PIMPRI CHINCHWAD EDUCATION TRUST'S

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE-44

A Project Report

On

Anti-Theft Tracking Device

By

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Under the Guidance of

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DEPARTMENT OF

ELECTRONICS AND TELECOMMUNICATION

B.E. 2022-23

CERTIFICATE

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This is to certify that the project ***Anti-Theft Tracking Device*** submitted by MR. KUSHAGRA MISHRA, SOHAM PHIRKE, SAHIL ADHAV, Department of Electronics and Telecommunication, for the fulfilment of the degree of *B.E (EnTC),* has completed their project work.

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DEPARTMENT OF

ELECTRONICS AND TELECOMMUNICATION

B.E. 2022-23

ABSTRACT

Currently, many cases of valuable objects or mentally challenged people are being stolen or lost respectively in many crowded areas as well as some mentally challenged people leave the house without any information which can lead to various unfortunate events. There are multiple ways of tracking lost valuable objects or mentally challenged persons by various tracking devices available in the market. But currently, available products are expensive and have a low coverage area. Here, we are proposing a low-cost object/mentally challenged person finder in the form of a compact tag. It will provide the feature of detecting and tracking the object/mentally challenged person by SMS to which the tag is attached. This device has limited firmware and compact hardware including Microcontroller, GSM, LTE modules, etc. which will be powered by a 12V battery and will be compatible with all the smartphones available in the market

ACKNOWLEDGEMENT

All the accomplishments in the world require the effort of many people and this project is no different. Regardless of the source, we express our gratitude to those who have contributed to the successof this project.

We gratefully acknowledge and express heartfelt regards to all the people, who helped us in makingthe idea of the project a reality. We express our gratitude towards **Prof. A.R. Suryawanshi** for his guidance andconstant supervision as well as for providing necessary information regarding the project also for their support in completing the project.

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LIST OF ABBREVIATIONS

GSM - Global System for Mobile Communication

GPS - Global Positioning System

IDE - Integrated Development

SMS - Short Message Service

LBS - Location-Based Service

PHP - Hypertext Processor

PCB – Printed Circuit Board

SIM – Subscriber Identity Mobile

PWM – Pulse Width Modulation

SOC- System on Chip

GNSS- Global Navigation Satellite System

IC- Integrated Circuit

LIST OF TABLES

CHAPTER: 1

INTRODUCTION

INTRODUCTION

1.1 Introduction

People are increasingly using cell phones with Android operating systems. The diversity of additional features offered by these cell phones is attracting an increasing number of people. As a result, including the most remarkable features and resources is essential nowadays. Moreover, GPS is a product that delivers excellent services for identifying a certain location. This capability aids in the creation of programs that can follow the places of every action of a mentally challenged person anytime they leave the house by using real-time location on Google Maps on their phones. A kid monitoring system allows parents to watch their child's activities. The concept was created with family members in consideration, and it assists them in locating disabled persons on the move activities. When a child or a mentally challenged person gets separated from their relatives in public or a busy setting, it is quite difficult to find them, even in communities. To deal with this problem, we will create an anti-theft tracking device in the form of wearables or compact devices. When the family wishes to check on the handicapped person or children who may have become lost, this system will communicate the location of the impaired person's device to the family's smartphone.

1.2 Motivation

The motivation behind creating the anti-theft tracking device is to provide a reliable and effective solution that enhances the safety and security of mentally challenged persons. The device aims to empower them to independently manage their belongings and prevent theft or loss, while also providing peace of mind to their caregivers and loved ones., the motivation to develop the anti-theft tracking device is also driven by the limitations of existing solutions in the market. Traditional anti-theft devices may not be suitable for mentally challenged persons due to their complex setup or operation, or may not be tailored to their unique cognitive abilities. Therefore, there is a need for a specialized device that is specifically designed to meet the requirements and challenges faced by mentally challenged persons.

1.3 Background

The anti-theft tracking device is a specialized solution designed to address the unique challenges mentally challenged persons face in managing their belongings and preventing theft or loss. Individuals with mental challenges may have difficulties remembering the location of their belongings or recognizing potential threats, making them vulnerable to theft or loss of their possessions. This anti-theft tracking device has been developed to provide an effective solution that caters to their specific needs and enhances their safety and security.

CHAPTER: 2

LITERATURE SURVEY

LITERATURE SURVEY

The Literature survey was carried out where different types of methods were assessed and their advantagesand disadvantages were found. The purpose of carrying out a literature survey was to acquire information onvarious techniques used to build a tracking device with various technologies.

2.1 Literature Survey

Table 2.1: Literature Survey table

Sr. no.	Title	Year	Publisher	Methodology	Conclusion
1	**Location Tracking for Blind Swimmers**	2020	IEEE International Conference on Power Electronics and Renewable Energy Applications	The most challenging and crucial task when it comes to blind swimmers is location tracking. Visually impaired swimmers often struggle to maintain awareness of their position swimming and may even get lost while trying to return to their starting point	The terminal displayed the readings collected from the programme, including the locations and the accelerometer coordinates (XYZ), which were generated by the application. This information was kept in a different file with the name output. Further use of this film was made of it in the coding phase for calculating distance. The distance between subsequent spots was measured, and some voice feedback in the form of directives was also provided

2	**Location-Based Parental Control- Child Tracking App Using Android Mobile Operating System**	2018	IEEE International Conference on Computing Communication and Automation	Due to the explosive rise in communication wirelessly and technologies with location-based positioning in the current day, location-based services (LBS) are emerging applications in mobile data services. Today, the cell phone has developed into a potent tool and an essential component of daily life for interpersonal connection. This new software programmes aid with location tracking and emergencies.	This paper suggests a location-based child tracking and parental control app that can obtain a Childs's SIM information, especially in an emergency. The app has also been tested, and it functions properly with GPS turned on. We are currently working to improve the functionality of this child-tracking and parental control app.

3	**Design and implementation of a real-time tracking system based on Arduino Intel Galileo**	2016	8th European Conference on Artificial Intelligence (ECAI) International Conference	Based on the GPS, tracking and monitoring of automobiles is being widely used (GPS). Framework based on the Arduino integrated board Google Galilee	An integrated solution for tracking and monitoring vehicles in real time was suggested in this research. For GPS-based vehicle tracking, the proposed system has been successfully developed and put into use. The gadget inside the car is made up of a SIM908 Module with GPS, GPRS, and GSM capabilities and an embedded board by Intel Galileo and Arduino. The system received GPS signals and sent data to the Apache web server. Additionally, the vehicle owner received this data by SMS. If a car is stolen, the vehicle's location data is provided by the proposed system, which includes latitude, longitude, altitude, date, satellites, speed OTG, and course.

4	**Directional Wi-Fi-Based Indoor Location System for Emergency**	2010	IEEE International Conference on Ubiquitous Intelligence & Computing	An inexpensive emergency location system with easy use indoors. For the building's perimeter, only two directional access points (APs) are needed, and training data from a few reference sites is all that is needed. While avoiding extensive data collection tasks, our solution is simpler to implement. The System locates mobile devices in real-time, according to experiment results, and its room-level accuracy is respectable.	The system's efficiency and precision are increased by the use of the directional antenna's angle information function. Additionally, we will develop a model for the propagation of directional WI-FI signals, which will reduce the number of training data points required for the prediction model, which is crucial for practical implementations.

2.2 Summary of literature survey

As the above literature survey presents a comparison of various research papers from different backgrounds. It is observed that the research of the systemis done on the primary level and the system implementation is explained in a very precise manner. This systemimplementation properly executes the function of various parameters. The choice of various hardware can be done by analyzing these surveys.

The summary of the above survey can be given as the fast development of wireless communication and location-based positioning technologies, location-based services (LBS) are an emerging use in mobile data services in the current era. Today, the cell phone has developed into a potent tool and an essential component of daily life for interpersonal connection. These new software programmes are beneficial for tracking whereabouts and emergencies. One of the most severe types of visual impairment that limits a person's ability to carry out daily chores is blindness. A blind individual needs assistance from another person to complete daily duties. As a result, the user lacks independence. When it comes to the situation of blind swimmers, location tracking becomes the most challenging and crucial responsibility. Visually impaired swimmers often struggle to maintain track of their position while swimming and may even get lost and not make it back to their intended destination. Currently, such technologies rely on a third party to assist these blind swimmers in avoiding these challenges. In emergencies, an easy-to-setup and real-time finding solution is crucial for prompt rescue, especially for indoor scenarios. But the majority of conventional solutions are ineffective for a variety of reasons: Indoor applications cannot use GPS, some require extensive pre-processing to get training data, and some call for expensive, specialized equipment. In this study, we provide a low-cost, user-friendly indoor positioning system for emergencies. The building can be surrounded by just two directional access points (APs), and training data froma few reference sites is all that is needed. In contrast, our system doesn't require extensive data collection labour and is simple to implement. The system can accurately and in real-time find mobile devices, according to test results. Based on the GPS, tracking and monitoring of automobiles is being widely used (GPS). A real-time tracking system is suggested in the paper. The suggested architecture would make excellent use of technological advancements founded on embedded boards such as Arduino, Intel,

and Galileo. To track and monitor vehicles, this system uses the GSM, GPS, and GPRS. It uses the SIM908 Module, which combines three technologies: GPS, GPRS, and GSM. GPRS sends these data to the server, GPS provides the vehicle's location coordinates, and finally, the GSM sends warning messages to the phone of the vehicle owner. This article demonstrates the development of the prototype of the vehicle tracking system that is currently being used. In particular, the system will employ GPS to gather the coordinates of the vehicle's location and transmit them to the owner's phone over a GSM modem and the online server. Following that, the browser goes to the PHP site page that uses Google Maps to show the location in real time. We evaluated the findings of the system offered with the various commercial GPS devices to determine the position accuracy of the suggested system.

CHAPTER: 3

METHODOLOGIES

METHODOLOGY

This chapter presents the Methodology and the implementation strategies to solve problems with the help of technology. This covers all the levels of the problem by using software and hardware and the diagrammaticexplanation is shown below.

3.1 Block diagram

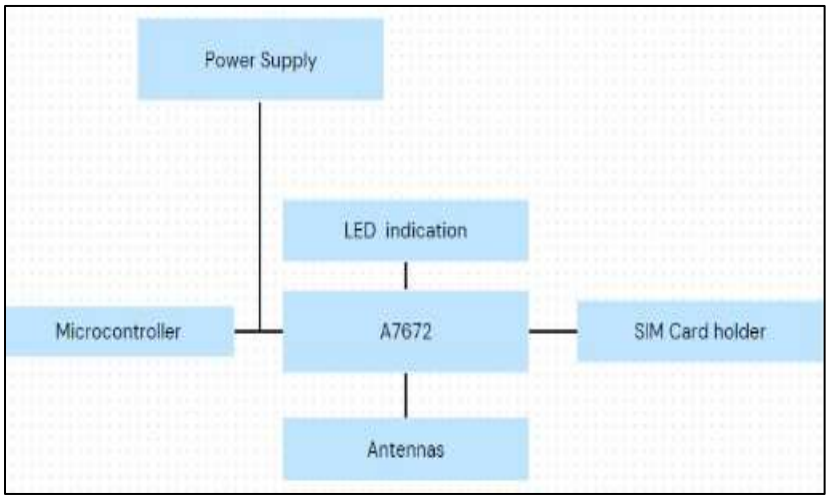


Figure 3.1: Block Diagram

3.1.1 Hardware specifications

This section illustrates the hardware requirement for the project along with specifications. the particularuse of the hardware in the project and the necessity of each are described as follows.

- **Power Supply:** Depending on the design and requirements, the anti-theft tracking device can be powered by either a rechargeable battery or an external power source. The power supply is a critical aspect of the device's functionality and longevity, as it determines its operational duration and reliability. The following details can be included in the technical specifications of the power supply

- **Microcontroller:** The microcontroller used in the anti-theft tracking device is a critical component that controls the overall operation of the device. The microcontroller plays a crucial role in executing the tracking device's programmed functions, processing data from the GPS and GSM modules, and managing the device's overall operation. Its capabilities and features are instrumental in ensuring the device's reliable performance and efficient tracking functionality.

- **A7672:** GSM module and a GPS module are used to enable communication and location-tracking functionalities. The module features multiple serial communication interfaces, such as UART, SPI, and I2C, for seamless data communication with the microcontroller and other external devices. The module operates on a supply voltage of 3.4V to 4.4V DC and consumes low power, making it suitable for power management in the tracking device. A network of satellites and receiving equipment called the global positioning system (GPS) is used to pinpoint a location on Earth. Some GPS receivers are so precise that they can pinpoint their location within one centimetre. Latitude, longitude, and altitude are all provided by GPS receivers as location information. They also give precise times.

- **Antennas:** Antennas play a crucial role in the wireless communication capabilities of the anti-theft tracking device. They are responsible for transmitting and receiving signals for GSM and GPS communication. The GSM antenna is designed to transmit and receive GSM signals for communication with the cellular network. The antenna is connected to the GSM module and is positioned in a way that ensures optimal signal reception and transmission. The GPS antenna is designed to transmit and receive GPS signals for precise location tracking. The antenna is connected to the GPS module and is positioned in a way that ensures optimal signal reception and accuracy of the location data.

- **Sim Card Holder:** The SIM card holder is typically a small plastic or metal slot that is designed to accommodate a standard-sized SIM card. It provides a secure and reliable connection between the SIM card and the GSM module, allowing for seamless communication with the cellular network.

The SIM card holder may include features such as a SIM card ejector mechanism or a latch for easy insertion and removal of the SIM card. It is typically located on the PCB of the tracking device, and its position and orientation may vary depending on the design of the device. The SIM card holder is an important component that ensures the proper functioning of the GSM module and enables the tracking device to establish communication with the cellular network.

3.2 Flow Diagram

The below figure illustrates the working of overall systems with the help of a Flow Diagram.

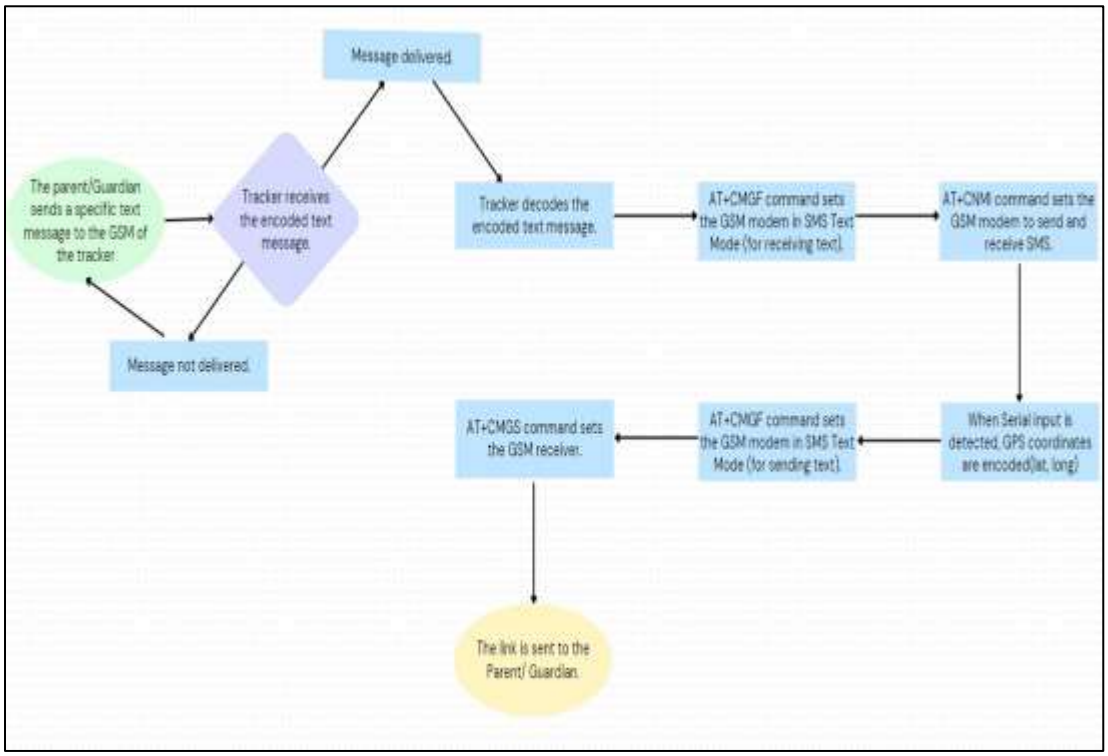


Figure 3.2: Flow Diagram

The system architecture for the anti-theft tracking device designed for mentally challenged individuals is carefully designed to provide reliable tracking and supervision. The system is divided into two main components: the family side and the impaired individual side. The family side acts as a" pseudo-server" for the system and is owned by the mentally challenged person's family. It consists of an

Android smartphone with SMS and internet services enabled, which serves as a communication hub for receiving location updates and alarms from the tracking device. On the other hand, the impaired individual side is equipped with a traceable module that includes GSM and GPS technology. This module serves as the assistive technology for the mentally challenged person, allowing them to be tracked and located in real time. The module communicates with the family's smartphone via SMS, providing continuous updates on the person's location coordinates, including latitude and longitude. The system relies on location services such as GPS or network-based location determination to accurately determine the mentally challenged person's position. The traceable module uses these location services to determine the coordinates based location of the person, which is then sent via SMS to the family's smartphone. This allows the family to track the person's location on a map using a designated tracking application. The tracking interface is developed on a Google map, allowing multiple users to access it by logging into the interface. The family can track the mentally challenged person's location in real time, as the module continually sends the position coordinates through SMS. The family's smartphone displays the location on a map, providing a visual representation of the person's whereabouts. This enables the family to monitor the person's movements, ensure their safety, and provide timely assistance when needed. Overall, the system's architecture is designed to be efficient and reliable, utilizing GSM and GPS technology along with SMS communication to provide accurate and real-time tracking of the mentally challenged person's location. The combination of these technologies allows for effective supervision and support, giving peace of mind to the person's family and caregivers.

CHAPTER: 4

HARDWARE IMPLEMENTATION

HARDWARE IMPLEMENTATION

4.1 Hardware Requirements

The Following sub-topics give the requirement of various hardware required toimplement the system.

- Microcontroller Atmega328P
- A7672
- LM2596 (Voltage Regulator)
- Resistors (8050 package)
- Capacitors (8050 package)
- Sim Card Holder (6 pin)
- Antenna Connectors
- Inductors

4.2 Hardware Specifications

This explains all the hardware i.e., Microcontroller and ICs used in this system is shown and details of their working along with calibration.

4.2.1 Microcontroller Atmega 328P

The ATmega328P is a microcontroller from the Atmel AVR family, commonly used in various embedded systems and electronic projects. It is a powerful and versatile microcontroller with a wide range of applications due to its rich feature set and extensive support within the Arduino ecosystem.

Figure 4.1: Atmega 328P (Source: www.google.com)

The ATmega328P microcontroller is based on the AVR RISC architecture and operates at a clock speed of up to 20 MHz It has 32 KB of Flash memory for storing the program code, 2 KB of SRAM for data storage, and 1 KB of EEPROM for non-volatile data storage. One of the key features of the ATmega328P is its support for digital and analog I/O (input/output) pins. It has a total of 23 I/O pins, which can be configured as digital inputs or outputs, as well as 6 analog input pins for reading analog sensor values. These pins can be used to interface with various sensors, actuators, displays, and other electronic components. The ATmega328P also has built-in peripherals such as UART (Universal Asynchronous Receiver/Transmitter) for serial communication, SPI (Serial Peripheral Interface) for interfacing with SPI devices, I2C (Inter-Integrated Circuit) for communicating with I2C devices, and timers for generating precise timing signals and controlling PWM (Pulse Width Modulation) outputs. In addition, the ATmega328P has extensive support for programming and debugging, with a wide range of development tools and software libraries available, including the popular Arduino IDE which provides a user-friendly interface for writing, compiling, and uploading code to the microcontroller.

4.2.2 A7672:

The A7672 is a system-on-chip (SoC) designed for use in global navigation satellite system (GNSS) receivers, such as those used in GPS devices. It is manufactured by the company Skyworks Solutions and includes both a GSM (2G) transceiver and a GPS receiver in a single chip.

Figure 4.2: A7672(Source: www.google.com)

The A7672 is designed to be low-power and highly integrated, making it a good choice for portable and battery-powered devices like smartphones, tablets, and wearables. It includes features like low-noise amplifiers (LNAs), filters, and power management circuits to help maximize battery life. Overall, the A7672 is a versatile and efficient SoC that can help enable the next generation of location-based services and devices.

4.2.3 LM2596:

The LM2596 is a popular voltage regulator integrated circuit (IC) that is widely used in electronic circuits to step down or regulate voltage levels. It is a versatile and efficient switching regulator that can convert higher input voltages to lower output voltages with high efficiency and low dropout voltage.

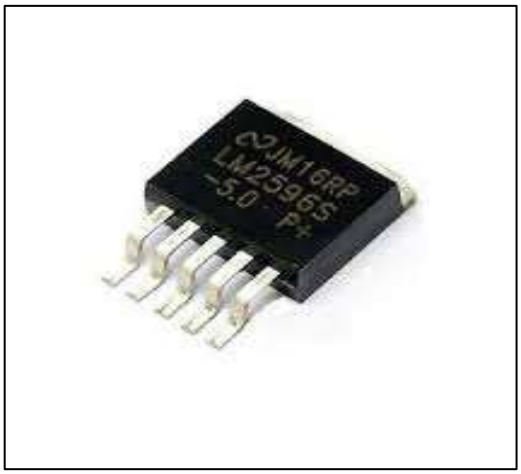


Figure 4.3: LM2596(Source: www.google.com)

The LM2596 operates as a step-down (buck) voltage regulator, which means it can convert a higher input voltage to a lower output voltage. It is capable of handling input voltages in the range of 4.5V to 40V, making it suitable for a wide range of applications. One of the key features of the LM2596 is its high efficiency, which is achieved through its switching mode operation. It uses a pulse-width modulation (PWM) technique to control the output voltage and regulate it to the desired level with minimal power dissipation. This makes it more efficient compared to linear regulators, which dissipate excess energy as a hat. The LM2596 also has built-in protection features such as thermal shutdown, overcurrent protection, and input/output voltage protection, which help safeguard the circuit against potential damage due to excessive temperature, current, or voltage conditions. The LM2596 is available in various package options, including through-hole and surface mount packages, making it easy to integrate into different types of electronic circuits. It requires only a few external components, such as input and output capacitors and an inductor, to operate, making it a cost-effective solution for voltage regulation.

4.3 Hardware Implementation

The implementation of all the sensors shown in the above section is shown in this chapter.

4.3.1 Circuit Diagrams

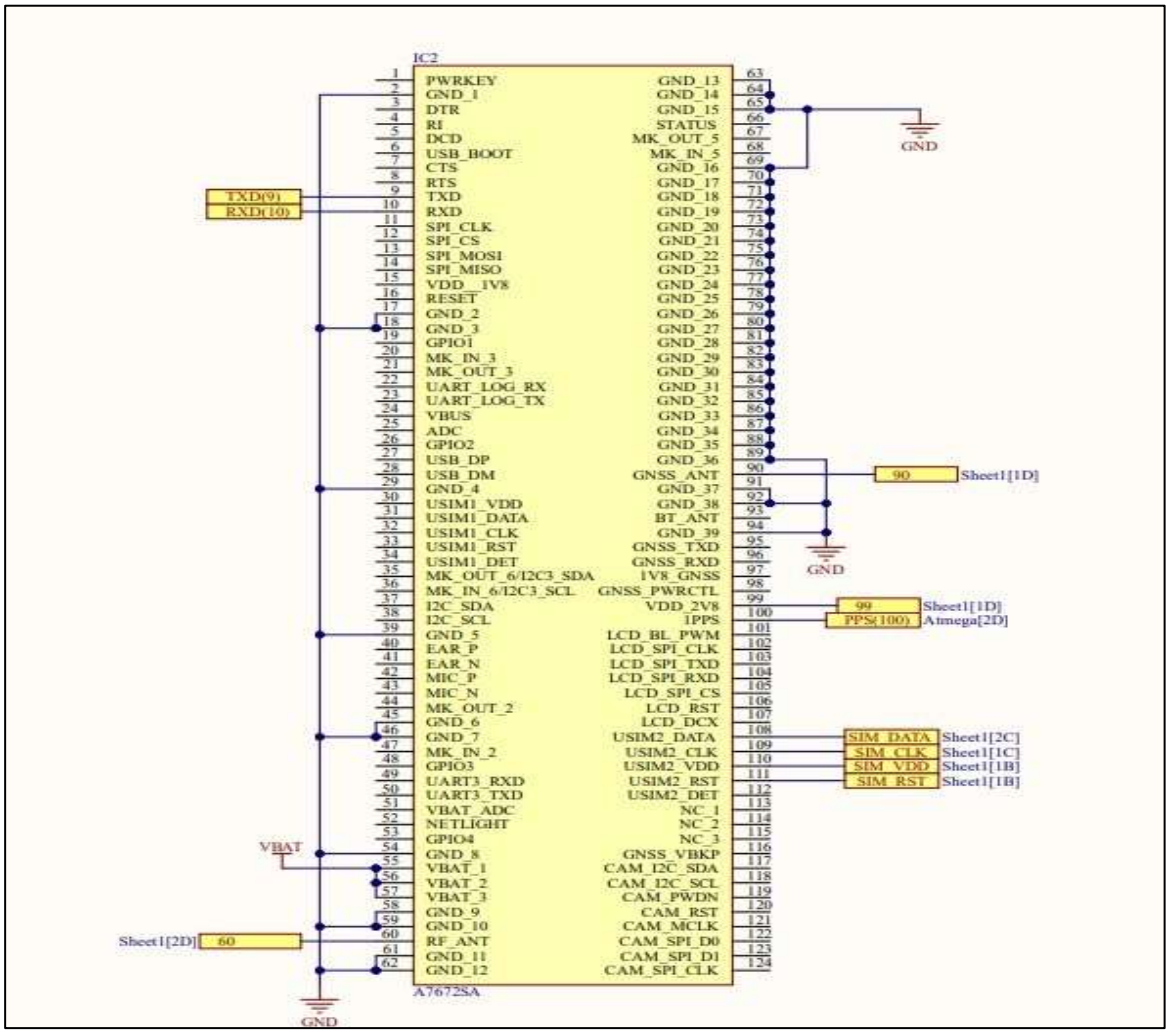


Figure 4.4 Circuit Design of A7672

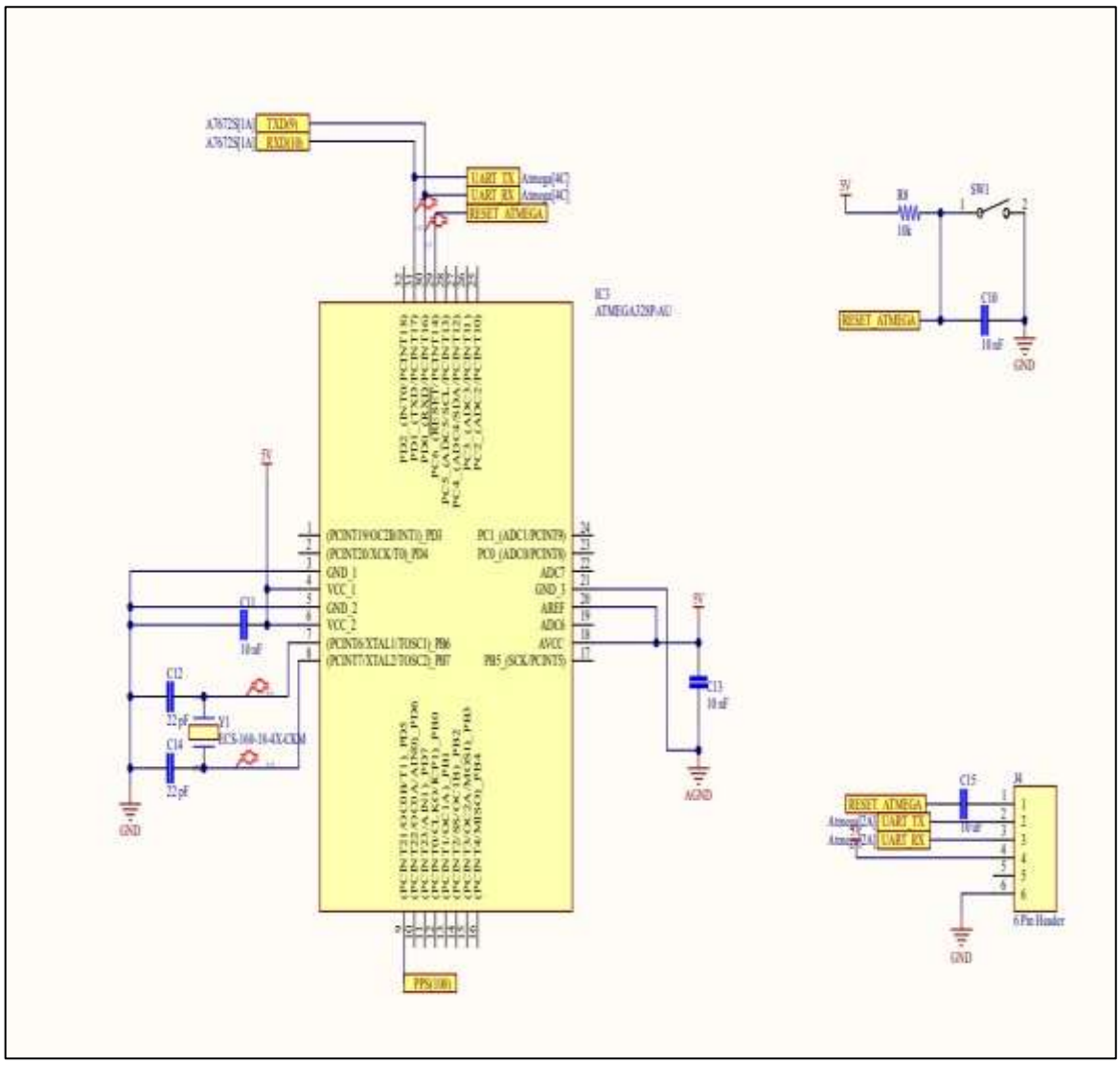


Figure 4.5 Circuit Diagram of Atmega 328P

The above figure represents the circuit design for Atmega 328P interfaced with A7672 IC's Tx, Rx and PPS pins

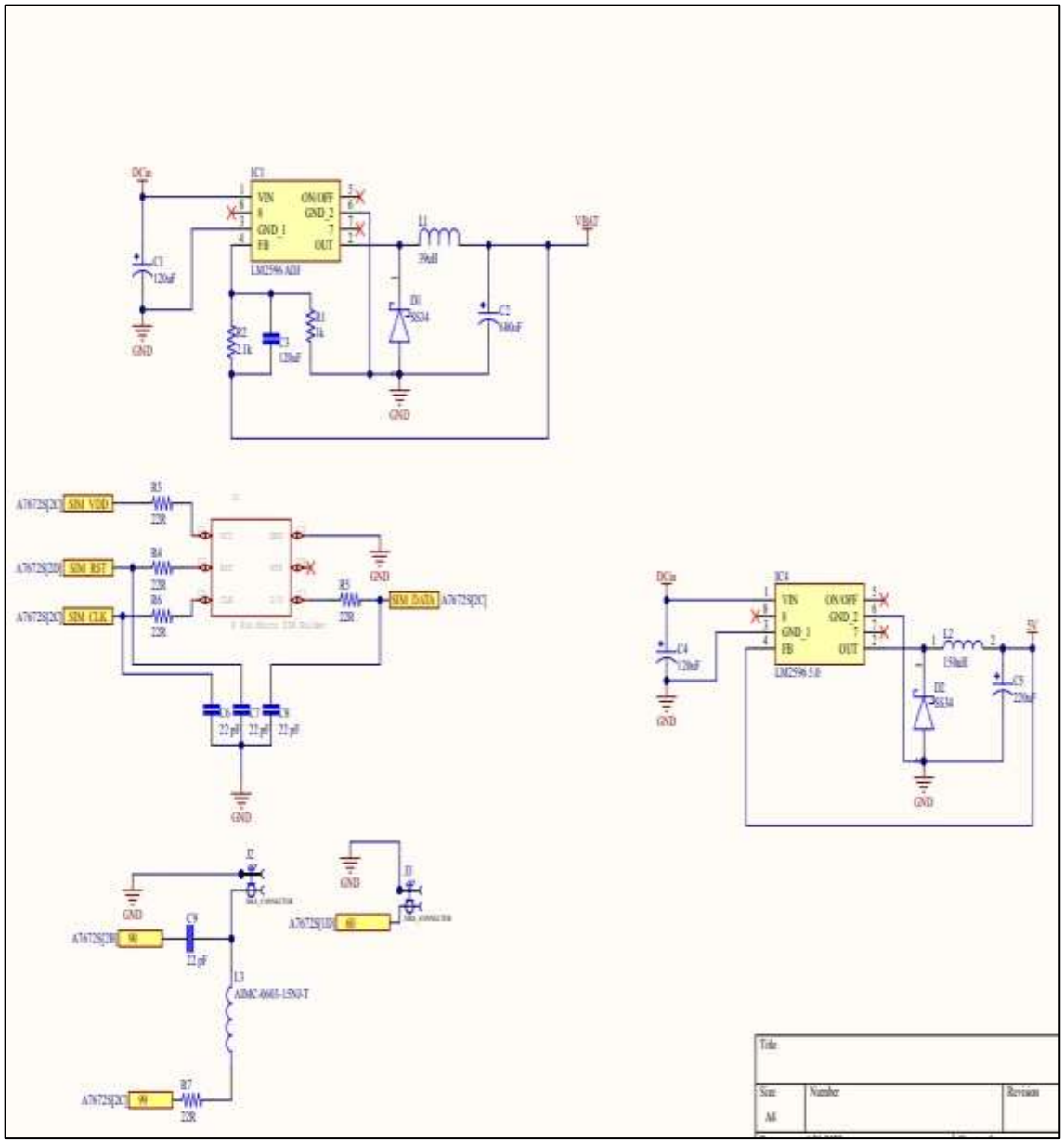


Figure 4.6 Circuit Diagram for Power Supply, Antennas and SIM Holder

The above figure represents the circuit diagram for power supply by using two LM2596 as step-down voltage regulators where one regulator converts 12V DC to 3.9V DC @ 2A and another regulator converts 12V DC to 5V DC @ 0.6A. Sim Holder connected to A7672 IC's VDD, RST, CLK and DATA pins. Antenna connectors interfaced with A7672 IC's RF and GNSS pins.

4.3.3 PCB Layout

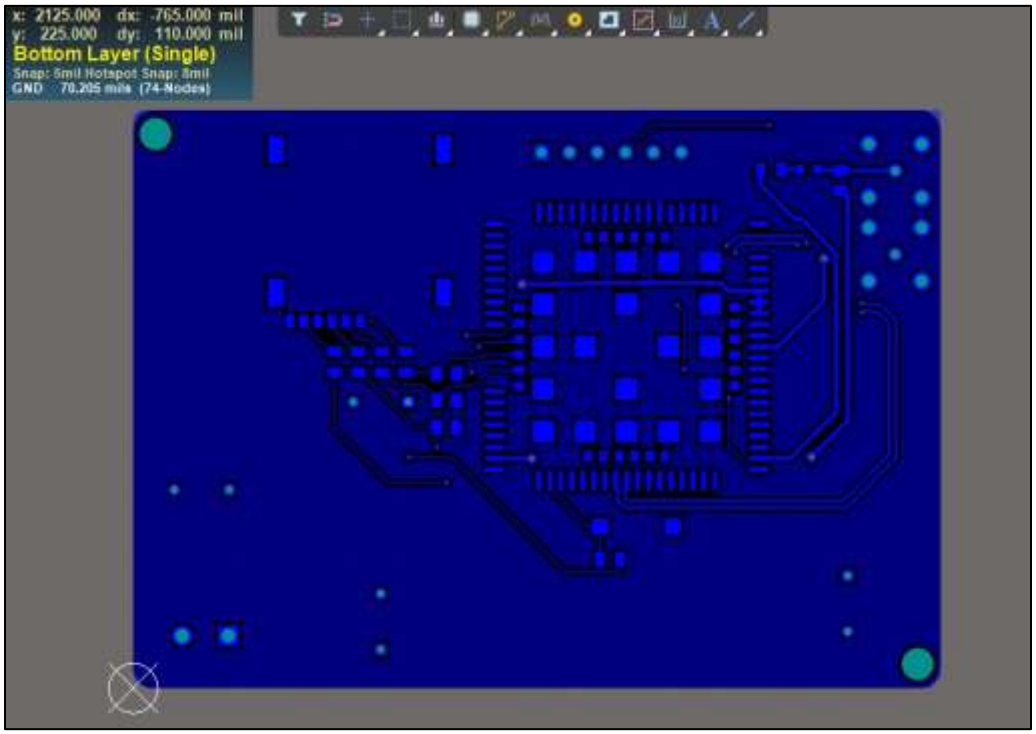


Figure 4.7 Bottom layer of PCB

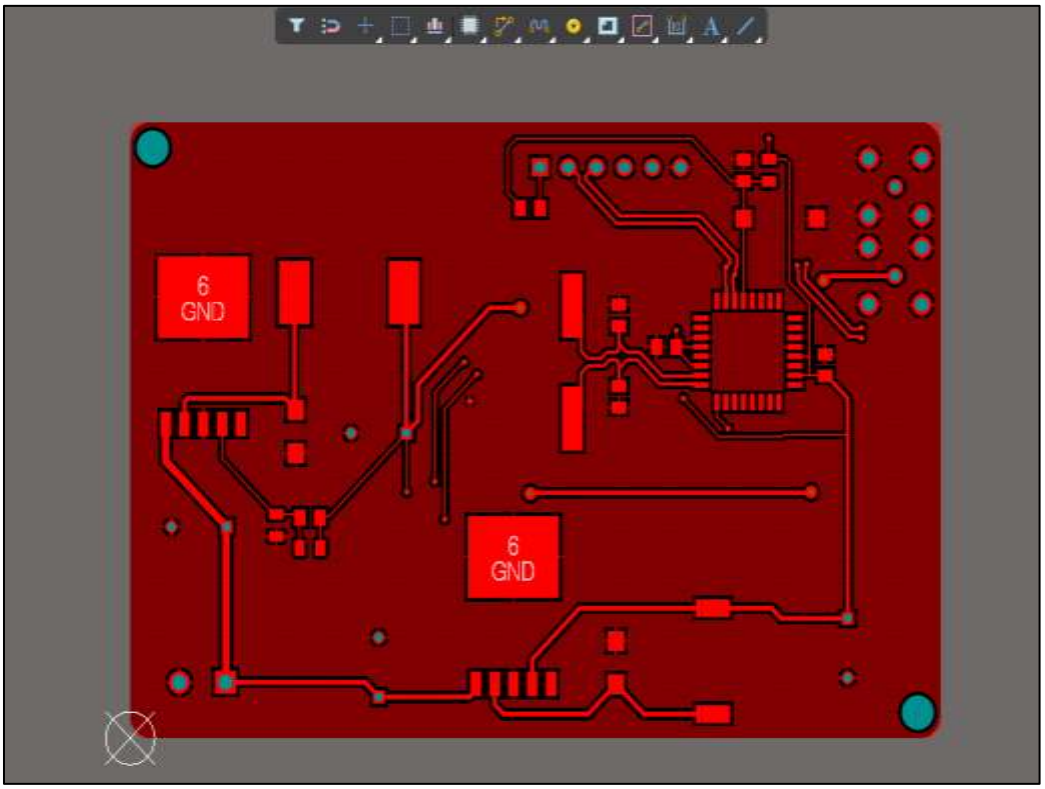


Figure 4.8 Top layer of PCB

The above figures 4.7 and 4.8 represents the bottom layer and the top layer of the PCB respectively which were created in ALTIUM software. The size of the PCB is 50mm X 70 mm. This makes the overall product compact size.

CHAPTER: 5

SOFTWARE IMPLEMENTATION

SOFTWARE IMPLEMENTATION

This chapter illustrates the importance of various software used to build the project.

5.1 Software Requirements

- **Arduino IDE:** It is an essential integrated development environment to develop a project onMicrocontroller Atmega 328P.

- **Altium:** Altium is a leading electronic design automation (EDA) software company that provides a wide range of tools and solutions for designing and developing electronic circuits and printed circuit boards (PCBs).

5.2 Software Specification

The project requirement for the software is given below.

5.2.1 Arduino IDE

Open-source software called the Arduino IDE is used to create and upload code to Arduino boards. For different operating systems, including Windows, Mac OS X, and Linux, the IDE programme is appropriate. C and C++ are supported as programming languages. Integrated Development Environment is referred to in this sentence. Sketching is a common term for writing a piece of code in the Arduino IDE. To upload the sketch created in the Arduino IDE software, it is necessary to link the Arduino and Arduino board with the IDE. The sketch has the .io file extension.

Figure 5.1: Arduino IDE(Source: www.google.com)

5.2.2 Altium

Leading electronic design automation (EDA) software provider Altium offers a variety of tools and solutions for creating printed circuit boards (PCBs) and electronic circuits. Engineers, PCB designers, and electrical hobbyists frequently utilize the software package from Altium, which comprises several applications like Altium Designer, Altium Circuit Maker, Altium Nexus, and Altium 365, for designing, prototyping, and manufacturing electronic circuits.

Figure 5.2: Altium(Source: www.google.com)

The company's flagship product, Altium Designer, is a comprehensive PCB design tool that includes a full suite of tools for schematic capture, PCB layout, and routing in addition to integrated simulation, 3D visualization, and production outputs. Professional PCB designers frequently use it because of its user-friendly and straightforward UI, powerful routing capabilities, and real-time collaboration features.

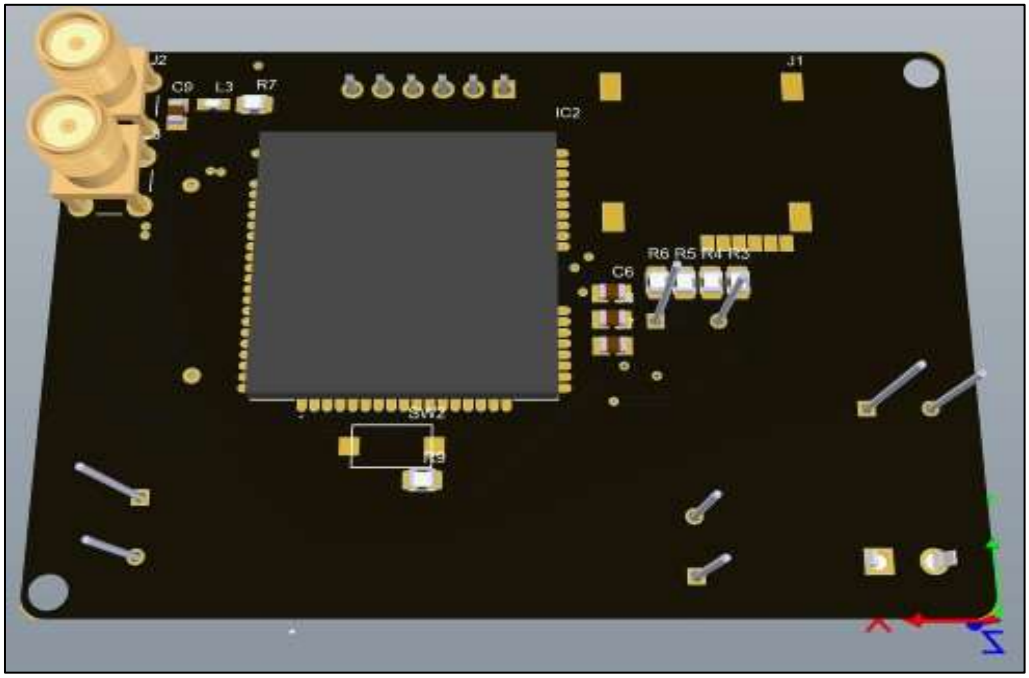
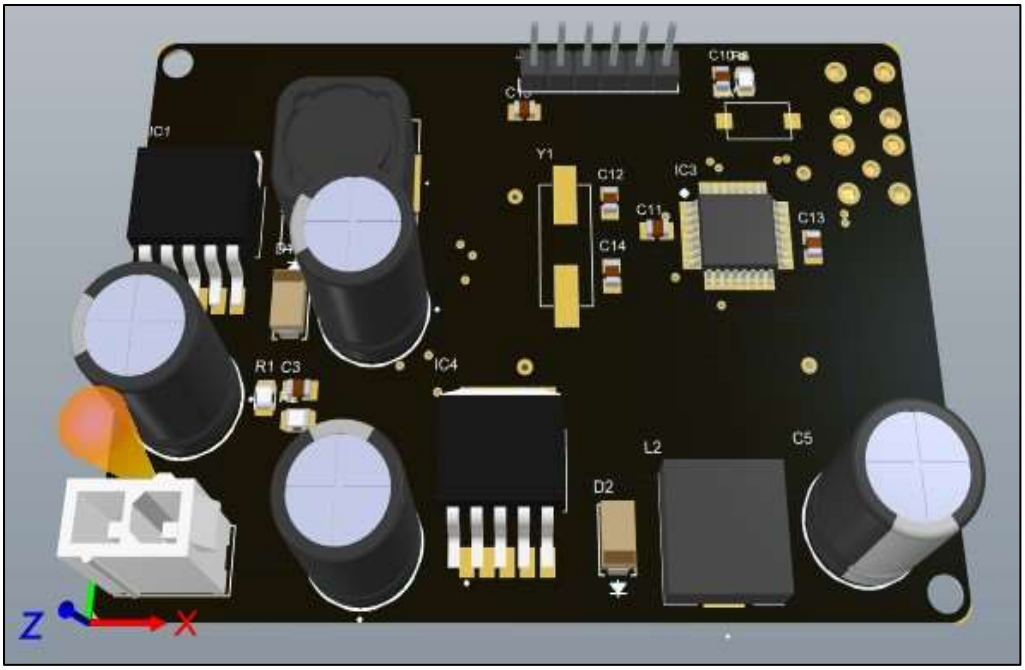


Figure 5.4: 3D design of PCB (Bottom layer)



Fgure5.4: 3D design of PCB (Top layer)

CHAPTER: 6

TESTING AND RESULTS

TESTING AND RESULTS

This chapter illustrates various results and outcomes of the project.

6.1 Testing

The use of anti-theft tracking devices that utilize GPS and GSM modules has become increasingly popular in recent years. These devices offer a powerful tool for tracking stolen vehicles, valuable assets, or even people in real time. However, to ensure that these devices are effective, it's crucial to test them thoroughly before deployment. The testing process typically involves GPS and GSM module testing, battery life testing, range testing, and overall performance testing. By conducting these tests, you can ensure that the device functions as intended and provides reliable protection against theft. With the increasing prevalence of theft and the rising demand for security solutions, anti-theft tracking devices that utilize GPS and GSM modules are likely to become even more prevalent in the future.

6.2 Testing Strategies and Test Procedures

The testing procedure for an anti-theft tracking device that utilizes a GPS and GSM module involves several steps. Firstly, the GPS functionality should be tested by taking the device to various locations and ensuring that it accurately detects and reports the location. Secondly, the GSM functionality should be tested by ensuring that the device can successfully connect to a cellular network and transmit data. Thirdly, the battery life of the device should be tested by leaving it on for an extended period and tracking its power usage. Fourthly, the anti-theft features of the device should betested by attempting to move or tamper with the device, and ensuring that an alert is sent to the designated recipient. Lastly, the tracking software used to monitor the device should be tested by verifying that it accurately displays the location of the device and provides timely alerts. By following these testing procedures, one can ensure that the anti-theft tracking device is functioning correctly and providing effective protection against theft.

6.3 Results

The following table shows the successful attempts and accuracy of a communication system for different ranges. The range is categorized into six intervals from 0-1 km to 10-13 km. For each range, the number of successful attempts and total attempts are recorded. The accuracy is calculated as a percentage by dividing the number of successful attempts by the total attempts and multiplying by 100. The highest accuracy of 100% is achieved for ranges between 3-13 km, while the lowest accuracy of 50% is recorded for the range of 0-1 km. The communication system exhibits superior performance over longer ranges.

Table 6.1: Accuracy of Attempts at Ranges for Tracking the Device

Sr. No	Range (km)	Successful Attempts	Total Attempts	Accuracy (%)
1.	0-1	3	6	50
2.	1-3	8	11	72.72
3.	3-5	3	3	100
4.	5-7	5	5	100
5.	7-10	15	16	93.75
6.	10-13	10	10	100

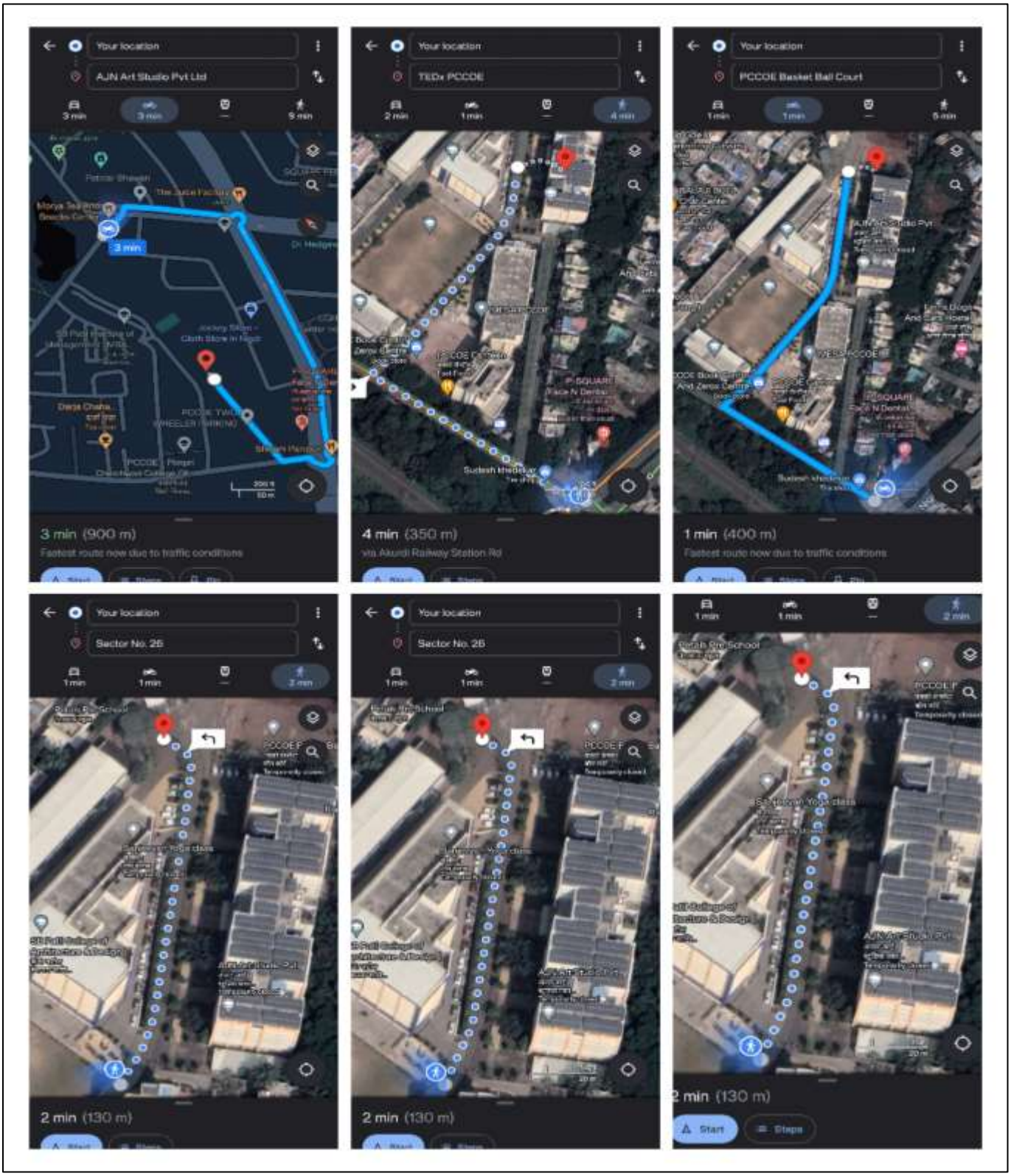


Figure 6.1: Results for the Range 0 km to 1 km

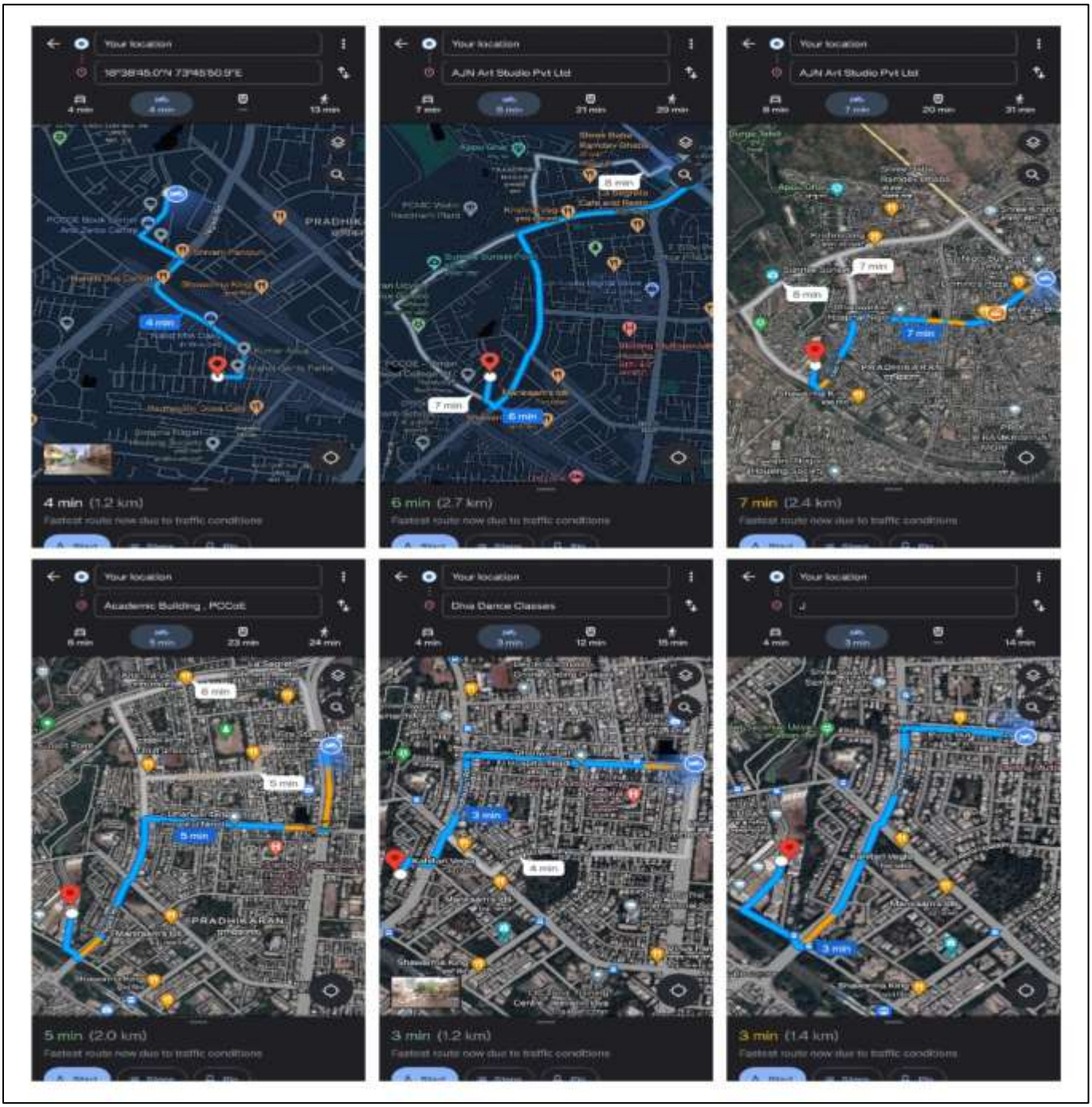


Figure 6.2: Results for the Range 1km to 3km

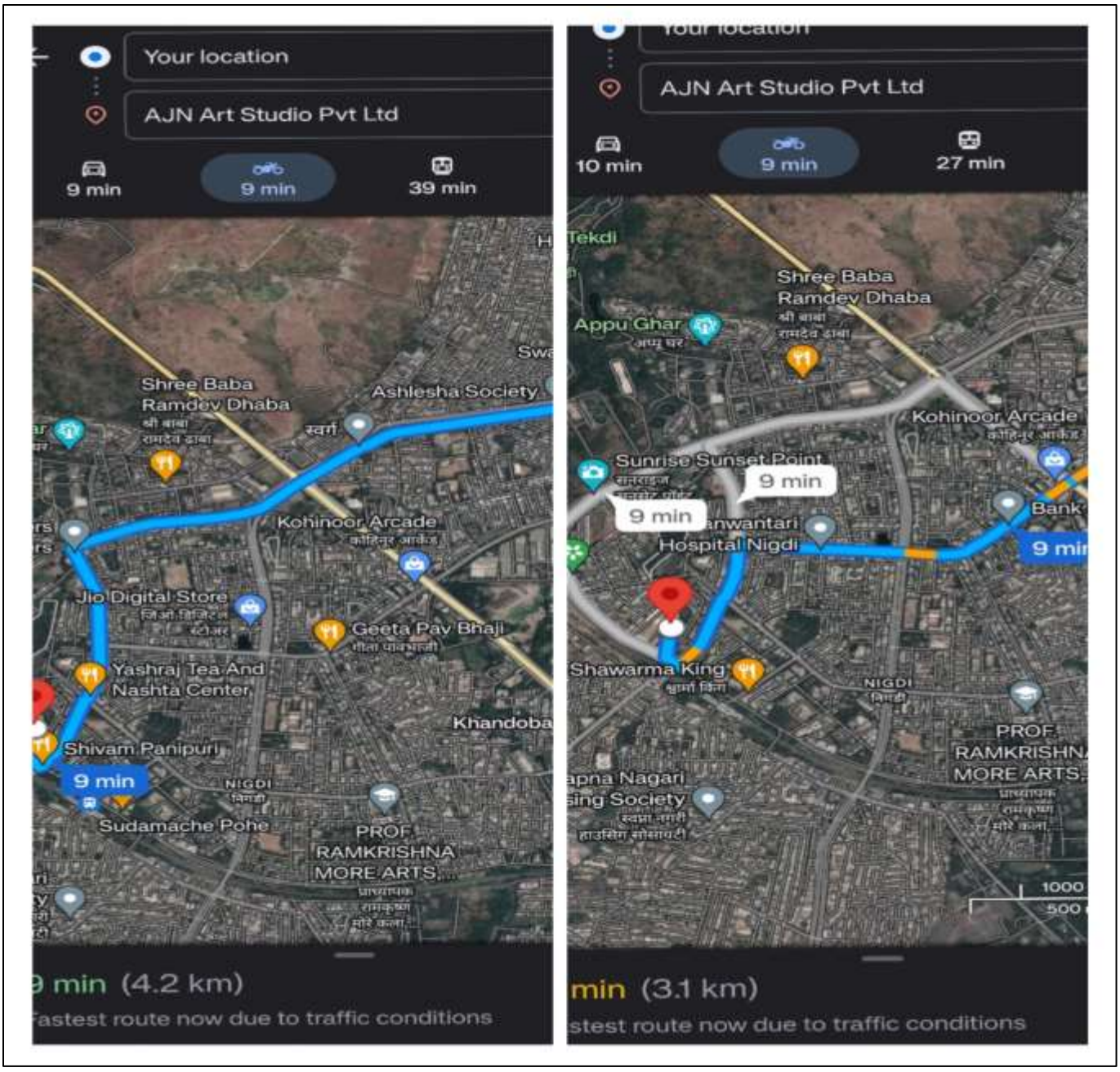


Figure 6.3: Results for the Range 3km to 5km

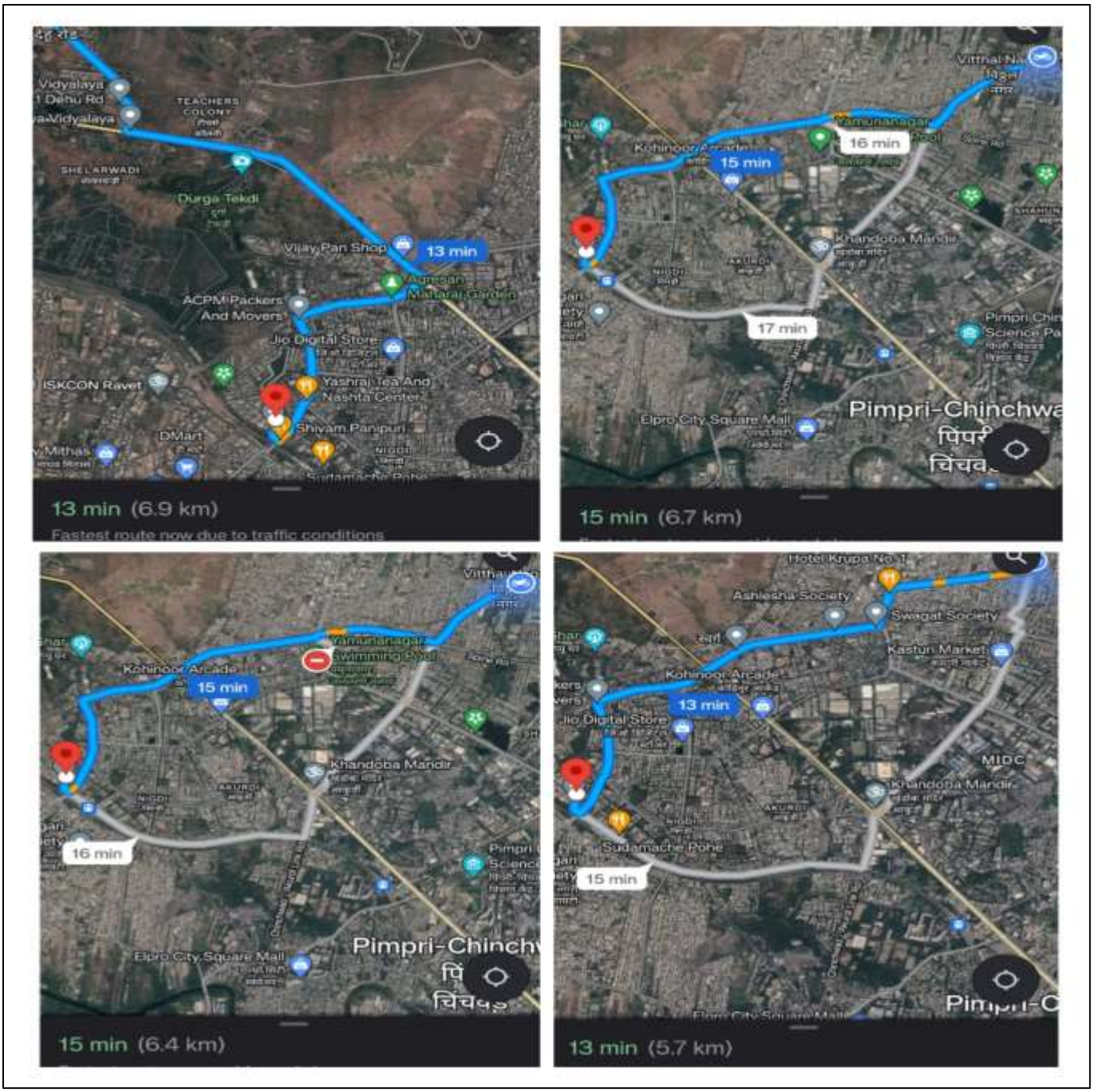


Figure 6.4: Results for the Range 5km to 7km

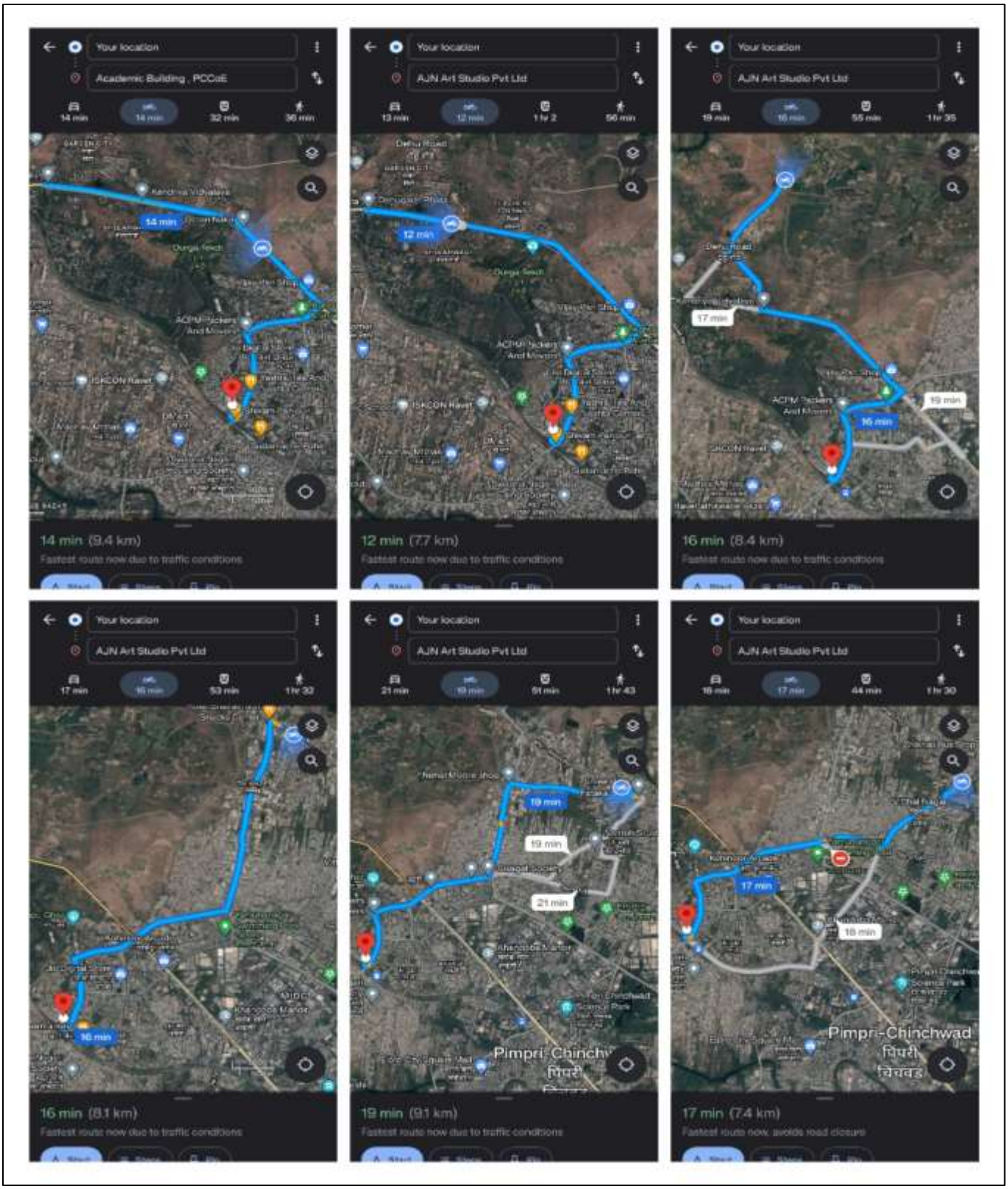


Figure 6.5: Results for the Range 7km to 10km

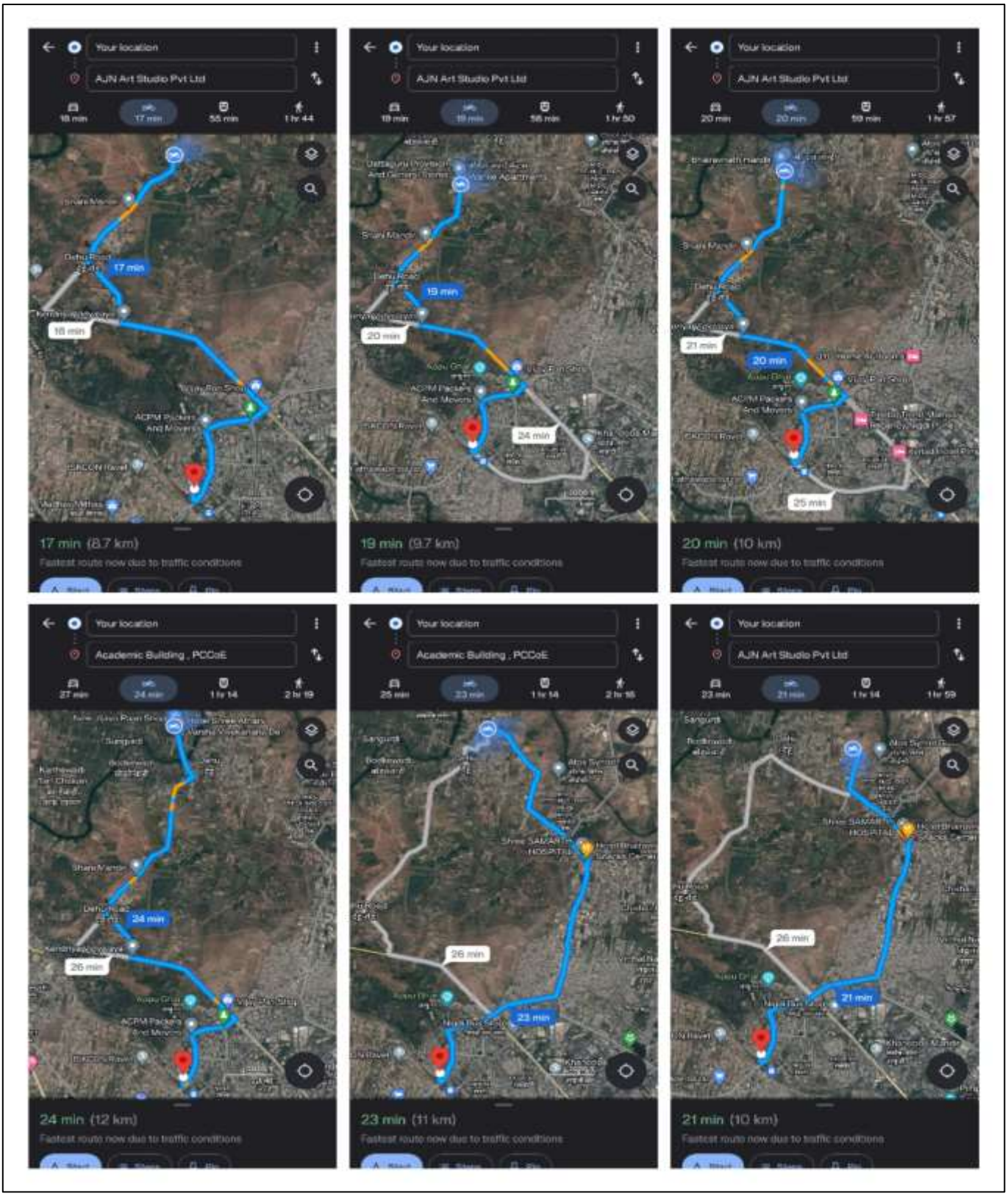


Figure 6.6: Results for the range 10km to 13km

CHAPTER: 7

ADVANTAGE AND APPLICATION

ADVANTAGE AND APPLICATION

7.1 Advantages:

- **Improved Security**: Anti-theft tracking devices can assist safeguard the safety and security of mentally challenged individuals who are prone to straying or becoming lost.
- **Peace of Mind for Caregivers**: Caregivers of mentally challenged individuals of- ten face challenges in ensuring their safety and well-being.
- **Quick Recovery of Stolen or Lost Objects**: Anti-theft tracking devices can also aid in the recovery of stolen or lost objects belonging to mentally challenged people.
- **Greater Independence**: Anti-theft tracking devices can provide mentally challenged people more independence and autonomy by allowing carers to remotely monitor their location and activities without continual physical supervision.
- **Low-Cost Solution**: When compared to other types of tracking or monitoring systems, anti-theft tracking devices are frequently low-cost.
- **Easy to Use**: Most anti-theft tracking devices are designed to be user-friendly, with simple interfaces and intuitive features.

7.2 Applications:

- **Location Tracking**: One of the primary applications of anti-theft tracking devices for mentally challenged individuals is location tracking.
- **Personal Belongings Tracking**: Anti-theft tracking devices can also be used to track the personal belongings of mentally challenged individuals, such as bags, wallets, or electronic devices. This can help prevent the loss or theft of valuable items and provide a means to recover them in case they are misplaced or stolen.
- **Emergency Alerts**: Many anti-theft tracking devices come with built-in emergency alert features that can be triggered by the individual or caregivers in case of an emergency.
- **Geo-fencing**: Geo-fencing is a feature available in some anti-theft tracking devices that allows caregivers to set virtual boundaries or safe zones for the mentally challenged individual.
- **Remote Monitoring**: Anti-theft tracking devices often come with remote monitoring capabilities, allowing caregivers or family members to monitor the location, activities, and well-being of the mentally challenged individual remotely.
- **Increased Independence**: Anti-theft tracking devices can promote increased in- dependence for mentally challenged individuals by allowing them to engage in various activities and outings with greater autonomy.
- **Prevention of Abuse or Exploitation**: In some cases, mentally challenged individuals may be vulnerable to abuse or exploitation. Anti-theft tracking devices can help prevent or mitigate such risks by allowing caregivers to monitor their whereabouts and activities, and take appropriate action if any suspicious or concerning behavior is detected.

CHAPTER: 8

CONCLUSION

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8.1 CONCLUSION

The implementation of an anti-theft tracking device utilizing GSM and GPS technology has proven to be highly effective in ensuring the safety and security of mentally challenged individuals. By providing higher accuracy for tracking distances exceeding 2km, this solution addresses the limitations of traditional systems that are limited to tracking within the 0 to 2km range. The utilization of GSM and GPS technology offers several advantages in terms of accuracy and range. GSM technology enables real-time communication between the tracking device and the monitoring centre, ensuring instant updates on the location of the individual with the help of SMS. This allows for immediate response in case of any emergency or potential threat. Moreover, the integration of GPS technology enhances the accuracy and reliability of location tracking. With the capability to provide precise coordinates, the system offers an expanded range of tracking beyond the previously restricted 0 to 2km distance. This extended range enables caregivers, authorities, and family members to locate and retrieve the mentally challenged individual promptly, regardless of their distance from the designated safe zone.

REFERENCES

Journal /Article /Paper

[1] Priyanka Kumar, Raghul M, “Location based parent control-child tracking app using android mobile operating system,” 4th IEEE International Conference on Computing Communication and Automation, Greater Noida, India, Dec. 14-15, 2018.

[2] Omar Abdulwahabe Mohamad, Rasha Talal Hameed, “Design and implementation of real time tracking system based on Arduino Intel Galileo,” 8th ECAI International Conference, Ploiesti, Romania, Jun-July 30-2, 2016.

[3] Mengmeng Wang, Daobilije Su, Le Shi, Yong Liu, Jamie Valls Miro, “Real-time 3D human tracking for mobilerobots with multisensors,” IEEE International Conference on Robotics and Automation, Singapore, May-Jun 29-3, 2017.

[4] Aparna Padman, Jisha D. Saiju, Prabitha Prasad, Sheethu Gopal, P.P.Hema, “Location tracking for blind swimmers,” IEEE International Conference on Power Electronics and Renewable Energy Applications, Kannur, India, Nov. 27-28,2020.

[5] Saad, S.A., Hisham, A.A.B., Ishak, M.H., Fauzi, M.H., Baharudin, M.A., and Idris, “ Real-time on-campus public transportation monitoring system,” IEEE 14th International Colloquium on Signal Processing and Its Applications, Malaysia, March 9-10, 2018.

[6] M. Zhao, H. Yang, J. Liu, Y. Chen and J. Zhou, "Directional Wi-Fi Based Indoor Location System for Emergency," 7th International Conference on Ubiquitous Intelligence & Computing and 7th International Conference on Autonomic & Trusted Computing, Xi'an, China, Oct. 26-29,2010

External Links

[1] https://embeddedschool.in/avr-microcontroller-programming/

[2] https://www.tag8.in/

[3] https://www.safewise.com/resources/wearable-gps-tracking-devices-for-kids-guide/

[4] https://www.u-blox.com/en/product/neo-m8-series

[5] https://en.wikipedia.org/wiki/Gps

[6] https://en.wikipedia.org/wiki/GSM_modem

Project Outcomes

Project Outcomes

- **Proposal Sanctioned from college:** Kushagra Mishra, Soham Phirke, Sahil Adhav, Prof. A.R.Suryawanshi**,** "**Anti-Theft Tracking Device**" to PCCOE of amount Rs. 13,200.
- **Presented work at Abhiyantrix 2023 in the Communication and Signal Processing track.**
- **Presented work at IETE-National Level Project Competition.**
- **Published a Research Paper at IJRT Journal.**

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CERTIFICATE OF PARTICIPATION

This is to certify that **Soham Phirke, Kushagra Mishra, Sahil Adhav**

has presented a paper in Communication and Signal Processing domain at Abhiyantrix'23, a conference organized by the Department of Electronics & Telecommunication, Pimpri Chinchwad College of Engineering, Nigdi, Pune on 10th - 11th April, 2023

Vaishnavi Gadhave	Pushkar Mahajan	Guruprasad Deshpande	Dr. M. T. Kolte
General Co-Chair	General Co-Chair	General Chair	HOD, E&TC

Geo-Tracker for mentally challenged people by evaluating positioning technologies

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***Abstract*—Currently, many cases of valuable objects or mentally challenged people are being stolen or lost respectively in many crowded areas as well as some mentally challenged people leave the house without any information which can lead to various unfortunate events. There are multiple ways of tracking lost valuable objects or mentally challenged persons by various tracking devices available in the market. But currently, available products are expensive and have a low coverage area. Here, we are proposing a low-cost object/mentally challenged person finder in the form of a compact tag. It will provide the feature of detecting and tracking the object/mentally challenged person to which the tag is attached. This device has limited firmware and compact hardware including Microcontroller, GSM, LTE modules, etc. which will be powered by a 12V battery and will be compatible with all the smartphones available in the market.**

Keywords—GSM, Object, Mentally Challenged Person

I. INTRODUCTION

People are increasingly using cell phones with Android operating systems. The diversity of additional features offered by these cell phones is attracting an increasing number of people. Systems for tracking and monitoring that are location-based have attracted a lot of interest in many different industries. [2] exemplifies how Arduino and Galileo may be integrated to provide effective tracking capabilities, with potential applications in a variety of industries including security, asset management, and logistics. [3] demonstrates a real-time, multi-sensor 3D human tracking system for mobile robots. By precisely observing and comprehending human movements in real time, which is essential for applications in human-robot interaction and collaborative environments, this work intends to improve the navigational capabilities of robots.

Research in [4] focuses on the particular difficulties experienced by visually impaired people taking part in swimming sports and offers a way to improve their performance and safety through real-time location tracking.

The work [5], is centered on improving the entire commuting experience for students, professors, and staff by maximizing the effectiveness of public transit inside campus areas through real-time monitoring. The requirement for parents to track and monitor their kids' whereabouts is to improve parental supervision and ensure their safety [1]. [6] reviews the difficulties that emergency response teams encounter when identifying people inside buildings. This technology delivers better precision and efficiency by utilizing Wi-Fi signals and directional data, enabling quick and efficient emergency responses, however, limiting to the building premises only for exact location tracking.

To find common patterns, problems, and possibilities in location-based monitoring systems, we analyze and integrate the insights offered by the research studies in this paper. The development of our suggested solution, which aims to progress location-based monitoring technologies and their applications in diverse sectors, will be guided by the conclusions from this research.

II. METHODOLOGY

A. Problem Statement

To design and develop a low-cost Geo-tracker using GSM and GPS modules to provide more coverage area than the existing products available in the market.

B. Hardware Method

PCB Layout: Below figures 1 and 2 represent the bottom layer and top layers of the PCB, respectively, created using the ALTIUM software. The size of the PCB created is 50mm X 70 mm. This makes the overall product compact size.

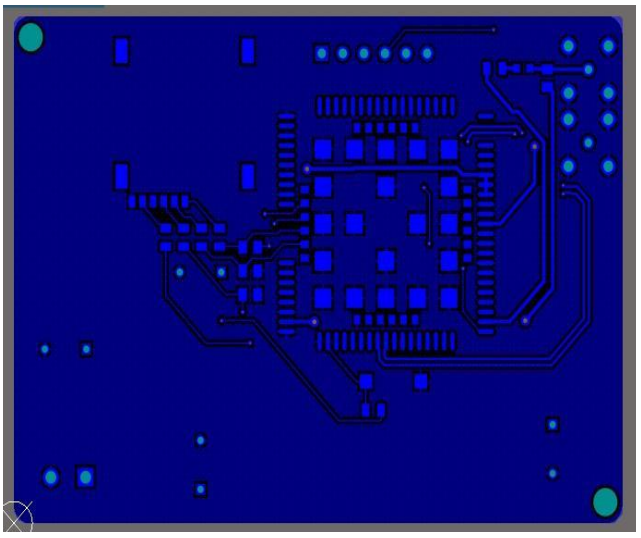


Fig. 1.1. PCB layout: Bottom Layer

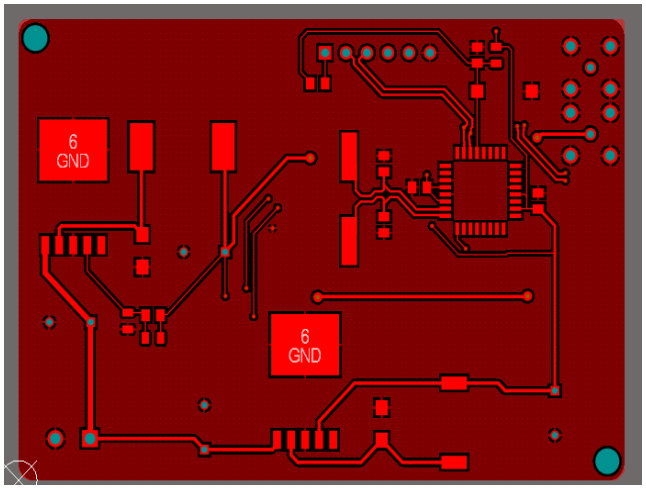


Fig. 1.2. PCB layout: Top Layer

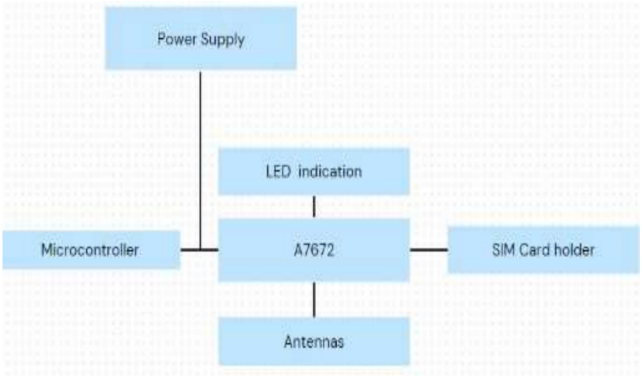


Fig. 7. Device Block Diagram

Power Supply: Depending on the design and requirements, the Geo-tracker can be powered by either a rechargeable battery or an external power source. The power supply determines its operational duration and reliability.

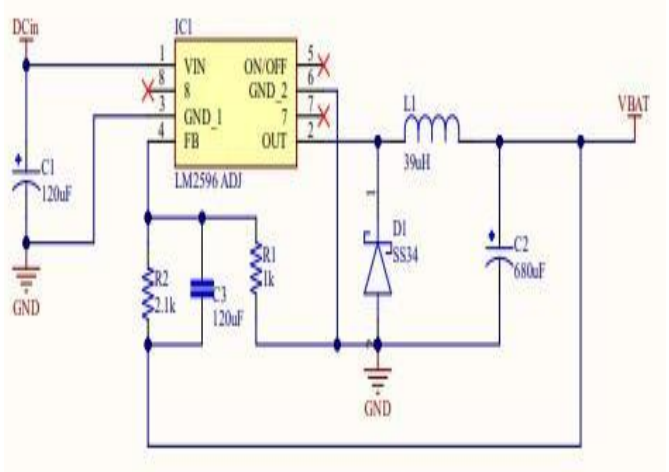


Fig. 2. Circuit Diagram: Power Supply-1

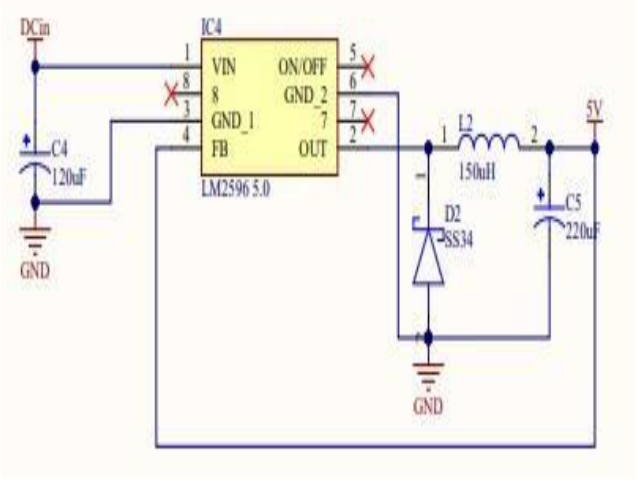


Fig. 3. Circuit Diagram: Power Supply-2

Microcontroller: A component that controls the overall operation of the device from executing the tracking device's programmed functions to processing data from the GPS and GSM modules. Its capabilities and features are instrumental in ensuring the device's reliable performance and efficient tracking functionality.

A7672: This module operates on a supply voltage of 3.4V to 4.4V DC and consumes low power, making it suitable for power management in the tracking device. A network of satellites and receiving equipment called the global positioning system (GPS) is used to pinpoint a particular location on Earth. Some GPS receivers are so precise that they can pinpoint their location within one centimeter. Latitude, longitude, and altitude are all provided by GPS receivers as location information.

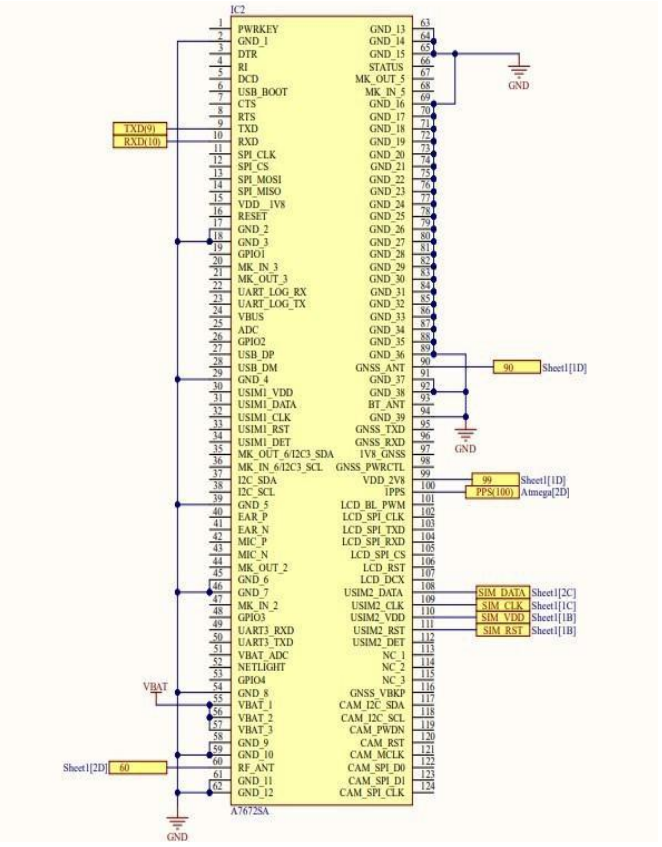


Fig. 4. Circuit Diagram: A7672

Antennas: They are responsible for transmitting and receiving signals for GSM and GPS communication. The GSM antenna is designed to transmit and receive signals for communication with the cellular network. The antenna is connected to the GSM module. The GPS antenna is designed to transmit and receive GPS signals for precise location tracking.

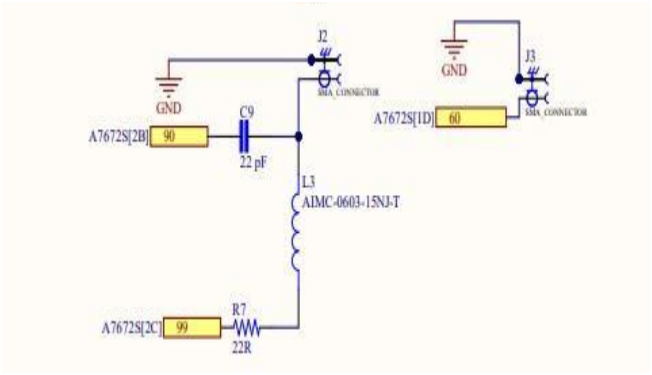


Fig. 5. Circuit Diagram: Antennas

Sim Card Holder: It is typically a small plastic or metal slot that is designed to accommodate a standard-sized SIM card. It provides a secure and reliable connection between the SIM card and the GSM module, allowing for seamless communication with the cellular network. It is typically located on the PCB (Printed Circuit Board) of the tracking device, and its position and orientation may vary depending on the design of the device. The SIM card holder enables the tracking device to establish communication with the cellular network.

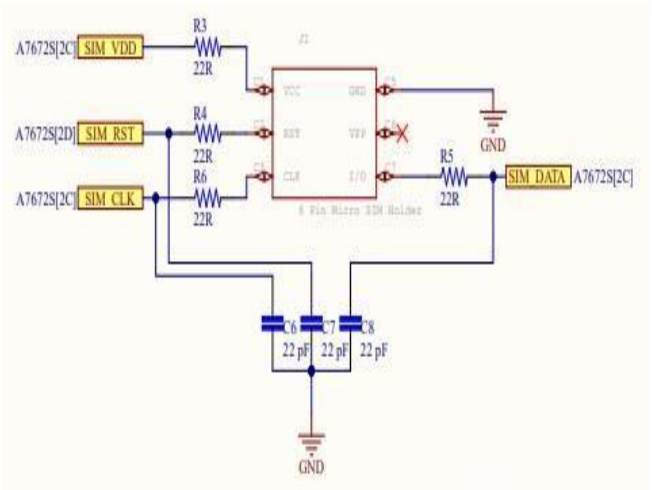


Fig. 6. Circuit Diagram: SIM Holder

C. *Work Flow*

The system architecture for the Geo-tracker designed for mentally challenged individuals is carefully designed to provide reliable tracking and supervision. The system is divided into two main components: the family side and the impaired individual side. The family side acts as a "pseudo server" for the system and is owned by the mentally challenged person's family. It consists of an Android smartphone with SMS and internet services enabled, which serves as a communication hub for sending a customizable text using SMS and receiving location updates from the tracking device. On the other hand, the impaired individual side is equipped with a traceable module/device that includes GSM and GPS technology. This device serves as the assistive technology for the mentally challenged person, allowing them to be tracked and located in real-time. The device communicates with the family's smartphone via SMS, providing continuous updates on the person's location coordinates, including latitude and longitude which is available whenever required. The system relies on location services such as GPS or network-based location determination to accurately determine the device's position. The traceable module uses these location services to determine the coordinates-based location of the person, which is then sent via SMS to the family's smartphone. This allows the family to track the per- son's location on a map using a designated tracking application. The tracking interface is developed on a Google map, allowing multiple users to access it by logging into the interface. The family can track the mentally challenged person's location in real time, as the module continually sends the position coordinates through SMS. The family's smartphone displays the location on a map, providing a visual representation of the person's whereabouts. This enables the family to monitor the person's movements, ensure their safety, and provide timely assistance when needed. The combination of both of these technologies allows for effective supervision and support, giving peace of mind to the person's family and caregivers.

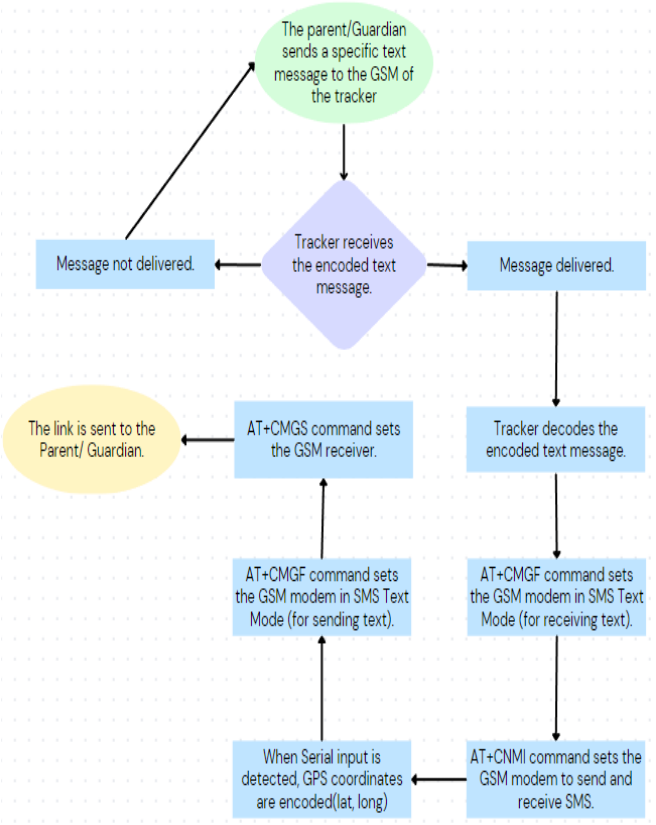


Fig. 7. Work Flow Diagram

III. RESULTS/FINDINGS

The following table shows the successful attempts and accuracy of a communication system for different ranges. The range is categorized into six intervals from 0-1 km to 10-13 km. For each range, the number of successful attempts and total attempts are recorded. The accuracy is calculated as a percentage by dividing the number of successful attempts by the total attempts and multiplying by 100. The highest accuracy of 100% is achieved for ranges between 3-13 km, while the lowest accuracy of 50% is recorded for the range of 0-1 km. The results indicate that the communication system exhibits superior performance over longer ranges.

Sr. No.	Range (km)	Successful Attempts	Total Attempts	Accuracy (%)
1.	0-1	3	6	50
2.	1-3	8	11	72.72
3.	3-5	3	3	100
4.	5-7	5	5	100
5.	7-10	15	16	93.75
6.	10-13	10	10	100

Table 1: Accuracy of Attempts at Ranges for tracking the device

A. Tracker Location at different proximity:

1. Results for the proximity of the tracker device and the mobile: 0-1 km:

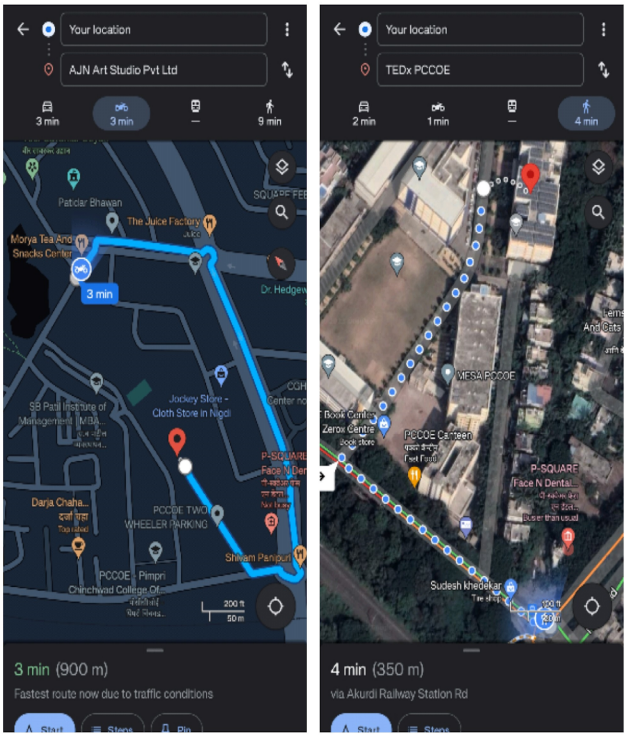


Fig. 8.1.1. Tracker Location Results: Proximity 0-1 km

Fig. 8.1.2. Tracker Location Results: Proximity 0-1 km

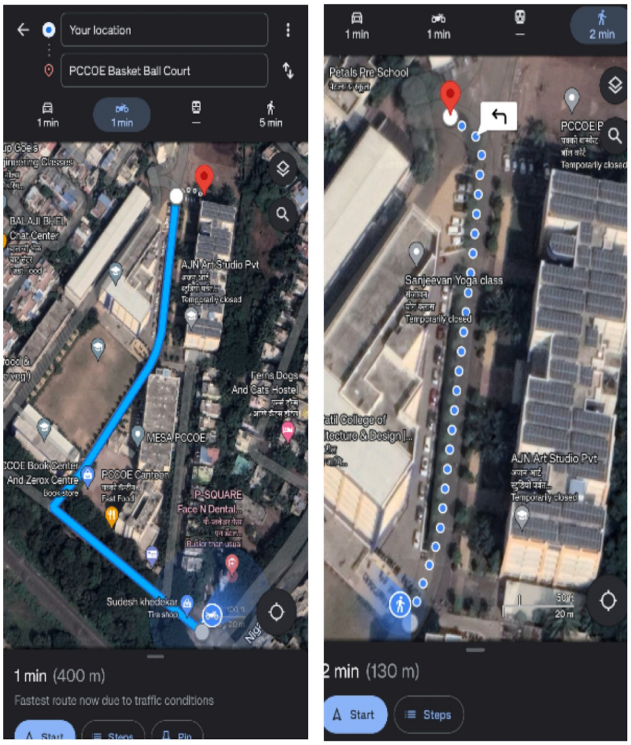


Fig. 8.1.3. Tracker Location Results: Proximity 0-1 km

2. Results for the proximity of the tracker device and the mobile: 1-3 km:

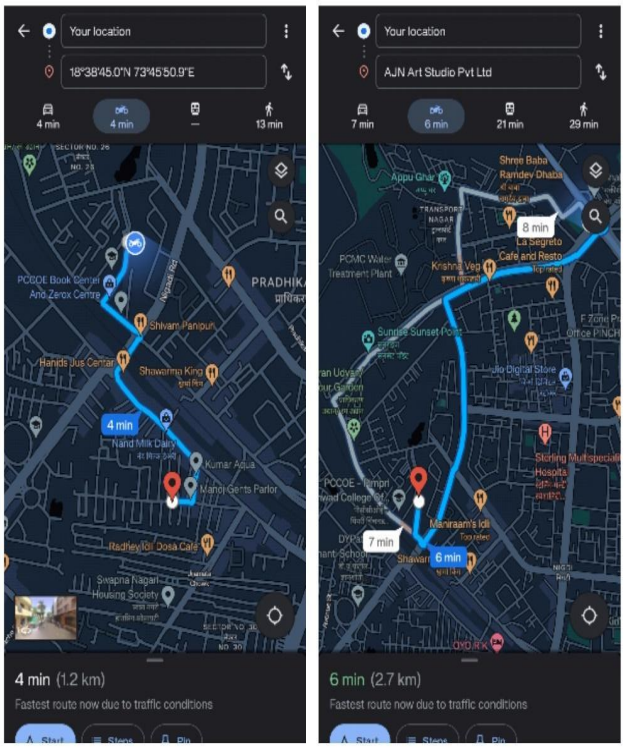


Fig. 8.2.1. Tracker Location Results: Proximity 1-3 km

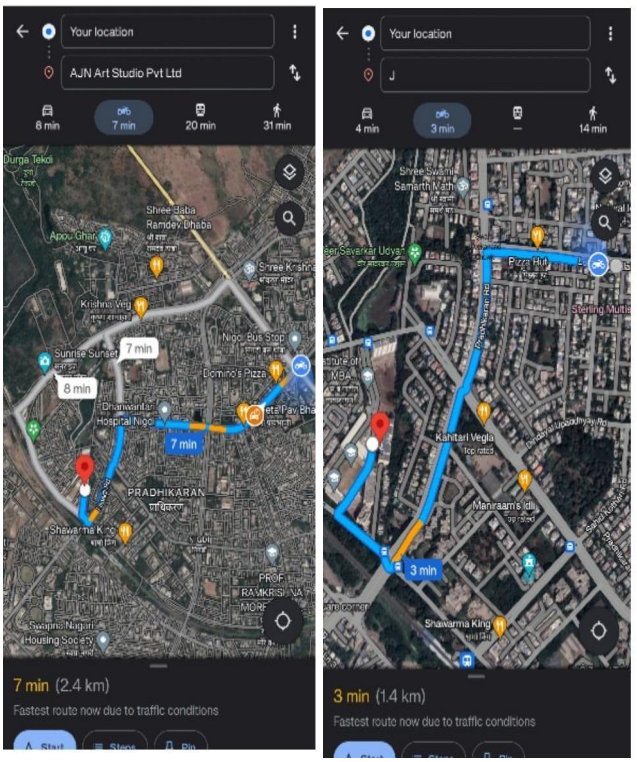


Fig. 8.2.3. Tracker Location Results: Proximity 1-3 km

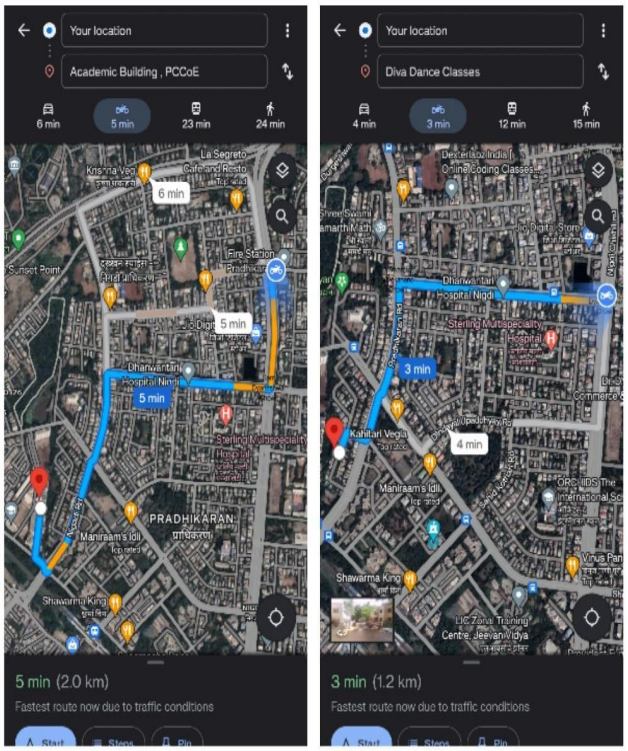


Fig. 8.2.2. Tracker Location Results: Proximity 1-3 km

3. Results for the proximity of the tracker device and the mobile: 3-5 km:

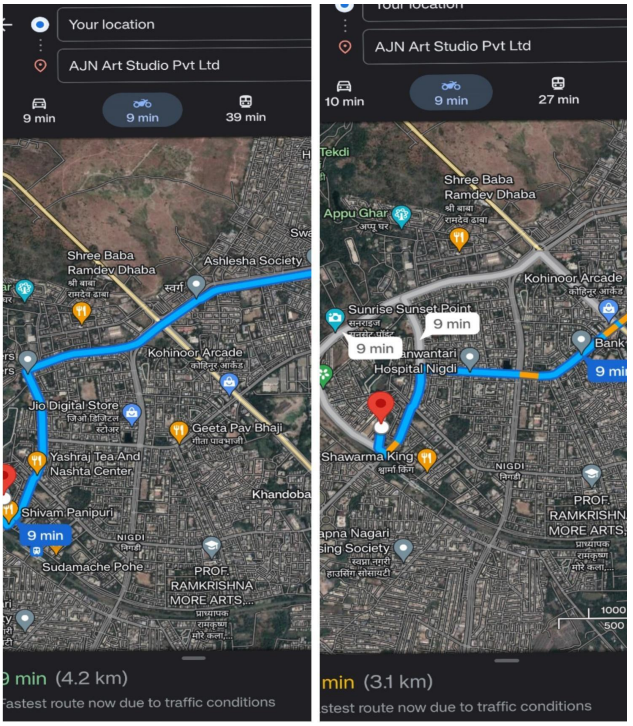


Fig. 8.3. Tracker Location Results: Proximity 3-5 km

4. Results for the proximity of the tracker device and the mobile: 5-7 km:

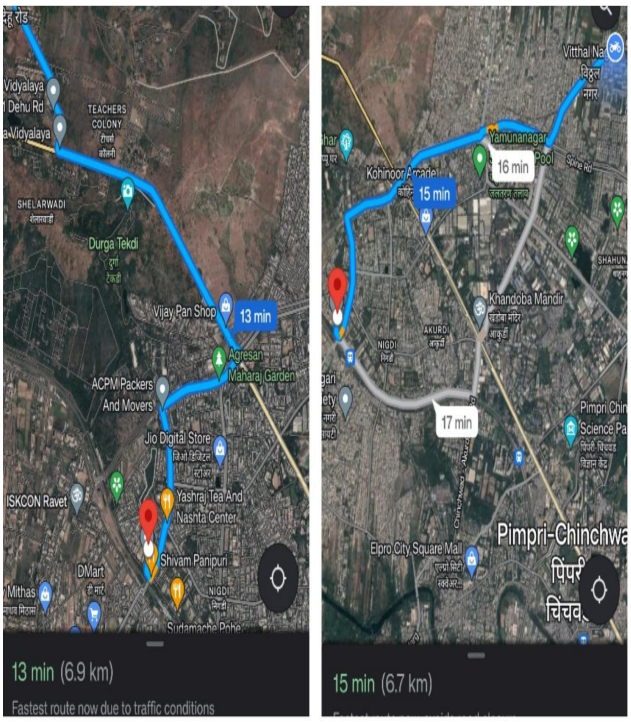


Fig. 8.4.1. Tracker Location Results: Proximity 5-7 km

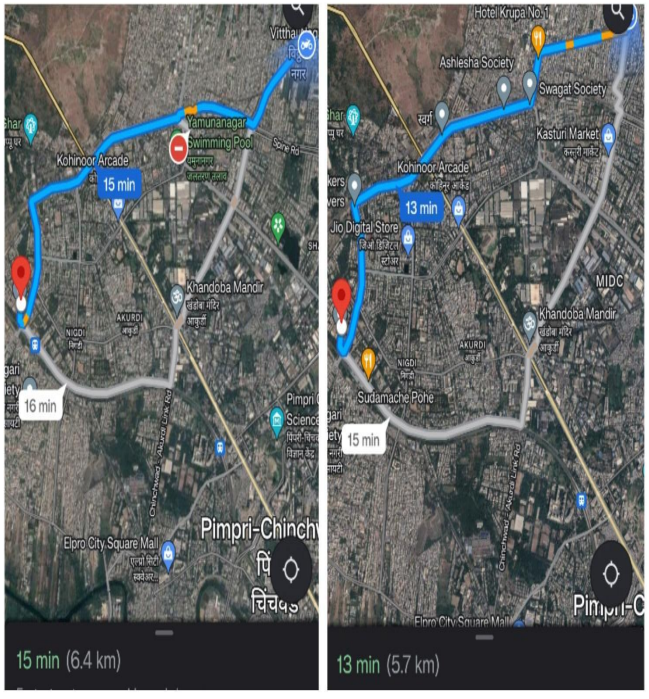


Fig. 8.4.2. Tracker Location Results: Proximity 5-7 km

5. Results for the proximity of the tracker device and the mobile: 7-10 km:

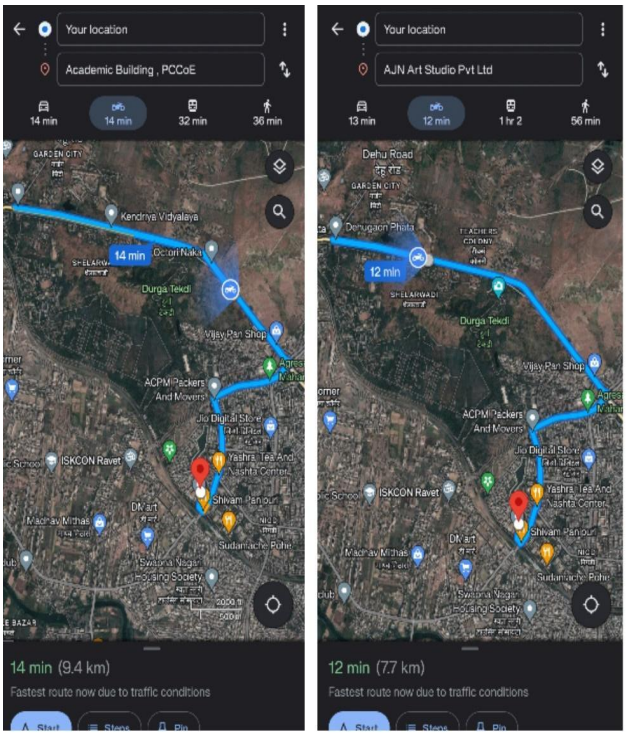


Fig. 8.5.1. Tracker Location Results: Proximity 7-10 km

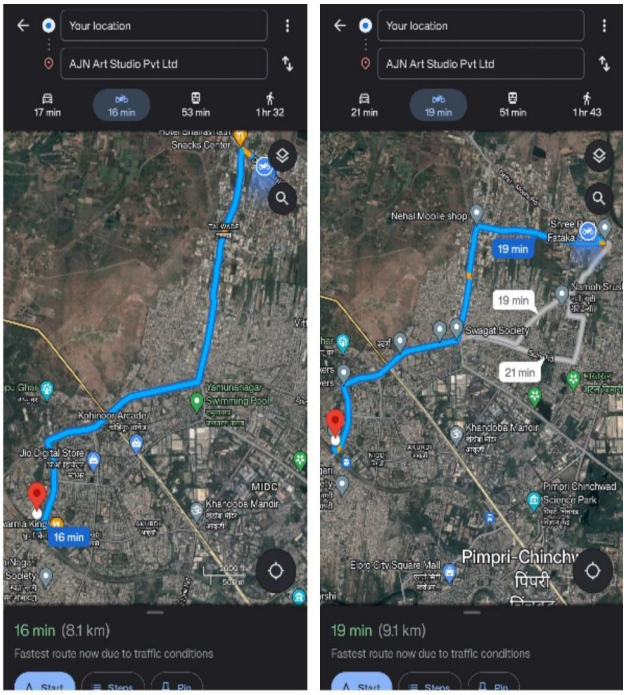


Fig. 8.5.2. Tracker Location Results: Proximity 7-10 km

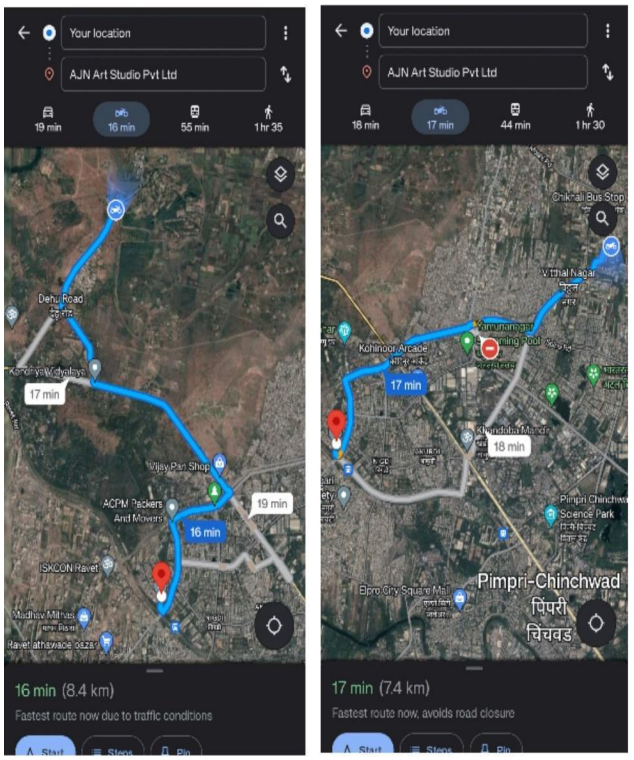


Fig. 8.5.3. Tracker Location Results: Proximity 7-10 km

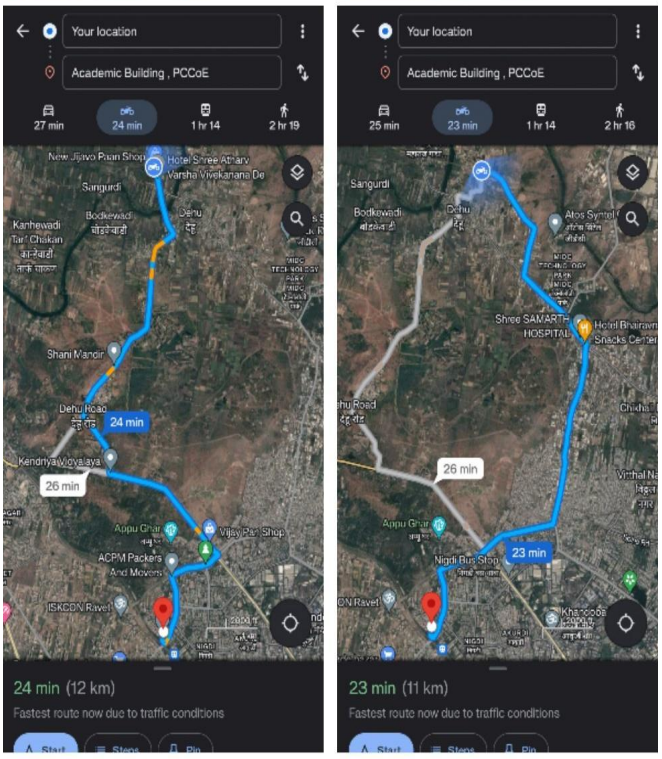


Fig. 8.6.2. Tracker Location Results: Proximity 10-13 km

6. Results for the proximity of the tracker device and the mobile: 10-13 km:

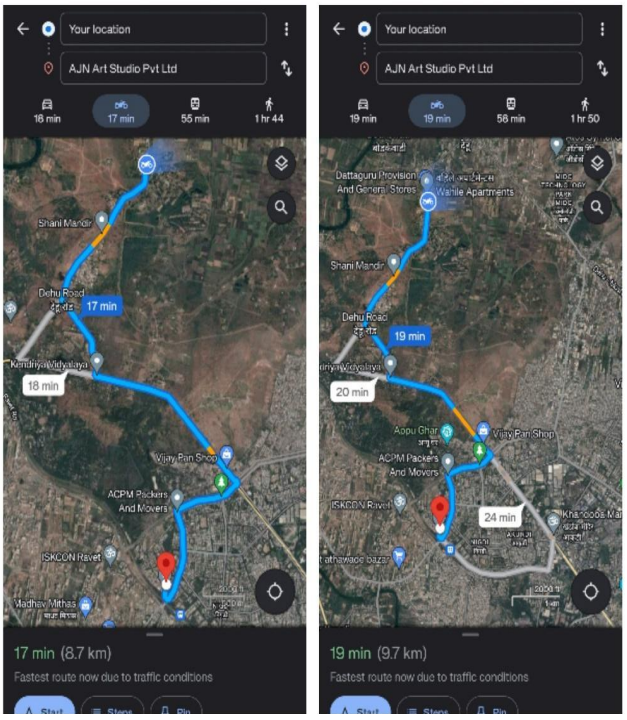


Fig. 8.6.1. Tracker Location Results: Proximity 10-13 km

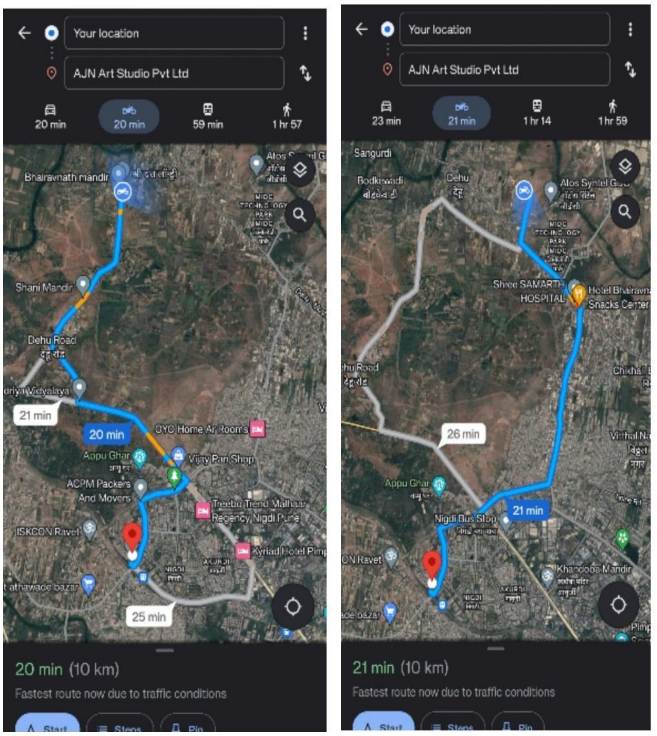


Fig. 8.6.3. Tracker Location Results: Proximity 10-13 km

IV. CONCLUSION

Tracking devices can be a valuable tool for ensuring the safety, security, and well-being of mentally challenged individuals. These devices provide real-time location tracking, personal belongings tracking, remote monitoring, and increased independence, among other benefits. They can help caregivers or family members keep track of the whereabouts and movement tracking of mentally challenged individuals, prevent the loss or theft of personal belongings, respond promptly to emergencies, promote independence, and prevent abuse or exploitation. When choosing a Geo-tracker for a mentally challenged individual, it's important to carefully consider their specific needs and requirements, and balance them with privacy and security concerns. With proper selection and use, Geo-trackers can be effective tools to enhance the safety and well-being of mentally challenged individuals and provide peace of mind to their caregivers or family members.

REFERENCES

[1] P. Kumar and R. M., "Location Based Parental Control-Child Tracking App Using Android Mobile Operating System," 2018 4th International Conference on Computing Communication and Automation (ICCCA), Greater Noida, India, 2018, pp. 1-4, doi: 10.1109/CCAA.2018.8777612.

[2] O. A. Mohamad, R. T. Hameed and N. Ţăpuş, "Design and implementation of real time tracking system based on Arduino Intel Galileo," 2016 8th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), Ploiesti, Romania, 2016, pp. 1-6, doi: 10.1109/ECAI.2016.7861114.

[3] M. Wang, D. Su, L. Shi, Y. Liu and J. V. Miro, "Real-time 3D human tracking for mobile robots with multisensors," 2017 IEEE International Conference on Robotics and Automation (ICRA), Singapore, 2017, pp. 5081-5087, doi: 10.1109/ICRA.2017.7989593.

[4] A. Padman, J. D. Saiju, P. Prasad, S. Gopal and P. P. Hema, "Location Tracking for Blind Swimmers," 2020 International Conference on Power Electronics and Renewable Energy Applications (PEREA), Kannur, India, 2020, pp. 1-5, doi: 10.1109/PEREA51218.2020.9339790.

[5] S. A. Saad, A. '. B. Hisham, M. H. I. Ishak, M. H. M. Fauzi, M. A. Baharudin and N. H. Idris, "Real-time on-campus public transportation monitoring system," 2018 IEEE 14th International Colloquium on Signal Processing & Its Applications (CSPA), Penang, Malaysia, 2018, pp. 215-220, doi: 10.1109/CSPA.2018.8368715.

[6] M. Zhao, H. Yang, J. Liu, Y. Chen and J. Zhou, "Directional Wi-Fi Based Indoor Location System for Emergency," 2010 7th International Conference on Ubiquitous Intelligence & Computing and 7th International Conference on Autonomic & Trusted Computing, Xi'an, China, 2010, pp. 501-502, doi: 10.1109/UIC-ATC.2010.53.

APPENDIX

a) Code

```
#include <SoftwareSerial.h>
SoftwareSerial myGSM(3, 2);
#include <TinyGPS.h>

TinyGPS gps;
String textMessage;
float slat, slon;
void setup() {

  Serial.begin(9600);
  myGSM.begin(9600);
  Serial.print("Serial ready...");

  myGSM.println("AT+CMGF=1\r");
  delay(100);

  myGSM.println("AT+CNMI=2,2,0,0,0\r");
  delay(100);
}

void loop() {
  if (Serial.available() > 0)
  {
    int c = Serial.read();
    if (gps.encode(c))
    {
      float slat, slon;
      gps.f_get_position(&slat, &slon);
      Serial.print("Latitude :");
      Serial.println(slat, 6);
      Serial.print("Longitude:");
      Serial.println(slon, 6);
    }
  }
  if (myGSM.available() > 0)
  {
    textMessage = myGSM.readString();
    Serial.println(textMessage);
    delay(100);
  }
```

```
if (textMessage.indexOf("STATE") >= 0)
{
  gps.f_get_position(&slat, &slon);
  Serial.println("Setting the GSM in text mode");
  myGSM.println("AT+CMGF=1\r");
  delay(2000);
  Serial.println("Sending SMS to the desired phone number!");
  myGSM.println("AT+CMGS=\"+919860431221\"\r");

  delay(2000);
  myGSM.print("http://maps.google.com/maps?q=loc:");
  myGSM.print(slat, 6);
  myGSM.print(",");
  myGSM.print(slon, 6);

  Serial.println("");

  delay(500);
  myGSM.println((char)26);
  delay(1000);
  Serial.println("Sent");
}
    }
```

DATASHEETS

Atmel

ATmega328P

8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash

DATASHEET

Features

- High performance, low power AVR® 8-bit microcontroller
- Advanced RISC architecture
  - 131 powerful instructions – most single clock cycle execution
  - 32 × 8 general purpose working registers
  - Fully static operation
  - Up to 16MIPS throughput at 16MHz
  - On-chip 2-cycle multiplier
- High endurance non-volatile memory segments
  - 32K bytes of in-system self-programmable flash program memory
  - 1Kbytes EEPROM
  - 2Kbytes internal SRAM
  - Write/erase cycles: 10,000 flash/100,000 EEPROM
  - Optional boot code section with independent lock bits
    - In-system programming by on-chip boot program
    - True read-while-write operation
  - Programming lock for software security
- Peripheral features
  - Two 8-bit Timer/Counters with separate prescaler and compare mode
  - One 16-bit Timer/Counter with separate prescaler, compare mode, and capture mode
  - Real time counter with separate oscillator
  - Six PWM channels
  - 8-channel 10-bit ADC in TQFP and QFN/MLF package
    - Temperature measurement
  - Programmable serial USART
  - Master/slave SPI serial interface
  - Byte-oriented 2-wire serial interface (Phillips I^2C compatible)
  - Programmable watchdog timer with separate on-chip oscillator
  - On-chip analog comparator
  - Interrupt and wake-up on pin change
- Special microcontroller features
  - Power-on reset and programmable brown-out detection
  - Internal calibrated oscillator
  - External and internal interrupt sources
  - Six sleep modes: Idle, ADC noise reduction, power-save, power-down, standby, and extended standby

- I/O and packages
  - 23 programmable I/O lines
  - 32-lead TQFP, and 32-pad QFN/MLF
- Operating voltage:
  - 2.7V to 5.5V for ATmega328P
- Temperature range:
  - Automotive temperature range: –40°C to +125°C
- Speed grade:
  - 0 to 8MHz at 2.7 to 5.5V (automotive temperature range: –40°C to +125°C)
  - 0 to 16MHz at 4.5 to 5.5V (automotive temperature range: –40°C to +125°C)
- Low power consumption
  - Active mode: 1.5mA at 3V - 4MHz
  - Power-down mode: 1µA at 3V

LM2596 SIMPLE SWITCHER® Power Converter 150-kHz 3-A Step-Down Voltage Regulator

1 Features

- New product available:
  - LMR51430 4.5 to 36-V, 3-A, 500-kHz and 1.1-MHz synchronous converter
- For faster time to market:
  - TLVM13630 3 to 36-V, 3-A, 200-kHz to 2.2-MHz power module
- 3.3-V, 5-V, 12-V, and adjustable output versions
- Adjustable version output voltage range: 1.2-V to 37-V ±4% maximum over line and load conditions
- Available in TO-220 and TO-263 packages
- 3-A output load current
- Input voltage range up to 40 V
- Requires only four external components
- Excellent line and load regulation specifications
- 150-kHz fixed-frequency internal oscillator
- TTL shutdown capability
- Low power standby mode, I_Q, typically 80 µA
- High efficiency
- Uses readily available standard inductors
- Thermal shutdown and current-limit protection
- Create a custom design using the LM2596 with the WEBENCH® Power Designer

2 Applications

- Appliances
- Grid infrastructure
- EPOS
- Home theater

3 Description

The LM2596 series of regulators are monolithic integrated circuits that provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version.

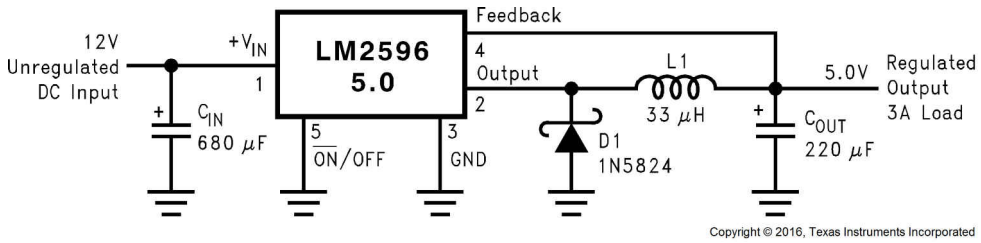
Requiring a minimum number of external components, these regulators are simple to use and include internal frequency compensation, and a fixed-frequency oscillator.

The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what can be required with lower frequency switching regulators. Available in a standard 5-pin TO-220 package with several different lead bend options, and a 5-pin TO-263 surface mount package.

Package Information

PART NUMBER	PACKAGE(1)	BODY SIZE (NOM)
LM2596	NDH (TO-220, 5)	14.986 mm × 10.16 mm
	KTT (TO-263, 5)	10.10 mm × 8.89 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



(Fixed Output Voltage Versions)

Typical Application

5 Description (continued)

A standard series of inductors are available from several different manufacturers optimized for use with the LM2596 series. This feature greatly simplifies the design of switch-mode power supplies.

Other features include a ±4% tolerance on output voltage under specified input voltage and output load conditions, and ±15% on the oscillator frequency. External shutdown is included, featuring typically 80 µA standby current. Self-protection features include a two stage frequency reducing current limit for the output switch and an overtemperature shutdown for complete protection under fault conditions.

6 Pin Configuration and Functions

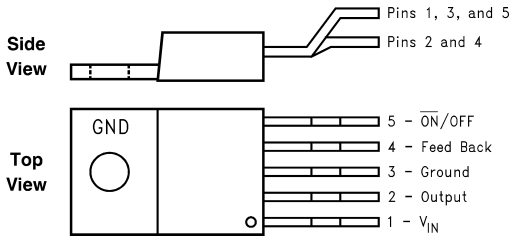


Figure 6-1. 5-Pin TO-220 NDH Package Top View

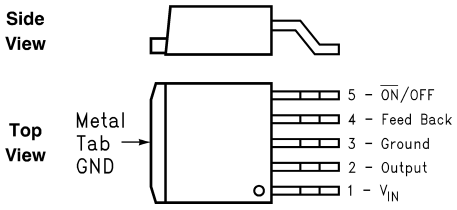


Figure 6-2. 5-Pin TO-263 KTT Package Top View

Table 6-1. Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	V_{IN}	I	This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents required by the regulator.
2	Output	O	Internal switch. The voltage at this pin switches between approximately ($+V_{IN} - V_{SAT}$) and approximately −0.5 V, with a duty cycle of V_{OUT} / V_{IN}. To minimize coupling to sensitive circuitry, the PCB copper area connected to this pin must be kept to a minimum.
3	Ground	—	Circuit ground
4	Feedback	I	Senses the regulated output voltage to complete the feedback loop.
5	$\overline{ON}$/OFF	I	Allows the switching regulator circuit to be shut down using logic signals thus dropping the total input supply current to approximately 80 µA. Pulling this pin below a threshold voltage of approximately 1.3 V turns the regulator on, and pulling this pin above 1.3 V (up to a maximum of 25 V) shuts the regulator down. If this shutdown feature is not required, the $\overline{ON}$/OFF pin can be wired to the ground pin or it can be left open. In either case, the regulator will be in the ON condition.

A7672X Series Hardware Design

LTE Module

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support@simcom.com
www.simcom.com

1 Introduction

This document describes the hardware interface of the module, which can help users quickly understand the interface definition, electrical performance and structure size of the module. Combined with this document and other application documents, users can understand and use A7672X module to design and develop applications quickly. SIMCom provides a set of evaluation boards to facilitate A7672X module testing and use. The evaluation board tools include an EVB board, a USB cable, an antenna, and other peripherals.

1.1 Product Outline

Aimed at the global market, the module supports GSM, LTE-TDD and LTE-FDD. Users can choose the module according to the wireless network configuration. The supported radio frequency bands are described in the following table.

Table 1: Module frequency bands

Standard	Frequency	A7672S	A7672E	A7672SA
GSM	900MHz	✓	✓	✓
	1800MHz	✓	✓	✓
LTE-FDD	LTE-FDD B1	✓	✓	✓
	LTE-FDD B2			✓
	LTE-FDD B3	✓	✓	✓
	LTE-FDD B4			✓
	LTE-FDD B5	✓	✓	✓
	LTE-FDD B7		✓	✓
	LTE-FDD B8	✓	✓	✓
	LTE-FDD B20		✓	
	LTE-FDD B28			✓
	LTE-FDD B66			✓
LTE-TDD	LTE TDD B34	✓		
	LTE TDD B38	✓		
	LTE TDD B39	✓		
	LTE TDD B40	✓		
	LTE TDD B41	✓		
Category		CAT1	CAT1	CAT1
GNSS		Optional	Optional	Optional
BlueTooth		Optional	Optional	Optional

With a small physical dimension of 24*24*2.4mm and with the functions integrated, the module can meet almost any space requirement in users' applications, such as smart phone, PDA, industrial handhold, machine-to-machine and vehicle application, etc.
A7672X provides 124 pins, including 80 LCC pins in the outer ring and 44 LGA pins in the inner ring. This document will introduce all the functional pins.

1.2 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:

- Power Supply
- USB 2.0 Interface
- Three UART Interface, one full function serial port, one ordinary serial port and one debug serial port
- USIM Interface
- General ADC Interface
- VBAT ADC Interface
- 4*4 matrix keyboard
- Analog audio MIC input interface
- Analog audio SPK output interface
- SPI Interface
- LDO Power Output
- I2C Interface
- General input and output interfaces (GPIO)
- SPI LCD Interface
- SPI Camera Interface
- Antenna Interface
- USB_BOOT interface
- Network status indication interface
- Module operation status indication interface

1.3 Hardware Block Diagram

The block diagram of the A7672X module is shown in the figure below.

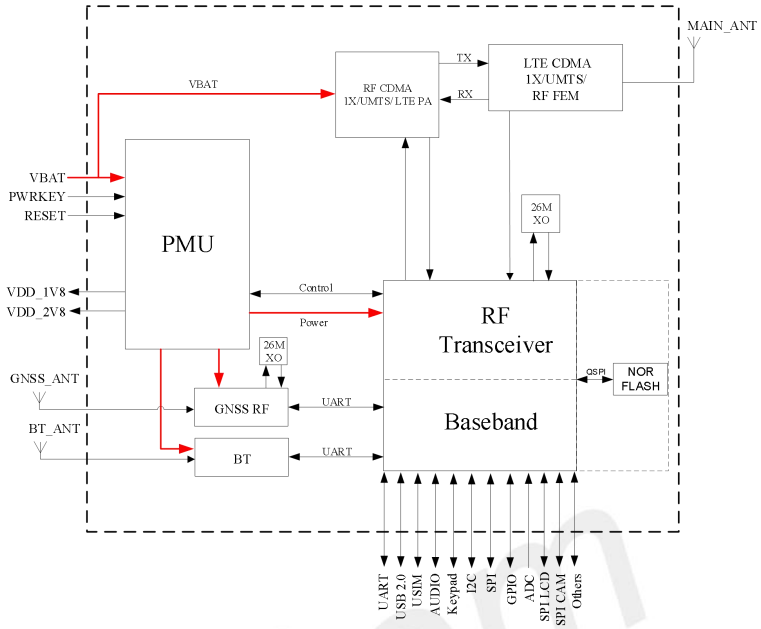


Figure 1: A7672X block diagram

1.4 Functional Overview

Table 2: General features

Feature	Implementation
Power supply	VBAT: 3.4V ~4.2V, Recommended VBAT: 3.8V
Power saving	Current in sleep mode: TBD
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power level: -- EGSM900: 4 (33dBm±2dB) -- DCS1800: 1 (30dBm±2dB) EDGE power level: -- EGSM900: E2 (27dBm±3dB) -- DCS1800 : E1 (26dBm+3dB/-4dB) LTE power level: 3 (23dBm±2.7dB)
Data Transmission Throughput	GPRS Multiple time slot level 12 EDGE Multiple time slot level 12 TDD/FDD-LTE category 1 : 10 Mbps (DL),5 Mbps (UL)
Antenna	GSM/LTE antenna interface GNSS antenna interface(optional) Bluetooth antenna interface(optional)
SMS	MT, MO, CB, Text, PDU mode Short Message (SMS)storage device: USIM Card, CB does not support saving in SIM Card

	Support CS domain and PS domain SMS
USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Phonebook management	Support phonebook types: SM/FD/ON/AP/SDN
Audio feature	Support analog audio interface
UART interface	●Full function serial port Baud rate support from 300bps to 3686400bps AT command and data can be sent through serial port Support RTS/CTS Hardware flow control Support serial port multiplexing function conforming to GSM 07.10 protocol ●Debug serial port Support debug usage ●UART3 serial port Ordinary serial port
USB	USB 2.0 compliant, host mode not supported. This interface can be used for AT command sending, data transmission, software debugging and upgrading.
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	Size:24*24*2.4m Weight:2.8±0.1g
Temperature range	Normal operation temperature: -30°C to +80°C Extended operation temperature: -40°C to +85°C* Storage temperature -45°C to +90°C

NOTE

Module is able to make and receive voice calls, data calls, SMS and make GPRS/LTE traffic in -40℃ ~ +85℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

2 Package Information

2.1 Pin Assignment Overview

The following Figure is a high-level view of the pin assignment of the module for A7672X.

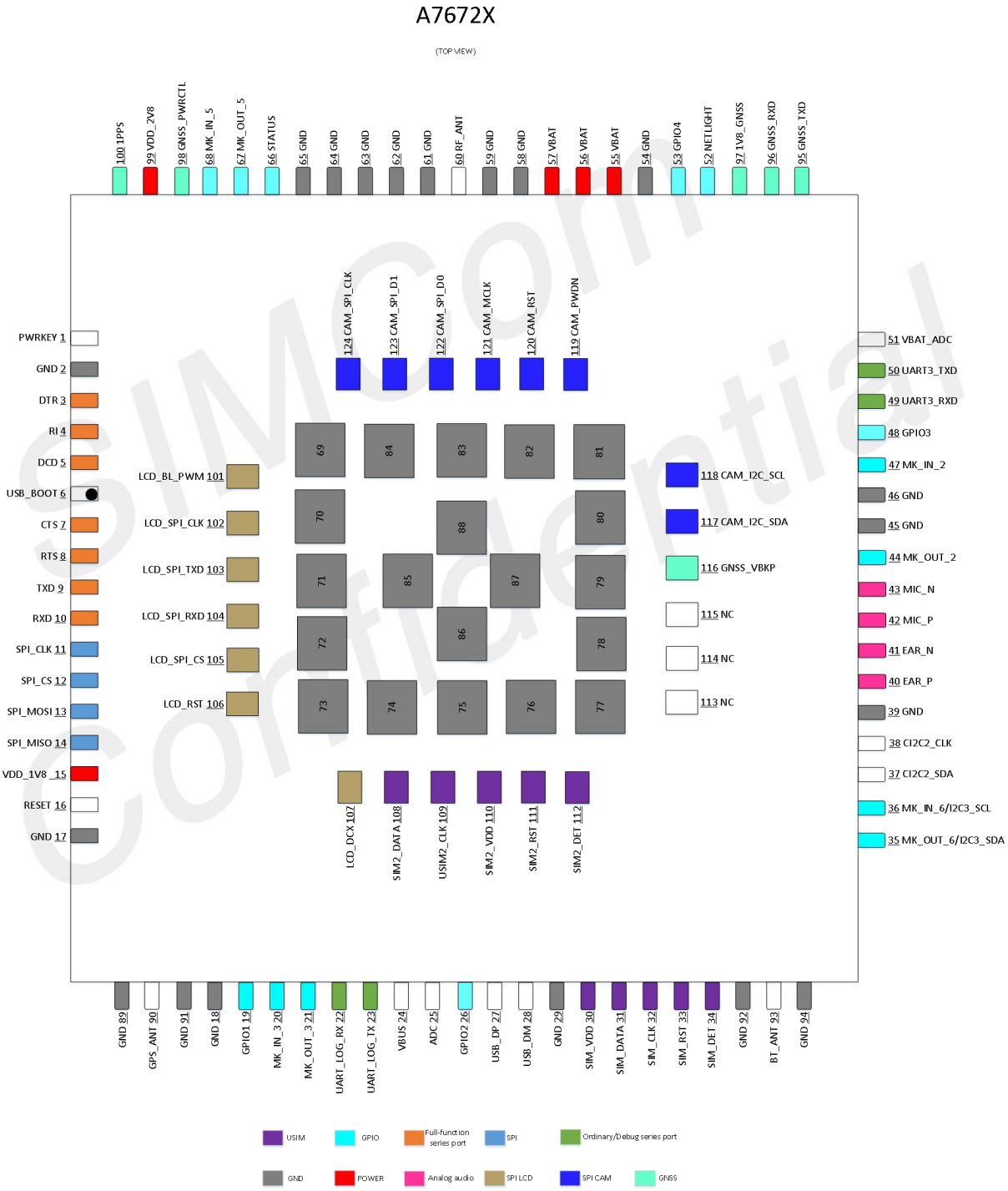


Figure 2: Pin assignment overview for A7672X

Table 3: Pin Description

PIN NO	PIN NAME	PIN NO	PIN NAME
1	PWRKEY	2	GND
3	DTR	4	RI
5	DCD	6	USB_BOOT●
7	CTS	8	RTS
9	TXD	10	RXD
11	SPI_CLK	12	SPI_CS
13	SPI_MOSI	14	SPI_MISO
15	VDD _1V8	16	RESET
17	GND	18	GND
19	GPIO1	20	MK_IN_3
21	MK_OUT_3	22	UART_LOG_RX
23	UART_LOG_TX	24	VBUS
25	ADC	26	GPIO2
27	USB_DP	28	USB_DM
29	GND	30	USIM1_VDD
31	USIM1_DATA	32	USIM1_CLK
33	USIM1_RST	34	USIM1_DET
35	MK_OUT_6/I2C3_SDA	36	MK_IN_6/I2C3_SCL
37	I2C_SDA	38	I2C_SCL
39	GND	40	EAR_P
41	EAR_N	42	MIC_P
43	MIC_N	44	MK_OUT_2
45	GND	46	GND
47	MK_IN_2	48	GPIO3
49	UART3_RXD	50	UART3_TXD
51	VBAT_ADC	52	NETLIGHT
53	GPIO4	54	GND
55	VBAT	56	VBAT
57	VBAT	58	GND
59	GND	60	RF_ANT
61	GND	62	GND
63	GND	64	GND
65	GND	66	STATUS
67	MK_OUT_5	68	MK_IN_5
69	GND	70	GND
71	GND	72	GND
73	GND	74	GND
75	GND	76	GND

77	GND	78	GND
79	GND	80	GND
81	GND	82	GND
83	GND	84	GND
85	GND	86	GND
87	GND	88	GND
89	GND	90	GNSS_ANT
91	GND	92	GND
93	BT_ANT	94	GND
95	GNSS_TXD	96	GNSS_RXD
97	1V8_GNSS	98	GNSS_PWRCTL
99	VDD_2V8	100	1PPS
101	LCD_BL_PWM	102	LCD_SPI_CLK
103	LCD_SPI_TXD	104	LCD_SPI_RXD
105	LCD_SPI_CS	106	LCD_RST
107	LCD_DCX	108	USIM2_DATA
109	USIM2_CLK	110	USIM2_VDD
111	USIM2_RST	112	USIM2_DET
113	NC	114	NC
115	NC	116	GNSS_VBKP
117	CAM_I2C_SDA	118	CAM_I2C_SCL
119	CAM_PWDN	120	CAM_RST
121	CAM_MCLK	122	CAM_SPI_D0
123	CAM_SPI_D1	124	CAM_SPI_CLK

NOTE

'●' Indicates that these Pins cannot be pulled down before the module powered up, otherwise it will affect the normal start-up of the module.

2.2 Pin Description

Table 4: Pin parameter abbreviation

Pin type	Description
PI	Power input
PO	Power output
AI	Analog input
AIO	Analog input/output

I/O	Bidirectional input /output
DI	Digital input
DO	Digital output
DOH	Digital output with high level
DOL	Digital output with low level
PU	Pull up
PD	Pull down

Table 5: 1.8V IO parameters definition

Power Domain	Parameter	Description	Min	Typ.	Max
	VIH	High level input	VCC * 0.7	1.8V	VCC + 0.2
	VIL	Low level input	-0.3V	0V	VCC *0.3
	Rpu	Pull up resistor	55KΩ	79 KΩ	121 KΩ
	Rpd	Pull down resistor	51 KΩ	87 KΩ	169 KΩ
	IIL	Input leakage current	-	-	10uA
	VOH	Output level range	VCC - 0.2	-	-
	VOL	Output low range	-	-	0.2V
	IOL	Maximum current driving capacity at low level output	-	-	13mA
	IOH	Maximum current driving capacity at high level output Vpad=VCC-0.2V	-	-	11mA

Table 6: 3.3V IO parameters definition

Power Domain	Parameter	Description	Min	Typ.	Max
3.3V	VIH	High level input	2V	1.8V	VCC + 0.3
	VIL	Low level input	-0.3V	0V	0.8V
	Rpu	Pull up resistor	26KΩ	47 KΩ	72 KΩ
	Rpd	Pull down resistor	27 KΩ	54 KΩ	267 KΩ
	IIL	Input leakage current	-	-	10uA
	VOH	Output level range	2.4V	-	-
	VOL	Output low range	-	-	0.4V
	IOL	Maximum current driving capacity at low level output	-	-	7mA
	IOH	Maximum current driving capacity at high level output Vpad=VCC-0.5V	-	-	7mA

Table 7: Pin description

Pin name	Pin No.	Pin parameter		Description	Note
		Power domain	Type		
Power supply					
VBAT	55,56, 57	-	PI	Module input voltage ranges from 3.4V to 4.2V, Typical values is 3.8V. and the peak current value can reach 2A.	
VDD_1V8	15	-	PO	1.8V power output, output current up to 50 mA. Cannot provide to high power load, can provide power for level conversion circuit, etc.	Can provide 1V8 power supply for GNSS. If unused, keep it open.
VDD_2V8	99	-	PO	Internal 2.8V power output, output current up to 50 mA. Cannot provide to high power load.	Can provide 2V8 power supply for LCD VCC_2V8. If unused, keep it open.
GND	2,17,18, 29,39, 45,46, 54,58, 59,61, 62,63, 64,65, 69,70, 71,72, 73,74, 75,76, 77,78, 79,80, 81,82, 83,84, 85,86, 87,88, 89,91, 92,94	-	-	Ground	
System Control					
PWRKEY	1	-	DI,PU	Power ON/OFF input, active low. VIH: 0.7*VBAT VIL: 0.3*VBAT	PWRKEY has been internally pulled-up to VBAT with 50KΩ resistor, default high.
RESET	16	-	DI,PU	System reset control input, active low. VIH: 0.7*VBAT VIL: 0.3*VBAT	RESET has been pulled-up to VBAT with 50KΩ (typical) resistor, default high.

USIM interface					
USIM1_DATA	31	1.8/3.0V	I/O,PU	USIM bus data, this pin has been pull-up with 4.7KΩ resistor to USIM1_VDD.	
USIM1_RST	33	1.8/3.0V	I/O,PU	USIM bus reset output.	
USIM1_CLK	32	1.8/3.0V	I/O,PU	USIM bus clock output.	
USIM1_VDD	30	1.8/3.0V	PO	USIM card power supply output, supports 1.8v/3.0v output according to the card type, its output current is up to 50mA.	
USIM1_DET	34	1.8V	I/O,PU	USIM insert detect, it can be set to high/low active with the AT command, refer to Document [25]	
USIM2_DATA	108	1.8/3.0V	I/O,PU	USIM bus data, this pin need pull-up with 4.7KΩ resistor to USIM2_VDD externally.	
USIM2_RST	111	1.8/3.0V	I/O,PU	USIM bus reset output.	
USIM2_CLK	109	1.8/3.0V	I/O,PU	USIM bus clock output.	
USIM2_VDD	110	1.8/3.0V	PO	USIM card power supply output, supports 1.8v/3.0v output according to the card type, its output current is up to 50mA.	
USIM2_DET	112	1.8V	DI,PD	USIM insert detect, it can be set to high/low active with the AT command, refer to Document [25]	
USB interface					
VBUS	24	-	AI	Valid USB detection input. Active high, Vmax(valid)=3.0V, Vmax(detection)=5.2V	
USB_DM	28	-	I/O	Negative line of the differential, bi-directional USB signal.	
USB_DP	27	-	I/O	Positive line of the differential, bi-directional USB signal.	
Full function UART interface					
RTS	8	1.8V	DI	RTS input	If unused, keep it open.
CTS	7	1.8V	DO	CTS output	
RXD	10	1.8V	DI	Data input	
TXD	9	1.8V	DOH	Data output	
RI	4	1.8V	DO	Ringing indicator	
DCD	5	1.8V	DO	Carrier detection	
DTR	3	1.8V	DI	DTE Ready	
Debug UART					
UART_LOG_TXD	23	1.8V	DOH	Log output	Default used as debug port.
UART_LOG_RXD	22	1.8V	DI	Log input	
Serial Port UART3					

UART3_TXD	50	1.8V	DOH	Log output	Two-wire serial port
UART3_RXD	49	1.8V	DI	Log input	
I2C interface					
I2C_SCL	38	1.8V	DO	I2C clock output	If unused, keep it open. Need pull up to VDD_1V8 externally.
I2C_SDA	37	1.8V	I/O	I2C data I/O	
SPI interface					
SPI_CLK	11	1.8V	I/O,PD	SPI clock	If unused, keep it open.
SPI_CS	12	1.8V	I/O,PD	SPI chip selection	
SPI_MOSI	13	1.8V	DO,PD	SPI Main output slave input	
SPI_MISO	14	1.8V	DI,PD	SPI Main input slave output	
Analog audio interface					
EAR_P	40	1.8V	AIO	Earphone output positive	If unused, keep it open.
EAR_N	41	1.8V	AIO	Earphone output negative	
MIC_P	42	1.8V	AIO	MIC input positive	
MIC_N	43	1.8V	AIO	MIC input negative	
GPIO					
GPIO1	19	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GPIO2	26	1.8V	IO,PD	General purple I/O	If unused, keep it open.
GPIO3	48	1.8V	IO,PD	General purple I/O	If unused, keep it open.
GPIO4	53	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GNSS Interface					
GNSS_PWRCTL	98	1.8V	DI	The enable control PIN of GNSS power supply.	Active high.
1V8_GNSS	97	-	PI	The power input for GNSS, the input voltage must not be less than 1.8V.	Module VDD_1V8 (PIN 15) can be used for this power supply
GNSS_VBKP	116	-	PI	GNSS VRTC power input, input voltage 1.4V~3.6V	If unused, keep it open.
1PPS	100	1.8V	DO	1PPS signal output	If unused, keep it open.
GNSS_RXD	96	1.8V	DI	GNSS UART RX	Connect to MCU UART_TX; Or use 10K resistors in series in module

					UART3_TX (pin 50).
GNSS_TXD	95	1.8V	DO	GNSS UART TX	Connect to MCU UART_RX; Or use 10K resistors in series in module UART3_RX (pin 49).
SPI LCD Interface					
LCD_BL_PWM	101	1.8V	DO	LCD backlight adjusting PWM	If unused, keep it open.
LCD_SPI_CLK	102	1.8V	DO	SPI clock	
LCD_SPI_TXD	103	1.8V	DI，DO	SPI DATA(Bidirectional)	
LCD_SPI_RXD	104	1.8V	DI	SPI DATA	
LCD_SPI_CS	105	1.8V	DO	SPI CS	
LCD_RST	106	1.8V	DO	LCD Reset	
LCD_DCX	107	1.8V	DO	Command/parameter selection	
SPI CAMERA Interface					
CAM_I2C_SDA	117	1.8V	DI, DO	Camera I2C data	If unused, keep it open.
CAM_I2C_SCL	118	1.8V	DO	Camera I2C clock	
CAM_PWDN	119	1.8V	DO	Camera power down	
CAM_RST	120	1.8V	DO	Camera reset	
CAM_MCLK	121	1.8V	DO	Camera main clock	
CAM_SPI_D0	122	1.8V	DI	Camera SPI D0	
CAM_SPI_D1	123	1.8V	DI	Camera SPI D1	
CAM_SPI_CLK	124	1.8V	DO	Camera SPI clock	
ANT interface					
RF_ANT	60	-	AIO	Main antenna	
GNSS_ANT	90	-	AIO	GNSS antenna	
BT_ANT	93	-	AIO	Bluetooth antenna	
Other pins					
ADC	25	-	AI	General Purpose ADC	If unused, keep it open.
VBAT_ADC	51	-	AI	VBAT ADC	If unused, keep it open.
NETLIGHT	52	1.8V	DO	Network registration status indicator (LED). For more detail, please refer the chapter 3.12.	
STATUS	66	1.8V	DO	Module status indicator (LED).	
USB_BOOT	6	1.8V	DI	Firmware download guide	Do place 2 test

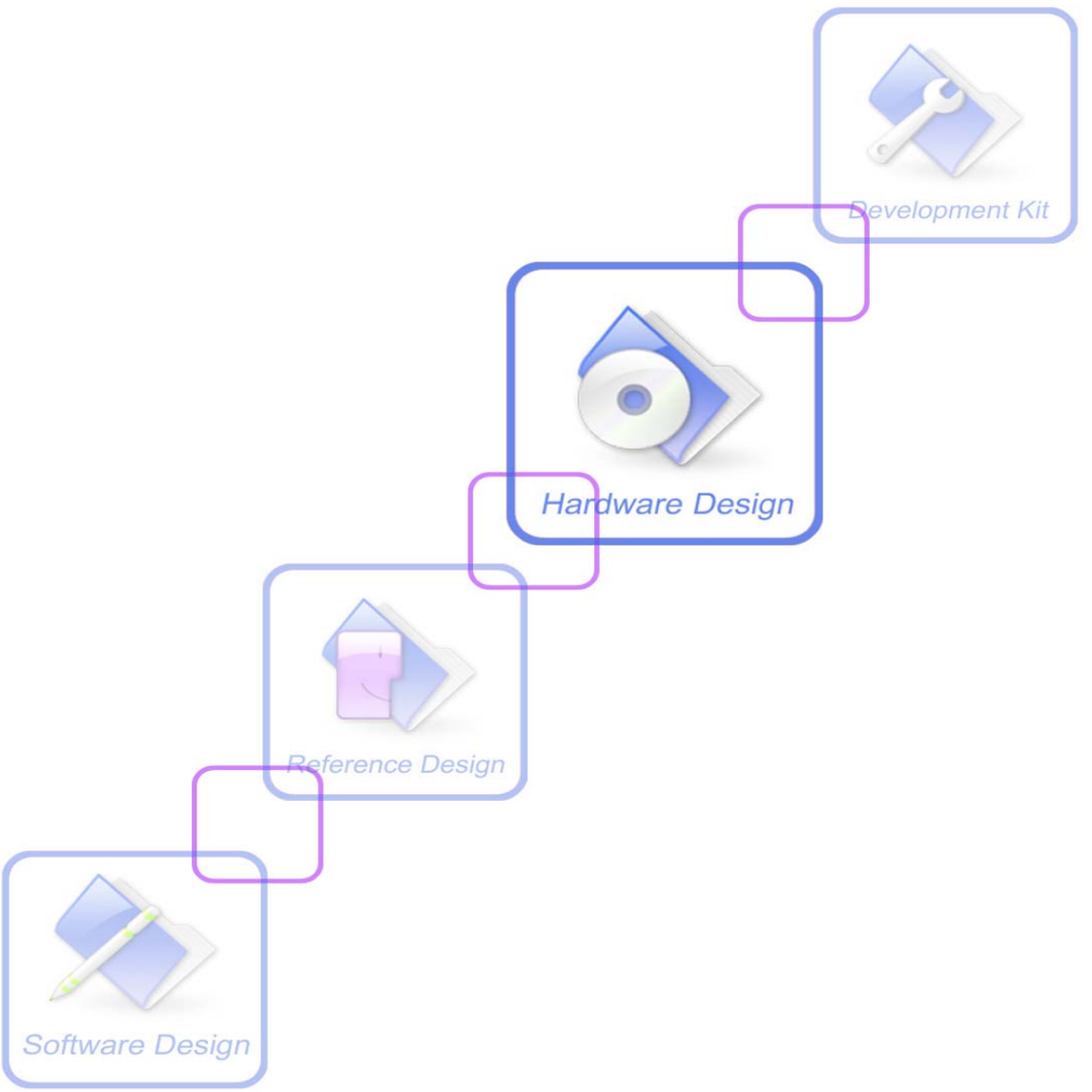
				control input. when pull-up to GND and press PWRKEY,module will access in USB download mode.	points for debug. Do not pull down USB_BOOT during normal power up !

NOTE

Please reserve a test point for USB_BOOT, VDD_EXT and UART_LOG_TX. If there is no USB connector, please also reserve a test point for USB_VBUS, USB_DP, and USB_DM for Firmware upgrade.

Hardware Design

SIM900A_HD_V1.01



1 Introduction

This document describes the hardware interface of the SIMCom SIM900A module that connects to the specific application and the air interface. As SIM900A can be integrated with a wide range of applications, all functional components of SIM900A are described in great detail.

This document can help you quickly understand SIM900A interface specifications, electrical and mechanical details. With the help of this document and other SIM900A application notes, user guide, you can use SIM900A module to design and set-up mobile applications quickly.

1.1 Related Documents

Table 1: Related documents

SN	Document name	Remark
[1]	SIM900A_ATC	SIM900A_ATC
[2]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[3]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[5]	GSM 07.05:	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6]	GSM 11.14:	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification
[10]	AN_Serial Port	AN_Serial Port

1.2 Terms and Abbreviations

Table 2: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
ARP	Antenna Reference Point
ASIC	Application Specific Integrated Circuit
BER	Bit Error Rate
BTS	Base Transceiver Station
CHAP	Challenge Handshake Authentication Protocol
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
I/O	Input/Output
IC	Integrated Circuit
IMEI	International Mobile Equipment Identity
Abbreviation	**Description**
kbps	Kilo bits per second
LED	Light Emitting Diode
Li-Ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE

MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value
Inorm	Normal Current
Imax	Maximum Load Current
Phonebook abbreviations	
Abbreviation	**Description**
FD	SIM fix dialing phonebook
LD	SIM last dialing phonebook (list of numbers most recently dialed)

MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	SIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

1.3 Safety Caution

The following safety precautions must be observed during all phases of the operation. Usage, service or repair of any cellular terminal or mobile incorporating SIM900A module. Manufactures of the cellular terminal should send words the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. If not so, SIMCom does not take on any liability for customer failure to comply with these precautions.

When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive to not operate normally for RF energy interference.

Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it be switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forget to think much of these instructions may lead to the flight safety or offend against local legal action, or both.

Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.

Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.

Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.

2.3 SIM900A Evaluation Board

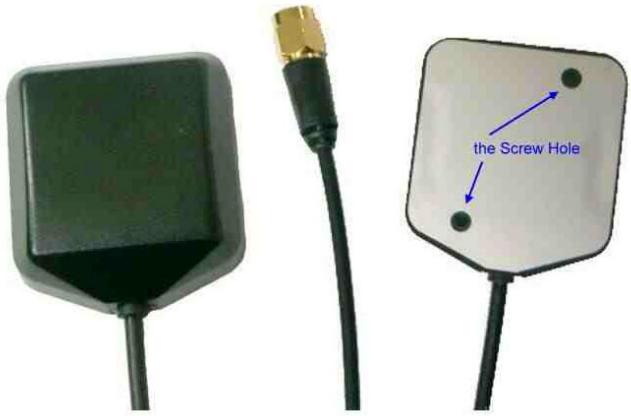
In order to help you on the application of SIM900A, SIMCom can supply an Evaluation Board (EVB) that interfaces the SIM900A directly with appropriate power supply, SIM card holder, RS232 serial port, handset port, earphone port, line in port, antenna and all GPIO of the SIM900A.

Figure 2: Top view of SIM900A EVB

For details please refer to the *SIM900A-EVB_UGD* document.

GPS Active Antenna

- Mini GPS Antenna with High Gain
- 1575.42MHz +/- 1MHz
- Active gain: +5dB
- VSWR <1.5:1
- 5metres RG174 Cable
- SMA Male Connector
- Dimensions 25 x 25 x 4mm
- Mag Mount and Screw Fix



Applications

- Car GPS Systems
- Hand held GPS Systems

Description

A compact Antenna for GPS applications where high performance is required from a small size. The antenna includes a Low Noise Amplifier and incorporates both magnetic mount and screw fixings.

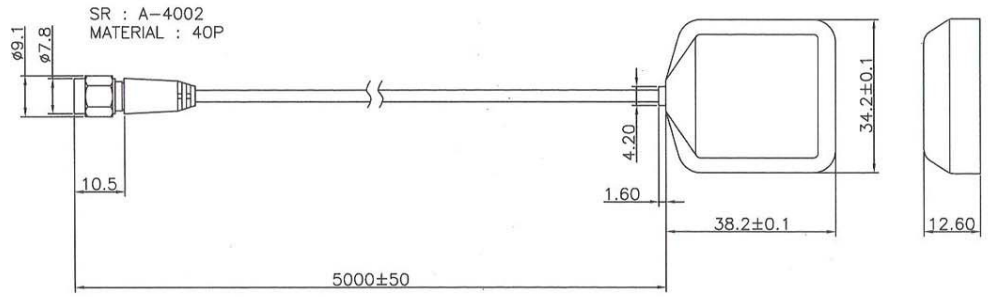
Part Numbers

	Description	Cable Length	Connector
ANT-GPSMG	Active GPS with cable and connector	5metres	SMA (M)

R F Solutions Ltd.,
Unit 21, Cliffe Industrial Estate,
Lewes, E. Sussex. BN8 6JL. England.
Email : sales@rfsolutions.co.uk http://www.rfsolutions.co.uk
Tel: +44 (0)1273 898 000 Fax: +44 (0)1273 480 661

Mechanical Detail

Cable	RG174/U
OD	ø2.6±0.1mm
Cover	Black
SMA M	Gold(鍍金)



Material:		Treatment:					
Drawer	Design	Aprov	Tolerance	Unit: mm		TITLE	SMA M+174U+10D
			X=±0.5 .X=±0.2 .XX=±0.1 .XXX=±0.05	Ver: B	Scale 1:1	Model NO	
				File NO: QR0402		Drawing NO	

NO	DESCRIPTION	MATERIAL	FINISH	Q"TY
Part NO				

Test Data

GENERAL

3.1 ENVIRONMENTAL CONDITIONS	
3.1.1 OPERATING TEMPERATURE	-40°C TO +85°C
3.1.2 STORAGE TEMPERATURE	-40°C TO +90°C (110°C MAX 1HR.)
3.1.3 RELATIVE HUMIDITY	20% TO 95%, rain
3.2 ELECTRICAL SPECIFICATIONS	
3.2.1 INPUT VOLTAGE Require:	2.5 to 5.5 VDC
3.2.2 POWER CONSUMPTION	10~25 mA
3.2.3 OUTPUT CONNECTOR	SMA male
3.2.4 CABLE Shikoku Cable	RG174U
	Loss at 1575 MHz < 1.32 dB per meter
3.3 MECHANICAL SPECIFICATIONS	
3.3.1 MOUNTING	Magnetic Mount
3.3.2 PULLING FORCE OF MAGNET	29.4N Min.
3.3.3 WATER PROOF	Waterproof (JISD0203 S2)
3.3.4 SHOCK	50G : Vertical Axis
	30G : All Axis
3.3.5 VIBRATION	10 through 200Hz. Log sweep 3.0G
	(Sweep Time : 15 MIN.) 3 AXIS
3.3.6 MAGNET MOUNT	Withstand speed of upto 180Km/h.
3.3.7 CABLE PULLING FORCE	49N MIN.
	Before Visible or electrical damage appears applying up to 49N pulling force between cable and antenna as well as between cable and connector.
3.3.8 BENDING TEST 1" radius	After bending test 90 degree right and left
	1,000 cycles, no permenant damage found.
3.3.9 ANTI-COROSION	Based on JIS Z 2371, spray 5% saltwater at 35°C should not rust after 96Hrs,
3.3.10 Dimensions	see mechanical drg

GPS Active Antenna

4.0 ANTENNA	
4.1 Outline Dimension	25x25x4 mm
4.2 FREQUENCY RANGE (minimum)	1,575.42 + 1.1 MHz
4.3 Frequency rejection (low side)	-10 dB or more rejection below 1500 MHz
4.4 Frequency rejection (high side)	-10 dB or more rejection above 1650 MHz
4.5 GAIN	1.0dBi minimum When MOUNTED ON A 25x25mm diameter metal GROUND PLANE
4.6 POLARIZATION	RHCP
4.7 AXIAL RATIO	3 dB MAX.
4.8 Bandwidth	10MHz
5.0 LNA	
5.1 FREQUENCY RANGE (minimum)	1,575.42 + 1.1 MHz
5.2 GAIN	32dB +3 dB (+30°C)
	32dB +4 dB (-40°C to +85°C)
5.3 NOISE FIGURE	1.8 dB MAX. (+30°C)
5.4 OUT OF BAND REJECTION	fo =1,575.42 MHz
	fo + 20MHz 7dB MIN.
	fo + 30MHz 12dB MIN.
	fo + 50MHz 20dB MIN.
	fo + 100MHz 30dB MIN.
5.5 OUTPUT IMPEDANCE	50ohm
5.6 OUTPUT VSWR	2.0:1 MAX.
6.0 Other Specifications	
6.1 ESD	ANTENNA SURFACE 15KV
	CONNECTOR PIN 8KV
	(TEST CONDITION JASOD001-94 C-3)
6.2 WEEE & Rohs compliant	Yes
7.0 MTBF	2,000 Hours
8.0 RECOMMENDED STORAGE CONDITION	-20°C~+45°C, HUMIDITY 80%MAX.
9.0 EXTERNAL APPEARANCE	NO VISIBLE STAIN OR FLAW.
10 Supplied DATA	GAIN and Current CONSUMPTION
	5.0V +0.2VDC At 1575 MHz

BILL OF MATERIAL

ELECTRONICSCOMP.COM
ONLINE ELECTRONICS & ROBOTICS COMPONENTS STORE

Invoice #2975745

Order Details	
ElectronicsComp.com Constflick Technologies Limited Building No. 28, 2nd & 3rd Floor, 2nd Cross Road, SGN Layout Opposite G Shantilal Transport, Bangalore, Karnataka - 560027 India. Customer Support - care@electronicscomp.com **Mobile** +91-9050832648 **E-Mail** care@electronicscomp.com **Web Site:** https://www.electronicscomp.com (https://www.electronicscomp.com)	**Date Added:** 20/04/2023 **Invoice No.:** INV/23-24/5712 **Invoice Date :** 20/04/2023 **Order ID:** 2975745 **Payment Method:** Credit Card / Debit Card / Net Banking / UPI and Wallet (Razorpay) **Shipping Method:** Flat Shipping Rate **GSTIN No.:** 29AAGCC1645N1ZA

Billing Address	Shipping Address
Soham Phirke C-1003 Bhoomi Orabelle Ravet., Opp. S.B.Patil School C-1003 Bhoomi Orabelle Ravet., Opp. S.B.Patil School Pimpri-Chinchwad 412101 Maharashtra India Contact No. - 9359584022 Email. - sohamphirke1712@gmail.com	Soham Phirke Pimpri Chinchwad College of Engineering C-1003 Bhoomi Orabelle Ravet., Opp. S.B.Patil School Sector 26, Pradhikaran,Nigdi, Pune, Pimpri-Chinchwad 411062 Maharashtra India

No. of Products	Model	HSN Code	Quantity	Price	Tax	Total
22 ohm Resistor - 0805 SMD Package - 20 Pieces Pack	EC-0834	85332929	1	Rs.16.00	IGST (18%)	Rs.16.00
2.2K ohm Resistor - 0805 SMD Package - 20 Pieces Pack	EC-0845	85332929	1	Rs.16.00	IGST (18%)	Rs.16.00
1K ohm Resistor - 0805 SMD Package - 20 Pieces Pack	EC-0836	85332929	1	Rs.16.00	IGST (18%)	Rs.16.00
10K ohm Resistor - 0805 SMD Package - 20 Pieces Pack	EC-0840	85332929	1	Rs.16.00	IGST (18%)	Rs.16.00
10nF (0.01uF) 50V Capacitor - 0805 SMD Package - 10 Pieces Pack	EC-1311	85322990	1	Rs.20.00	IGST (18%)	Rs.20.00
10uF (10000nF) 50V Capacitor - 0805 SMD Package - 10 Pieces Pack	EC-1404	85322990	1	Rs.20.00	IGST (18%)	Rs.20.00

No. of Products	Model	HSN Code	Quantity	Price	Tax	Total
1.5nF (1500pF) 50V Capacitor - 0805 SMD Package - 10 Pieces Pack	EC-1324	85322990	1	Rs.20.00	IGST (18%)	Rs.20.00
22pf (0.022nF) 50V Capacitor - 0805 SMD Package - 10 Pieces Pack	EC-1339	85322990	1	Rs.20.00	IGST (18%)	Rs.20.00
120uF 16V Electrolytic Capacitor - 3 Pieces Pack	EC-3887	85322990	1	Rs.14.00	IGST (18%)	Rs.14.00
220uF 25V Electrolytic Capacitor - 3 Pieces Pack	EC-0009	85322990	1	Rs.9.00	IGST (18%)	Rs.9.00
					Sub-Total	Rs.167.00
					Coupon (GET10)	Rs.-16.70
					Flat Shipping Rate	Rs.49.00
					IGST (18%)	Rs.35.87
					Total	Rs.235.17

1 Packet

DUPLICATE

Tax Invoice

Campus Component Pvt. Ltd.
3rd Floor,Akruti Chamber,
Office no:-308, Swargate, Near Laxmi Narayan Theater,
Pune Maharashtra 411037
India
GSTIN 27AAECC2567M1ZB

Invoice#	: CCPLI/23-24/0277
Invoice Date	: 20/04/2023
Terms	: Due On Receipt
Due Date	: 20/04/2023

Details of Receiver (Bill To)

Soham Phirke
C-1003 Bhoomi Orabelle Ravet.
Opp. S.B.Patil School
Pimpri-Chinchwad
412101 Maharashtra
India

Details of Consignee (Ship To)

Soham Phirke
C-1003 Bhoomi Orabelle Ravet.
Opp. S.B.Patil School
Pimpri-Chinchwad
412101 Maharashtra
India

No	Item & Description	Brand /MFR No	Qty	Rate	Taxable Amount	CGST %	CGST Amt	SGST %	SGST Amt
1	A7672S-FASE (with GNSS + BLE) - WI-2383-D SPQ:300 , MOQ:1 HSN: 85177990	SIMCOM/S2-10AG3	1	950.00	950.00	9%	85.50	9%	85.50
				Sub Total	₹950.00		85.50		85.50

Total In Words
Indian Rupee One Thousand One Hundred Twenty-Two Only

Thank you for the payment. You just made our day.

Shipping charge	0.80
(GST18 (18%))	0.140
SAC: 996513	
Rounding	0.06
Total	**₹1,122.00**

Bank Details:-

Bank Name	Kotak Mahindra Bank
Account Number	0111460045
IFSC Code	KKBK0001771
Account Type	Current Account
Branch	Pune - Satara Road

Terms & Conditions
1) GST Extra @ 18%.
2) Freight Charges Extra (Generally 150 Rs + GST for shipment per KG by AIR or 95 Rs + GST per KG by Road).
3) Payment Terms Advance.
4) Price Reference Ex Works Pune.
5) Transit Insurance If any to be arrange by buyer.

For Campus Component Pvt.Ltd.

Campus Component Pune 37

Authorized Signature

Krishna Smart Technology
151, Shree Sharan Business Park, Near IOCL Petrol Pump, Panchratna Industrial Estate Part 2, Sarkhej Bavla Road, Changodar
Ahmedabad, Gujarat, India – 382213
GSTN : 24BUVPR2990A1ZA
Mobile: 93284 47397 / 90167 54957

INVOICE

Billing Address:
Pimpri Chinchwad College of Engineering
Soham Phirke
C-1003 Bhoomi Orabelle Ravet.
Opp. S.B.Patil School
Pimpri-Chinchwad 412101
Maharashtra
sohamphirke1712@gmail.com
9359584022

Invoice Number:	232400678
Invoice Date:	April 20, 2023
Order Number:	92528
Order Date:	April 20, 2023
Payment Method:	Credit Card / Debit Card / UPI / Netbanking / PayTM

Product	SKU	HSN	Qty	Rate	Item Total
Micro SIM Card Holder 6 pin - Spring Loaded Push Type	KSTS0188	85366990	1	₹16.94	₹19.99
SMA Connector - Female - Right Angle	KSTC0395	85366990	1	₹20.30	₹23.95
47nH Inductor - 200mA - 5% - SMD 0603	KSTI0036	85045090	15	₹0.85	₹15.00
SS34 Diode SMB - Schottky Diode - DO-214AA	KSTD0461	8541	6	₹2.46	₹17.40
LM2596HVS-5.0 Step Down Regulator - Fixed Output 5V - TO-263-5	KSTI0174	85423100	1	₹23.26	₹27.45
3x4x2mm SMD Tactile Switch	KSTS0761	85366990	5	₹1.95	₹11.50
16 Mhz Crystal SMD - HC49SMD - YXC	KSTC0789	85416000	4	₹7.04	₹33.20
Inductor 150uH - 10x10x4mm - CDRH104R - SMD	KSTI1278	8504	1	₹11.40	₹13.45
Inductor 39uH - 5.2x5.8x4.5mm - CD54 - SMD	KSTI1292	8504	2	₹8.05	₹19.00

Subtotal	₹180.94
Shipping	₹141.60 via Express Shipping - Bluedart (Delivery within 1 to 4 days)
Total Taxable Value	₹273.34
Total	**₹322.54 (includes ₹49.20 18% IGST)**

Report for plag (1)

by Vaishali Nilesh Patil

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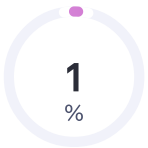

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55	**Correctness**	
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15	Punctuation in compound/complex sentences	
10	Mixed dialects of english	
3	Improper formatting	
6	Comma misuse within clauses	
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1	Incomplete sentences	
1	Incorrect phrasing	
4	Misplaced words or phrases	
4	Misspelled words	
3	Incorrect noun number	
2	Incorrect verb forms	
1	Confused words	
31	**Engagement**	
31	Word choice	
151	**Clarity**	
47	Wordy sentences	
68	Passive voice misuse	
28	Unclear sentences	
8	Intricate text	
7	**Delivery**	
3	Tone suggestions	

1	Potentially sensitive language	
3	Inappropriate colloquialisms	

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Measures vocabulary diversity by calculating the percentage of words used only once in your document

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unique words

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Measures depth of vocabulary by identifying words that are not among the 5,000 most common English words.

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rare words

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Measures average word length

5.3

characters per word

Sentence Length

Measures average sentence length

11.7

words per sentence

Report for plag (1)

Anti-Theft Tracking Device

2022-2023

E&TC Department, PCCOE

Anti-Theft Tracking Device

1