CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

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.: Land navigation, Marine Navigation, Aeronautic Navigation etc. The campus navigator is a mobile application which is basically used for navigating routes inside any campus premises e.g.: Mall, College, Hospital etc... Mobile phones are nowadays far more than merely devices to communicate with. Especially, Smartphones which are products that help to make our work and everyday life easier. Along with the advance in 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 used to determine the orientation of the device, location-based applications coupled with augmented reality views are also possible. Location-based services denote services provided to mobile users according to their geographic locations (Barnes, 2003). Such services use the ability to dynamically determine and transmit the location of persons within a mobile network by means of their terminals (Virrantaus et al, 2001). These services include capabilities to search for information about physical location, and have features that support finding routes to specified destinations. This work presents a web-based location guidance system that assists visitors and new students to locate their destinations on the campus. Many GPS aided application have always had to develop a prototype map for the navigation app but in recent days since the implementation of the Google Map API and other API's just like it the development of such apps couldn't be more convenient. These maps do not require any equipment to be mounted on the campus to capture the landscape of the campus.

1.2 Motivation

A campus is a complex infrastructure, especially for the new students and people who are on it for the first time have a hard time to orientate themselves and find places. The TAI SOLARIN UNIVERSITY OF EDUCATION campus occupies a very large area of land. The campus has many different buildings. Most of the buildings are connected to each other. 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 it is possible to help freshmen and other inexperienced people orientate themselves in the campus and to support them in finding places on campus with the help of modern techniques. The answer to this question is "CAMPUS NAVIGATION SYSTEM".

1.3 Problem Statement

More often than not, people are faced with a number of challenges while considering the environment where they are vis-a-vis locating the exact place they are going at a particular instance. Currently, there is no portable navigation system for the students or the staff of the school. Notably, the cost of getting by for someone who has to use his/her calling credit to get to their destination is somewhat high, and the time taken to locate a particular place on the campus will be longer because of the "unknown" status of the location. While this technology has been around for a while the implementation has not been sought after, the implementation will bring about ease of navigation to the staff and whole body of the school system.

1.4 Aim and Objectives

The aim of this project is to develop a system that incorporate mobile application, which provides the capabilities to show the current location of a user and also enable the user to easily navigate the campus, this application will also possess the ability to augment reality displaying 3D image of buildings and showing hybrid road map for easier recognition of locations. Provide a useful, informative, mobile based solution for campus navigation inside TASUED, which will contain all the necessary details, in order to ensure easy, accurate navigation and identification of various buildings, departments and help the students (especially new) and visitors to reach their desired locations without any inconvenience.

1.5 Scope of Study

The scope of the project is determined by the allocated time, resources and the system requirements. The Application has the **Navigation** module, the **Help** module which is to guide/orientate the user on the proper use of the application to avoid any ignorance on the client side against the use of the application. In the navigation module the user will be able to switch the map view from road map to a 3D augmented view of the campus setting.

1.6 Limitations of Study

The system has some limitations which arises from the client side, some of these are low battery status on the mobile device, turning off of the geo-location service on their mobile device can also lead to the system not being able to pin point the location of the user but this will not hinder the display of the map and layout of the school which can still be used to navigate the campus and you can only tell where you are by comparing structures from the augmented reality to the reality, another limitation to the application is the lack of internet access which is not going to allow the application to display the map at all.

1.7 Definition of Technical and Conceptual Terms

1.7.1 Navigation: Navigation may be defined as the process or activity of accurately ascertaining one's position and planning and following a route.

1.7.2 API: API (application program interface) is a set of routines, protocols, and tools for building software applications. The API specifies how software components should interact and APIs are used when programming graphical user interface (GUI) components.

1.7.3 Satellite: This is an artificial body placed in orbit round the earth or another planet in order to collect information or for communication.

1.7.4 Campus: The term “campus” may be defined as the grounds and buildings of a university, college or school.

1.7.5 Map: A map is a diagrammatic representation of an area of land or sea showing physical features, cities, roads, etc.

1.7.6 GPS: The Global Positioning System (GPS) is a satellite based navigation system made up of a network of 24 satellites placed into orbit by the US Department of Defense.

1.7.7 Latitude: This is the angular distance of a place north or south of the earth’s equator, usually expressed in degrees and minutes.

1.7.8 Longitude: This is the angular distance of a place east to west of the Greenwich meridian usually expressed in degrees and minutes.

1.7.9 Location: A location is a place or position where something is or where a particular event is occurring.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Navigation System

A navigation system is an electronic map combined with route instructions, usually displayed on a dashboard video screen. Global Positioning System is one of the commonest navigation systems in the world. A geographic information system (GIS) is a system which is used to store, retrieve, map and analyze geographical data. These systems store any kind of information which is related to a geographical location. These spatial features are stored in a coordinate system which references a certain place on the surface of the earth (Lautenschläger, 2012). An outdoor augmented reality system which can be connected to a GIS allow the human operator to move freely without restraint in its environment, to view and interact in real time with geo-referenced data via mobile wireless devices.

Maps have been used for centuries to transit users from one place to another. In the last decade, navigation devices have used digital maps to locate the position of the user and assist in providing navigational directions (Akanbi et al, 2014). Recently, maps have become more than just visualization tool in navigation systems; they are now an aiding tool for enhancing the reliability of the obtained navigation solutions (Attia, 2013). Navigation is a field of study that focuses on the process of monitoring and controlling the movement of a craft or vehicle from one place to another (Bowditch, 2002). The field of navigation includes four general categories: land navigation, marine navigation, aeronautic navigation, and space navigation.

The basic concepts in navigation are the longitude, latitude and altitude (Bayrak, 2013). According to Graham et al (2012), one of the objectives of augmented reality is to enhance perception or the visibility of the physical world. The smartphone's screen acts as a window onto the real world whose video flow can be augmented this is made possible through mobile applications. Mobile applications consist of software or a set of program that runs on a mobile device and performs certain tasks for the user. Mobile application is a new and fast developing segment of the global ICT.

Mobile application is easy, user friendly, inexpensive, downloadable and can run in most of the mobile phone including inexpensive and entry level phone (Harrison et al, 2013). Mobile application has wide uses for its vast functioning area like calling, messaging, browsing, chatting, social network communication, audio, video, game etc. The usefulness of mobile devices has increased greatly in recent years allowing users to perform navigation tasks in a mobile context (Kumar & Kumar, 2014). The use of devices such as smartphones and tablets which come along with the excessive use of mobile applications is becoming more and more common, especially in the university domain. Majority of these mobile devices have built-in techniques to determine geographical position. These devices combined with the right software can provide new users with location-based information on buildings and facilities etc. in the university campus. In this study a mobile navigation system architecture is presented, a google map for the university has specified various buildings and roads within the main campus.

2.2 Geographic Information System

A geographic information system (GIS) is a system which is used to store, retrieve, map and analyze geographical data. These systems store any kind of information which is related to a geographical location. These spatial features are stored in a coordinate system which references a certain place on the surface of the earth. The main use of geographic information systems is resource management, development planning and scientific research. The GPS is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United State government and is freely accessible by anyone with GPS receiver with some technical limitations which are only removed for military users. GPS is used on incidents in a variety of ways, such as (Coleman, 2011):

(i) To determine position locations; for example, you need to radio a helicopter pilot the coordinates of your position location so the pilot can pick you up.

(ii) To navigate from one location to another.

(iii) To create digitized maps; for example, you are assigned to plot the fire perimeter and hot spots.

(iv) To determine distance between two points or how far you are from another location.

Augmented reality (AR) is a live, copy, view of a physical, real-world environment whose elements are supplemented by computer-generated sensory input such as sound, video, graphics or GPS data as stated by (Gerhard, 2012), The goal of an outdoor augmented reality system is to allow the human operator to move freely without restraint in its environment, to view and interact in real time with geo-referenced data via mobile wireless devices. This requires proposing new techniques for 3D localization, visualization and 3D interaction, adapted to working conditions in outdoor environment (brightness variation, features of displays used, etc.). AR systems are being introduced in industrial, commercial, medical and scientific markets for a variety of tasks such as computer aided surgery and assisting in complex repair tasks (in airplanes, for instance).

2.2.1 Describing Geographical Data

To describe a geographical position the terms latitude and longitude are used. They are measures of the angles from the center of the earth to a point on the surface.

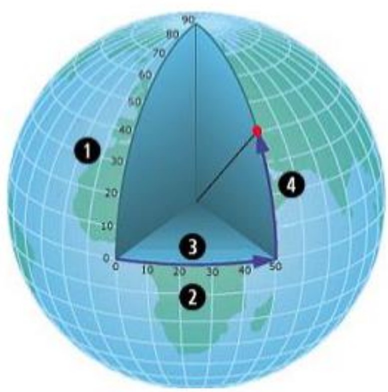

Fig. 2.1 GIS - Latitude and Longitude (Source: Esri Map Projections)

Figure 2.1 shows the sphere of the earth with lines that represent latitudes (1) and longitudes (2). The red dot in this figure is described by the coordinates 50 degrees east (3) and 40 degrees north (4).

To transform the surface of the earth onto a two dimensional plane, map projections are needed. Therefore, a projection surface, which is unfolded or unrolled in the end, has to be chosen. *Figure 2.2* shows three examples of projection surfaces.

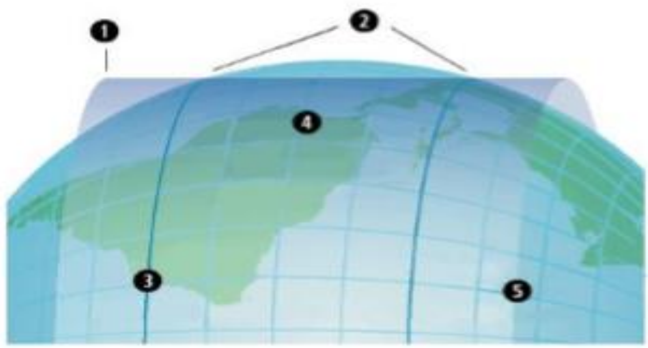

Fig. 2.2 GIS – Projection Surfaces (Source: Esri Map Projections)

No map projection is perfect. Parts of the map are always distorted when represented in a 2D plane. In *Figure 2.3* the distortion problem is illustrated. The projection surface (1), in this case a cylinder, is attached to the sphere of the earth at the secant lines (2). These lines are the only part of the projection without distortion. Inside these lines (4) features are smaller; outside (5) they are bigger.

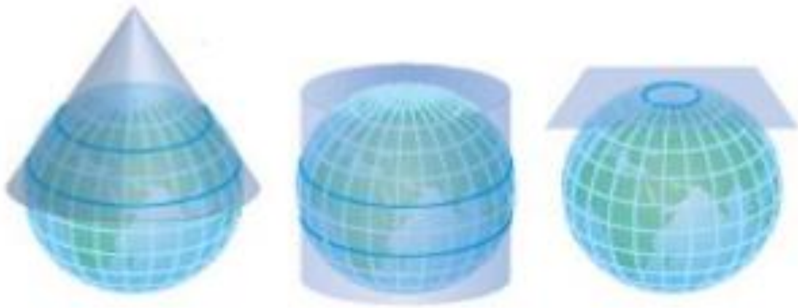

Fig. 2.3 GIS – Projection Problems (Source: Esri Map Projections)

To reduce distortion, different projections are used for different areas on the earth. A GIS is able to project geospatial features from one map projection to others.

2.3 Location Tracking on Mobile Devices

Location-based systems are becoming increasingly popular with the widespread availability of handheld devices with onboard Global Positioning System (GPS) units (Michael, 2008). It is one of the most popular applications in the field of mobile Internet (Yuan & Zhang, 2012). Location-based systems are systems that exploit and leverage the concept of mobility in context of local or remote environmental conditions and factors, and are founded on the core principle of anyplace as the driving rationale (David & Khawar, 2011). Essentially, these systems deliver information that is relevant to users in the context of their location at any particular point in time and where the focus or contextualization of information and services is governed by location (D'Roza & Bilchev, 2003). Location-based systems are value-added systems in which position information is used to present diverse and interesting services to users. These services include emergency services, vehicle navigation services, tourist broadcasting services and searching in country-wide or urban sites data banks using maps (Fatemeh et al, 2012). Developments in location-based systems have been driven by regulatory requirements such as international legislation and a growing awareness of the commercial opportunities which is facilitated by exploiting the technical ability to provide value added information and enhanced experience to mobile consumers, and through emerging demand levels, typical services and associated business models (Rao & Minakakis, 2003). Location-based systems are strongly coupled to the concept of context within mobile computing systems and form a special class of context-aware systems (Streefkerk et al, 2008). The design of a location-based system typically consists of two sub-tasks. The first is to determine the location of the user. The second is to provide relevant information based on the location (Ronald et al, 2007).

As location-based services have increased in popularity over the last years, the need for positioning of mobile devices becomes more and more important.

2.3.1 GPS-Based Positioning

The Global Positioning System (GPS) is the leading technology to determine locations on mobile devices. Almost every smartphone on the market has the capability to receive GPS signals. GPS is a freely accessible system based on satellites. To determine a position the GPS receiver needs a line of sight to four or more satellites. Given this fact, GPS only works outdoors. Each satellite is equipped with a highly accurate atomic clock and sends out this time along with position data of the satellites and error correction data. A GPS receiver compares the satellite time with its own clock and computes based on the difference the distance to the satellite. The distance to the satellite and its absolute position defines a sphere, centered at the satellite as depicted in *Figure 2.4*. The position of the receiver has to be at one point on this surface. Adding data from a second satellite, another sphere can be drawn. Not considering the unlikely event they intersect in one point, both spheres intersect in a circle. A third sphere, computed by the data of the third satellite narrows the position of the receiver down to two points on this circle. For position determination used by smartphones, the intersection point closest to the earth's surface is the correct position of the receiver. The fourth satellite is to correct the error which arises by the fact that the clock of the receiver is not as accurate as the atomic clocks of the satellites. The accuracy of a position determined by GPS depends on the receiver. Most consumer receivers have an accuracy of 5 to 10 meters.

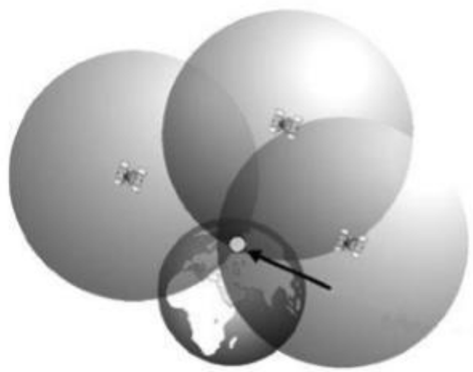

Fig. 2.4 Intercepting Spheres (Source: GPS Theories 2)

2.3.2 Wi-Fi-Based Positioning

While the GPS method for positioning works great outdoors it is not usable indoors, due to the fact that it needs a line of sight to at least four satellites. With an accuracy of 50 - 300 meters, the location tracking method using the mobile phone network is also not suitable. To determine a usable indoor location estimate, different approaches based on Wi-Fi technology can be used.

Nearest Sensor

The easiest way to get a location estimate based on wireless networks is to use the nearest access point. This system is integrated into most of the access point management systems. It determines the access point to which a client is connected. Under the assumption that this is the closest access point and based on the information of it, it computes how far the signal of this access point radiates. The client has to be in range of this area.

Received Signal Strength Indication (RSSI)

Similar to the computation of the GPS-based position, a location estimate can be calculated by the received signal strength of the nearby wireless networks. Whereas the time difference of arrival (TDOA) was used to determine the distance to the satellite, the distance to Wi-Fi access points can be deduced from the RSSI. With the outgoing power level of the access point and signal strength received by the client, the absolute loss of the signal strength is calculated. With the free space path loss equation this leads to the distance to a specific access point. With the distance to three access points and their absolute position, the position of the client can be computed by using a trilateration algorithm.

Radio Frequency Fingerprinting

A relatively high effort is needed for the initial setup of this method. A physical walk around with special spectrum analysis units is needed to create radio frequency (RF) fingerprints for different points of the area where the location should be tracked. A fingerprint identifies locations by measures of the radio frequency setting, which is created by the wireless network access points. Management systems from different vendors include functionality to manage these fingerprints. Based on the measured fingerprints these systems have the ability to compute fingerprints for every other point of the needed area with sophisticated interpolation algorithms. To determine the position of a mobile device, the device sends the current RF fingerprint of its environment to a server. The server compares this real-time fingerprint with the ones in the database and computes a position based on the fingerprints which are similar to it. The benefit of this system is that it also takes environmental effects like reflections on walls or other objects into account.

2.4 Related Works

In this section of the project report some applications are described, which are related to the research direction and system under development.

2.4.1 Oregon University App

In 2011 a team of graduate student developers and undergrad cartographers from the

University of Oregon implemented a mapping application for the university’s’ 20,000+ students and faculty members.

Fig. 2.5 Screenshot of Oregon University App (Source: Oregon University App, 2011)

Besides news and information about upcoming events of the university, the main features of the application are browsing maps and routing on campus. Connected to an ArcGIS server, the application offers users, after defining two places on campus, a route which leads to the destination point. Users of this software also have access to a campus tour, which is set up as a predefined route on the GIS (University of Oregon App [Online], 2011).

2.4.2 Project Glass

Project Glass is a program of Google for research and development of an augmented reality application using glasses as head mounted display. Basically this device enables a user to do things that are normally only possible with a smartphone. The user is, for example, able to look up context based information, take pictures and videos, get directions to stores or other locations or do video chats with this device. Information is displayed on a heads-up display as seen in *Figure 2.6*.

Fig. 2.6 HUD of Project Glass (Source: Google Premiers the patents Project Glass, 2012)

Different to augmented reality applications for mobile devices today, this project is based around a head mounted display in the form of glasses, shown in *Figure 2.7*. It is voice controlled and offers the user hands free interaction.

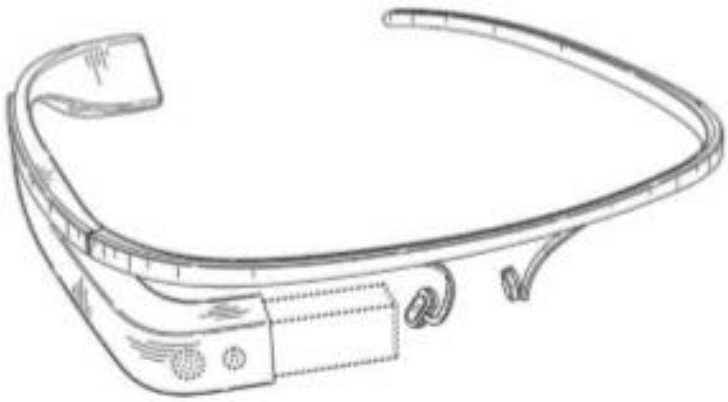

Fig. 2.7 Google Glass Explorer Edition (Source: Google Premiers the Project Glass, 2012)

At the opening keynote of Google's I/O conference, they announced that they will ship the device, named "Glass Explorer Edition", in early 2013 for the price of $1,500 (Engadget [Online], 2012).

2.4.3 UNIOSUN Navigation System

In 2014, Akanbi et al developed a navigation system for the large number of students of the Osun state University. In this design, the user can have a satellite view of the campus, search for various buildings and have an augmented view of the campus. There are various gestures the user can perform which include a pinch, swipe etc. It gives a quick overview of all components of the system environment and shows how they interact with each other. The main components are navigation module, Google Map database (server) and QR Data server.

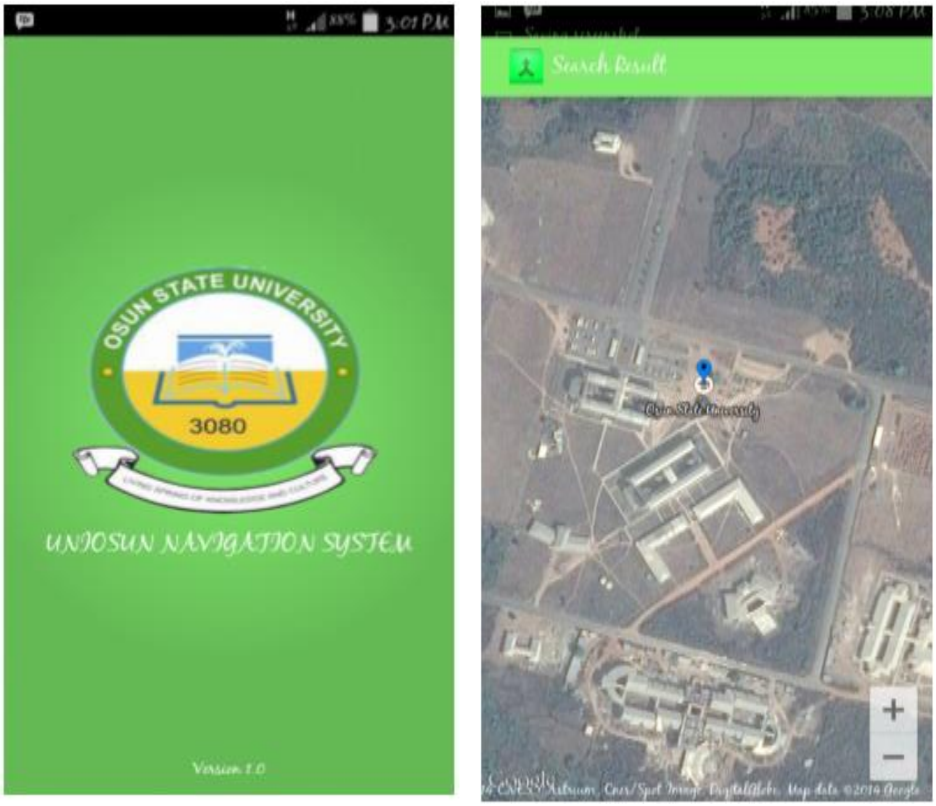

Fig. 2.8 UNIOSUN Navigation System (Akanbi et al, 2014)

2.5 Summary of Literature Review

This chapter presented some important facts about the navigation system which will help the reader to know more about the topic of this project and it also discusses about some other systems which have a similarity with the context of this system. When implementing this campus navigation system the review of the related works will unveil new features which can be added to the existing system which will improve the usability of this system.

CHAPTER THREE

METHODOLOGY AND DESIGN

3.1. Introduction

According to the Merriam-Webster dictionary, a methodology is defined as the analysis of the principles of methods, rules, and postulates employed by a discipline. A methodology outlines a collection of procedures, techniques, tools and documentation aids which will help in the effort to implement the project.

This chapter deals with different approaches on how to create an intuitive application for a mobile device to support navigation on campus to different locations.

System design phase is an iterative process in which requirements gathered in analysis are translated into a "blue print" for constructing the system. At first, the blue print depicts a high level abstract view of the system. Afterwards this can be elaborated into detailed functional behavioral requirements. The lower level abstractions are achieved through design interactions and continuous enhancements. Software design phase accompanies an architecture diagram with pointers to detailed feature specification of smaller pieces of the design. A design is a stable reference, outlining all parts of the software and how they will work (Somerville, 2006).

The methodological steps that will be taken towards the achieving this project fall into two categories.

3.1.1. Research Methodology

No project can succeed without adequate information about the required topic. Research methodology involves gathering all relevant information for the proposed application. This includes facts finding and analysis of the existing systems.

3.1.2. System Methodology

System methodology involves the methods in which we conceive, plan, design, construct and use systems (Hitchins, 2005). System methodology exposes how the project should be managed, the components making up the application, the tools to be utilized, the plan, analysis and design of the system.

3.2. Requirement Gathering and Analysis

3.2.1. Fact Finding Method

This is the most important phase to implement a high quality application. As it is given many information about what user really want and what are the requirements of the user. If the requirements are correctly gathered, then the system can be correctly implemented. There are many techniques that can be used to gathered facts, in formal methods as well as informal methods. Some examples for the fact finding techniques are close-ended interview, open-ended interview, observation, document review, surveys and scenarios.

3.2.2. Analysis of existing systems

It is useful to discover the existing systems and traditional methods in order to develop a new system. Some of the current systems are expensive to maintain and do not fulfil what the user really want. At present, there is no hundred percentage (100%) fulfilled system. Most of them are not fit enough with user requirements. Here are some traditional manual systems that are currently existing.

- Displaying a map covering the whole campus at the entrance.
- Showing arrows as directions.
- Naming departments.

3.2.2.1 Displaying a map covering the whole campus at the entrance

In front of the entrance, there was a 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 are presently not existing. So the information of the map is not far enough to find the destination. 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.

3.2.2.2 Showing arrows as directions

There are banners and arrows that directing the user saying the correct path. Sometime 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 are fallen down. So they are not certify the stability. On the other hand it is effected to environmental pollution and it ruins the beauty of the natural environment.

3.2.2.3 Naming departments

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 faces to rain and get damaged.

3.2.3. Functional requirements of the proposed system

Outdoor navigation of places inside the University

System shall identify the building or places which are being searched. Details of the locations, event details and description of buildings and other important places of the university are stored in the database. Once the user enter the place where he/ she wants to visit, system finds the related data and the data are displayed on the screen in user friendly way. If the input data of the user is invalid, system should suggest related data or display some message that the data are found.

- Road Map view: This view shall display the POIs with the data in a map. Inside the application, a map of university and surrounded area are created and when user enter the desired location as the input, system checks the database table and compare most suitable locations. Finally those places shall be indicated in the map.

- Hybrid Map view: This view shall display the POIs in an aerial view which will show a 3D hybrid detailed view of the map of the university and the surrounded area.

- Search List view: If user has successfully searched the database/ server for a location, this list view shall be more important. Data retrieved as a result of the search input are displayed in a user friendly list view.

3.2.4. Non-Functional requirements of the proposed system

Non-functional requirements specify the important properties and constraints that the system should possess, in order to provide an optimal performance. Non-functional requirements as the name suggests, are the requirements which are not directly concerned with the specific functions delivered by the system. However, failing to meet non-functional system requirements may make the whole system unusable. The key non-functional requirements that the system should attain is given below.

3.2.4.1. Performance

Response Time: The output should be generated within a maximum of 10 seconds depending on the internet connection speed and peak hours of the Internet usage.

Transactions per second: The database can handle 15 transactions per second

Capacity: System can serve 2000 users simultaneously.

Resource Utilization: The application utilizes minimum amount of CPU and memory of the device.

3.2.4.2. Reliability

System should provide the correct positions. Every main buildings can be found without giving users any inconveniences. System shall work with every kinds of phones which operates the Android 2.3 version or above.

In a case of failure user can manually restart the application if the system gets confused. But user may not need to do it as the system has contained error handling or if it is fail to correct the error, the system may be automatically restarted by itself.

3.2.4.3. Availability

The server should be available 24/7/365 standby to serve user requests except the time of maintenance or upgrade.

3.2.4.4. Usability

Simple GUI: The user interface is designed to be simple to use with graphical elements. Texts are simple, clear and readable. Colors are used according to a theme which makes it more usable.

Ease of use: Full screen is used with right size buttons to suit big fingers. Easy navigation among menus. Users can switch their prefer modes such as hybrid map view and roadmap view.

User Guidance: Users are provided with a small help guide and tool tips.

3.2.4.5. Accuracy

The output should be accurate to the best possible percentage and should avoid conflicting and misleading outputs when the inputs are confusing. (Minimum defect rate) i.e. critical bugs have to be eliminated.

3.2.4.6. Portability

All users who has a smart phone with android 2.3 version or above, GPS tracker and other main features can use the system.

3.2.4.7. Maintainability

System is a summation of simple modules that focuses to specific task. So the updating or editing is easy rather than studying the whole parts. It may not necessary to change the complete system in the future, because most of the modules are not directly depend on with the phone and higher versions of androids and others. Once an error is found, it can be corrected and put on the Internet and when the user connect to the server it shall update. So the users shall not need to install the whole package again.

3.3. System Design

3.3.1. Process Model

A Software or system process model is a description of the sequence activities carried out in a software development project, and the relative order of these activities. There are various software development approaches which are employed during the development process of software. Each process model follows a particular life cycle in order to ensure success in the process of software development. Some of the common SDLC models are described below.

3.3.1.1. Waterfall Model

The waterfall model derives its name as the cascading effect from one phase to the other. In the waterfall model each phase has well defined starting and end point, with identifiable deliveries to the next phase. Previous phase must be completed before the next phase starts. The model consists of a number of independent stages in a sequential manner. This means that any stage in the development process begins only if the previous phase is complete. The output of one stage in the process always serves as input for the next stage. The waterfall model make no stipulates about what methods are used at any of its stages, nor does it stipulate what notations are used for the products at each stage.

3.3.1.2. Prototyping Model

In the prototype model, it is functionally equivalent to a component of the product. It allows the user to interact and working with the prototype of the product. It is very useful to identify the correct requirements of the client. The developmental process only continuous once the client is satisfied with the functioning of the prototype.

3.3.1.3. Rapid Application Development (RAD)

Rapid application development (RAD) is a software development methodology that uses minimal planning in favour of rapid prototyping. This is an incremental software development process model that emphasis a very short development cycle [typically 8-12 weeks]. It is an adaptation of the linear, sequential model (waterfall model) using a component-based approach, reusable codes and fourth generation tools. It generally includes dividing the system into development teams each with specific assignment, when each team completes their respective assignment; it is reviewed and then added to the system.

3.3.1.4. Iterative Development Model

The Iterative development model is a faster, more flexible alternative to the waterfall model. With Iterative development, the project is divided into small parts. This allows the development team to demonstrate results earlier on in the process and obtain valuable feedback from system users. This model does not start with a full specification of requirements. Instead, development begins by' spacing and implementing parts of the software, which can then be reviewed in order to identify further requirements. This process is then repeated, producing a new version of the software for each cycle of the model. Each iteration is actually a mini-Waterfall process with the feedback from one phase providing vital information for the design of the next phase. In a variation of this model, the software products, which are produced at the end of each step (or series of steps), can go into production immediately as incremental releases.

3.3.1.5. V-Model

The V-model is a software development model which can be presumed to be the extension of the traditional waterfall model. Each phase must be completed before the next phase, begins. Instead of moving down in a linear way, the process steps are bent upwards after the coding phase, to form the typical V shape. Testing is emphasized in these model more than the waterfall model and testing is done after the completion of each phase. The V-Model demonstrates the relationships between each phase of the development life cycle and its associated phase of testing.

3.3.2. Choice of Process Model and its Justifications

Having considered the various system development models, their strength and weaknesses, the most model that would be adopted as the most appropriate for the purpose of this project is the waterfall model, This model is one of the oldest models and is widely used in government projects and in many major companies (Munassar & Govardhan, 2010). This choice is justified based on the following strengths of the model:

i. Works well with large projects handled by weak teams

ii. Easy to understand and use

iii. It emphasizes design before implementation.

iv. Good for management control

One of the shortcomings of the waterfall model that could have serious implications is the fact that the software is delivered late into the project. But to avoid such problems the feasibility study has been carried out swiftly so as to enhance the quick delivery of the system application.

The waterfall model is depicted in *Figure 3.1*.

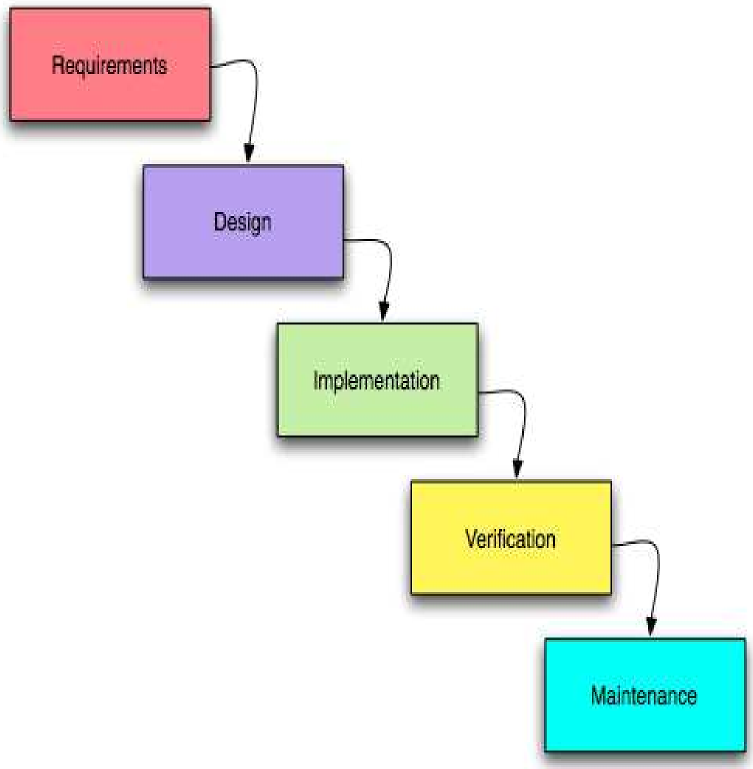

Fig. 3.1 A Typical Waterfall Model (Source: Munassar & Govardhan, 2010)

3.3.3. Design Techniques

Design techniques are the methods is used to model the solution domain. There are many design practices for design techniques. Some of them are modern structured design, Prototyping, Rapid Application Development and Object Oriented design techniques (Object Oriented Design, Wikipedia).

In the Object Oriented design mainly includes abstract, inheritance, polymorphism and encapsulation. Unified Modeling Language (UML) plays an important role in OO design. Unified Modeling Language (UML) consists of series of textual and graphical models of the proposed solution. It defines the scope, components and user interaction with the system. This gives an overview of how the system's components interact with one another to implement the system's functionality.

Use-Case diagrams: Use Case diagram describes how outside entities will interact with the system. The outside entities can be the systems or people, and they are referred to as actors in UML. This actor interact with the system based on his individual role. The Use Case diagram for this project is shown in Figure 3.2.

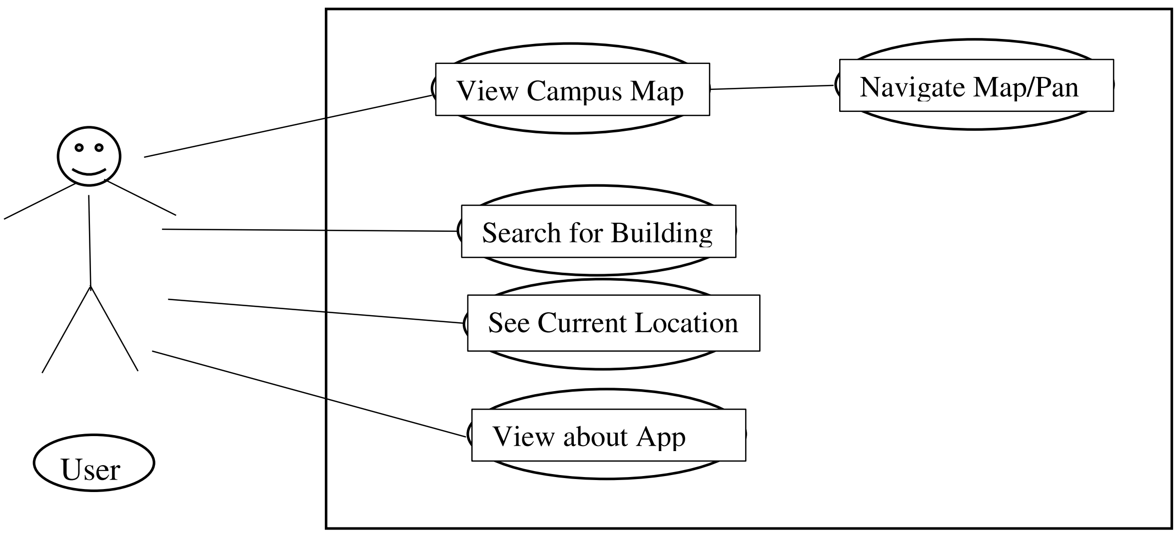

Fig. 3.2 Use Case Diagram of the system

Activity diagrams: The activity diagram depicts the flow of activities that occurs during an operation by the user. It gives a view of the workflow at various levels of focus and shows the transition from one activity to the next.

Sequence diagrams: A 'Sequence diagram' is an interaction diagram is a construct of a message sequence chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the Logical View of the system under development. Sequence diagrams are sometimes called event diagrams, event scenarios.

Class diagrams: The class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualizing, describing and documenting different aspects of a system but also for constructing executable code of the software application. The class diagram describes the attributes and operations of a class and also the constraints imposed on the system. The class diagrams are widely used in the modeling of object oriented systems because they are the only UML diagrams which can be mapped directly with object oriented languages. The class diagram shows a collection of classes, interfaces, associations, collaborations and constraints. It is also known as a *structural diagram*.

3.3.4. User Interface Design

The main source of interaction between a user and the system are the user interfaces where the user is allowed to work with the system without bothering about the backend logics which are neatly hidden from the user. This system is to possess these attributes.

1. Simple, graphical user interface: The user interface is designed to be simple to use with graphical elements. Texts are simple, clear and readable. Colors are used according to a theme which makes it more usable.

2. Minimal surprise: Interface is designed considering the user experience of using android application with providing minimal surprise.

Some other main user interface design rules were followed while designing the system. As specified below.

- Provide clear and consistent navigation along with easy access.

- Display visual elements by following special organization which allows for quick location.

- Use images or icons to make the user to feel comfortable while using the system.

- Choose a font and the text-size which is clear and readable.

3.3.5. System Architecture

To sum up the technical decisions made in this chapter, the resulting system architecture is shown in Figure 3.3. It gives a quick overview of all components of the system environment and shows how they interact with each other. Arrows indicate the communication direction. Labels on the arrows represent the interface between both nodes.

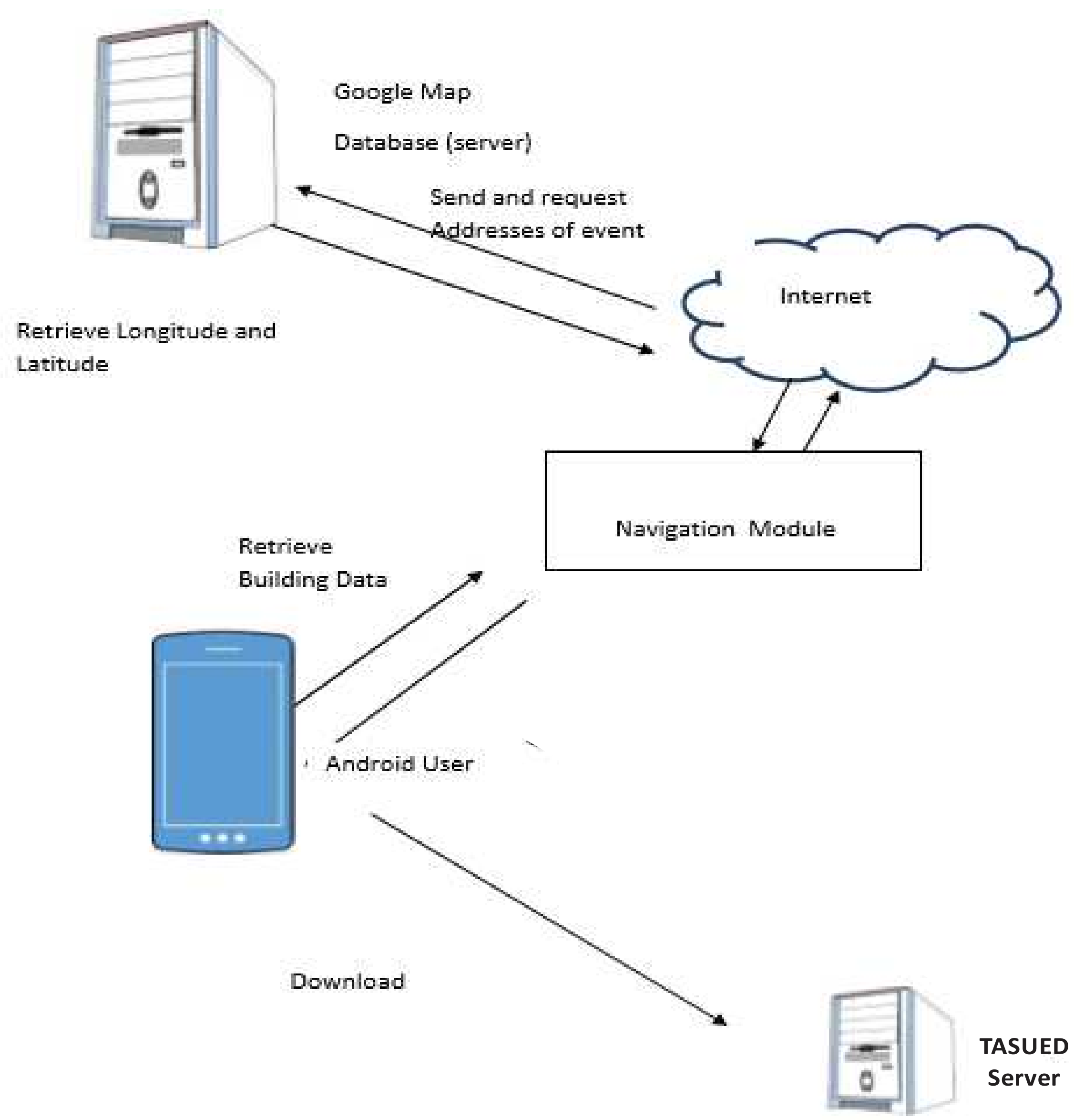

Fig. 3.3 System Architecture of the Campus Navigation System

3.3.5.1. Google Maps JavaScript API Database

Google Maps JavaScript API is a free service, available for any web site that is free to consumers. It lets people to embed Google Maps in web pages and provides number of utilities for manipulating maps and adding content to the map through variety of services, allow to creating robust customized maps applications. Hybrid Map view and Road Map view of the system in design were developed using the directions and map APIs of Google Maps API.

3.3.5.2. Android User

The android users are the clients in this system, the android is a smartphone with a wide range of users. They consume the information of the servers and display it to the user.

3.3.5.3. TASUED Server

The TASUED Server (http://www.tasued.edu.ng) will be the default download server for the system application, any client visiting the server is able to download the application on their smartphone.

CHAPTER FOUR

SYSTEM DEVELOPMENT AND IMPLEMENTATION

4.1. Introduction

Design and Development processes transforms the specification to an executable program, which are, most of the time interleaved. The system has been implemented in order to fulfil the requirements identified so far in the system analysis phase. The design patterns and technologies identified in the system designing phase were highly supported to implement the system timely and efficiently. Once design and concept of web application have been developed in the previous sections, this section will show the main steps to realize it.

4.2. Development Environment

Table 4.1 Development Environment

	Hardware	**Software**
Computer	• Intel(R) Core(TM) i7 M640 @ 2.8GHz • 4 GB RAM • 640 GB Hard disk	Microsoft Windows 10 Pro 64 Bit Chrome Browser Intel XDK 3.1 Microsoft Visual Studios 13

Smartphone	Quad-core 1.5 GHz Krait processor 1 GB RAM 16 GB Primary Storage GPRS, EDGE, HSDPA, HSUPA Enabled	Android Kitkat 4.4.2 Java SDK and JRE

When finalizing the implementation environment various factors were taken into consideration. When selecting the development tool, most of them were free and open source (FOSS) which will not cause much trouble when getting the copyrights of the system. The following will give a brief summary of development environment.

Further the system was implemented in responsive way such that it is fully compatible with all modern Android operating systems in mobile phones and will support for mobile devices like tablets regardless of the android version and the screen size of devices.

4.3. Technologies Used

The System Application was implemented based on the HTML5, CSS and Cordova cross-platform deployment into native apps.

Android was chosen as the main target of the system application.

JavaScript was used to develop all the modules that handles the communication with Google Maps JavaScript API V3 server.

4.3.1. HTML5

HTML is a language for describing web pages.

- HTML stands for **H**yper **T**ext **M**arkup **L**anguage
- HTML is a **markup** language
- A markup language is a set of markup **tags**
- The tags **describe** document content
- HTML documents contain HTML **tags** and plain **text**
- HTML documents are also called **web pages**

HTML5 is the next major revision of the HTML standard superseding HTML 4.01, XHTML 1.0, and XHTML 1.1. HTML5 is a standard for structuring and presenting content on the World Wide Web.

HTML5 is a cooperation between the World Wide Web Consortium (W3C) and the Web Hypertext Application Technology Working Group (WHATWG).

The new standard incorporates features like video playback and drag-and-drop that have been previously dependent on third-party browser plug-ins such as Adobe Flash, Microsoft Silverlight, and Google Gears (TutorialsPoint, 2016).

4.3.2. CSS

Cascading **S**tyle **S**heets, fondly referred to as CSS, is a simple design language intended to simplify the process of making web pages presentable.

CSS handles the look and feel part of a web page. Using CSS, you can control the color of the text, the style of fonts, the spacing between paragraphs, how columns are sized and laid out, what background images or colors are used, as well as a variety of other effects.

CSS is easy to learn and understand but it provides powerful control over the presentation of an HTML document. Most commonly, CSS is combined with the markup languages HTML or XHTML.

CSS defines HOW HTML elements are to be displayed.

Styles are normally saved in external .css files. External style sheets enable you to change the appearance and layout of all the pages in a Web site, just by editing one single file! (TutorialsPoint, 2016).

4.3.3. JavaScript

JavaScript started life as LiveScript, but Netscape changed the name, possibly because of the excitement being generated by Java.to JavaScript. JavaScript made its first appearance in Netscape 2.0 in 1995 with a name *LiveScript*.

JavaScript is a lightweight, interpreted programming language with object-oriented capabilities that allows you to build interactivity into otherwise static HTML pages.

The general-purpose core of the language has been embedded in Netscape, Internet Explorer, and other web browsers.

The ECMA-262 Specification defined a standard version of the core JavaScript language.

JavaScript is:

- JavaScript is a lightweight, interpreted programming language
- Designed for creating network-centric applications
- Complementary to and integrated with Java
- Complementary to and integrated with HTML
- Open and cross-platform

Client-side JavaScript is the most common form of the language. The script should be included in or referenced by an HTML document for the code to be interpreted by the browser.

It means that a web page need no longer be static HTML, but can include programs that interact with the user, control the browser, and dynamically create HTML content.

The JavaScript client-side mechanism features many advantages over traditional CGI server-side scripts. For example, you might use JavaScript to check if the user has entered a valid e-mail address in a form field.

The JavaScript code is executed when the user submits the form, and only if all the entries are valid they would be submitted to the Web Server.

JavaScript can be used to trap user-initiated events such as button clicks, link navigation, and other actions that the user explicitly or implicitly initiates (TutorialsPoint, 2016).

4.4. Tools Used

4.4.1. Intel XDK

Intel XDK is a development kit created by Intel to create native apps for mobile phones and tablets using web technologies like HTML5, CSS and JavaScript (Hilliar, 2014). Apps are compiled online via the Cordova platform for making cross-platform apps. It is available to download for free for Windows, OS X and Linux (both 32-bit and 64-bit). The kit allows a developer to compile the same solution to different platforms, thus reducing the amount of code required to ship a cross-platform product. The XDK was first launched in October 2013.

4.4.2. Firebug 2.0 Debugging Tool

It is a web development tool which can be installed in 'Google Chrome' web browser in order to inspect HTML and modify style and layout in real-time. Further it provides JavaScript debugging, analyzing network usage/performance and many more to support web development tasks.

4.5. Third Party Plugins Used

4.5.1. jQuery

jQuery is a lightweight, "write less, do more", JavaScript library.

The purpose of jQuery is to make it much easier to use JavaScript on your website. jQuery takes a lot of common tasks that require many lines of JavaScript code to accomplish, and wraps them into methods that you can call with a single line of code.

jQuery also simplifies a lot of the complicated things from JavaScript, like AJAX calls and DOM manipulation.

The jQuery library contains the following features:

- HTML/DOM manipulation
- CSS manipulation
- HTML event methods
- Effects and animations
- AJAX
- Utilities

4.6. System Application Interface Screenshots

4.6.1. Main Menu

The main menu shown in *Figure 4.1* is the entry point of this application. It offers four self-explanatory options to the user, while it is open we can see the map displayed underneath the menu depending on the map mode the user has selected, *Figure 4.1 (a)* shows the underneath to be Hybrid map mode and in the menu the Hybrid map mode is highlighted with blue background, while in *Figure 4.1 (b)* show the underneath as a road map and in the main menu the road map mode is highlighted with a blue background.

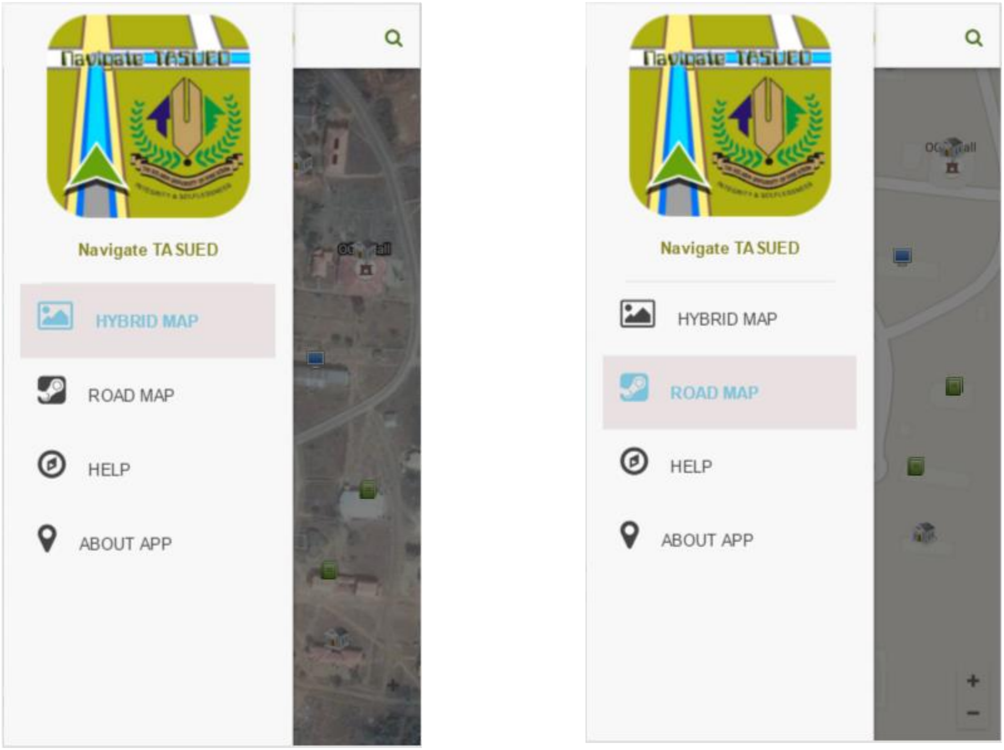

Fig. 4.1 (a) Main Menu/ Hybrid Map, (b) Main Menu/ Road Map

4.6.2. Search Form

This search form can be accessed by a click on the search icon on the display layout as shown in *Figure 4.2*.

With the standard Android keyboard the user can specify his/her search criteria and the automatic search begins on each tap of the keyboard to save the user the stress of having to traditionally tap on a seach button or clicking a “Go” command buton to initiate the search.

If there is more than one result he gets those displayed on a list screen as shown in *Figure 4.2 (b)*, In the case of no match, the search form stays present and displays no search result or a message telling the user that his/her search was not successful.

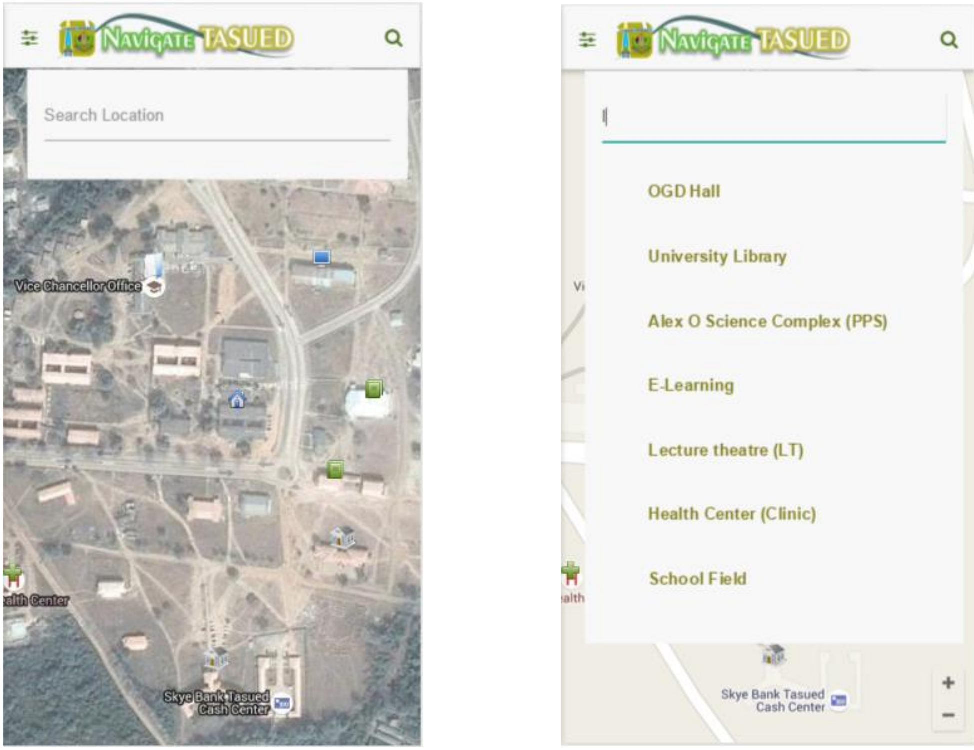

Fig. 4.2 (a) **Empty** Search Form, (b) **Populated** Search Form

4.6.3. Map View

The main activity of the system application is the map activity. It displays the campus map of the Tai Solarin University of Education as shown in *Figure 4.4 (b)*. The user can zoom and scroll this map with multi touch gestures as shown in *Figure 4.3*. The building map is the basic layer of this screen.

Fig. 4.3 - Multi-touch Gestures: (a) Pinch, (b) Spread, (c) Scroll

(Source: http//:google.com/image)

To interact with this activity the user can switch map mode by accessing the main menu by clicking the menu icon on the display layout. An option menu appears as seen in *Figure 4.1*. The "Hybrid Map" menu item exchanges the building and floor plans with a satellite image of the campus.

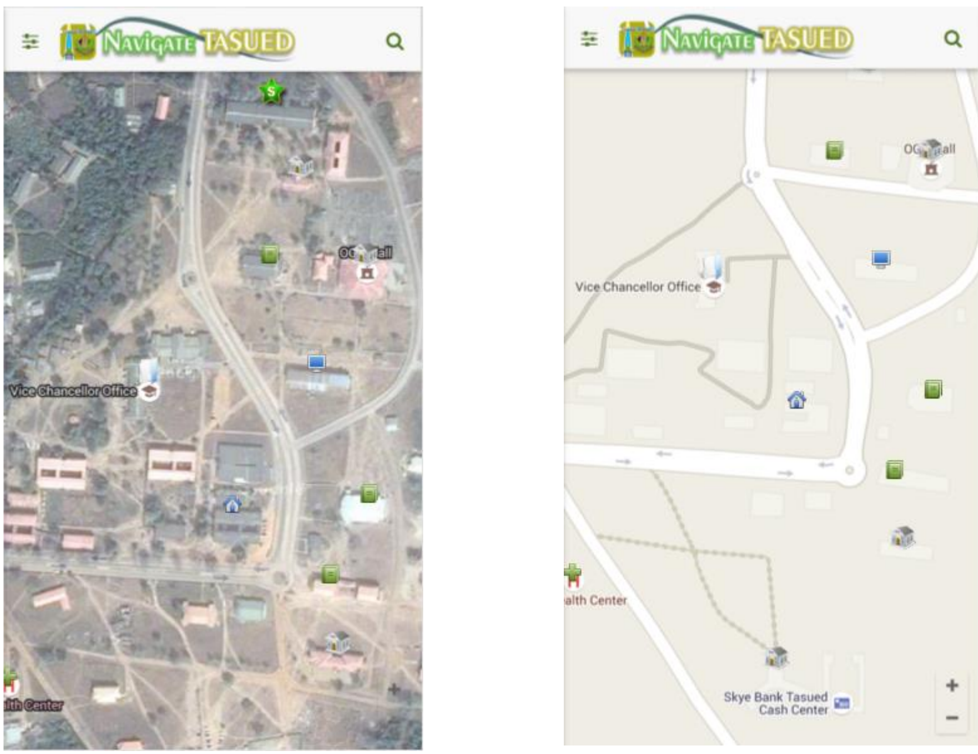

Fig. 4.4 (a) Hybrid Map Activity, (b) Road Map Activity

4.7. Summary of System Development

This chapter discussed about the implementation phase of the System application software of this project. It described the usage of major tools and technologies, software SDKs, software frameworks, Third Party Components and Services etc. used to implement this project successfully. Major code segments of important scripts were also shown and the importance of major methods were expressed using comments.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.1. Summary

The goal of this project was to create a system that incorporate mobile application which helps people on the campus of the Tai Solarin University of Education to orientate themselves and find their destination.

In order to achieve this, a system environment was designed based on the requirements from chapter one and two, and the techniques described in chapter three and four. Different data sources have been analyzed and integrated into this system. Finally, 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.

The strength of this application is the easy to use navigation feature which is able to find paths on campus to user-defined locations. A lot of different techniques and data sources were integrated into this application. Although not every feature could be implemented, the application offers a fully functional routing feature.

5.2. Conclusion

Campus Navigation System is a system 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. This system is being introduced to enhance the user satisfaction and ease the self-touring experience within the Tai Solarin University of Education.

The most typical needs of students and visitors of the university is been calculated and taken into consideration for the development of the system. There are no heavy user involvement in data or information processing only they need to get to know the correct details for the purpose of navigating through the premises of the university. Before this system was first introduced and implemented, many of the visitors had faced the common general issues that have being addressed by the application in present time.

The implementation of the Campus Navigation System has quite impact on the university environment, given that the system allows students, lecturers and visitors navigate, search for a place of interest with complete ease.

REFERENCES

Akanbi, C.O., Ogundoyin, I.K. & Lawal, A.O. (2014). “Implementing A University Mobile Navigation System”, African Journal of Computing & ICT, Vol. 7, No. 5, Pp. 143 – 150.

Attia, M. (2013). "Map Aided Indoor and Outdoor Navigation Applications" Unpublished Thesis, Department of Geomatics Engineering, University of Calgary, Alberta.

Barnes, S. J. (2003). “Location-Based Services: The State of the-Art”, e-Service Journal, Vol. 2, No. 3, Pp. 59-69.

Bayrak Meydanoglu, E.S. (2013). "QR Code: An Interactive Mobile Advertising Tool "International Journal of Business and Social Research (IJBSR), Vol. 3, No. 9.

Bowditch, N. (2002). ‘’Basic land navigation’’, National Wildfire Coordinating Group. Retrieved from www.nwcg.gov/pms/pubs/475/PMS475_ chap5.pdf.

Coleman, J. (2011). Kansas Library Association College and University Libraries Section Proceedings: QR Codes: What Are They and Why Should You Care? Kansas, United States.

David, G. & Khawar, H. (2011). The Use of Design Patterns in a Location-Based GPS Application. International Journal of Computer Science Issues (IJCSI), Vol. 8, Issue 3, No. 1.

D'Roza, T. & Bilchev, G. (2003). An overview of location-based services. BT Technology Journal, 21(1), Pp. 20-27.

Engadget, "Google unveils Project Glass" (2012). Retrieved from http://www.engadget.com/2012/06/27/google-unveils-project-glass-explorer-edition/.

Esri Map Projections (n.d.). Retrieved from www.webhelp.esri.com/arcgisexplorer/900/en/map_projections.htm

Fatemeh, K., Mehregan, M. & Maedeh, K.S. (2012). Designing a recommender system based on Social networks and location based services. International Journal of Managing Information Technology (IJMIT) Vol. 4, No. 4.

Gerhard, S. (2012). "Mobile Augmented Reality for Human Scale Interaction with Geospatial Models: The Benefit of Mobile Augmented Reality for Industrial Applications'', Springer.

Google Premiers the patents Project Glass. (2012). www.pmanewsline.com/2012/05/16/google-patents-project-glass/.

GPS Theories 2: GPS Geotagging. (n.d.). Retrieved from http://theoxymoron.wordpress.com/category/gpsgeotagging/.

Graham, M., Zook, M., & Boulton, A. (2012). "Augmented reality in urban places: contested content and the duplicity of code." Transactions of the Institute of British Geographers, DOI: 10.1111/j.14755661.2012.00539.

Harrison, R., Derek, F., & David, D. (2013). "Usability of mobile applications: literature review and rationale for a new usability model", Journal of interaction science. Retrieved from www.journalofinteractionscience.com/content /1/1/1.

Hilliar, Gastón (2014). "Developing Cross-Platform Mobile Apps with HTML5 and Intel XDK". *Dr. Dobb's Journal*. UBM plc.

Hitchins, D.K. (2005). “Systems Methodology whitepaper: HTML and CSS white paper”. Retrieved from hitchins.net/The%20Systems%20Approach.pdf.

Kumar, M.V. & Kumar, S.R. (2014). "Fingerprint Based Licensing System for Driving" International Journal of Advanced Research in Computer and Communication Engineering. Vol. 3, Issue 9.

Lautenschläger, B. (2012). "Design and Implementation of a Campus Navigation Application with Augmented Reality for Smartphones", Unpublished bachelor thesis Department of Computer Science, University of Calgary, Alberta, Canada.

Michael, M. (2008). Prototyping of a Location-Based Tour Guide. M.Sc. Dissertation. Faculty of Science, University of Ontario Institute of Technology.

Munassar, & Govardian (2010). A traditional System Analysis and design with Agile Methodologies. Retrieved from http://en.wikipedia.org/wiki/waterfall-model.

Object oriented design, Wikipedia, The Free Encyclopedia (n.d.). Retrieved from http://en.wikipedia.org/wiki/Object-oriented_design.

Rao, B. & Minakakis, L. (2003). Evolution of mobile location-based services, Commun. ACM, 46(12), Pp. 50 - 61.

Ronald, B., Bernard, M. & Nafaa, J. (2007). An Architecture for Delivering Location-Based Services. International Journal of Computer Science and Network Security, Vol. 7, No. 7.

Somerville, I. (2006). Software Engineering, 8th edition, Addison-Wesley.

Streefkerk, J.W., Van Esch-Bussemakers, M.P. & Neerincx, M.A., (2008). Mobile HCI '08: Proceedings of the 10th international conference on Human computer interaction with mobile devices and services, Field evaluation of a mobile location-based notification system for police officers. ACM, Pp. 101-108.

TutorialsPoint (2016). Developers guide to CSS, HTML and JavaScript. Retrieved from http://www.tutorialspoint.com.

University of Oregon App (2011). Retrieved from www.uoregon.edu/mobile.

Virrantaus et al (2001). “Developing GIS-supported location-based services”, Proceedings of the Second International Conference on Web Information System Engineering, in C. Claramunt, W. Winiwarter, Y. Kambayashi, Y. Zhang (Eds.), Vol. 2 , Pp. 66 –75.

Yuan, Y. Y. & Zhang, L. (2012). Design and Implementation of Positioning and Navigation System Based on Android. National Conference on Information Technology and Computer Science (CITCS 2012), Pp. 686 -689.

APPENDIX

SOURCE CODE

MAIN WINDOW SEGMENT

```
<!DOCTYPE html>
<html lang="en">
<head>
    <title>
        Navigate TASUED
    </title> <!-- Character set configuration -->
    <meta charset="UTF-8">
    <!-- Viewport configuration, scaling options -->
    <meta name="viewport" content="width=device-width, initial-scale=1.0, maximum-
        scale=1.0, user-scalable=no">
    <!-- Hide the browser UI -->
    <meta name="apple-mobile-web-app-capable" content="yes">
    <!-- Android toolbar color -->
    <meta name="theme-color" content="#69f0ae">
    <link href="img/logo.png" rel="icon" />
    <link href="css/main.css" rel="stylesheet" />
    <link href="css/bootstrap.min.css" rel="stylesheet" />
    <link href="css/font-awesome.min.css" rel="stylesheet" />
    <link href="css/materialize.css" rel="stylesheet" />
    <script src="http://maps.googleapis.com/maps/api/js"></script>
    <style>
        a:hover {
```

```
            text-decoration: none !important;
        }
    </style>
</head>
<body>
    <!-- Navigation bar -->
    <div class="navbar-fixed" id="nav">
        <nav class="navbar navbar-default bold appTop">
            <div class="nav-wrapper container-fluid">
                <!-- Mobile menu button -->
                <a href="#" data-activates="m_menu" class="button-collapse"><i class="fa fa-
            sliders" style="color:#4e7423;font-size:16px;"></i></a>
                <!-- Site name -->
                <a class="navbar-brand col-xs-6" href="javascript:;">
                    <img src="img/navit.png" class="mainAppLogo" />
                    <img src="img/navitsmall.png" class="smallAppLogo" />
                </a>
                <a href="#" id="nav-toggle" data-toggle="collapse" data-target="#b_menu"
            class="searchtab pull-right"><i class="fa fa-search" style="color:#4e7423;font-
            size:16px;"></i></a>


                <!-- Static menu -->
                <ul class="right hide-on-med-and-down table-of-contents">
                    <li><a href="javascript:;" class="hybridMap act mapType">HYBRID
            MAP<span class="sr-only">(current)</span></a></li>
                    <li><a href="javascript:;" class="roadMap mapType">ROAD MAP</a></li>
                    <li><a href="#modalHelp" data-toggle="modal">HELP</a></li>
```

```
        <li><a href="#modalAbout" data-toggle="modal">ABOUT APP</a></li>
    </ul>
    <div id="b_menu" style="margin-left:5px;width:100%;" class="collapse navbar-collapse">
        <form class="navbar-form" role="search" id="filter" style="border:0 !important;" action="javascript:;">
            <input id="txtSearch" class="form-control inputSearch" type="text" title="Search Location" placeholder="Search Location">
            <ol id="task-list" style="display:block;background:#f8f8f8;">
                <li><a href="#" onclick="initialize('ogd')">OGD Hall</a></li>
                <li><a href="#" onclick="initialize('library')">University Library</a></li>
                <li><a href="#" onclick="initialize('pps')">Alex O Science Complex (PPS)</a></li>
                <li><a href="#" onclick="initialize('ict')">ICT</a></li>
                <li><a href="#" onclick="initialize('sbk')">SBK</a></li>
                <li><a href="#" onclick="initialize('cepep')">CEPEP</a></li>
                <li><a href="#" onclick="initialize('auditorium')">Auditorium</a></li>
                <li><a href="#" onclick="initialize('elearning')">E-Learning</a></li>
                <li><a href="#" onclick="initialize('vcbuilding')">VC Office</a></li>
                <li><a href="#" onclick="initialize('adoffice')">Admission Office</a></li>
                <li><a href="#" onclick="initialize('lt')">Lecture theatre (LT)</a></li>
                <li><a href="#" onclick="initialize('etfcoaevot')">ETF</a></li>
                <li><a href="#" onclick="initialize('kaaf')">KAAF</a></li>
                <li><a href="#" onclick="initialize('coaevot')">COAEVOT</a></li>
                <li><a href="#" onclick="initialize('cosmas')">COSMAS</a></li>
                <li><a href="#" onclick="initialize('clinic')">Health Center (Clinic)</a></li>
```

```
        <li><a href="#" onclick="initialize('field')">School Field</a></li>
      </ol>
    </form>
  </div>
  <!-- Mobile menu, make sure it is equal to the statis menu -->
  <ul class="side-nav" id="m_menu">
    <div class="mobmenu">
      <div class="inmenu">
        <img src="img/logo.png" class="responsive-img" alt="Logo"
style="margin:auto;width:70%;">
      </div>
      <div class="menuid">
        <span style="color:#848124;font-weight:bolder;">Navigate
TASUED</span>
      </div>
    </div>
    <div class="container">
      <div class="divider"></div>
    </div>
    <li><a href="javascript:;" class="hybridMap act mapType"><i class='fa fa-
image sidemenimg'></i>HYBRID MAP<span class="sr-
only">(current)</span></a></li>
    <li><a href="javascript:;" class="roadMap mapType"><i class='fa fa-steam-
square sidemenimg'></i>ROAD MAP</a></li>
    <li><a href="#modalHelp" data-toggle="modal"><i class='fa fa-compass
sidemenimg'></i>HELP</a></li>
    <li><a href="#modalAbout" data-toggle="modal"><i class='fa fa-map-marker
sidemenimg'></i>ABOUT APP</a></li>
  </ul>
```

```
        </div>
    </nav>
</div><div id="googleMap" class="col-xs-12 mapContainer"></div>
<div class="modal fade modTop" id="modalAbout" tabindex="-1" role="dialog" data-
        backdrop="static" aria-labelledby="myModalLabel" aria-hidden="true">
    <div class="modal-dialog">
        <div class="modal-content">
            <div class="modal-header">
                <button type="button" class="close" data-dismiss="modal" aria-
        hidden="true"></button>
                <h4 class="modal-title" style="text-align:center;">
                    <img src="img/navit.png" style="height:35px;" />
                </h4>
            </div>
            <div class="modal-body">
                <h3 class="text-center">About Navi-T</h3>
                <p>
                    This application is designed to serve as a navigation guide to new students
        and visitors to the
                    school campus.
                </p>
                <p>
                    <font class="authName">Adekoniye Adedoyin Michael</font> <br />
                    <strong>20120204012</strong> <br />
                    Computer Science Department
                </p>
                <p> &copy; 2016 </p>
```

```
          </div>
          <div class="modal-footer">
            <button type="button" class="btn btn-danger" data-dismiss="modal">View
        Map</button>
          </div>
        </div>
        <!-- /.modal-content -->
      </div>
      <!-- /.modal-dialog -->
    </div>
    <div class="modal fade modTop" id="modalHelp" tabindex="-1" role="dialog" data-
        backdrop="static" aria-labelledby="myModalLabel" aria-hidden="true">
      <div class="modal-dialog">
        <div class="modal-content">
          <div class="modal-header">
            <button type="button" class="close" data-dismiss="modal" aria-
        hidden="true"></button>
            <h4 class="modal-title" style="text-align:center;">
              <img src="img/navit.png" style="height:35px;" />
            </h4>
          </div>
          <div class="modal-body">
            <h3 class="text-center">Help</h3>
            <ol>
              <li>
                Pinch or spread screen to zoom in or out of the map.
              </li>
```

```
            <li>
              Drag map from one point in the opposing direction to pan across the map.
            </li>
            <li>
              Click on Road Map to change map type to a vector map showing road
    network and building structure.
            </li>
            <li>
              Click on Hybrid map to change map type to the default satelite view of the
    campus.
            </li>
          </ol>
        </div>
        <div class="modal-footer">
          <button type="button" class="btn btn-danger" data-dismiss="modal">View
    Map</button>
        </div>
      </div>
      <!-- /.modal-content -->
    </div>
    <!-- /.modal-dialog -->
  </div>
  <div id="triangles" class="scrollspy display-hide"></div>
  <!-- Scripts -->
  <script src="scripts/build.js"></script>
  <script src="js/main.js"></script>
  <script src="js/search.js"></script>
```

```
    <script src="js/bootstrap.min.js"></script>
</body>
</html>
```

INITIALIZATION MODULE

```
function initialize(x) {
    //Define marker icons
    var icton = 'img/markers/admin_small.png';
    var blocks = 'img/markers/house.png';
    var sbkon = 'img/markers/star.png';
    var buildings = 'img/markers/assets_small.png';
    var marker = 'img/markers/marker.png';
    var ltcon = 'img/markers/book.png';
    var fieldon = 'img/markers/medal_gold_1.png';
    var lib = 'img/markers/gl_small.png';
    var elearn = 'img/markers/monitor.png';
    var pin = 'img/markers/pin.png';
    var clinicon = 'img/markers/add.png';
    //Building LatLng
    var vcbuildingP = new google.maps.LatLng(6.784308, 3.927735);
    var ogdP = new google.maps.LatLng(6.785381, 3.929760);
    var libraryP = new google.maps.LatLng(6.785048, 3.930760);
    var ppsP = new google.maps.LatLng(6.786310, 3.930818);
    var ictP = new google.maps.LatLng(6.783944, 3.931726);
    var sbkP = new google.maps.LatLng(6.786841, 3.928881);
    var cepepP = new google.maps.LatLng(6.786198, 3.929170);
```

```
var auditoriumP = new google.maps.LatLng(6.785425, 3.928870);
var elearningP = new google.maps.LatLng(6.784419, 3.929304);
var adofficeP = new google.maps.LatLng(6.783136, 3.928525);
var ltP = new google.maps.LatLng(6.783225, 3.929783);
var etfcoaevotP = new google.maps.LatLng(6.782484, 3.929428);
var kaafP = new google.maps.LatLng(6.781742, 3.930599);
var coaevotP = new google.maps.LatLng(6.781820, 3.929508);
var cosmasP = new google.maps.LatLng(6.780712, 3.928338);
var clinicP = new google.maps.LatLng(6.781545, 3.926448);
var fieldP = new google.maps.LatLng(6.781800, 3.924914);
var minZoomLevel = 17;
//Default settings
var mapProp = {
  center: new google.maps.LatLng(6.783447, 3.928291),
  zoom: minZoomLevel,
  mapTypeId: google.maps.MapTypeId.HYBRID,
  zoomControl: true,
  mapTypeControl: false,
  scaleControl: false,
  streetViewControl: false,
  rotateControl: false,
  fullscreenControl: true
};
var infoWindow = new google.maps.InfoWindow({ map: map });
// Try HTML5 geolocation.
if (navigator.geolocation) {
```

```
    setInterval(function () {
        navigator.geolocation.getCurrentPosition(function (position) {
            var pos = {
                lat: position.coords.latitude,
                lng: position.coords.longitude
            };
            var marker = new google.maps.Marker({
                position: pos,
                map: map,
                title: 'Present Location',
                visible: true
            });
            marker.setMap(map);
            infoWindow.setPosition(pos);
            infoWindow.setContent('Location found');
            map.setCenter(pos);
        }, function () {
            handleLocationError(true, infoWindow, map.getCenter());
        })
    }, 3000);
} else {
    // Browser doesn't support Geolocation
    handleLocationError(false, infoWindow, map.getCenter());
}
//create map
var map = new google.maps.Map(document.getElementById("googleMap"), mapProp);
```

```
// Limit the zoom level
google.maps.event.addListener(map, 'zoom_changed', function () {
   if (map.getZoom() < minZoomLevel) map.setZoom(minZoomLevel);
});
//change map type
$('.mapType').on('click', function () {
   var self = $(this);
   var nextTypeID = this.text;
   if (nextTypeID = "HYBRID MAP(current)") {
      map.setMapTypeId(google.maps.MapTypeId.HYBRID);
   } else {
      map.setMapTypeId(google.maps.MapTypeId.ROADMAP);
   }
   $('.mapType').removeClass('act');
   self.addClass('act');
});
//add markers to the map
var ogdwindow = new google.maps.InfoWindow({
   content: 'Otunba Gbenga Daniel Hall'
});
var ogd = new google.maps.Marker({
   position: ogdP,
   map: map,
   title: "OGD HALL",
   icon: buildings
});
```

```
google.maps.event.addListener(ogd, 'click', function () {
   ogdwindow.open(map, ogd);
});
ogd.setMap(map);
var librarywindow = new google.maps.InfoWindow({
   content: 'TASUED Library'
});
var library = new google.maps.Marker({
   position: libraryP,
   map: map,
   title: "TASUED Library",
   icon: lib
});
google.maps.event.addListener(library, 'click', function () {
   librarywindow.open(map, library);
});
library.setMap(map);
var ppswindow = new google.maps.InfoWindow({
   content: 'Pet Chem Complex'
});
var pps = new google.maps.Marker({
   position: ppsP,
   map: map,
   title: 'ALex O. Science Complex',
   icon: buildings
});
```

```
google.maps.event.addListener(pps, 'click', function () {
   ppswindow.open(map, pps);
});
pps.setMap(map);
var ictwindow = new google.maps.InfoWindow({
   content: 'Information and Communication Technology'
});
var ict = new google.maps.Marker({
   position: ictP,
   map: map,
   title: "ICT!",
   icon: icton
});
google.maps.event.addListener(ict, 'click', function () {
   ictwindow.open(map, ict);
});
ict.setMap(map);
var sbkwindow = new google.maps.InfoWindow({
   content: 'Science Complex'
});
var sbk = new google.maps.Marker({
   position: sbkP,
   map: map,
   title: "SBK Building!",
   icon: sbkon
});
```

```
google.maps.event.addListener(sbk, 'click', function () {
   sbkwindow.open(map, sbk);
});
sbk.setMap(map);
var cepepwindow = new google.maps.InfoWindow({
   content: 'CEPEP Building'
});
var cepep = new google.maps.Marker({
   position: cepepP,
   map: map,
   title: "CEPEP Building!",
   icon: buildings
});
google.maps.event.addListener(cepep, 'click', function () {
   cepepwindow.open(map, cepep);
});
cepep.setMap(map);
var auditoriumwindow = new google.maps.InfoWindow({
   content: 'The College Auditorium'
});
var auditorium = new google.maps.Marker({
   position: auditoriumP,
   map: map,
   title: "The College Auditorium!",
   icon: ltcon
```

```
});
google.maps.event.addListener(auditorium, 'click', function () {
   auditoriumwindow.open(map, auditorium);
});
auditorium.setMap(map);
var elearningwindow = new google.maps.InfoWindow({
   content: 'E-Learning Building'
});
var elearning = new google.maps.Marker({
   position: elearningP,
   map: map,
   title: "The University Block",
   icon: elearn
});
google.maps.event.addListener(elearning, 'click', function () {
   elearningwindow.open(map, elearning);
});
elearning.setMap(map);
var vcbuildingwindow = new google.maps.InfoWindow({
   content: "Vice Chancellor's Office"
});
var vcbuilding = new google.maps.Marker({
   position: vcbuildingP,
   map: map,
   title: "Vice Chancellor's Office!",
   icon: lib
```

```
});
google.maps.event.addListener(vcbuilding, 'click', function () {
   vcbuildingwindow.open(map, vcbuilding);
});
vcbuilding.setMap(map);
var adofficewindow = new google.maps.InfoWindow({
   content: 'Admission Office (Block F)'
});
var adoffice = new google.maps.Marker({
   position: adofficeP,
   map: map,
   title: "Admission Office (Block F)!",
   icon: blocks
});
google.maps.event.addListener(adoffice, 'click', function () {
   adofficewindow.open(map, adoffice);
});
adoffice.setMap(map);
var ltwindow = new google.maps.InfoWindow({
   content: 'Lecture Theatre'
});
var lt = new google.maps.Marker({
   position: ltP,
   map: map,
   title: "Lecture Theatre!",
   icon: ltcon
```

```
});
google.maps.event.addListener(lt, 'click', function () {
   ltwindow.open(map, lt);
});
lt.setMap(map);
var etfcoaevotwindow = new google.maps.InfoWindow({
   content: 'ETF'
});
var etfcoaevot = new google.maps.Marker({
   position: etfcoaevotP,
   map: map,
   title: "ETF!",
   icon: ltcon
});
google.maps.event.addListener(etfcoaevot, 'click', function () {
   etfcoaevotwindow.open(map, etfcoaevot);
});
etfcoaevot.setMap(map);
var kaafwindow = new google.maps.InfoWindow({
   content: 'Keshington Building (KAAF)'
});
var kaaf = new google.maps.Marker({
   position: kaafP,
   map: map,
   title: "Keshington Building!",
   icon: buildings
```

```
});
google.maps.event.addListener(kaaf, 'click', function () {
   kaafwindow.open(map, kaaf);
});
kaaf.setMap(map);
var coaevotwindow = new google.maps.InfoWindow({
   content: 'COAEVOT Building'
});
var coaevot = new google.maps.Marker({
   position: coaevotP,
   map: map,
   title: "COAEVOT Building",
   icon: buildings
});
google.maps.event.addListener(coaevot, 'click', function () {
   coaevotwindow.open(map, coaevot);
});
coaevot.setMap(map);
var cosmaswindow = new google.maps.InfoWindow({
   content: 'COSMAS Building'
});
var cosmas = new google.maps.Marker({
   position: cosmasP,
   map: map,
   title: "COSMAS Building",
   icon: buildings
```

```
});
google.maps.event.addListener(cosmas, 'click', function () {
   cosmaswindow.open(map, cosmas);
});
cosmas.setMap(map);
var clinicwindow = new google.maps.InfoWindow({
   content: 'TASUED Health Centre (Clinic)'
});
var clinic = new google.maps.Marker({
   position: clinicP,
   map: map,
   title: "Health Centre!",
   icon: clinicon
});
google.maps.event.addListener(clinic, 'click', function () {
   clinicwindow.open(map, clinic);
});
clinic.setMap(map);
//field
var fieldP = new google.maps.LatLng(6.781800, 3.924914);
var fieldString = 'Sports field';
var fieldwindow = new google.maps.InfoWindow({
   content: 'TASUED Sports Complex'
});
var field = new google.maps.Marker({
   position: fieldP,
```

```
    map: map,
    title: "Field!",
    icon: fieldon
});
google.maps.event.addListener(field, 'click', function () {
    fieldwindow.open(map, field);
});
field.setMap(map);
switch (x) {
    case 'ogd':
        ogdwindow.open(map, ogd);
        break;
    case 'library':
        librarywindow.open(map, library);
        break;
    case 'pps':
        ppswindow.open(map, pps);
        break;
    case 'ict':
        ictwindow.open(map, ict);
        break;
    case 'sbk':
        sbkwindow.open(map, sbk);
        break;
    case 'cepep':
        cepepwindow.open(map, cepep);
```

```
    break;
case 'auditorium':
    auditoriumwindow.open(map, auditorium);
    break;
case 'elearning':
    elearningwindow.open(map, elearning);
    break;
case 'vcbuilding':
    vcbuildingwindow.open(map, vcbuilding);
    break;
case 'adoffice':
    adofficewindow.open(map, adoffice);
    break;
case 'lt':
    ltwindow.open(map, lt);
    break;
case 'etfcoaevot':
    etfcoaevotwindow.open(map, etfcoaevot);
    break;
case 'kaaf':
    kaafwindow.open(map, kaaf);
    break;
case 'coaevot':
    coaevotwindow.open(map, coaevot);
    break;
case 'cosmas':
```

```
            cosmaswindow.open(map, cosmas);
            break;
        case 'clinic':
            clinicwindow.open(map, clinic);
            break;
        case 'field':
            fieldwindow.open(map, field);
            break;
    }
}
google.maps.event.addDomListener(window, 'load', initialize);
//handle location error
function handleLocationError(browserHasGeolocation, infoWindow, pos) {
    infoWindow.setPosition(pos);
    infoWindow.setContent(browserHasGeolocation ?
                          'Error: The Geolocation service failed.' :
                          'Error: Your device doesn\'t support geolocation.');
}
```

SEARCH MODULE

```
$(window).on('load',function(){
                        $("#task-list>li").css({
                                    'display':'none',
                        });
                        $("#task-list>li>a").css({
                                    'color':'#848124',
```

```
                'font-weight':'bold',
                'text-decoration':'none'
            });
            $('#txtSearch').on('keyup change',function(){
                $("#task-list>li").css({
                    'display':'none',
                });
            var search = $(this).val();
    if (jQuery.trim(search) != '') {
      var low = search.toLowerCase();
      var high = search.toUpperCase();
                var b = search.split('');
                b[0] = b[0].toUpperCase();
                var sent = b.join('');
      $("#task-list>li:contains('"+ low +"')").css('display','block');
      $("#task-list>li:contains('"+ high +"')").css('display','block');
      $("#task-list>li:contains('"+ search +"')").css('display','block');
      $("#task-list>li:contains('"+ sent +"')").css('display','block');
    } else {
      $('#task-list li').hide();
    }
      });
});
```