

SOFTWARE ENGINEERING PROJECT

TITLE OF PROJECT

LU NAVIGATION MOBILE APPLICATION

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ABSTRACT

The proposed application is a useful tool in navigation of a campus area. Majority of people find it difficult to explore new areas or unknown locations by themselves. We faced many challenges in navigating the institute when we entered the university campus for the first time. So as students we thought of it as an opportunity to showcase what can be done to navigate and modernize the wayfinding within the campus for the campus newcomers.

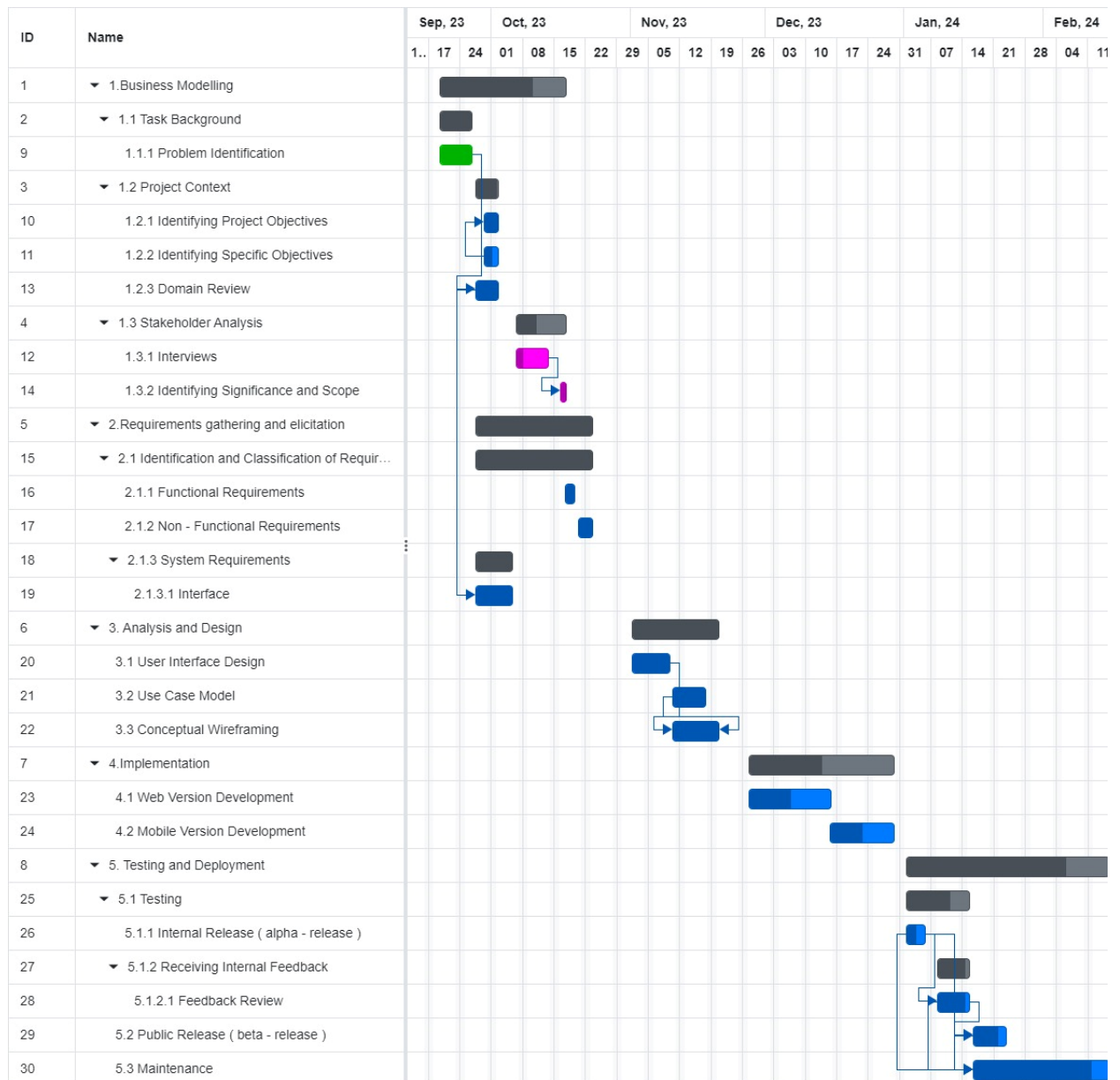
Hence the proposed application will serve as a helper to them and aid in navigation through the university campus, which we have selected as the area for our study. We currently aim at developing a mobile application that shall enable a new person to explore unknown university campus area which he is unfamiliar to. Furthermore, the proposed project may be extended at a larger scale, and we can set a large amount of data as a trained data in the database.

The study uses qualitative methods such as in-depth interviews and observation to gather data from a sample of students, instructors, employees and visitors to the university campus. The findings of the project suggest that several physical features, such as building architecture, campus layout, and signage, play a significant role in shaping the visitors' experience and perception of the campus. The study provides insight into how campuses can enhance the experience of new visitors and make them feel more welcomed and oriented. We recommend that other universities may adopt the use of the application which shall enable the visitors to navigate through an unknown area with the help of application.

Figure 1: Photo of Lakehead University Map



GANTT CHART



MEMBER'S CONTRIBUTION

1 – Daya Aldwery

Problem Statement, Significant and Scope, Functional/ No Functional Requirements, References.

2 – Kaixiang Zhang

Reading Chapters from Reference book, Technologies used in the development of this project, Analysis, Topic review section.

3 – Graham Kulp

Taking interviews, help with making this project report, Stakeholder Analysis, Requirement and Functionality, Topic Review.

4 – Ashfi Hasnain

Taking interviews, help with making this project report, Domain Review section, use case Mode, help with wire-framing, User-case scenarios, and object diagrams.

5 – Abhinav Mishra

Gantt Chart preparation, conclusion, Testing and Evaluation, Iterative Model Design, looking after everyone's work and making sure we all are stucked to the timeline decided.

LIST OF ABBREVIATIONS

APP	- Application
SDLC	- System Development Life Cycle
UML	- Unified Modeling Language
GIS	- Geographic Information Service
GPS	- Global Positioning System
UI	- User Interface
Wi-Fi	- Wireless Fidelity
API	- Application Programming Interface
LU	- Lakehead University

CHAPTER ONE

1. INTRODUCTION AND PROBLEM DESCRIPTION

1.1. Background

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. This mobile application is basically used for navigating routes inside university campus premises. Mobile phones nowadays are far more than merely devices to communicate with – they 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 mobile-based location guidance system that assists visitors and new students to locate their destinations on the university campus. Many GPS aided application has 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.

The phones that we use now-a-days come equipped with technologies like camera, GPS, internet, Wi-Fi, Bluetooth, accelerometer, proximity sensors, etc. All these technologies can be used with an android operating system, which is currently on top and most widely used operating system in the market. Android provides easy user interface. It is open source, so the developers can develop applications for free and sell them or distribute them on the app store.

1.2. Problem Statement

Universities around the world including Lakehead University in Thunder Bay are expanding structurally at a rapid rate especially when the number of students gets greater and greater in every year whereby thousands of new students are enrolling at university.

It is difficult for newly enrolled students to find their way around the university campus at various buildings, departments, libraries, canteens, classrooms, and other places within the university campus.

1.3. Project Objective

Main objective of the project is to develop an android based application for mobile devices or any handheld android powered device, which shall enable the user to navigate through an unknown area in university campus with the help of GPS.

1.4. Specific Objective

Therefore, the specific objective of this application is:

- To develop an android mobile application
- To develop an application that show markers at source and destination and with the help of predefined path.

1.5. Significant and Scope

1.5.1. Significance

The implementation of LU NAVIGATION MOBILE APPLICATION will provide convenience and quality services to users. The application provides very useful features for facilitating the user to perform activities when using the application i.e., LU NAVIGATION MOBILE APPLICATION. Below are the significances.

- To reduce the wastage of time and dissatisfaction
- Easier navigating to certain location
- Informative navigate helper for students, faculty members, and visitors.

1.5.2. Scope

The scope of the project is determined by the allocated time and resources, currently will use only main campus location details. They can browse buildings, locations etc. or search for locations within the Lakehead University Campus.

CHAPTER TWO

2. LITERATURE REVIEW AND METHODOLOGY

2.1. Topic Review

Literature review is a very important element that of any project since it contains the relevant knowledge and information to help in project implementation and system development.

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).

Maps have been used for centuries to navigate 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 programs 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. 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.

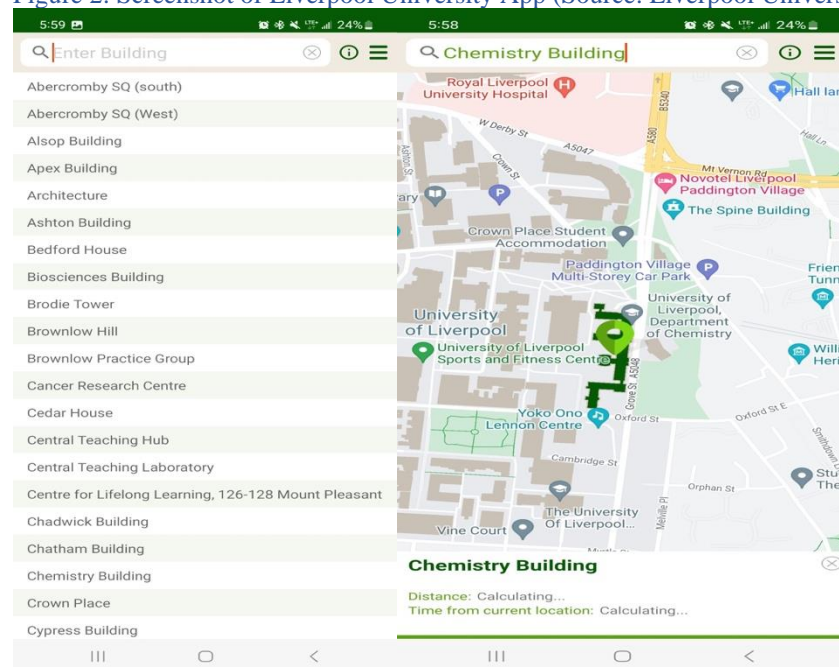
2.2. Domain Review

This section is responsible for reviewing the existing similar navigation mobile application that are into use. It will also highlight the functionalities of the outlined systems and suggest why I should implement a LU NAVIGATION MOBILE APPLICATION.

2.2.1. University of Liverpool App

In 2009 a team of graduate student developers and undergrad cartographers from the University of Liverpool implemented a mapping application for the university's 45,000+ students and faculty members.

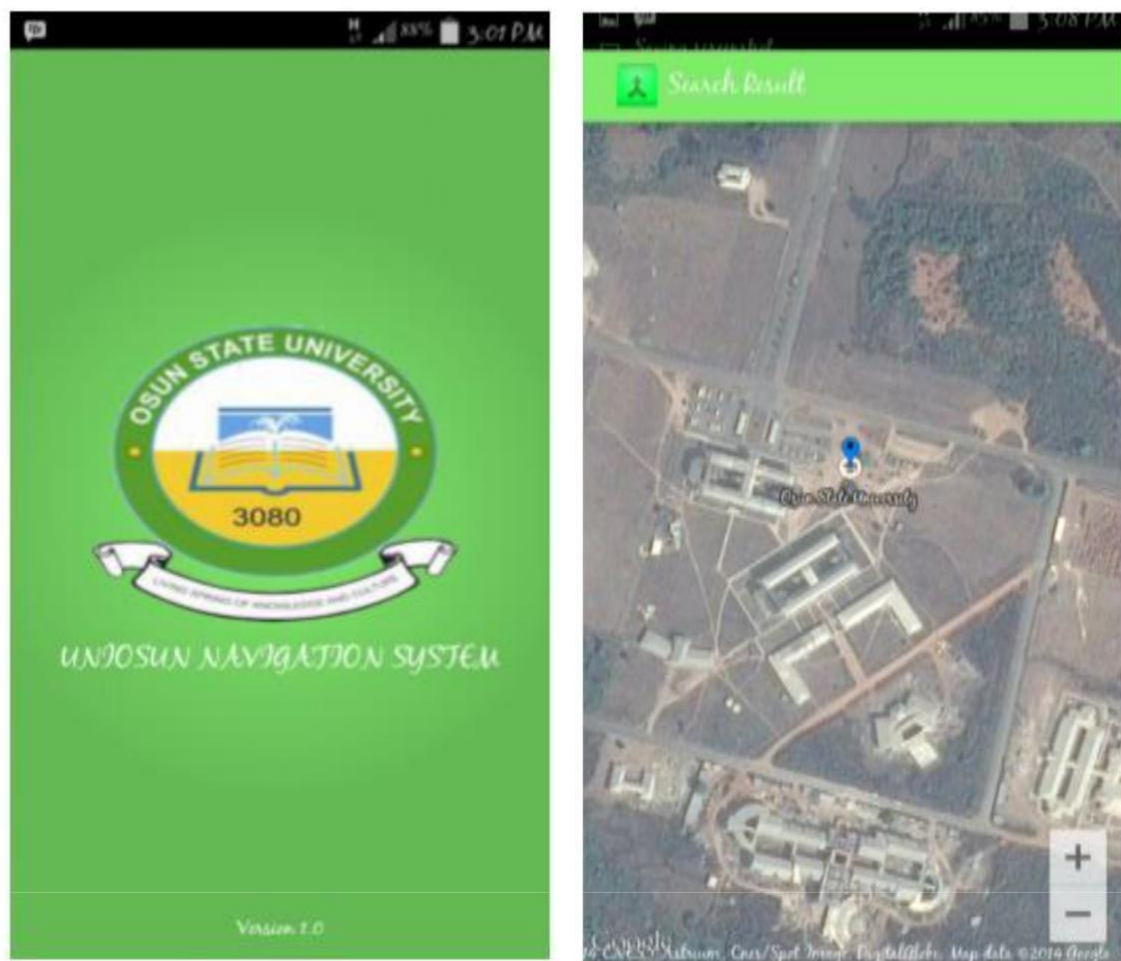
Figure 2: Screenshot of Liverpool University App (Source: Liverpool University App)



2.2.2. UNIOSUN Navigation System

In 2014, Akanbi et al developed a navigation system for the large number of students at 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.

Figure 3: UNIOSUN Navigation System (Akanbi et al, 2014)



2.3. Problem Conclusion and Conceptual Framework

The explained literature review has helped to improve the analysis on how the LU Navigation Application is going to be developed from the beginning stages research, data collection and design. It also helped to widen mind with many aspects such as Mobile Application development by which as another developer could think developing something as a solution to the society. When implementing this navigation application, the review of the related works will unveil new features which can be added to the existing application which will improve the usability of this application.

CHAPTER THREE

3. REQUIREMENT ELICITATION AND SYSTEM ANALYSIS

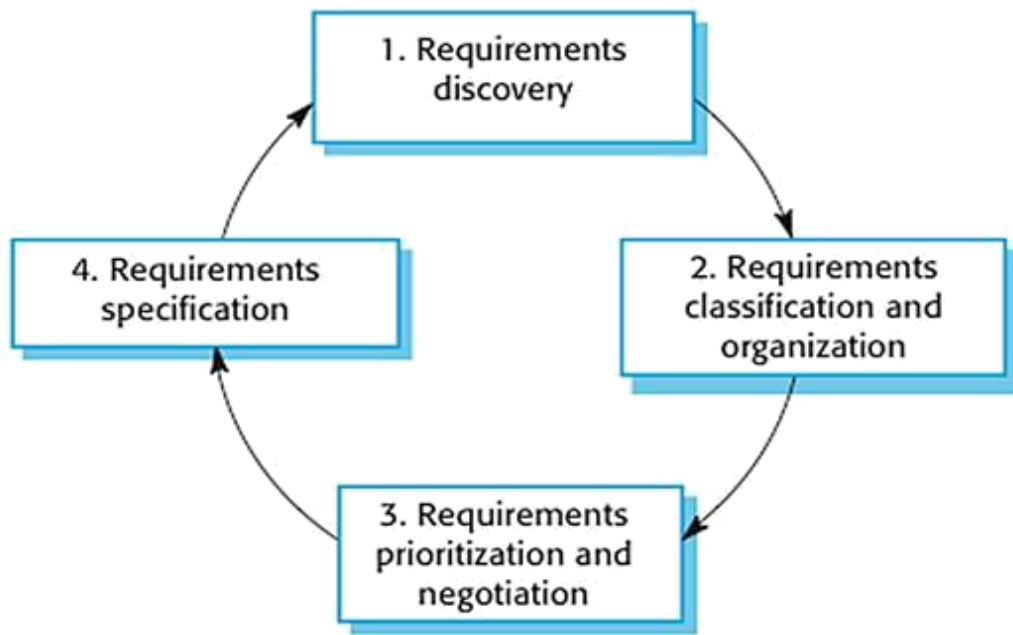
3.1. Introduction

Several system developments must meet the intended requirements, whereby the requirement elicitation plays the major role in system development. It is recognized as the first stage many system development/design engineering processes. Requirement elicitation combines the elements of problem solving, elaboration, negotiation, and specification. In order to encourage a collaborative, team-oriented approach to requirements gathering, stakeholders work together to identify the problem, propose elements of the solution, negotiate different approaches, and specify a preliminary set of solution requirements (Pressman, 2005).

In meeting the objectives of the system, it must carry several functionalities both functional and non-functional requirements. This part is going to elaborate the analysis of the current platforms, the investigation of the performance and how the elicitation was done to fill the gap with the implementation of the new application. The success of the requirements elicitation activity leads to the development of correct application which involves collecting of the information from users of the system. The information collected enhanced the designer to design the or come with the product that suit the user needs. At this stage, the system developer and system designer work together to: -

- Find out more about the problem to be solved.
- To describe the functionality of the system
- Performance of the system
- Hardware constraints
- System User Experience
- System user Requirement
- System Testing

Figure 4: Requirement elicitation process; Source: (Gabry, 2016).



System analysis is a process of figuring out the basic element of the project and decides to combine them in the best way to solve problem. It is the second of five phases in the System Development Life Cycle (SDLC) with the purpose of building logical model of the application. In this chapter, there will be explanation about identification of users and use cases, specification of the system functional and non-functional requirements. System requirement is a characteristic or feature that must be included in an information system to satisfy business requirements and be acceptable to users (Shelly & Rosenblatt, 2012).

3.2. Classification of System Requirements

Requirement is a careful assessment of the needs that an application is to fulfill, during requirement classification number of question must be considered such as why the application is needed based on the current application, which maybe the internal operations, what application feature will serve to satisfy the user needs and must say how the application is to be constructed. Basically, system requirement is classified into functional requirements and non-functional requirements.

3.2.1. Functional Requirements

In system design and development, functional requirements define the functions of the system or its components. This may be calculations, data manipulation and processing and specific functionalities that a system has to accomplish to solve a particular problem.

In **LU Navigation Application**, the following are the Functional Requirements

- Application shall identify the building or places which are being searched.
- Application shall show details of the locations and description of buildings.
- Application should suggest related data or display some message that the data not found.

3.2.2. Non-Functional Requirements

These are the requirements which specifies criteria that can be used to judge the operation of a system rather than specific behaviors. Such requirements affect the system response time, up time, confidentiality, integration and so many more.

In **LU Navigation Application**, the following are the Non-Functional Requirements

- **Availability**
The application has to be always available.
- **Maintainability**
The application should be easily to maintain and debug for errors and bugs when available.
- **Performance**
The application should have a time-fast response in order to maximize utilization of resource.

3.2.3. Interface requirement

The interface should be easy and straight forward. With the new technologies, the interface can adopt to any device screen whether a small screen or a big screen (smart phones, tablets, pads). This ensures that very little knowledge is needed to make use of the application in different platforms. Also, it easy to integrate the application with other programming languages such as Java.

3.2.3.1. Response Time

The application performs faster, guarantee response time is only 3 seconds to 5 seconds to the point a user has full access of the application.

3.2.3.2. Requirement and Functionality

Currently the application is focused to improve the usability and experience. The basic need of the application is to have the smart phone device which support android operating system.

3.3. System Analysis

3.3.1. Use case mode.

Different analysis model can be used to getting the requirement of the system, use case mode is a methodology used in system analysis to identify, clarify, and organize the system requirements. A use case is a list of actions or event steps, typically defining the interactions between a role (known in the Unified Modeling Language (UML) as an actor) and a system, to achieve a goal. An actor can be a human or other external system. It is used to explain and document the interaction that is required between user and system to accomplish user task. With the main purpose of capturing the dynamic aspect of the system.

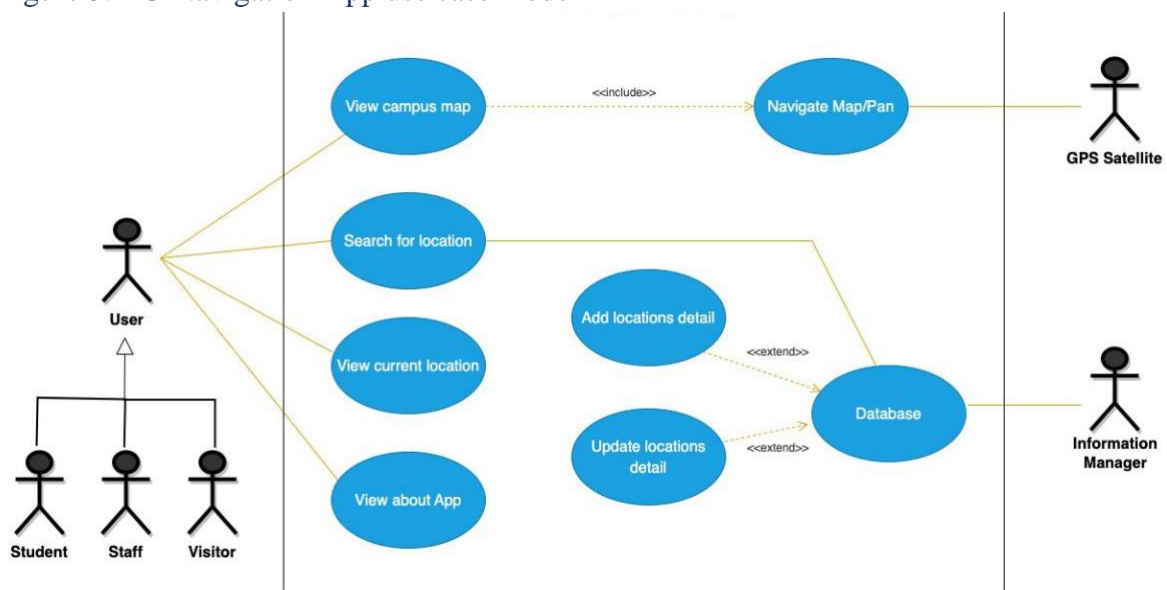
List of Actors in LU Navigation Application

- Users interact with the system based on his individual role.
- GPS Satellite interact with the system based on displaying map.
- Information managers interact with the system based on managing building details.

List of Use case

- View campus map
- Search for location
- View current location.
- View about app
- Navigate Map/Pan
- Add location detail.
- Update location detail
- Database

Figure 5: LU Navigation App use case model



Use Case Scenario

This is an example of how one user could use the app:

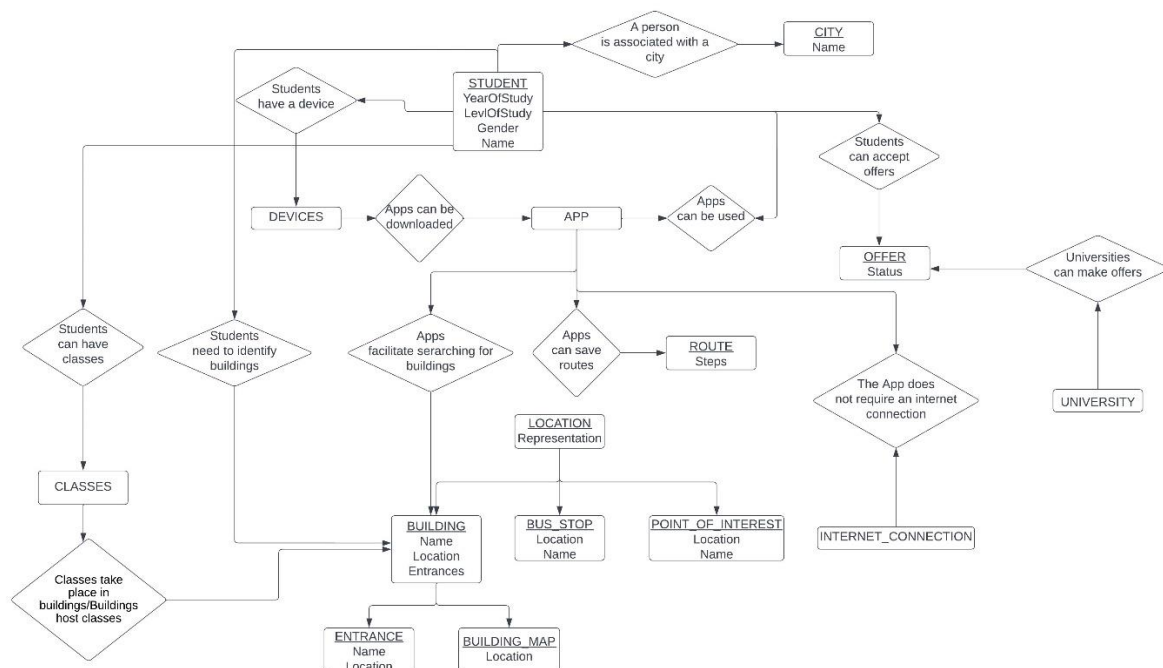
Elizabeth is a first-year undergraduate student who has never been to Thunder Bay before. She accepted an offer at Lakehead University and has just moved to the city. She has classes in various buildings, including the ATAC, Ryan, and Centennial Buildings. Nonetheless, she has no idea which one is which.

Elizabeth can download the Campus Navigation App and use it to find the buildings. Suppose, she comes to the campus by bus, getting off at the main stop. She can then set her starting point as the mentioned bus stop and select her first class – at the Ryan Building. The app will give her an easy and convenient route, regardless of the presence of internet. All she has to do is follow the steps and get to the Ryan Building. The app will lead her to the entrance of the building, from where she can read the building map to find her classroom.

Between classes, Elizabeth can also use the app to get directions to the amenities the campus has to offer, including the cafeteria, bookstore, and library. She can also choose to save the routes she uses frequently but does not always remember – such as from the cafeteria to the Centennial building, or Ryan Building to Agora.

From this scenario, we can see objects that are associated with the app:

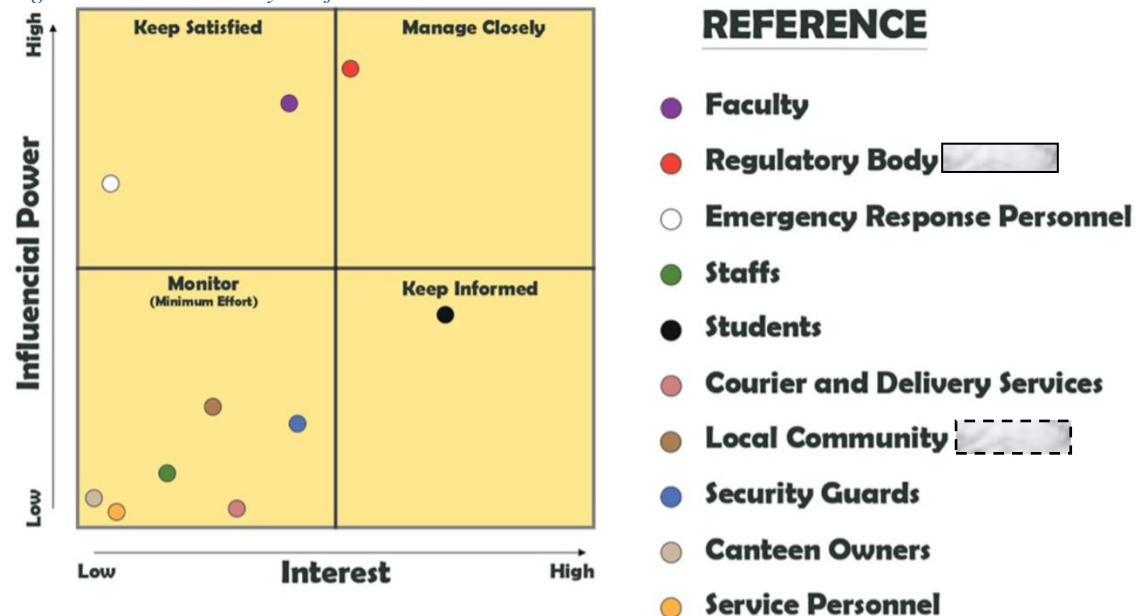
Figure 6: Object Diagram of Objects Associated with the App



3.3.2. STAKEHOLDER ANALYSIS

To improve the success rate of this project we need the required support from stakeholders and specifically target those stakeholders with high influence and higher interest to prove a direction and momentum to the project.

Figure 7: Pictorial Analysis of Stakeholders



- Canteen owners, staffs, service personnel, courier and delivery services look for their productivity and profit and hence they don't have much interest in wayfinding neither do they have the power to implement any system, and they don't have any problem if the system is upgraded.
- To our surprise, Security Guards showed much more interest than our expectations, but they also don't have any influence in the system other than emergency situations, but that too under someone's supervision from the administration.
- Students have interest to change or upgrade the existing system. They lack in power and authority to do so which are controlled by the higher authority that includes faculty and regulatory bodies.
- For the successful implementation of this project, an information hierarchy is to be followed.

CHAPTER FOUR

4. SYSTEM DESIGN

4.1. Introduction

System design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. This chapter of system design focuses on the design model and architecture of the intended system. Also explain the structure of the system internal interaction and the system architecture. The goal of the design is to provide a clear picture for implementation and maintenance activities and to provide a blueprint for implementation testing and maintenance activities.

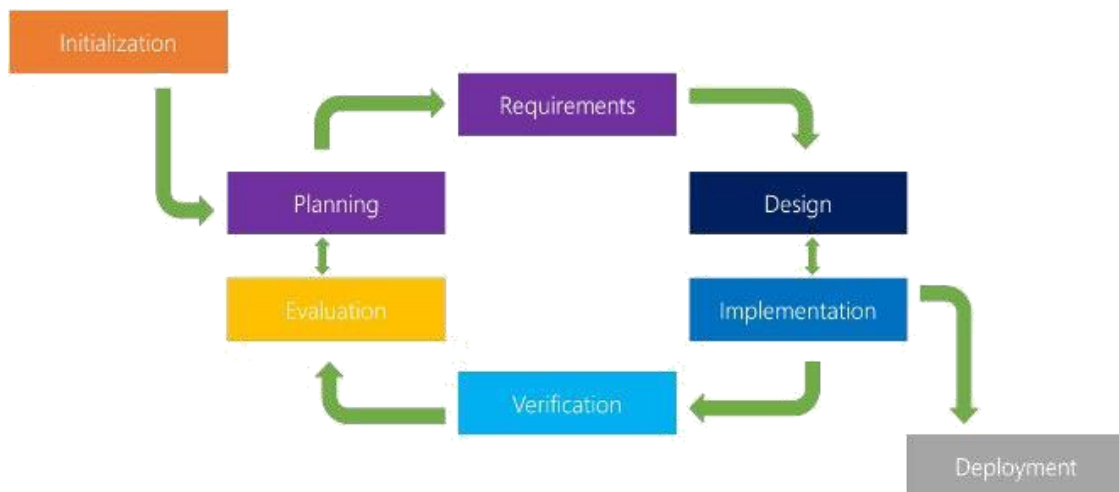
4.2. System Design Methodology and Technologies

In this section we will look at different design methodologies, which are Architectural design, Logical design and Physical design whereby architectural design is the design of the system that emphasizes on the design of the system architecture which describes the structure, behavior and more views of the system and analysis (Eppinger & Ulrich, 2000).

4.2.1. *Iterative Model*

An iterative life cycle model does not start with a full specification of requirements. In this model, the development begins by specifying and implementing just part of the software, which is then reviewed to identify further requirements. Moreover, in iterative model, the iterative process starts with a simple implementation of a small set of the software requirements, which interactively enhances the evolving versions until the complete system is implemented and ready to be deployed. Each release of Iterative Model is developed in a specific and fixed time period, which is called iteration.

Figure 8: Iterative Structure model



4.2.2. *Technologies used in the application deployment.*

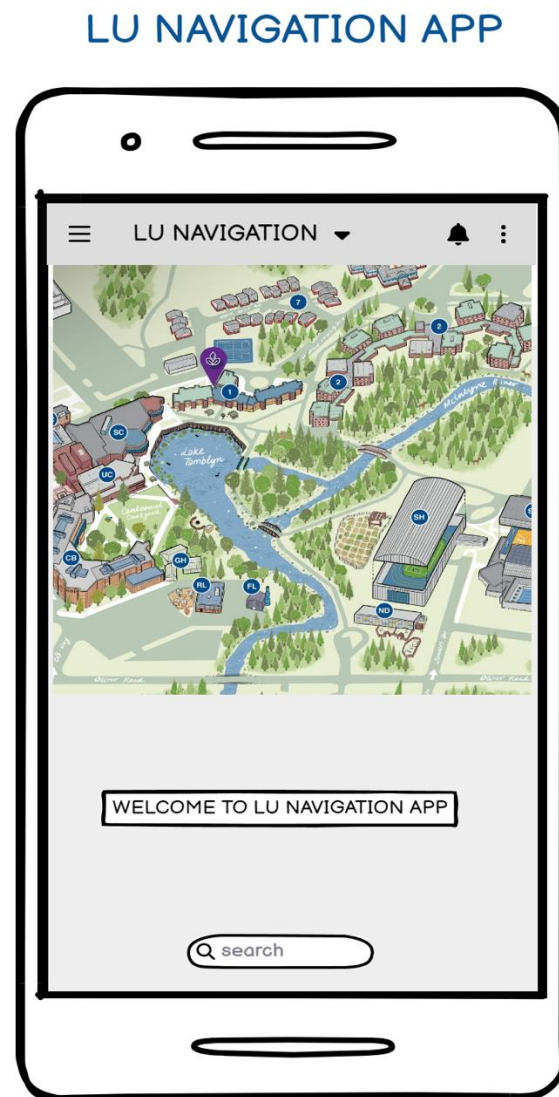
The technologies involved in the development and deployment of the application are: -

- 1) **Kotlin**, is a modern programming language designed to be fully interoperable with Java. It is used for developing Android applications and offers concise syntax, null safety, and functional programming capabilities. Kotlin provides enhanced developer productivity, improved code readability, and seamless integration with existing Java codebases.
- 2) **Android Studio** is the official integrated development environment (IDE) for Android app development. It provides a comprehensive set of tools and features that assist developers in designing, building, testing, and debugging Android applications. Android Studio includes a code editor, visual layout editor, emulator, and powerful debugging tools, making it the preferred choice for Android app development.
- 3) **Mapbox**, is a mapping and location data platform that provides developers with tools to integrate customizable maps, navigation, and geolocation services into mobile applications. It offers a wide range of features, including interactive maps, route optimization, real-time location tracking, geocoding, and spatial analysis. Mapbox provides APIs and SDKs that allow developers to create engaging and location-aware applications across various platforms, including Android.

4.3. User Interface Design

User Interface design is the design of websites, computers, appliances, machines, mobile communication devices and software application with the focus on the user's experience and interaction. The goal of user interface design is to make the user's interaction as simple and efficient as possible in terms of accomplishing user goals what is often called user-centered design.

Figure 9: LU Navigation App user interface design



CHAPTER FIVE

5. SYSTEM IMPLEMENTATION

5.1. Introduction

System implementation is the realization of the technical specifications or algorithm as a program software component or other computer system through programming and deployment. Implementation may exist for given specification or standard. For example, web browser contains implementation of world wide web consortium recommended specifications and software development tool contains implementation of programming language. Also, in implementation phase, the two earlier component of software development stated in this document namely analysis and design, have been put into practice. I have implemented this application (Mobile Based Application) by using Kotlin, Android Studio and Mapbox technologies.

5.2. Functionalities of Implementation

1) **Find Location**

This functionality enables the user to easily finding areas by category or by searching area names in search box.

2) **Navigate to Location**

This functionality enables the user to easily and quickly navigating to desired locations around the campus area.

3) **Calculate Time and Distance**

This functionality enables the user to calculate distance and time between two location points.

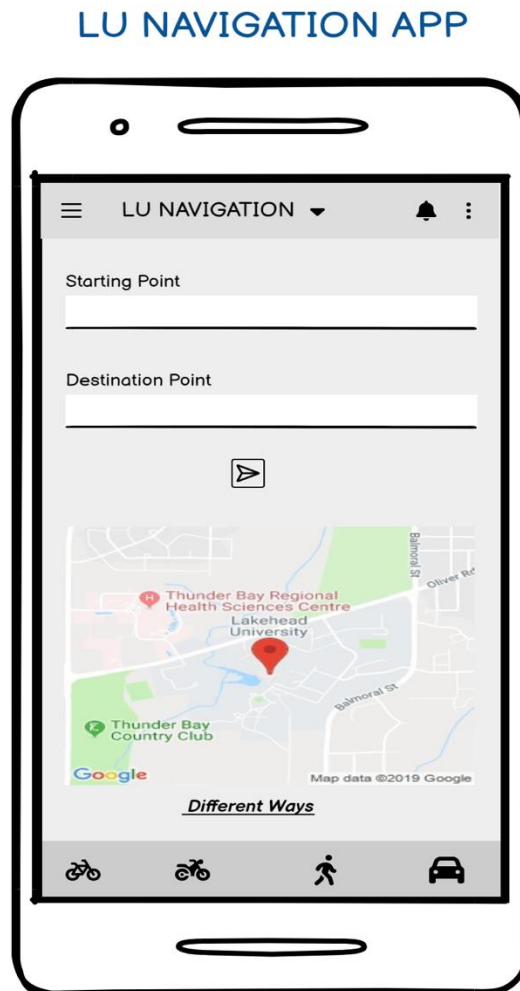
5.3. User Interface Implementation

Implementation of the user interface is the practice of producing an interface so as a user can see and use the resources with an abstraction from the sophisticated components of the system. It is the part of the information system that is directly accessed and interacted by the user of the system. It enables a user to request services of underlying information system. The user interface of the application has been implemented using XML.

5.4. Home page

This is where a user sees first after accessed the application.

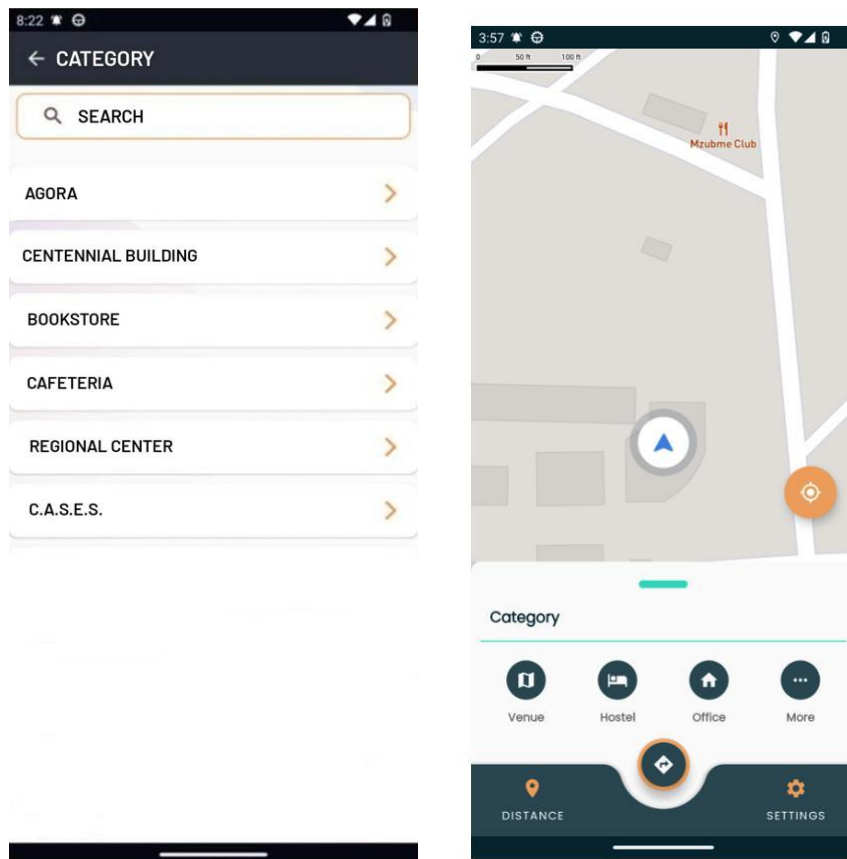
Figure 10: Home page interface



5.5. Location selection page

This is where a user choosing destination to navigate to, user can look for location from categories displayed at home page or by clicking more button to view more categories in category page.

Figure 11: Location selection page interface



5.6. System Testing and Evaluation

System testing is testing conducted to evaluate the system compliance with the specified requirements. It verifies the system to be delivered, meets the specification and its purpose by investigating both functional and non-functional requirements. LU Navigation App has been tested under the following categories.

- **Preliminary Test (Unit testing)**

Refers to the technique by which individual units are tested to determine if it fits for use. It is basically written and executed by a system developer to make sure that the code meets its design perspective. This includes testing every unit piece of code during programming process where each piece of code was tested before moving forward.

- **Test Plan**

The test plan is basically the way the final product is being tested and how it responds. We tested the application in a way that all input/output are pushed to the application and wait for the response.

- **Integration Testing**

It is the process whereby integration between component and interaction of different part of the application are tested to verify its compatibility. The purpose of integration testing in LU Navigation App is to verify functional, performance and reliability requirement of the application. Basically, integration testing is done after Unit testing and before validation testing.

- **Validation Testing**

Validation testing is done toward the end of the development process, and it is performed after the verification is complete. It is used to determine if the system complies the requirement and perform the function as it is intended to meet the user need.

CHAPTER SIX

6. CONCLUSION

6.1. Summary of Achieved Objectives

The goal of this project was to develop a mobile application that helps students and visitors on the campus of the Lakehead University to orientate themselves and find their destination.

In order to achieve this, a mobile application 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 application. 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.

6.2. Conclusion

LU Navigation App is an application with severely unique functions and properties that delivered in a well user-friendly way to typical users of the application. It apparently gives the user productivity with the combination of technical and user requirements in advance.

The most typical needs of students and visitors of the university has been calculated and taken into consideration for the development of the application. 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.

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