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COLLEGE OF COMPUTING & INFORMATION SCIENCES

# CAMPUS GUIDE

by

**GROUP 32**

**Department of Computer Science**
**School of Computing & Informatics Technology**

*A Project Report Submitted to the*
*School of Computing and Informatics Technology for the Study Leading to*
*a Project Report in Partial Fulfilment of the requirements for the*
*Award of the Degree of Bachelor of Science in*
*Computer Science of Makerere University*

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JUNE, 2023

# Declaration

We Group 32 do hereby declare that this Project Report is original and has not been published and/or submitted for any other degree award to any other University before.

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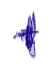
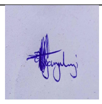
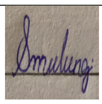
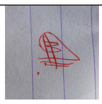
|---|---|---|---|
| 1 | NASSANGA PENINNAH REGINAH | 20/U/5710/PS |  |
| 2 | KYAGULANYI DEO | 20/U/5680/EVE |  |
| 3 | MULUNGI STELLA PRECIOUS | 20/U/0051 |  |
| 4 | MUWANGUZI CYRUS | 20/U/5723/PS |  |

Date: 1/08/2023

# Approval

This Project Report has been submitted for examination with the approval of the following supervisor.

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# Dedication

We dedicate this report to the Almighty God without whom we can do nothing. We further dedicate it to our parents and guardians for their unceasing and selfless support throughout our stay in this university.

# Acknowledgement

We are deeply indebted to our project supervisor Mr.Emmanuel Lule whose unlimited steadfast support and inspirations have made this project a great success. In a very special way, we thank him for every support he has rendered unto us to see that we succeed in this challenging study.

Special thanks go to our friends and families who have contained the hectic moments and stress we have been through during the course of the research project.

We thank the school for giving us the grand opportunity to work as a team which has indeed promoted our team work spirit and communication skills. We also thank the individual group members for the good team spirit and solidarity.

# Abstract

An increasing number of new geolocation services are widely used to their profound benefits and affordances in real-life applications most of which incorporate GPS location. There are fewer applications for providing both indoor and outdoor locations partly due to the cost of the required infrastructure. The paper proposes a solution of developing a GPS-based navigation system integrated with POI (point of interest) database of locations and places in Makerere University Main campus. To accomplish this, an application that runs on smartphones will be developed running on both android OS and IOS such that it can better indicate and trace the current location and information of the searched place, give exact directions to offices as well as the possible relevant paths and routes that will be derived from GPS technology and by means of Google Maps functions. The application will be cost effective since the user only requires to have a smartphone and internet connection. Finally, we believe that the application will make navigating around Makerere University Main Campus more convenient , timely and faster.

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# Chapter 1

# Introduction

## 1.1 Background

In human navigation, finding a path to the intended destination is an everyday problem, which, however, has been treated with less intent around campus[4]. Way finding is basically a directed movement in which people aim to reach a destination that is not directly seen or sensed from origin [9]. With that mentioned, finding the way around the great large Makerere University has always proved to be an issue to first time visitors and students since the institution has several landmarks such as colleges, schools, office complexes, lecture rooms, halls of residence, roads, churches to mention but a few. This has increasingly made it difficult for first time visitors and fresher students to locate their desired locations around the institution. Furthermore, continuing students also face a challenge of not knowing their lectures and other officials' offices such as the departments their offices are found at, the blocks and also levels, hence students adopting to ineffective means of communication. In an interview we conducted, 85% of the students confirmed that this is indeed a problem they face each day and are we willing to embrace any technology to help them solve it. Recently, the navigation field has been dominated by google maps where conventional map information is converted into a digital map yet this has proved to not satisfy users since they cannot find out the real direction to their intended destinations [5] since its mainly outdoor based not indoor. Research conducted at Kasetsart university tried to solve the same exact problem by using a GPS-based navigation system integrated with a point-of-interest database of locations and places in that Campus [7] to help students go around the university focusing again only on the outdoor. These studies and many others that we will review in the coming literature section have surely tried to solve the navigation crisis but only gone as far as only solving one end of the burden that is, only the outdoor or indoor problem but not both. This research project intends to solve all the above-mentioned problems by helping both the students and visitors to find their intended locations by drawing for them a clear route /path from where they are to the desired destinations be it inside the buildings using the CAMPUS GUIDE application. In addition, the rationale for this project is that the proposed application will: 1) provide efficient navigation around the campus, 2) give them a clear direction from the outside to the inside of buildings ,3) provide information such as contacts and e-mails to students.

## 1.2 Problem Statement

Every person would wish to know the exact direction to where he/she is headed to, unfortunately, this has continued to be a problem in the modern world today as people still find it a challenge to navigate through large places like universities, hospitals to mention but a few. A few technologies have been developed lately in response to this challenge and the mostly used Google Maps helps people locate places but it does not go into the details of giving them directions inside the building. The navigation and location system for offices ,lecture rooms , halls of residences, canteens ,departments, pitches among other important features in Makerere University is currently inefficient and time-consuming, resulting in confusion and delays for both staff , visitors and students. There is a need for both an indoor and outdoor navigation and location system that can accurately and efficiently guide individuals to their desired destinations within the university's premises.

The current system relies mostly on verbal directions, which can be confusing and difficult to follow, especially for newcomers. As a result, students endup being misled on the people concerning their affairs such as registration and enrolment as they are charged money by other people to accomplish for them those tasks which would not be the case if they had all the information about the responsible people such as where their offices are at, at which levels, blocks and departments .Therefore, there is a need for an indoor and outdoor navigation and location system that utilizes modern technologies to accurately guide individuals to their desired locations within the university. Such a system would improve efficiency and productivity, reduce confusion and delays, and enhance the overall experience of staff , visitors and students within Makerere University.

## 1.3 Main Objective

- To develop an efficient and user-friendly navigation application system that can accurately guide students, staff, and visitors to their desired destinations within the university's buildings and surrounding areas.

### 1.3.1 Specific Objectives

The specific objectives of the study were:

- To identify the weaknesses of the current navigation system around the campus so as to come up with the necessary requirements needed to implement the proposed navigation application .These requirements will include Google Map APIs , smartphones, GPS and internet connection.
- To design a mobile navigation application that shall be used for navigation purposes by users at Makerere University. This is to be accomplished by use of Data flow Diagrams ,Entity Relationship Diagram and flow charts which will represent detailed information about how users will interact with the application.
- To implement the mobile navigation application using the flutter flame work .
- To test and validate the mobile navigation application so as to prove that it works as intended

## 1.4 Scope of the study

This project was carried out in the geographical confines of Makerere University and it's target audience was any person that would wish to find their way around the campus. The project required intensive research as we learnt new ideas and approaches of accomplishing our goal using different software , data collection from all offices and people through interviews so as to know most inquired about landmarks and offices and physical interactions with officials to get necessary information from them therefore identifying the specific needs and requirements of the users so as to add them to the application.
We went ahead and created the user interfaces and the application that the users will use to interact with the system.. The deliverables that were expected at the end of the project were ; a well written full report, concept

paper , project proposal , a presentation to the panel and a running application . This project ran for about 10 months and we used a cost estimate of about Ugsh 200,000

## 1.5 Significance of the study

- Students at the campus will use the application to locate their desired lectures' offices for consultation and any other reasons and other officials for the necessary assistance.
- Visitors will find it easy to go around the campus when attending events like conferences, seminars to mention but a few.
- Fresher students will easily locate the responsible people for their registration, enrollment and accounts creation hence reducing the rate at which other students charge these students money for any assistance.
- It will also enable fresher students to easily locate their colleges and lecture theatres in their first visits at the campus.
- This project will also bring to light the use of indoor navigation to enable identifying of offices, levels, and lecture theatres which has not been considered with great importance by other technologies trying to solve the exact problem.

# Chapter 2

# Literature Review

## 2.1 Introduction

The main purpose of this chapter is to present some general consensus on the theoretical support and previous empirical studies on both indoor and outdooor navigation systems.

## 2.2 EXISTING NAVIGATION SYSTEM AT MAKERERE UNIVERSITY

Currently , there is no specific navigation system used at the campus. Most visitors and students have resorted to verbally asking other people for directions to their destinations, as well as others make use of emails and phone calls to reach out to the people whose offices they want to visit so as to get directions to their offices. This method has negatively impacted mostly the fresher students during their first days at campus when enrolling for their course units and registering on their students' portals. Some continuing students tend to impersonate themselves as college officials and ask these fresher students for money so as to accomplish for them some of the above-mentioned tasks which is usually not a good first experience for these students. The above-mentioned methods are also a tiresome means of locating places because mostly the people approached may not be certain about the destination being inquired about hence causing the person to ask multiple people about their interested destination. Furthermore , people who choose to use emails may not get directions to their interested destinations because most of these official do not care to respond to them. The good thing about verbally asking other people for directions is that it creates friendships and connections at the campus which connections can be useful for fresher students.

## 2.3 GPS (GLOBAL POSITIONING SYSTEM)

GPS is a network of orbiting satellites that send precise details of the position of objects space in relevance with earth (Wichian et al ,2016)[7]. The signals are obtained by GPS receivers and are then used to interpolate the exact location. These receivers must receive the signals from at least four satellites in an orbit and each of these satellites transmits microwave signals to the receiver in order to calculate the distance between them. The triangulation technique is then used to increase the accuracy of the position estimation. Figure 1 shows how satellites triangulation technique is calculated.

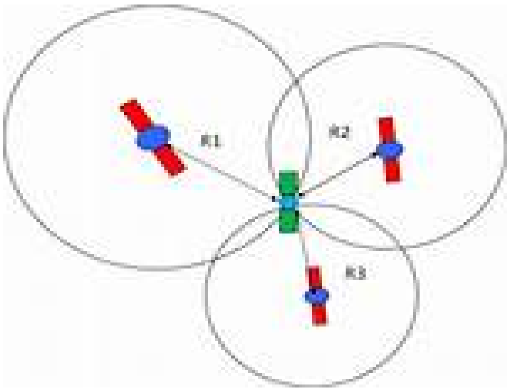



Figure 2.1: Triangulation calculated

[8]

GPS is often used together with a map system in order to develop a navigator system. This map system includes a set of Google Map APIs operating on a web or mobile application. Whereas outdoor navigation systems typically rely upon GPS, indoor systems have to rely upon different techniques for localizing the user as GPS signals cannot be received indoor (Navid et al, 2013) [2]. 4.3 GPS ( A Web-Based Tourist Information Tools Using Google Map Pan et al (2007) [6] showed how Google Map APIs can be utilized in the tourism industry. The developed application takes two destinations as inputs and calculates the optimal routes visualized real time on the user's device. Given the user-specified locations, the navigator gathered the relevant neighboring location information and suggests the important POIs to the user as an interactive trip planner. The developed navigation system out performed the existing system which suffered low latency and stability issues due to limited memory and as a result many hotels used it and proved that Google Map is flexible and agile for developing destination -specific online services. Although the system was a success, it did not solve the problem of indoor navigation. 4.4

## 2.4 A GPS -Based Navigator for Kasetsart University

Wichian et al (2016) [7] developed a GPS-based navigator application integrated with a POI(point of interest) database of locations and places in Kasetsart University, Kamphaeng Saen Campus using positioning technologies. The developed system was capable of searching routes based on the categories available on the menu, displaying the current location and optimal route to the destination, corresponding destination coordinates and optionally the google Street View of physical places along the way. The data that was collected via MySQL was used to better search and trace positions and distances of routes derived from GPS technology and by means of Google Maps functions, enabling users to search for current. In order to assess the extent of user's satisfaction toward the developed application, two aspects were considered, studied and analyzed ;1) ease of use and 2) size of location coverage. The findings showed;

- High location coverage ability of 91.12%
- Ease of use of 90.50% satisfactions

However, just like other technologies developed before this, the application does not go into details of the exact building, floors or even offices at the campus . Our Campus Guide project seeks to address all the abovementioned short comings in the existing technologies currently being used. When developed, the application will incorporate both out door and indoor navigation by giving people direction from the outside to the inside of the campus. At the end of the project, a GPS -based system integrated with POI database of locations and places in Makerere University will be developed and the data collected will be used to better search and trace positions and distances of routes enabling the user to users to search for their current location, destination, best possible traces to reach the destination, optimal route to the destination, exact directions to offices, contacts and emails of the desired officials. We believe that the development of this application will make navigating around the Main campus more convenient, timely, faster and easy for our users both indoors and outdoors.

## 2.5 CONCLUSION

In conclusion, the above reviewed literature shows the short comings of the different existing systems in use today. These short comings include tiresomeness when asking for directions , fraud when inquiring from imposters, systems only providing either indoor or outdoor navigation but not both and systems requiring expensive instruments to operate. This therefore means that the existing systems have failed to help users accomplish their interests in finding their intended destinations in the fastest and cheapest way possible. The application we have developed intends to solve all the above-mentioned short comings of the existing systems hence making it easy and cheap for users to accomplish their navigation issues around the campus.

# Chapter 3

# Methodology

## 3.1 Introduction

The goal of this project was to develop an indoor and outdoor navigation system for a university campus that will provide students, visitors, and staff with a reliable and user-friendly tool for navigating the complex and varied terrain of the campus. To achieve this goal, we used a multi-step methodology that involved a combination of research and requirements gathering , data collection, technology selection, system development, user testing, and implementation.

## 3.2 Research And Requirements Gathering

At this stage , we typically focused on acquiring relevant information and understanding the key aspects of the project and the following were conducted;

### 3.2.1 Literature review

This involved conducting a comprehensive review of the existing various navigation technologies, algorithms , mapping techniques ,user interfaces and applications so as to identify any existing gaps in these systems. The literature review section gives more insight on how these applications operate.

### 3.2.2 Stakeholder Identification

This involved identifying stakeholders for our project such as the the end users and determining their specific requirements, expectations and pain points related to navigation around the campus.We also considered their preferences and mobility constraints.

### 3.2.3 User Needs Analysis

This was performed to understand the specific requirements and preferences of the end users. This was done by conducting surveys , interviews and focus groups to gather insights into their navigation challenges , desired features and usability expectations therefore tailoring a navigation system that meets their needs effectively.

## 3.3 Data Collection

In this stage of our methodology, we conducted a needs assessment to identify the specific features and functions that the navigation system should include in order to meet the needs of the university community. We then selected the technology and software that would be best suited to the project, taking into account factors such as accuracy, cost, and ease of use. We used data collection tools such as notebooks, recorders,phones and pens.

This stage involved collecting data on the campus complexes like offices, halls of residences,departments , grounds and other relevant features using techniques such as interviews, observations and questionnaires as explained below .

### 3.3.1 Questionnaires

A questionnaire is a research instrument that consists of a list of questions or items used to gather data from respondents about their attitudes, experiences or opinions. (Pritha ,2022)[1]

The data that was collected was used to create detailed floor plans and maps of outdoor areas, as well as to identify points of interest and other important features that would be included in the navigation system.A copy of the questionnaire we used is shared in the appendices section.

### 3.3.2 Interviews

An interview is a method that relies on asking questions in order to collect data (Tegan,2022)[3]. During this stage ,we first identified a clear objective for our interview in-order to gain valuable insights,perspectives and feedback about the navigation system. We went ahead and selected participants to represent the various groups of users such as students and staff meeting one-to-one and these interviews lasted for about 30 minutes. The following key topics were highlighted during the interviews;

- General experiences and challenges faced by participants in navigating the university campus, both indoors and outdoors.
- Perception of the existing navigation infrastructure, such as signage, maps, mobile apps, or other available resources.
- Specific pain points, difficulties, or areas of improvement participants have encountered while finding locations, buildings, or facilities on campus.
- Awareness and usage of any existing indoor or outdoor navigation systems or tools provided by the university.
- Suggestions, preferences, or desired features for an improved navigation system within the university.

### 3.3.3 Observation

In this data collection method, we took time with different people and observed how they found new landmarks we requested them to get to at the campus. According to the ways most of the people used to find their way around campus and the interactions we had with them , we came to conclusions on how to represent certain places to make it easier for all users.

## 3.4 System Design

System design refers to defining elements of a system like modules, architecture, components and their interfaces. Process modelling will be achieved by the use of Data Flow Diagrams which are a graphical representation or flow of the data through a system. Data was modelled using Entity Relationship models which describe interrelated things of interest in a specific domain of knowledge. ER models are basically composed of entity types and specify relationships that can exist between entities in the system. Additionally, Unified modelling language diagrams such as Use Cases were used to detail the interaction between the users and the system. A use case is a list of actions or event steps typically defining the interactions between an actor and the system to achieve a goal. The actor can be a human or any other external system for example, according to our application, the actors will be students wanting to get directions. The software system will also be modelled together with the data elements it contains using text and symbols clearly representing the data and how it flows. This phase also included navigation algorithm development such as route planning .

## 3.5 Implementation

This phase involved the actual development of the navigation application using the data and technology selected during requirements collection. This is where the user interface was developed through which users interact with the system, database connected, front end and back end worked upon. This step also involved integrating the navigation algorithms developed in the system design phase with the hardware and software components of the system, to provide real-time navigation information.

**Flutter Framework**

We implemented the application using the Flutter framework for the Dart language.The flutter framework has a number of advantages that makes it a popular choice for application development some of which being;

- Cross-Platform Development: Flutter allows you to write code once and deploy it on multiple platforms, including iOS, Android, web, desktop, and even embedded devices. This significantly reduces development time and effort compared to building separate native apps for each platform.
- Fast Development and Hot Reload: Flutter's hot reload feature enables developers to see the changes they make to the code almost instantly without restarting the app. This significantly speeds up the development process, allowing for rapid iterations and real-time UI adjustments.
- Dart Programming Language: Flutter uses Dart as its programming language, which offers features like a modern syntax, a just-in-time (JIT) compiler during development for fast iteration, and an ahead-of-time (AOT) compiler for optimized performance in production.
- Testing and Debugging Tools: Flutter provides a suite of testing and debugging tools, including a powerful widget testing framework, integration testing support, and DevTools for inspecting and analyzing the app's performance.

- Beautiful and Customizable UI: Flutter provides a rich set of pre-designed widgets and a highly customizable UI framework. It allows developers to create visually appealing and engaging user interfaces, resulting in a polished and native-like user experience across platforms.
- The flutter framework is also easy to both use and learn.

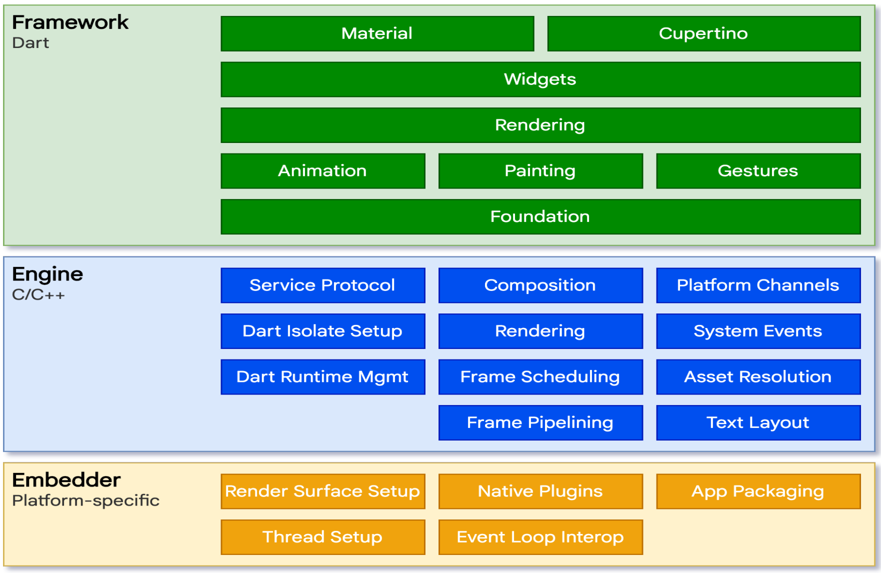



Figure 3.1: Flutter framework architectural overview

**Hardware Tools**

The hardware requirements we used included strong laptops, smart phones and recorders . We used the laptops to main write the code for the application , the phone for testing the accuracy of the system and the recorders for mainly data collection during interviews.

**Visual Studio Code**

Visual Studio Code is a lightweight, versatile, and powerful source code editor developed by Microsoft. It provides a highly customizable and user-friendly environment for writing, editing, and debugging code. We used Vs code on our laptops to write the software for our application together with the android studio emulator which allows app testing and debugging without physical devices.

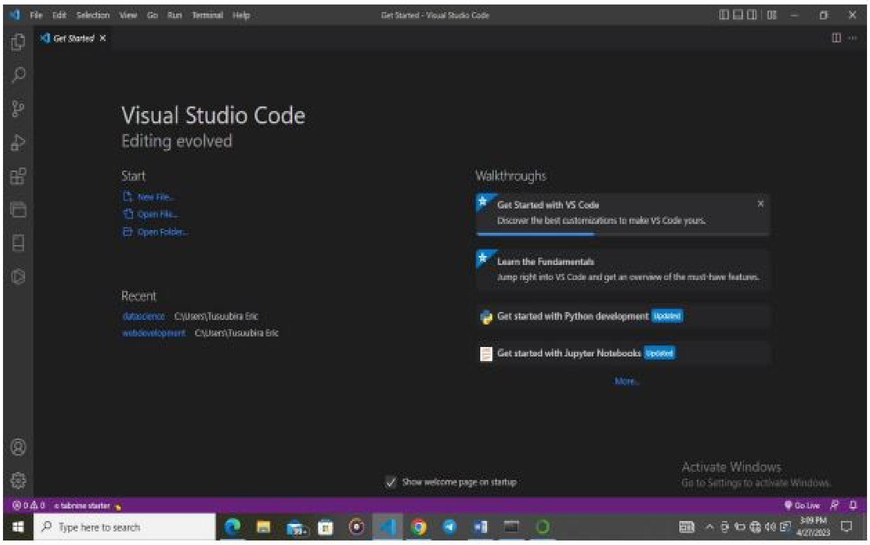



Figure 3.2: Vs Code

## 3.6 Testing

Once the system was developed, it was tested with members of the university community to ensure that it met their needs and was easy to use. Feedback was collected and incorporated into the system as necessary. Different sections of the application were developed and tested at a time as the project progressed to check whether they are perfectly working such as the logins, drawing routes among others. After different sections were tested, they were embedded together and tested again to check any inconsistencies so as to be corrected. After the errors were worked upon, the resulting system was again tested .

## 3.7 Conclusion

Finally, the navigation system was implemented across the campus, with training provided for faculty, staff, and students on how to use the system. Ongoing maintenance and updates will be required to ensure that the system continues to meet the needs of the university community.

Overall, our methodology provided a structured and rigorous approach to developing a navigation system that meets the needs of the university community, and can be used as a model for other organizations looking to implement similar systems.

# Chapter 4

# System Study, Analysis and Design

## 4.1 Introduction

This chapter contains a detailed explanation of the system design and architecture .

## 4.2 Requirements

During the data collection process, we identified the requirements that would satisfy the users' needs and interests for the mobile application. These requirements were grouped into functional and non-functional requirements.

## 4.3 Data Analysis From Collected data

### 4.3.1 Qualitative Analysis

We conducted an online survey asking different users about their experiences with navigation applications and what they think should be added to the existing navigation applications they normally use and below are some of the feedback we collected.

What are the main challenges you face when using navigation applications?

10 responses

- inaccurate directions , complex interfaces
- Network issues
- Irritating interfaces
- Data issues
- Misinterpretation
- Most of them may seem not updated and would indicate routes that ought to have been evaded.
- They stop at the door.
- Need for internet connection
- Poor directions

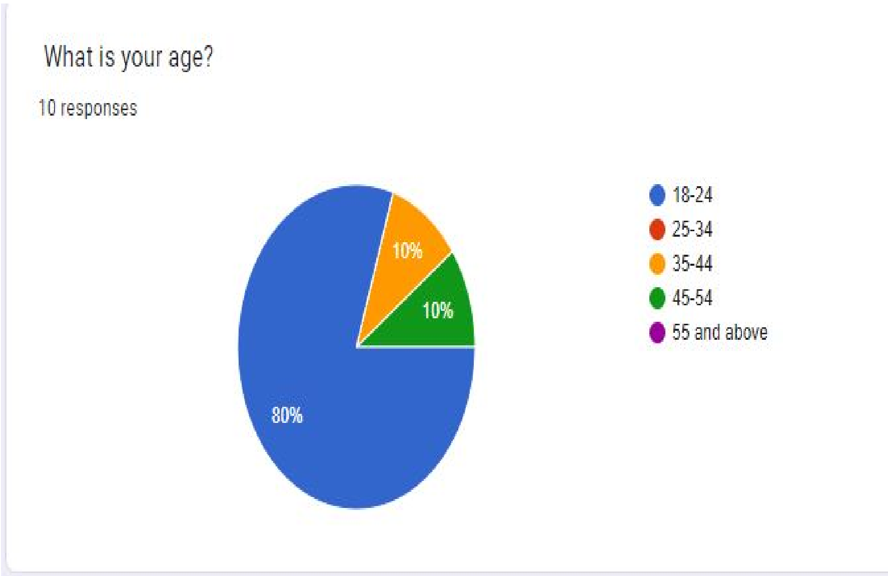
What are the main features you are looking for in a navigation application?

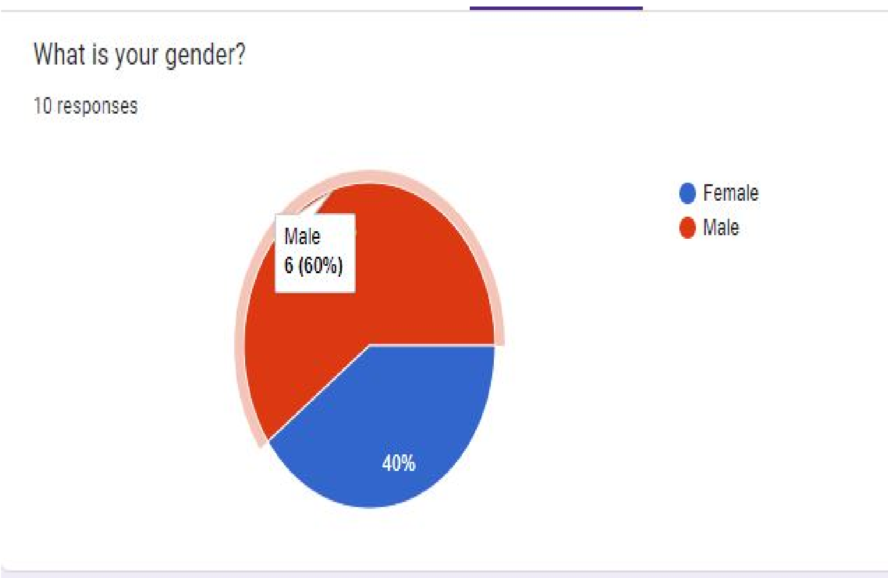
10 responses

- map that gives directions
- Alternative routes
- Fast
- Directions
- The easiest and quickest route to my final location
- Directions
- Easy navigation and visible location direction
- Verbal directions
- Turn by turn directions

### 4.3.2 Quantitative Analysis

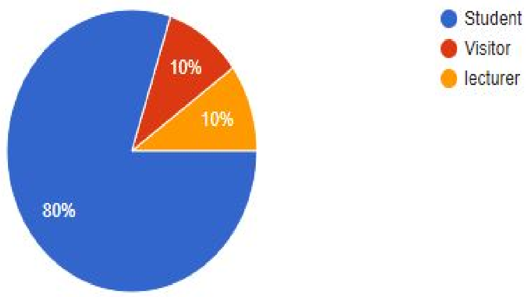
A big percentage (80%)of the people we interviewed accepted to have ever used an out door navigation application but not an outdoor one . The small percentage that had experience with indoor navigation applications had many complaints on it as presented below.



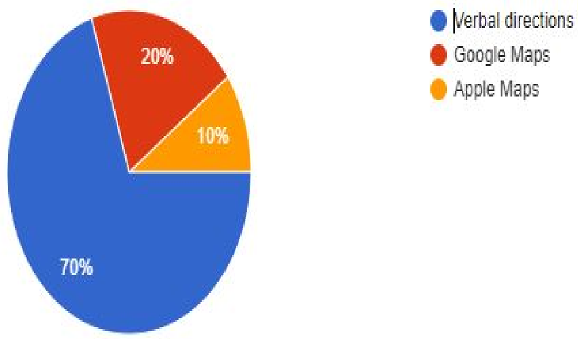
What is your title?

10 responses



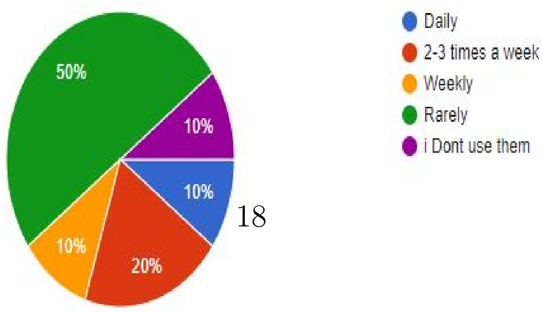

How do you get directions around campus?

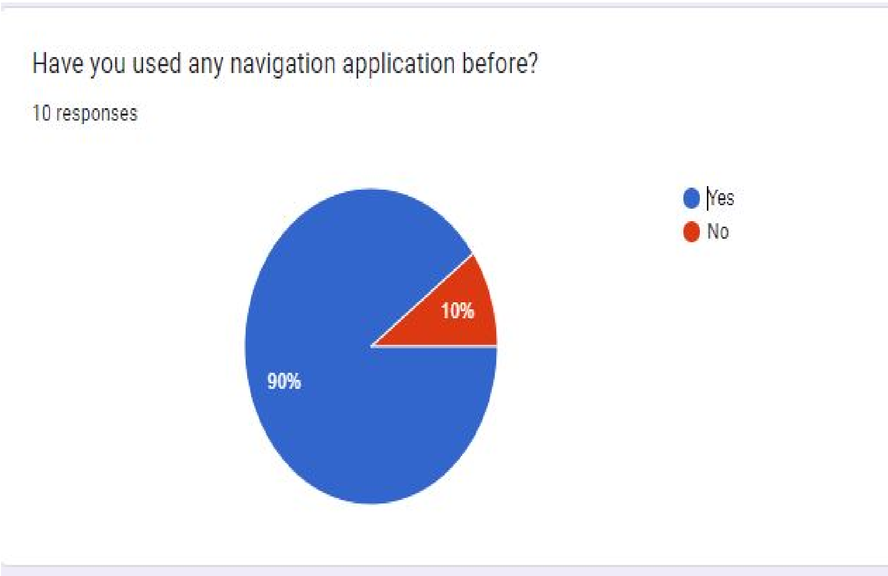
10 responses

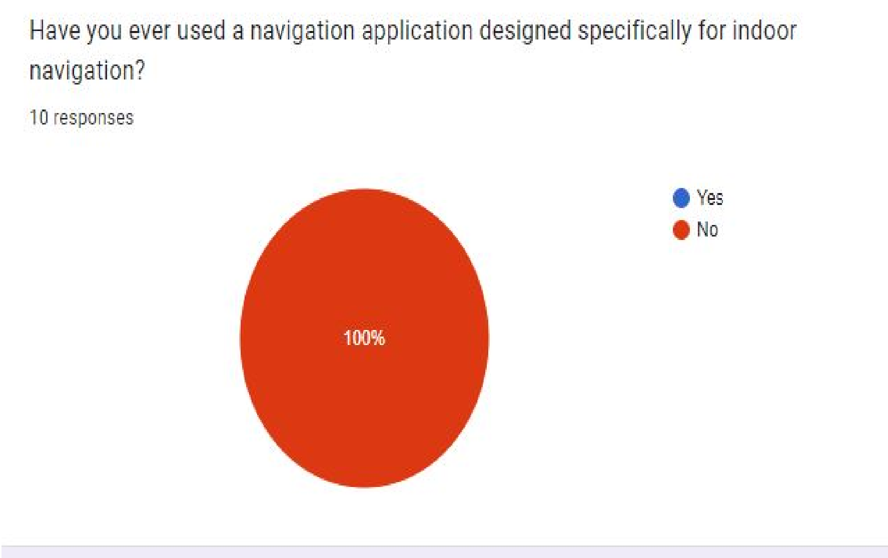



If yes, how frequently do you use navigation applications for indoor or outdoor navigation?

10 responses

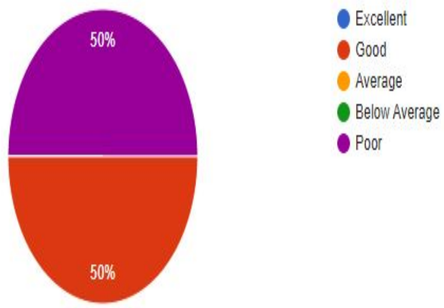



Have you used any navigation application before?
10 responses
Yes
No
10%
90%


Have you ever used a navigation application designed specifically for indoor navigation?
10 responses
Yes
No
100%

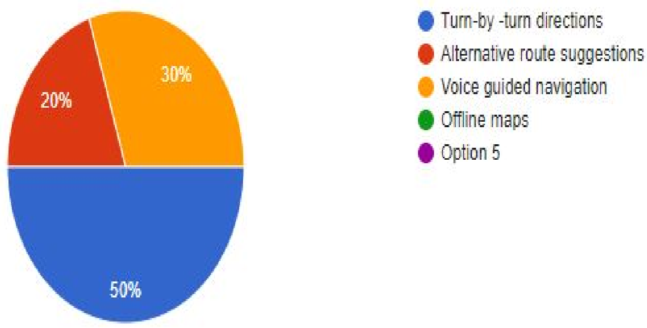
If yes,how would you rate your experience with indoor navigation applications?

2 responses




What features do you find essential in an outdoor navigation application?

10 responses



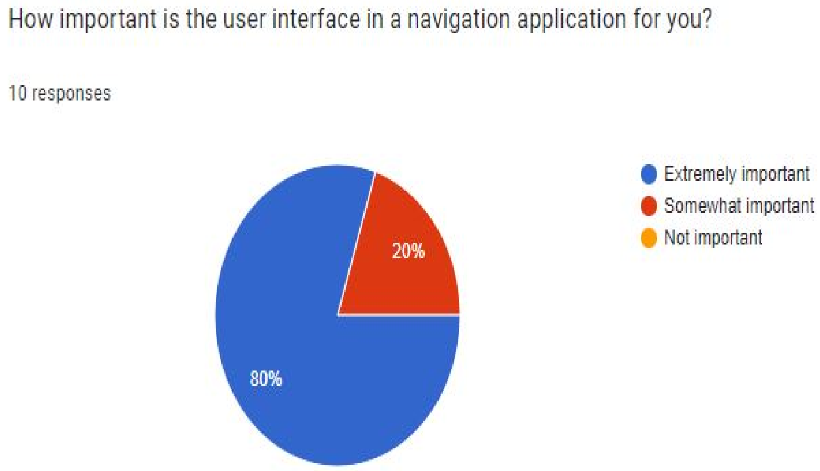



Figure 4.1: A pie chart showing the distribution of how important the UI is

### 4.3.3 Functional Requirements

Functional requirements define the specific features, capabilities, and behaviors that a software system or application should exhibit.These requirements are typically expressed as specific functionalities that the system must provide to fulfill user needs or business requirements.

- The system should show users their current locations.
- The system should allow users to input their desired destinations.
- Return the shortest route to reach a destination in the shortest possible time.
- Always give out accurate and correct directions.

### 4.3.4 Non-Functional Requirements

Non-functional requirements, also known as quality attributes, define the qualities or characteristics that the system should possess. Unlike functional requirements that focus on what the system does, non-functional requirements emphasize how well the system performs or behaves. These requirements are often related to system attributes such as performance, reliability, security, usability, and maintainability.

- The user interface should be intuitive and easy to navigate for both novice and experienced users.
- The system should be able to handle a significant number of concurrent users without any noticeable performance degradation.
- The application should provide very fast and responsive results and page loads to ensure a perfect user experience

## 4.4 Overview of the System

This section presents how data flows between the user , the system and additional components.

### 4.4.1 Use Case Diagram

A use case diagram is a visual representation that depicts the interactions between users (known as actors) and a system to accomplish specific tasks or achieve certain goals. It is a type of behavior diagram in UML (Unified Modeling Language) used in software development to illustrate the functional requirements of a system from a user's perspective.

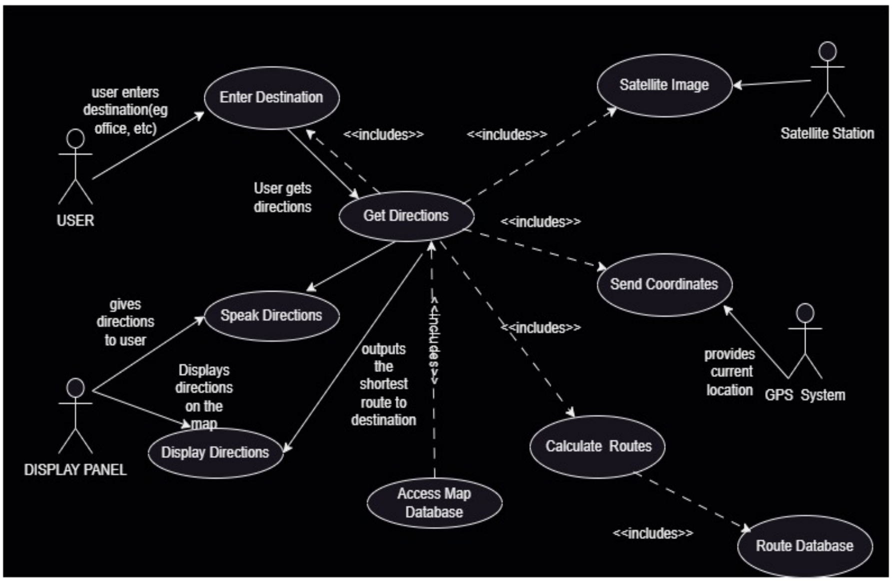



Figure 4.2: Figure showing the use case diagram

The user interacts with the system by inputting their desired destination .The system first determines their current location from their GPS and then determines whether the destination is in Makerere University. If the destination if indeed in Makerere , the system will determine all possible route to the destination and then choose the shortest using the A* search Search Algorithm and if the destination is not in Makerere the user will be required to re-enter their destination.
After the shortest is found , the system will interact with the user through the display panel by both speaking directions and displaying them.

### 4.4.2 Architectural Diagram

An architectural diagram, also known as a system architecture diagram provides an overview of the structure and components of a software system. It illustrates how various elements of the system interact with each other and the external entities they communicate with.

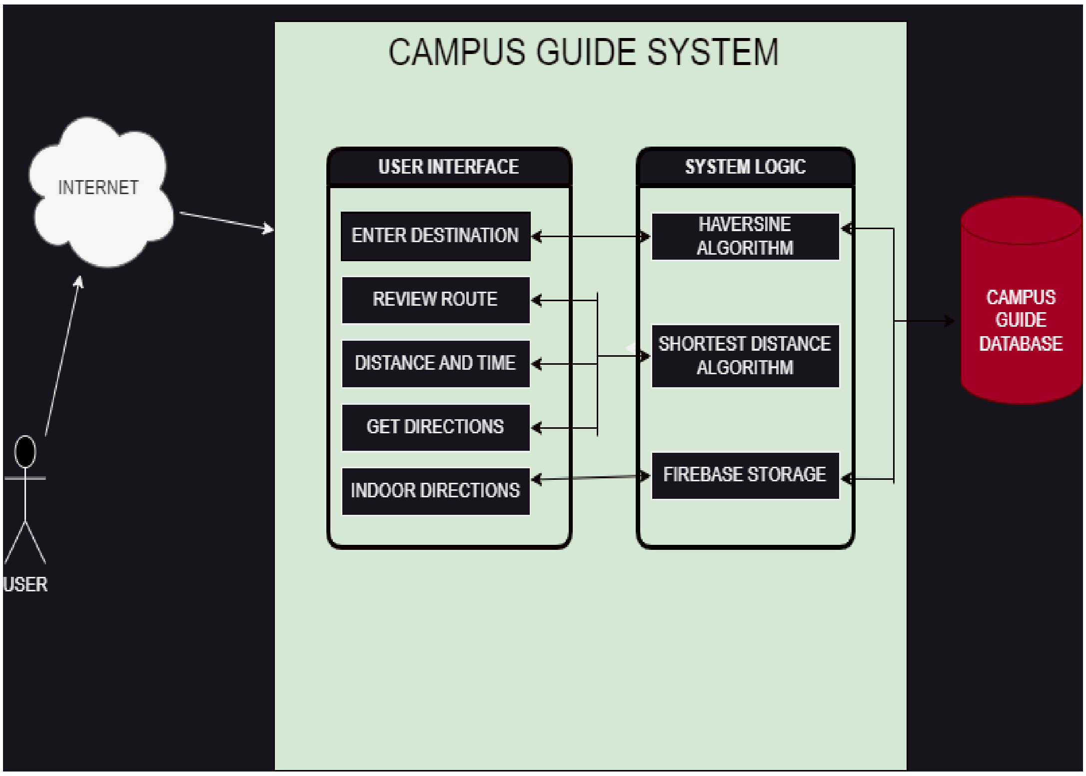



Figure 4.3: Figure showing the architectural diagram

### 4.4.3 Flow Chart

A flow chart is a diagrammatic representation that illustrates the sequence of steps or actions involved in a process. It uses various shapes and arrows to depict the flow of control or data within the process.

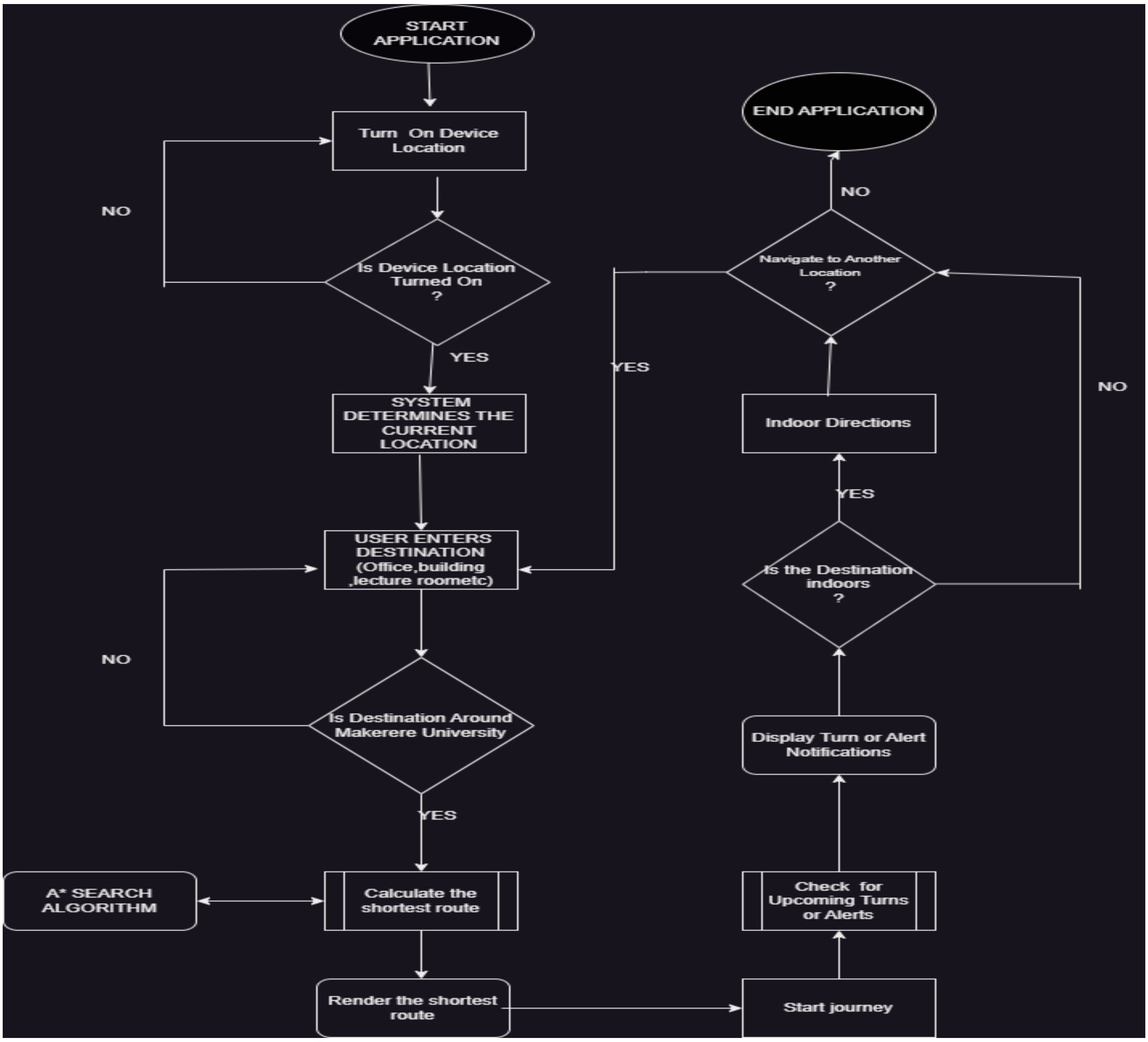



Figure 4.4: Figure showing the flow of data in the system

### 4.4.4 How The Shortest Route Is Determined

We used the A* search Algorithm in order to determine the shortest route from the users' current location to their destination .
In the beginning ,start and end nodes are created using the current location and provided destination and then all edges and weights between nodes are calculated using the CalculateEdges Function. This function iterates over all pairs of nodes and calculates the heuristic distance between them using the Euclidean distance formula. If the weight is below a certain threshold (0.00004 in this case), it creates edges between the nodes and adds them to their respective edges lists.
Secondly, the constructGraph function reads a GeojSON file containing map data (in this a case a line shapefile) and constructs a graph by creating nodes for each coordinate in the line geometry.
The aStarSearch function performs the A* search algorithm to find the shortest path between the start and end nodes. It initializes the necessary data structures, including open and closed sets, and iterates until the open set is empty or the goal node is reached . It calculates the tentative G score for each neighbor node and updates its scores and previous node if a shorter path is found. Finally , the algorithm reconstructs the shortest path by following the previous node pointers from the end node to the start node.If the shortest path is empty, it means the destination is not reachable from the current location and if a valid shortest path is found , it converts the nodes in the path to polyline coordinates.

# Chapter 5

# Presentation of Results

## 5.1 Introduction

This chapter shows screenshots of the system interfaces and also explains the programming environment.

When the user starts the application, they are required to turn on their location services so as to identify their current location. Once the current location is identified , the system asks the user to input a desired destination. The haversine algorithm checks to confirm whether the destination is within the premises of Makerere University. If it isn't , the user will be required to check their spelling otherwise the application will not assist them.
The system uses the Dijkstra algorithm to calculate the shortest route from the current location to the destination location. Once the shortest route is calculated , the user can review the route , the distance and time it will take for them to complete the journey. The application provides turn by turn directions for users until they reach the destination.
If the destination is indoors , an image ,Geo coordinates and indoor directions are provided to the user. This information is fetched from the fire store database that contains all indoor information .

## 5.2 Screenshots

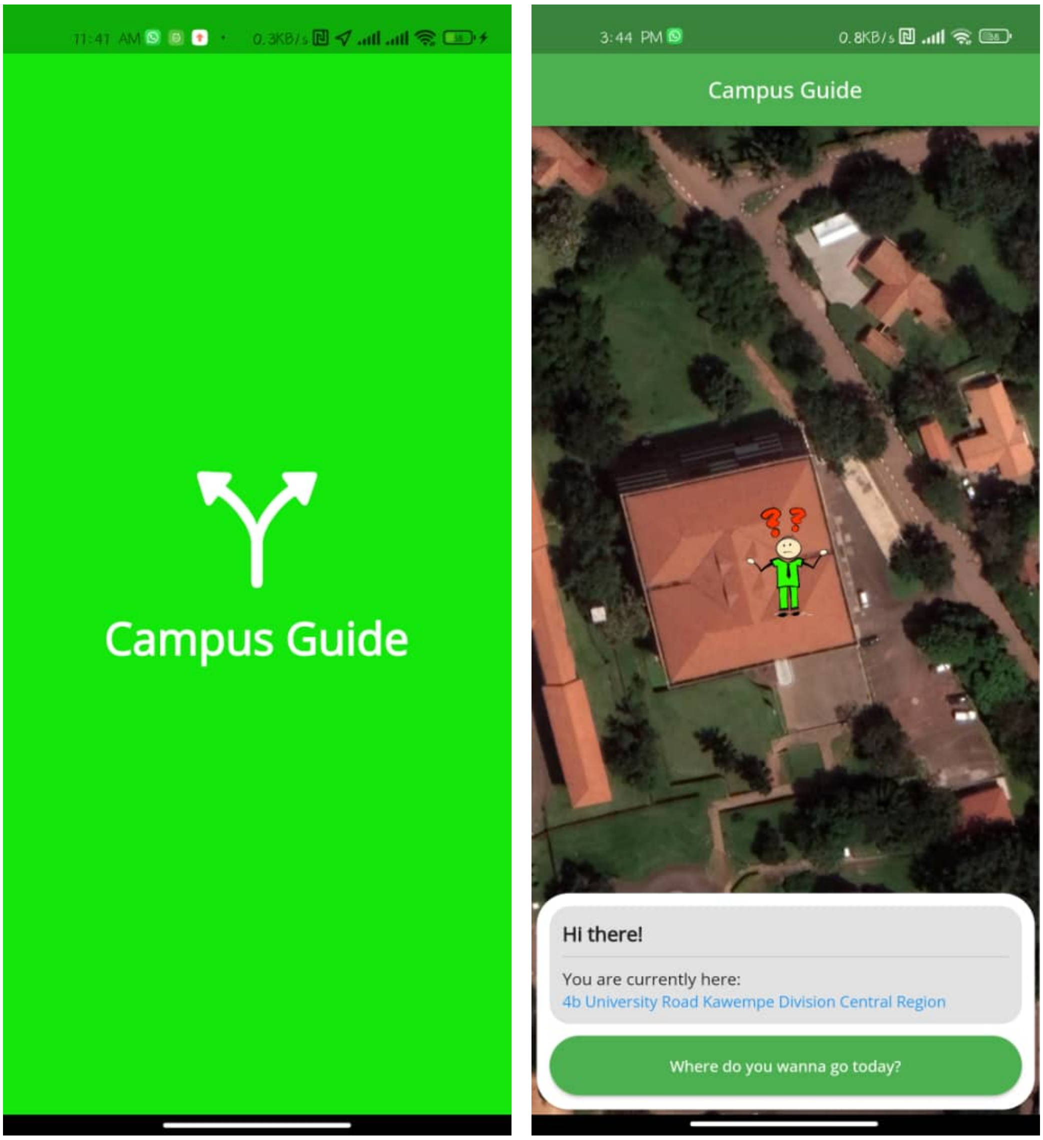



Figure 5.1: The splash Screen and Welcome Screen

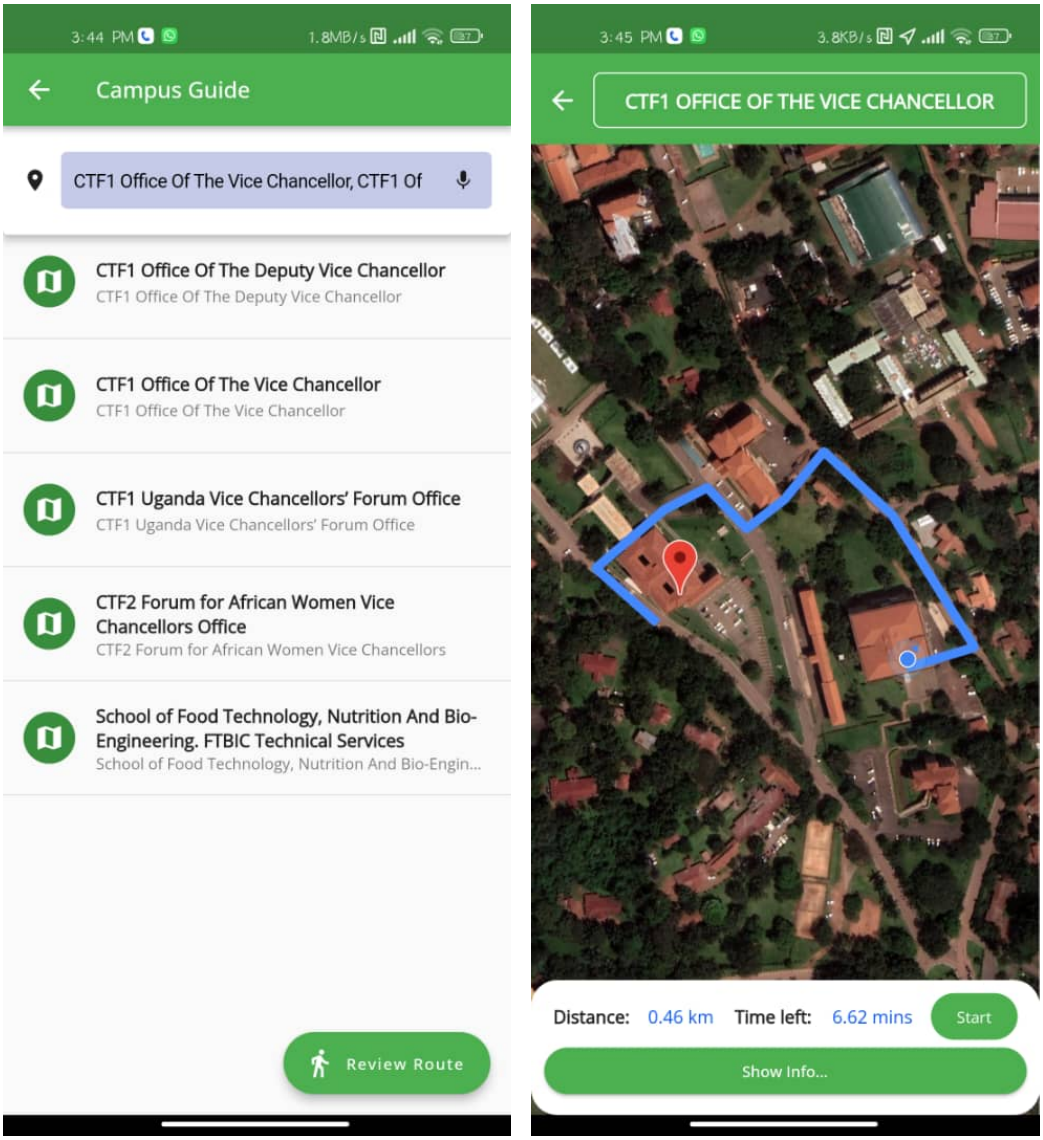



Figure 5.2: The search screen and shortest route possible screen

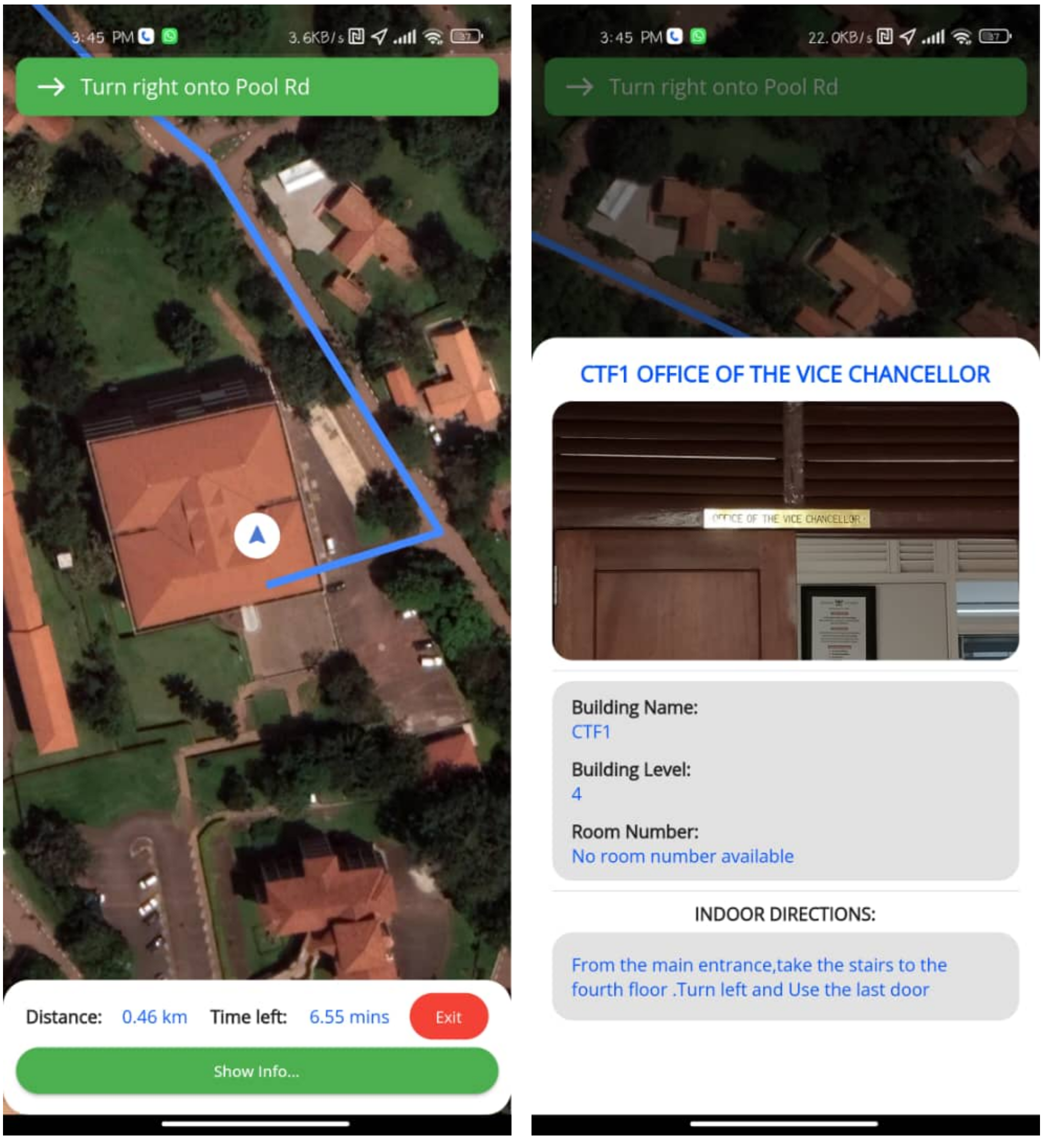



Figure 5.3: Both the outdoor and indoor directions pages

# Chapter 6

# Limitations, Recommendations and Conclusion

## 6.1 Introduction

This chapter presents a conclusion to the project highlighting the limitations faced during the project duration, the recommendations to over some of these problems and a conclusion.

## 6.2 Limitations

Below are some of the limitations we faced during the course of the project;

- We faced a problem of rigidity from lecturers when collecting personal data like their contacts and emails since most of them didn't trust us with their information fearing personal and security concerns.
- We also faced a problem of a limited amount of time to accomplish the project since we were doing the project together with other course units , exams and tests in a semester.This made it difficult to focus solely on the project since we had to divide our time so as to achieve other milestones .
- During the implementation stage, we faced a problem of having to purchase some software so as to develop our application such as Google Map APIs .
- We also faced a problem of high costs of research during requirements and data collection stage . This involved transportation costs to attend seminars about how to use some tools in our project, costs of

hardware such as powerful laptops and phones to develop, run and test the application.

- We also faced a problem of technical limitations related to the navigation technologies we choose to use thereby making it difficult for accuracy especially in indoor environments where GPS signals are weak or unavailable.

- Many colleges we visited did not have room numbers so it was hard for us to properly label them in our system.

- It was hard for us to get the names of every lecturer especially in colleges we do not study at. We ended up using departmental room allocations.

## 6.3 Recommendations

- We recommend that the university gives students more time to deliver a written report and a complete working Application without pressuring the students in the mid of semesters.

- Offices should be properly labeled with room numbers and the names of the staff members occupying them to make it easier for students to find them.

- We also recommend that the university provides students with transportation so as for students to attend important seminars on how to do their projects, collect data from sites and to pay for soft-wares to use for projects.

- We also recommend that the university provides us with official documents that we can provide to people to assure them that their information is safe and won't be disclosed to anyone .

## 6.4 Conclusion

According to the literature we reviewed, it was evident that no such system had been developed to address the problem of both indoor and outdoor navigation using the same system as most of the systems address only one of the problems but not both. Furthermore, most systems required using expensive hardware to accomplish these simple tasks. This thus motivated us to develop a Campus Guide application that will address both problems at the same time using only a smart phone and this will application will run on both android and IOS devices. The users will be allowed to query the database for any destinations they may wish to get to, get their current locations, have clear paths drawn for them to destinations, optimal paths and exact indoor directions to offices. In conclusion, the Campus Guide project was successful since it was tested and proved to do everything that it was intended to do.Also this project was a perfect challenge that enabled us to use the knowledge we earned from our classes into practice.

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# Chapter 7

# Appendices

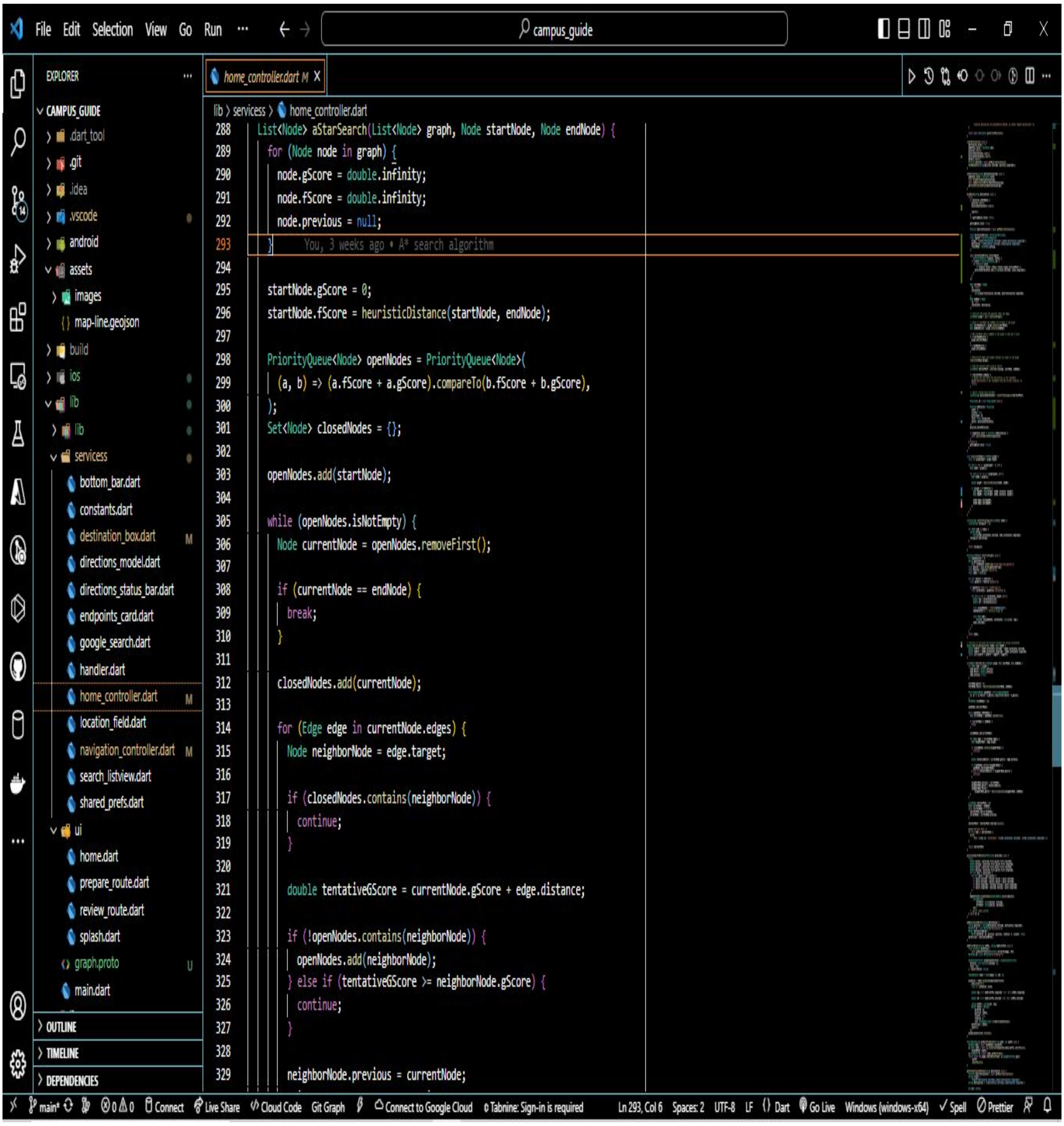


Figure 7.1: A* search Algorithm code

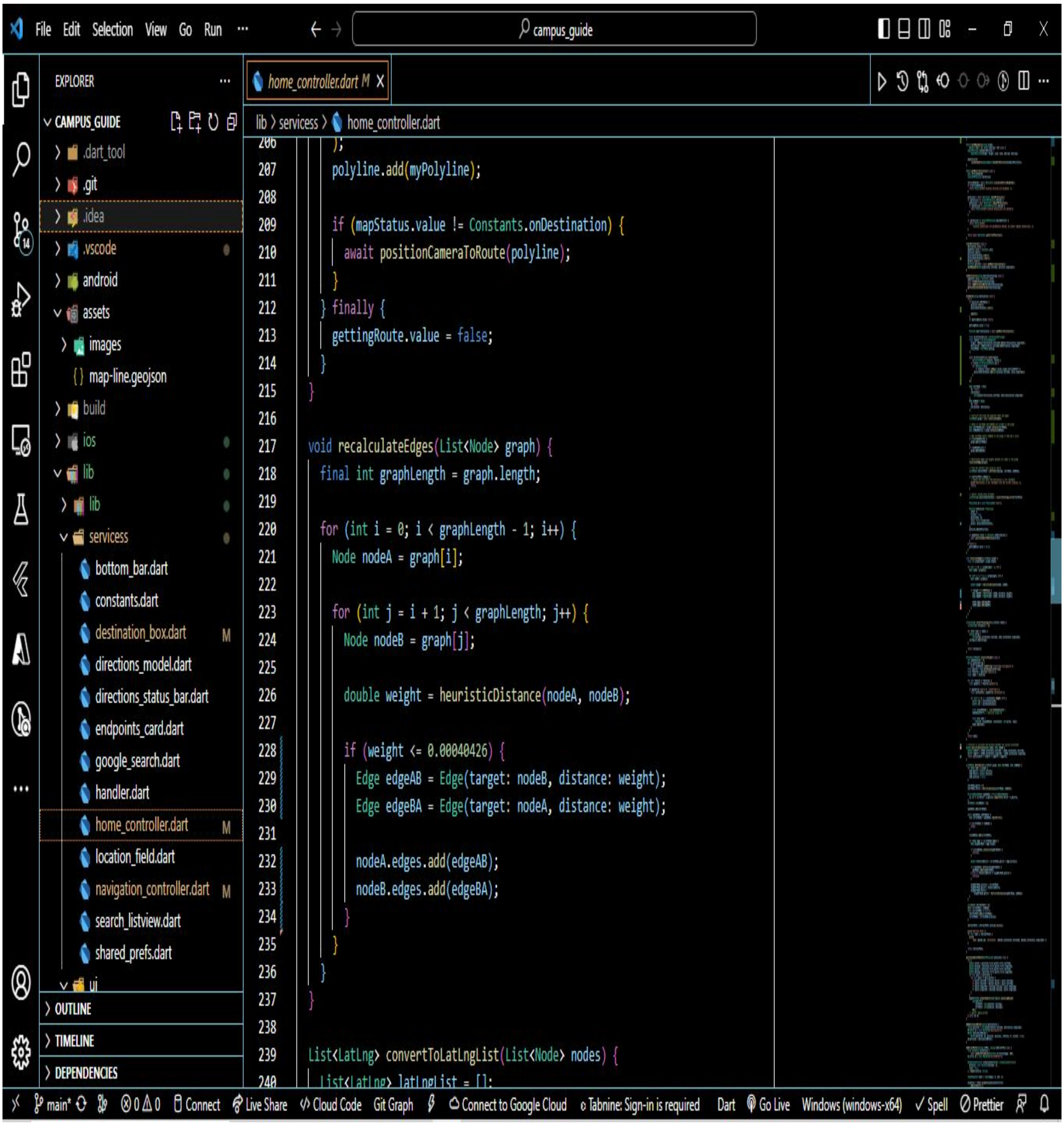

Figure 7.2: code calculating the edges between two nodes

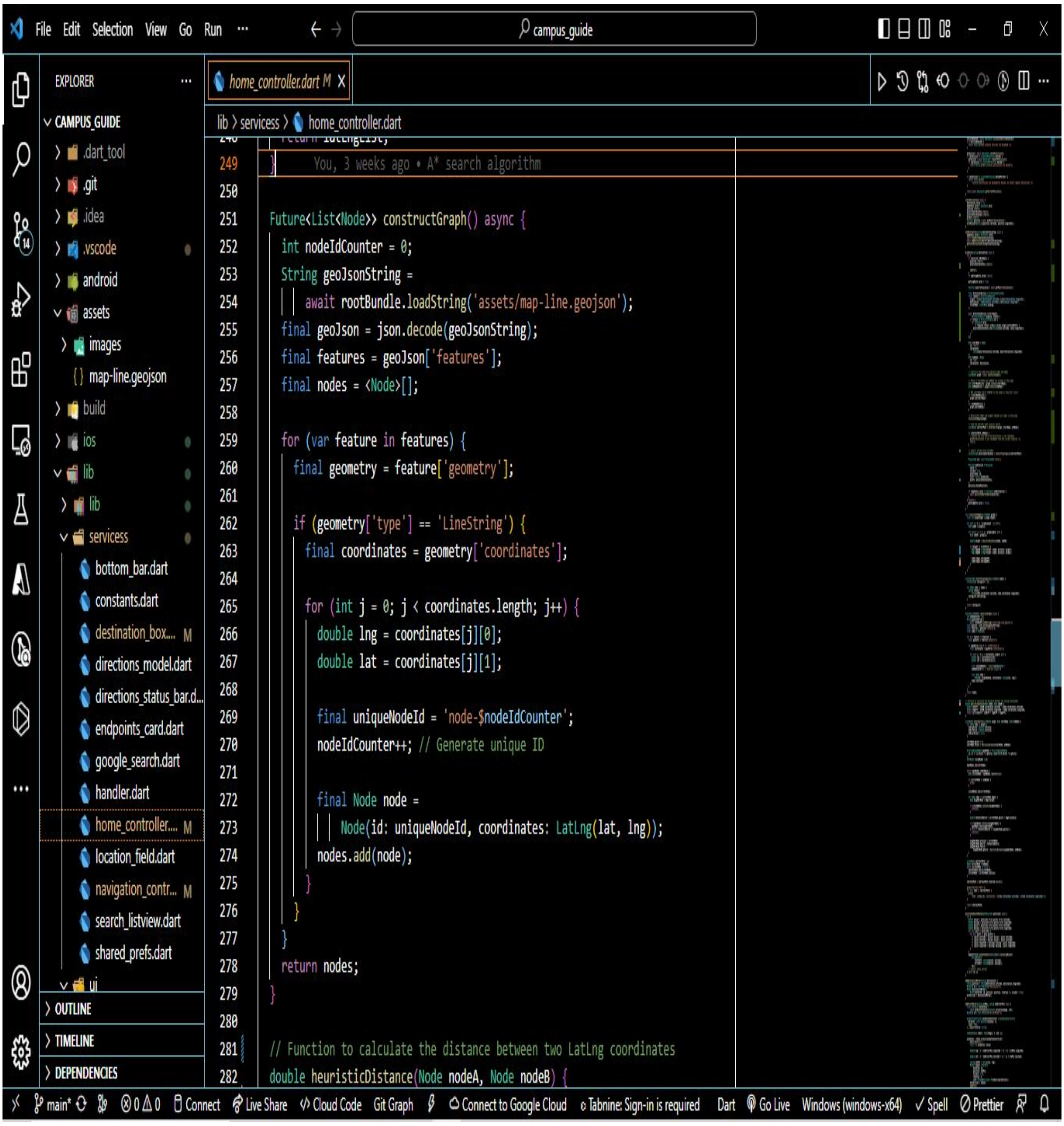


Figure 7.3: code for constructing the graph used in the A* search algorithm