
## Faculty Of Electronics & Computer Technology & Enginering

# DEVELOPMENT OF WEARABLE CHILD TRACKERS USING WIFI FOR CHILD MONITORING IN CROWDED PLACES



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**Bachelor of Electronics Engineering Technology (Telecommunications) with Honours**

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# DEVELOPMENT OF WEARABLE CHILD TRACKERS USING WIFI FOR CHILD MONITORING IN CROWDED PLACES

**PUTRI NATASYA NAJWA BINTI KHAIRUL HISHAM**

**A project report submitted**
**in partial fulfillment of the requirements for the degree of**
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## DEDICATION

*To my beloved mother, Siti Mazatul Binti Abdul, and father, Khairul Hisham Bin Saripin,*

*As I stand on the threshold of this transformative project, I want to express my deepest gratitude to both of you. Your unwavering support, guidance, and the strength you instilled in me during moments of doubt have been the foundation of my journey. Your moral, spiritual, emotional, and financial support has been a pillar supporting me, fostering an environment where I can grow and aspire to greater heights.*

*To my sisters and brother, who have been a constant source of inspiration, guidance, and strength, especially when the going seemed tough and the idea of giving up crept into my mind. Your encouragement, coupled with the unwavering support you provided at every turn, has been instrumental in shaping the trajectory of this endeavor.*

*To my friends, whose friendship and support have been invaluable, I express my deepest gratitude. Your drive to overcome challenges and your timely messages of inspiration have been a driving force, pushing me towards the successful completion of this important project. Your unwavering belief in my abilities has been a source of strength during moments of uncertainty.*

*To my respected lecturers, who not only believed in our capabilities but also played an important role in refining this project. Your guidance, insights, and willingness to share inspiring stories from your own academic journey have been instrumental in shaping our approach. Your dedication to our success has not gone unnoticed, and I am grateful for the guidance you have provided throughout this endeavor.*

*And finally, with deep dedication, we started the culmination of this project. It is a testament to the collective effort, sacrifice, and unwavering commitment of all the above. As we approach the final stretch, let our dedication be the driving force that propels us to new heights of achievement. May our efforts prove the power of cooperation, resilience, and common aspirations.*

## ABSTRACT

The child detection system developed in this project prioritizes the safety and security of children through real-time detection capabilities. It integrates GPS technology and wireless communication for accurate and seamless location tracking. The objective is to create a compact and user-friendly design to ensure consistent use. The performance of the system will be evaluated based on traditional tracking methods, considering factors such as accuracy, reliability, ease of use and overall effectiveness in ensuring the safety of children. This project aims to showcase the advantages and potential of child detection systems in improving child safety measures. By providing parents and guardians with a reliable way to monitor and protect their children, this system increases peace of mind. Through rigorous evaluation and comparison, this project contributes to the advancement of child detection systems and their important role in protecting children in various environments. In conclusion, the development of small-scale child tracking systems using GPS technology and wireless communication holds significant promise in improving children's safety and well-being.

## *ABSTRAK*

Sistem pengesanan kanak-kanak yang dibangunkan dalam projek ini mengutamakan keselamatan dan keselamatan kanak-kanak melalui keupayaan pengesanan masa nyata. Ia menyepadukan teknologi GPS dan komunikasi tanpa wayar untuk penjejakan lokasi yang tepat dan lancar. Objektifnya adalah untuk mencipta reka bentuk yang padat dan mesra pengguna untuk memastikan penggunaan yang konsisten. Prestasi sistem akan dinilai berdasarkan kaedah pengesanan tradisional, dengan mengambil kira faktor seperti ketepatan, kebolehpercayaan, kemudahan penggunaan dan keberkesanan keseluruhan dalam memastikan keselamatan kanak-kanak. Projek ini bertujuan untuk mempamerkan kelebihan dan potensi sistem pengesanan kanak-kanak dalam meningkatkan langkah keselamatan kanak-kanak. Dengan menyediakan ibu bapa dan penjaga cara yang boleh dipercayai untuk memantau dan melindungi anak-anak mereka, sistem ini meningkatkan ketenangan fikiran. Melalui penilaian dan perbandingan yang rapi, projek ini menyumbang kepada kemajuan sistem pengesanan kanak-kanak dan peranan penting mereka dalam melindungi kanak-kanak dalam pelbagai persekitaran. Kesimpulannya, pembangunan sistem pengesanan kanak-kanak berskala kecil menggunakan teknologi GPS dan komunikasi tanpa wayar memegang janji penting dalam meningkatkan keselamatan dan kesejahteraan kanak-kanak.

## ACKNOWLEDGEMENTS

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## LIST OF SYMBOLS

| | | |
|---|---|---|
| $m/s$ | - | Meter per second |
| Vout | - | Output voltage |
| Vin | - | Input voltage |

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| $V$ | - | Voltage |
| Mhz | - | Megahertz |
| dB | - | Decibel |
| m | - | Meter |
| mm | - | Millimetre |
| Wi-Fi | - | Wireless Fidelity |
| GPIO | - | General- purpose input/output |
| GSM | - | Global system for mobile communication |
| SMS | - | Short Message Services |
| RSSI | - | Received Signal Strength Indicator |
| IoT | - | Internet of Things |
| SoC | - | System on a chip |
| USB | - | Universal Serial Bus |
| RAM | - | Random Access Memory |

## LIST OF APPENDICES

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Child tracking systems have emerged as a technology-driven solution to address concerns about child safety and security. These systems utilize advanced technologies such as GPS, wireless communication, and sensors to provide real-time monitoring and location tracking of children. With a focus on ensuring their well-being, child tracking systems offer peace of mind to parents and guardians in today's complex world.

## 1.2 Introduction

In today's modern society, ensuring our children's safety and well-being is of paramount importance. Statistics from reputable sources like the National Center for Missing and Exploited Children reveal alarming figures. There are an estimated 800,000 children reported missing each year in the United States alone. In response to this critical issue, the development of a wearable child tracker utilizing Wi-Fi, a widely adopted wireless communication protocol, offers a promising solution for accurate and reliable child detection.

Credible research studies and real-world applications have demonstrated the limitations of traditional child monitoring methods, necessitating innovative technologies. Wearable devices have emerged as a practical and proactive approach to address the challenges faced by parents, guardians, and caretakers in keeping track of their children,

particularly in crowded or public spaces. The incorporation of Wi-Fi technology into the proposed child tracker adds credibility to its effectiveness.

Wi-Fi technology has become ubiquitous and standardized, providing a solid foundation for developing a robust and efficient child-tracking solution. Its widespread use and compatibility make it an ideal choice for accurate and continuous monitoring of children's whereabouts. Wi-Fi's high data transfer rates and extended-range communication capabilities enhance communication links between the wearable device and a centralized monitoring system, eliminating potential blind spots.

Furthermore, numerous case studies and testimonials attest to the practicality and viability of Wi-Fi-based child tracking systems. These implementations have demonstrated the ability to track and monitor children in real-time, enabling parents and guardians to proactively ensure their safety. Such evidence strengthens the justification for pursuing the development of a wearable child tracker using Wi-Fi, as it builds upon a solid foundation of verified technology.

This project aims to design and develop a wearable device tailored for children, leveraging Wi-Fi's proven capabilities. By incorporating advanced detection algorithms, the child tracker aims to accurately identify the location of the child, mitigating potential risks and providing timely notifications to responsible adults. The accompanying centralized monitoring system, which receives and processes data from the wearable child tracker in real time, further enhances the solution's reliability and effectiveness.

Throughout the development process, the project will consider feedback from parents, guardians, and caretakers. By integrating their perspectives, the wearable child tracker can be tailored to suit their needs, providing a seamless and intuitive child safety solution. The device will be easy to use and offer real-time notifications to the parents. It

will also provide an option to control the content accessible to the child, ensuring they are not exposed to any inappropriate content.

In conclusion, the development of a wearable child tracker using Wi-Fi technology builds upon the proven efficacy of this wireless communication standard. Backed by credible research, real-world implementations, and the pressing need to protect our children, this project aims to deliver a reliable and user-friendly device capable of accurate child detection and real-time monitoring. By harnessing Wi-Fi's established track record and advancing child safety measures, we take a significant step toward creating a safer environment for our children.

## 1.3 Problem Statement

Parental and guardian concern for the safety and security of their children is of primary importance. Incidents of children getting lost or going missing in crowded or public spaces are still prevalent. Traditional child monitoring methods, such as visual supervision or smartphone tracking apps, have limitations and may not provide optimal safety measures. Additionally, existing GPS-based child trackers often suffer from battery life issues and a limited range of communication, hindering their effectiveness in real-time monitoring.

In response to these challenges, there is a pressing need for an innovative approach to child tracking that addresses the shortcomings of existing methods. The development of a wearable child tracker becomes crucial to overcome these obstacles and provide accurate and reliable detection of children. To achieve this, the tracker should leverage Wi-Fi, a widely adopted wireless communication protocol, to establish robust communication links between the wearable device and a centralized monitoring system. The goal is to create a solution that offers extended battery life, long-range communication, and precise detection

capabilities, ensuring parents and guardians can quickly locate and monitor their children in various environments.

Traditionally, child monitoring methods are not effective in crowded or public areas, and GPS-based child trackers have limited battery life and communication ranges. As a result, there is a lack of real-time monitoring and accurate detection of children's whereabouts. To address these challenges, there is a need for a comprehensive solution that leverages Wi-Fi technology for efficient communication and reliable children detection. This solution should also be user-friendly, considering the specific needs and preferences of parents, guardians, and caretakers. Achieving these objectives will contribute to enhancing child safety measures and providing parents and guardians with a reliable and efficient tool to monitor and track their children in real time, thereby reducing the risk of children going missing or getting lost.



## 1.4 Project Objective

The objective of this project is:

1) To study and propose the functionality and method used in the child tracking system.

2) To develop the child tracking system by using Wi-Fi

3) To analyze about the performance of the tracking system

## 1.5 Scope of Project

Locating and hanging child abductions will provide parents with information about their children's location and prevent child abductions. This involves researching and

analyzing existing tracking systems, selecting suitable tracking technology such as GPS, designing and developing the child tracking system with a user-friendly interface, integrating GPS technology for accurate location data, conducting thorough testing and validation, and documenting the system for deployment. The project does not cover physical hardware development or mass production aspects, and privacy and data security measures will be considered throughout the development process. The project scope may be adjusted based on available resources and stakeholder requirements.

## 1.6 Expected Result

The project aims to deliver a fully functional child-tracking system utilizing Wi-Fi technology for reliable communication and precise location tracking. By harnessing Wi-Fi, the system will establish robust and high-speed wireless connections between the wearable child tracker and the centralized monitoring system. This will ensure seamless data transmission, allowing parents to monitor and track their children's location in real time. Wi-Fi integration will enhance communication range, enabling effective tracking areas. Rigorous tests and validation procedures will be conducted to guarantee the system's accuracy and reliability, including Wi-Fi communication. With Wi-Fi, the child tracking system can be implemented to provide parents with peace of mind and increased child safety by effectively tracking children's whereabouts.



## 1.7 Thesis Organization

A description of the project possibilities is provided in Chapter 1. In this section, this project is brief. There will also be objectives, a problem statement, and a scope for the

project. Chapter 2 will explain project characteristics. This section also discusses ideas, features of equipment, and components used in this project. Chapter 3 describes the methodology of this project. The methodology will explain the steps and the study to be conducted to achieve the desired outcome. Additionally, this section explains the development of this project. Chapter 4, this section will discuss the expected results and discussion of this project. A summary of the results and discussion will be presented based on the methodology used. This project is summarized in Chapter 5. The conclusions are based on the expected results. The chapter also discusses potential future research directions.

## 1.8 Thesis Organization

Chapter 1 introduces the project's emphasis on child safety and the development of wearable child trackers using Wi-Fi technology. It begins by underscoring the paramount importance of children's well-being and presents alarming statistics about missing children, particularly in the United States. This chapter elucidates the limitations of conventional child monitoring methods and underscores the imperative for innovative technologies to effectively address these challenges. Furthermore, it establishes Wi-Fi technology's credibility as a widely adopted wireless communication protocol, known for its widespread use, compatibility, and high data transfer rates.

This chapter furnishes supporting evidence for the viability of Wi-Fi-based child tracking systems through credible research studies and real-world implementations. It highlights the practicality and effectiveness of Wi-Fi technology in accurately tracking and monitoring children in real-time. This contributes to the justification for continuing the development of wearable child trackers using Wi-Fi. The project objectives are outlined, focusing on reducing child abduction. They propose Wi-Fi as tracking technology and aim

to develop a user-friendly child-tracking system tailored to parents, guardians, and caregivers.

Additionally, this chapter defines the problem statement by accentuating the challenges parents and guardians face in monitoring their children, especially in crowded or public areas. It underscores the limitations of traditional methods and existing GPS-based trackers, such as insufficient battery life and communication range, which hinder their effectiveness in real-time monitoring. The project scope is established, encompassing research, technology selection, system design and development, testing, and documentation. The anticipated outcome is described as a fully functional child-tracking system that leverages Wi-Fi technology to provide reliable communication and accurate location tracking.

Finally, this chapter concludes by providing an overview of the thesis organization, indicating the content of subsequent chapters, including project characteristics, methodology, expected results, and discussion, and concluding remarks with potential future research directions.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction

The current debate about child trackers requires consideration of both their benefits and concerns. Despite the negative aspects, child trackers provide real-time monitoring of children and location tracking, especially in densely populated or unfamiliar environments. As a result of this technology, parents and guardians can feel safe knowing that their child can be quickly located in the event of an emergency or danger. In addition to privacy concerns, child trackers also raise data security concerns. In order to ensure adequate protection of collected data, only authorized individuals may access it. Considering the consent and autonomy of tracking children is an ethical consideration, which requires a balance between security and privacy. By choosing a reliable and well-tested tracking device, technical limitations such as battery life and signal range can be addressed. The impact on children, as well as the relationship between a parent and his or her child, should also be considered. The impact on children's trust, independence, and sense of freedom is considered here. In order to meet the needs of parents and guardians, research should be conducted to develop ideas comparable to the current demand.

## 2.2 Related Work

### 2.2.1 LoRaWAN GRS Tracker

As cities continue to grow, ESP32, LoRaWAN, RSSI signal strength, and GPS technology are being used to track children separated from their parents in crowded places. This paper presents the results of the testing of a GPS tracker utilizing an integrated module

consisting of an ESP32 and a LoRaWAN. This testing has been conducted to measure the real performance of the integrated module. Meanwhile, the testing includes indoor and outdoor. The indoor testing includes single-stair and multi-stair and horizontal and diagonal directions. Moreover, the GPS module is attached for testing the data of location transmission. This has been discussed in this report prepared by Suppakarn Chansareewittaya [1].

The LoRaWan in the tracking service a developed to solve problems by creating a tracker attached to the child and the person who wants to track. This tracker can be monitor by the application in real time. Some of these are upcoming technologies and existing technologies combined, mainly involving data transmission, divided into three types such as cellular, Wi-Fi, and Lora. Experiments or overall evaluations usually rely on experimental testing performed by parents who send the device to be used in real life. A LoRaWAN GPS tracker, low-energy radio frequency transmission, and long distance transmission over a medium or gateway are used to track mobile devices in real time.

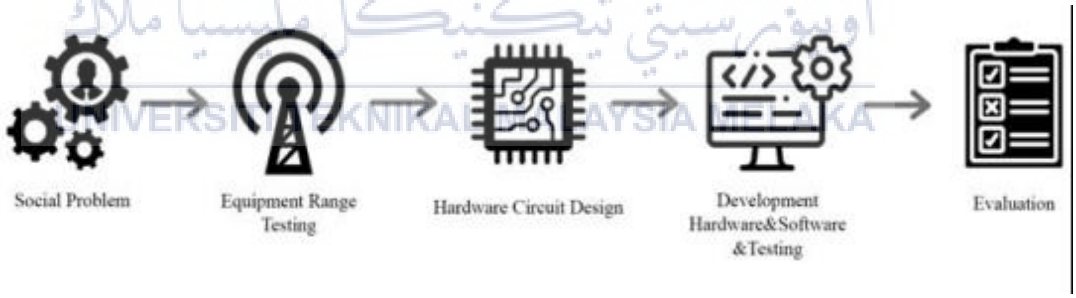


Figure 2.1: Methodology design

A measurement of the radius of the transmission can be made with the help of testing, development of hardware, software, and sand tests, testing of the transmission after redesigning the band and antenna, and testing the software to display real-time results. Evaluation is conducted by testing it in practice and looking at its shortcomings.

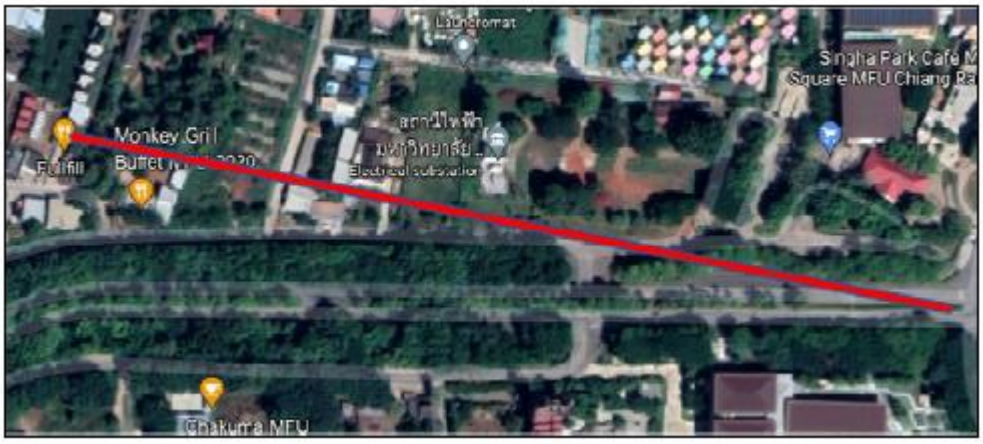


Figure 2.2 : Outdoor horizontal testing with obstacle

Table 2.1 : Signal strength of the experimental result

| Distance | dB |
|---|---|
| Close together | 24+- |
| Close together and remove receiver head | 54+- |
| 1m | 74+- |
| 50m | 88+- |
| 100m | 91+- |
| 150m | 94+- |
| 200m | 104+- |
| 300m | 105+- |
| 400m | 115+- |
| 500m | 117+- |
| 540m | 119+- |



This identification system uses LoRaWAN and ESP32 to identify moving objects such as individuals and track them using RSSI signal strength. ESP32 and LoRaWAN are proposed for integration testing. Based on the experimental results, there are conditions that reduce signal strength, such as obstacles and distance. Therefore, this system could effectively track and identify objects, even in cases of signal strength reduction.

### 2.2.2 Kids Tracker: An Android Application for Tracking Children

A kids' tracker allows parents to track their children's location without giving them mobile phones [2]. This system provided detailed information about their child's location and movements through an application. It uses a tracking device coupled with the parents' smart phone that will send them notifications. The current location of the child can also be accessed with the track of its movement. This covers the last seven days. The system was programmed by region. Its name is Green Zone. However, if the child is in the defined region but outside the expected day and time, the region is colored in gray (gray zone). Finally, if the child is in an undefined location, the red color is used for this location (red zone). As soon as a child enters a red or gray zone, an instant alert notification is sent to the user.

This project used the Raspberry Pi as a microprocessor that is equipped with a GPS unit and an antenna to send signals to the server using the Global Positioning System (GPS). GPS gives area and time data under all climate conditions. The database is modified by the periodic signal that is transmitted from the wearable devices to the server. It sends different notifications to the parent's smart phone with updated information about their children's locations. Furthermore, the application of kids' tracker, GPGGA is used to format the server to find locations and then store them into the database. The Android application will send a periodic "get region" request to the server every 5 seconds. The server replies by posting the current region of the child and required calculations to determine the type of this region and updating the marker.

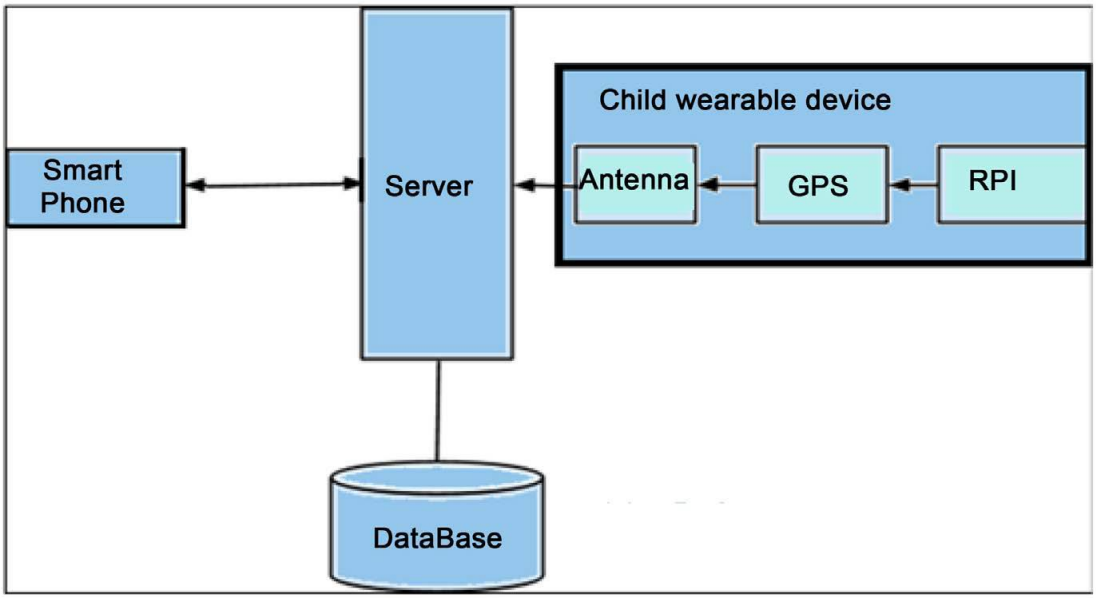


Figure 2.3 : Kid tracker system design.

An Android application for tracking children has been discussed by the author. It is convenient to use the system proposed by the user. However, there is plenty of room for improvement and future work. For example, the alert notification is only sent when the child is in the red zone to alert the parents that the situation is urgent.

### 2.2.3 GPS and SMS-Based Child Tracking System Using Smart Phone.

In this study, a child tracking system using GPS and SMS-Based was an application at the parent side that will allow parents to send a location request to a child side[3]. It will retrieve the location from the request reply and show it on a map. The smart phone information will be used to locate by smartphone. Additionally, the application will include features such as real-time tracking of the child's location, alerts for when the child deviates from a predetermined route, and parental control over the app. GPS coordinates and time are gathered and sent to the parent's smart phone preregistered on the application. The system allows it to work without internet connection thus allows the application to be implemented on smart phones that don’t support.

GPS and SMS were used to track the child's location in the project. Nevertheless, GPS and GSM technology have one of the most useful features in smart mobile platforms, which is SMS, by which the parent of the device can communicate with the child to locate the coordinates. Moreover, SMS provides a convenient way for parents to ensure their child's safety and well-being, by allowing them to stay in constant communication and always check the child’s location. The system will automatically respond to the requested location on SMS, and it will update the updated location and proceed to viewing the map on UL.


Figure 2.4 : Architecture of the Proposed System



In conclusion, the proposed child tracking systems utilize GPS technology and are compatible with smartphones without internet connectivity. GPS technology can provide a safe solution for parents to monitor their children's location. Privacy concerns should also be considered when implementing such systems. Tracking systems should be discussed with children and their consent obtained to address these concerns. Additionally, all data collected by the system should be encrypted and stored securely, and the system should include measures to prevent unauthorized access. Furthermore, parents should be aware of the potential for GPS-enabled devices to be hacked and consider the risk of data breaches. In

addition, they should ensure that the data collected is protected and used only for its intended purpose.

### 2.2.4 GPS and SMS-Based Child Tracking System Using Smart Phone.

This paper was proposed about school child tracker systems that track the location of school buses and notify the admin on the school side[4]. A Safety System is being developed that uses RFID to track student entry and exit from school. The proposed system tracks the child's exact location using RFID and GPS cost-effectively. It could be implemented in smaller schools, so it could be implemented in a variety of situations. Abductions must be reduced through the installation of systems such as these.

This child tracker system was operated using RFID scanning to locate identification through GPS and notify by notification. RFID scanning is used for attendance at the entrance to a school building to notify the attendance status to the parent. GPS is a second module for tracking an ID card's location and tracing the student's current location. It will display the location on the phone. Only his child's location will be displayed to their parents. This system notifies parents through SMS once the child enters or leaves school and tracks the live location of the child.

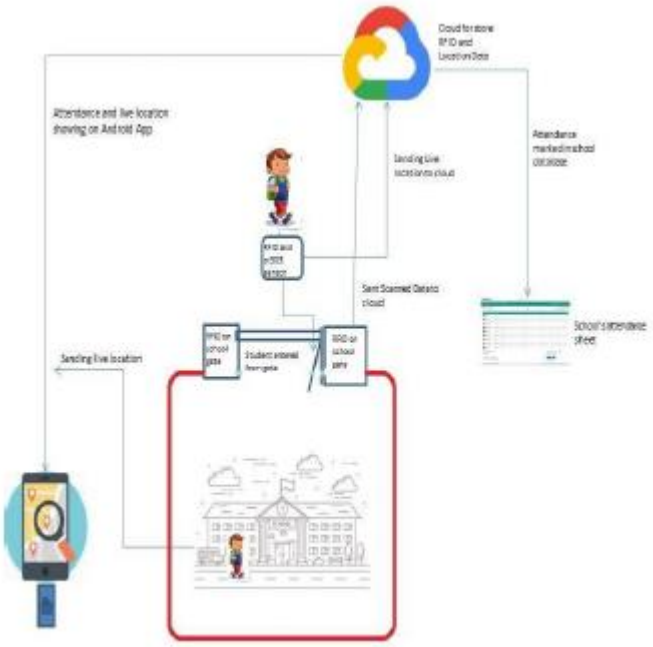

Figure 2.5 : System Design of School Child Tracker

As a conclusion, the intelligent child tracker system would be able to assist to maintain the security of the school children during their daily outings because of its improved capabilities. The RFID system can be used to detect whether the child is at school or not, by using a real-time tracking system. The message will be sent simultaneously to parents and the school. In addition, the school's database will also be updated with information regarding the attendance of each child. The GPS is used for live tracking of the child if it wanders off the normal path, and it displays to the parent through an android application. Finally, to improve the performance of this system, the author recommends that the application should be updated regularly. This will ensure that the school and parents have access to the latest information. The application should also be equipped with advanced features such as an alarm system for when a child strays too far from the designated route. Finally, the application should be user-friendly and easy to use.

### 2.2.5 GPS and SMS-Based Child Tracking System Using Smart Phone.

This project was about a high-performance implementation of RSSI based Wi-Fi location tracker for Android application[5]. The system came up with an idea to design a chip that can be attached to the object to be monitored and tracked continuously indoors. The chip will remind the user by a notification in the Android application, to carry it when the user leaves the wallet at home. The proposed system, RSSI (Received Signal Strength Indicator) technology, will be able to track any object or person in a confined indoor space. It is designed to work with any existing home automation system. So, this integrated module adds safety to the home. Also, it could be attached to a GPS tracking system as an additional function to increase performance.

In the implementation of hardware, the ESP 32 microcontroller was programmed and provided with a full TCP/IP stack and capability. This has the main advantage of low cost, compactness, and of a growing community. It can connect to Wi-Fi and the chip is fixed to the portable module used for tracking. Second, the Infra-Red Sensor is fixed to the door to detect whether it is locked or not. So, whenever the user forgets to close the door, an intimation is given to the user of the software application. The tracking object is fixed to Buzzer. The Software Application is designed in a way that when the button is clicked the buzzer will start to ring to notify the user of the place where it is hidden.

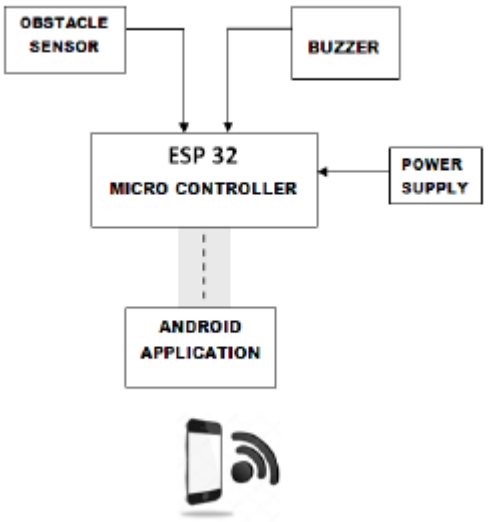


Figure 2.6 : System Design of RSSI Based Wi-Fi Location Tracker

The project is when the user is moving a certain distance forgetting the object then there will be a notification popping up in the mobile phone of the user by means of the software application. It will be installed on the concerned mobile phone concerned. And with the help of the button on the screen of the application which when pressed it will make the buzzer ring. In this case the user will get to know the position or location of the objects with the help of the sound that arises from the buzzer attached to the object and the user will be able to determine the exact position by the strength of the sound from the buzzer. However, when the user forgets to close the door then a notification will pop up like the "Door is open" and when the door is closed the notification will be like "Door is closed". It also can be used to monitor a child so that the parents can always keep track of their child whenever it goes out of reach of its parents in a confined place.



A RSSI Based Wi-Fi Location Tracker was introduced to provide effective system processing. With the presence of this system, the parents can monitor their children in real-time and receive alerts if their child moves out of their designated area. The system also

provides an alert if the child is in an unsafe location. It also collects data for future analysis to improve the safety of the child.

### 2.2.6 A Comprehensive Smart IoT Tracker for Children, Elder, and Luggage with the Assistance of Mobile App

This study examines the use of smart IoT trackers coupled with a mobile application[6]. A tracking system may be used to track children, luggage, or elderly individuals. This system has two ways of operating to fulfill its purpose. First, an IoT device connects with the user's mobile app through Bluetooth. IoT device holders require this mode. In some cases, the user is shopping with children or carries their luggage or valuable items. A second way is that the IoT device is not connected through Bluetooth to the user's mobile. This mode is needed when the IoT device is far from the user, and the user can track the device from anywhere. Moreover, the IoT device is connected to the operator's mobile phone via Bluetooth. Bluetooth's range is 100 meters. As soon as the IoT device and the phone are disconnected, the phone will vibrate, alerting the owner or parents to take necessary precautions. It also gets disconnected from Bluetooth if the IoT device is triggered. Then it sends GPS coordinates to the Firebase server.



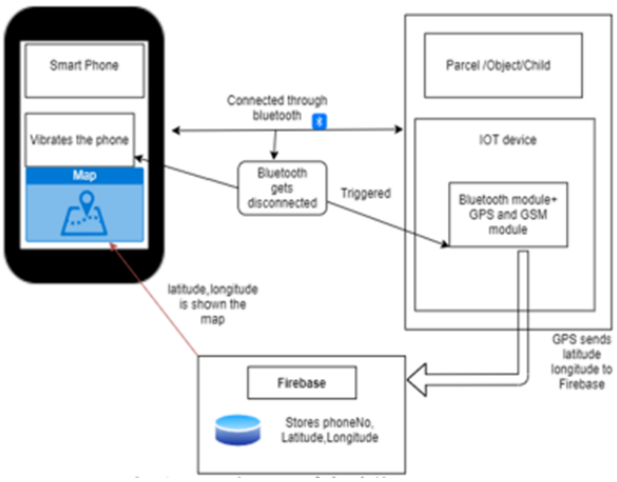


Figure 2.7 : Syatem Design Of Smart IoT Tracker

This tracking device is designed to help the public. It is more focused on creating a system that prevents people from feeling unsafe in public places. The system uses ESP32 NodeMCU as the main board, with Bluetooth, Wi-Fi, and SIM800L GSM modules. A GPS module is used in this system to collect location data and the IoT device is connected to the Internet using the built-in GSM. Location data will be sent to the Firebase server from the IoT device as required. The program also manually triggers an "emergency" button through an IoT device or smartphone app. As a result of this trigger, the Mobile GPS will generate coordinates and notify nearby volunteers that an emergency has occurred. The entire system is designed to protect endangered women, but it is not automatically activated when necessary. The other focused on children's monitoring by their parents through an Android application. This application sends geo-coordinates to the parent. There is also a messaging feature inside the app. Furthermore, parents can set a geofencing boundary for their children, which means they are informed whenever the child crosses the boundary.

In this paper, Smart IoT trackers with a mobile app were studied. The use of GPS technology can collect additional data related to children, luggage, or elderly people. As a reliable wireless communication interface for remote sensor data transmission, Zigbee technology must be widely applied in IoT trackers.



### 2.2.7 Design and Implementation of An Elderly Tracker System

IoT technology enables the seamless transfer of data over the internet in real time, opening new possibilities for connected devices. While some Internet-connected gadgets require adjustments to facilitate data exchange, there are more elegant solutions that eliminate those adjustments[7].

(Kim et al., 2017) have researched the implementation of a tracking system that takes advantage of this seamless data exchange. This program is specifically designed for elderly individuals whose safety is the primary concern of their families. Through GPRS and GPS technology, personal trackers can instantly send location information to those in need of help. This is done on a cloud server or mobile app. This feature empowers individuals to easily access relevant information, facilitating self-rescue. Device applications include navigation services, public safety measures, tracking functions, and personalized information services all based on location. Undoubtedly, the success of realizing detection capabilities is closely related to location techniques advancement.

The terminal described in this scenario is built using seamless integration of GPRS (General Packet Radio Service) and GPS (Global Positioning System) technologies. It consists of several key elements, mainly a mobile terminal specifically designed to track elderly individuals. In addition, the system includes a cloud server that facilitates data management and processing. The basic framework of this system is visually depicted in Figure 1.



When the elderly venture outside the home equipped with a tracking terminal, the terminal generates and compiles relevant information at regular intervals of 30 seconds (can be configured according to customer needs). This information includes real-time dynamic longitude and latitude coordinates, altitude, and timestamp obtained from the current GPS module. After that, the compiled data is encapsulated in a message format and sent to the cloud server. This server establishes an internet connection through the GPRS connection available on the terminal.

After receiving the sent message, the cloud server performs the critical tasks of data reception, analysis, and evaluation. The most significant thing is the server's assessment of

whether the user's current location coincides with an accident-prone or dangerous area. If the user's location matches such an area, the server issues command to the terminal accordingly. In response, the terminal immediately alerts the user through its integrated loudspeaker, effectively notifying them of their presence in a dangerous zone and emphasizing the need to increase vigilance.

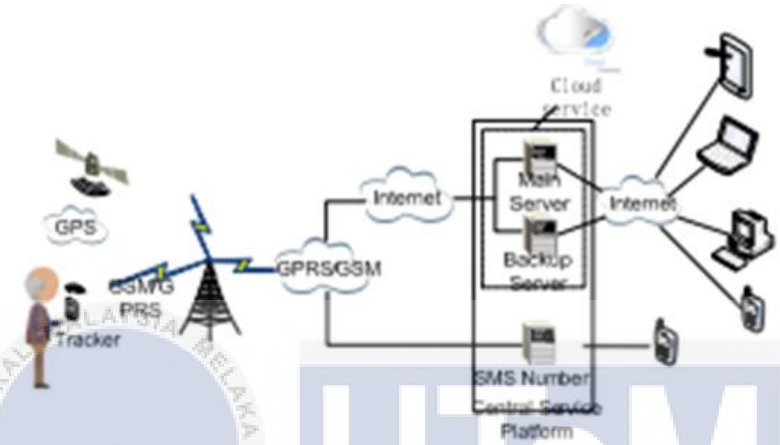


Figure 2.8 : Connection Between The Terminal And The Cloud



As part of the development of this project, the SIM900 module is used as the secondary GSM/GPRS development function. Moreover, in the low consumption mode, the current use is about 1.2mA and this really satisfies the demand for using power. It also uses a GPS module called the SIM28 module. It reaches the fastest speed in 13s as a cold reboot. For hardware, the DEBUG serial port of SIM900 is connected to SIM28 serial port. It acquires NMEA GPS data from SIM28 for SIM900. SIM28 collects current GPS location information.

In this study, Implementation of An Elderly Tracker System to get accuracy results. Some of the problems can be solved. The system can be used to find the elderly or people

with cognitive disabilities who may wander off and alert their caretakers. It also can provide useful data on location and activity history, allowing caretakers to better monitor their words.

### 2.2.8 Students Bus Tracker (SBT) Enabled GPS Device for Regular Monitoring of Heavy Vehicles through Android Application

The development of the Student Bus Tracker system is a smart communication device, which has evolved to form a crucial and life-sustaining part of our daily activities[8]. Almost everyone, regardless of age, needs safe transportation to get around in their daily lives. The best scenario is that when it comes to students, institutions must provide safe and timely transportation facilities. Since travel safety cannot be compromised and a lot of safety devices have been invented. Credibility in monitoring how efficiency updates research ideas. Although GPS and other tracking algorithms provide approximate information about time schedules, there is a need for more accurate programs to provide more up-to-date and accurate vehicle status.



GPS and Android OS are the main components of the Student Bus Tracker system. Most vehicle tracking systems use GPS. GPS satellites transmit signals to ground equipment. It receives satellite signals but does not transmit them. This system modifies the app in a way that requires communication between parents, children, and management. It will give more satisfaction to parents if education management cares for their children without affecting their travel or medical safety. Therefore, this system was created according to the Global Positioning System (GPS) which is user-friendly to find buses and students' positions. It also developed an Android application called Students Bus Tracker (SBT) which consists of five efficient modules: Registration, Tracking, Attendance, Monitoring, and Feedback. Communication will only be carried out over the wireless network. The student's role is to register the application and allow the software to set the location and other basic details.

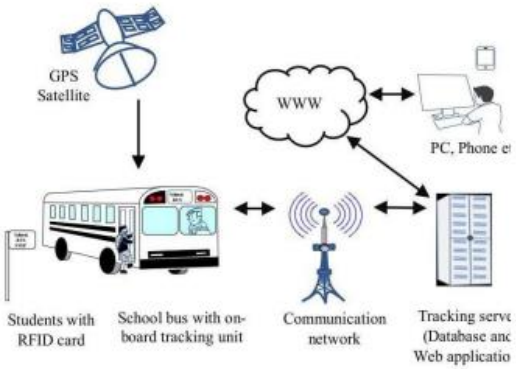


Figure 2.9 : Architecture Of Students Bus Tracker

This SBT project uses GPS Application as an extensive data line steering system created based on 24 satellites next to their Earth station. A GPS receiver can receive signals from three satellites, and it shows its position. The GPS tracker mounted on the SBT chassis is a NEO 7m GPS tracker. i.e., continuously track the bus and report parameters such as speed, geographic location, and bus route to the SBT application via the server. This is viewed all the way through a mobile smartphone application. It is also capable of providing support in establishing the actual location of the independent SOC of the college transport vehicle with a coordinated arrangement of TCP/IP conventions. in addition, it has 11 General Purpose Input/output pins, and analog input as well. This module is related to the GPS module and is used to transfer location data.




Figure 2.10 : The Actual Picture Of The SBT Device

By using GPS technology, the beneficiary will be able to access the current location of their college or school vehicle and the speed at which it is being transported as part of the project. The three main users of our project are the students, drivers, and the administration; separate logins were provided for security purposes. The students have a feedback option through which they can express their views; it will immediately be sent to the administration. This application provides an attendance system. Attendance will be viewed through an application. The administration has access to attendance information. Admin options include the ability to view all buses and the attendance system can be found in the admin section. The user can view attendance by selecting the view attendance option. Furthermore, our specially developed SBT application allows the admin to view the location of all their transport vehicles. A future feature of the application could be an emergency alert option that can be accessed from within the application. This emergency alert can be used to inform the other users or the admin in case of any accidents or unforeseen events. The admin can also use this feature to alert the users about any changes in the routes or any other updates. The users will also have the option to send feedback about their journey used by the users in case of an emergency.



## 2.3 Hardware

### 2.3.1 Microcontroller Unit (MCU)

The are many types of Arduino board and microcontroller on the market today, Arduino Nano 33 Iot, NodeMCU 8266, Arduino pro mini and Arduino lily are the microcontrollers that are used by engineers.

In (Hani Al-Mimi1, Ali Al-Dahoud1, Mohamed Fezari, And Mohammad Sh. Daoud, 2020), an Arduino nano was used as a microcontroller to construct electronic devices in

which sensors and actuators interacted with the external environment. Over the internet, information can be input, output, processed, received, and sent. IoT Cloud compatibility Arduino Nano 33 IoT. It is equipped with an Arm Cortex-M0+ processor based on the ATSAMD21 microcontroller, 802.11n Wi-Fi and Bluetooth v4.2, and Wi-Fi. Arduino Nano 33 IoT also supports wireless allows designers to control and monitor their projects. This is because it is also compatible with the Arduino IoT cloud service.

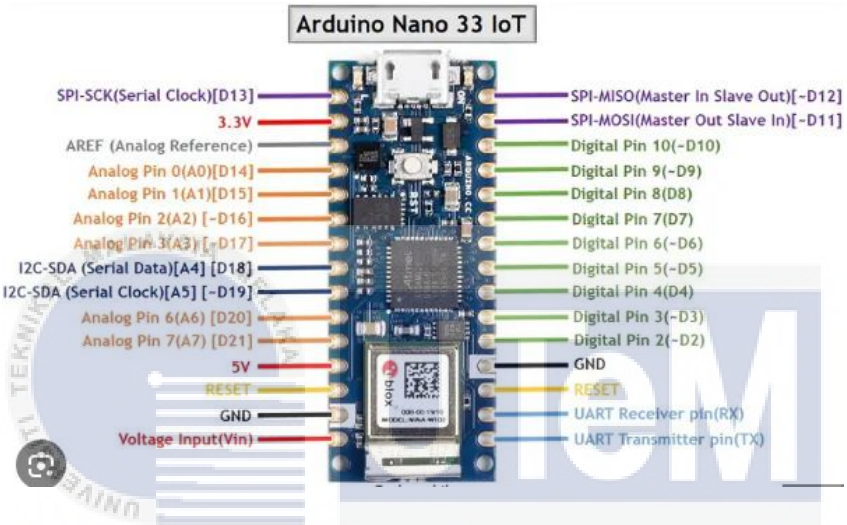


Figure 2.11 : Arduino Nano 33 Iot

The NodeMcu ESP8266 board has similar functions to the Arduino, but it's on a different board. NodeMcu ESP8266 has a a low-cost Wi-Fi module that allows for controlling and lower power . The chip has an operating frequency of 160MHz. Through its multiple modes of operation and power-saving features, It requires only 3.3 Volts power supply. The NodeMcu ESP8266 chip consumes 100 mA. NodeMcu ESP8266 also has excellent Wi-Fi module and supports WPA/WPA2, WEP authentication, and open networks. This makes the NodeMcu ESP8266 an ideal choice for IoT projects.

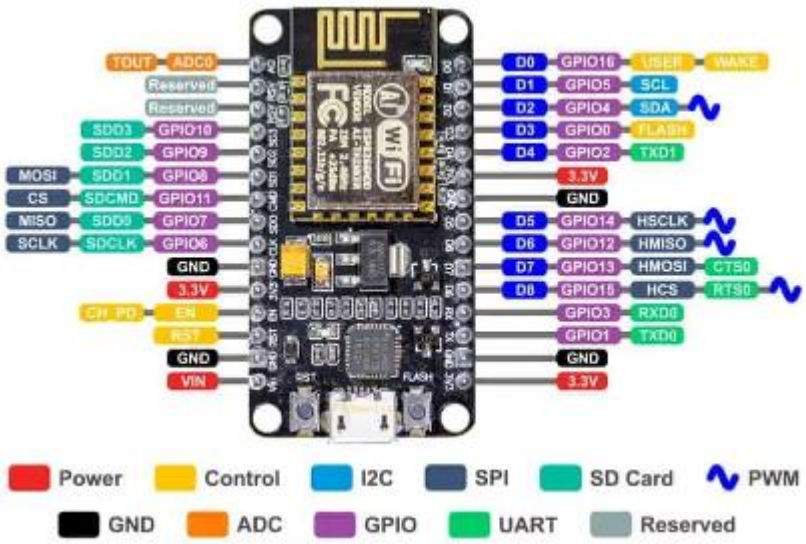


Figure 2.12 : NodeMcu ESP8266 Microcontroller

Arduino lily is a board that can be attached to fabric, sensors, power supplies, and actuators. The conductive thread for joining this board with the required object. The Lilypad Arduino can operate a voltage range between 2.7 V to 5.5 V. Moreover, there are two ways to generate regulated +5V power source: Using +5V pin of the Mini USB Adapter or employing another 2.7-5.5V power source using Lithium rechargeable battery [9].



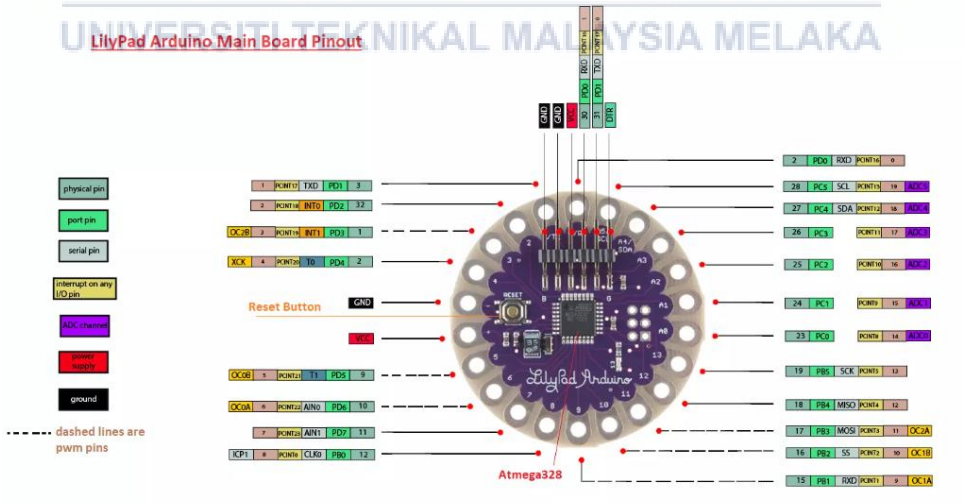


Figure 2.13 : Arduino Lily Pad

A small Arduino board with one voltage regulator is called an Arduino Pro Mini. There are two versions of the Arduino Pro Mini, 5V and 3.3V, which run at 16MHz and

32MHz respectively. Most Arduino boards connect to the PC using USB, but Arduino Pro Mini, there are no USB ports on the board. USB to Serial module connects Arduino Pro Mini to the PC. Since Arduino is small, it fits into many projects. The cost of Arduino Pro Mini is also considerably lower than that of other Arduinos. Arduino Pro Mini is not compatible with Arduino shields.

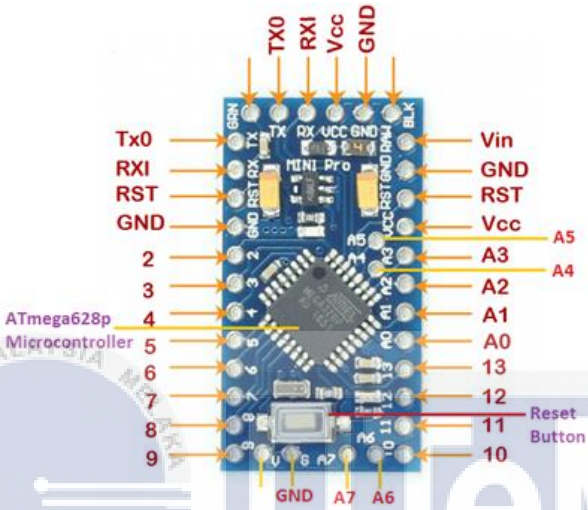


Figure 2.14 : Arduino Pro Mini

Table 2.2 : Comparison Between Arduino

| | **ArduinoNano33 Iot** | **NodeMcu ESP8266** | **Arduino pro mini** | **Arduino lily** |
|---|---|---|---|---|
| **size** | 45mm x 18mm. | 26mm x 49mm | 18mm x 45mm | 48mm x 20mm |
| **cost** | RM80 to RM100. | RM18 to RM100. | RM8 to RM40. | RM60 to RM80. |
| **Operating voltage** | 3.3V | 3.3V | 3.3V or 5V | 3.3V |
| **speed** | 48MHz. | 80MHz-160MHz. | 16MHz | 8MHz. |

The microcontroller used in this project is an NodeMcu ESP8266. It is being used as the microcontroller for the tracking system. It is more suitable for child tracking systems to use the microcontroller NodeMcu ESP8266, which has the characteristics of low-cost

Wi-Fi module, low price, and has excellent Wi-Fi module and supports WPA/WPA2, WEP authentication, and open networks.

### 2.3.2 Tracking System

The Global Positioning System (GPS) is used to provide accurate positioning and navigation information. For applications requiring the highest accuracy, the quality of the inertial sensors required is usually assumed to be very high. This is to detect or track the ground position of an object such as a human, vehicle, or pet. GPS modules are available in many types, including Adafruit Ultimate GPS Breakout and NEO-6M GPS Module.

Currently, the NEO-6M GPS module is one of the most popular modules on the market. It is a well-performing complete GPS receiver with a built-in 25 x 25 x 4mm ceramic antenna, which provides strong satellite search capability. With power and signal indicators, it is possible to monitor the module status. The supply needed for this module is 3-5V, default baud rate: of 9600bps.




Figure 2.15 : Neo-6m Module

This GPS module tracks up to 22 satellites on 66 channels and works with the Adafruit Ultimate GPS Breakout. With -165 dBm tracking and a built-in antenna, it is an excellent high-sensitivity receiver. Tracking or logging in high-speed, extreme-

sensitivity can take up to 10 location updates per second. During navigation, only 20 mA of power is used.


Figure 2.16 : Adafruit Ultimate GPS Breakout

Table 2.3 : Comparison About Tracking System

| **Feature** | **Adafruit Ultimate Gps Breakout** | **Neo-6m Gps Module** |
|---|---|---|
| Update Rate | Up To 10 Times Per Second | Once Per Second |
| Antenna | Built-In | Not Included |
| Accuracy | Within 10 Meters | Within 100 Meters |



Neo 6m GPS module is being used as the tracking system in this project. It is more suitable use in this project is because of Neo 6m is equipped with data backup battery and it has low power consumpation . It allow the tracking system function in long period. Besides, Neo 6m has lower cost compare to the Adafruit Ultimate Gps Breakout.

### 2.3.3 Communication Device

Wi-Fi is a wireless technology that provides high-speed Internet connectivity using radio waves. Wi-Fi has a limited range, its signal can be blocked by walls, furniture and other objects. Wi-Fi is convenient and flexible. With Wi-Fi, users can connect to the

Internet wirelessly from anywhere within the network range, enabling easy mobility and staying connected on multiple devices simultaneously. The wireless network's range is less than 100 meters from the access point [10]. Due to its short range, Wi-Fi is challenging to use in low-power applications at several meters. Wi-Fi requires energy. However, advances in technology have led to the development of low-power Wi-Fi solutions that can be used over short distances without excessive power consumption. These innovations have opened up new possibilities for applications such as smart home devices and wearable technology.

Bluetooth is a short-range wireless technology standard that enables data exchange between fixed and mobile devices over short distances. In the most used mode, transmission power is limited to 2.5 milliwatts. Bluetooth has a limited range of 10 meters. This means that devices must be close to each other to communicate. It has a slower data transfer rate than other wireless technologies, such as Wi-Fi. Therefore, it is not suitable for high-bandwidth applications, such as transferring large files. Security risks can be posed by hacking devices. This is why it is so crucial to use a strong passcode when pairing devices and keep your software up to date.



Table 2.4 : Comparison of Wi-Fi and Bluetooth

| | **Wi-Fi** | **Bluetooth** |
|---|---|---|
| Standard | Wi-Fi is based on the IEEE 802.11 family of standards | uses standards developed by the Bluetooth Special Interest Group (SIG). |
| Frequency | 2.4 GHz and 5 GHz. | 2.4 GHz |
| Network topologies | uses a star network topology. | uses a point-to-point or point-to-multipoint topology |

| | | |
|---|---|---|
| Power | 50 mW to 200 mW | 100mW |
| Data rate | >1 Mbyte | >250 Kbyte |
| Power consumption | Higher power consumption, devices used constant power supply | Lower power consumption than wi-fi but higher than Zigbee |
| Bandwidth | A Wider Bandwidth. Range From 20 MHz (802.11a/B/G) Up To 160 MHz (802.11ac/Ax). | A Moderate Bandwidth Of 1 MHz in the 2.4 GHz Frequency Band. |
| Range | Long Range, Up To 100 Meters Indoors | Short Range, Up To 10 Meters |

This project uses Wi-Fi as a communication device since it is inexpensive, low-rate, and has low power consumption characteristics. Additionally, Wi-Fi offers a cost-effective solution compared to other communication devices.



### 2.3.4 IoT Platform

Google Cloud Platform was created by Google. GCP focuses on high-performance computing products. SQL databases, such as My SQL and PostgreSQL, are the only ones available through GCP. It also provides huge storage and enables big data. Google Cloud relies on the FortiGate Next-Generation Firewall. Other than that, GCP also offers discounts and contracts.

Table 2.5 : Advantages and Disadvantages of Google Cloud Platform

| **Advantage** | **Disadvantage** |
|---|---|
| Google Cloud Platform is a powerful and scalable platform that can handle large amounts of data and traffic. | can be complex to set up and use. |
| can be used to track the location of children, pets, and other devices. | data is stored on Google's servers. If you are concerned about privacy, you may want to consider using a different platform. |
| data is stored on Google's servers. If you are concerned about privacy, you may want to consider using a different platform. | |

Arduino cloud is a cloud-based platform that uses NodeMcu ESP8266 to track children's location. It is easy to set up and use, and it offers a variety of features. Arduino cloud allows you to track children, pets, and other devices for free and easily. Encryption ensures your data's safety. Its tracking capabilities are versatile, but it may have fewer features than other child-tracking solutions. For real-time tracking, it also requires devices that support NodeMcu ESP8266 technology, as well as a connection to the internet.

Table 2.6 : Advantages and Disadvantages of Arduino Cloud

| **Advantage** | **Disadvantage** |
|---|---|
| Arduino Cloud simplifies the process of connecting IoT (Internet of Things) devices, providing a user-friendly platform for easy integration. | have limitations in terms of customization, restricting advanced users who require more flexibility in their IoT projects. |
| Enables remote monitoring and control of Arduino-based devices, allowing users to access and manage their projects from anywhere with an internet connection. | Users are dependent on the Arduino ecosystem, and the compatibility is primarily designed for Arduino boards, potentially limiting the use of other hardware platforms. |
| Arduino Cloud features a built-in web editor, facilitating code development and updates directly from the cloud platform | |

| NO | AUTHOR(S) | TITLE | FUNCTIONAL | REMARKS<br><br>(METHOD & APPLICATION) |
|---|---|---|---|---|
| 1 | Nattaphit Jengsriwong2 and Suppakarn Chansareewittaya (2023) | LoRaWAN GPS Tracker | 1. Signal Strength:<br>• Measures signal strength in dB using RSSI.<br>2. Testing Scenarios:<br>• Tests indoors and outdoors in different directions.<br>3. GPS Module:<br>• Integrated GPS for location transmission via LoRaWAN.<br>4. Long-Distance Success:<br>• Achieves a successful long-distance test of 5.67 km.<br>5. Frequency and Standards:<br>• Operates at 925 MHz, following specified standards.<br>6. Addressing Missing Children: | Applications:<br>1. Child Tracker:<br>• Real-time location monitoring for child safety.<br>2. Vehicle Tracker:<br>• Tracks vehicle location to prevent theft or locate lost vehicles.<br>3. IoT (Internet of Things):<br>• Enables efficient device connectivity and communication.<br>4. Distance Testing and Optimization:<br>• Evaluates and optimizes LoRaWAN and ESP32 performance in varying conditions. |

| | | | | |
|---|---|---|---|---|
| | | | • Aims to solve the problem of missing children. | 5. Safety and Security Applications:<br>• Addresses safety concerns with a reliable tracking system for missing persons. |
| 2 | Sweidan, S.Z., Saifan, R., Darabkh, K.A., Abu-Kaff, S. and Al-Ali, S. (2017) | Kids Tracker: An Android Application for Tracking Children | • Location Tracking: The system tracks the child's location using GPS technology.<br>• Region Calculation: The server calculates the child's region based on predefined zones (green, gray, red) using location data.<br>• Database Management: The system maintains a database to store the child's location for the last seven days. | Method:<br>• GPS Signal Processing<br>• Server Communication<br>• Database Integration<br>• Notification System<br>• Map Visualization<br>• Periodic Requests |

| | | | | |
|---|---|---|---|---|
| | | | • Alert Notifications: Instant alert notifications are sent to parents. | |
| 3 | A. Al-Mazloum, E. Omer, and M. F. A. Abdullah (2013) | GPS and SMS-Based Child Tracking System Using Smart Phone | • GPS Tracking: The system utilizes GPS technology to track the child's location in real-time.<br>• SMS Communication: The system uses SMS messages to send and receive information between the child's device and the parent's smartphone.<br>• Location Updates: The system periodically sends location updates from the child's device to the parent's smartphone. | Applications:<br>• GPS Tracking Algorithm<br>• SMS Communication Protocol<br>• Geofencing Algorithm<br>• Location Update Mechanism<br>• Emergency Alert System |

| | | | | |
|---|---|---|---|---|
| | | | • Geofencing: The system sets up virtual boundaries (geofences) and triggers alerts if the child enters or exits these boundaries.<br>• Emergency Alerts: The system includes an emergency alert feature that allows the child to send distress signals to the parent's smartphone. | |
| 4 | by Shruti Anant Tiwarkar, Shaila Suresh Bhumannavar, Gaurav Kishor Kshirsagar, Aishwarya Dinkar Ghare (2020) | School Child Tracker System Using IOT | • Real-time Location Tracking: The system tracks the location of school buses and provides real-time updates to the admin.<br>• Attendance Monitoring: RFID scanning is used to track student entry and exit from the school, providing attendance information to parents and the school. | Methods:<br>• RFID Scanning for attendance.<br>• GPS Tracking for live location updates<br>• Notification System for alerts<br>Applications: |

| | | | | |
|---|---|---|---|---|
| | | | • Geo-fencing: The system sets up virtual boundaries and triggers notifications when a child enters or leaves the school premises.<br>• Emergency Alerts: The system notifies parents through SMS when the child enters or leaves the school. | • School Administration<br>• Parents/Guardians<br>• Safety and Security<br>• Attendance Management |
| 5 | M.Koushiga Nanthini, S.Siddharthan, V.Oviyapriya, M.Poovizhi, S.T.Harini, Assistant Professor, ECE, SNS College of Engineering, | Rssi Based Wi-Fi Location Tracker for Android Application | • Object/Person Tracking: The system tracks the location of objects or people in a confined indoor space using RSSI technology.<br>• Reminder Notifications: The system sends reminder notifications to the user's Android application when an object is left behind or forgotten. | Methods:<br>• ESP32 Microcontroller Programming<br>• Infrared Sensor Integration<br>• Buzzer Attachment<br>Applications: |

| | | | | |
|---|---|---|---|---|
| | Coimbatore & Tamilnadu (2019) | | • Door Status Monitoring: The system uses an infrared sensor to detect whether the door is locked or unlocked and provides notifications to the user.<br>• Buzzer Alert: The system triggers a buzzer to ring when the user wants to locate the object. | • Object Tracking<br>• Home Automation<br>• Child Monitoring |
| 6 | A. Z. M. Tahmidul Kabir, Al Mamun Mizan, Plabon Kumar Saha, Golam Kibria, Akib Jawad Ta-sin, Md Saniat Rahman Zishan,2020 | A Comprehensive Smart IoT Tracker for Children, Elder, and Luggage with the Assistance of Mobile App | • Tracking of children, elders, and luggage<br>• Bluetooth connectivity for IoT device and mobile app communication<br>• GPS module for collecting location data.<br>• Vibration alert when IoT device and phone disconnect. | Methods:<br>• Use of ESP32 NodeMCU as the main board<br>• Integration of Bluetooth, Wi-Fi, and SIM800L GSM modules<br>• Utilization of GPS technology for location tracking |

| | | | | |
|---|---|---|---|---|
| | | | • Sending GPS coordinates to the Firebase server<br>• Manual trigger for emergency situations<br>• Mobile GPS activation and notification to nearby volunteers<br>• Geofencing feature for boundary notifications | • Connection to the Internet using the built-in GSM module.<br>• Communication between IoT device and mobile app through Bluetooth<br>• Data transmission to the Firebase server<br>Applications:<br>• Ensuring safety and security in public places<br>• Tracking and monitoring of children by parents |

| | | | | |
|---|---|---|---|---|
| | | | | • Safety measures for endangered women<br>• Real-time notification and assistance in emergency situations<br>• Geo-coordinates sharing between the IoT device and the parent's mobile app.<br>• Messaging feature for communication within the app<br>• Setting geofencing boundaries for children's safety |

| | | | | |
|---|---|---|---|---|
| 7 | (Xiangning Meng, Rui Wang and Xirui Li,2016) | Design and Implementation of An Elderly Tracker System | • Real-time tracking of elderly individuals<br>• Seamless transfer of location information<br>• Data management and processing on a cloud server<br>• Assessment of user's location for accident-prone or dangerous areas<br>• Alerting the user through an integrated loudspeaker<br>• Low power consumption mode for efficient operation<br>• GPS module for collecting current GPS location information | Methods:<br>• Integration of GPRS and GPS technologies<br>• Regular generation and compilation of relevant information from the tracking terminal<br>• Encapsulation of compiled data in a message format<br>• Sending data to the cloud server through the GPRS connection<br>• Data reception, analysis, and evaluation on the cloud server |

| | | | | |
|---|---|---|---|---|
| | | | | Applications:<br>• Ensuring the safety of elderly individuals<br>• Empowering individuals for self-rescue in emergency situations<br>• Navigation services based on real-time location.<br>• Public safety measures by identifying accident-prone or dangerous areas.<br>• Personalized information services based on location. |

| | | | | |
|---|---|---|---|---|
| | | | | • Tracking functions for monitoring and caretaking of elderly individuals<br>• Providing useful data on location and activity history for better monitoring |
| 8 | Francy Irudaya Rani, Niranjana Suresh, Udhaya Prakash, and Shah Mohamed Ilyas, 2021 | Students Bus Tracker (SBT) Enabled GPS Device for Regular Monitoring of Heavy Vehicles through Android Application | • Real-time tracking of college or school vehicles<br>• Monitoring of vehicle location and speed<br>• Registration module for students to set their location and basic details.<br>• Tracking module to track buses and students' positions. | Methods:<br>• Integration of GPS technology for real-time location updates<br>• Communication between parents, children, and management through Android applications |

| | | | | |
|---|---|---|---|---|
| | | | • Attendance module for recording and viewing attendance.<br>• Feedback module for students to provide feedback to the administration.<br>• Admin section to view all buses, attendance, and vehicle locations.<br>• Emergency alert option (planned for future enhancement) | • Use of GPS receiver and NEO 7m GPS tracker for tracking bus parameters<br>• Utilization of TCP/IP protocols for communication between the SBT application and the college transport vehicle's independent SOC<br>• Secure login system for students, drivers, and administration<br>• Feedback option for students to express their views.<br>• Attendance system for tracking and viewing attendance records. |

| | | | | |
|---|---|---|---|---|
| | | | | Applications:<br>• College and school transportation management<br>• Real-time tracking and monitoring of vehicles.<br>• Simplified attendance record-keeping<br>• Efficient communication between students, drivers, and administration<br>• Feedback collection and administration response |

| | | | | |
|---|---|---|---|---|
| | | | | • Future application of emergency alert feature for user safety |

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

The purpose of this chapter is to discuss the methodology. There are several steps in project methodology that are used to accomplish a project's objectives. Hardware and methods used in this project will be discussed in this chapter. In addition, a flow chart, hardware and software implementation and block diagram will also be shown in this chapter.

## 3.2 Project Workflow

The general setup used in this project is discussed in this section. Figure 3.1 shows the general flow chart of this project.



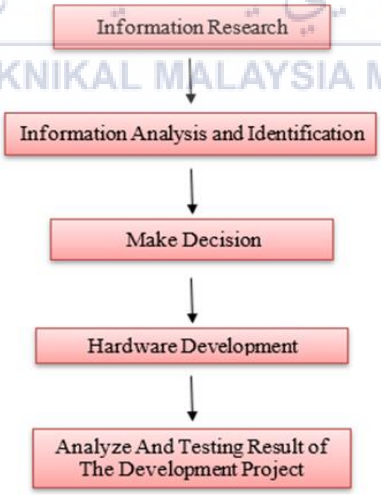


Figure 3.1 : General Flowchart for the project

In the initial step of the project, extensive research is conducted to gather pertinent information and establish a deep understanding of the project's problem statement. Objectives are set to address the identified challenges, and a comprehensive analysis is undertaken to comprehend the information obtained from diverse sources. The literature review section facilitates meaningful comparisons between hardware components and methods, nurturing a profound comprehension of their functionalities.

Armed with enhanced knowledge, informed decision-making takes place in the selection of hardware components and programming languages. The project then progresses to the development phase, where chosen components are translated into tangible advancements. Through an iterative process of testing and modification, a deeper understanding of the project's intricacies is fostered, leading to continuous improvement until the desired outcomes are achieved.

Following the hardware development, a comprehensive analysis is conducted to assess the performance of the developed system. By comparing it with the existing system, valuable insights are gained, showcasing the advancements accomplished. Finally, the project concludes with an all-encompassing analysis and overview, fostering a comprehensive understanding of the outcomes and providing valuable insights for future endeavors.



## 3.3 Hardware

NodeMcu ESP8266, GY-61 DXL335 3-Axis Accelerometer Module, and Neo 6m GPS module are used in this project to monitor and track the child tracking system. Table 3.1 shows the function and application of the components.

Table 3.1 : Function and Application for component

| Component | Functions | Specification |
|---|---|---|
| NodeMcu ESP8266 | Use to control whole process with GPS and GY-61. | low-cost Wi-Fi module that allows for controlling and lower power |
| GY-61 DXL335 3-Axis Accelerometer Module | Used to actively monitors whether a child is wearing their tracker, enhancing safety by issuing alerts. | low noise , power consumption and can measure the static acceleration of gravity in tilt-sensing applications. |
| Neo 6m GPS module | Used to detect coordinates of child | Lower cost |



### 3.3.1 NodeMcu ESP8266

The NodeMcu ESP8266 is an affordable system-on-chip with low-power features. It incorporates Bluetooth and Wi-Fi capabilities and is powered by Tensilica Xtensa LX6 microprocessors. The ESP8266 includes a power amplifier, receiver amplifier, filter, and power management module. With 16 GPIO pins, 4 available for SPIs and 2 for UART, it offers versatile control for devices like LEDs, motors, and sensors. The ESP8266 also features a USB port for connectivity, allowing it to be easily linked to a computer or other devices. Programming in C++ is facilitated through integrated development environment software.

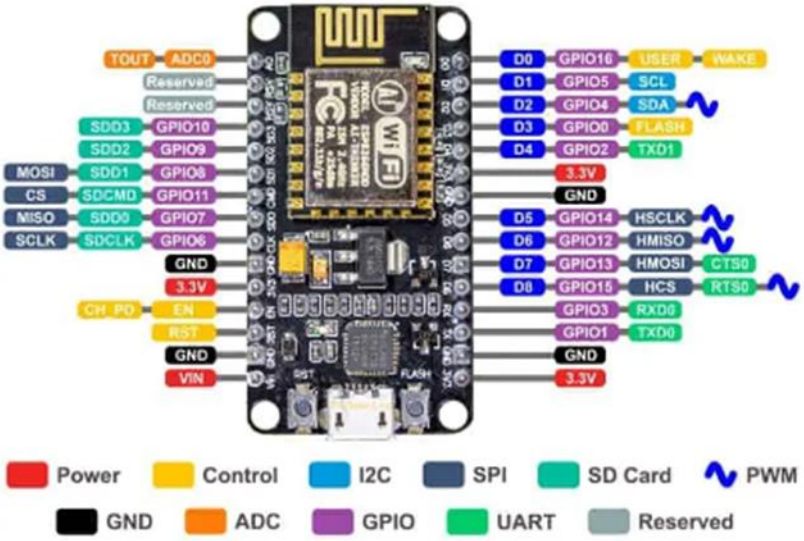


Figure 3.2 : NodeMcu ESP8266 Pinout Function

Table 3.2 : NodeMcu ESP8266 details

| Pin Type | Pin Name | Pin Description |
|---|---|---|
| Power | Micro-USB, 3.3V, Vin, GND | **Micro-USB:** It can power the NodeMCU.<br>**3.3V:** A regulated 3.3V supply can also power the NodeMCU.<br>**Vin:** External power supply pin<br>**GND:** Ground pins |
| Control pins | **EN, RST** | The button and pin can reset the microcontroller. |
| Analog pins | A0 | It measures analog voltage within the range of 0-3.3v. |
| GPIO pins | GPIO1 to GPIO16 | There are sixteen general-purpose input-output pins on the NodeMCU board. |
| SPI pins | SD1, CMD, SD0, CLK | There are four pins that work for SPI communication on NodeMCU. |
| UART pins | TXD0, RXD0, TXD2, RXD2 | NodeMCU features two UART interfaces including UART0 (RXDO and TXD0) and UART1 (RXD1 and TXD1). You can use UART1 to upload programs or firmware |
| I2C pins. | | You can get I2C functionality support on NodeMCU. However, you have to find the I2C pin because of these pins' internal functionality. |

### 3.3.2 GY-61 DXL335 3-Axis Accelerometer Module

The GY-61 ADXL335 3-Axis Accelerometer Module is designed to measure acceleration in three dimensions. It incorporates the ADXL335 sensor, offering precise and reliable data on the acceleration experienced along the X, Y, and Z axes. This module is suitable for various applications, including motion sensing, tilt sensing, and vibration monitoring.

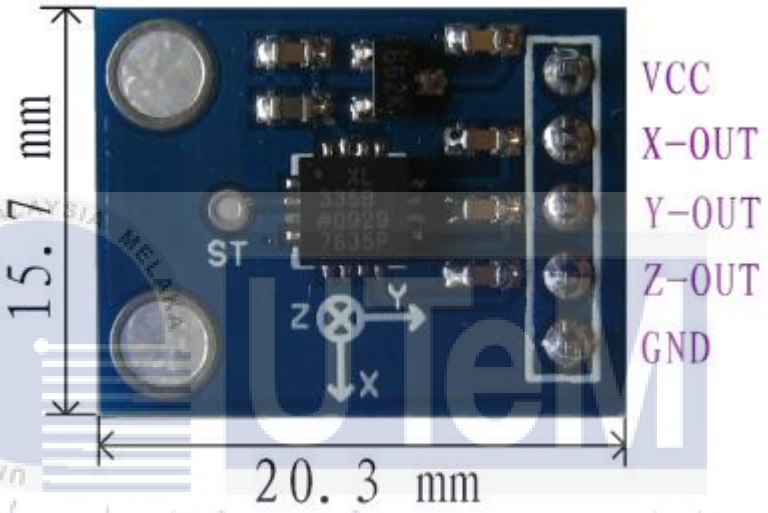


Figure 3.3 : NodeMcu ESP8266 Pinout Function



Table 3.3: Pin Description

| Name | Description |
|---|---|
| VCC | Power supply (3.3V to 5V) |
| X_OUT | Analog output |
| Y_OUT | Analog output |
| Z_OUT | Analog output |
| GND | Ground |

### 3.3.3 Neo 6m GPS Module

The Neo 6m GPS module is a fully featured GPS receiver with a ceramic antenna, with a size of 25 x 25 x 4mm. It is designed to provide a powerful satellite search capability. There are 5 pins in the Neo Gm GPS module which are VCC. RX. TX. PPS and GRD. Power supply is provided by VCC and GND, and serial communication between the GPS module and microcontroller is provided by RX and TX.

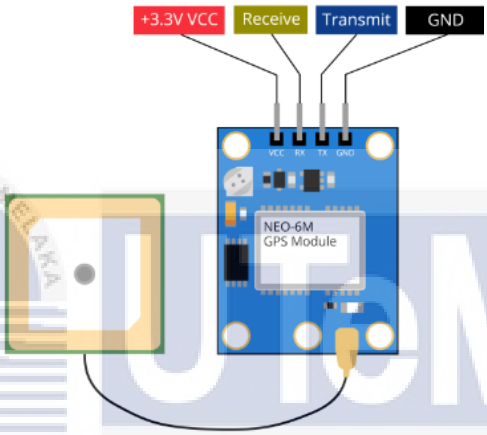


Figure 3.4 : Neo 6M GPS Module



### 3.3.4 Power Supply

Lithium polymer battery (LiPo battery) is being used as the power supply for child tracking system. LiPo battery is a rechargeable battery with high energy density and small size. Slim thickness. Light weight and low cost. The LiPo battery will support ESP 32 microcontroller, Neo 6M GPS module and the NF24LE1 Zigbee module.


Figure 3.5 : Lithium Polymer Battery (Lipo Battery)

A TP4056 LiPo battery charging board charges a LiPo battery. It uses a micro-USB connector to connect the breakout board to any USB adapter. It provides 1000mA charge current by default and 4.5 to 5.5V input voltage. Table 3.5 shows the charging board pin configuration.

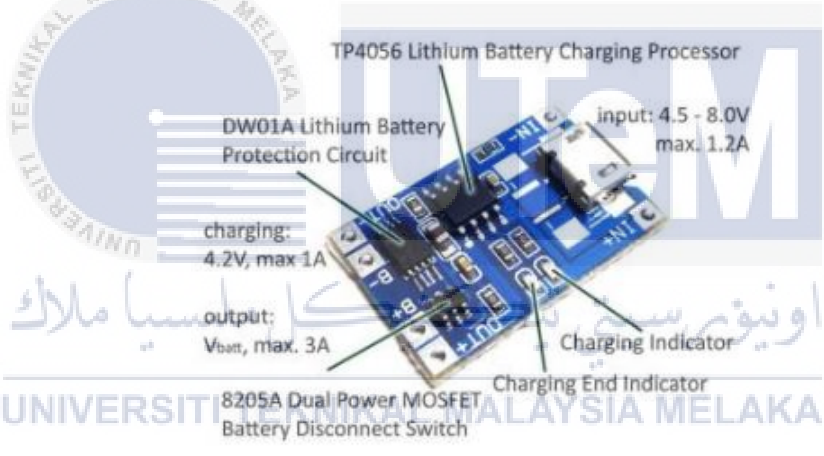


Figure 3.6 : TP4056 Lipo Battery Charging Board Charges

Table 3.4: Pin Configuration

| Pin Name | Description |
|---|---|
| OUT+ | This pins outputs the positive voltage from battery. It should be connected to the circuit which has to be powered by the battery |
| B+ | Outputs positive voltage from USB cable to charge to battery. It should be connected to the positive of the battery |
| B- | Outputs negative voltage from USB cable for charging battery. It should be connected to negative of the battery |
| OUT- | This pin outputs negative voltage from battery. It should be connected to the ground circuit which has to be powered by the battery |
| IN+ | provide +5V, can be used if charge cable not available |
| IN- | provide ground of the 45V supply, can be used if charge cable not available |
| LED RED | Battery is charging |
| LED GREEN | Battery is fully charged |



## 3.4 Transceiver Connectivity

This project used Arduino Cloud as the IoT platform. As the Arduino Cloud can establish a connection with the Arduino, it can be connected to the Arduino via Ethernet, Wi-Fi, Bluetooth, Cellular, and Serial connections. A USB serial connection, Bluetooth connection, and Wi-Fi connection were tested to control Arduino via the Arduino Cloud app.

The Arduino receiver connects directly to the Arduino Cloud platform through USB to display data. Using the Arduino Cloud application, microcontrollers can be connected to computers and enable data to be sent and displayed on smartphones. Using the smartphone directly connected to the microcontroller without CMD support resulted in the Arduino Cloud app not displaying data. This project was not suitable for Bluetooth because of incompatibility with large packets sent to the Arduino Cloud platform. Consequently, the Wi-Fi module was selected due to its low latency and ability to transmit large packets of data to Arduino Cloud.

## 3.5 Troubleshooting

The child tracker using Wi-Fi contains two parts, one is transmitter part, and one is receiver part. The build of transmitter system was constructed by using NodeMcu ESP8266, GY-61 DXL335 3-Axis Accelerometer Module and Neo 6M GPS module. Furthermore, the receiver system is constructed by using Arduino Cloud. GPS module is used to detect the location of the child distance using RSSI signal strength between the transmitter and the receiver. Although NodeMcu ESP8266 serves as the microcontroller, it presents a challenge due to providing only one serial port. This becomes problematic when connecting both the Wi-Fi module and GPS module to NodeMcu ESP8266. To address this issue, several options are available. For the first option, it is recommended to replace NodeMcu ESP8266 with Adafruit Feather HUZZAH ESP8266. This substitution aims to enhance code uploading efficiency and stabilize the board.

## 3.6 Project System Architecture

The child tracker is equipped with a GPS module that precisely tracks the child's location, providing high-precision GPS coordinate output. RF transmitters within the child trackers continuously transmit specific data sets to receivers. NodeMcu ESP8266 enables detection over long distances, even in crowded areas. Parents receive notification alerts when the child is 6 meters away. Additionally, the Gy-61 sensor actively monitors whether children are wearing their trackers, enhancing safety by providing alerts. These trackers not only monitor the child's location but also send data from the transmitter to the receiver using a communication device. The tracker receiver's data is then displayed on the smartphone via the Arduino Cloud, showing the child's location on a map.

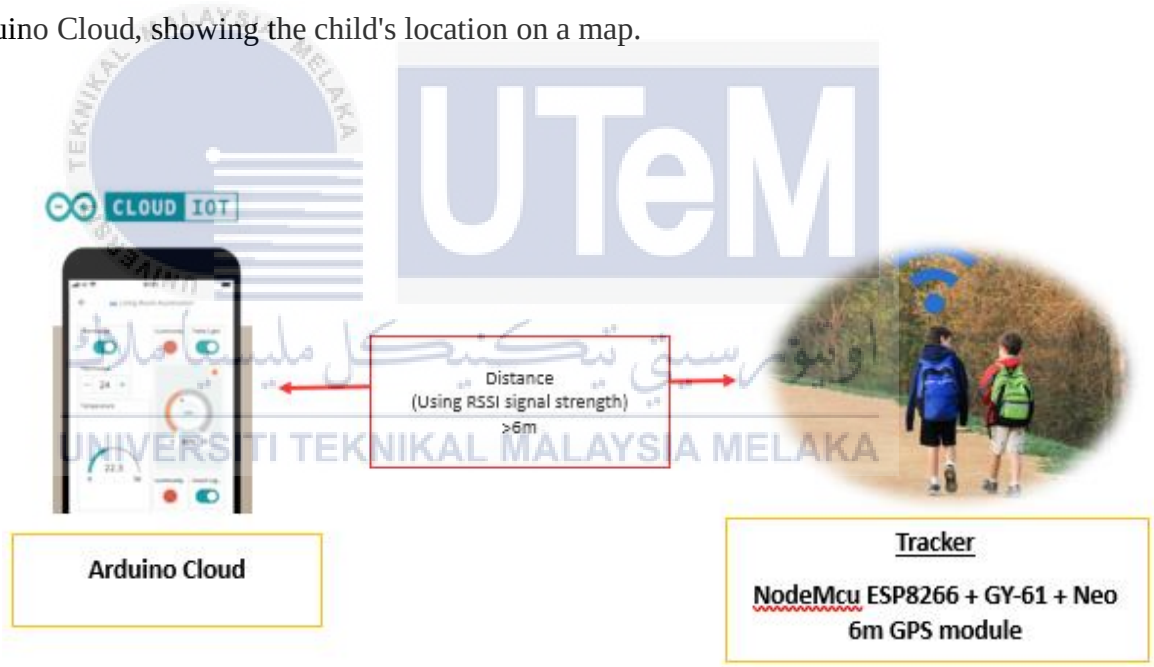


Figure 3.7 : System Overview Of GPS Child Tracking System

Communication devices using Wi-Fi are used in the development of detection systems. The Gy-61 component and the Neo 6M GPS module are connected to the NodeMCU ESP8266 microcontroller. The Neo 6M GPS module tracks the child's location, while the NodeMCU ESP8266 transceiver module handles data transmission and reception.

Below, the connection setup of the NodeMCU ESP8266 microcontroller transceiver module, Neo 6M GPS module, and Gy-61 is illustrated.

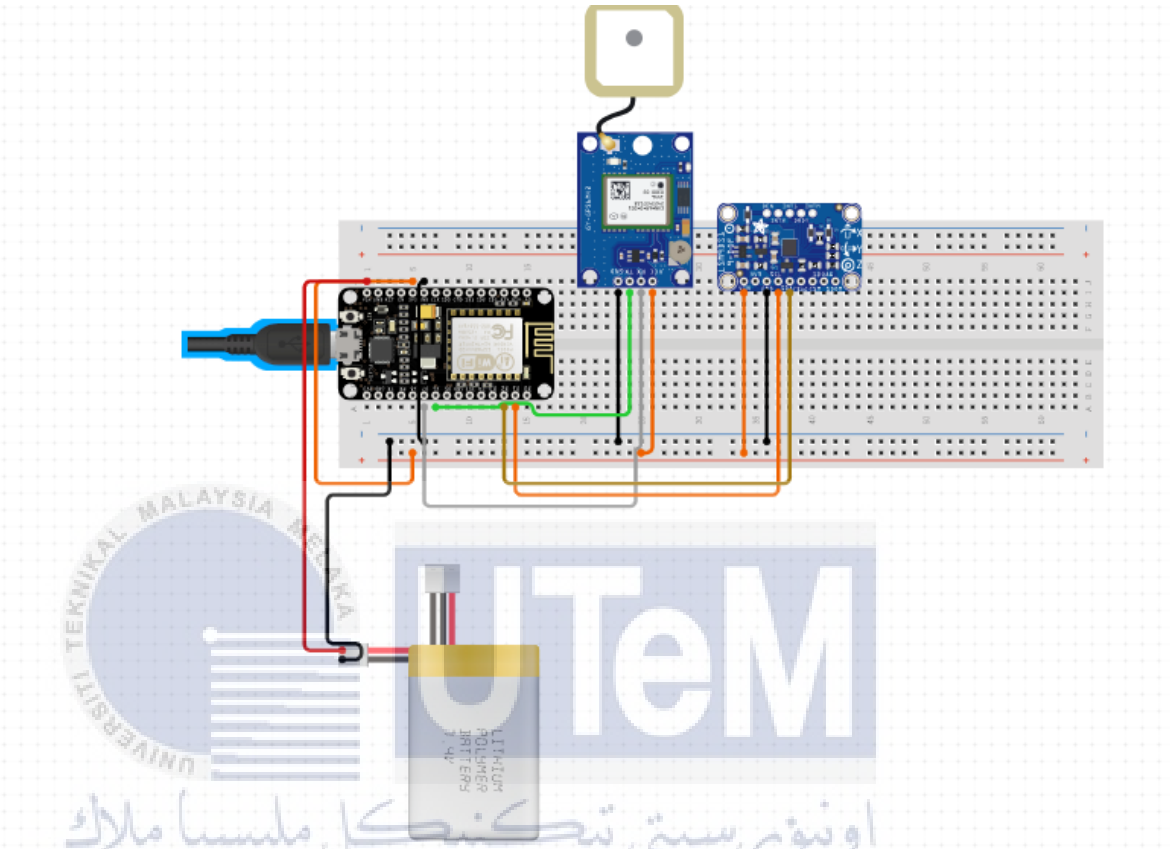

Figure 3.8 : The Wiring Diagram of Wi-Fi Child Tracker



Table 3.5 : Pinout Configuration

| **NodeMCU ESP8266** | **Gy-61** |
|---|---|
| VCC | VCC |
| GND | GND |
| A0 | X_OUT |

| **NodeMCU ESP8266** | **Neo- 6m module** |
|---|---|
| VCC | VCC |
| GND | GND |
| TX | 3 |
| RX | 1 |

Table 3.6 : Range Of Warning

| Distance | RSSI signal strength | Level |
|---|---|---|
| 2 meter until 3.9 meter | >65 | Green |
| 4 meter until 4.9 meter | >-75 | Yellow |
| >6 meter | >75 | Red |

Based on this table, Child trackers incorporate distance thresholds and notifications to ensure child safety. When the child is within 2 to 3.9 meters, a "green radar" notification is triggered, indicating a safe distance. This assures parents or guardians that the child is close and secure. If the child moves slightly further away, within 4 to 4.9 meters, a "yellow radar" notification is generated, alerting parents to be more vigilant and mindful of the child's location. The parent app provides the child's current location along with an emergency notification when the child is beyond 6 meters, indicating a "red radar."

The parental notifications and radar designation provide real-time information about the distance between the child and their guardian. As the system alerts users to changes in proximity, they are able to monitor potential safety threats in real-time and respond appropriately. Through distance thresholds and notifications, the child tracker system enhances child safety. Parents and guardians can take appropriate measures to ensure the safety of their children in various environments by utilizing the "green," "yellow," or "red" radars.

### 3.6.1 Operation Flow

The operating flow of this project is discussed in this section. Figure 3.9 shows the general flow chart of a detection system.

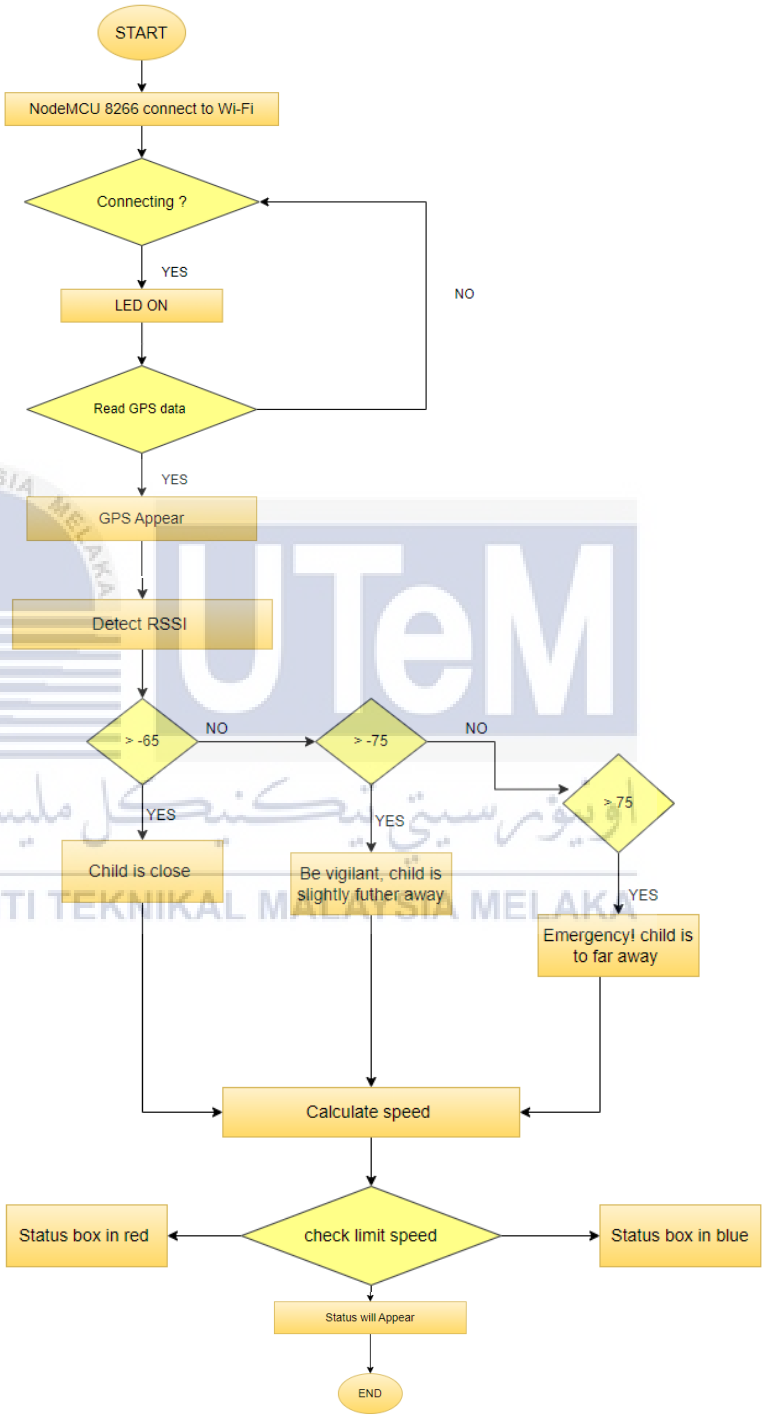


Figure 3.9 : Shows A General Flow Chart For A Detection System.

The detection system will begin by scanning the location within the coverage area. The tracker sends and appears the location and checks the speed motion between the child and parents. The notification will be displayed on the smartphone through the Iot remote application. A notification is sent to the mobile phone if the child's location is 4m from the owner. The tracking system tracks the child's location.

## 3.7 Block Diagram

Wi-Fi technology is employed in the development of children's GPS trackers, enabling efficient tracking in crowded conditions. This technology serves as a communication medium to send and receive child tracking coordinates over varying distances. The data received by the Wi-Fi system is accessible on a smartphone through a dedicated mobile application.

The system comprises a transmitter model, attached to the child, and a receiver model used on a mobile device. The transmitter model sends the child's location to the receiver model, and the received data is then displayed in a mobile application, such as Telegram. This Wi-Fi-based GPS tracking system offers a reliable way to track and display the location of children, especially in crowded environments.



## 3.8 Software Implementation

The combination of Arduino Cloud and Wi-Fi technology offers a user-friendly solution for sending notifications in the child tracking system. Wi-Fi is a wireless communication technology that enables child tracking devices to connect and exchange information with each other. It boasts several advantages, including a low-cost Wi-Fi module for control, lower power consumption, and the ability to create a robust network of connected devices.

With Wi-Fi, child tracking devices can communicate wirelessly with the Arduino Cloud. This means that information about the child's location or other important events can be sent to caregivers without the need for physical connections or complicated setups. Wi-Fi technology ensures that these notifications are reliable and can be transmitted over a considerable distance of the tracking devices. It also allows for a seamless and continuous flow of information, even in the presence of obstacles or environmental interferences.

By combining Arduino Cloud with Wi-Fi, caregivers can receive real-time notifications about their child's safety and whereabouts through the user-friendly Arduino cloud platform. This integration provides an easy-to-use and efficient solution for keeping caregivers informed and connected to the child tracking system.

# CHAPTER 4

# RESULTS AND DISCUSSIONS

## 4.1 Introduction

This project is related to the tracking system where it is possible to monitor children in crowded places. The aim of this chapter is discussed about the design and the hardware implementation for the tracking system. The results analysis on the performance of the tracking system is observed when the receiver receives data from the transmitter.

## 4.2 The Developed GPS Tracking System

The design of the tracking system is discussed in this section. Figures 4.0 and 4.1 illustrate the development of the prototype project in the tracking system. The child tracking system consists of a transmitter and a receiver. The transmitter, constructed using NodeMCU 8266 as the microcontroller, GY-61 DXL335 3-Axis Accelerometer Module as a motion sensor, and Neo 6M GPS module as the tracking system, is detailed in Figure 4.0.

On the receiver side, Arduino Cloud is utilized to track the child's location. Figure 4.1 displays the hardware of the transmitter for the tracking system. The receiver software setup involves using Arduino Cloud, with NodeMCU 8266 as the communication device responsible for transmitting data from the receiver. Figure 4.1 further depicts the receiver features for the tracking system using IoT remote. The location of the child is tracked via the Wi-Fi module upon successful data transmission.

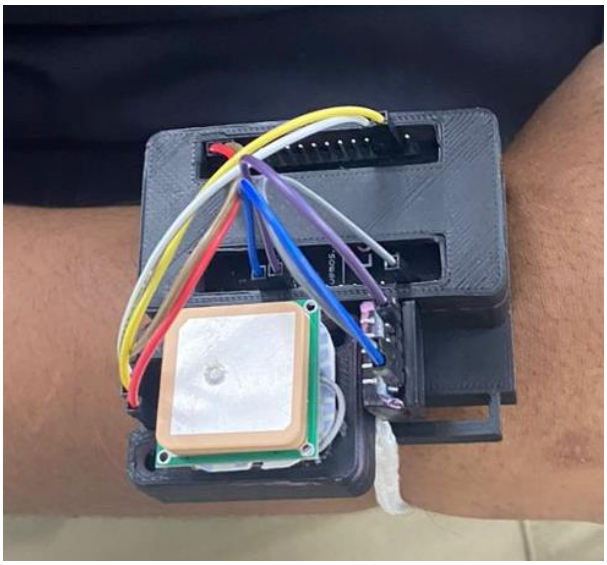

Figure 4.1: Transmitter of  child tracker using Wi-Fi

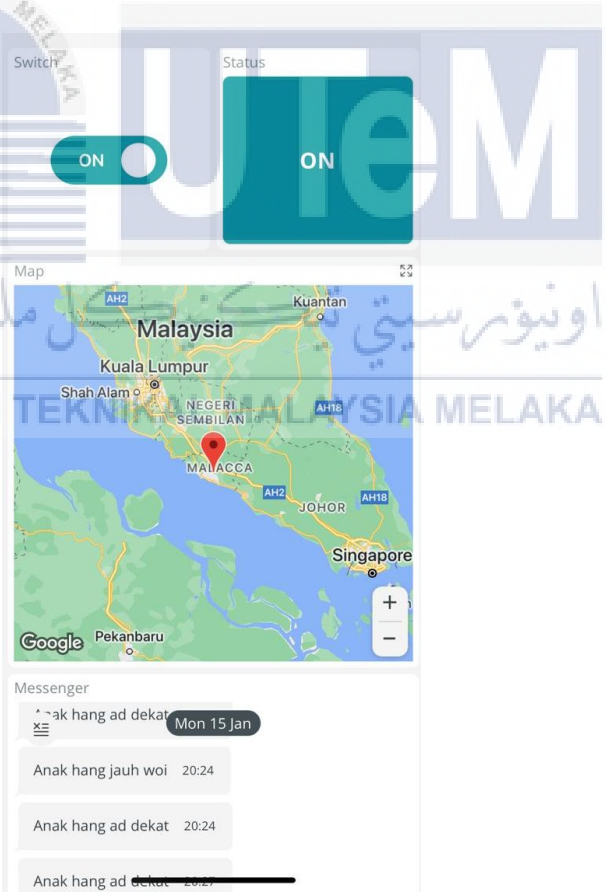


Figure 4.2: Receiver of  child tracker using Wi-Fi

## 4.3 Display of results

This section is to discuss the performance of the tracking system. The time responses for the Wi-Fi tracking system had been observed by comparing the time taken to receive data from the transmitter and distance of the object.

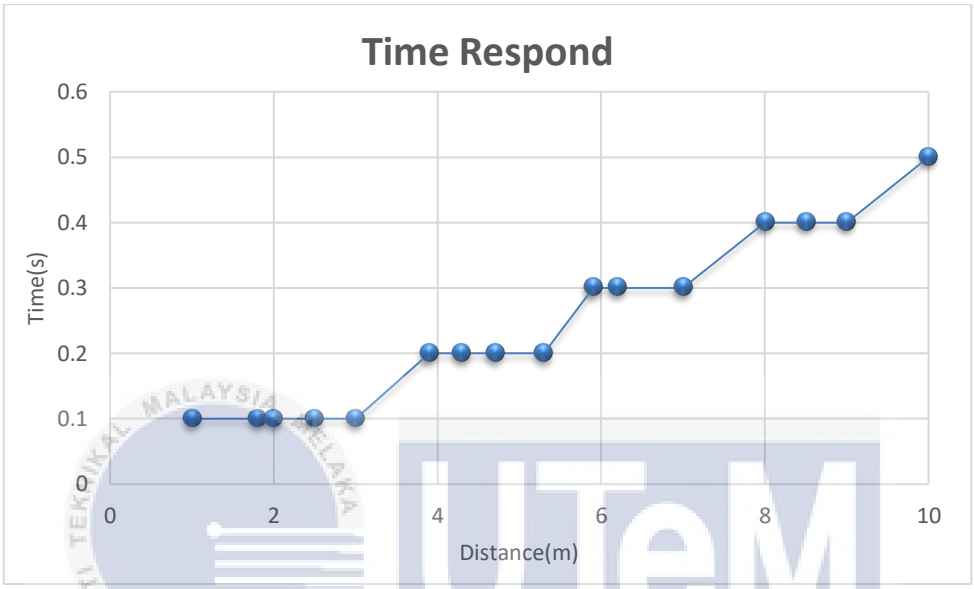


Figure 4.3: Time respond for child tracker using Wi-Fi

Based on the Figure 4.3, the graph shows the distance between the transmitter and the receiver against time taken receive data. The time taken to receive data had been recorded from the distance 1m to 10m. It is difficult to compare the distance between the transmitter and receiver when the distance was smaller than 10m due to notification will sent to the phone. the average time taken for data receive was about 0.1s when the distance was in the range of 2m to 3.9m. Furthermore, the average time taken for data receive was around 0.2s when the distance between the transmitter and receiver was in the range of 4m to 4.9m. Besides, the average time taken for data receive was about 0.3s when the distance went up to the range of > 6m. It increased about 0.1s by compare with the initial average time respond for the distance range of 4m to 4.9m. This graph illustrates the distance between transmitter and receiver increase, the time taken to receive data increases.

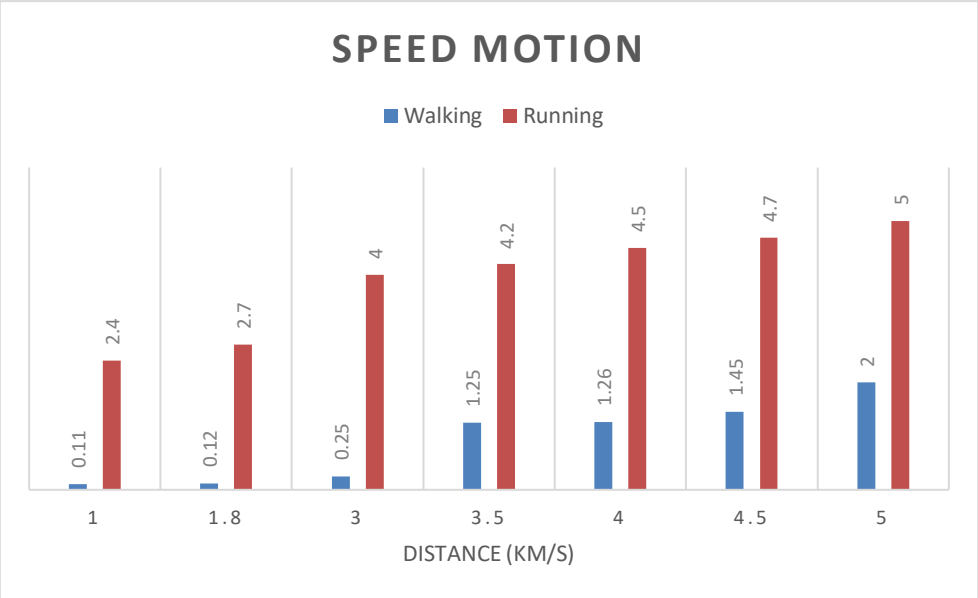


Figure 4.4: Speed for child tracker using Wi-Fi

In accordance with the data depicted in Figure 4.4, the graphical representation illustrates the correlation between the spatial separation of the transmitter and the receiver and the velocity of motion during the reception of data. The interpretation of the graph becomes intricate, particularly when the motion velocity exceeds 5 km/s. Under such circumstances, the system status transitions to either green or red on the mobile device.

Significantly, a comprehensive analysis has been conducted employing two distinct methods: walking and running, as clearly illustrated in the graph. Observations reveal that when walking at a speed ranging from 1 to 3 km/h, it leads to a status indicative of a favorable situation. Conversely, in the case of running, covering a considerable distance at a heightened pace results in a red status, underscoring a critical situation.

Hence, the derived speed from the graph approximates around 5 km/h, providing a nuanced understanding of the varying statuses associated with different speeds in both walking and running scenarios. This detailed comparison sheds light on the nuanced dynamics of speed and distance, emphasizing the significance of the presented graph in assessing and categorizing the situational aspects of these activities.

### 4.3.1 Arduino cloud

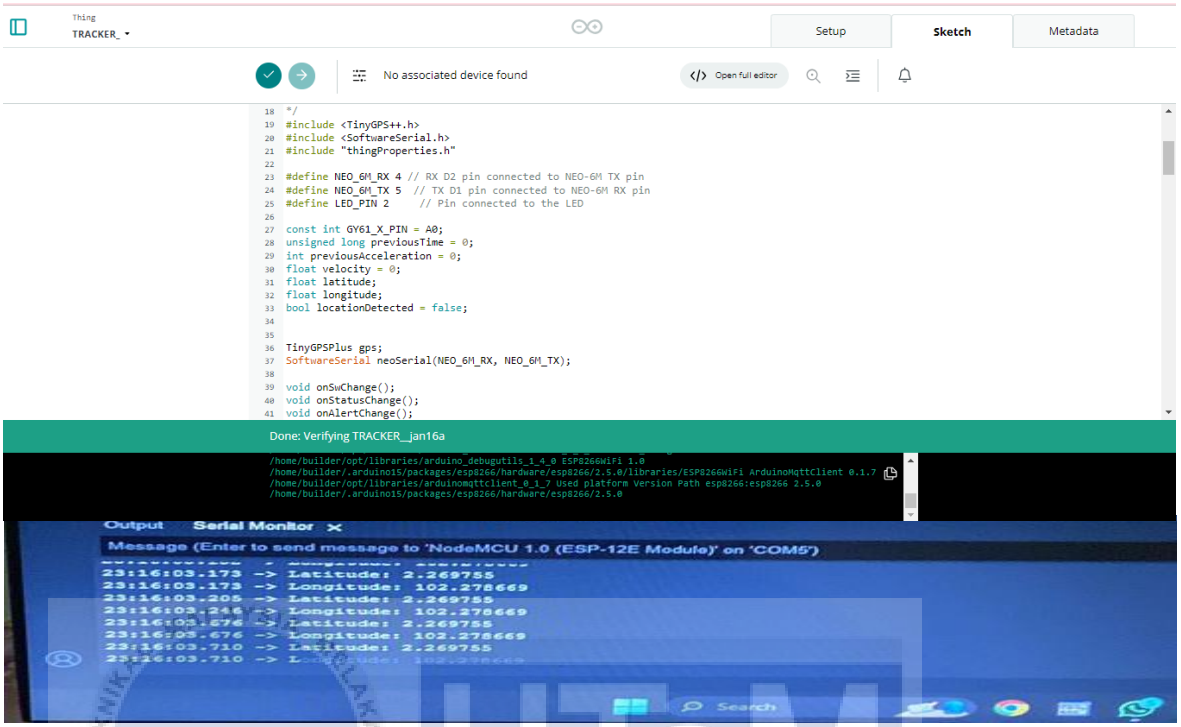


Figure 4.5: Show the Serial Monitor tool of the Arduino cloud

The baud rate is set to 9600. The result in the serial monitor has shown that the GPS Module at the transmitter and receiver are works as expected. The transmitter sends the data to the receiver and NodeMCU 8266 sends data to the serial port.



The GPS module at the transmitter detected the location's coordinate and sent the coordinate to the Serial Port viaNodeMCU 8266. Figure 4.5 shows the receiver's data in the Serial Monitor of Arduino cloud. The Wi-Fi module at the trasmitter was used to receive data from the transmitter and shows the result at the Serial Monitor of Arduino cloud . The data of the location's coordinate was not accurate at initial due to the GPS Module failed to detect the correct position coordinate at the starting time. The error can be ignored after the receiver received the accurate data successfully in a few minutes later. The distance between the transmitter and the receiver had been received by using one GPS module.

### 4.3.2 Arduino cloud Map Widget

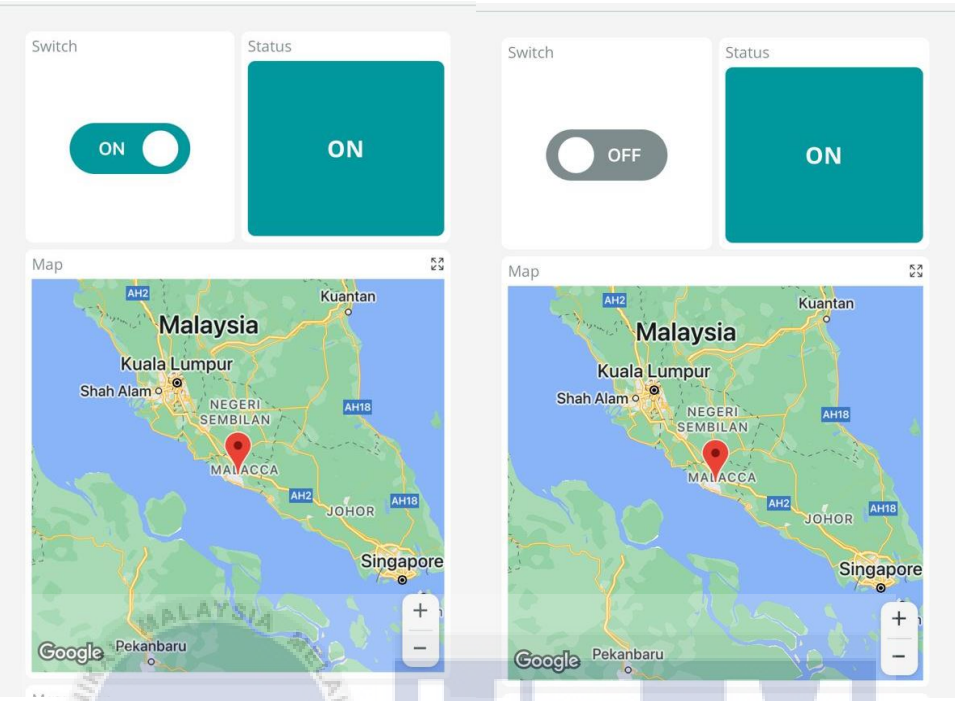


Figure 4.6: The current location of the child

The marker represent of the position of the pet to move around. From the Figure 4.6, it shows location of the pet moving from one place to another. This is a real time tracking system. The parent can obtain the location of their child immediately from their Iot remote mobile application due to the identity of this real time tracking system.



### 4.3.3 Notification

Notification widgets were added on Arduino cloud application in this project.

```
141   velocity = 0;
142
143   int rssi = WiFi.RSSI();
144   //Serial.print("RSSI: ");
145   //Serial.println(rssi);
146
147   if (rssi > -65)
148   {
149     //Serial.println("Good signal - Green");
150     alert = ("Child Safe");
151   }
152   else if (rssi > -75)
153   {
154     //Serial.println("Moderate signal - Yellow");
155     alert = ("Be vigilant, child is sligthly fulther away");
156   }
157   else
158   {
159     //Serial.println("Weak signal - Red");
160     alert = ("Emergency!!! child too far away");
161   }
```

Figure 4.7: Coding for calling notification

From the Figure 4.7, it showed the coding of calling notification. The first line of the example coding declares the RSSI in the coding. There are three criteria are executed, which are RSSI range, subject, and body The second line of the coding call the Notification which activates the alert for Mobile OS.

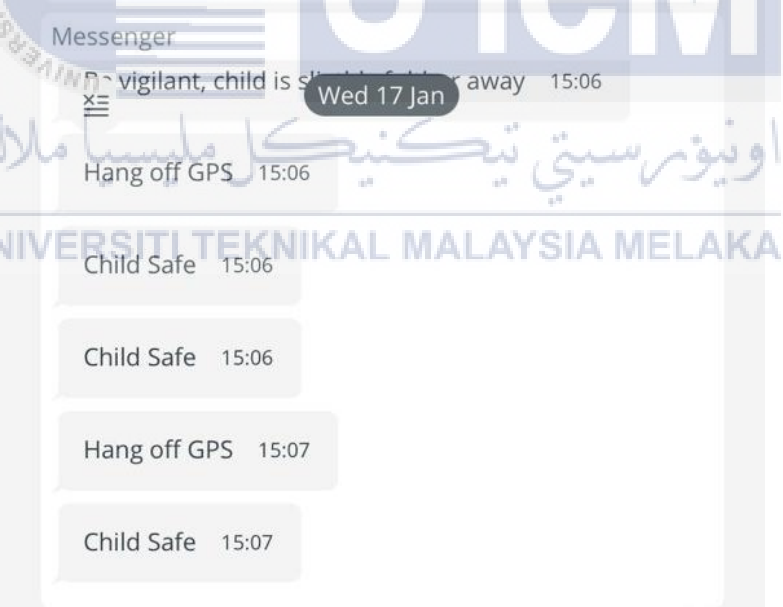




Figure 4.8: Notification

Figure 4.7 shows the push notification that has been received via Arduino cloud application. Notification is called when the child near and away from the parent based on the RSSI signal

strength that have been programed. It can remind parents to pay attention to their child in order to prevent the child from going missing.

## 4.4 Summary

From this chapter, the analysis of this project has been obtained to calculate the time response for the tracking system in the operation of transmission data from transmitter to receiver. The time taken to receive data will increase when the distance between the transmitter and receiver increases. This illustrates that the shorter the time taken for the receiver to receive data, the more accuracy of the tracking system. It was difficult to obtain accurate distance when both GPS module were too close to each other due to the unstable accuracy signal. Arduino cloud application was chosen as the IoT platform for this project. Arduino cloud map widget is added in Arduino cloud application in order to display the location of the child. The parents can monitor their child easily when there was in crowded places. In order to reduce the possibility of child loss, Arduino cloud application has been set to send notification to the parent when the child is far away for a certain distance. As the result, the probability of losing child will reduce since the monitoring improved due to the warning notification in time.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

This project involves both hardware and software development. The hardware components include a transmitter and a receiver. The transmitter is constructed using NodeMcu ESP8266, GY-61 DXL335 3-Axis Accelerometer Module, and Neo 6m GPS module. The receiver, on the other hand, is built using the Arduino Cloud. As for the software, the project is implemented using the C++ programming language.

Wi-Fi technology, chosen for its low data rate and low power consumption characteristics, provides a cost-effective solution compared to other communication devices. The Child Trackers Using Wi-Fi tracking system consists of two main parts: the transmitter and the receiver. The Wi-Fi module serves as the communication device for both receiving and transmitting data. The Arduino Cloud platform is utilized to control the NodeMcu ESP8266 and display the child's location on a map. Child Trackers Using Wi-Fi is a real-time tracking system that allows parents to trace their child's current location. An automatic alert system is in place to notify parents when the child leaves a designated zone.

Besides, the performance of the tracking system had been analyzed by comparing the average time response in different distance range. The distance between the transmitter and receiver increases this cause the signal to become weaker. Thus, the receiver takes longer time to receive data. The objective for this project had been achieved successfully.

## 5.2 Recommendation and Future Work

In this project, ESP8266 NodeMCU, Neo 6M GPS module, GY-61 DXL335 3-Axis Accelerometer Module, and LiPo battery are used as critical components. However, challenges arise due to the limitations of these components in certain scenarios.

For the ESP8266 NodeMCU, it is noted that its current setup may result in a time-consuming initialization and motion detection process. To address this, an upgrade to a higher System on Chip (SOC) is recommended, which can significantly improve performance.

The Neo 6M GPS module, while effective in outdoor locations, faces limitations when used indoors. To overcome this constraint, a proposal has been made to replace the GPS module with a Global Navigation Satellite System (GNSS) module, which is known for its high sensitivity in indoor environments.

The GY-61 DXL335 3-Axis Accelerometer Module, a valuable asset for motion detection, is part of a system that operates continuously, potentially leading to unnecessary notifications. The proposed fix involves integrating a mode button to block notifications during certain events or festivals, improving user convenience.



The LiPo battery, chosen for its rechargeable nature and compact design, presents a challenge when paired with the ESP8266 NodeMCU, which can only provide a maximum current of 200mA. To solve this issue, exploring battery options with lower current characteristics is recommended for a more suitable power supply.

These component-specific recommendations aim to optimize the efficiency and functionality of the tracking system, ensuring its adaptability to various scenarios and user needs.

## 5.3 Project Potential

This Wi-Fi-based tracking system, originally designed for the NodeMCU ESP8266, has versatile applications beyond object tracking, making it ideal for tracking children and monitoring dementia patients. It serves as a valuable tool for anti-theft protection when used on items such as luggage or valuables. In case of theft, it triggers a notification on the smartphone or via email, allowing the user to identify the location of the stolen item via the Arduino Cloud on their smartphone.

Additionally, Wi-Fi child trackers are designed to monitor the whereabouts of children and dementia patients. Users receive automatic alerts when children or patients leave the designated safe zone. This feature enables immediate action to prevent possible tragedies. Wi-Fi technology not only improves anti-theft functionality but also expands system utility to prioritize the safety and well-being of children and vulnerable individuals.

This product goes beyond mere functionality, it represents a comprehensive solution that combines the latest technology with practical utility. The market potential is vast, meeting the needs of concerned parents looking for enhanced security measures for their children and discerning travelers who want a robust anti-theft solution for their valuables. The applications are limitless, making our Wi-Fi tracker an indispensable tool for those who prioritize security and peace of mind.

Invest in the epitome of tracking technology, where security meets convenience. Make our Wi-Fi-based tracking system an essential component of your daily life and commercial endeavors, embracing a future where security seamlessly integrates with sophistication.

# REFERENCES


[1] Nattaphit Jengsriwon and Suppakarn Chansareewittaya, " LoRaWAN GPS Tracker ," 2023.

[2] S. Z. Sweidan, R. Saifan, K. A. Darabkh, S. Abu-Kaff, and S. Al-Ali, "Kids' Tracker: An Android Application for Tracking Children," *Journal of Software Engineering and Applications*, vol. 10, no. 13, pp. 907–924, 2017, doi: 10.4236/jsea.2017.1013052.

[3] [3] E. O. M. F. A. A. A. Al-Mazloum, "GPS and SMS-Based Child Tracking System Using Smart Phone," 2014.

[4] [4] S. A. Tiwarkar, S. Suresh Bhumannavar, G. Kishor Kshirsagar, and A. Dinkar Ghare, "School Child Tracker System Using IOT," 2020. [Online]. Available: www.IJARIIT.com.

[5] [5] M. Koushiga Nanthini, S. Siddharthan, V. Oviyapriya, M. Poovizhi, and S. T. Harini, "RSSI BASED Wi-Fi LOCATION TRACKER FOR ANDROID APPLICATION", doi: 10.1155/2015/52874.

[6] [6] A. Z. M. Tahmidul Kabir, Al Mamun Mizan, Plabon Kumar Saha, Golam Kibria, Akib Jawad Ta-sin, and Md Saniat Rahman Zishan, "A Comprehensive Smart IoT Tracker for the Children, Elder, and Luggage With the Assistance of Mobile App," 2020.

[7] [7] Xiangning Meng, Rui Wang, and Xirui Li, "Design and implementation of an elderly tracker system," 2016.

[8] [8] E Francy Irudaya Rani, Niranjana. R, Shah Mohammed Ilyas. S, and Suresh. A, "Students Bus Tracker (SBT) Enabled GPS Device for Regular Monitoring of Heavy Vehicles through Android Application," 2021.

[9] [9] Mohamed FEZARI and Ali Aldahoud, "Arduino LilyPad Best Fit Microcontroller for wearable devices ," 2019.

**APPENDICES**

Appendices 1 : Gantt Chart

| Project Activity/Task | Week | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Project Briefing | | | | | | MIDTERM BREAK | | | | | | | | |
| Research Project | | | | | | | | | | | | | | |
| Background, Problem Statement and objective | | | | | | | | | | | | | | |
| Identify Component | | | | | | | | | | | | | | |
| Make Project proposal | | | | | | | | | | | | | | |
| Project flow chart | | | | | | | | | | | | | | |
| Methodology | | | | | | | | | | | | | | |
| Review report | | | | | | | | | | | | | | |
| Submit 1st darft report | | | | | | | | | | | | | | |
| Presentation | | | | | | | | | | | | | | |

Plan
Actual

Appendices 2 : Coding

```
/*
  Sketch generated by the Arduino IoT Cloud Thing "Untitled"
  https://create.arduino.cc/cloud/things/b172976c-4944-40b0-9f4b-cd0308c8aea3

  Arduino IoT Cloud Variables description

  The following variables are automatically generated and updated when changes are made to the Thing

  String alert;
  CloudSwitch sw;
  int speed;
  CloudLocation place;
  bool status;

  Variables which are marked as READ/WRITE in the Cloud Thing will also have functions
  which are called when their values are changed from the Dashboard.
  These functions are generated with the Thing and added at the end of this sketch.
*/
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
#include "thingProperties.h"

#define NEO_6M_RX 4 // RX D2 pin connected to NEO-6M TX pin
#define NEO_6M_TX 5  // TX D1 pin connected to NEO-6M RX pin
#define LED_PIN 2     // Pin connected to the LED

const int GY61_X_PIN = A0;
unsigned long previousTime = 0;
int previousAcceleration = 0;
float velocity = 0;
```

```
float latitude;
float longitude;
bool locationDetected = false;


TinyGPSPlus gps;
SoftwareSerial neoSerial(NEO_6M_RX, NEO_6M_TX);

void onSwChange();
void onStatusChange();
void onAlertChange();

void setup()
{
  // Initialize serial and wait for port to open:
  Serial.begin(9600);
  Serial1.begin(9600);
  pinMode(LED_PIN, OUTPUT);
  pinMode(GY61_X_PIN, INPUT);
  delay(1500);

  // Defined in thingProperties.h
  initProperties();

  // Connect to Arduino IoT Cloud
  ArduinoCloud.begin(ArduinoIoTPreferredConnection);
  setDebugMessageLevel(2);
  ArduinoCloud.printDebugInfo();
}

void loop()
```

```
{
  ArduinoCloud.update();
  // Your code here
  // Process GPS data
  //location = neoSerial.read();
  while (neoSerial.available() > 0)
  {
    locationDetected = true;
    char c = neoSerial.read();
    gps.encode(c);
  }
    // Check if a fix is available
    if (gps.location.isUpdated())
    {
      //locationDetected = true;
      //Serial.print("Location: ");
      //Serial.print(gps.location.lat(), 6);
      //Serial.print(", ");
      //Serial.println(gps.location.lng(), 6);


      latitude = gps.location.lat();
      longitude = gps.location.lng();

      Serial.print("Location coordinates: ");
      Serial.print(latitude, 6);
      Serial.print(", ");
      Serial.println(longitude, 6);

      //coordinates = Location(latitude, longitude);
      place = Location(gps.location.lat(), gps.location.lng());
```

```
  //Serial.print("coordinates: ");
  //Serial.println(coordinates);

}
else
{
  if (locationDetected)
  {
    // The component was previously able to detect a location, but can no longer do so
    Serial.println("Location detection lost. Check the GPS connection or satellite signal.");
    locationDetected = false;
    delay(200);
  }
  else
  {
    Serial.println("Waiting for GPS fix...");
    alert = ("Waiting for GPS fix...");
    delay(200);
  }
}

unsigned long currentTime = millis();
float deltaTime = (currentTime - previousTime) / 1000.0;

int acceleration = analogRead(GY61_X_PIN);
Serial.print("acceleration: ");
Serial.print(acceleration);

velocity += (((0.5 * (acceleration + previousAcceleration) * deltaTime) / 1000) * 60);
```

```
// Print speed in m/s
Serial.print("\n Speed: ");
Serial.print(velocity);
Serial.println(" Km/s");

previousAcceleration = acceleration;
previousTime = currentTime;

if (velocity >= 5)
{
  status = false;
}
else
{
  status = true;
}

velocity = 0;

int rssi = WiFi.RSSI();
//Serial.print("RSSI: ");
//Serial.println(rssi);

if (rssi > -65)
{
  //Serial.println("Good signal - Green");
  alert = ("Child Safe");
}
else if (rssi > -75)
{
  //Serial.println("Moderate signal - Yellow");
```

```
      alert = ("Be vigilant, child is sligthly fulther away");
    }
    else
    {
      //Serial.println("Weak signal - Red");
      alert = ("Emergency!!! child too far away");
    }
int switchState = sw;

  if (switchState == HIGH)
  {
    digitalWrite(LED_PIN, LOW);
  }
  else
  {
    digitalWrite(LED_PIN, HIGH);
    alert = ("Hang off GPS");
    status = true;
  }
}

void onAlertChange()
{

}

/*void onSwChange()
  {

  }*/
```

```
void onStatusChange()
{

}

/*
  Since Speed is READ_WRITE variable, onSpeedChange() is
  executed every time a new value is received from IoT Cloud.
*/
void onSpeedChange()  {
  // Add your code here to act upon Speed change
}

/*
  Since Sw is READ_WRITE variable, onSwChange() is
  executed every time a new value is received from IoT Cloud.
*/
void onSwChange()  {
  // Add your code here to act upon Sw change
}
```