

**OFFLINE NAVIGATION SYSTEM FOR NEW STUDENTS IN THE
UNIVERSITY OF BENIN**

BY

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**SUBMITTED IN PARTIAL FUFILMENT OF THE REQUIREMENT
FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE
(B.SC.) IN COMPUTER SCIENCE, UNIVERSITY OF BENIN, EDO
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JULY 2021.

CERTIFICATION

This is to certify that this project work has been carried out by **DAVID VICTOR** under my supervision, and it is adequate and satisfactory both in scope and content, for the award of Bachelor of Science (B.sc) Degree in Computer Science of the University of Benin.

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APPROVAL

This project work is hereby approved in partial fulfilment of the requirements for the award of Bachelor of Science (B.sc) Degree in Computer Science of the University of Benin.

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DATE

DEDICATION

I dedicate this work to God Almighty for giving me the needed strength to carry out the work and for his care, protection throughout my stay in the prestigious University of Benin.

I also dedicate this work to my parents who successfully made me a graduate today and to my siblings too.

ACKNOWLEDGEMENT

My utmost appreciation goes to God Almighty who has seen me through all my education years. Praised be his name forever, Amen.

Words are not enough to express my profound gratitude to my project supervisor, F.O Oliha, Ph.D. for his patience, motivation and immense support all through my stay in the University of Benin.

Special gratitude goes to the Head of Department of Computer Science, Prof. Dr, F.I Amadin, my project coordinator, and all the lecturers in the Department of Computer Science, University of Benin, for their support and inspiration in one way or the other: Prof E.A Onibere, Prof. (Mrs) S.C Chiemekwe, Prof (Mrs) Akwukwuma, Prof. (Mrs) F.A. Egbokhare, Prof A.A Imiavian, Prof G.O. Eguobase, Prof. (Mrs) A.O Egwali, Dr. K.C Ukaoha, Dr. (Mrs) S. Konyeha, Dr. E.P Ebietomere, Mr. E.E Obasohan, Dr. (Mrs) R.O Osaseri, Mr, P.E.B Imiefoh, Mr. N.E.O. Agbonlahor, Mr. S.O.P. Oliomogbe Mr. E. Nwelih, Mrs. R.A. Usiobaifo, Mr. E.C. Igodan, Mr. K.O. Otokiti, Miss O.L. Usiosefe, Mr. F. Osagie, Mr. E. Obayagbona, Mrs. T. Agenmonmen, Mrs. O. Aziken, Mrs. Odetayo. God bless you all.

All thanks to my ever loving parents, Pstr and Mrs Victor for their profound help and support during the course of this project work and my stay in school. All thanks to my siblings: Dan, and Dam Victor for their love, care, understanding and prayers and friends, for their unconditional support throughout my stay in this university. Also thanks to my uncle Fortune who really sacrificed a lot of his time to help out in my project even from a distance and to Mr Ben who helped me to even get started out on the project. God in his infinite mercy, bless you all!

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ABSTRACT

In a world where movement of people can't be overemphasized, the need for navigation is crucial. This project seeks to bring a solution to some of the many problems of the existing navigation systems we have today by proposing an offline navigation system model. It also gives a theoretical background to the existing navigation systems already in place with an idea of their workings.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Quite often, we find ourselves in need of direction when we happen to be in a new city or town for the first time. It is more urgent when we don't even have close contacts or a mind picture of how the place looks prior to going there. Therefore, the need for navigation arises.

The term stems from the 1530s, from Latin *navigacionem* (nom. *navigatio*), from *navigatus*, pp. of *navigare* "to sail, sail over, go by sea, steer a ship," from *navis* "ship" and the root of *agere* "to drive". Navigation refers to the method of determining aspects such as position, speed, and direction during travel. In the pre-modern era, direction and position were determined using an altazimuth, a compass, and a map; these are now considered primitive forms of navigation.

To begin with, when travelling from point A to point B, we would all have to use our heads and pay attention to the world around us. This might not be a bad thing: we'd be less likely to drive into rivers or over cliffs because we trusted our guidance systems too much. We rarely get lost when we utilize devices with navigation systems. If it fails, the roads would be clogged with cars stopping to look at signs or examine maps

Navigation was regarded one of the seven mechanical arts in medieval Europe, along with tailoring, agriculture, construction, fighting and hunting, trade, cookery, and metallurgy, none of which were employed for long voyages over open oceans. Polynesian navigation is probably the earliest form of open-ocean navigation, it was based on memory and observation recorded on scientific instruments like the Marshall Islands Stick Charts of Ocean Swells. Early Pacific Polynesians used the motion of stars, weather, the position of certain wildlife species, or the size of waves to find the path from one island to another. (Wikipedia 2020).

Systems for navigation have evolved over the years. Starting from ancient methods like celestial navigation, it has improved all the way up to satellite navigation otherwise known as the Global Positioning System (GPS).

1.2 Motivation

Talking about my motivation, it came mainly from observation as well as experience. As a new student, I found it difficult to navigate around the school to lecture halls, faculty buildings and the likes. I would have to ask someone and still their explanations and directions would not be always easy to follow. This is what led me to thinking of building an offline app just for directing new students to find out the different important buildings in the university, and also find it easily themselves with much less help from others.

1.3 Problem Statement

A new undergraduate student has a need to navigate around the school more often than already established students. This calls for accurate knowledge of the right place to be in the school on time. The inaccuracy of the right place poses a challenge to a new student and also causes delay in timeliness for that student. He then has to go around asking several people on how to get to a place and that takes time. There is also the challenge of not well to do students not having access to mobile data hence the need for this offline app. There are several navigation apps available on the market. But most of them need internet to connect to servers hooked up to satellites in order to give a direction. There is the need for a student who is just registering his presence in the school to be in the right place on time, without having to bother much about his cost of buying data bundles to hook up to the internet. It is these problems that this project sets out to solve.

1.4 Research Aim and Objectives

The aim of this research is to develop a total offline navigation app that gives pictorial directions from one faculty building to another. The main goal is to ease the accurate movement and punctuality of the new student to the right offices, buildings, lecture halls, etc. It's important to note here that this project does not cover every single point to point navigation on the campus. It basically is meant to help the new student navigate from one faculty to another with a idea of how the place looks like, using the pictorial data included.

The following constitutes the objectives of this research:

- i. Research existing navigation systems, both electronic and analog or non-electronic means of navigation and direction.
- ii. To expose some of their shortcomings which this project seeks out to solve.
- iii. To increase the punctuality of the new student to the said places

1.6 Significance of Study

This research is significant to:

- i. Students around the University of Benin campuses.
- ii. New visitors to the University of Benin.
- iii. App developers seeking to make their apps work easily offline.

1.7 Limitation of Study

There are many intricacies in developing an offline app that routes a person from point a to b especially when it's offline. This project does not include directions to every spot in the school. It doesn't also go into in-depth discussion of navigation systems. This is due to:

- i. Time constraints in searching for and securing sources for information about the discussed systems, also in developing the app.
- ii. Finances

1.5 Research Methodology

The methodology used in this research is that of the expository method. This is due to the fact that only a prototype model was discussed and the actual app wasn't built.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter gives an preview into some other studies conducted by notable researchers with regards to the applications of offline GPS for quick and accurate navigation in our immediate environs (UNIBEN in this case). The chapter also gives a brief synopsis of the history and present status of the problem describe by a brief review of previous researches conducted in this regard.

2.1 What is a Navigation?

The word “navigate” is derived from the Latin words ‘navis’, meaning ship, and ‘agere’, meaning to move or direct. Navigation was first thought of as a concept in sea transportation.

Hobbs (1981) defines navigation as the process of directing the movements of a vessel from one place to another. In today’s world of rampant inflation and increasingly serious energy shortages including that of the internet, the cost of replacing a vessel lost through negligent navigation on sea can often be completely prohibitive, quite apart from the consideration of any attendant injuries or deaths among the vessel’s crew or loss of cargo. Revenue losses caused by inefficient navigation with consequent increases in fuel bills and other operating costs can be almost if not equally as severe over time especially when one loses his way in the sea. Thus, modern navigation may be more properly defined as the process of directing the movements of a vessel safely and efficiently from one place to another.

Navigation focuses on the direction of the movement of a craft, vehicle or a person from one place to another. Navigation covers a lot of fields. The field of navigation includes four general categories: land navigation, marine navigation, aeronautic navigation, and space navigation.

Land navigation is the discipline of following a route through unfamiliar terrain on foot or by vehicle, using maps with reference to terrain, a compass, and other navigational tools. The same goes for aeronautic navigation. They also have their own tools for finding their way across their various terrain. This research has to do with a system built for land navigation.

2.2 Navigation Systems

Navigation systems are a combination of the tools used for navigation all put together to create a means of navigation. Navigation systems are broadly divided into two sections viz:

- Manual system of Navigation which made use of tools such as the compass, astrolabe and the likes.
- Electronic system of Navigation which made use of electronic or digital instruments to aid navigation.

The sections following give a review on manual and electronic systems afore mentioned

2.2.1 Celestial navigation

Celestial navigation systems were one of the oldest systems of navigation dating back to the stone age. It made use of tools such as the sextant to measure angles, an almanac or use the positions of the Sun, Moon, Planets, and Navigational Stars. Both terrestrial and intergalactic navigation rely on these types of technologies. Knowing where point on the spinning earth a celestial object is above and measuring its height above the observer's horizon allows the navigator to calculate his distance from it. A naval almanac and a marine chronometer are used to determine the subpoint on Earth a celestial body is passing through, and a sextant is used to determine the body's angular height above the horizon. The height can then be used to calculate the distance between the subpoint and the origin to generate a circular line of position. A navigator fires a series of stars in rapid succession to create a series of overlapping position lines. The celestial fix is found when they cross. It's also possible to use the moon and the sun. The sun can also be used to calculate a position by shooting a series of lines of position (best done around local noon).

Below is a diagram showing a sphere on the celestial system of navigation.

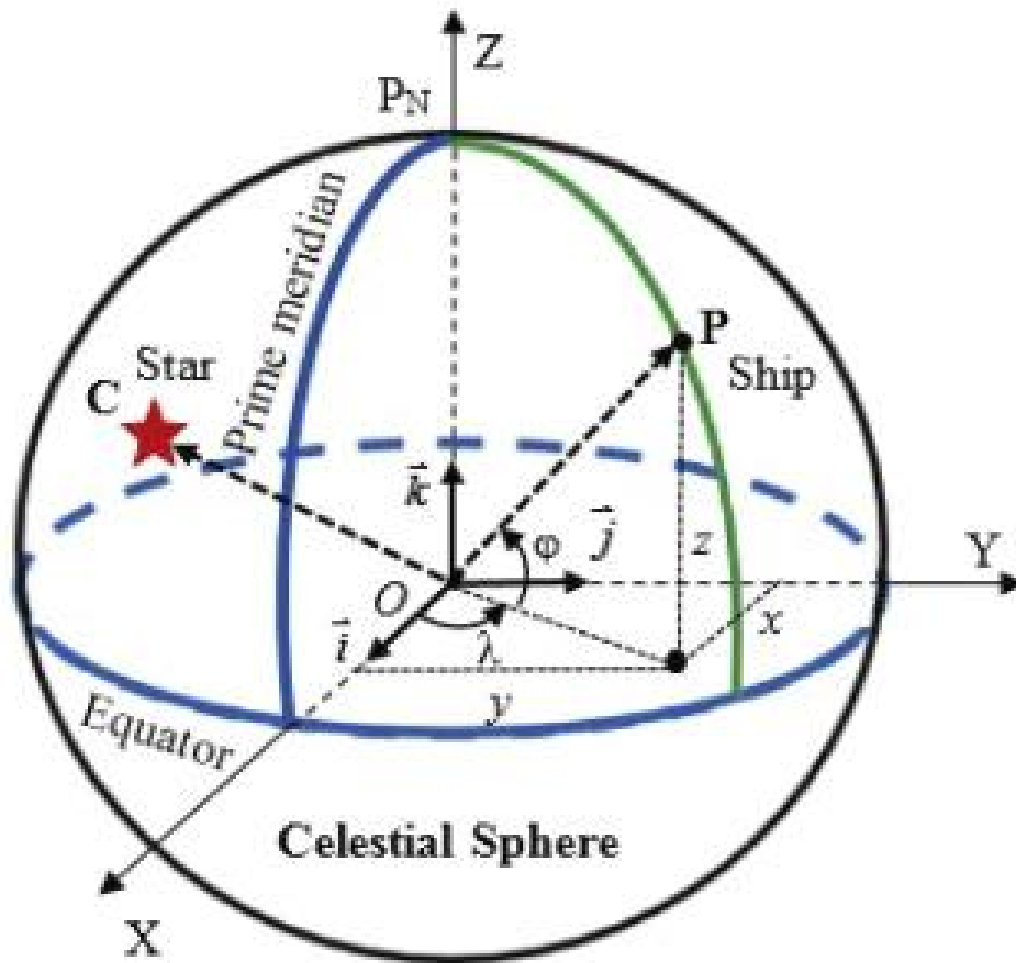


Fig 2.1 The celestial sphere on Cartesian coordinate system

2.2.2 Inertial navigation

The **inertial navigation system (INS)** is a form of navigation system that uses motion sensors to calculate its position. The initial latitude and longitude, as well as the INS's physical orientation relative to the earth (e.g., north and level), are determined before actively navigating. An INS receives impulses from motion detectors that measure (a) acceleration along three axes (accelerometers) and (b) rate of rotation about three orthogonal axes after they've been aligned (gyroscopes). These allow an INS to calculate its current latitude and longitude in real time (and often velocity).

An INS has the advantage over conventional navigation systems in that it does not require outside information once it is aligned. An INS is unaffected by inclement weather, and it cannot be detected or jammed. Its downside is that, because the current position is determined

entirely from prior locations and motion sensors, mistakes accumulate with time, growing at a rate roughly proportionate to the time since the initial position was entered. As a result, inertial navigation systems must be constantly rectified with a 'fix' from another sort of navigation system.

The V-2 navigation system, introduced by the Germans in 1942, is said to be the first inertial system. Inertial sensors, on the other hand, date back to the early 1800s. INSs were used in airplanes, missiles, surface ships, and submarines because to their advantages. During the Polaris missile program, for example, the US Navy built the Ships Inertial Navigation System (SINS) to assure a stable and precise navigation system to initial its missile guidance systems. Until satellite navigation systems (GPS) became available, inertial navigation systems were widely used. Submarines and long-range missiles still employ INSs since they can't get a fix from GPS or other sources while submerged.

2.3 Electronic navigation

Electron. It was first manual and now electronic devices such as radios and mobile phones were now being used. The three main types of electronic navigation that were used were the **radio navigation**, **radar navigation** and the **satellite navigation** (which we all know as the **Global Positioning System** or **GPS**) which is at the peak of what was addressed in this research. This is because the satellite navigation is what is widely used today on mobile phones. In the subsections following, the various means of electronic navigation are being discussed.

2.3.1 Radio Navigation

A radio direction finder, often known as an RDF, is a device that determines the direction to a radio source. Radio is a particularly useful navigation technology for ships and airplanes operating at a distance from land because of its ability to traverse very great distances "beyond the horizon."

RDFs operate by rotating a directional antenna and listening for the direction in which a recognized station's signal is strongest. During the 1930s and 1940s, this type of method was commonly employed. RDF antennae are visible on German World War II planes as loops

under the back section of the fuselage, although most American planes had the antenna hidden behind a thin teardrop-shaped fairing.

Below is a diagram illustrating the long range radio navigation system

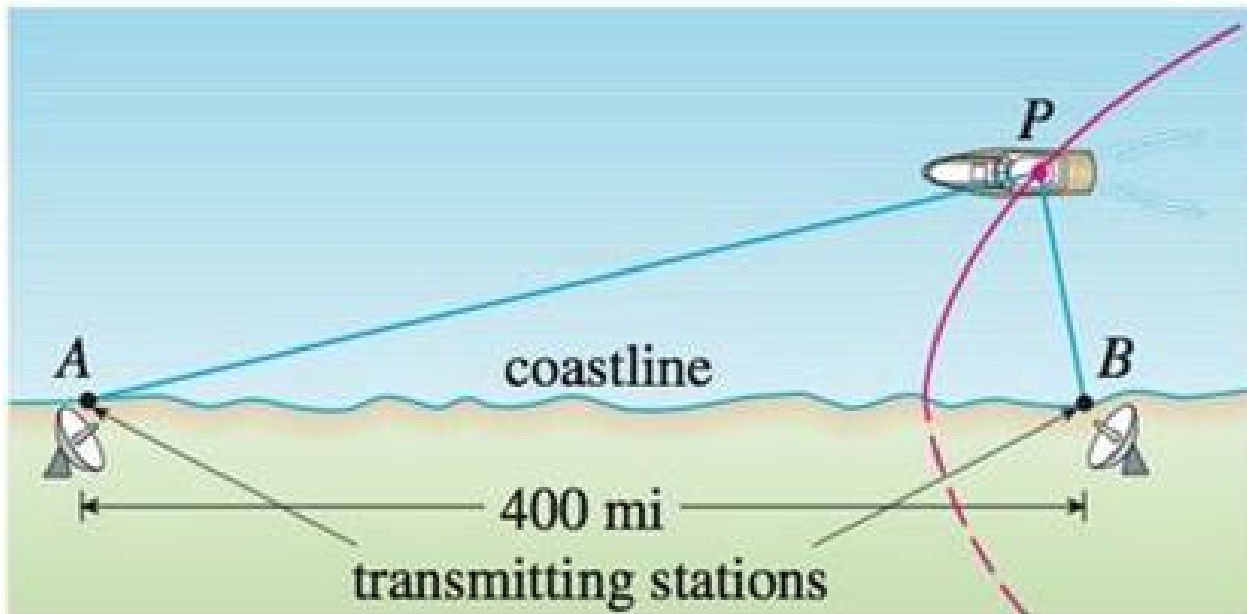


Fig 2.2 The LORAN (Long Range Navigation) radio navigation system

RDF signals are delivered in navigational applications in the form of radio beacons, which are the radio equivalent of a lighthouse. The signal is usually a simple AM broadcast of a series of letters in morse code, which the RDF may tune in to determine if the beacon is "on the air." Because of their great strength and proximity to large cities, most current detectors can also tune in to any commercial radio stations.

2.3.2 Radar Navigation

When a vessel is within radar range of land or special radar navigation aids, the navigator can measure distances and angular bearings to charted objects and use them to draw arcs and lines of position on a chart. A radar fix is a fix that consists solely of radar data. Types of radar fixes include "range and bearing to a single object," "two or more bearings," "tangent bearings," and "two or more ranges."

In his 1957 book *The Radar Observer's Handbook*, William Burger defined parallel indexing as a strategy. This method entails drawing a line on the screen parallel to the ship's course but

offset to the left or right by a certain amount. The navigator can keep a set distance from hazards by following this parallel line.

For specific conditions, some techniques have been created. The "contour method," for example, entails drawing a translucent plastic template on the radar screen and dragging it to the chart to fix a point.

Another unique technique, known as the Franklin Continuous Radar Plot Technique, includes drawing on the radar display the route a radar item should take if the ship continues on course. During the transit, the navigator can ensure that the ship is on course by ensuring that the pip is parallel to the sketched line.

Below is an illustration of the radar system.

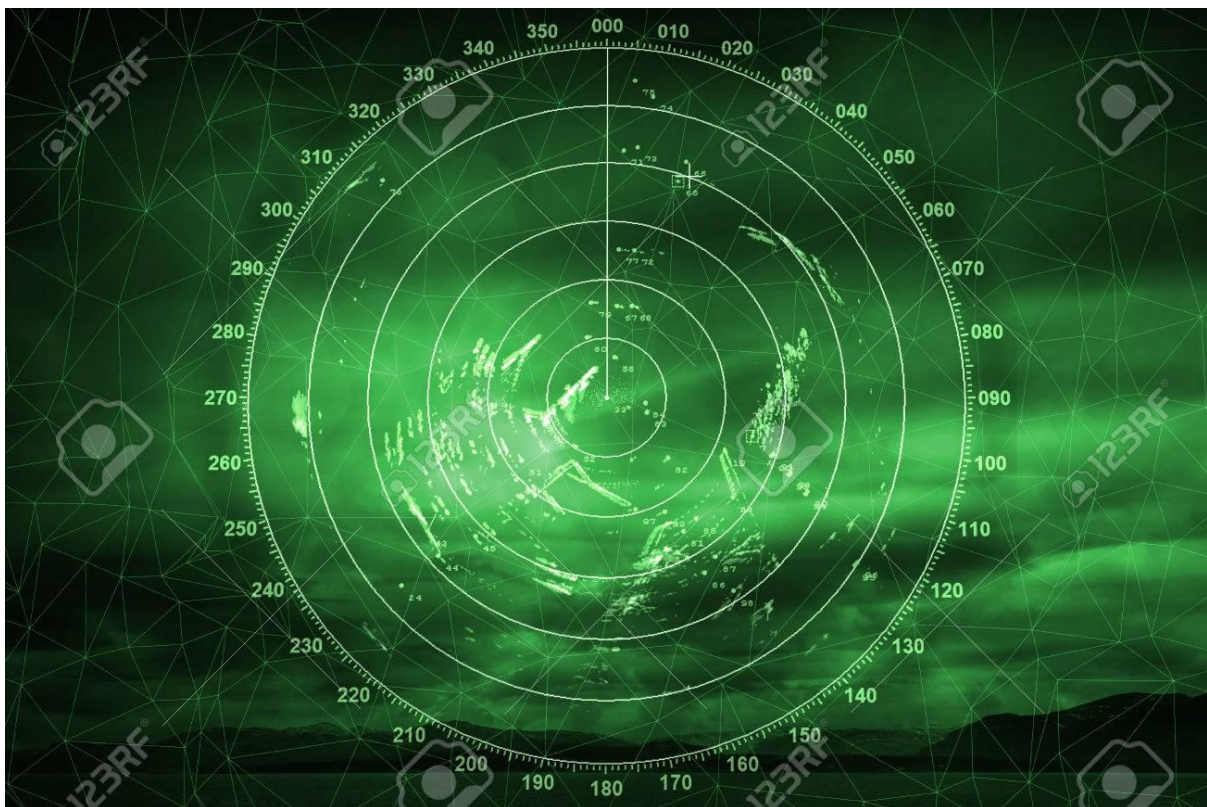


Fig 2.3 Green navigation system screen with illuminated radar image

2.3.3 Satellite Navigation

Global Navigation Satellite System or GNSS is the term for satellite navigation systems that provide positioning with global coverage. A GNSS allow small electronic receivers to determine their location (longitude, latitude, and altitude) within a few meters using time

signals transmitted along a line of sight by radio from satellites. Receivers on the ground with a fixed position can also be used to calculate the precise time as a reference for scientific experiments.

The acronym GPS, which stands for Global Positioning System, is a guidance system for navigation and direction. It was initially developed in order to allow accurate determination of geographical locations. It is based on the use of satellites in Earth orbit that transmit information which allow to measure the distance covered by the user and also pinpoint their exact location.

The present GPS is based on a development programme that began in the early 1970's at the US Department of Defence. It has several components, each of which represents impressive use of current, advanced technology and mathematics.

The three main components of a GPS are the GPS satellites, the GPS receivers, and the complex computer software needed to decode the signals and compute the geographical position of the user.

J. Lee (2009), defined GPS as a space-based navigation system nominally consisting of a 24-satellite constellation that provides positioning and timing information to military and civilian users worldwide.

These satellites continuously emit coded high-frequency radio signals which may be received by special GPS receivers. These signals contain information about the exact orbits of the satellites and the time of atomic clocks onboard the satellites. When comparing the arrival times, the time delay between emission and receipt is measured and from the speed of light, just below 300,000 km/sec, the distance between the satellite and the receiver is computed.

When signals from three or more satellites are received, the GPS receiver will compute the best possible location of the user, that is, that point (in space) that best reproduces the measured time delays.

Modern smartphones act as personal GPS navigators for civilians who own them. Overuse of these devices, whether in the vehicle or on foot, can lead to a relative inability to learn about navigated environments, resulting in sub-optimal navigation abilities when and if these devices become unavailable. Typically, a compass is also provided to determine direction when not moving.

The GPS has diverse of fields in which it's being applied.

Virtually all civil aircraft are now equipped with GPS. This allows the pilot to know the position of the aircraft and by continuously plotting this position on a computer map, to follow the progress of the flight along the chosen route. The same is true for ships - no sailor would ever attempt an ocean crossing without guidance from a GPS device.

Even more recently, GPS has come into use in connection with automatic car guidance. With suitable computer equipment, the driver of a car with such a system can be guided by voice through a city unknown to him/her, arriving safely at the destination along the shortest route. It is also used by some truck companies to know where their trucks are located at any time and some taxi companies have begun to use it, thereby improving the allocation of taxicabs to incoming requests from customers.

2.4 Offline Navigation Systems

Any mapping app has the ability to track your location without needing an internet connection. Without getting too complicated, the GPS system inside your smartphone works in two different ways.

When you have a data connection, your phone uses Assisted GPS, or A-GPS. This uses the locations of cell phone towers and known Wi-Fi networks to figure out roughly where you are.

When you first load your navigation app, you've probably seen your location go from a big blue circle to a smaller, more precise circle.

2.5 Related Works

The system known as the Global Positioning System, which is the most widely used navigation system, had its roots. There were efforts made to innovate easier-to-use navigation systems right from the 1980's up till today. Some of such efforts put in place are discussed under this heading.

V.S. Shebashevich proposed the use of satellites for navigation for the first time in 1957. This concept arose during research into the potential use of radio-astronomy technologies for

aeronavigation. Further research was carried out in a number of Soviet institutes in order to improve the precision of navigation definitions, global support, everyday application, and weather independence. In 1963, the research findings were employed in an R&D project for the first Soviet low-orbit “Cicada” spacecraft. The first Soviet navigation satellite, "Cosmos-192," was launched in 1967. During its active lifetime, the navigation satellite broadcasted continuous radio navigation signals on frequencies of 150 and 400 MHz.

In 1979, the four-satellite "Cicada" system was launched. The navigation satellites were launched into 1,000-kilometer-high circular orbits with an inclination of 83 degrees and an even distribution of orbital planes relative to the equator. Users might acquire one of the satellites every hour and a half or two and fix their position within 5-6 minutes of starting a navigation session. One-way user-to-satellite range measurements were utilized in the navigation system "Cicada." Along with improving satellite onboard systems and navigation equipment, increasing the precision of estimating and predicting characteristics of navigation satellite orbits received a lot of attention.

Later, on the “Cicada” satellites, reception measuring equipment was installed to identify distress radio beacons. These signals were received by satellites and rebroadcast to special ground stations where the exact coordinates of emergency items (ships, aircraft, etc.) were computed. The "Cicada" satellites, which tracked distress radio beacons, comprised the "Cospas" system, which, in conjunction with the US-French-Canadian "Sarsat" system, created an integrated search and rescue operation that saved thousands of lives. The “Cicada” space navigation system (and its modification, the “Cicada-M”) was built for military navigation support and has been in operation since 1976. Users of the "Cicada" and "Cicada-M" systems began to use the GLONASS system in 2008, and the operations of those systems were halted. Low-orbit systems were incapable of meeting the needs of a large number of users.

Marine users' successful use of low-orbit satellite navigation systems drew significant attention to satellite navigation. To address the needs of the vast majority of potential users, a general-purpose navigation system was required.

The United States Navy employed the first satellite navigation system, Transit, which was successfully tested in 1960. It could provide a navigational fix once per hour using a constellation of five satellites. The Timation satellite, constructed by the US Navy in 1967, demonstrated the potential to install accurate clocks in space, a technique that the GPS

system relies on. The ground-based Omega Navigation System, which was based on signal phase comparison, became the first global radio navigation system in the 1970s.

The Decca Navigator system originated in the United States, but Decca Radio and Television Ltd. of London eventually evolved it into an operational system. It was originally designed by an American, W (Bill) J. O'Brien, as a technique of determining the ground speed of aircraft conducting trials, and was simply referred to as the 'Aircraft Position Indicator.' O'Brien worked on the system independently from 1936 to 1939, unaware of Harms or Honore's patents and even of Shanklin, Donnelly, and Holmes' discoveries in the United States. He was unable to arouse interest in the US Armed Forces or civil authorities, and the system fell into disuse until the onset of World War II in 1939. The idea was then pitched to the British Air Ministry by his friend H. F. Schwarz, an American working for the Decca Record Company in London. Watson-Watt dismissed the proposal as jammable and susceptible to interference because neither was aware of the work being done on pulsed navigation systems in Britain.

O'Brien and Schwarz, with support from Decca, then tested a prototype system in California using a master transmitter at 300 kHz and a slave at 600 kHz. Comparison was made at 1200 kHz and the accuracy of the system was demonstrated in a car. It proved the basic viability of the system and was a major departure from earlier proposals by using harmonically related radio frequencies for transmission. Without requiring any modulation, this solves the difficulties of identification and phase comparison at the lowest common multiple of the carrier waves. It was a clever approach that had the added benefit of occupying a very narrow bandwidth and requiring very little power for transmission. However, it did not solve the problem of "ambiguity."

The British Admiralty, which began organizing the ultimate landings in France in 1941, needed a precise navigational system and became interested in Decca in 1941. There was also a need for a backup navigational system to protect against the danger of the existing "Gee" system becoming jammed, therefore Decca's development was accelerated. In mid-1942, trials were held off the coast of Anglesey, using the same frequencies and equipment as in California. This study was a huge success, and it prompted more research with the help of the Admiralty Signals Establishment (ASE).

Early in March 1943, Decca was given the order to produce 27 receivers plus the driver and phase control units needed for the transmitters. All equipment was delivered by mid-May when the Royal Navy began its training and preparations in earnest. In January 1944, a test of

Decca (or QM as it was then known) on new frequencies was carried out in the Irish Sea and it was also compared with the Royal Air Force Gee system for accuracy.

Decca, OMEGA, and LORAN-C are three hyperbolic navigation systems that are similar. Decca was a hyperbolic low frequency radio navigation system (also known as multilateration) that was originally utilized by the Allies during World War II to ensure accurate landings. Its major purpose, like with Loran C, was to aid ship navigation in coastal waters. The majority of post-war users were fishing vessels, but it was also used on aircraft, including a very early application of moving-map displays (1949). The device was installed in the North Sea and was utilized by oil platform helicopters.

The OMEGA Navigation System, managed by the United States in collaboration with six partner nations, was the first completely global radio navigation system for airplanes. OMEGA is a military aviation system created by the United States Navy. It was approved for development in 1968 and claimed true global oceanic coverage with only eight transmitters and the ability to fix a position with a four-mile (6-kilometer) accuracy. The system was originally intended to guide nuclear bombers across the North Pole to Russia. It was later shown to be useful for submarines. During the 1990s, the use of Omega fell due to the success of the Global Positioning System, to the point that the cost of operating Omega could no longer be justified. On September 30, 1997, Omega was decommissioned, and all stations were shut down.

LORAN is a terrestrial navigation system that uses low-frequency radio transmitters to estimate the position of a ship or aircraft based on the time delay between radio signals received from three or more stations. The most widely used version of LORAN is LORAN-C, which operates in the low frequency section of the electromagnetic spectrum between 90 and 110 kHz. The system is used by a number of countries, including the United States, Japan, and several European nations. In the same frequency band, Russia utilizes the CHAYKA system, which is essentially identical. The use of LORAN is rapidly declining, with GPS becoming the principal substitute. There are, nevertheless, efforts to improve and re-popularize LORAN. LORAN signals are less sensitive to interference than GPS signals and can penetrate foliage and buildings better.

As of October 2011, only the United States NAVSTAR Global Positioning System (GPS) and the Russian GLONASS are fully globally operational GNSSs. The European Union's Galileo positioning system is a next generation GNSS (**Global Navigation Satellite**

System) in the final deployment phase, and became operational in 2016. China has indicated it may expand its regional Beidou navigation system into a global system.

More than two dozen GPS satellites are in medium Earth orbit, transmitting signals allowing GPS receivers to determine the receiver's location, speed and direction.

Since the first experimental satellite was launched in 1978, GPS has become an indispensable aid to navigation around the world, and an important tool for map-making and land surveying. GPS also provides a precise time reference used in many applications including scientific study of earthquakes, and synchronization of telecommunications networks.

Developed by the United States Department of Defence, GPS is officially named NAVSTAR GPS (Navigation Satellite Timing And Ranging Global Positioning System). The satellite constellation is managed by the United States Air Force 50th Space Wing. The cost of maintaining the system is approximately US\$750 million per year, including the replacement of aging satellites, and research and development. Despite this fact, GPS is free for civilian use as a public good.

2.6 Summary

Based on the several innovations that were discussed in this chapter and the methods of navigation that were given. This chapter highlighted the challenges of several approaches to making use of the discussed means of navigation. Some of them are deemed to be crude methods. But there is one thing that the mobile GPS systems have in common. They all make use of the internet which isn't always available and always reliable and that is the main issue that this research sets out to solve. The proposed solutions and design model are spelt out in the next chapter.

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN

3.0 Introduction

This section covers the system analysis phase which is a core phase in software development. The purpose of system analysis and design is to identify the new system and state what the system does as well as the roles and functionalities of the system.

The methodology used in this research is the popularly known OOAD, which stands for Object Oriented Analysis and Design. This was chosen because it has a step-by-step process that is easy to understand. It was also chosen because it's the most commonly used as a research methodology that include developing both mobile and desktop applications or software. At first, I take a brief look at the term "**system analysis**".

3.1 What is System Analysis?

System analysis is the process of gathering and evaluating data, detecting issues, and breaking down a system into its constituent parts. It's also the process of evaluating an existing system and pointing out their flaws (GPS as the main in this project) in order to produce a system solution to a problem or to devise changes to such a condition.

A system analysis is carried out to investigate a system or its components in order to determine its goals. It is a problem-solving approach that enhances the system and guarantees that all of the system's components work together to achieve their goals.

The purpose of system analysis is to specify or determine what the system should do.

3.2 Analysis of Existing Navigation Systems

In this research, the Global Positioning System is being analyzed as the main navigation tool or system. This is because it has become the most popular and widely used means of navigation worldwide even on mobile phones.

The basic GPS service provides users with approximately 7.8-meter accuracy, 95% of the time, anywhere on or near the surface of the earth. To accomplish this, each of the 31 satellites emits signals to receivers that determine their location by computing the difference

between the time that a signal is sent and the time it is received. GPS satellites carry atomic clocks that provide extremely accurate time. The time information is placed in the codes broadcast by the satellite so that a receiver can continuously determine the time the signal was broadcast. The signal contains data that a receiver uses to compute the locations of the satellites and to make other adjustments needed for accurate positioning. The receiver uses the time difference between the time of signal reception and the broadcast time to compute the distance, or range, from the receiver to the satellite. The receiver must account for propagation delays, or decreases in the signal's speed caused by the ionosphere and the troposphere. With information about the ranges to three satellites and the location of the satellite when the signal was sent, the receiver can compute its own three-dimensional position. An atomic clock synchronized to GPS is required in order to compute ranges from these three signals. However, by taking a measurement from a fourth satellite, the receiver avoids the need for an atomic clock. Thus, the receiver uses four satellites to compute latitude, longitude, altitude, and time.

3.3 Weakness of The Existing Systems

Following are the drawbacks of GPS:

- GPS chip is power hungry which channels battery in 8 to 12 hours. This requires either battery substitution or re-energize.
- It cannot fully function without a working internet connection. This also drains the battery of your mobile phone quickly.
- GPS signal doesn't penetrate through the strong dividers or designs. Additionally, it is influenced by enormous structures or constructions. Because of this, client won't use GPS administration in inside or submerged or in thick tree locales or in underground stores or places and so forth
- GPS exactness relies upon adequate got signal quality. GPS signal gets influenced due to multipath, environment (for example ionosphere), electromagnetic obstruction and so on This prompts blunder of around 5 to 10 meters in GPS signal.

3.4 Overview of the Proposed System

The system in question is an app I call UniDirect. It is a mobile application that runs on the android operating system. It is a navigation app that gives that's meant to show directions

from one faculty to another in the University of Benin in a faster and yet efficient manner. It was especially modeled to aid the new student in the university of Benin find their way around. The app contains a localized map of the University of Benin with the faculty buildings in the school especially marked out. Unlike the Global Positioning System that has to connect to at least four satellites via the internet, this app is modelled to work totally offline.

Steps in using the app:

- The user opens the app on his mobile device
- He's welcomed and asked what faculty they're at i.e., their location
- The app then receives that information and displays an image of the faculty building he's at to verify by sight that he's in the right place
- The mobile application then asks to input his destination information
- The system then collects that information and then displays an image of the faculty building which is his destination point.
- Then a pictorial direction is provided along a text description.

Some advantages of using UniDirect

- It's totally offline and therefore has no need for internet use
- It's generally cost effective because no money is spent on data plans
- It's faster to boot up since there's no need for it to buffer
- It is totally localized and therefore

3.5 System Design

System design is the process of establishing the various system aspects for a system based on given requirements.

The systems design phases include specifying software and hardware architecture, components, modules, interfaces, and data in order for a team to operate based on a set of well-defined operating criteria.

Systems design is an interdisciplinary scientific activity that allows effective systems to be realized.

In general, systems design, no matter the field

all refer to the same intellectual process of being able to define and model complex interactions among many components that comprise a system, and being able to implement the system with proper and effective use of available resources. Systems design could also be seen as the application of systems theory to product development. System design is generally divided into

- Logical Design
- Physical Design

3.5.1 Logical Design

Logical Design pertains to an abstract representation of the data flows, inputs and outputs of the system. This is often conducted using an over-abstract (and sometimes graphical) model of the actual system.

3.5.2 Physical Design

Physical Design is related to the actual input and output processes of the system. This is laid down in terms of how data is input into a system, how it is verified/authenticated, how it is processed and how it is displayed as output. In physical design, following requirements about the system are decided: Input requirement, output requirement, storage requirements, processing requirements, system control and backup or recovery.

3.6 System Design Tools

System design tools play an important role in system development. It is similar to designing the blueprint of a house before actual constructing beings.

Design tools are tools which are used to show graphical representation of the “flow” of data through an information system, modelling its process aspects. Some design tools include;

Entity-Relationship model (ER Model): is a data model for describing the data or information aspects of a business domain or its process requirements, in an abstract way that lends itself to ultimately being implemented in a database such as a relational database. The main

components of ER Models are entities (things) and the relationships that can exist among them.

In other words, an entity relationship model, also called an entity-relationship (ER) diagram, is a graphical representation of entities and their relationships to each other and typically used in computing in regard to the organization of data within the databases or information systems. An entity is a piece of data an object or concept about which data is stored. An ER Model is typically in a database. In the case of a relational database which stores data in tables, every row of each table represents one instance of an entity.

Some data fields in these tables point to indexes in other tables; such pointers represent the relationships.

3.6.1 System Flow Chart

The system flow chart is a diagrammatic representation to explain how a system work, the diagrammatic representation is easier to understand than a lengthy text. The system flow chart is one of the major tools of the system analyst to show an overview of the processing in a complete system. It is more advantage than program flow chart only describes the flow of data. Showing the sequence of operation symbols. The figure below shows the system flow chart for UniDirect.

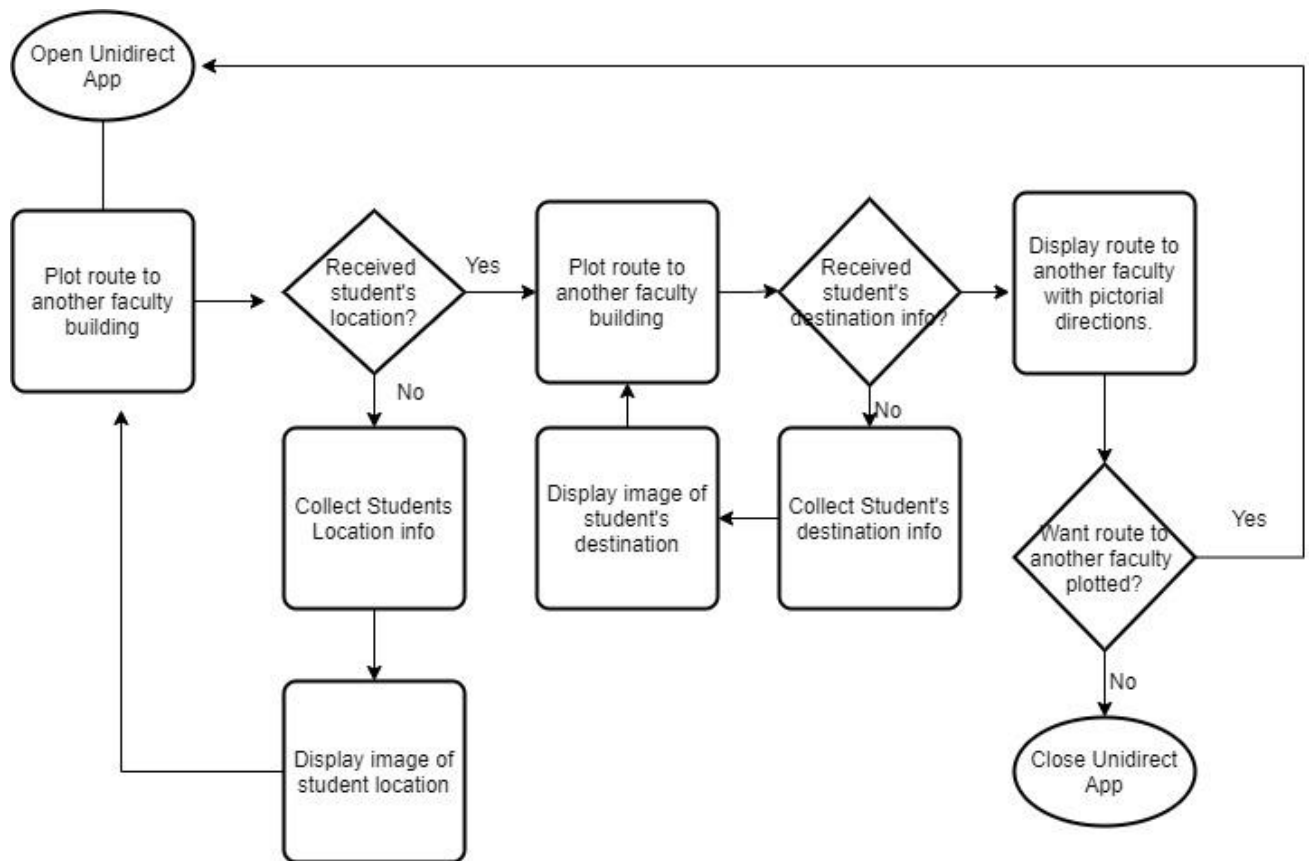


Fig 3.1. System flow chart showing the working of UniDirect.

3.6.1 A Data Flow Diagram (DFD)

This is a graphical representation of the “flow” of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system, which can later be elaborated. DFDs can also be used for the visualization of data processing (structured design). A DFD shows what kind of information will be output from the system, where the data will come from and go to and where the data will be stored. It does not show information about the timing of process or information about whether processes will operate in sequence or in parallel (which is shown on a flow chart).

3.6.2 Unified Modelling Language (UML)

This is a general-purpose modelling software in the field of software engineering, which is designed to provide a standard way to visualize the design of a system. It offers a way to visualize a system’s architectural blueprints in a diagram, including elements such as: any activities (jobs), individual components of the system and how they can interact with other

software components, how the system will run, how entities interact with others (components and interfaces), external user interface. UML has many types of diagrams which are divided into two categories. Some types represent structural information (emphasize the things that must be present in the system being modelled) and the rest represents general type of behaviour (emphasize what must happen in the system being modelled) including a few that represents aspects of interactions.

3.6.2.1 Use Case Diagram

In the Unified Modelling Language (UML), a use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system. To build one, you'll use a set of specialized symbols and connectors. An effective use case diagram can help your team discuss and represent:

- Scenarios in which your system or application interacts with people, organizations, or external systems
- Goals that your system or application helps those entities (known as actors) achieve
- The scope of your system

A use case diagram was used to show relationship between the user and UniDirect

A Table describing symbols used in the use case diagram is shown below:

Objects	Symbol	Description
---------	--------	-------------

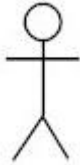



Actor		Actors are the users of a system. It performs role in a given system. This could be a person, organization or an external system.
Use case		Use case is a list of steps, typically defining interactions between an actor and a system, to achieve a goal.
System		A system in a UML Use Case Diagram is a rectangle spanning all the use cases in the system that defines the scope of your system. Anything within the box represents functionality that is in scope and anything outside is not.
Relationship		Illustrate relationships between an actor and a use case with a simple line.

Table 3.1 Use Case Diagram Notation and Description

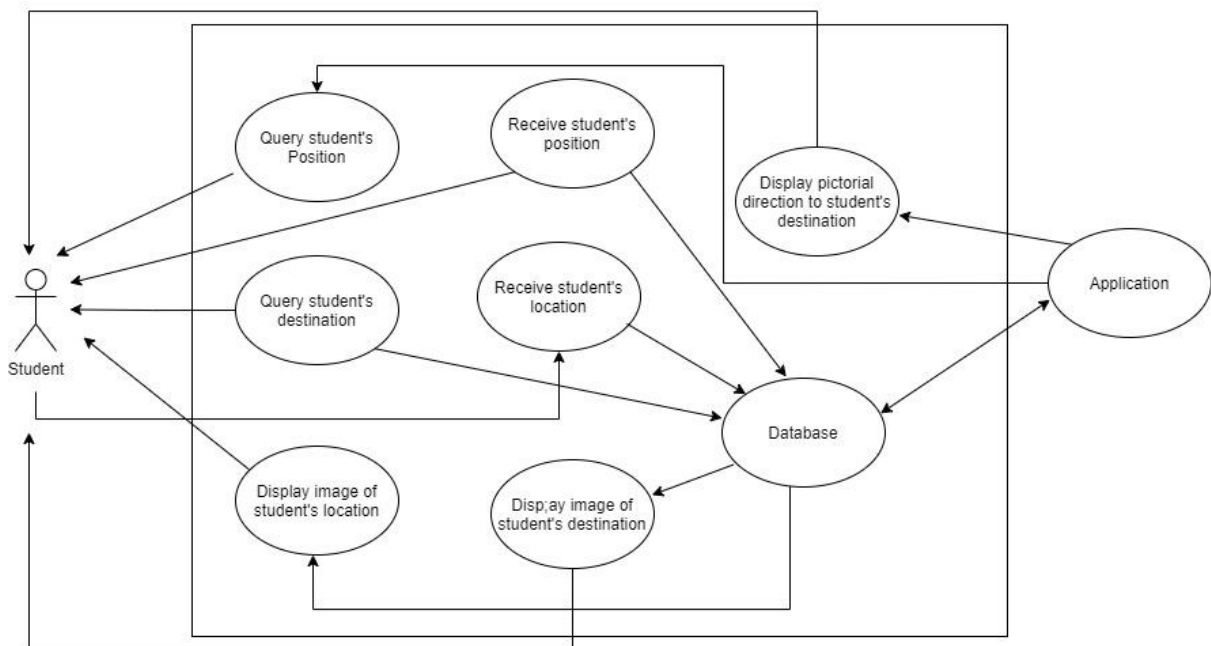


Fig 3.3 Use Case diagram showing relationship between the student and UniDirect

3.7 System Development Process Model

The process model used in this work is that of Agile process model prototyping, this model was chosen because of the following characteristics possessed by agile process model.

Agile is based on the **adaptive software development methods**, whereas the traditional SDLC models like the waterfall model is based on a predictive approach. Predictive methods entirely depend on the **requirement analysis and planning** done in the beginning of cycle. Any changes to be incorporated go through a strict change control management and prioritization.

Agile uses an **adaptive approach** where there is no detailed planning and there is clarity on future tasks only in respect of what features need to be developed. There is feature driven development and the team adapts to the changing product requirements dynamically. The product is tested very frequently, through the release iterations, minimizing the risk of any major failures in future.

Agile methods are being widely accepted in the software world recently. However, this method may not always be suitable for all products. Here are some advantages of agile model

- It is a very realistic approach to software development.
- Promotes teamwork and cross training.
- Functionality can be developed rapidly and demonstrated.
- Resource requirements are minimum.
- Suitable for fixed or changing requirements.
- Delivers early partial working solutions.
- Good model for environments that change steadily.
- Minimal rules, documentation easily employed.
- Enables concurrent development and delivery within an overall planned context.
- Little or no planning required.
- Easy to manage.
- Gives flexibility to developers.

Hence, Agile process model saves me time in the development of this system. Fig 3.6 shows a diagrammatic example of Agile process model.

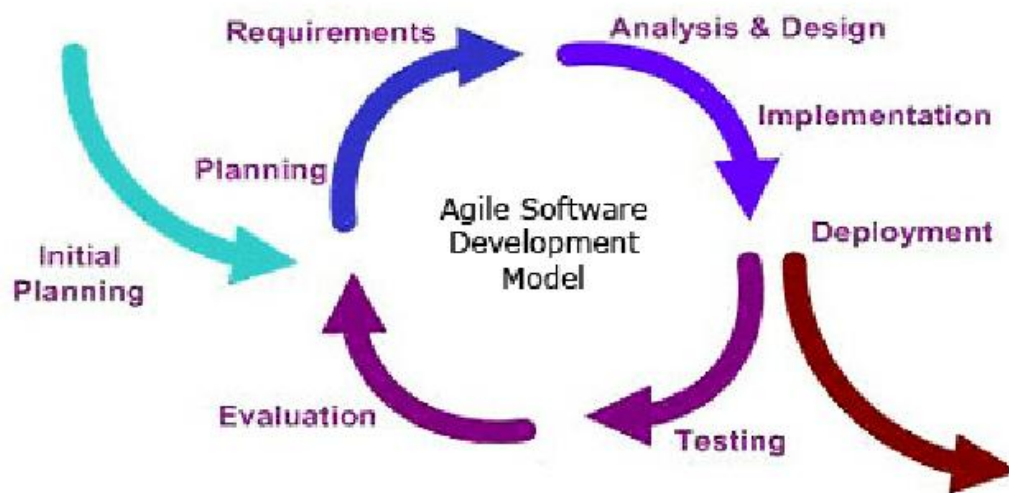


Fig 3.6 A representation of the agile model approach

CHAPTER FOUR

SYSTEM IMPLEMENTATION AND DOCUMENTATION

4.0 Introduction

System Implementation: The term "implementation" can be described as the process of replacing an existing manual or computerized system with a newly built system and making it operational without disrupting the organization's normal operations. This chapter discusses the different interfaces of the UniDirect application.

4.1 System Requirements

All computer software needs certain components resources to function and execute effectively. These prerequisites connote the system requirement for this chapter.

4.1.1 Hardware and Software Requirements

iOS supported Devices

- iPhone 5S or later
- iPad Air or iPad Air 2
- iPad Mini 2 or later
- iPad Pro (1st generation) or later
- iPad (5th generation) or later
- iPod touch (6th generation)

Android Supported Devices: Basically, any android mobile device running at least the Android version 5.0 (lollipop)

The UniDirect app will require the mobile device to have at least:

- 1GB of RAM

4.2 Tools for System Design and Implementation

This section describes the tools used in the app development. These are the software or programs that were used to design the mobile application. There were a bunch of tools used in the development of UniDirect. The following sub-section sheds light on those programs or tools used.

4.2.2 JavaScript

JavaScript is a scripting or programming language that allows you to implement complex features on web pages — every time a web page does more than just sit there and display static information for you to look at — displaying timely content updates, interactive maps, animated 2D/3D graphics, scrolling video jukeboxes, etc. — you can bet that JavaScript is probably involved. JavaScript is a dynamic computer programming language. It is lightweight and most commonly used as a part of web pages, whose implementations allow client-side script to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities. Some of the reasons it was used was that JavaScript is

- Designed for creating network-centric applications.
- Complementary to and integrated with Java.
- Complementary to and integrated with HTML.
- Open and cross-platform

JavaScript was used for event management (implementing the search function, setting markers and tags, etc.) in the development of UniDirect.

4.2.2 React Native

React Native is an open-source mobile application framework created by Facebook, Inc. It is used to develop applications for Android, Android TV, iOS, macOS, tvOS, Web, Windows and UWP by enabling developers to use React's framework along with native platform capabilities. React Native is the younger sibling of React which is an open-source JavaScript library for building user interfaces (UI) specifically for single-page

applications. React Native is also based on JavaScript but is designed to build native mobile applications with reusable components. What does that mean? Imagine a builder used a different drill to build a house and to build an apartment. It would be tedious and unnecessary. Before React Native, app developers had to use various tools for different platforms like a builder having a special drill for each type of building he constructs. That's where the real power of React Native lies. React Native enables the creation of applications across multiple platforms (Windows, Android, iOS) smoothly and seamlessly. React Native was used to build the main tech stack of UniDirect.

4.2.2 Android Studio

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. Android Studio provides the fastest tools for building apps on every type of Android device. React Native made use of the Android Studio software development tools to build UniDirect.

4.2.3 JSON

JSON (JavaScript Object Notation) is used to represent data on a server. It's fairly easy to read by humans, and easy for machines/applications to understand. Let's look at an example of JSON from a product on BigCommerce:

```
{ "name": "BigCommerce T-Shirt",  
  "price": "25.00",  
  "Category": "Shirts",  
  },  
  "weight": 4,  
  "type": "physical"  
}
```

Fig 4.1 Sample JSON Code

This is easy to understand as it's outputted in key/value pairs, with the key on the left, and a value on the right. Keys are a fixed object defined by the application and will remain the same as with "category." Whereas the values will be unique, such as "Shirts."

JSON was used for data transfer in UniDirect.

4.2.4 Hyper Text Markup Language (HTML)

HTML is the standard mark-up language used to create web pages. HTML is written in the form of HTML elements consisting of tags enclosed in angle brackets (<h1>Here</h1>). A web browser can read HTML files and compose them into visible or audible web pages. The browser does not display the HTML tags, but uses them to interpret the content of the page. HTML elements form the building blocks of all websites. HTML allows images and objects to be embedded and can be used to create interactive forms. HTML describes the structure of a website semantically along cues for presentation, making it a mark-up language, rather than a programming language. It provides a means to create structured documents by donating structural semantics for text such as headings, paragraphs, lists, links and other items.

4.2.5 Cascading Style Sheet (CSS)

Cascading Style Sheet (CSS) is a style sheet language used for describing the look and formatting of a document written in a mark-up language, which is most often used to change the style of web pages and user interfaces written in HTML and XHTML. CSS is designed primarily to enable the separation of document content from document presentation, including elements such as the layout, colours, and fonts. This separation can improve content accessibility, provide more flexibility and control in the specification of presentation characteristics enable multiple HTML pages to share formatting by specifying the relevant CSS in a separate CSS file, and reduce complexity and repetition in the structural content, such as semantically insignificant tables that were widely used to format pages before consistent CSS rendering was available in all major browsers. With the latest advancement in CSS (CSS3) it helps in rendering a different view for different devices (responsiveness),

such as tablet, iPad, mobile and laptop without designing different or separate page for each and also gave rise to frameworks like bootstrap, foundation, ionic, etc.

4.2.6 Google's Map API

An API (Application Programming Interface) is a set of functions that allows applications to access data and interact with external software components, operating systems, or microservices.

API lets a developer make a specific “call” or “request” in order to send or receive information. This communication is done using a programming language called “JSON.” It can also be used to make a defined action such as updating or deleting data. There are four basic request methods that can be made with API:

- GET – Gathers information
- PUT – Updates pieces of data
- POST – Creates
- DELETE – deletes an information already posted

Google Maps' API is a robust tool that can be used to create a custom map, a searchable map, check-in functions, display live data syncing with location, plan routes, or create a mashup just to name a few. Version 2 Google Maps' API was used to add maps. The routing mechanism for the UniDirect was also done using Google Maps' API.

The map data was also downloaded from google maps.

4.3 UniDirect Design

This consist of all the different interfaces that make up the UniDirect App.

The following subsections show the different interfaces that'll be shown in the UniDirect App.

4.3.1 Input Design

This is the method of translating user-oriented inputs to computer-based format.

This is where the student inputs his location and destination which is then received and transferred by JSON to Google Maps' API. Images of the input design are shown below.

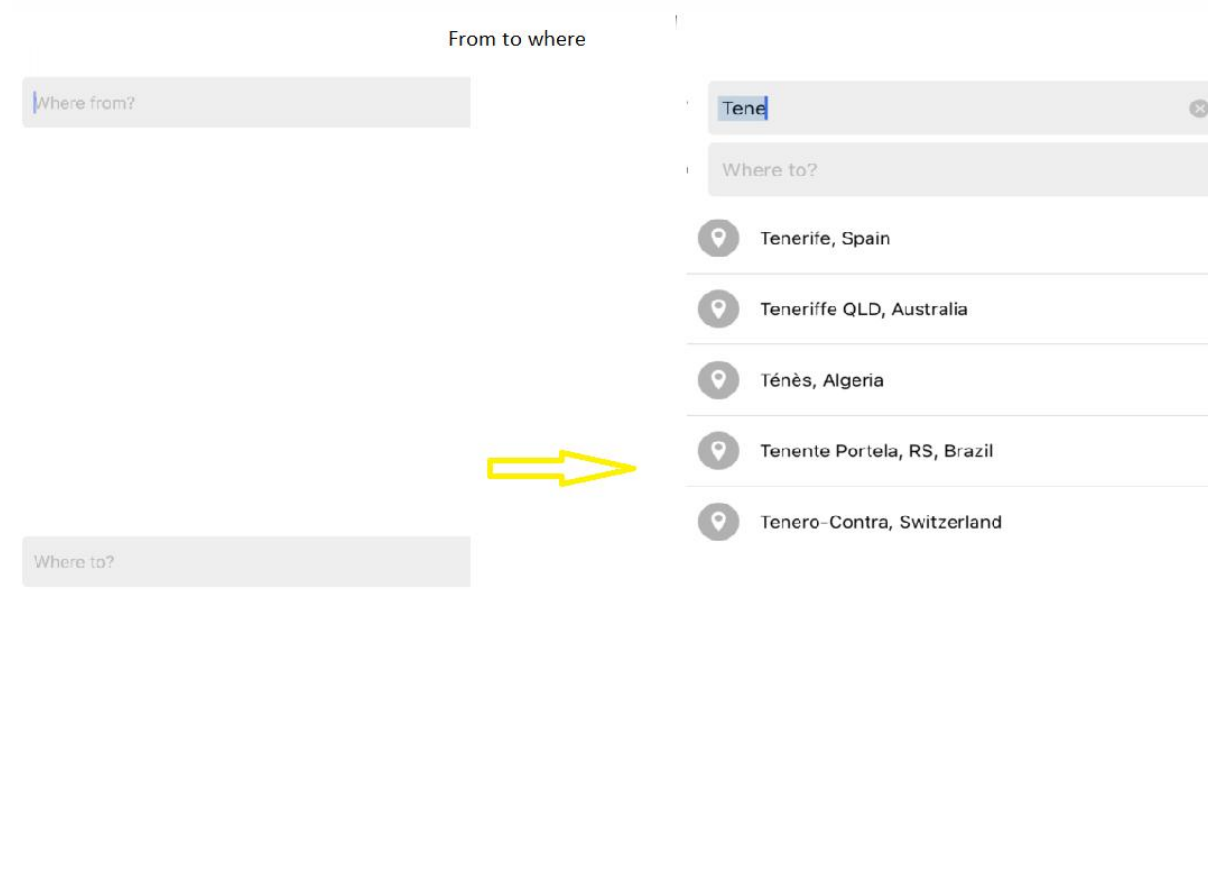


Fig 4.1 Input screen sample1 of the UniDirect App

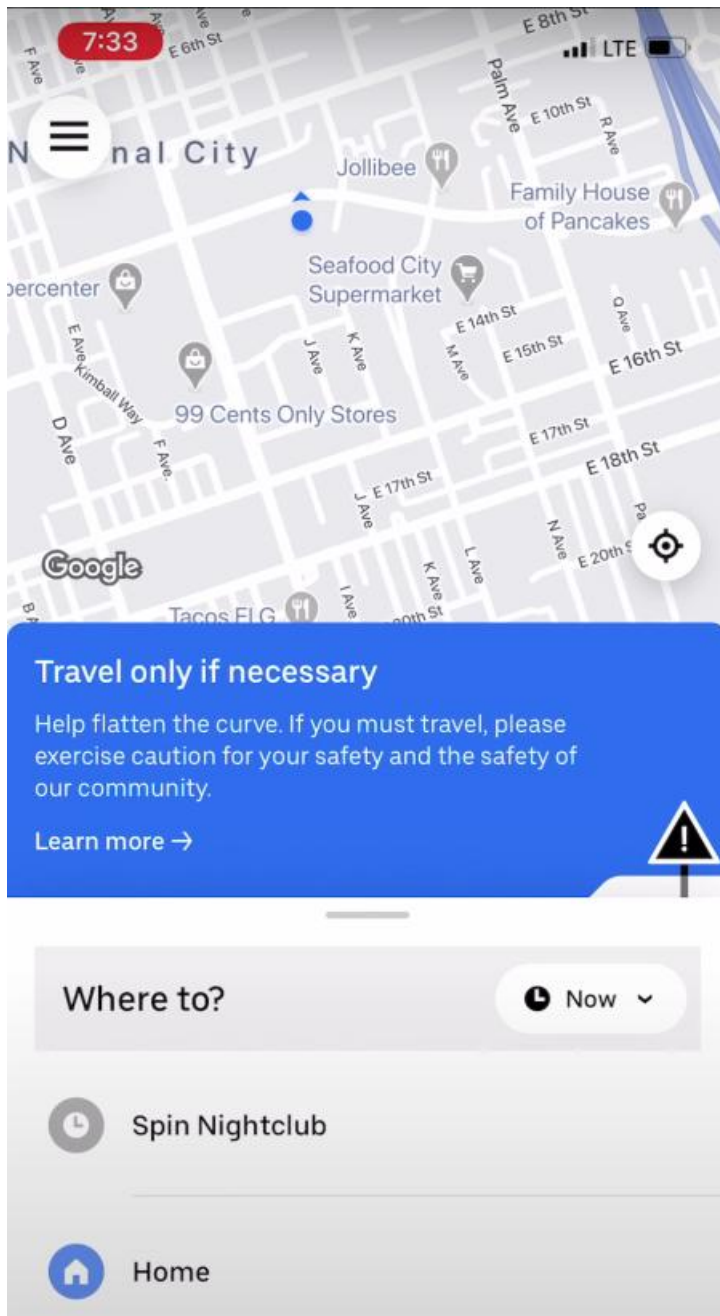


Fig 4.2 Input screen sample2 of the UniDirect App

4.3.2 Navigation Page Design

This shows the routing ability of the API at work. This is where the route between location and destination is shown. Below are some of the images showing connected routes from one faculty to another.

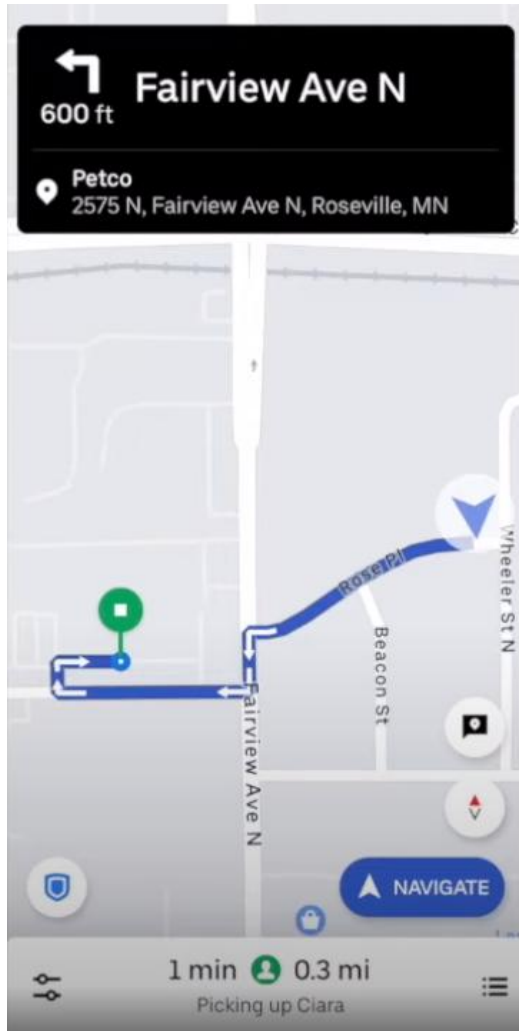


Fig 4.3 Image showing connected route

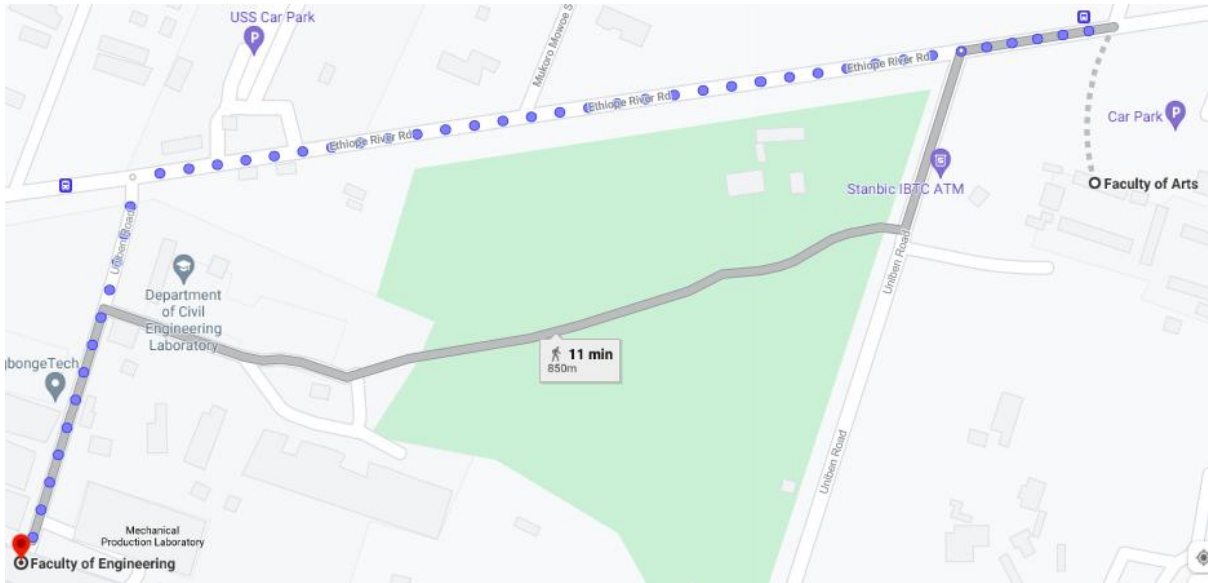


Fig 4.4 Image showing connected route from Faculty of Engineering to faculty of Arts

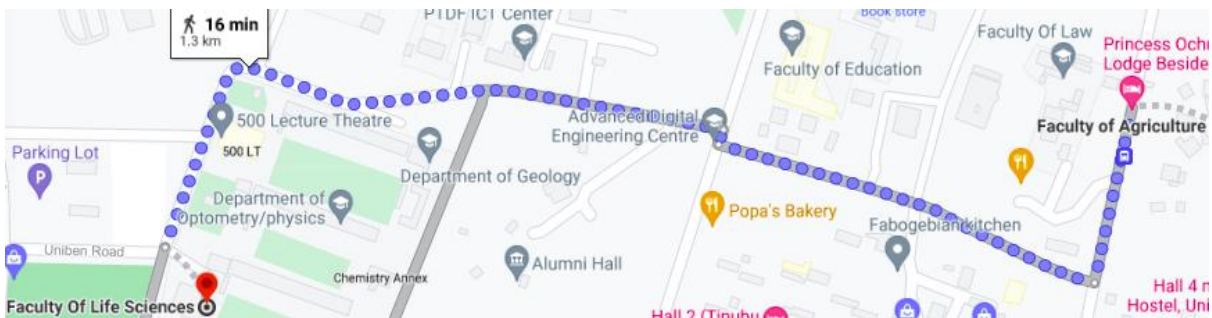


Fig 4.5 Image showing connected route from Faculty of Life Sciences to Faculty of Agriculture

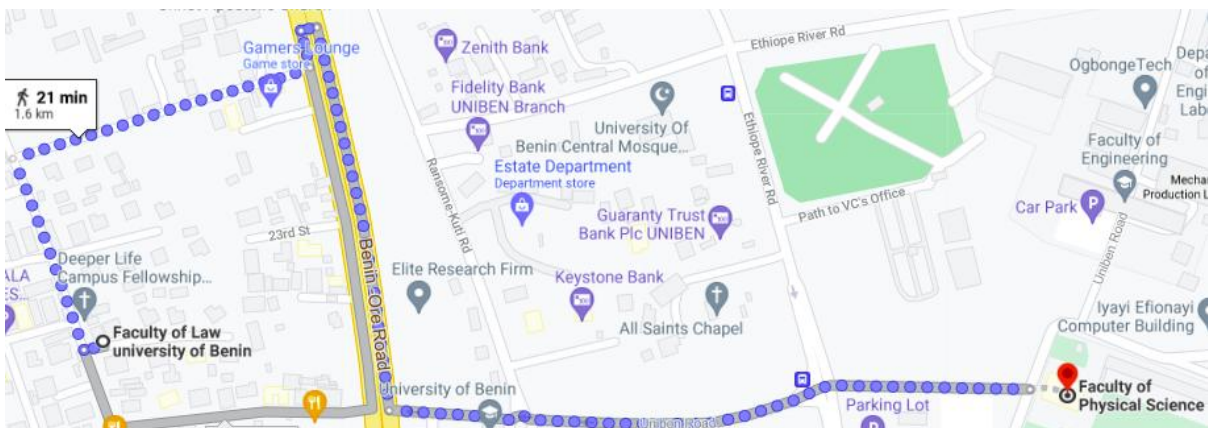


Fig 4.6 Image showing connected route from Faculty of Law to Faculty of Physical Sciences

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

As the world increases in population, so also does technological innovations increase and improve. And with the busyness of people going here and there very frequently, there's the need for navigation especially in areas that are completely new to a person. The problem associated with undependable internet connection and low network in some rural zones still very much abound so that even when we want to reach out to loved ones on our mobile phones, we can't reach them to ask for directions around in a given **localized** area. Some of these areas aren't even tagged on the GPS as we know it.

The research work focuses on solving this localization and lack of dependable network issues. First, it involved establishing the aim which was to build a totally offline navigation app which with an objective to solve the given shortcomings of the existing system, the GPS in this case.

The app was designed using the flutter framework and made use of the dart programming language.

5.2 Conclusion

The development of this research was challenging. Owing to the fact there wasn't much work done in this aspect as a research work and so the literature review was rather scanty.

In conclusion, UniDirect as an offline navigation app for the new students mainly in University of Benin would greatly be of help as it will help them navigate their way from one faculty to another without much stress.

5.3 Recommendation

This work and especially its implementation is useful to the students and staff of the University of Benin and loners that hardly communicate to people when they need help. Students don't have to walk round the school premises looking for and asking where a faculty is or what direction it would be at. Right from the comfort of the residence or even when

active on the campus, they can find directions to faculty buildings without having to contact anyone.

This work is also recommended to the University of Benin ICT department as a means to aid new incoming students to find their way around the necessary faculty buildings on the campus.

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APPENDIX A

Codes

```
/**
 * Sample React Native App
 * https://github.com/facebook/react-native
 *
 * @format
 * @flow strict-local
 */
import 'react-native-gesture-handler';

import React, {useEffect} from 'react';
import {StatusBar, PermissionsAndroid, Platform} from 'react-native';
import Geolocation from '@react-native-community/geolocation';
import {withAuthenticator} from 'aws-amplify-react-native'

import Router from './src/navigation/Root';

navigator.geolocation = require('@react-native-community/geolocation');

import Amplify from 'aws-amplify'
import config from './aws-exports'
Amplify.configure(config)

const App: () => React$Node = () => {

  const androidPermission = async () => {
    try {
      const granted = await PermissionsAndroid.request(
```

```

PermissionsAndroid.PERMISSIONS.ACCESS_FINE_LOCATION,
{
  title: "Uber App Camera Permission",
  message:
    "Uber App needs access to your location " +
    "so you can take awesome rides.",
  buttonNeutral: "Ask Me Later",
  buttonNegative: "Cancel",
  buttonPositive: "OK"
}
);
if (granted === PermissionsAndroid.RESULTS.GRANTED) {
  console.log("You can use the location");
} else {
  console.log("Location permission denied");
}
} catch (err) {
  console.warn(err);
}
}

useEffect(() => {
  if (Platform.OS === 'android') {
    androidPermission();
  } else {
    // IOS
    Geolocation.requestAuthorization();
  }
}, [])

return (
  <
  <StatusBar barStyle="dark-content" />

```

```

    <Router />
  </>
);
};

export default withAuthenticator(App);
/* eslint-disable */
// WARNING: DO NOT EDIT. This file is automatically generated by AWS Amplify. It will
be overwritten.

const awsmobile = {
  "aws_project_region": "eu-west-1",
  "aws_cognito_identity_pool_id": "eu-west-1:49abc0d6-caec-4d80-b176-c0fb2dbef50b",
  "aws_cognito_region": "eu-west-1",
  "aws_user_pools_id": "eu-west-1_Q0ukyAmCD",
  "aws_user_pools_web_client_id": "54tqt471sm7603cpmi0koecv11",
  "oauth": {},
  "aws_appsync_graphqlEndpoint": "https://pagm5rr44fa5bdvx4y5duk7vjq.appsync-api.eu-
west-1.amazonaws.com/graphql",
  "aws_appsync_region": "eu-west-1",
  "aws_appsync_authenticationType": "AMAZON_COGNITO_USER_POOLS"
};

export default awsmobile;

# OSX
#
.DS_Store

# Xcode
#
build/

```

```
*.pbxuser
!default.pbxuser
*.mode1v3
!default.mode1v3
*.mode2v3
!default.mode2v3
*.perspectivev3
!default.perspectivev3
xcuserdata
*.xccheckout
*.moved-aside
DerivedData
*.hmap
*.ipa
*.xcuserstate
```

```
# Android/IntelliJ
```

```
#
```

```
build/
```

```
.idea
```

```
.gradle
```

```
local.properties
```

```
*.iml
```

```
# node.js
```

```
#
```

```
node_modules/
```

```
npm-debug.log
```

```
yarn-error.log
```

```
# BUCK
```

```
buck-out/
```

```
\.buckd/
```

```
*.keystore
!debug.keystore

# fastlane
#
# It is recommended to not store the screenshots in the git repo. Instead, use fastlane to re-
generate the
# screenshots whenever they are needed.
# For more information about the recommended setup visit:
# https://docs.fastlane.tools/best-practices/source-control/

*/fastlane/report.xml
*/fastlane/Preview.html
*/fastlane/screenshots

# Bundle artifact
*.jsbundle

# CocoaPods
/ios/Pods/

/* eslint-disable */
// WARNING: DO NOT EDIT. This file is automatically generated by AWS Amplify. It will
be overwritten.

const awsmobile = {
  "aws_project_region": "eu-west-1",
  "aws_cognito_identity_pool_id": "eu-west-1:49abc0d6-caec-4d80-b176-c0fb2dbef50b",
  "aws_cognito_region": "eu-west-1",
  "aws_user_pools_id": "eu-west-1_Q0ukyAmCD",
  "aws_user_pools_web_client_id": "54tqt471sm7603cpmi0koecv11",
  "oauth": {},

```

```
    "aws_appsync_graphqlEndpoint": "https://pagm5rr44fa5bdvx4y5duk7vjq.appsync-api.eu-west-1.amazonaws.com/graphql",
    "aws_appsync_region": "eu-west-1",
    "aws_appsync_authenticationType": "AMAZON_COGNITO_USER_POOLS"
  };
```

```
export default awsmobile;
```

```
/**
```

```
 * @format
```

```
 */
```

```
import {AppRegistry} from 'react-native';
```

```
import App from './App';
```

```
import {name as appName} from './app.json';
```

```
AppRegistry.registerComponent(appName, () => App);
```

```
/**
```

```
 * Metro configuration for React Native
```

```
 * https://github.com/facebook/react-native
```

```
 *
```

```
 * @format
```

```
 */
```

```
const blacklist = require('metro-config/src/defaults/blacklist');
```

```
module.exports = {
```

```
  resolver: {
```

```
    blacklistRE: blacklist([/#current-cloud-backend\/.*\/]),
```

```
  },
```

```
  transformer: {
```

```

getTransformOptions: async () => ({
  transform: {
    experimentalImportSupport: false,
    inlineRequires: false,
  },
}),
});

```

APPENDIX B

More images showing connected routes from one faculty to another in the university of Benin

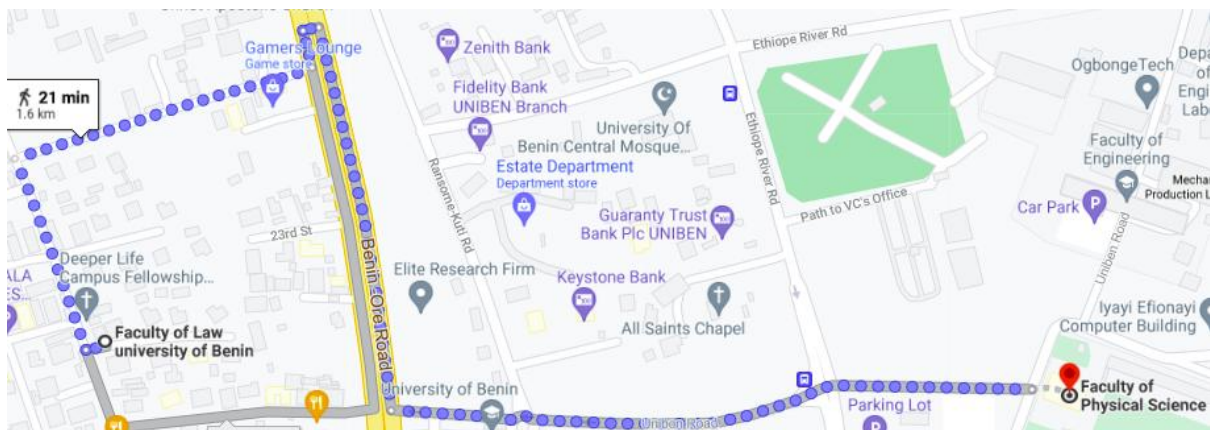


Fig 1 Image showing connected route from Faculty of Law to faculty of Physical Sciences

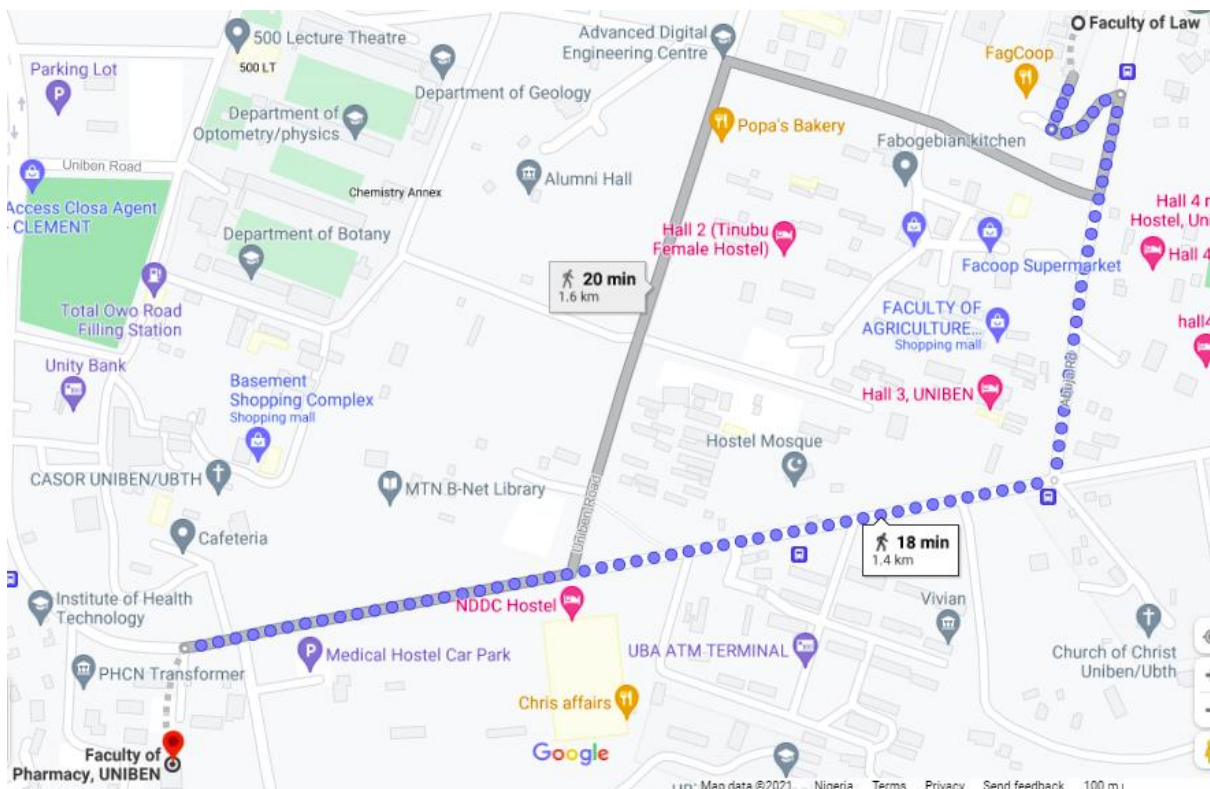


Fig 2 Image showing connected route from Faculty of Pharmacy to Faculty of Law

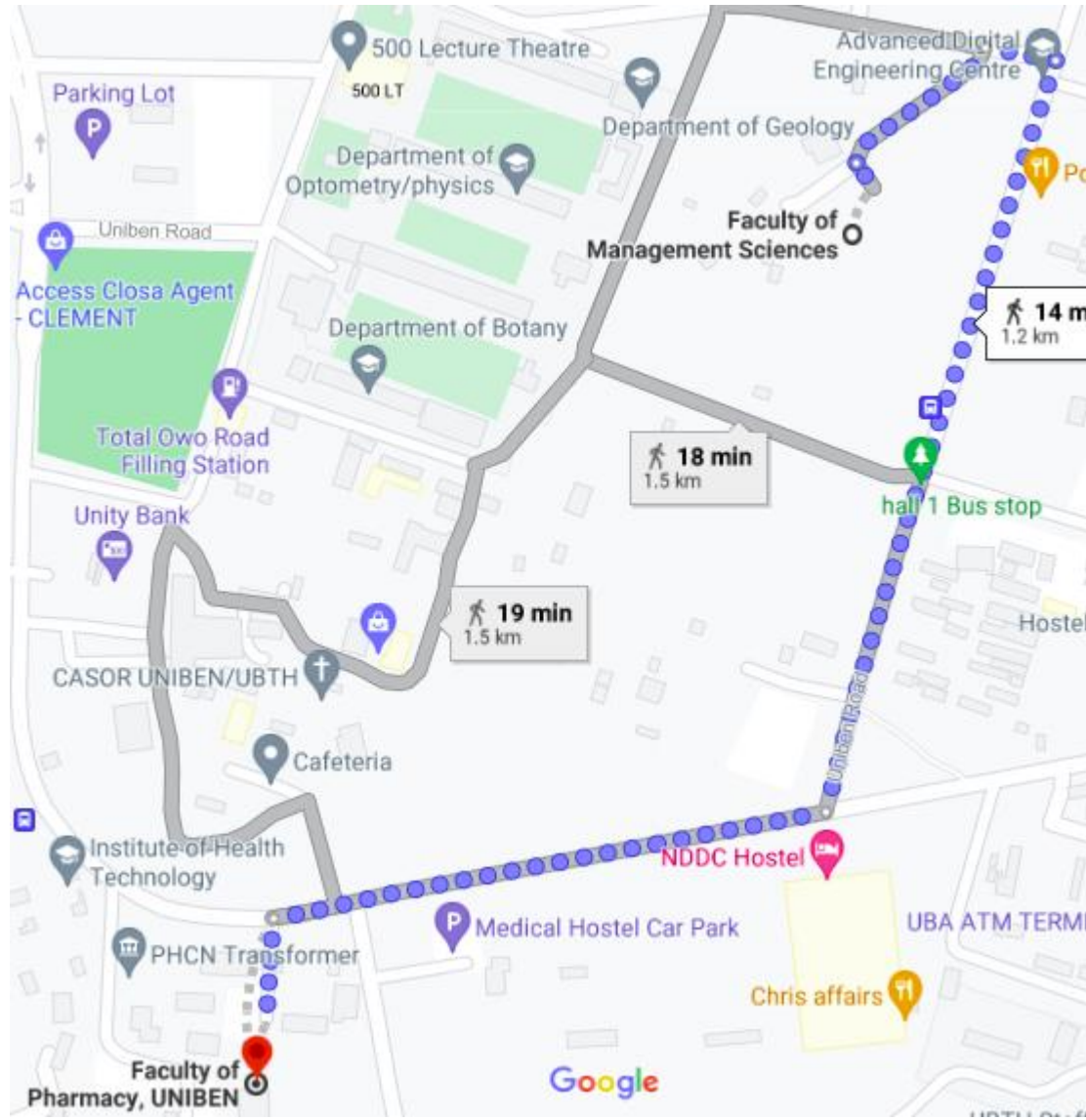


Fig 3 Image showing connected route from Faculty of Pharmacy to Faculty of Management Sciences

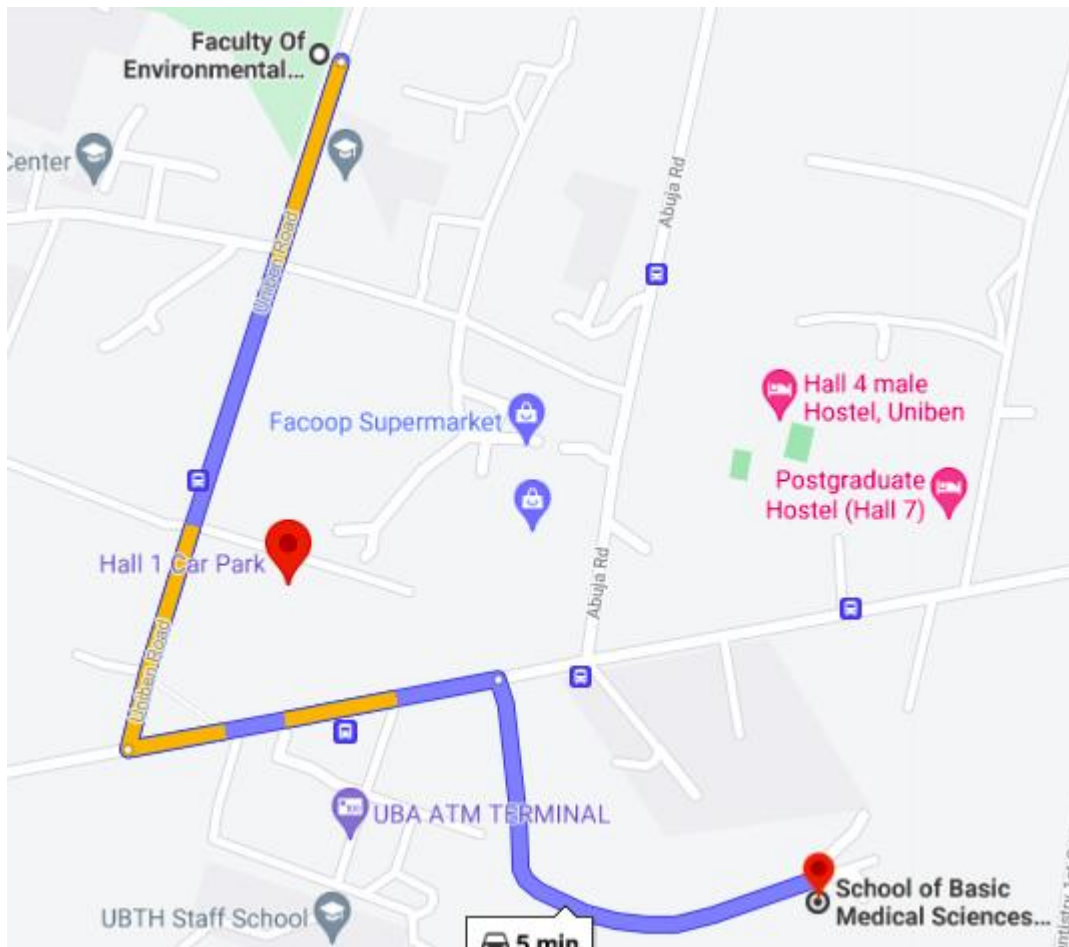


Fig 4 Image showing connected route from School of Basic Medical Sciences to Faculty of Environmental Sciences

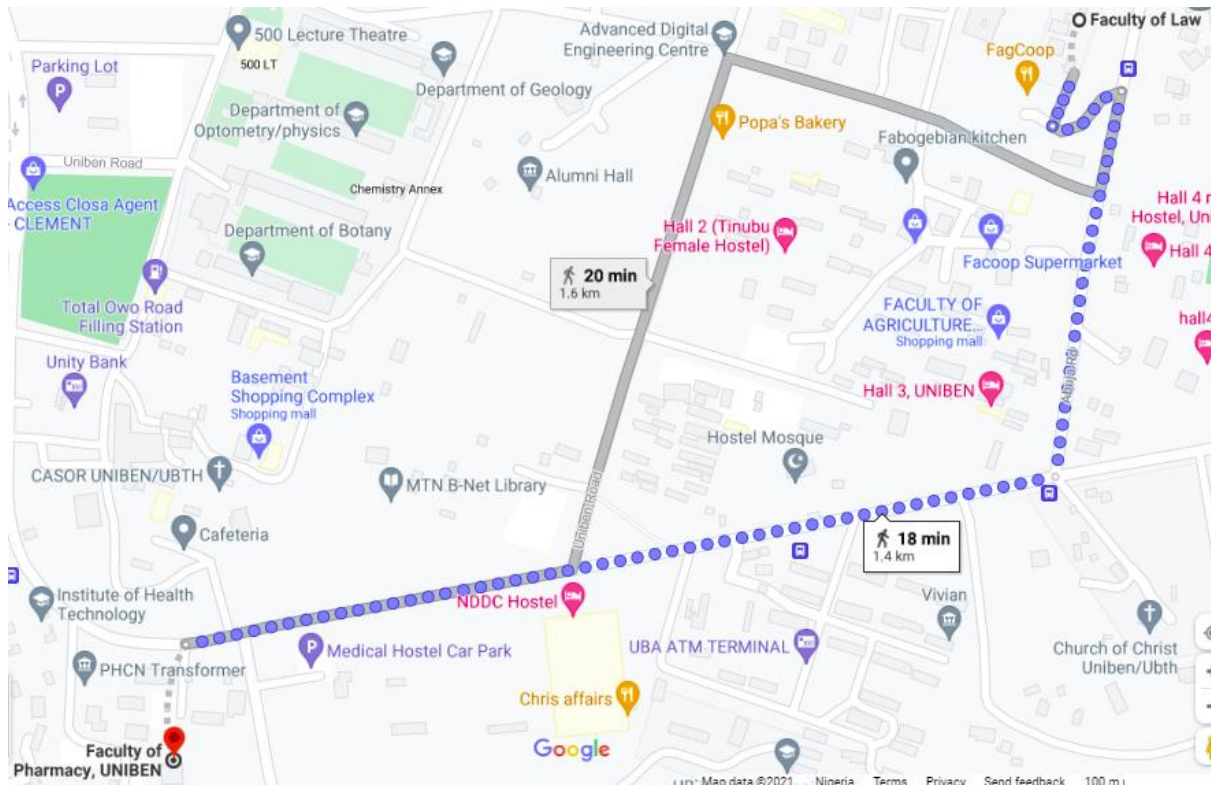


Fig 5 Image showing connected route from Faculty of Pharmacy to Faculty of Law

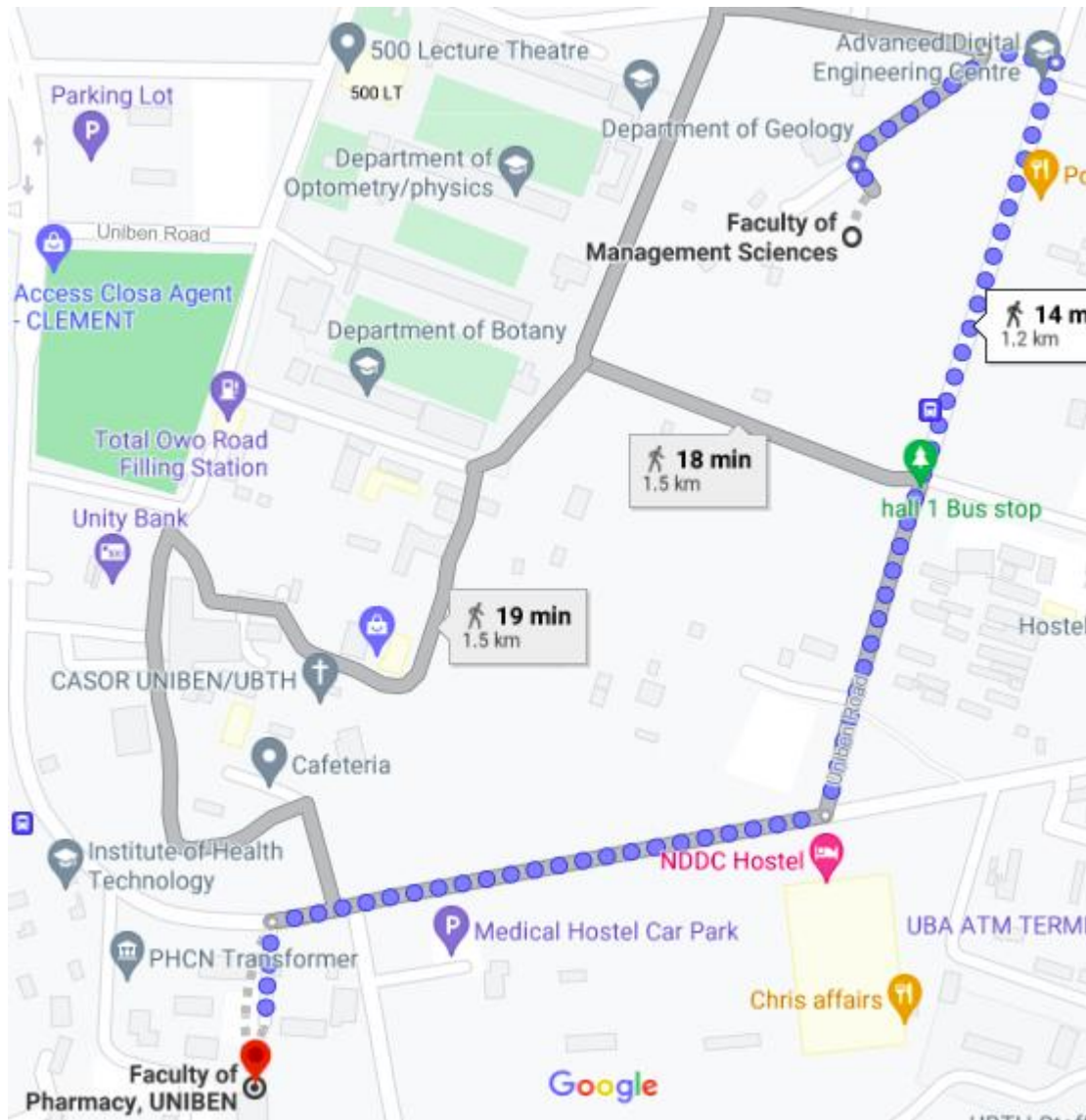


Fig 5 Image showing connected route from Faculty of Pharmacy to Faculty of Management Sciences