools to Use

4.1.1 Hardware

- Smart Phone Device

Operating System	Android 4.2.2 Jelly Bean
CPU	ARM Cortex A9, 1200 MHz, cores - 2
GPU	ARM Mali-400 MP4, 266MHz, Core: 4
RAM	1 GB
Positioning	GPS

- Computer

Operating System	Windows 10 Genuine 64-bit
CPU	Intel(R) Core(TM) i7-3610QM CPU @ 2.30GHz
GPU	NVIDIA GeForce GT 650M
RAM	4 GB

4.2.2 Software

Eclipse IDE -
Eclipse Integrated Development Environment (IDE) is used to write the application for the smart device.

Android SDK -
The Android Software Development Kit (SDK) is used to develop the application based on Android platform, which includes a comprehensive set of development tools. These include a mobile phone emulator based on QEMU, libraries, debugger, documentation, tutorials, and sample code.

Metaio SDK -
The Metaio SDK is used for programming PC, mobile, web and custom offline augmented reality applications. It is currently supported on iOS, Android and Windows. It released the free version of SDK with a Metaio watermark, if want to remove the watermark have to upgrade to BASIC / PRO license.

5 SURVEY OF TECHNOLOGIES

5.1 Mobile Augmented Reality (MAR)

The concept of mobile augmented reality (MAR) was developed in the mid-1990s. It takes AR and applies it to a mobile setting, away from the conditioned, closed environments with desktops as tools (Karimi, 2004). The diversity within AR creates the need to define where the domain of MAR stands in the AR field. Kourouthanassis et al. (2013) define MAR as an extension of the scope and prospective functionality of "traditional" AR whose interaction occurs through wireless devices, such as smartphones and tablets. To create that interactive environment, MAR combines AR with wireless communication and location-based computing and services (LBS).
The location data is derived from the compass, accelerometers and GPS data. All of these can be found in a smart phone. Even though all of these have improved in the last years and will continue improving, the fact that exact accuracy is still hard to achieve puts a restraint on how good MAR applications can be when using locational data to provide information. The other big part of MAR is the wireless communica-

tion, which occurs through wireless networks. For this to work you need connection to networks wherever you are, which is something that is not a certinty on all locations. Other challenges that MAR applications face may include object recognition and tracking, real-time information retrieval, user interaction and information visualization (Kourouthanassis et al., 2013). All these areas might become challenges because MAR applications are highly decentralized and focus on muliple objects at the same time in the same environment. Hence the application needs to be able to discern each object from one another and decide which is of interest and search for information that might be semantically attached to that object and then present that information in a way that is user friendly.

6 CONCLUSION

The problem and motivation of this project is that most of the existing navigation system are unable to provide routes accurately as well as further information of the building within a region such as campus, shopping mall, hospital and etc. Furthermore, the method of by typing words is sometimes inconvenient, an advanced search method by using images can be used to substitute the method of typing words into the search engine. Mobile Campus Navigation Application with Augmented Reality is an application with severely unique functions and properties that delivered in a well user-friendly way to typical users of the system. It apparently gives the user productivity with the combination of technical and user requirements in advance.

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