INTERNET OF THING (IOT) BASED REAL-TIME SYSTEM FOR LOCALIZATION AND TRACKING

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INTERNET OF THING (IOT) BASED REAL-TIME SYSTEM FOR LOCALIZATION AND TRACKING

HASSAN ALI MOHAMMED

A thesis submitted in fulfilment of the
requirements for the award of the degree of
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School of Computing
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DEDICATION

This thesis is dedicated to all the people who've helped me to reach this moment and achieving all the objectives that made me who I am today especially my family who were my biggest supporters and some close people who fall under the word friends but they had a huge impact on the person who I am right now and I'm looking further to achieve more and feel prouder and prouder about myself every single day.

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ABSTRACT

The Internet of Things (IoT) is a term that refers to the millions of physical objects that are now connected to the internet and collecting and exchanging data all over the world. Because of the widespread use of wireless networks and the development of low-cost computer chips. By connecting all of these disparate items and putting sensors to them, even the most usual devices gain a level of technological intelligence, allowing them to convey real-time data without the need for a supervisor. The Internet of Things is combining the physical and digital worlds to make the core of our surroundings intelligent and adaptive. Businesses are currently motivated by IoT and its potential to increase revenue, reduce operating costs, and improve efficiency. Simply give the data and insights needed to enhance processes, analyses usage patterns, automate operations, meet regulatory requirements, and compete successfully in a fast-paced company environment. Localization and tracking are a burgeoning scientific research topic with a wide range of applications. Customers can take advantage of a slew of advantages that come with localization. In this project, we will use the Internet of Things to track and locate the capacity of things such as animals and other living beings. In the second phase, we will follow the movement of animals, children, and the elderly, as well as other moving objects. We provide the essential technological features and compare the IoT-based solutions efforts for localization including non-IoT-based services, and finally demonstrate their utility in a wide range of application types in this article state-of-the-art in Abased localization and tracking. Localization and tracking based on IoT have been discovered to be more common and more accurate than previously used methods.

ABSTRAK

Internet of Things (IoT) ialah istilah yang merujuk kepada berjuta-juta objek fizikal yang kini disambungkan ke internet dan mengumpul serta bertukar-tukar data di seluruh dunia. Kerana penggunaan rangkaian tanpa wayar yang meluas dan pembangunan cip komputer kos rendah. Dengan menyambungkan semua item yang berbeza ini dan meletakkan penderia padanya, malah peranti yang paling biasa memperoleh tahap kecerdasan teknologi, membolehkan mereka menyampaikan data masa nyata tanpa memerlukan penyelia. Internet Perkara sedang menggabungkan dunia fizikal dan digital untuk menjadikan teras persekitaran kita pintar dan menyesuaikan diri. Perniagaan kini didorong oleh IoT dan potensinya untuk meningkatkan hasil, mengurangkan kos operasi dan meningkatkan kecekapan. Hanya berikan data dan cerapan yang diperlukan untuk meningkatkan proses, menganalisis corak penggunaan, mengautomasikan operasi, memenuhi keperluan kawal selia dan bersaing dengan jayanya dalam persekitaran syarikat yang pantas. Penyetempatan dan penjejakan ialah topik penyelidikan saintifik yang sedang berkembang dengan pelbagai aplikasi. Pelanggan boleh memanfaatkan pelbagai kelebihan yang datang dengan penyetempatan. Dalam projek ini, kami akan menggunakan Internet Perkara untuk mengesan dan mengesan kapasiti benda seperti haiwan dan hidupan lain. Pada fasa kedua, kita akan mengikuti pergerakan haiwan, kanak-kanak, dan orang tua, serta objek lain yang bergerak. Kami menyediakan ciri teknologi yang penting dan membandingkan usaha penyelesaian berasaskan IoT untuk penyetempatan termasuk perkhidmatan bukan berasaskan IoT, dan akhirnya menunjukkan kegunaannya dalam pelbagai jenis aplikasi dalam artikel terkini ini dalam penyetempatan berasaskan IoT dan Penjejakan. Penyetempatan dan penjejakan berdasarkan IoT telah didapati lebih biasa dan lebih tepat daripada kaedah yang digunakan se.

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IOT	Internet of thing

Chapter 1

INTRODUCTION

1.1. Introduction

The Internet of Things (IoT) is a concept that has changed the evolution of internet access by allowing a huge number of sensors, actuators, and smart devices to remain connected to it. On a technological level, it incorporates a number of new characteristics that are crucial for connected living activities. One of the most apparent of these value-added services is localization. For reasons such as security monitoring and law and order preservation, localization is crucial in the connected living environment. Due to the location of moving objects, tracking is essential for similar applications. For novel applications in a range of industries, both localization and tracking are required allows us to access to information from almost anywhere, anywhere at moment, on any device. It also aids in improving communication between connected electrical devices. Sending data packets through a link saves time and money. Due to their availability and precision in these functions, IoT-based localization and tracking have recently received a lot of attention (Abushahma, R. I. H., Ali, M. A., Al-Sanjary, O. I., & Tahir, N. M, 2019). As reported by (Abushahma, R. I. H., Ali, M. A., Al-Sanjary, O. I., & Tahir, N. M, 2019) many new ways are being developed to capitalize on these IoT scenarios.

According to Kalman filters (Chiou, Y. S., Liu, Y. H., Chen, Y. J., Chen, S. L., Lin, T. L., Chen, W. T., ... & Lin, T. C, 2020).m to extract real-time localization and tracking information from objects moving, a Kalman filtering-based technique was developed. In this technique, sensor data obtained from IoT nodes is evaluated. The key components of IoT have been covered from both a theoretical and architectural standpoint. It describes the primary roles of IoT nodes as well as their properties for various sensing and interaction elements that are mentioned in (Tian, Y., Liu, S., Liu, W., Chen, H., & Dong, Z, 2022). Throughout this Final Project, we highlight the most

recent advances in localization and tracking utilizing IoT. We begin with the distinctions among IoT-based localization or no IoT-based solutions. Next, we demonstrate how IoT can be used for localization and tracking. We demonstrate many contemporary IoT systems in localization and tracking.

1.2. Problem background

Nowadays, people need to transmit expensive or high value packages, but the lack of security and the ability to access it or even losing track of that specific package makes that process of transmission very risky, or not even bothering of attempting to deliver that specific package to the wanted destination. The wanted object might be a person, vehicle, bags, or even valuable jewelry which has to be sent. Regardless of the mentioned issued, one more problem might be faced which is the capacity of the existing technologies for tracking and localizing. This issue might occupy a lot of space or having some weight that adds up to the wanted package by making it heavier than it should hence it's a very sensitive character for transportation and mobility of the package. Depending on the valued object this project will reduce the risk of losing this object hence provides the ability to monitor your object throughout its path.

1.3. Project aim

The aim of this final BSc project is to create compact circuit with a sensor specifically for tracking that is capable of sending location to cloud then to be displayed on a phone application.

1.4. Project Objectives

The following are several objectives that the project can provide:

1. A functional circuit that holds the sensor in position with enough power delivered.
2. Compact in size and fully mobile, easy to carry around.
3. Data can be sent and received within the circuit, cloud and the application (typical IoT concept).
4. The sensor should send the location continuously.

1.5. Project Scope

The main focus of this project is to use the features of the IoT technology for the purpose of tracking and localization. Using a circuit that has a sensor on board that is capable of sending location to a cloud then to be displayed on a smart device. Power is supplied to the sensor to allow the user to monitor its high valued object from point A to point B, and the path will be recorded and stored in the cloud precisely.

1.6. Project Importance

This project will serve a wide variety of users from different fields and business, by providing the location of their high valued package and monitor it while it's out and away of their reach during its journey of the delivery. For instance, A business owner who's responsible of the package security can monitor the high value package until its delivered. this circuit will continuously send the location of the package to the cloud making it easy to track in case the package was stolen, hence reducing the chances of not finding the package again.

1.7.Report Organization

In this chapter, a clear vision of this final project is explained. The idea was introduced in the introduction part, followed by the project problem background and what are the project aims along with scope with the objectives that should be achieved. In the upcoming chapter (Chapter 2) which is the literature review that is about the comparison between the ongoing technologies of tracking and localization and how this final project can benefit from these technologies and different techniques along with how the use of IoT technology can turn these technologies cons into pros, and how this final project can become more up to date compared to these projects.

Chapter 2

LITERATURE REVIEW

2.1. Introduction

As the world progresses in terms of technology and development, the field of tracking and localization has evolved and changed significantly. This chapter focuses on comparing the advantages and disadvantages of the existing technologies to those of the other systems. Because each system has its unique set of tools and software, these systems will be classified according to their features.

Video provides a powerful way to help you prove your point. When you click Online Video, you can paste in the embed code for the video you want to add. You can also type a keyword to search online for the video that best fits your document. To make your document look professionally produced, Word provides header, footer, cover page, and text box designs that complement each other. For example, you can add a matching cover page, header, and sidebar.

2.2. Case Study

In 2017, Saurav et al. published research on “Accurate Localization and Tracking of a Passive RFID Reader Based on RSSI Measurements”. This study demonstrates a detailed localization and tracking scheme using two RFID tags attached to a single object. Rather than employing a per-tag localization scheme, consider adding one more. Adding an RFID tag to an object has various advantages (Subedi, S., Pauls, E., & Zhang, Y. D, 2017).

(Xiao, F., Wang, Z., Ye, N., Wang, R., & Li, X. Y, 2017).Ning et al. published a paper titled "One More Tag Enables Fine-Grained RFID Localization and Tracking" in 2018. Using two RFID tags affixed to a single object, this study offers a thorough localization and tracking technique. Adding one more RFID tag to an object, rather than using a per-tag localization approach, has a number of advantages (Xiao, F., Wang, Z., Ye, N., Wang, R., & Li, X. Y, 2017).

"Energy-Efficient Tracking and Localization of Objects in Wireless Sensor Networks," by Mahmuda et al., was published in 2018. A complete tracking and localisation technique for WSNs is described in this study. Given the constraints of static clusters, an energy-efficient Incremental Clustering approach is provided at the boundary area, followed by Gaussian Adaptive Resonance Theory. The proposed study enables for incremental learning, formation, updating, and retention of clusters using online learning to adapt to continuous motion patterns (Akter, M., Rahman, M. O., Islam, M. N., Hassan, M. M., Alsanad, A., & Sangaiah, A. K, 2018).

Monaem et al. published a paper in 2018 titled "Wireless Visual Sensor Network Platform for Indoor Localization and Tracking of a Patient for Rehabilitation Task." This paper describes specific WVSN nodes that may detect surrounding signals from a patient in a rehabilitation environment and perform local computations wirelessly sent within the WVSNs under consideration. This article explains the idea requirements and the implementation of WVSN nodes based on KINECT and Raspberry Pi 3 (RPi 3) boards, assuming the WVSN platform for patient rehabilitation supervision. This collaboration platform consists of three nodes with three processing cores to help with the development phases (Idoudi, M., Bourennane, E. B., & Grayaa, K, 2018).

Guilherme et al. released an article in 2018 titled "Outdoor Localization System based on SigFox." The article outlines the design and execution of a Sigfox-based localization and tracking system that only requires one base station and, as a result, a GPS device to communicate coordinates. Using an IoT network application paradigm, the Information Centric Network (ICN) concept offered a new information-

driven service architecture (Ribeiro, G. G., de Lima, L. F., Oliveira, L., Rodrigues, J. J., Marins, C. N., & Marcondes, G. A, 2018).

in 2019, Tim has published a research paper under the title of “Indoor Localization of IoT Devices by Dynamic Radio Environment Mapping”. This paper for utilizing dynamic radio mapping, this paper addresses the challenge of accurate radiolocation of cheap low power radio devices in indoor installations. People's motions have an impact on indoor circumstances. things in the surroundings; causing major differences in radio propagation effects on performance (Farnham, T, 2019).

2.3.Current System Analysis

Table 2.1 represents the comparison of several current systems in terms of software and tools used.

Table 2-1 Comparison of outgoing systems of tracking and localization

No.	Paper	Year	Title	Software	Tool (s)
1	(Subedi, S., Pauls, E., & Zhang, Y. D, 2017).	2017	Accurate Localization and Tracking of a Passive RFID Reader Based on RSSI Measurements	RFID/RSSI measurement	RFID reader(tags)
2	(Xiao, F., Wang, Z., Ye, N., Wang, R., & Li, X. Y, 2017).	2018	One More Tag Enables Fine-grained RFID Localization and Tracking	Imping Software Developer’s Kit, C#	RFID tag, reader antenna
3	(Akter, M., Rahman, M. O., Islam, M. N., Hassan, M. M., Alsanad, A., & Sangaiah, A. K, 2018).	2018	Energy-Efficient Tracking and Localization of Objects in Wireless Sensor Networks	MATLAB simulator	Sensor node (STUN)
4	(Idoudi, M., Bourennane, E. B., & Grayaa, K, 2018).	2018	Wireless Visual Sensor Network Platform for Indoor Localization and Tracking of a	IoT (Wi-Fi and ZigBee) / C# and C++ programming languages	Raspberry Pi 3 boards, Kinect, and ID sensor

			Patient for Rehabilitation Task		
5	(Ribeiro, G. G., de Lima, L. F., Oliveira, L., Rodrigues, J. J., Marins, C. N., & Marcondes, G. A, 2018).	2018	Outdoor Localization System based on SigFox	Sigfox (IoT) / API	STEVAL-FKI915V1 kit / U-Blox6M/ SBS-T902/ Nucleo-L152RE card
6	(Farnham, T, 2019).	2019	Indoor Localization of IoT Devices by Dynamic Radio Environment Mapping	IoT (Internet of things) / C# / OpenCV	Intel 5300 radio, dipole antenna,

According to the shown details of each paper, each paper is developed and implemented somehow individually even though they use the same software or tool such as IoT for software or RFID as a tool these two aspects are considered as reliable and more efficient compared to the rest of the papers.

2.4.Comparison between existing systems

Each research has its own benefits and drawbacks as shown in the below table.

Table 2-2 Showing the Pros and Cons of each Paper

No.	Paper	Year	Pros	Cons
1	(Subedi, S., Pauls, E., & Zhang, Y. D, 2017).	2017	• This system is very accurate and durable in terms of tracking and localization	• Can be complex to implement and program due to the RFID technology
2	(Xiao, F., Wang, Z., Ye, N., Wang, R., & Li, X. Y, 2017).	2018	• Can reduce negative multipath effects • Low cost and battery free	• Low security and has the possibility of being hacked
3	(Akter, M., Rahman, M. O., Islam, M. N., Hassan, M. M., Alsanad, A., & Sangaiah, A. K, 2018).	2018	• Low energy consumption, relies on wireless sensors due to a technique called clustering-based.	• Can't do both indoor and outdoor tracking • Small network size
4	(Idoudi, M., Bourennane, E. B., & Grayaa, K, 2018).	2018	• Relies on a Wi-Fi-Based connection between the nodes(sensor)	• Lacks outdoor tracking and localization and it can only be used indoors, has a short capability

			• Its hybrid system that consists of ZigBee and Wi-	
			Fi thus it is considered as reliable	
5	(Ribeiro, G. G., de Lima, L. F., Oliveira, L., Rodrigues, J. J., Marins, C. N., & Marcondes, G. A, 2018).	2018	• Performs on a high-level application • Uses GPS services for better accuracy	• Has a low data rate support? • Applies narrow band-IoT system • High energy consumption
6	(Farnham, T, 2019).	2019	• Has the tendency to overcome multipath effects	• High energy consumption because it requires ultrawide band transmission

As the papers and their technologies have been differentiated their pros and cons, now can be obvious hence showing which paper is more suitable for the tracking and localization purpose, paper no. 5 can be considered the most balanced and more efficient and accurate compared to the other current systems due to the G.PS service that is used in it.

2.5.Literature Review of Technology Used

The technologies of each system have been presented in Table 2.3.

Table 2-3 The technology of each paper

No.	Paper	Year	Technology
1	(Subedi, S., Pauls, E., & Zhang, Y. D, 2017).	2017	RFID reader(tags)
2	(Xiao, F., Wang, Z., Ye, N., Wang, R., & Li, X. Y, 2017).	2018	RFID tag, reader antenna
3	(Akter, M., Rahman, M. O., Islam, M. N., Hassan, M. M., Alsanad, A., & Sangaiah, A. K, 2018).	2018	Sensor node (STUN)
4	(Idoudi, M., Bourennane, E. B., & Grayaa, K, 2018).	2018	Raspberry Pi 3 boards, Kinect, and ID sensor
5	(Ribeiro, G. G., de Lima, L. F., Oliveira, L., Rodrigues, J. J., Marins, C. N., & Marcondes, G. A, 2018).	2018	STEVAL-FKI915V1 kit / U-Blox6M/ SBS-T902/ Nucleo-L152RE card
6	(Farnham, T, 2019).	2019	Intel 5300 radio, dipole antenna

The technology of the papers makes each one of them stand apart from the rest but the use of RFID sensors is common and obvious, since it relies on radio frequency which can be more accurate and durable compared to the technologies.

2.6.Chapter Summary

By the end of this chapter which is the literature review for the purpose of tracking and localization there's a majority of technologies and techniques, and each one of these outgoing systems serve in a different and a specific way cause some of them were implemented for indoor uses while others were implemented for outdoor uses. After comparing along with bringing out their pros and cons it's clear that which paper has the most suitable tools and software compared to the other papers.

Chapter 3

SYSTEM DEVELOPMENT METHODOLOGY

3.1. Introduction

In the recent chapters a complete and clear vision of this FYP have been discussed, started from the first chapter which was about giving a brief into along with scope, aim of the project as well as the background problems that can be faced and how well this system can provide a solution to it. Moving to the second chapter (literature review) basically it was a comparison between some research papers that were related to this field. but each paper had its own style and uniqueness that they all come to the same point of solving the tracking and localization challenge. For that reason, well get the benefit of the past chapters for chapter three, the reuse of the tools and software that were compared before. This chapter will evolve around the mechanism and the methodology of this project in specific as well as the procedure of how these step-by-step layers are achieved to carry out that function.

3.2. Methodology Choice and Justification

Rapid application development (RAD) is the best fit for this FYP because of its versatility as well as its speed and excellent quality of development. RAD is primarily concerned with one thing: swiftly creating prototypes for testing features and functions without regard for how the final product will be affected (Maitra, S., Abdelgawad, A., & Yelamarthi, K, 2019). Furthermore, one of the key characteristics of this development approach is that it does not require a large number of members to be productive, resulting in a significant reduction in development time, as well as a high level of flexibility due to the ability to change requirements and quick reviews.

3.3. Phases of the Chosen Methodology

RAD phases

The RAD methodology is divided into four stages, as follows:

- **Defining the Project Requirements:** The RAD phases begin with stakeholders selecting a limited set of project needs, similar to how traditional development cycles begin with project scoping. This stage of planning is brief, with a focus on prototype iterations, but crucial to a project's overall effectiveness.
- **Building the Prototype:** Teams begin building basic models and prototypes when a project has been scoped. The goal is to swiftly produce a practical design that the client can see. Clients and developers work together until the final product is ready, guaranteeing that the client's needs are met. As the project progresses, this stage is repeated as needed. It's common for developers to cut corners on an early-stage prototype in order to provide a usable product that the product owner approves of.
- **Rapid Construction and Feedback Receiving:** Through application coding, system testing, and unit integration, rapid building transforms prototypes and prototype platforms into working models. This phase can be repeated as necessary to accommodate new elements or changes. Low-code or rapid software development solutions are commonly used to move a program forward quickly.
- **Finalizing Software, or Implementation:** Developers tackle the technical debt created during early prototyping in the final stage of fast application development, optimizing implementation to boost stability and maintainability as they ready the program for launch. Items are moved to a live production environment for full-scale testing to find defects in the product.

3.4. Technology Used Description

Both of the block diagrams (Figure 3.1) and the flowchart (Figure 3.2) represent the work flow of the project as well as how these devices connect and interact at a level, where data can be shared in between then it can be displayed in an easy form for a user. Data or the information about the existing location of the sensor is saved then sent to the cloud to be shared and understandable on a display for the user.

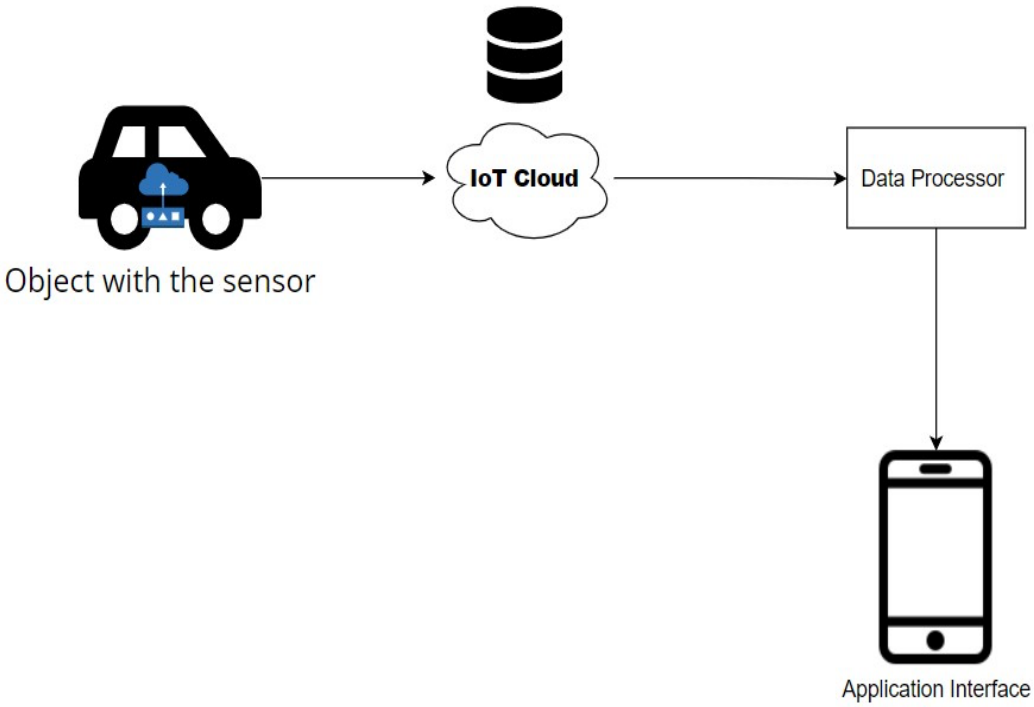

Figure 3-1 System Block Diagram

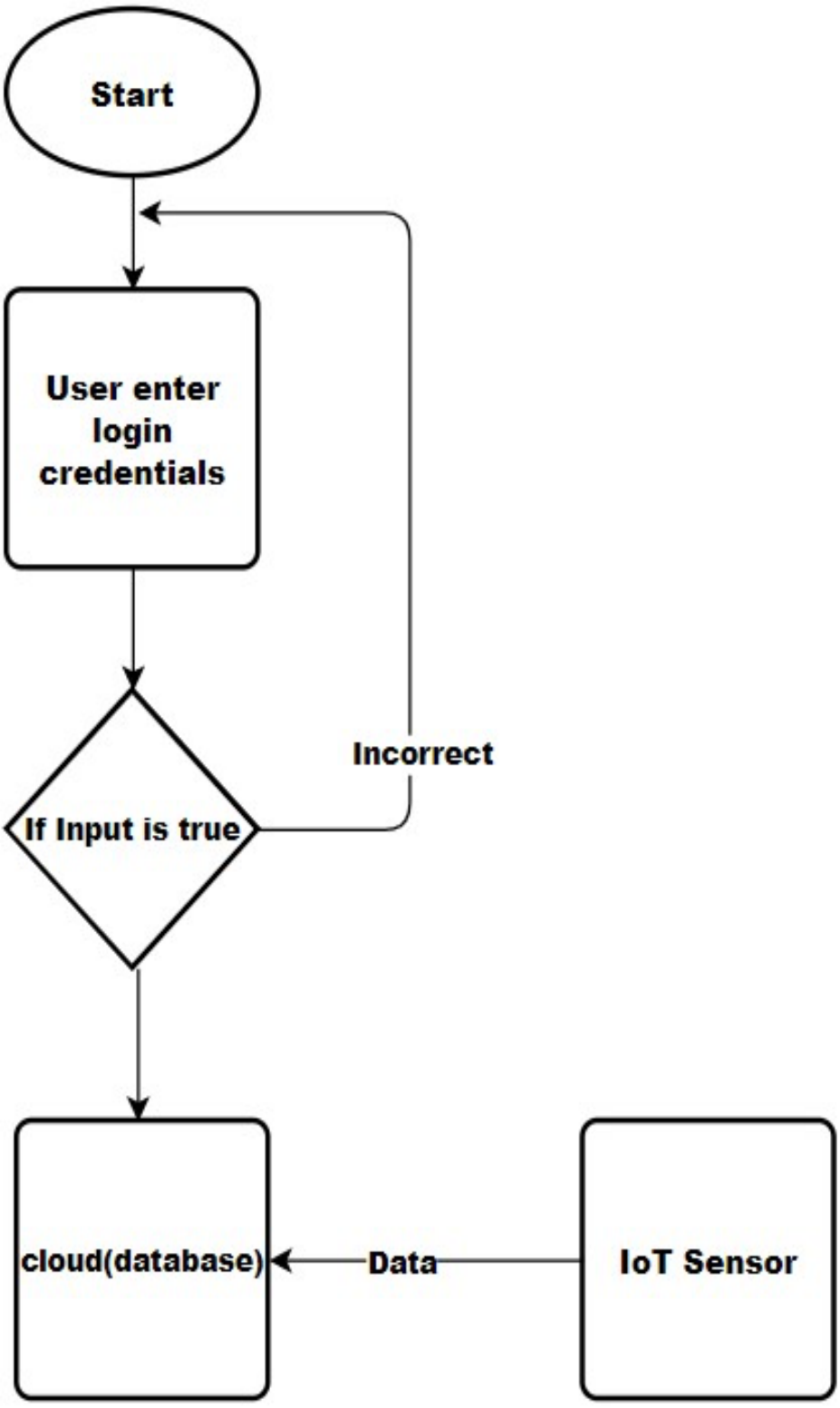

Figure 3-2 The Proposed System's Flowchart

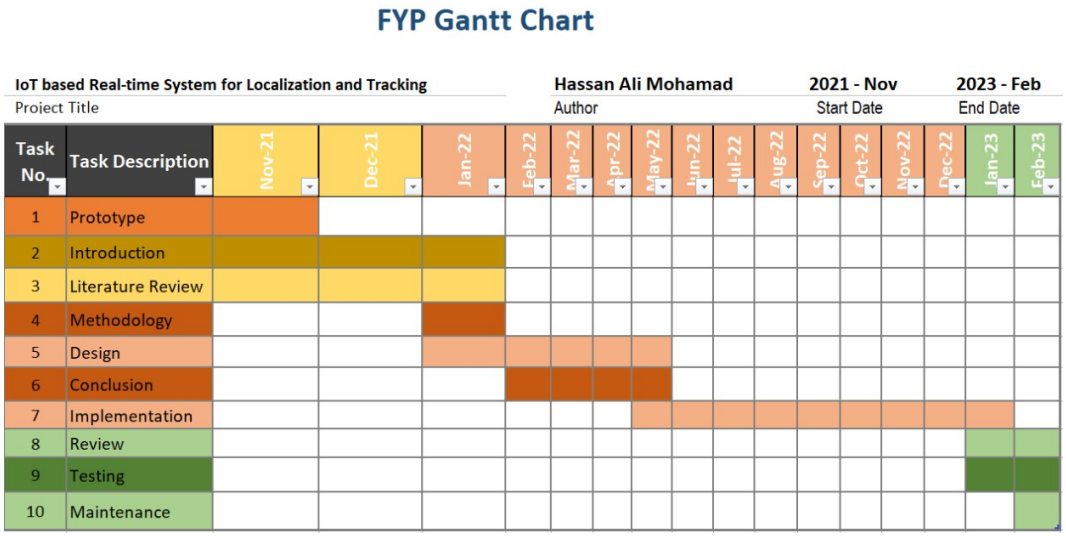

Figure 3-3 Gantt Chart for the FYP1

3.5. System Requirement Analysis

The following table illustrates the technologies and tools that are required to accomplish the wanted results.

Table 3-1 Tools and Technologies Used

Tools	Technologies
• Dart • Arduino IDE	• Laptop or Personal Computer • Mobile device • Arduino Microcontroller • IoT Sensor • WIFI & GPS

3.5.1. Hardware Requirements

The below table shows the hardware and their specifications that are required for the project to make sure that system can function at its finest efficiency without facing sort of issues throughout the process.

Table 3-2 Hardware Requirements for the System

No.	Hardware	Specifications
1	Personal Computer	• At least an Intel Core i5 processor • Windows 10 • 8 GB of RAM. • Wireless networking (for internet)
2	Smart IoT Sensor	NEO6M GPS Module
3	Arduino Board	esp8266
4	Internet SP	At least 512kbps

3.5.2. Software Requirements

This project must have an interface for the user to monitor the object during the tracking and localization process. For that purpose, a software will be developed for the front-end via Dart, which is a programming language that can support multiple platforms such as iOS and Android. For the Arduino Board, Arduino has its own IDE called Arduino IDE.

3.6. Chapter Summary

This chapter main aim is to show the methodology of the project and how it will be implemented, declares all the factors that contribute in order to make the procedure and the work flow understandable. With the aid of diagrams and charts the duration of the tasks along with the upcoming plans are obvious. The workflows and the diagrams state the flow of this project since this chapter is mainly focused on the flow of the phases throughout the project.

Chapter 4

REQUIREMENTS ANALYSIS AND DESIGN

4.1. Introduction

In the recent chapter, a brief explanation was made to show and define the methodology of the tracking and localization system. With the use of IoT to gain the ability of multiaccess of users to the cloud where the data that have been collected are stored there safely and securely. Many different methods were compared before and the IoT Technology is the chosen one due to its functionality and features that helps it standout form the rest of the methods.

In this chapter, some diagrams will show the relations and capabilities of each segment that is a part of this process whether its direct or indirect, clarifying the requirements and activities of the users while they're involved in this system. Many diagrams will be presented such as UML diagram to show the methods and attributes of each class and how they're related, use case diagram to clarify the activities of each actor within the system, sequence diagram to show the arrangement of the steps within the system.

4.2. Requirement analysis

Requirement's analysis, often known as requirements engineering, is the process of defining user expectations for a new or changed product. These features are both important and unique. The report will analyses the requirements in this section utilizing numerous diagrams such as use case modelling, sequence modelling, activity diagram, and class diagram.

4.2.1. Unified Modeling Language (UML)

Unified Modeling Language (UML) is a standardized general-purpose modeling language used in the field of object-oriented software engineering. UML is a set of strategies for employing a set of graphic notation tools to create visual models of object-oriented software systems. UML is a modeling language that combines the approaches of data modeling, business modeling, object modeling, and component modeling. It can be utilized at any stage of the software development process and with a wide range of implementation technologies.

4.2.1.1. Use Case Modeling

A UML behavior or dynamic diagram is a use case diagram. In use case diagrams, actors and use cases are used to model how a system works. Use cases are a collection of tasks, services, and operations that the system must perform. In this context, a "system" refers to something that is being created or maintained, such as a website. The "actors" are people or things who carry out certain tasks within the system.

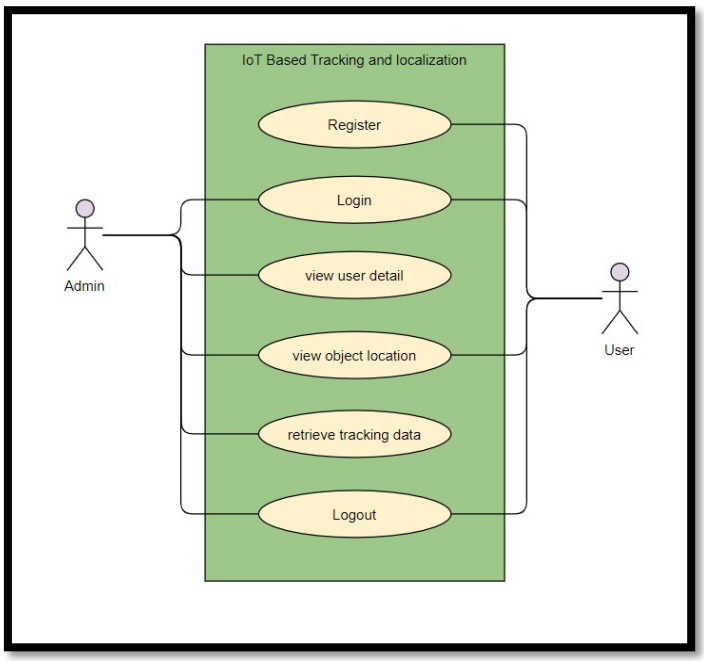

Figure 4-1 Use Case Diagram

4.2.1.2. Sequence Modelling

UML Sequence Diagrams and other interaction diagrams describe how activities are carried out. They capture the way things interact in a collaborative atmosphere. Sequence Diagrams are time-focused and use the vertical axis of the diagram to represent time and the messages delivered and received to visually portray the order of an interaction. Login sequence diagram/ shows how the user and admin can login the system. Illustrated in figure 4.2

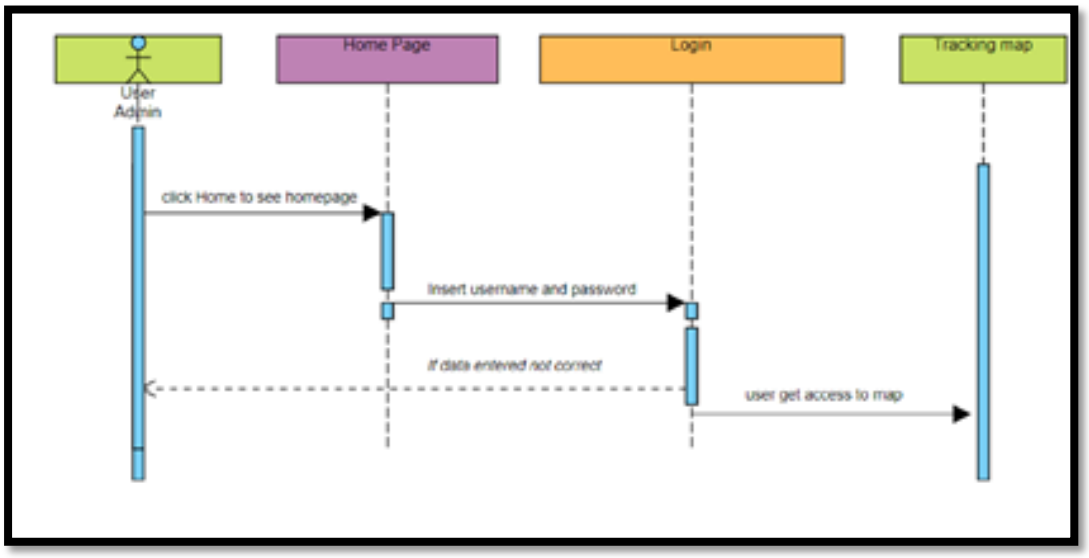

Figure 4-2 Login Sequence Diagram

Register sequence diagram/ shows how a user can register and fill up the registration info, illustrated in figure 4.3

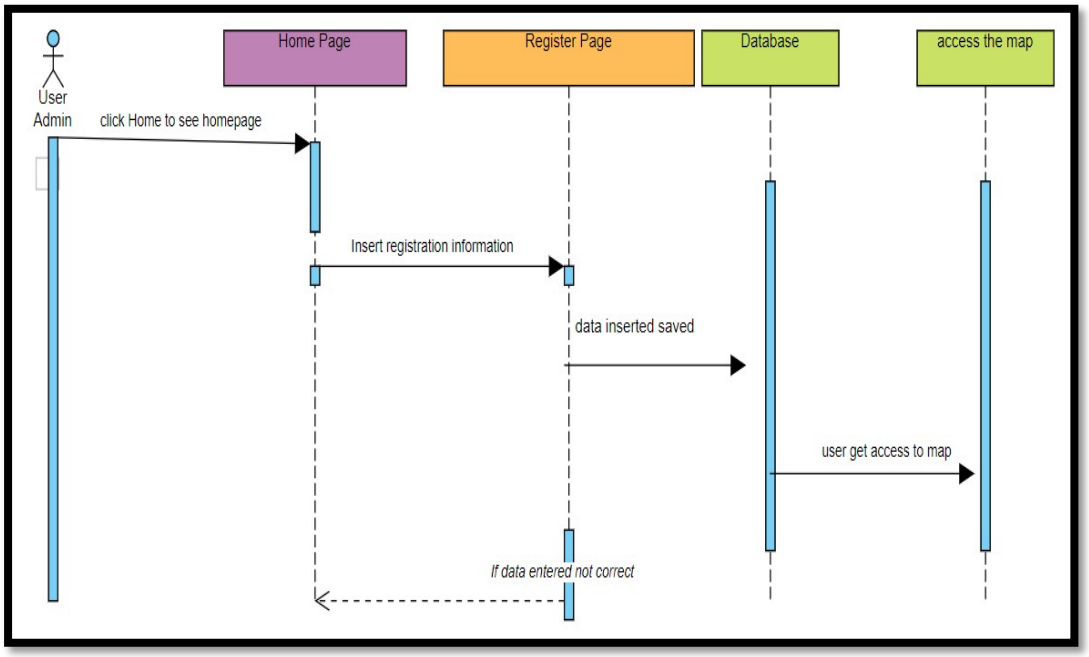

Figure 4-3 Register Sequence Diagram

User gain access to view and monitor using the map to track an object. Illustrated in figure 4.4

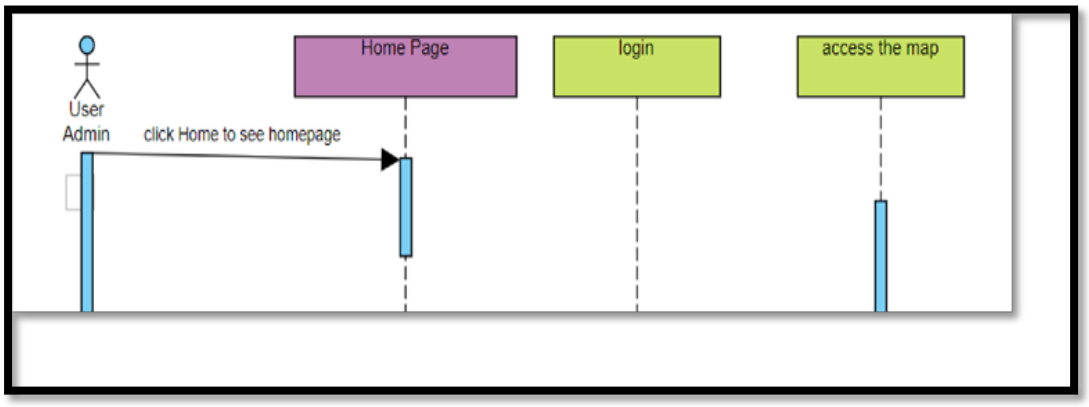

Figure 4-4 Monitoring The Map Sequence Diagram

4.2.1.3. Activity Diagram

The procedures involved in the execution of a use case are depicted in an activity diagram, which is used to show the flow of control in a system. We model sequential and concurrent actions using activity diagrams. As a result, we use an activity diagram to illustrate operations in a transparent manner. The condition of flow and the order in which it occurs are the emphasis of an activity diagram. An activity diagram is a visual representation of what causes a certain event.

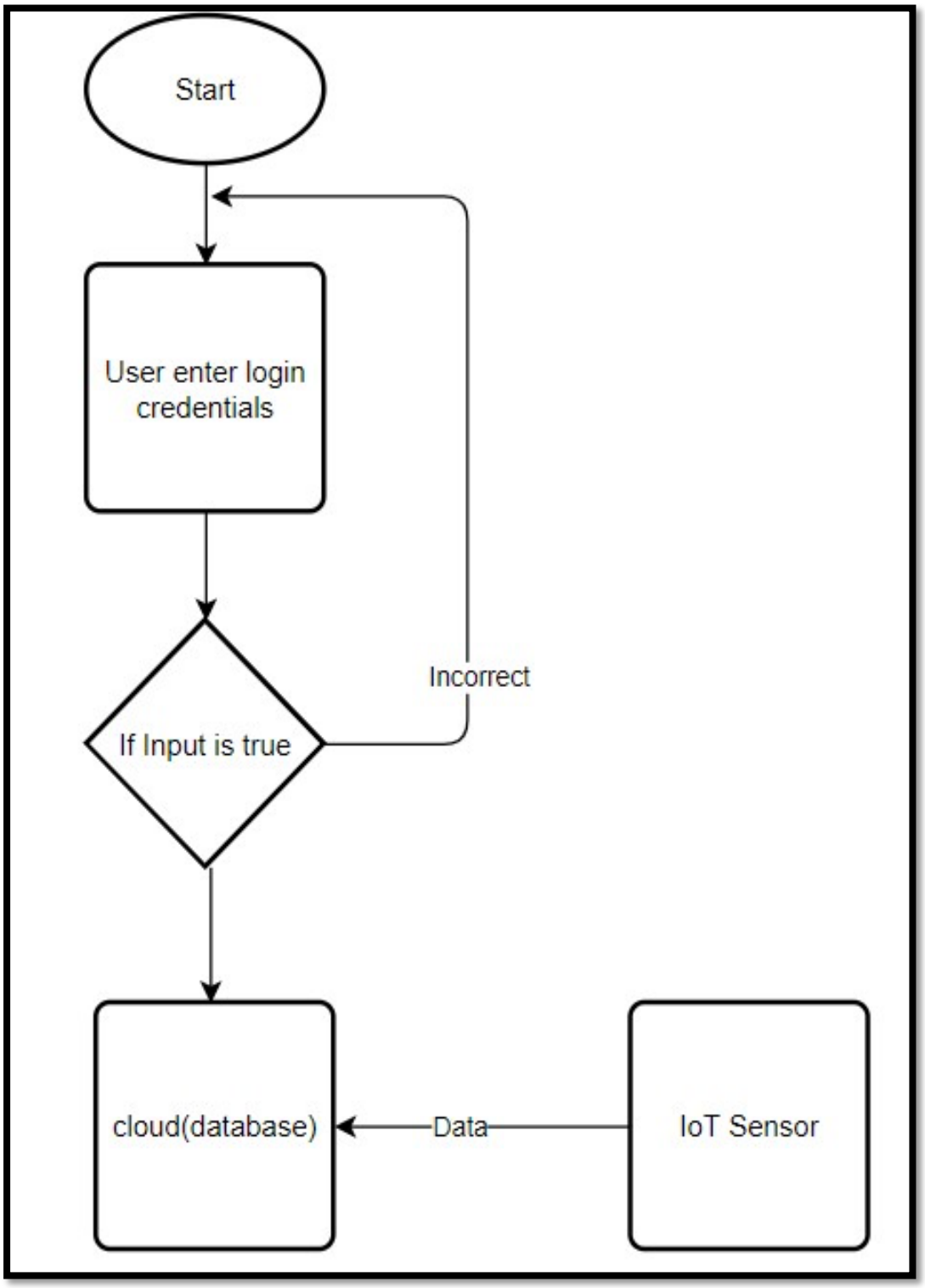

Figure 4-5 System Activity Diagram

4.2.1.4. Class Diagram

It displays the static view of an application in a class diagram. A class diagram can be used to visualize, describe, and document various aspects of a system, as well as to create executable code for a software application. The features and activities of a class, as well as the system's restrictions, are depicted in a class diagram. Class diagrams are often used in the design of object-oriented systems since they are the only UML diagrams that can be directly mapped with object-oriented languages.

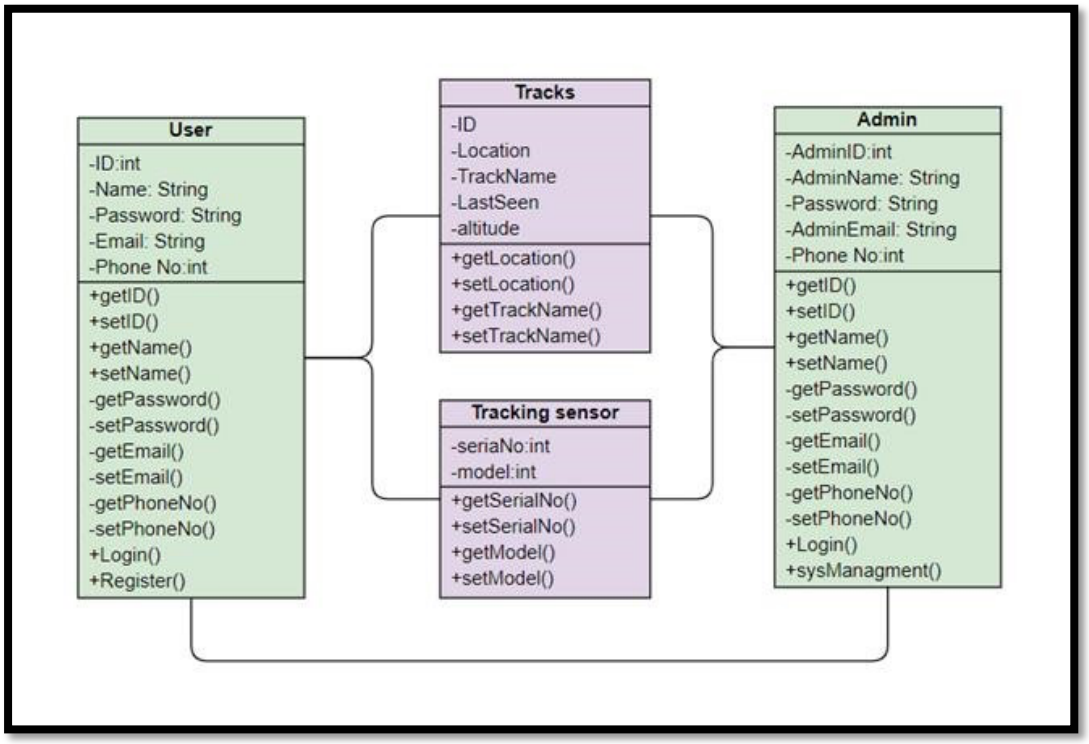

Figure 4-6 The System Class Diagram

4.3. Project Design

Architectural design is a field of study that focuses on addressing and meeting people's requirements and desires in order to develop living spaces through the application of specific tools and, most importantly, creativity. Despite the belief that architecture is exclusively a technological activity, the goal is to combine

technological and aesthetic elements. Design, which is defined as the creative process, is combined with architecture, which is defined as the production and presentation of technical solutions. By merging both disciplines, architectural design examines the principles and formal features of works through spatial experiences. It is most commonly associated with project drawings, sketches, or outlines, and it is one of its most important foundations.

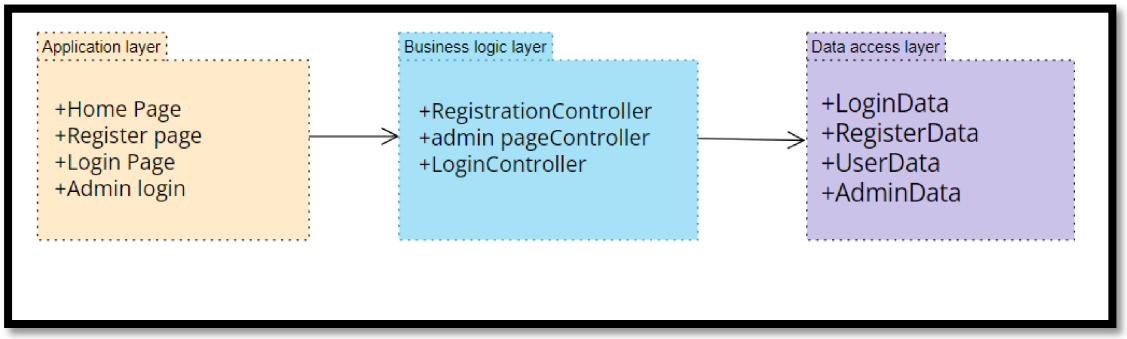

Figure 4-7 Layered Architecture Design

4.4. Interface Design

User interface (UI) design refers to the process of creating user interfaces in software or digital devices with a focus on appearance or style. Designers aim to create user interfaces that are both easy and entertaining to use. Both graphical and non-graphical user interfaces, such as voice-controlled interfaces, are included in UI design. The user will be transported to this page, which is the login page, after pressing the login button on the home page.

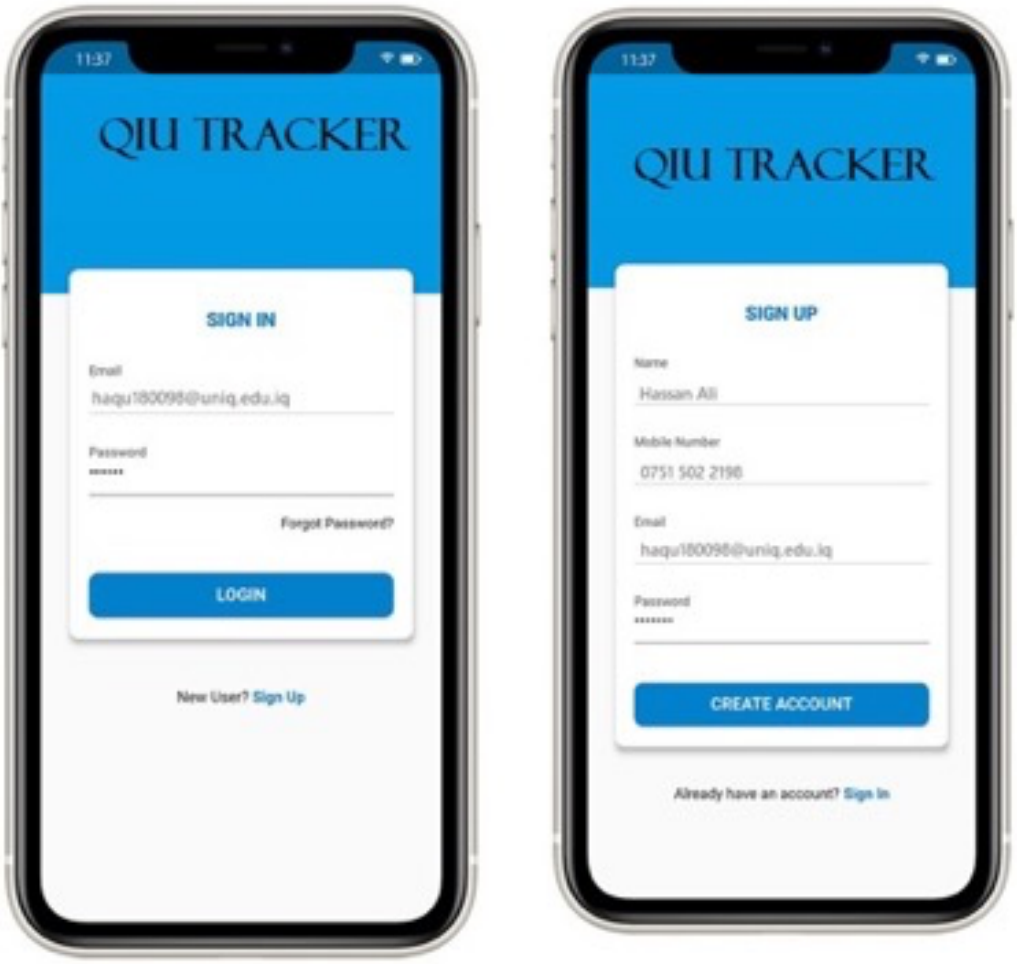

Figure 4-8 Login and Register page

Then after accessing the system, the Dashboard and Contact Us illustrates all the features that can be accessed via the dashboard. Feedbacks can be recorded and sent back to the system. Illustrated in Figure 4.9.

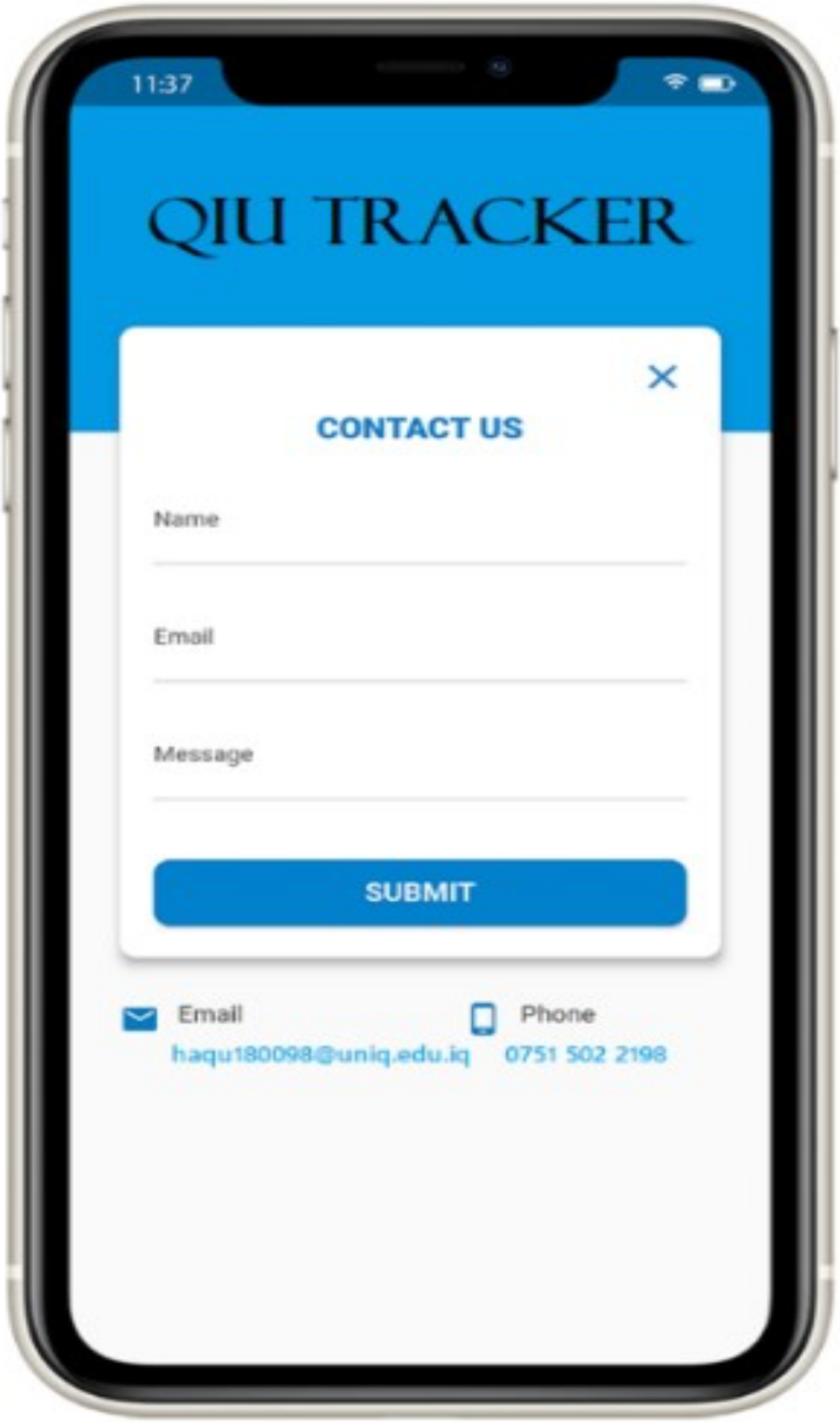

Figure 4-9 Dashboard and Contact Us

Profile and editing: Each User that access the system have their own account even though they might monitor the same sensor, users must be distinguished and customize their own profiles.

Figure 4-10 Profile and edit profile page

Sensors and tracking: Because each sensor is unique and has a unique position, it must be registered in the system with its own ID, even if it is being tracked by two users at the same time. A map can depict the path and tracks taken by the sensor till it arrives at its destination. For improved accuracy, the searching procedure can be done by searching by sensor name, ID, or dates, so every path is logged by date and considered a history of that sensor.

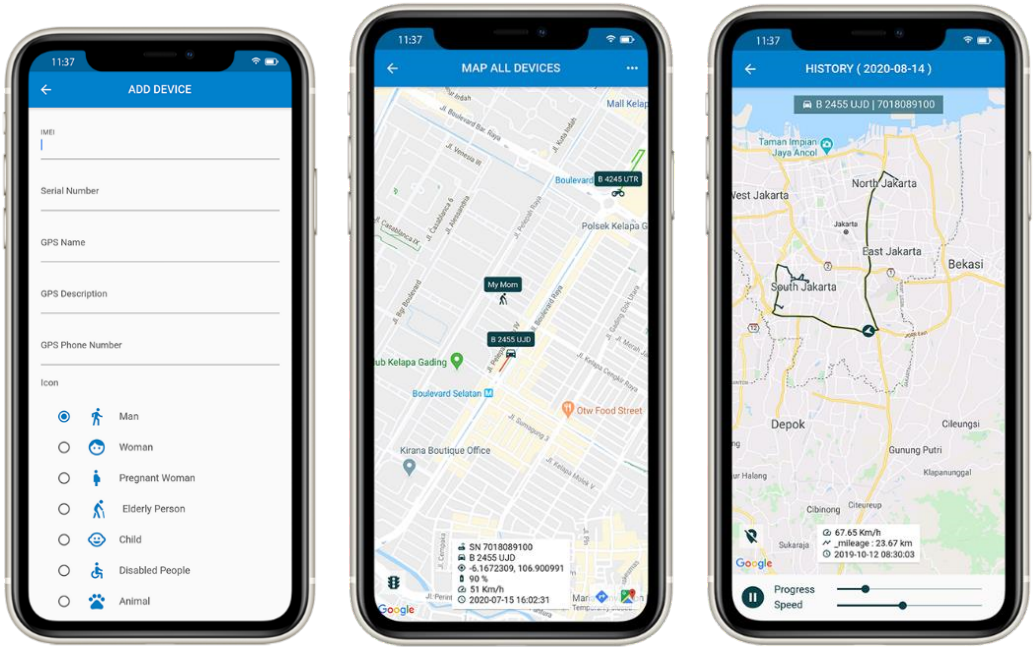

Figure 4-11 Sensor path and identification

4.5. Chapter Summary

In conclusion, the design of the system has been clarified as well as all the diagrams illustrated the design and analysis of the system were covered. Such diagrams like class diagrams, use case, sequence diagram was all made to simplify the understanding of this system. The goal of this chapter is to clarify and simplify all the requirements analysis of this system.

Chapter 5

IMPLEMENTATION, AND TESTING

5.1. Introduction

IoT-based tracking and localization reveals that IoT-based solutions are more versatile than earlier localization methods. In terms of tracking and location, these gadgets are also more precise. For applications that require location and tracking, IoT deployment is a natural fit. It's growing more and more popular. On the other hand, security concerns remain a source of concern for these applications. Aside from the advantages, IoT-based tracking and localization has a number of disadvantages. The security of users' data is a top priority. Security in the Internet of Things has not developed to the expected level. Attackers can easily get access to IoT networks and disrupt service. Privacy and security for localization and tracking are still challenges that need to be addressed in order to improve reliability and trustworthiness.

5.2. Coding of the System Main Function

This PSM was like a theoretical side of the system that is mainly focused on giving a clear vision of the system before implementation as well as being a plan for the future during the implementation stage. Without the design and the system requirement analysis, bringing the system into life would be much difficult, therefore these steps were important to make. Relying on all the past works that have been made in the previous chapters will be used again in the next PSM to improve the implementation process. In the first phase of testing in this phase, as the developer are searching and looking after the requirements it does need and the developers do all our research based on the willingness of the customer or in other words the user and look after every point that is needed to implement inside of the program. Then after that,

the software solution is created in the Design phase to fulfil the design requirements. The system design might be brand new or a continuation of prior development. And the developers look for a very eye-catching and modern design. The last but not least step is that all developers do is based on the design phase and the requirement phase is that we implement codes and that developers work on a well-based structure to get it run based on the requirements.

The system is created throughout the implementation and test phases by coding and developing the user interface and modules, which are then included and tested. Last phase of testing and implementation is in this phase after all that is done, developers will search after any improvements that developers could add based on the review that the user gives toward the developer. The software is estimated and tested against the current need during the review process. Then, in the following iteration, further needs are discussed and analyzed in order to submit an update.

Chapter 6

CONCLUSION AND RECOMMANDATION

6.1. Conclusion

In today's society, maintaining security for personal and corporate cars is critical. As a result, a vehicle monitoring system is proposed to determine the location of a car when it is lost or concealed elsewhere. GPS technology is utilized to track the user's location, and this information is relayed to the user through Gprs. In addition to the tracking system, an anti-theft system is being created to enhance safety. It is typically used in fleet management, transportation systems, industrial uses, school buses, and public vehicles, among other things. This system can be used in multiple ways and can help a lot of fields through by providing the location of the wanted target regarding the low cost compared to other type of gadgets that can help detect location this sensor can handle the task flawlessly, with the use of the IoT technology the monitoring will be easy to do yet precise and with IoT a few users can track the object as a real-time. The project consists of an Arduino board connected to sensor (for tracking) then both of these small devices are connected to the cloud. The data that haven been returned form the cloud are displayed on the smart phone via an application that is developed with Dart programming language (hybrid flutter) and it has to be connected to the web and must be able to work even online in case the board is not sending any data. extract real-time localization and tracking information from objects moving, a Kalman filtering-based technique was developed. In this technique, sensor data obtained from IoT nodes is evaluated.

The key components of IoT have been covered from both a theoretical and architectural standpoint. It describes the primary roles of IoT nodes as well as their properties for various sensing and interaction elements that are mentioned in. Throughout this Final Project, we highlight the most recent advances in localization and tracking utilizing IoT. We begin with the distinctions among IoT-based

localization or non-IoT-based solutions. Next, we demonstrate how IoT can be used for localization and tracking. We demonstrate many contemporary IoT systems in localization and tracking.

6.2. Future Work

This system may be improved further to become sophisticated. system that operates the car using the Internet of Things idea Anyone from anywhere in the globe may access it remotely. It is possible. organized in such a way that a call may be connected to the owner alternatively it might transmit the presentation to a group of people. A buzzer can be added to the board in case the user got way to close to the board yet can’t find it in a small room if it’s not in sight. One more feature can be adding a LED screen to the board to display a QR code to shorten the connection time between the app and the board hence improve the security of the project overall.

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Appendix A

SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

1. INTRODUCTION

The Internet of Things (IoT) is a concept that has altered the evolution of internet access and allows a huge number of sensors, actuators, and smart devices to stay connected to it on a technological level. It has a number of unique features that are essential for efforts to promote connected life. One of these value-added services that is the most noticeable is localization. In the connected living environment, localization is essential for reasons like security monitoring and maintaining law and order. Due to the location of moving objects, tracking is necessary for similar applications. For innovative applications in a number of industries, localization and tracking are both crucial.

1.1 Purpose

This SRS describes how the product has come along, and how many things we had to change to our product for it to preform that way it is now. The purpose of this SRS document is to allow the reader or stakeholder to understand what my product is for, and what are the pros of investing in my product. This SRS document is intentionally for those who are willing to invest into highly modified GPS tracker for their equipment or their company items. Most of our audience will be attracting car companies that are looking for a highly modified GPS tracker for their new base vehicles.

1.2 Scope

The software product is called “Localization and Tracking”, and the objective of this product is to allow a functional circuit hold a sensor in a position with enough

power to be delivered to it, a compact size device, fully mobile, easy to carry around, and also data can be sent and received within the circuit cloud and the application. The data will be sent through IoT. The sensor will also send the location to the mobile application continuously. This project's major goal is to track and locate objects using the capabilities of IoT technology. utilizing a circuit with a built-in sensor that can transmit location data to the cloud for display on a mobile device. The sensor is powered so that the user can track a highly valuable object from point A to point B, and the path will be precisely recorded and saved in the cloud.

1.3 Definitions, Acronyms and Abbreviation

Keywords:	Explanation:
SRS	Software requirement specification
bugs	An error inside the product

1.4 References

M. M. Rana, et al., 2020 in Proc. IEEE ICACT 2020, February 2020, pp. 541–544.

L. Tang et al., in Proc. IEEE ICSPCS 2019, December 2019, pp. 1–6.

Maitra, S.; Abdelgawad, A.; Yelamarthi, K. Lab in a Box: A Rapidly Deployable Environmental Monitoring IoT System. In Proceedings of the 2019

IEEE 62nd International Midwest Symposium on Circuits and Systems (MWSCAS), Dallas, TX, USA, 4–7 August 2019

1.5 Overview

The software requirement specification document (SRS) will be containing the product perspective which will be including the system interface, user interface, hardware interface, software. Interface, and communication interface. It will also be including the constraints of the product with what will also happen in the future for the new product interfaces or functions. The last part of the SRS will be containing the external interface of my software and hardware project. The external interfaces are just the user, hardware, software, and communication interface. With also the systems features explained in separate modules with use case specification table, activity diagram, and sequence diagram. Lastly, it will show the performance requirements with also the design constraints and software system attributes. This software requirement specification document is a formal document that is organized by IEEE format.

2. OVERALL DESCRIPTION

This section will show all the features that my product has and how each feature works.

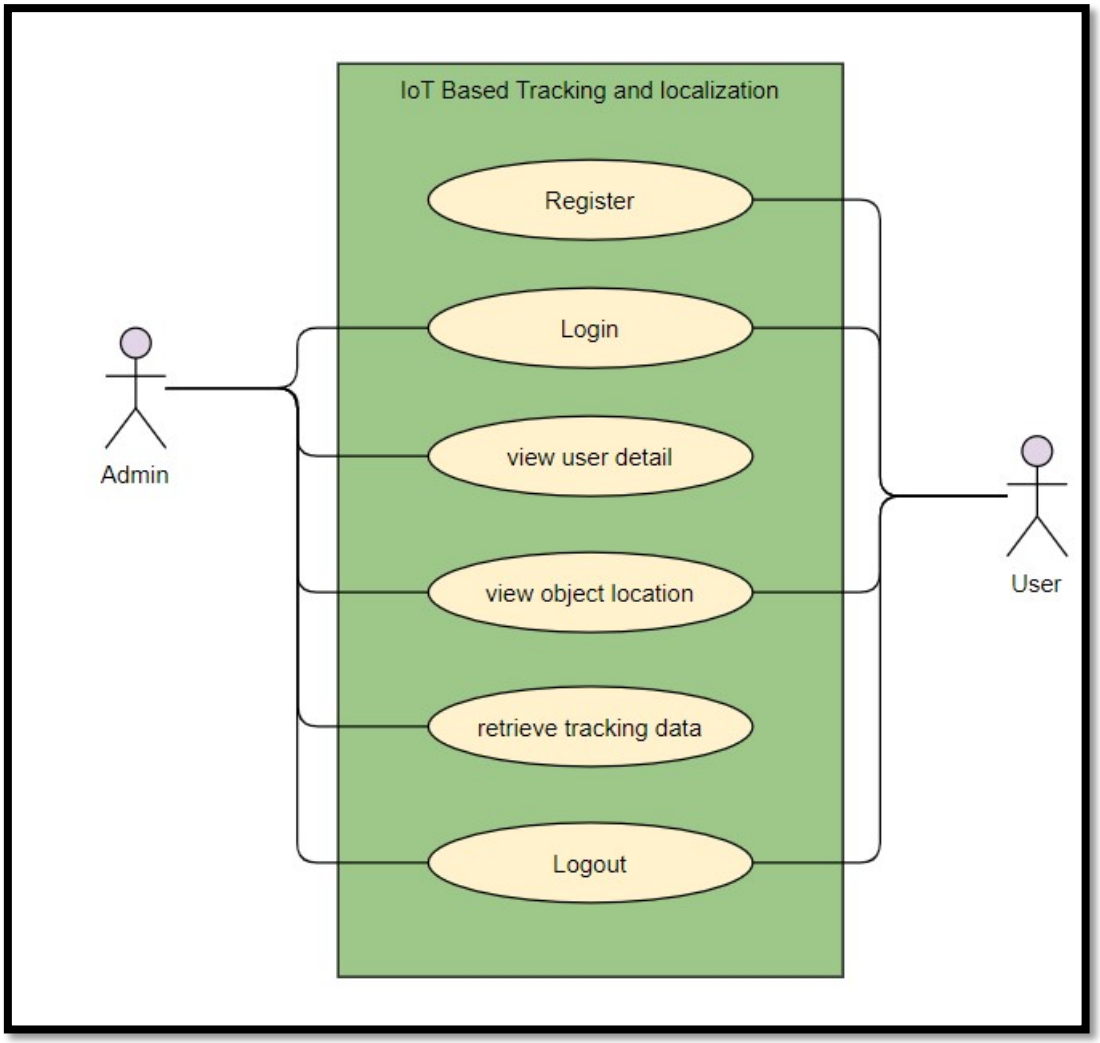


Figure 2.1: Use Case Diagram of < Localization and Tracking >

2.1 Product Perspective

Both the block diagrams (Figure 3.1) and the flowchart (Figure 3.2) show how the project's work is carried out as well as how these devices link to one another and interact at a level that allows data to be shared between them and then displayed to users in an intuitive manner. Data or information about the sensor's current location is saved, then uploaded to the cloud so that it can be shared and shown for users to comprehend.

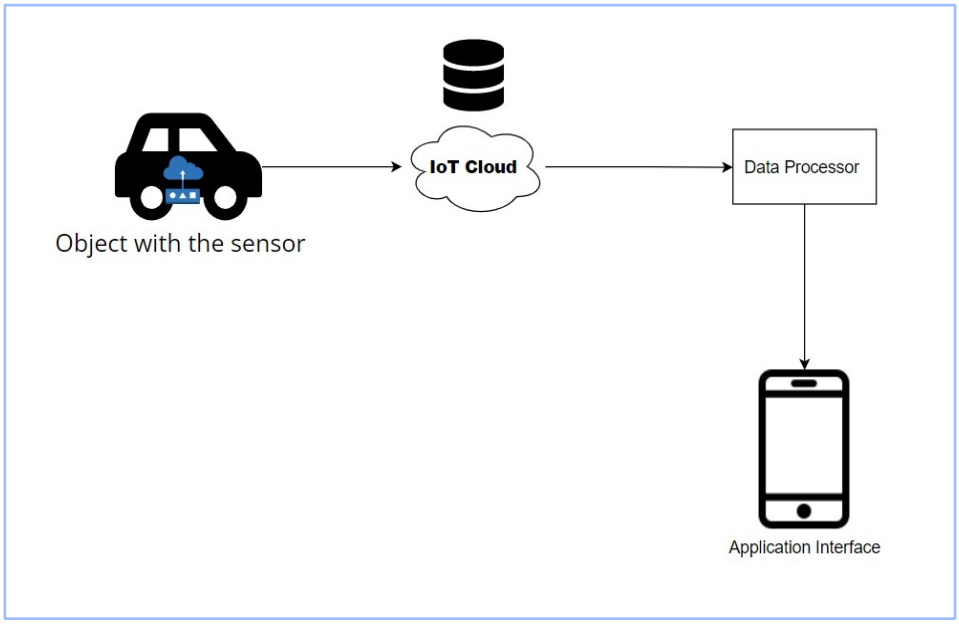


Figure 3.1 Block diagram

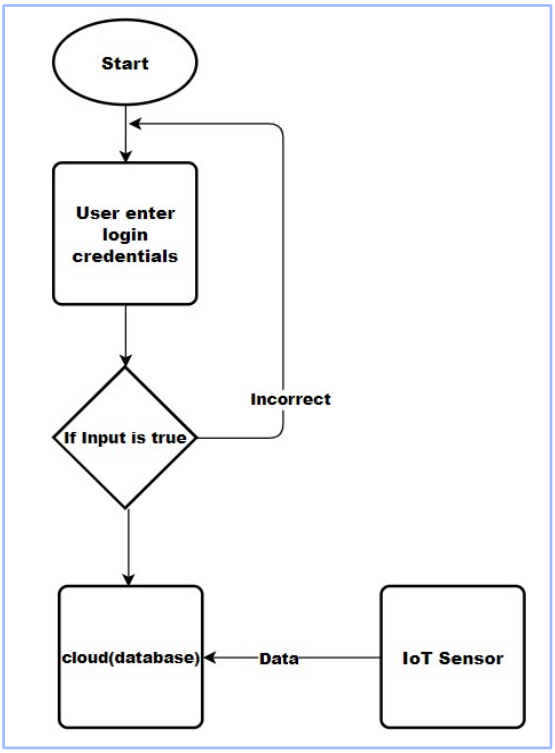


Figure 3.2 Block diagram

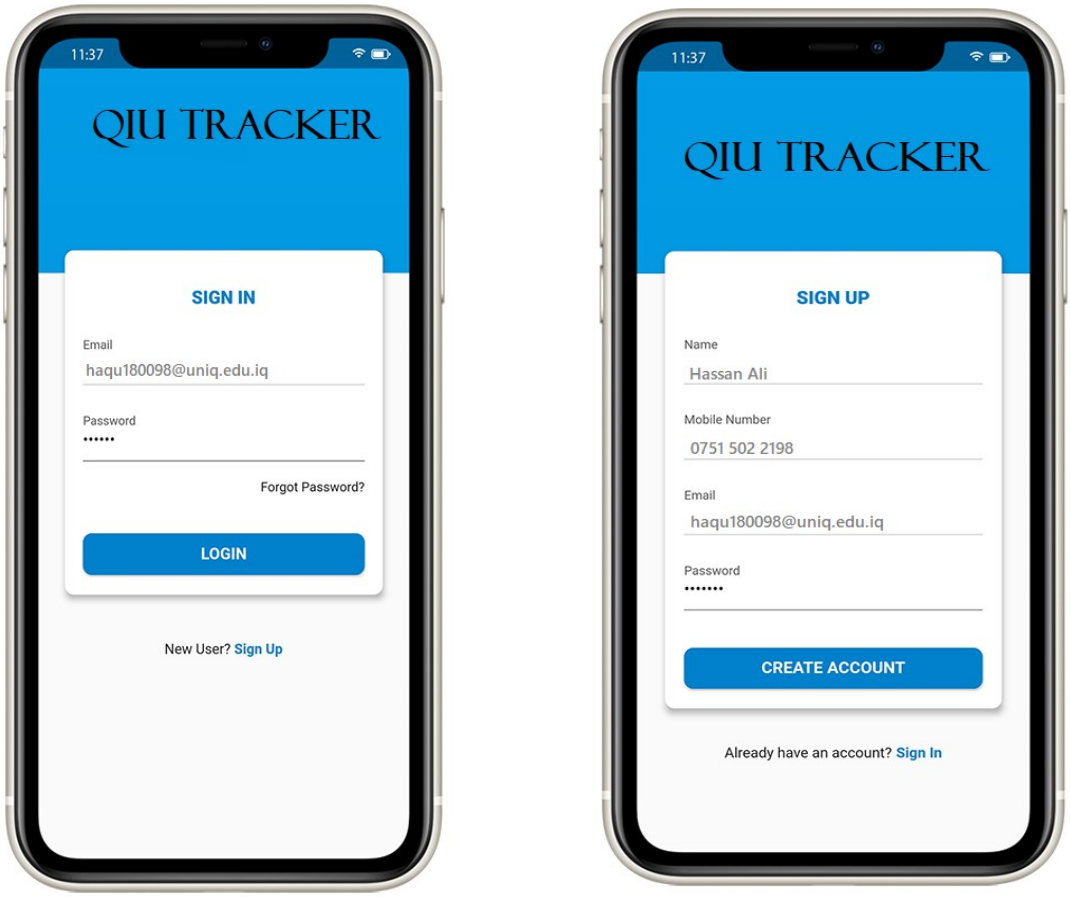
2.1.1 System Interfaces

This section will show the system interface functionality of my software. It will show the register, login, viewing user details, viewing object location, retrieve tracking

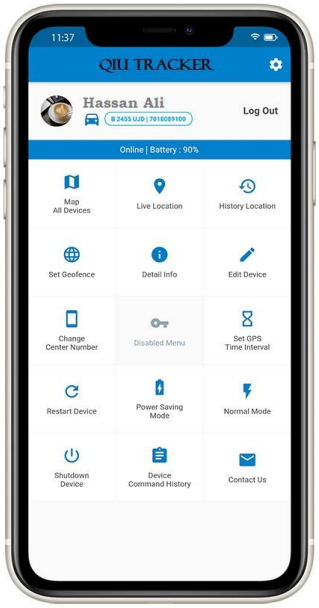
data, and logout. This will be separated to the user and the admin; different roles will have different features that will be available to access.

2.1.2 User Interfaces

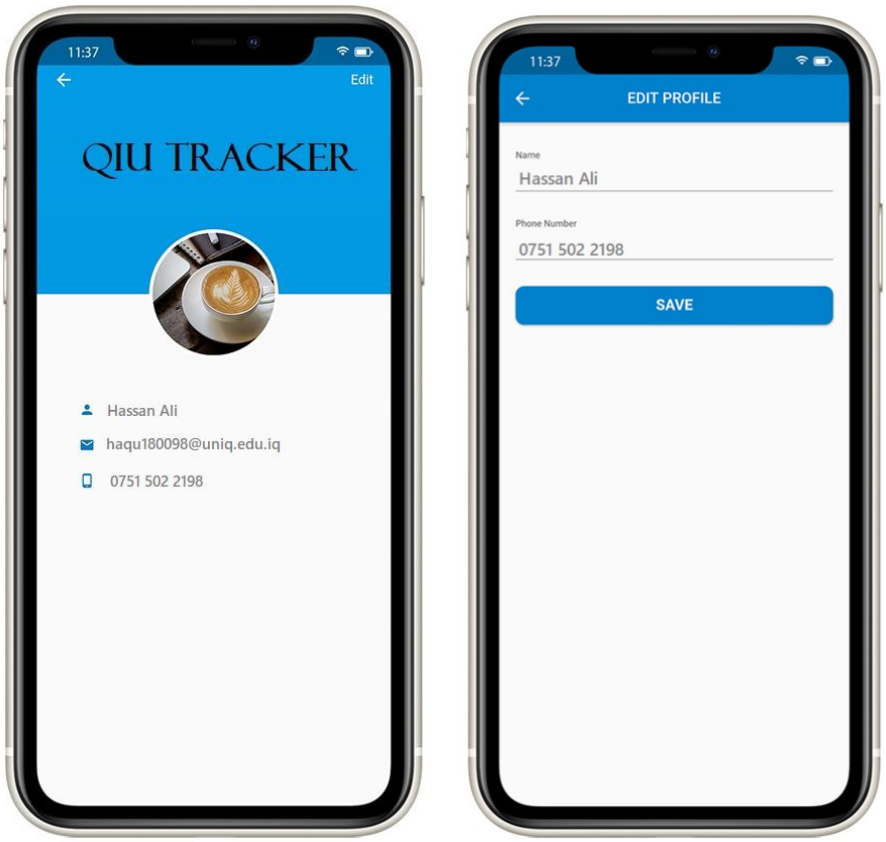
User interface (UI) design is the process of creating user interfaces for software or digital devices with an emphasis on look or style. It's the goal of designers to create user interfaces that are both easy to use and pleasant. Both graphical and non-graphical user interfaces, such as voice-controlled interfaces, are included in UI design. The user will be directed to this page, which is the login page, after pressing the login button on the main page. There are two choices: registration and login (QIU Tracker).



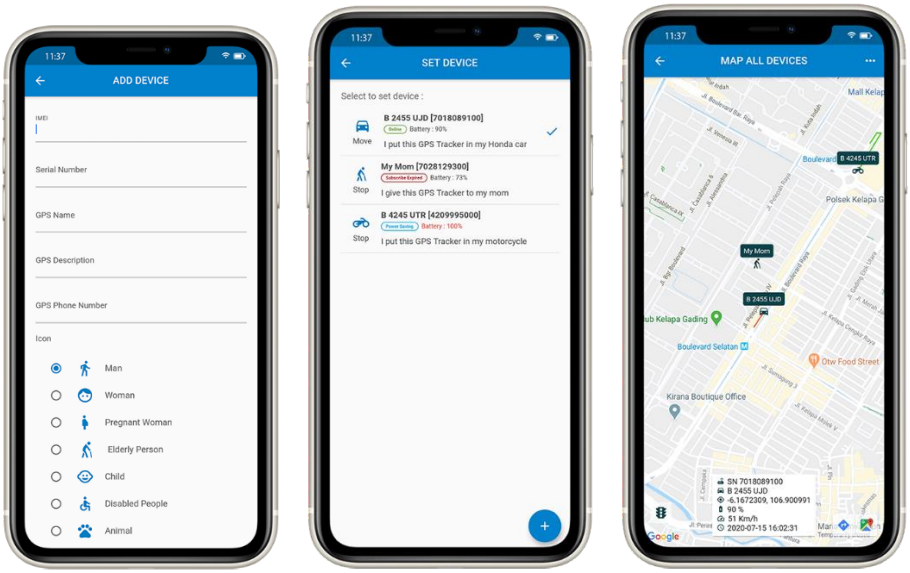
This is the page is for the login and register of the application.

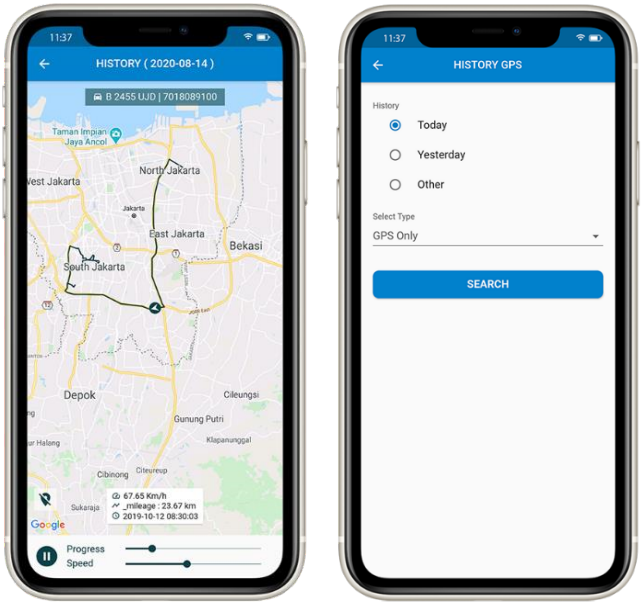


This shows the dashboard and the contact us page of the application.



This is the profile of the user, and they are able to edit their profile page if they want.





This is how the sensor path works with the GPS, and the identification.

2.1.3 Hardware Interfaces

The hardware needed for the project is listed below in the table below, along with its specs, to ensure that the system will work as efficiently as possible throughout the entire procedure.

Table 3.2: Hardware Requirements for the System.

No.	Hardware	Specifications
1	Personal Computer	• At least an Intel Core i5 processor • Windows 10 • 8 GB of RAM. • Wireless networking (for internet)
2	Smart IoT Sensor	NEO6M GPS Module
3	Arduino Board	esp8266
4	Internet SP	At least 512kbps

2.1.4 Software Interfaces

The user interface for this project must allow the user to keep track of the object while it is being tracked and located. For that reason, a program using Dart, a programming language that can handle various platforms including iOS and Android, will be created for the front-end. The Arduino IDE is the company's own IDE for the Arduino Board.

2.1.5 Communication Interfaces

The communication interface for my product will be used as an IoT system, this IoT will be connected to the GPS device and the database. The database will be

also communicating to the application which will hold the data of the GPS, and continuously refreshing and changing the GPS data.

2.1.6 Memory

All of the memory and data of my product will be collected into two memory slots, the primary memory slot is on the cloud which will easily accessible to the admin, and the second memory slot will be stored into a hard drive because it has more memory slot inside of it rather than an SSD.

2.1.7 Operations

The user will be able to register as a new account, and after this, they will be able to login with their username and password. Later they are able to view the location of the GPS when they activate it, after they are done with the product use, they can easily logout if they prefer to. This product will also have a back-up option for the data that the GPS detects, so if they wish to view the last spot the GPS was active from yesterday, they can do that.

2.2 Product Functions

Use Case:	*Description:*
Register	*User can register a new account to the application*
Login	*User will be able to enter their username and password*
View user detail	*The admin can view the user's information*
View object location	*The admin and the user can view the GPS location*
Retrieve tracking data	*The admin can retrieve the data of the GPS if the user allows them to*
Logout	*Both admin and user can logout out of the application if they wish to.*

2.3 User Characteristics

Role:	*Description:*
User	*The user is restricted to some features of the application, but they are still using the reason of why the application is made for.*
Admin	*The admin can retrieve the data of the GPS when asked too, and view users' information, and do all the other stuff that the user is able to do.*

2.4 Constraints

The constraints for the GPS product are that the GPS device cannot be inaccurate in the location signals and receiving signals. Also, the signal or battery failure is uninhabited due to the reason people need the GPS tracker. The final constraint that is the most important part is the security of our product, without security for not allowing other people to access where your GPS tracks and where it doesn't. there will be privacy issues and maybe this might be a crime to access private information from a user.

2.5 Assumption and Dependencies

The features are all dependent on the GPS device, because without the GPS device, the application will be useless. The tracking feature on our application is implemented to the GPS tracker, and the user will be satisfied from this feature.

2.6 Apportioning of Requirements

For later in the future, I want to later update the map of the GPS tracker to include landmarks, and also PTO event tracking. There are many other features that will be created in my product, but these two are the highest priority features that I will do in the future.

3. SPECIFIC REQUIREMENTS

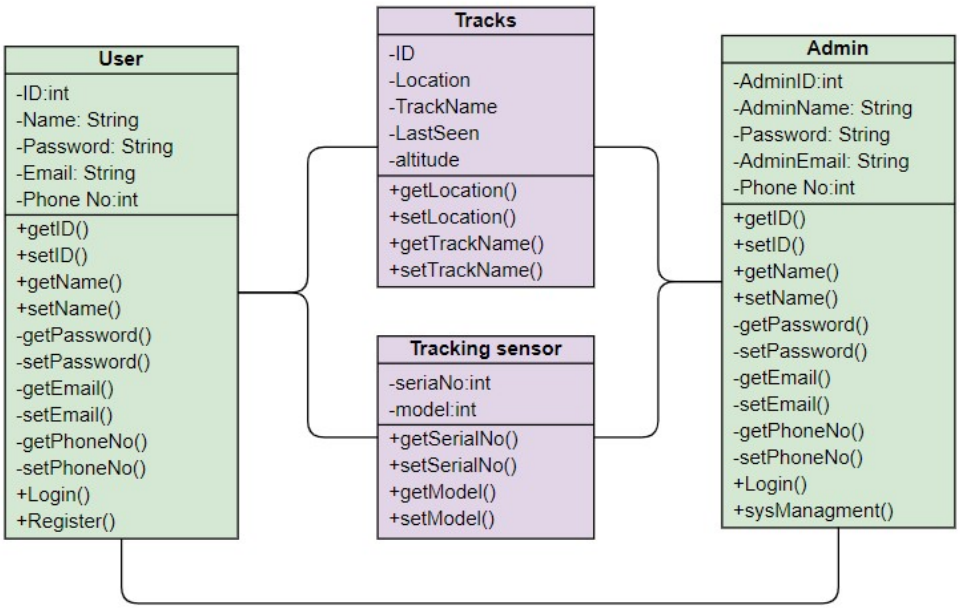


Figure 3.1: Domain Model of <Localization and Tracking>

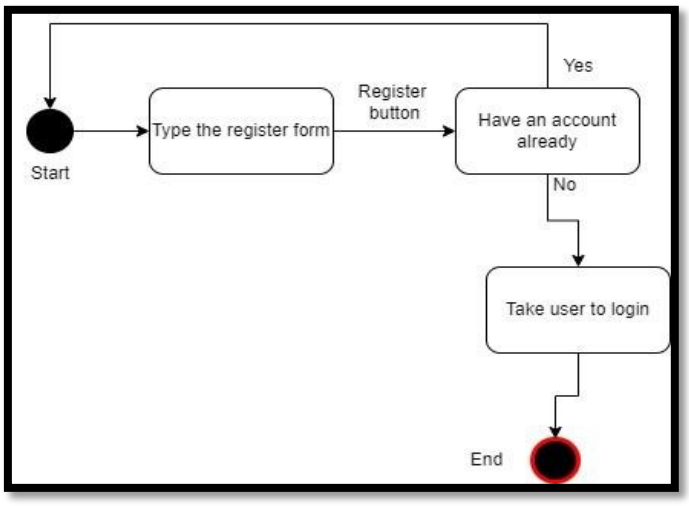


Figure 3.2: State Machine Diagram of <Register User>

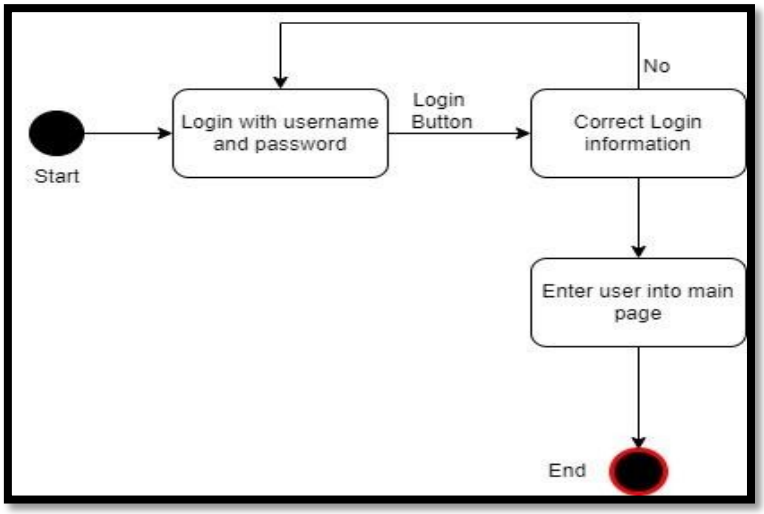


Figure 3.3: State Machine Diagram of <Login>

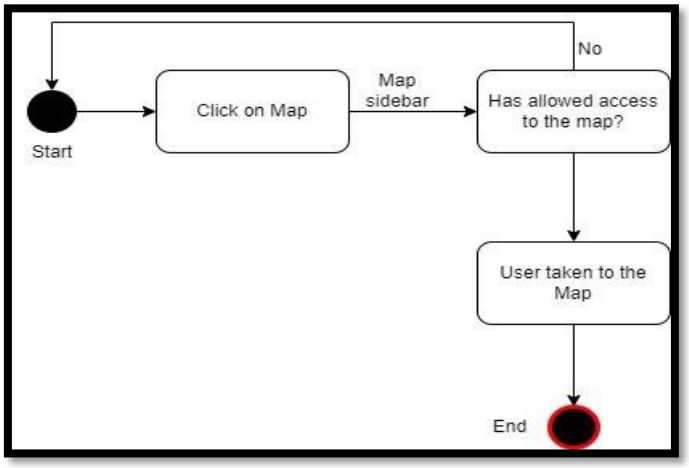


Figure 3.4: State Machine Diagram of <Map Monitoring>

3.1 External Interface Requirements

3.1.1 User Interfaces

The external user interface for my product is only the database on cloud and the GPS tracker too. The interface for the GPS is a button that will activate the tracker manually, and it is also possible to automatically turn on the GPS tracker on the application.

3.1.2 Hardware Interfaces

For the external hardware interface, the only hardware the is external in my project is the GPS tracker that can be anywhere and still be tracked with my application, but it has to be connected to a Wi-Fi connection.

3.1.3 Software Interfaces

External software interface is the database that controls the data of the GPS track. This database will be saved temporally to the admin, but the admin will be restricted to view the users GPS tracker only if they are asked to or by law asked to.

3.1.4 Communication Interfaces

The external communication interface in my project is the connection between the GPS tracker and the database, and the database to the application. All of these connections have a communication with each other and without one another, the whole system will fall apart.

3.2 System Features

3.2.1 Module <User>

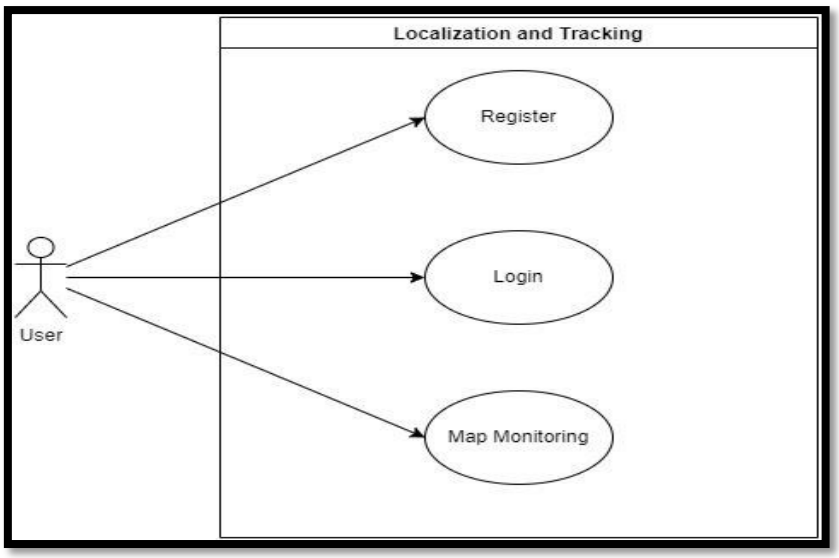


Figure 3.5 Use Case Diagram <User>

3.2.1.1 UC001: Use Case <Register User>

Use Case Name:	Register User
Scenario:	A new user will create a new account on the application.
Triggering Event:	A new person has found our application and device and wanted to use my product
Brief Description:	This will allow the new user to access all the features we give them
Actors:	Users, Admin
Related Use Cases:	Nothing
Stakeholder:	Car companies and other technology companies
Preconditions:	Person must not be a bot, and not already have an account
Postconditions:	The user will have an account on my application
Flow of Events:	1. User downloads the application

	2. Clicks on register 3. User creates their username and password 4. The system will save their data inside the cloud
Exception Conditions:	The register feature doesn't work because an account has been already made by that username.

Table 3.1: Use Case Description for <Register User>

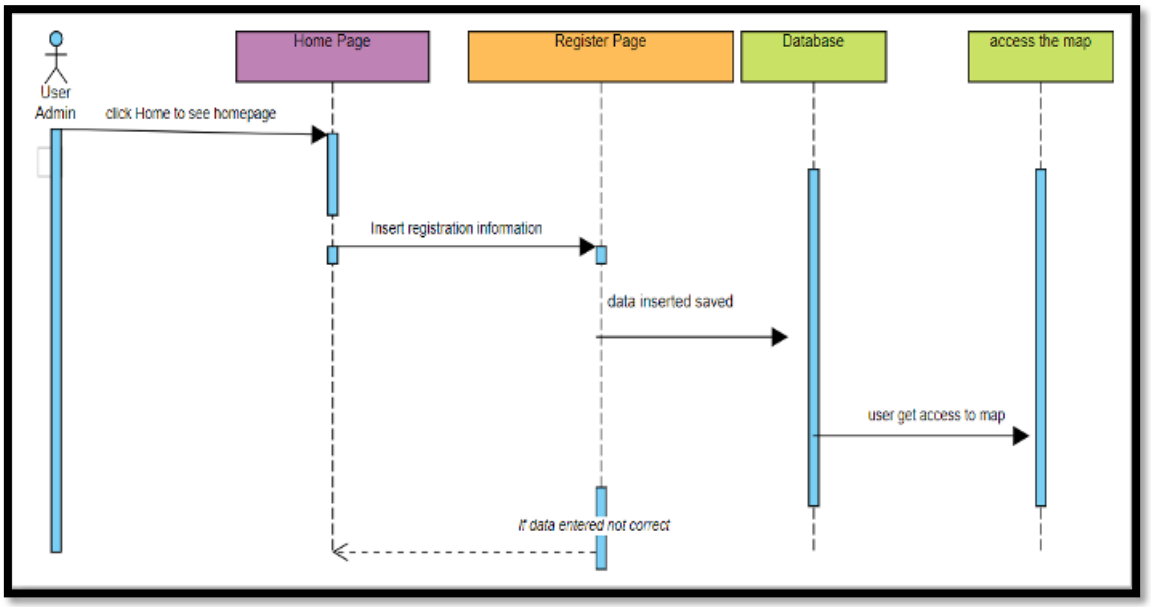


Figure 3.6: System Sequence Diagram of <Register User>

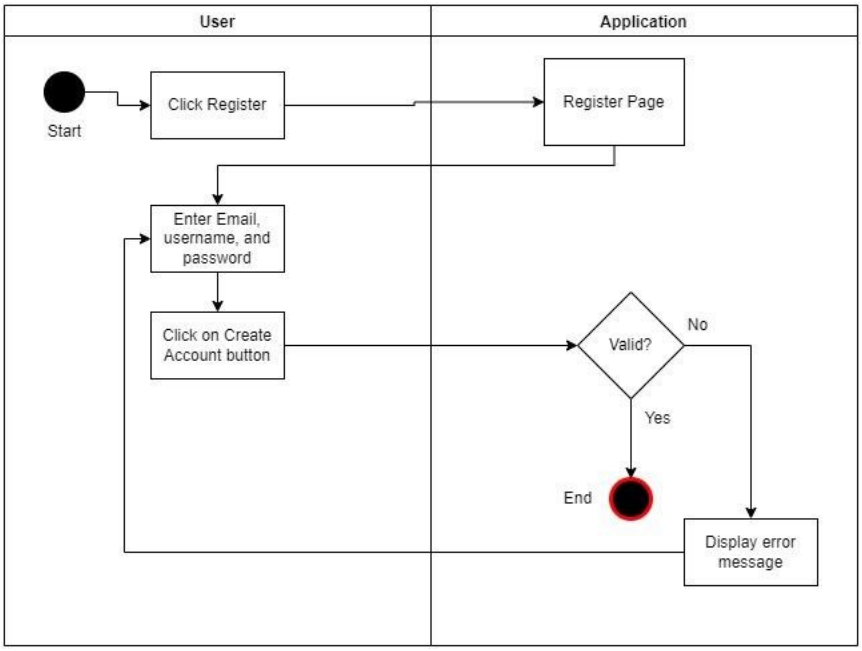


Figure 3.7: Activity Diagram of <Register User>

3.2.1.2 UC002: Use Case <Login>

Use Case Name:	Login
Scenario:	The user wishes to log back in the application
Triggering Event:	The user wishes to use the product again
Brief Description:	The user will type in their username and password on the application
Actors:	Users, admin
Related Use Cases:	Includes: Register User
Stakeholder:	Car companies and other technology companies
Preconditions:	The user has logged out of their account previously
Postconditions:	The user will have access to the application after logging in
Flow of Events:	1. The user will open the application 2. User will type in their username and password 3. Click the login button
Exception Conditions:	Incorrect username and password might occur if it is incorrect.

Table 3.2: Use Case Description for <Login>

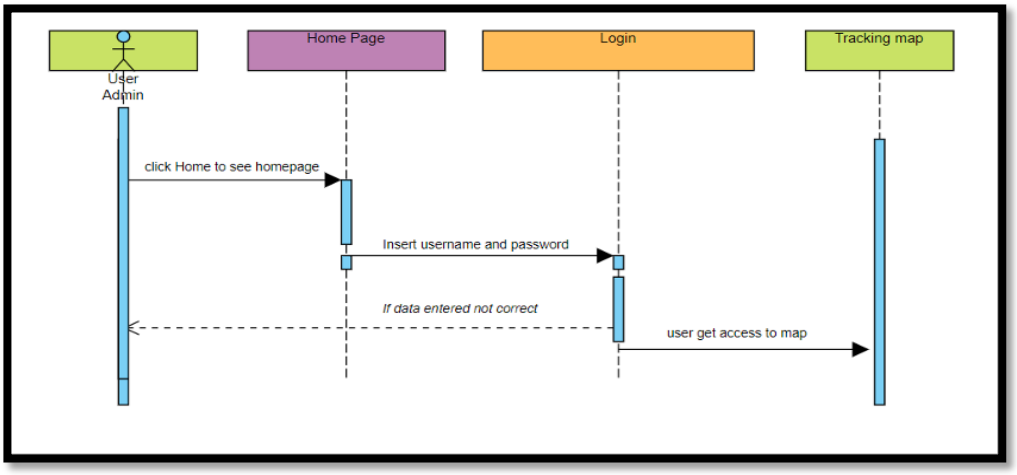


Figure 3.8: System Sequence Diagram of <Login>

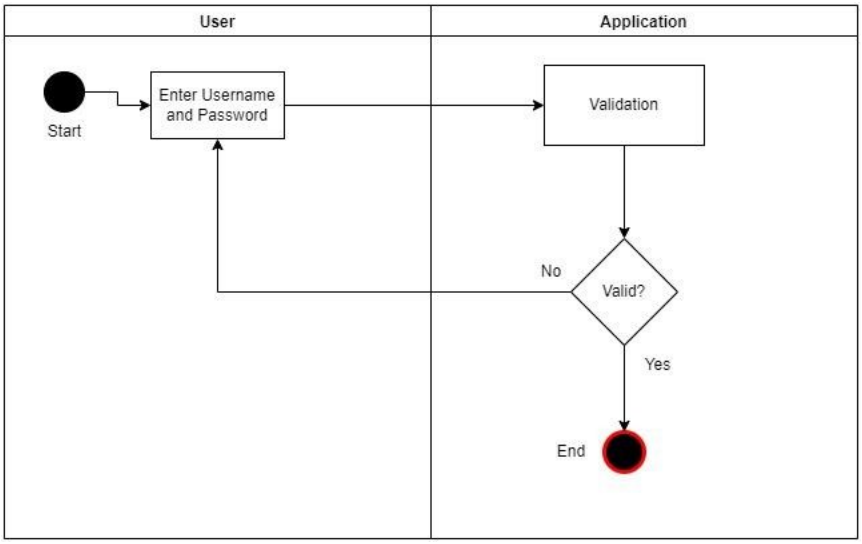


Figure 3.9: Activity Diagram of <Login>

3.2.1.3 UC003: Use Case <Map Monitoring>

Use Case Name:	Map Monitoring
Scenario:	The GPS will be monitored on a map
Triggering Event:	The user or admin wishes to track the GPS tracker
Brief Description:	The GPS will be monitored on a map and it will change the direction of the tracker if the GPS moves from one place to another
Actors:	Users, admin
Related Use Cases:	Includes: Login
Stakeholder:	Car companies and other technology companies

Preconditions:	The application is opened and logged in already
Postconditions:	The GPS has been tracked
Flow of Events:	1. The user will click on the track GPS sidebar 2. The system will find the GPS location 3. The user will see the tracker on a map
Exception Conditions:	The GPS has no Wi-Fi connected to it or has no battery source left.

Table 3.3: Use Case Description for <Map Monitoring>

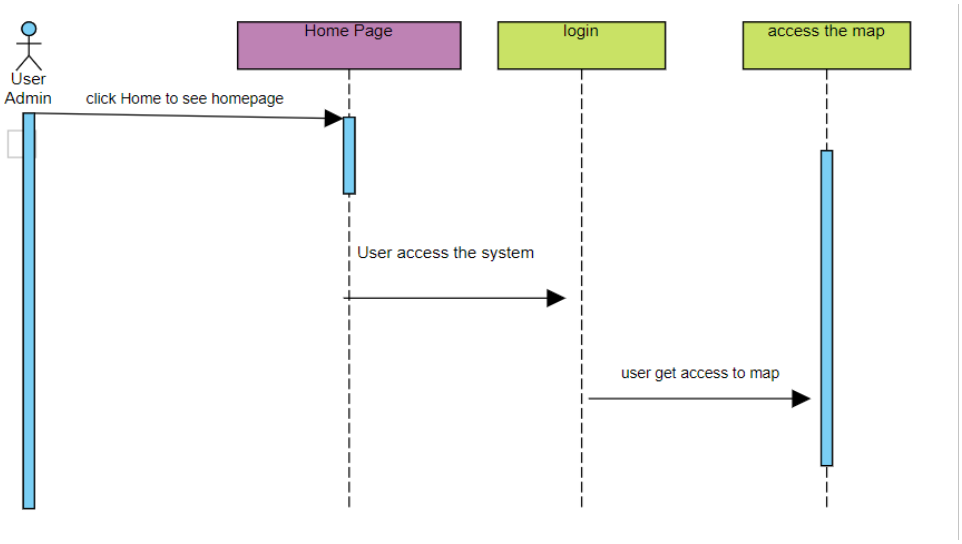


Figure 3.10: System Sequence Diagram of <Map Monitoring>

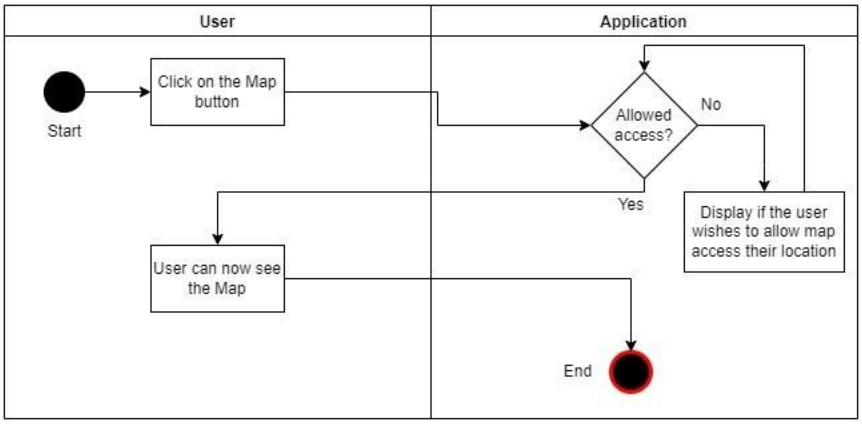


Figure 3.11: Activity Diagram of <Map Monitoring>

3.3 Performance Requirements

In my project, there isn't a lot of performance requirements that needs mentioning, but I think the one performance we need is allowing more users being able to access the application and request for things sequentially without a bug occurring.

3.4 Design Constraints

The product application will have to simple for the user to interact with because just in case they use the application while they are driving, the design has to be simple for no driving distraction, and also the lack of local knowledge.

3.5 Software System Attributes

Since our product will be mostly used by adult users, we will have to make it a simple concept of interaction and easy to view for the elderly if they use our application.

Appendix B

SOFTWARE DESIGN DOCUMENT (SDD)

REVISION PAGE

a. Overview

Nowadays, people are required to ship expensive or precious goods, but because the delivery process is so risky due to a lack of security, accessibility issues, or even a loss of track of the box, some people decide not to even try. The sought-after thing may be a person, a car, luggage, or even a rare gem that must be transported. The capabilities of existing technology for tracking and localizing, in addition to the problems already mentioned.

b. Target Audience

The businesses who export pricey and precious goods to another location or nation are the kind of clientele I'm attempting to reach. These businesses include, for instance, Amazon, FedEx, etc. This form of commerce is practiced by a lot more businesses, which benefits my goods.

c. Version Control History

Version	Primary Author(s)	Description of Version	Date Completed
Version 1.0	Hassan Ali	GPS device with application tracker	27/6/2022

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

This SDD describes the design of my product, and how it will be shown to the user. Also, this project will help many consumers from different sectors and enterprises by providing the location of their pricey goods and enabling them to track it when it is out of their grasp throughout the delivery procedure. A company owner who manages package security, for example, may monitor a valuable consignment until it is delivered. This circuit will continuously update the cloud with the package's location, enabling easy tracking of any theft and decreasing the possibility that it won't be located again.

1.2 Scope

The main objective of this project is to monitor and find things utilizing IoT technology. using a circuit that has an integrated sensor and can send location information to the cloud for display on a mobile device. The sensor is enabled to enable the user to track a priceless object from point A to point B, with the path being accurately recorded and preserved in the cloud.

1.3 Definitions, Acronyms and Abbreviation

Keywords:	Description:
IoT	Internet of Things
Cloud	Online storage

1.4 References

Saurav Subedi, Eric Pauls, and Yimin D. Zhang, Accurate Localization and Tracking of a Passive RFID Reader Based on RSSI Measurements IEEE JOURNAL OF RADIO FREQUENCY IDENTIFICATION, VOL. 1, NO. 2, JUNE 2017.

Fu Xiao, Ruchuan Wang, and Xiang-Yang Li , One More Tag Enables FineGrained RFID Localization and Tracking IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 26, NO. 1, FEBRUARY 2018.

Mahmuda Akter, Md. Obaidur Rahman, Md. Nazrul Islam, Mohammad Mehedi Hassan, Energy-Efficient Tracking and Localization of Objects in Wireless Sensor Networks 2018.

Monaem IDOUDIa, b, El-Bay BOURENNANEa , Khaled GRAYAAb ,

Wireless Visual Sensor Network Platform for Indoor Localization And Tracking of a Patient for Rehabilitation Task 2018

Guilherme G. L. Ribeiro1 , Luan F. de Lima1 , Luiz Oliveira1 Joel J. P. C. Rodrigues1,2,3 , Carlos N. M. Marins1 , Guilherme A. B. Marcondes1 , An Outdoor Localization System based on SigFox 2018.

Tim Farnham Indoor Localisation of IoT Devices by Dynamic Radio Environment Mapping, 2019 IEEE 5th World Forum on Internet of Things (WF-IoT).

1.5 Overview

In this Software design documentation SDD, there will be a clear explanation of how the product will be designed, and which part of the product will be designed for what reason to see if it was a pass or a failure to the end users of my product. There will be component diagrams, sequence, package, and class diagrams for each feature that will be in my product.

2. SYSTEM ARCHITECTURAL DESIGN

2.1 Architecture Style and Rationale

For the architectural style I will be using for my product will be the Architectural Cases and Solutions, because I believe that my product is a small project so the best way to show the style of my product is show how the project reacts to different scenarios.

2.2 Architecture Model

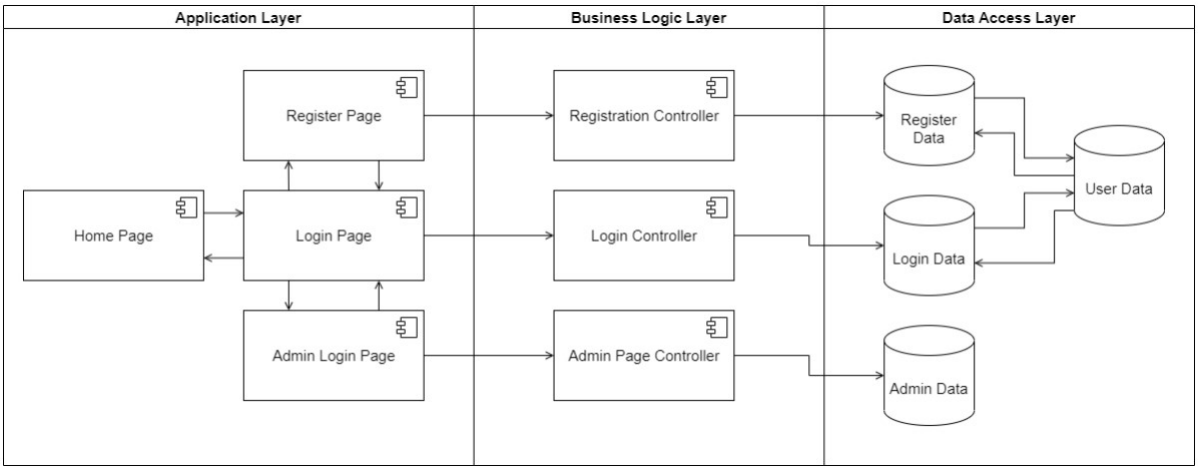


Figure 2.1: Component Model of Localization and Tracking

2.3 Use Case Diagram

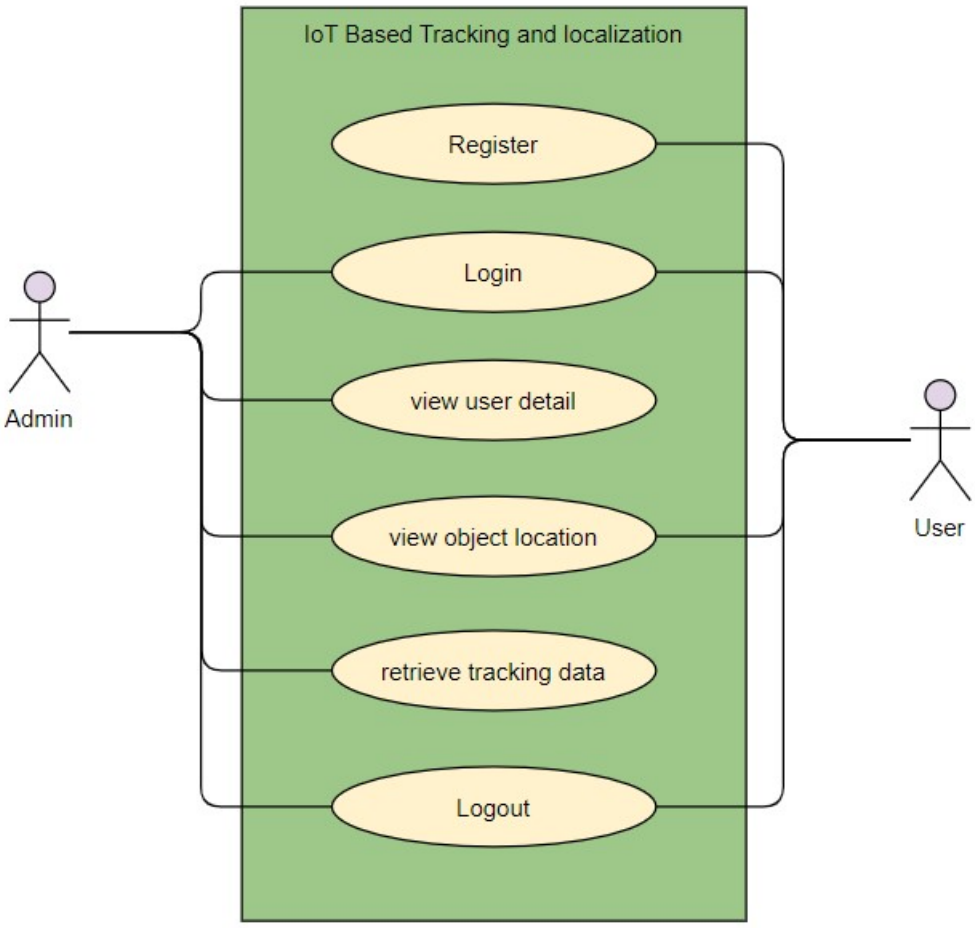


Figure 2.2: Use Case Diagram of Localization and Tracking

3. DETAILED DESCRIPTION OF COMPONENTS

3.1 Complete Package Diagram

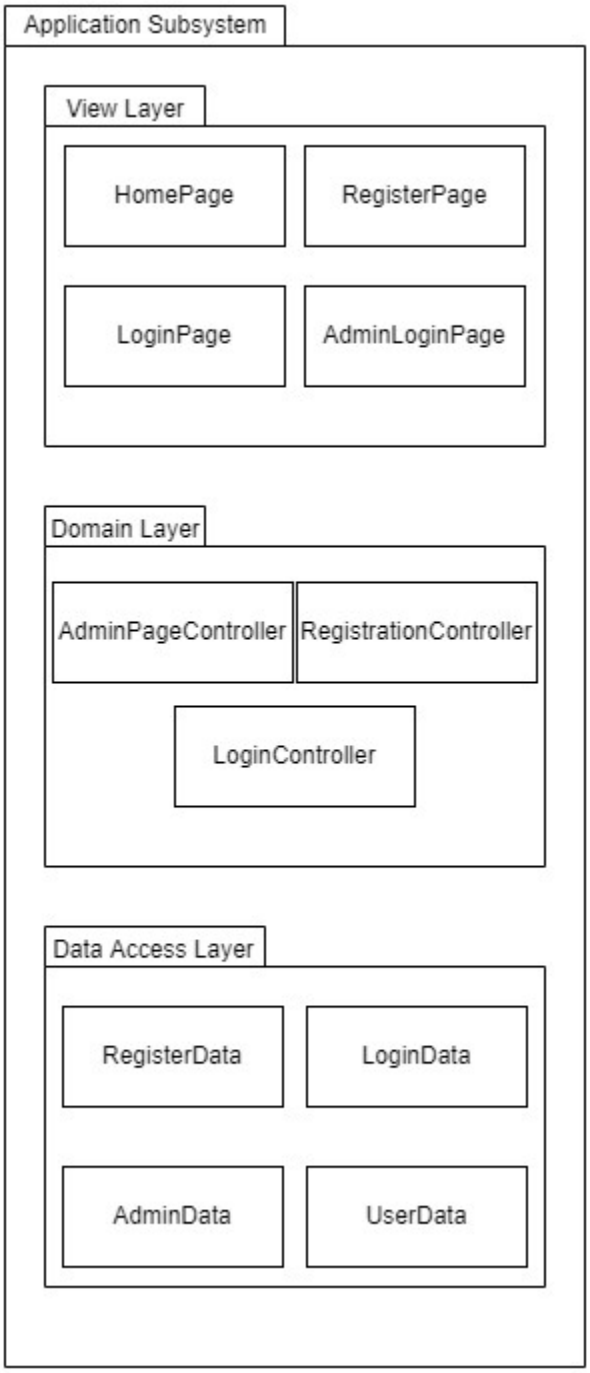


Figure 3.1: Subsystem of Localization and Tracking

3.2 Domain Model

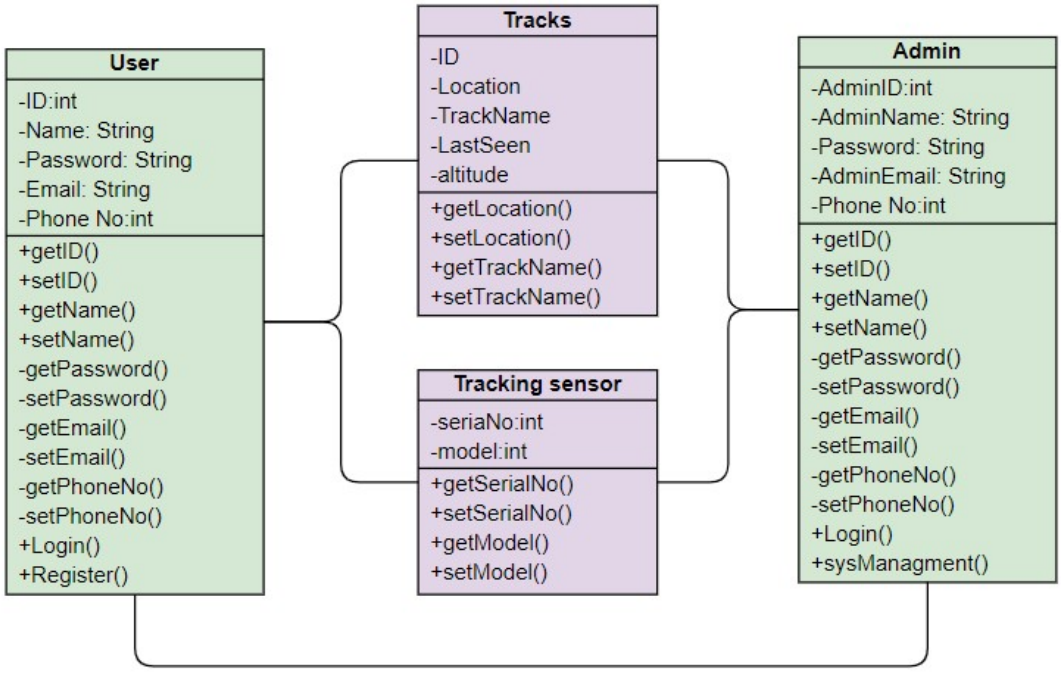


Figure 3.2: Domain Diagram of Localization and Tracking

3.3 Detailed Description

3.3.1 Subsystem Localization and Tracking

3.3.1.1 P001: Package Localization and Tracking

The whole product of mine is a small project, so it is allowed and perfectly able to fit into one package. It will show how the user and admin can and cannot do, and the similarities and differences between them.

3.3.1.2 Class Diagram

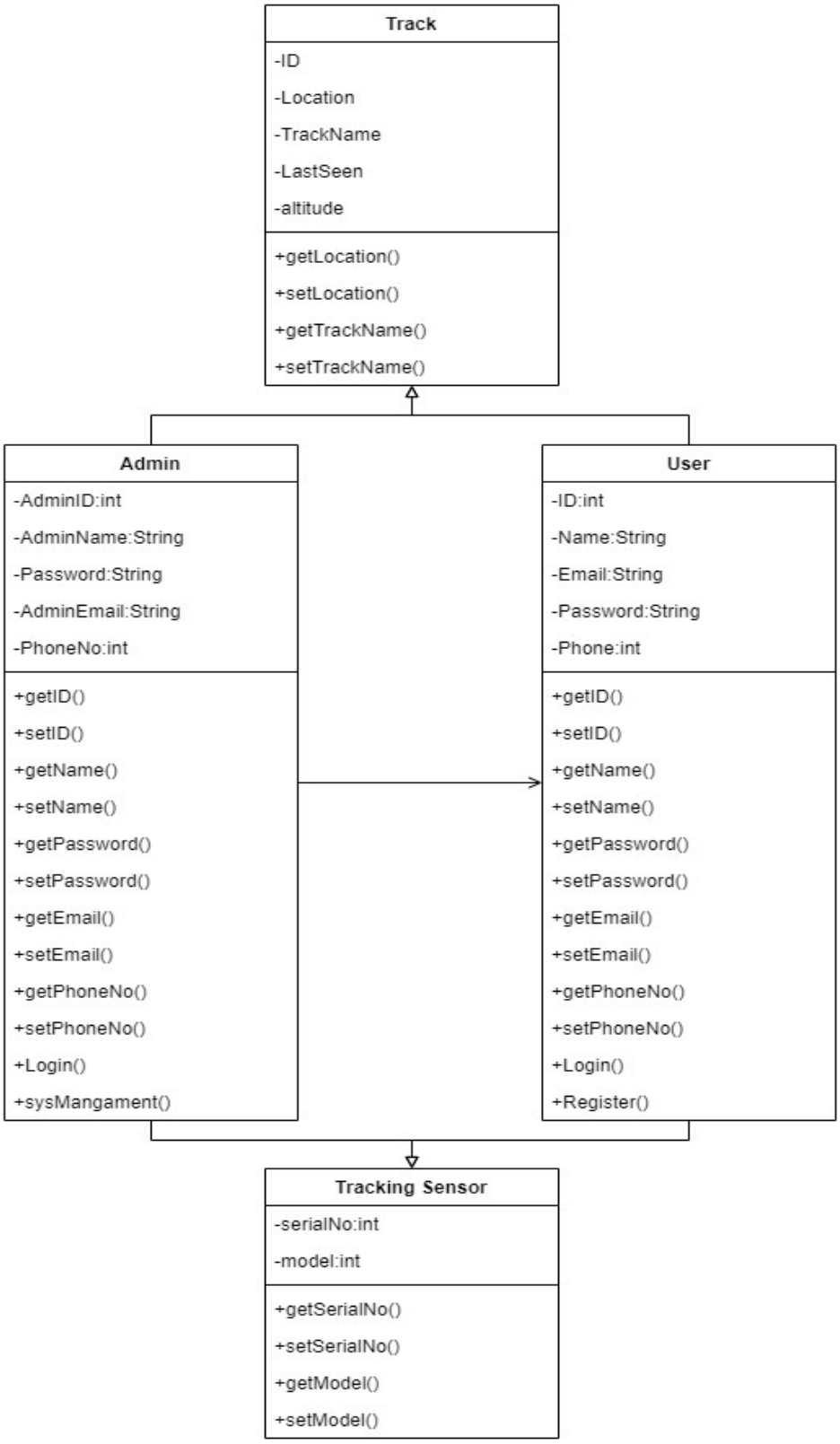


Figure 3.2: Class diagram for Localization and Tracking

3.3.1.3 Sequence Diagrams

a) **SD001: Sequence diagram for Register User**

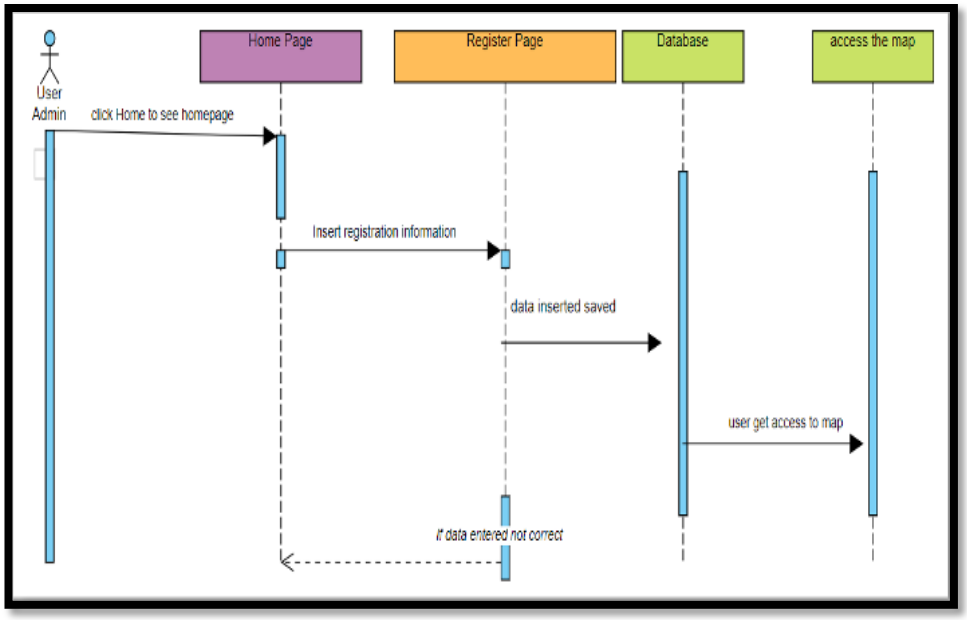


Figure 3.3: Sequence Diagram of Register User

b) **SD002: Sequence diagram for Login**

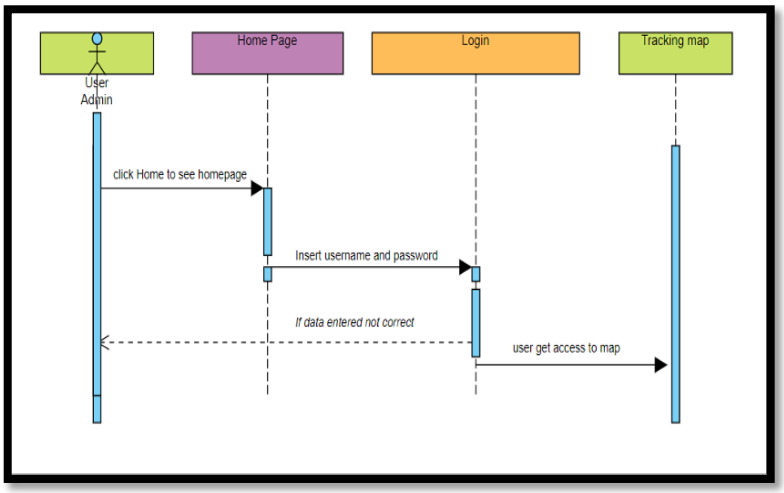


Figure 3.4: Sequence Diagram of Login

c) **SD003: Sequence diagram for Map Monitoring**

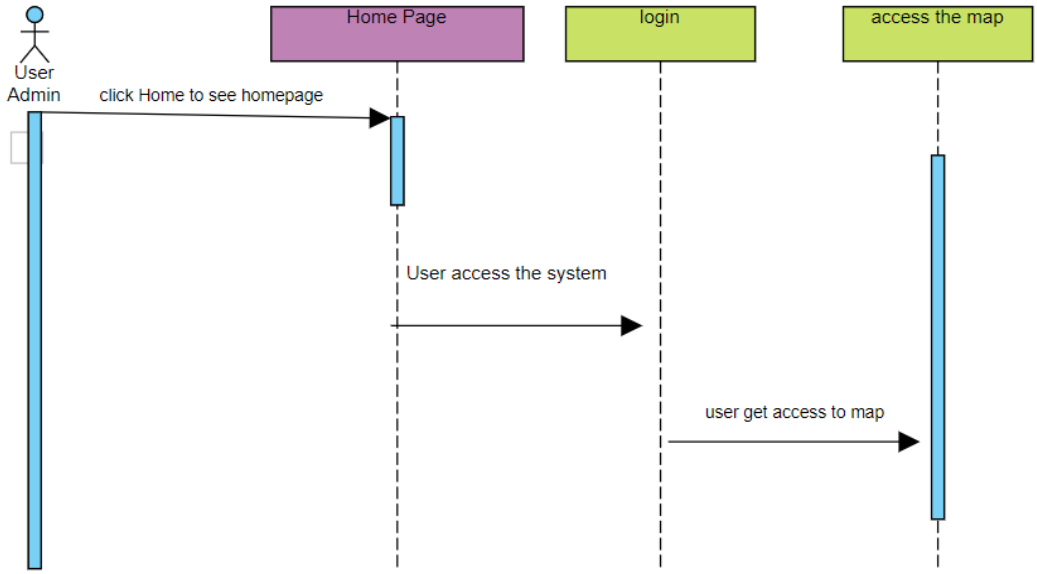


Figure 3.5: Sequence Diagram of Map Monitoring

DATA DESIGN

3.4 Data Description

Tools	Technologies
• Dart • Arduino IDE	• Laptop Or Personal Computer • Mobile device • Arduino Microcontroller • IoT Sensor • Wi-Fi & GPS

Inside my database, it holds the admins data, users' data, login data, and tracking data. For the admin data, it will save the admins account information and their responsibilities, users data holds their account information with also what GPS tracker they have connected or not connected, login data holds who logs in at what time, and tracking data holds the GPS tracking device information for later use.

4. USER INTERFACE DESIGN

4.1 Overview of User Interface

The user can either create an account on the application or if they already have an account, they can easily login into their account. Once the user has made an account or logged in, they will be shown the home page where they can navigate to the icons with writing under them. All these icons have their own purpose and when the user wishes to view or add a device for the map tracking. All they must do is just click “add device” on the home page and it will give the user the form they have to fill in about their GPS tracking device. After they have filled in the form, they can now see the tracker work on the live map.

4.2 Screen Images

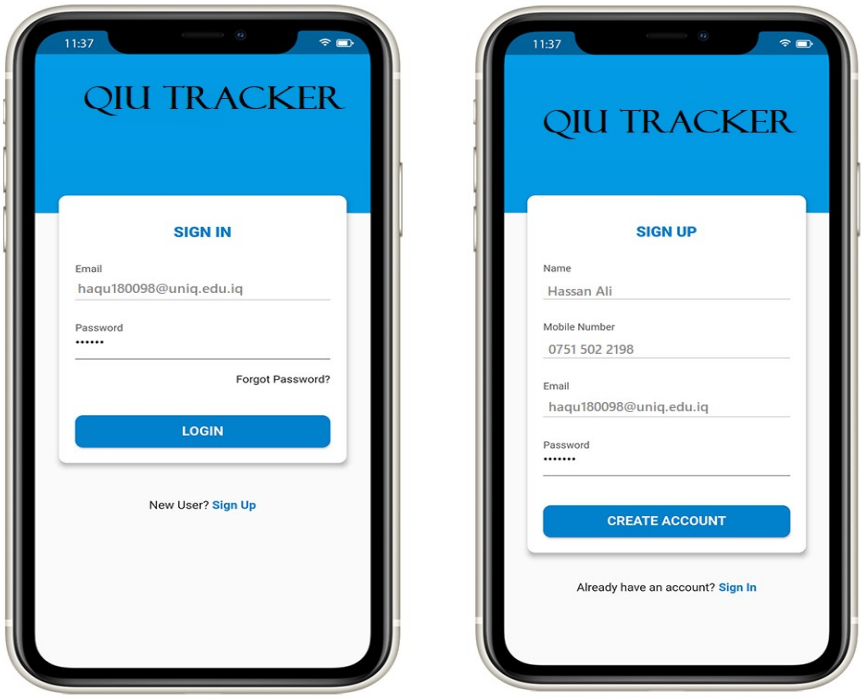


Figure 4.1 Login and Register Page

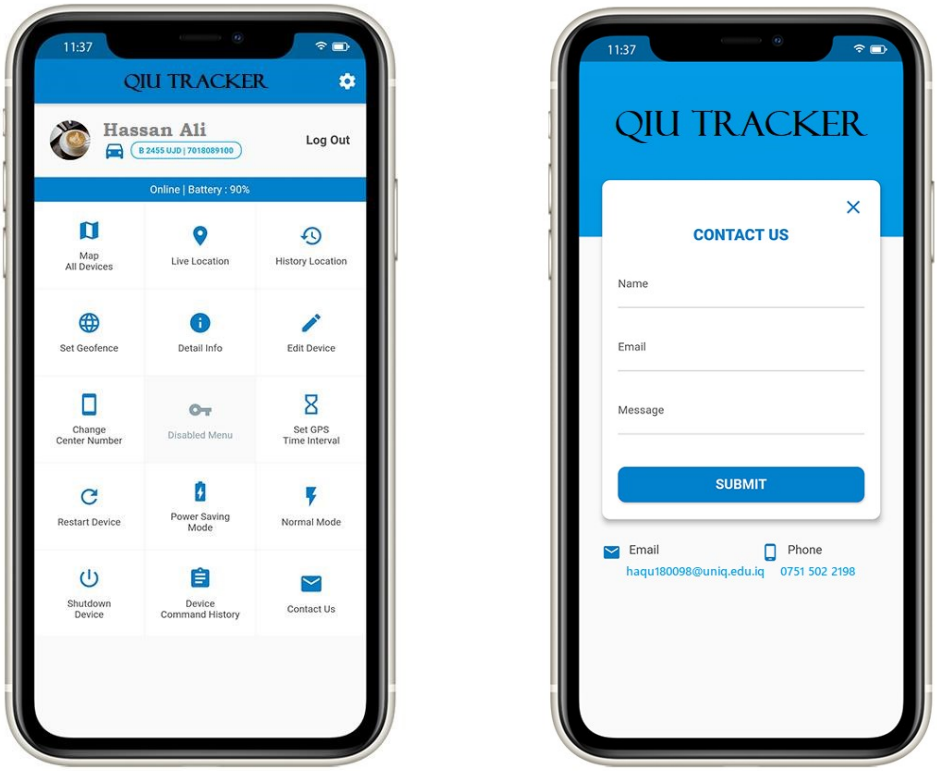
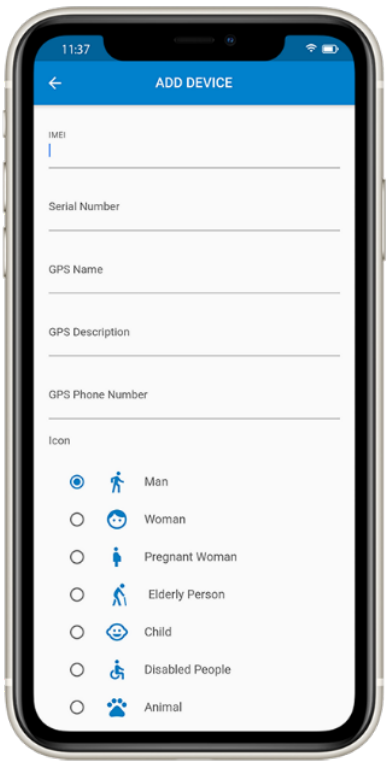
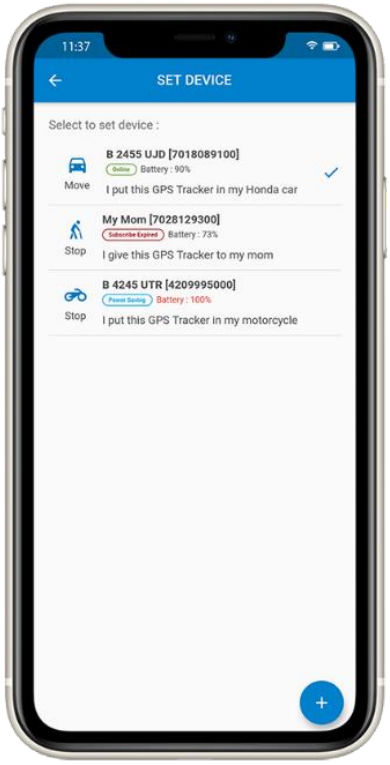
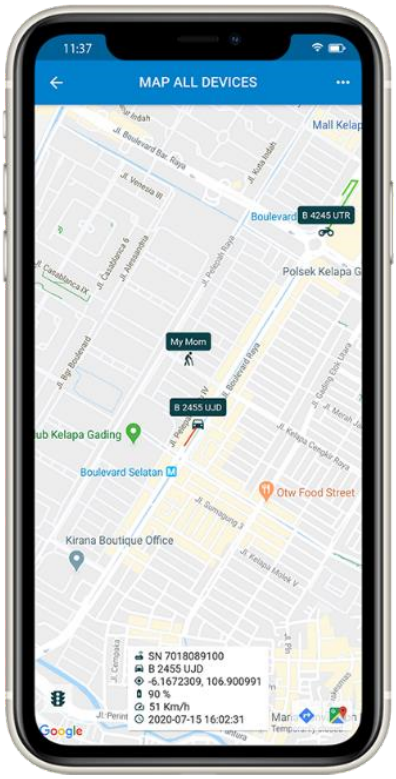


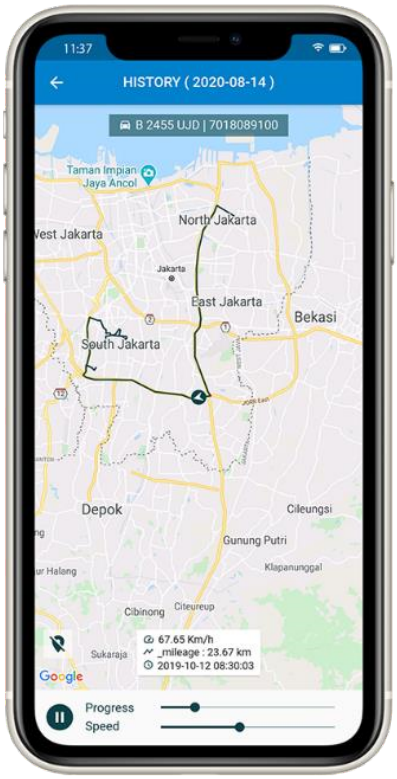
Figure 4.2 Dashboard and Contact Us

Figure 4.3 Profile and Edit Profile Page


11:37
ADD DEVICE
IMEI
Serial Number
GPS Name
GPS Description
GPS Phone Number
Icon
Man
Woman
Pregnant Woman
Elderly Person
Child
Disabled People
Animal


11:37
SET DEVICE
Select to set device :
B 2455 UJD [7018089100]
Battery : 90%
Move
I put this GPS Tracker in my Honda car
My Mom [7028129300]
Battery : 73%
Stop
I give this GPS Tracker to my mom
B 4245 UTR [4209995000]
Battery : 100%
Stop
I put this GPS Tracker in my motorcycle


11:37
MAP ALL DEVICES
B 4245 UTR
My Mom
B 2455 UJD
Boulevard Selatan
Otw Food Street
Kirana Boutique Office
SN 7018089100
B 2455 UJD
-6.1672309, 106.900991
90 %
51 Km/h
2020-07-15 16:02:31
Google


11:37
HISTORY (2020-08-14)
B 2455 UJD | 7018089100
Taman Impian Jaya Ancol
North Jakarta
East Jakarta
Bekasi
South Jakarta
Depok
Cileungsi
Gunung Putri
Cibinong
Citeureup
67.65 Km/h
_mileage : 23.67 km
2019-10-12 08:30:03
Google
Progress
Speed

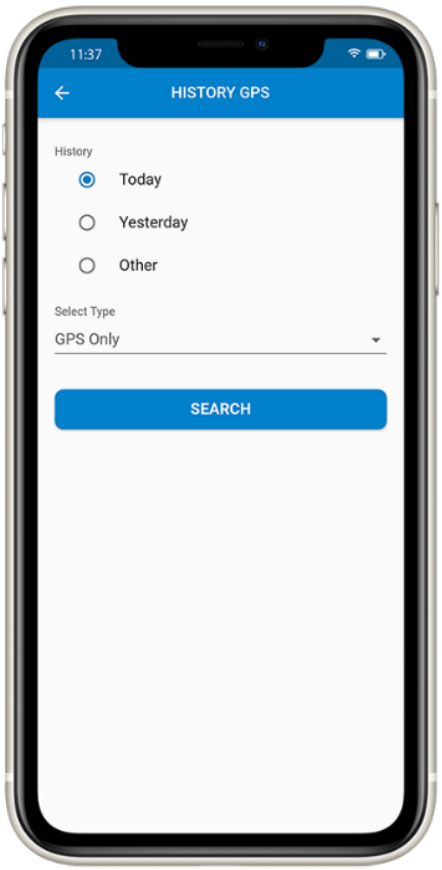


Figure 4.3 Sensor Path and Identification

REQUIREMENTS MATRIX

	P001	P002	P004
UC001	X		
UC002		X	
UC003			X

Appendix C

SOFTWARE TESTING DOCUMENTATION (STD)

REVISION PAGE

a. Overview

Nowadays, individuals must send expensive or valuable products, but because of the lack of security, accessibility, or even loss of track of that box, the transmission procedure is quite hazardous, and some people choose not to even try to deliver that package to the desired location. A person, car, baggage, or even priceless treasure may be the sought-after item and must be sent. In addition to the previously described issues, the capability of the current technologies for tracking and localizing.

b. Target Audience

The type of audience that I am trying to target is the companies that are in the exporting expensive and valuable items to another place or country. Some examples of these companies might be Amazon, FedEx, etc.… There are many more companies that are in this type of business, so that is also good for my product. **i. C. Version Control History**

Version	Primary Author(s)	Description of Version	Date Completed
Version 2.0	Hassan Ali	GPS device with application tracker	26/6/2022

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Purpose

By giving the position of their expensive product and allowing them to keep track of it when it is out of their reach throughout the delivery process, this initiative will benefit a wide range of users from various industries and businesses. A business owner, for instance, who oversees package security, can keep an eye on a high-value shipment until it is delivered. This circuit will continually communicate the package's position to the cloud, making it simple to monitor if it was stolen and lowering the likelihood that it won't be found again.

1.2 Scope

This project's major goal is to track and locate objects using the capabilities of IoT technology. using a circuit with a built-in sensor that can transmit location data to the cloud for display on a mobile device. The sensor is powered so that the user may track a very valuable object from point A to point B, and the path will be precisely recorded and saved in the cloud.

1.3 Definitions, Acronyms and Abbreviation

Keywords:	**Description:**
IoT	Internet of Things
Cloud	Online storage

1.4 References

L. Tang et al., in Proc. IEEE ICSPCS 2019, December 2019, pp. 1–6.

Maitra, S.; Abdelgawad, A.; Yelamarthi, K. Lab in a Box: A Rapidly Deployable Environmental Monitoring IoT System. In Proceedings of the 2019 IEEE 62nd International Midwest Symposium on Circuits and Systems (MWSCAS), Dallas, TX, USA, 4–7 August 2019.

M. M. Rana, et al., 2020 in Proc. IEEE ICACT 2020, February 2020, pp. 541–544.

T.-L Kim, et al., in Proc. IEEE CIS 2019 and IEEE RAM 2019, November 2019, pp. 374–379.

Guilherme G. L. Ribeiro1 , Luan F. de Lima1 , Luiz Oliveira1 Joel J. P. C. Rodrigues1,2,3 , Carlos N. M. Marins1 , Guilherme A. B. Marcondes1 , An Outdoor Localization System based on SigFox 2018.

1.5 System Overview

In this Software testing documentation STD, there will be a clear explanation of how the product was tested, and which part of the product was tested to see if it was a pass or a failure. There will be test cases for each feature that will be featured into my product.

2. TEST CASES, DATA AND EXPECTED RESULTS

2.1 Test TC001 for Module User: <Register (UC001)>

This test contains the following test cases:

UC001_01: Register (Name)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC001_01_01	Hassan Ali	Go to Mobile Number part	Correct	Pass
TC001_01_02	Hassan	Name and surname, try again	Hassan (‘surname’) will be correct	Fail
TC001_01_03	1234&Hassan Ali	Name can’t have numbers or special symbols, try again	Hassan Ali correct form	Fail
TC001_01_04	HASSAN ALI	Name cannot be in all CAPS, try again	‘Hassan Ali’ correct way	Fail

UC001_02: Register (Mobile Number)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC001_02_01	07515022198	Mobile Number is acceptable	Correct	Pass
TC001_02_02	**blank**	Mobile Number Missing	‘07515022198’ an example of the correct way	Fail
TC001_02_03	07713456341	Mobile Number is acceptable	Correct	Pass
TC001_02_04	5323	Mobile Number unknown	Too short, near the 10-digit place	Fail
TC001_02_05	0771abc542	Mobile Number cannot have alphabet inside it	‘0771576542’ would be a correct version with no ‘abc’	Fail

UC001_03: Register (Email)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC001_03_01	Haqu180098@uniq.edu.iq	Email is OK	Correct	Pass
TC001_03_02	hassan@gmail.com	Unknown Email	Doesn’t allow any other email except **QIU emails**	Fail
TC001_03_03	10	Unacceptable Email	‘10’ is unacceptable because it is just a number	Fail
TC001_03_04	Haqu180098@uniq.iq	Unacceptable Email	This email is incomplete	Fail
TC001_03_05	ab12!@	Unknown Email	This isn’t an email	Fail

UC001_04: Register (Password)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC001_04_01	5 characters	Password is too short, try again	5 characters is too short for a password	Fail
TC001_04_02	8 characters	Password is too short, try again	8 characters is too short for a password	Fail
TC001_04_03	10 characters without special characters	Password is too weak, try again	10 characters is enough characters, but it needs to be difficult too	Fail
TC001_04_04	10 characters with special characters	Password OK	Correct	Pass
TC001_04_05	ab12!@	Password is too short, try again	Password isn't 10 characters	Fail
TC001_04_06	QWERTY3451	Password OK	Correct	Pass

2.2 Test TC002 for Module User: <Login (UC002)>

This test contains the following test cases:

UC002_01: Login (Email)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC002_01_01	Haqu180098@uniq.edu.iq	Email is OK	Correct	Pass
TC002_01_02	hassan@gmail.com	Go to password field	Doesn't allow anything other than **QIU emails**	Fail
TC002_01_03	qwtyui@uniq.edu.iq	Go to password field	Unknown QIU email	Fail
TC002_01_04	14121	Username is too long, try again	Not an email	Fail

UC002_02: Login (Password)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC002_02_01	QWERTY	Password is too short, try again	Password needs special characters	Fail
TC002_02_02	QWERTY853234	Password OK	Correct	Pass
TC002_02_03	QWER2352@514	Password OK	Correct	Pass
TC002_02_04	QWERTYYTRQW-QWERTYYTRWEQ	Password is too long, try again	Password is too long for this application	Fail
TC002_02_05	QWRETY@#$234	Password OK	Correct	Pass

2.3 Test TC003 for Module User: <Object Location (UC003)>

This test contains the following test cases:

UC003_01: Object Location (Serial Number)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC003_01_01	1234567	Serial Number is OK	Correct	Pass
TC003_01_02	1410110058	Serial Number is OK	Correct	Pass
TC003_01_03	13101NAYO10168	Serial Number is OK	Correct	Pass
TC003_01_04	1346@#$@3424	Serial Number cannot have special characters	Password is too long for this application	Fail
TC003_01_05	12546	Serial Number is too short	Correct	Fail

UC003_02: Object Location (GPS Name)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC003_02_01	Asivichapt	GPS Name is OK	Correct	Pass
TC003_02_02	**blank**	GPS name cannot be blank	Any proper name is allowed	Fail
TC003_02_03	Raman1234	GPS Name is OK	Correct	Pass
TC003_02_04	Tracker@QIU_1435	GPS Name doesn't allow special characters	GPS Name only allows alphabet and numbers	Fail
TC003_02_05	Gps Thony	GPS Name is OK	Correct	Pass

UC003_03: Object Location (GPS Description)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC003_03_01	1 word	GPS Description is OK	Correct	Pass
TC003_03_02	10 words	GPS Description is OK	Correct	Pass
TC003_03_03	20 words	Too many words	15 words is the max	Fail
TC003_03_04	15 words	GPS Description is OK	Correct	Pass

UC003_04: Object Location (GPS Phone Number)

Test Case ID	Input data	Expected result	Actual result	Pass / Fail
TC004_04_01	077777	GPS Phone Number is too short	0777777777 could be a correct phone number	Fail
TC004_04_02	07515022198	Password OK	Correct	Pass
TC004_04_03	07714215445	Password OK	Correct	Pass
TC004_04_04	0770526abc4322	GPS Phone Number doesn't accept alphabets	07705264322 is the correct form	Fail

3. TEST APPROACH ANALYSIS

UC001: REGISTER

NAME
EP class 1 (valid): First name && Surname

EP class 2 (invalid): First name

EP class 3 (invalid): First name {number} | {symbol}

EP class 4 (invalid): {number} | {symbol}

Mobile Number

EP class 1 (valid): mobile number == 11

EP class 2 (valid): mobile number = Iraqi number

EP class 3 (invalid): mobile number {character, symbol}

Email

EP class 1 (valid): email == QIU emails

EP class 2 (invalid): email! = any other form of emails **Password**

EP class 1 (valid): 11 < password < 20

EP class 2 (valid): password {symbol} | {numbers}

EP class 3 (invalid): password {character}

UC002: LOGIN

EMAIL
EP class 1 (valid): email == QIU emails

EP class 2 (invalid): email != any other form of emails

Password

EP class 1 (valid): 11 < password < 20

EP class 2 (valid): password {symbol} | {numbers}

EP class 3 (invalid): password {character}

UC003: OBJECT LOCATION

SERIAL NUMBER

EP class 1 (valid): 5 < serial number < 25

EP class 2 (invalid): serial number > 30

EP class 3 (invalid): serial number {symbol}

GPS Name

EP class 1 (valid): 5 < GPS name < 20

EP class 2 (invalid): GPS name = 0

EP class 3 (valid): GPS name {character, number}

GPS Description

EP class 1 (valid): 1 < GPS description < 15

EP class 2 (invalid): GPS description > 20

GPS Phone Number

EP class 1 (valid): mobile number == 11

EP class 2 (valid): mobile number = Iraqi number

EP class 3 (invalid): mobile number {character, symbol}

ADDITIONAL MATERIAL

APPENDIX A. TEST LOGS

A.n.1 Test Results

A.n.2 Incident Report

APPENDIX A. TRACEABILITY MATRIX

Test Case ID	**Use Case ID/ Sequence Diagram ID**	**Package ID**
TC001 for User Register • TC001_01 • TC001_02 • TC001_03 • TC001_04	UC001 • SD001	P001
TC002 for User Login • TC002_01 • TC002_02 • TC002_03 • TC002_04 • TC002_05	UC002 • SD002 • SD003 • SD004	P002
TC003 for User Object Location • TC003_01 • TC003_02 • TC003_03 • TC003_04 • TC003_05	UC003 • SD005 • SD006 • SD007 • SD008 • SD009	P004