AUTONOMOUS BOUNDARY ALERT SYSTEM FOR CHILD/CRIMINAL MONITORING

This thesis report is submitted in partial fulfillment of the requirements for the Degree of Bachelor of Science in Electrical and Electronic Engineering

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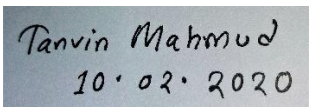
February 2020

CERTIFICATION

This is to certify that this thesis entitled **"**AUTONOMOUS BOUNDARY ALERT SYSTEM FOR CHILD/CRIMINAL MONITORING**"** is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirement for the degree of bachelor of Science in Electrical and Electronic Engineering. The Presentation of the work was held on September 2019.

Signature of the candidates



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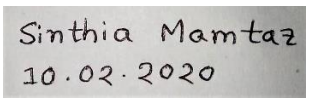

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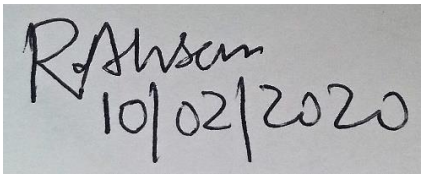

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Daffodil International University

Dedicated

To

Our Fathers

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LIST OF ABBREVIATION

GPS	Global Positioning System
GPRS	General Packet Radio Service
GSM	Global System for Mobile
LAT	Latitude
LON	Longitude
USB	Universal Serial Bus
LED	Light Emitting Diode
I/O	Input / Output
DC	Direct Current
SMS	Short Message Service
IC	Integrated Circuit
PWM	Pulse Width Modulation
KHZ	Kilohertz
MHZ	Megahertz
GHZ	Gigahertz
Li-ion	Lithium-ion
Li-Po	Lithium polymer
DIP	Dual Inline Package
WHO	World Health Organization
RAM	Random Access Memory
CPU	Central Processing Unit
RICS	Reduced Instruction Set Computing
TX	Transmit
RX	Receive
GND	Ground

ACKNOWLEDGEMENT

First, we express our gratefulness to Almighty Allah for His heavenly blessing makes us possible to complete our thesis.

Our heartiest thanks to our respected supervisor Dr. Md. Rezwanul Ahsan, Assistant Professor, Department of Electrical and Electronic Engineering, Daffodil International University, who took time out to hear, guide and keep us on the correct path. He was always so involved in the entire process, shared his knowledge and encouraged and motivate us to think.

This thesis is a golden opportunity for learning and self-development. We consider ourselves very lucky and honored to be a part of this thesis.

Last but not the least there was so many who shared valuable information that helped in the successful completion of this thesis.

ABSTRACT

The alarm base system using GPS system is to identify where the target unit is. The project has two main unit 1) Base Unit, 2) Target Unit. Base Unit get notify if the target unit is not inside the range. This project can be used in every alarming part of the society. The criminal monitoring, in hospitals also for working mother who want to track their child.

The main hardware of this project is Arduino can read the input and write the output like turning the lights on, activating a motor and can able to print any kind of information. This papers discuss the design and implementation of a buzzing alarm system using the Arduino which operates the entire system.

The target unit will sent a signal to the base unit via SIM module with the help of Arduino board. After getting signal base unit Arduino will turn ON the BUZZER, print a massage in LCD is “Target Escaped” and turn the red LED indicator ON.

The main object of this project is to make this project is to make an alert system with low cost. If it is not affordable people cannot purses it. From this type of project we can increase the safety zone of the society.

CHAPTER 1
INTRODUCTION

1.1 Introduction

Now a days tracking systems are more popular in our daily life because of its importance, and our behavior are increasingly influenced by their uses. Now in different part of our life keeping track of objects or even people has become usual. There are different type of monitoring system like mail monitoring, SMS monitoring are using for various purpose. For example, online shopping often involves shipping orders by mail. So postal companies offer the possibility of tracking package. In modern society tracking system are visible in everywhere. Even employees drives a company vehicle during office hour, tracking system are also used on them. Many tracking apps are used for company requirement to track them. Also tracking personal information involves on them. And this type of information are more accessible and shareable to the companies where more devices are equipped with sensors that keeps their owner position. Now smartphones are available in everyone's hand, which is capable of so many things, even tracking the person with their position.

Sometimes personal information and location tracking system capability does not harmful if the purpose of tracking is someone's safety. But on the other hand if a tracking system's objective is to maintain someone's safety the security should be much higher. The focus of this thesis is to increase the alert system if the target is out of the specified range. Target can be a Criminal, a Baby, a person with a mental imbalance, and so many cases.

1.2 Motivation

Monitoring someone's position grows some security issues. The question varies with the condition of the targeted person. In the case of targeting any person, there is always a conflict between security measures and acceptable privacy loss. Tracking the position of an adult wellbeing person that does not represent any wrong to the society but sometimes it may represent the mistreatment of terms and privacy issues of that person and also it can be an impact of raising ethical issues.

There are some observations that, tracking a person without informing is harmed the relationship that should be existing between the targeted person and the monitoring person. But when a target is a Suspicious Person, a Prisoner or a Criminal who should be monitored for the security issues of society. According to the WPB (World Prison Brief), in 2019, the number of prisoner population total is 88,211 (including pre-trial detainees/remand prisoners) and it is known to all that sometimes prisoner tries to escape from the cell. With a big number of prisoners, it is more difficult to be monitored manually all of them at the same time and that decreases the security factor. If the Prisoner Monitoring Base has no automatic system then it becomes more difficult and that increases the chance of Manpower shortage. For the solution of the problem, the Autonomous Boundary Alert System becomes the most essential and the most crucial weapon for keeping observation of the Prisoners all the time.

In the case of Children, nowadays most of all the parents are always in fear about their children. Various types of Accidents and Criminal activities are happening around their child. In May 2017, Johns Hopkins University in the United States published the results of a study carried out with three of its partner organizations in Bangladesh. According to that study, in Bangladesh, about 5,000 children die in water every year. Another famous news publisher BBC says that “In the proportion of the population, the most children die drowning in water in Bangladesh”. Disaster forums conducted a survey on 364 children drowned in 268 accidents and the result is 244 of the children were immature children (under 16) and about 5 percent of total children's deaths were under 8 years. Discussion analysis also shows that children under the age of 5 are dying in the water whose home is mostly near to rivers or canals. And the astonishing fact is the time to drown water is also very near coincidence and that is in between 11 am to 2 pm. During this time, Housemothers are busy with cooking and in other activities. The Accidents are occurring in a short time just when the child is out of vision. In this case, it is so difficult and maybe impossible to keep observing children all the time for resisting them from this type of accident if there is not an automatic alerting system when the children are out of their safety area or go to the danger zone like rivers or canals. This Autonomous Boundary Alert System can play a vital role in keeping observation of the child all the time and any kind of situation.

Another target group will be most acceptable in a society that is in the sense of Dementia Patients. Dementia is a disease in which there is deterioration in memory of a person. According to the World Health organization’s report, there are 50 million

people have dementia, and there are 10 million new people are including in this group every year. When there is a huge chance for a Dementia Patient to forget his safe home areas and get lost, this Autonomous Boundary Alert System could be the best of all solutions.

So although monitoring a person's position may result in some privacy invasion but with all this importance the Autonomous Boundary Alert System also expresses itself as an important and vital need for the people and society.

1.2.1 Ethics on Human Tracking

Ethics is very important in human tracking. Because it can damage a society balance. There are some research works in ethics on tracking systems aimed at human monitoring. Some of that states that the privacy and ethics on tracking humans and proposes a framework for tracking system with three points:

- The localization should be demand-driven.
- Privacy of the monitored person should be respected and his location only revealed to authorize only.
- The framework must be technology-independent as far as possible.

But there are no ethical problem when GPS is used only for social security issues as a navigation system. Then, some research testing took place, where patients carried a GPS device and caregivers observed their position using a PC. The tests discovered that the caregivers do not require information at all times, since they just want to know if the patient is having a memory loss or is wandering. Both caregivers and patients specified that the communication should be elusive, not excessive and used only when necessary. Concerning the patient's feedback, they don't want to be intrusively contacted. Also, they discovered it was important that the device's design is should be simple and that the use of such devices could recover stress for families and relatives.

1.2.2 Security on Human Tracking

The security accept arises in the tracking system when the location is a piece of critical information about a person. When there is a set of targets are children, mentally disorder people, suspicious person or a criminal there should be an extra security issue and that should be taken into account with concern very carefulness. A state of dishonor on security factors where the location of a child may be visible to kidnappers, or dementia

patient can be lost permanently due to misuse of this technology. As it is a networking system, some hacking attacks can happen on this tracking system at different points of the information flow with a highly trained technical expert for a bad intention. In these types of attacks, it can result in an incorrect location showing. But the main worry is that if the attack could occur in the communication channel, it may reveal the location to the attacker or unauthorized person and if that person having a bad intention he or she can give the wrong indication about the boundary or can change the message that simulating the normal operation of our system. This can damage society's balance. In our system, it was a crying need to keep in mind all of these security issues so that our system cannot be misused by a person having bad intentions.

1.3 Objective and Requirements

The goal is to create a platform that can helps the society to solve its some of the main critical issues like criminal escaping, child drowning in water, losing mentally unstable person etc. This system will help parents to monitor their children location where is a chance of get lost, will help the police to keep an eye on a suspicious person or a criminal who need to be monitored, will help the hospital or caretaker to look after a mentally unstable person like dementia patient. The system will inform the monitored target moves outside a certain predefined safe area. And the system will able to give performance for 24 hours in a day, 7 days in a week. After observing the social demands on this system another objective comes in mind that is to implement the theory in a device that are easy to work out and comfortable to be carried or wear like a smart watch. Due to these factors the final design must face a set of requirements to improve its acceptance and advantage of using. The requirements are:

- **Functional Requirements:**

    - **Localization –** The system must be able to read and write the location of a person by using understandable localization approaches.
    - **Communication of Information –** The system must be able to communicate with the Base from where the Target is being monitored.
    - **Direction –** The system must be able to notify the Target when it is outside of its predefined safe zone so that Target can get knowledge and direction to stay inside safe zone.

- **Autonomously Performable –** As the main goal is to get free the Caretaker from manually look or targeting the Target, The system must be operate automatically after starting.

- **Non-Functional Requirements:**

  - **Security –** The system must have some certain security to confirm:

    - Confidentiality – Only the authorized individual can access the information about the information about the location of the Target.
    - Integrity – The information should be the same as it was sent form the Target
    - Freshness – The communication should be on time to time. It means sent information about location should be as recent as possible not the old one.

  - **Performance** – The wearable device of the Target unit has limited energy because of its free movement capacity. So the performance should be as efficient as possible.
  - **Durability** – When the Target is a Human being it has to keep in mind that peoples activities are not like material. Human must has movement and does many other activity. In this case the system should be built with maximum durability so that after doing all the human activities by the Target, it remains working.
  - **Usability** – The device will be carried by children or people with mental disability, so it should be easy and comfortable to carry.
  - **Ethics** - The system must take on account security, privacy and ethical issues as far as possible.

1.4 Main Contribution

One of the main contribution of this thesis the system design. It allows many Parents, Caretakers, Doctors, Companies, and police to keep an eye automatically to monitor the Person or their required Target. It is simple, complete and an automatic solution. Another contribution is the experimental evaluation of this system proves the usefulness

of tracking as a monitoring system by confirming that tracking system is also able to provide security to human and help society to secure their life.

1.5 Dissertation Outline

Last of all the thesis report should be organized as follows. Chapter 2 will discuss and divided it into many section as it works. After explaining some important work related concept in Chapter 2, this paper will discuss in details about the important component that are used to designed the system practically in Chapter 3. And in Chapter 4, this paper will discuss about the system design like, block diagram of the system, wiring diagram of the system and description of all diagrams of the system. Chapter 5 and 6 will state about the Implementation of programming into the designed system and about the final result analysis of the designed system respectively. Chapter 7 is all about conclusion.

1.6 Summary

This chapter is an overview of the tracking system and how it is important and why this necessary for every section of livelihood. The topic of security, motivation, and contribution that tell how it becomes the crying need for human society. It proves that if we implement this system in our society, the tracking system will find a new perspective positive path in human society.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

Depending on its use, the characteristics and functionalities are different from other human monitoring system. The concepts and methods of localization for tracking Children, Criminal, and Dementia Patients are different. Taking in account the motivation for this thesis and requirements proposed, it is mandatory to analysis two aspects. Monitoring a person's position in a certain area is one of the requirement. The concepts of geofencing is another requirement because it gives the major functionality which is localization process. To find someone's position on surface there are so many sources, structures, technics and security issues. Building this system there are also some analysis related work that helps to predefine there mapping architecture, the solving solution and unsolved problems to this work.

2.2 Overall Concept of the System

In the present era, there are so many systems are available for monitoring something and fundamentally they are used for an object as well as human needs like personal location monitoring using smartphones, vehicle's location monitoring, package location monitoring, etc. But all of this system is generally operated manually by an individual. In sense of this sun-continent, there is not likely an available system that can observe a person's location and also can give information to the caretaker person autonomously. So we took this opportunity to build up a system that is able to observe location autonomously.

This system actually operates by observing the location of a human by taking is GPS data. For observing GPS data of a person it use GPS module remarked as Neo-6M. This GPS module actually calculates the Latitude and Longitude for pointing the location of the Targeted person on the earth's surface. With a deep observation and calculation, an area can be specified by the range of Latitude and Longitude value. When the Targeted person like Child, Suspicious People, and Dementia Patients cross the pre-specified area by Latitude and Longitude, the system works for informing the

person and also the caretaker person. For a better understanding of the localization process, the next topic should be taken into consideration.

2.3 Global Positioning System (GPS)

A satellite-based global navigation system that made up of at least 24 satellites is known as Global Positioning System (GPS). The system is owned by United States Government and operates by United States Space Force. It is a global navigation satellite system (GNSS) that provides geo-location and time information to a GPS receiver anywhere or near the Earth where there is an unobstructed line of sight to four or more GPS satellite. GPS operates in any kind of weather conditions, anywhere in the worlds, 25 hour a day, with no acceptance fees or setup charges. Obstacles like mountains, buildings, big construction site or blocks the relatively weak GPS signals.

2.4 How GPS works?

GPS satellites orbit the earth twice in a day in a fixed orbit. Each satellite sends a unique signal and orbital parameters that allows GPS devices to decode and compute the fixed location of the satellite. GPS receiver take this information to measure the user's exact location. Substantially, the GPS receiver calculate the distance to each satellite by the value of time it takes to receive a signal that was sent.

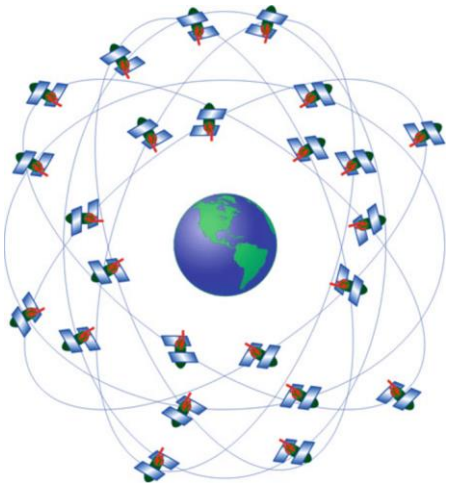

Fig 2.1 Circulation of GPS Satellite around Earth

2.5 Google Maps

A web based service that offers in-depth information regarding geographical areas and sites around the world is known as Google Maps. Additionally conventional road maps,

Google Maps offers overhead and satellite views of whole world. Now-a-days it offers street views including photographs taken from vehicles. In addition to all this features of Google Maps, a user can get Latitude and Longitude value of a specific area or point on the Earth.

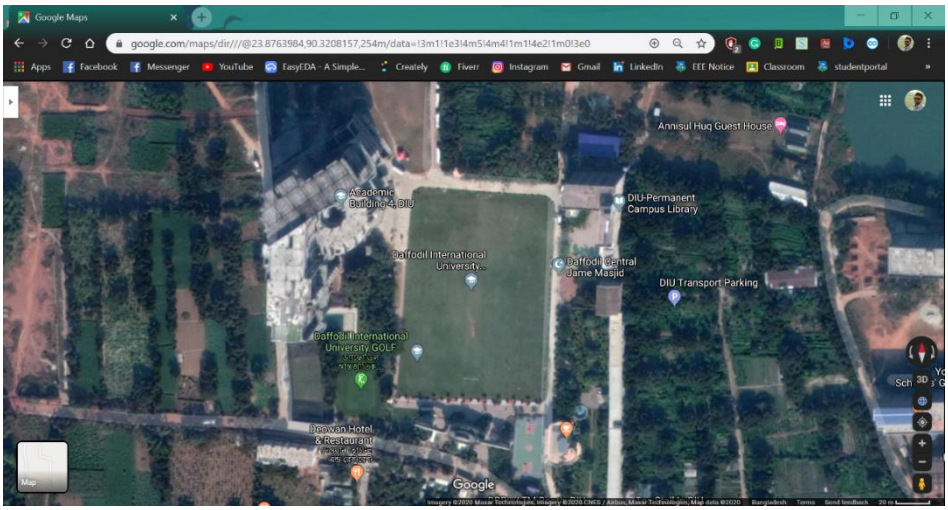

Fig 2.2 Satellite View of Daffodil International University Campus in Google Map

2.6 Latitude and Longitude

A geographic coordinate that indicates the North-South position of a point on the earth's surface is known as **Latitude.** It is a number of angle which ranges from 0° at Equator to 90° at the poles. Lines of latitude are all parallel to each other, thus they are often mentioned to as parallels. One degree of Latitude is equivalent to 69 nautical miles (364,000 fits), one minute equivalent to 1.15 nautical miles (6068 fits), and one second equivalent to 101 fits.

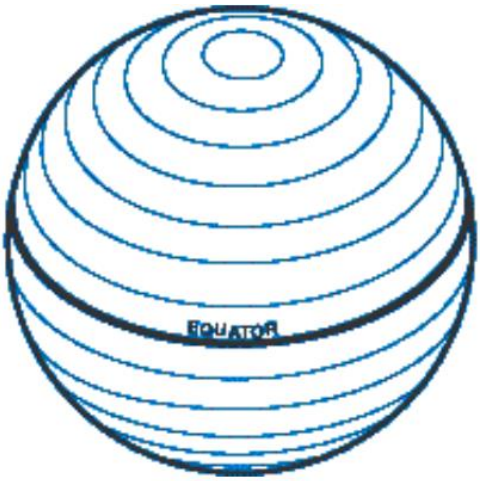

Fig 2.3 (a) Lines of Latitude on Earth

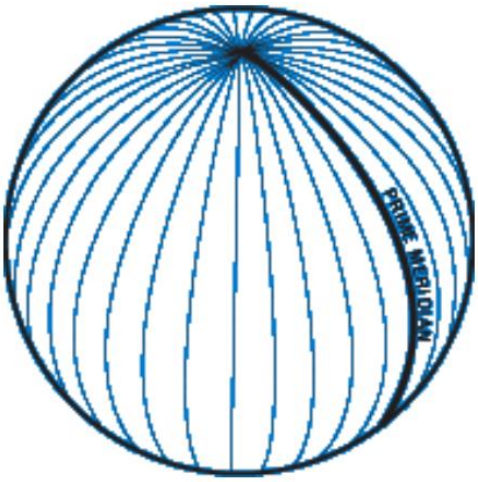

Fig 2.3 (b) Lines of Longitude on Earth

A geographic coordinate that indicates the East-West position of a point on the earth's surface is known as **Longitude.** It is a number of angle which ranges from 0° at Equator to 90° at the poles. Lines of latitude are all parallel to each other, thus they are often mentioned to as parallels. One degree of longitude is equivalent to 54.6 nautical miles, one minute is 4800 fits (0.91 miles), and one second equals is 80 ft.

2.6.1 Getting Latitude and Longitude of a Point

There are several websites provides Latitude and Longitude value of a specific point by clicking on that. And this is the easiest way to find a latitude and longitude value of a point. For doing this finder have to go to those website and should follow the websites instruction. In this system we use latlon.com for getting our expected Latitude and Longitude value.

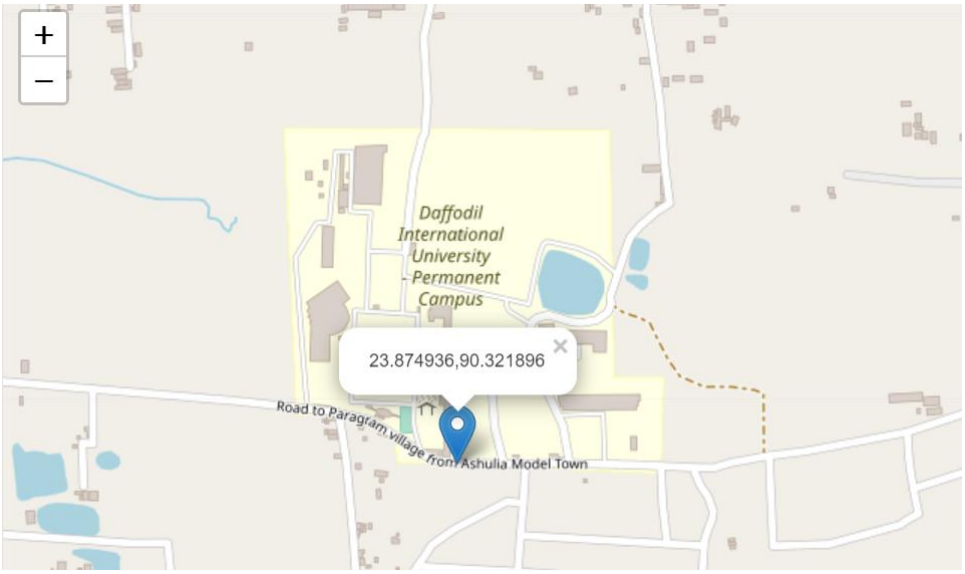

Fig 2.4 Latitude and Longitude value of Daffodil International University Main Entrance.

In figure 2.4 the number "**23.874936,90.321896"** is denotes that the Latitude value of this point is 23.874936 and the Longitude value is 90.321896.

- Latitude value 23.874936 denotes that the point is in 23 degrees, 52 minutes and 29.7696 seconds North
- Longitude value 90.321896 denotes that the point is in 90 degrees, 19 minutes and 18.8256 seconds East

With these two navigational information one can get access easily in a particular point on the earth.

2.6.2 Setting Boundaries through Latitude and Longitude

For Setting Boundaries of any area there should be a proper knowledge about Latitude and Longitude of that area. In our subcontinent Latitude differs horizontally and remains unchanged vertically. On the other hand Longitude differs vertically and remains unchanged horizontally. By close observation of an areas Latitude and Longitude value boundary can be created. We will observe the **Central Playground of Daffodil International University** for better understanding about getting Latitude and Longitude values.

Fig 2.5 Latitude and Longitude value of DIU central playground's edges.

In Fig 2.5 we can see that the highest Latitude value of this playground is **23.876907** where the lowest value is **23.875730.** So we can point that the latitude range of this ground is from **23.875730** to **23.876907.** And the highest Longitude value of this playground is **90.321309** where the lowest value is **90.320392.** So we can point that the Longitude range of this ground is from **90.320392** to **90.321309.**

As our system will work for creating restrictions to the "Target Unit" to stay inside a boundary we could use those Latitude and Longitude ranges for Implementation.

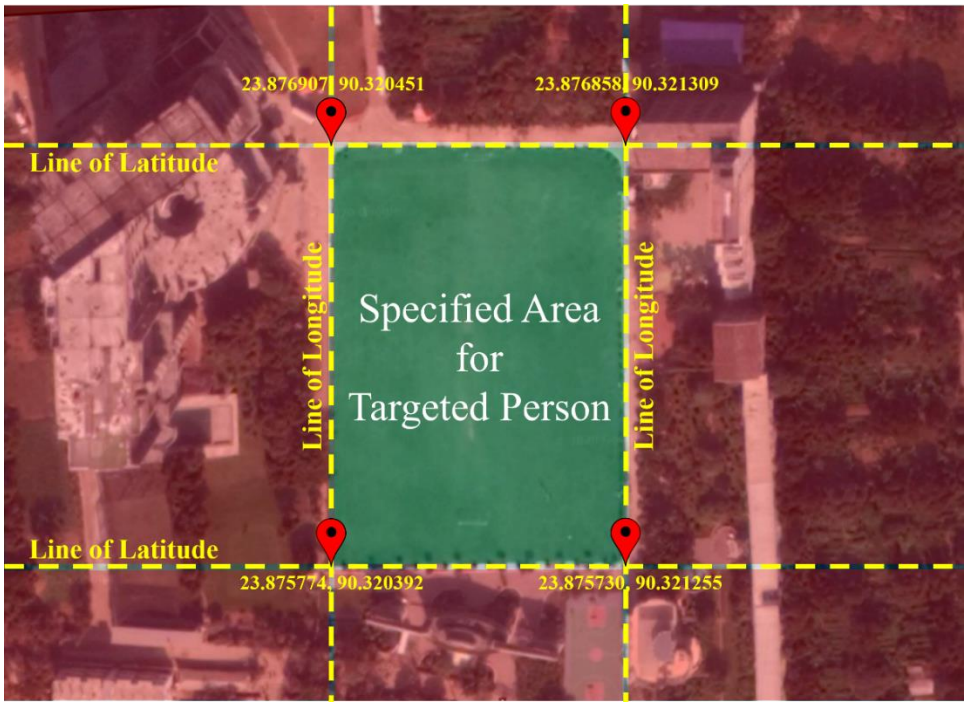

Fig 2.6 Specified Area view of DIU Central Playground's for Targeted person.

2.7 Summary

This chapter gives the idea about the localization method of the system which was the major part for building the system. It describes, How GPS can help to find one's position and the idea of Latitude and Longitude. Using Latitude and Longitude the boundary or the area defining was the main focus of this chapter. This shows how GPS system gives the specified areas of someone individual's. And in next chapter will discuss the other major and main components that were used to build our Autonomous Boundary Alert System.

CHAPTER 3

ANALYSIS OF THE SYSTEM COMPONENTS

3.1 Introduction

In this chapter we are originally discussing about the hardware equipment that we used to design our project and how we have made a bridge of connection between the components and software. We are describing details about each and every component that we have used to build our devices.

3.2 List of the Components

We have two unit in hardware section. One is “Base Unit” and another is “Target Unit”. “Target Unit” sent information to the “Base Unit” and when the targeted person is out of the specific area and then “Base Unit” shows us expected output.

The “Base Unit” has the following main component are

i. Arduino Uno
ii. SIM800L Mini GPRS GSM Module
iii. LCD Display (16×2)
iv. IIC I2C Interface LCD Module
v. HW133 Micro DC-DC Buck Converter
vi. 3.7V Li-ion Battery
vii. Breadboard
viii. Switch (2 pin)
ix. LED (Blue, Green, Red)
x. Buzzer
xi. Resistor
xii. Jumper Wires

The “Target Unit” has the following main component are

i. Arduino NANO
ii. Ublox NEO-6m GPS Module

iii. SIM800L Mini GPRS Module
iv. HW133 Micro DC-DC Buck Converter
v. Mini Switch
vi. LED (Green, Red)
vii. Vibration Motor
viii. Resistor
ix. Diode
x. 3.7V 800mAh 25C Li-Po Battery Tiger (2ps)

3.2.1 Arduino

Arduino is an open source electronics platform based on easy to use hardware and software. It is able to read different types of input and able to write digital output like, turning on lights, activating a motor, printing any kind of information to the display as well as publishing something through different type of network protocol. By giving a set of information of instruction to the microcontroller it can be able to process and print the expected output.

3.2.1.1 Arduino Uno R3

Arduino UNO R3 is one of the most popular Arduino board. It is a microcontroller board based on removable, dual inline package (DIP) ATmega328 AVR microcontroller. Over the years Arduino Uno R3 has been selected as the most demanding instrument as the thousands of project, from daily object to complex scientific instruments. A thousand of students, hobbyists, artists, programmer, engineering's and professionals has gathered around this open source platform to bring their dreams come to true and their contributions have added up to an fantastic amount of accessible knowledge that can be of great support to not only the beginners and but also experts.

Main features of the Arduino UNO R3:

- Microcontroller used in Arduino Uno R3 is ATmega328
- The operating voltage is 5V
- Recommended Input voltage is 7 volts to 12 volts
- Limitation of the Input Voltage is set to 6 volts to 20 Volts

- There is 14 digital Output pins and of which 6 provides pulse-width modulation (PWM) output.
- It has 6 Analog Input pin
- DC Current amount per Input/output pin is 40mA
- DC current for 3.3V pin is 50mA
- Flash memory is 32KB of which 0.5KB used by the boot loader
- SRAM: 2KB
- EEPROM: 1KB
- Clock speed is 16MHz
- There is built in LED in pin 13
- Length of the board is 68.6 mm and the Width is 53.4 mm
- The weight is 25 g

Fig 3.1(a) Front view of Arduino UNO R3 Board

Board Description of Arduino Uno R3:

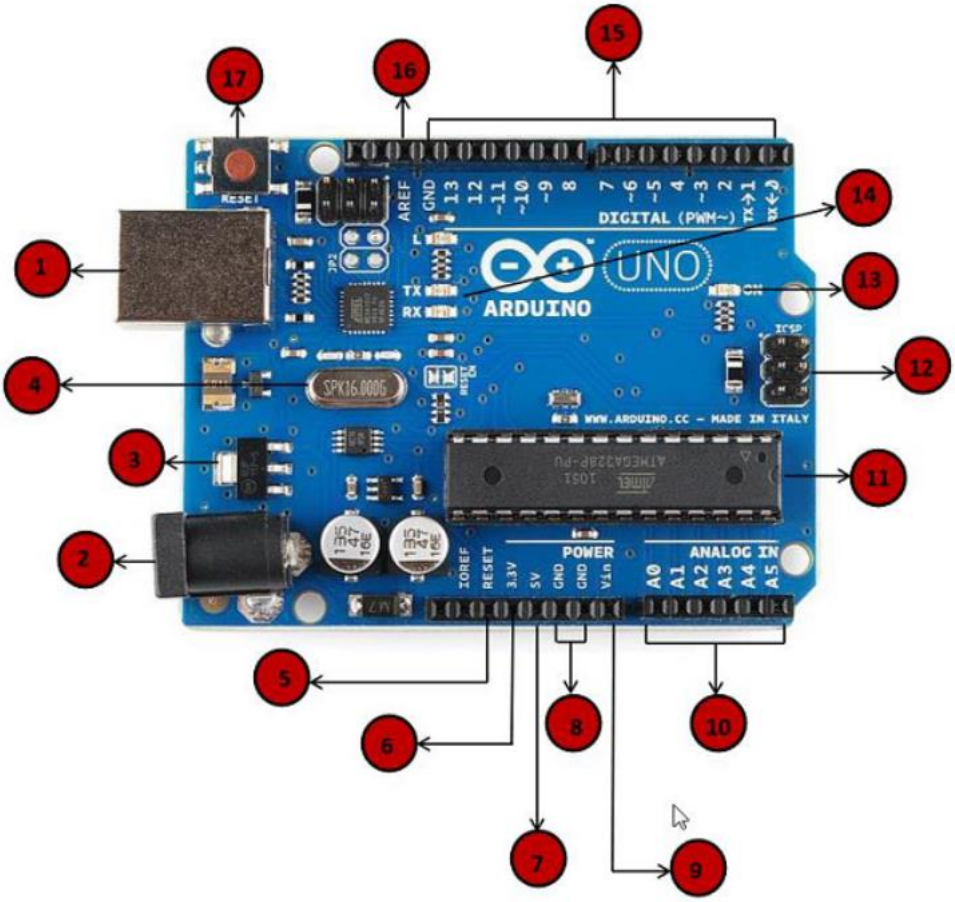

Fig 3.1(b) Arduino UNO R3 board breakdown

Arduino UNO R3 is a combined result of so many component. Now we are discussing about the role of the component of the Arduino UNO R3 board.

1. **USB Connector:** This is a USB port that used to upload a program from the software named Arduino IDE onto the Arduino UNO R3 board. This port can also be used for power up the Arduino UNO R3 board by using USB cable from computer.
2. **Power Port:** Through an AC -to-DC adapter or a battery the Arduino UNO R3 board can be powered. By plugging in 2.1mm center-positive plug into the power jack of the board, the power source can be connected.
3. **Voltage Regulator:** The role of the voltage regulator is to control the incoming voltage of the Arduino UNO R3 board given by the use of USB Connector or Power Port. It balances the DC voltage used by the processor and other elements.

4. **Crystal Oscillator:** The Crystal Oscillator helps Arduino UNO R3 in dealing with time issues. The main role of Crystal Oscillator is helping Arduino UNO R3 to calculate time. This is a quartz crystal oscillator which ticks 16 million times per second. On each tick, the microcontroller performs one operation, for example, addition, subtraction, etc.
5. **Arduino Reset Pin:** By connecting an external reset button to the Arduino UNO R3 board pin marked "RESET" the Arduino board can be reset, i.e., start the uploaded program from the beginning.
6. **3.3V pin:** It supply 3.3 volts DC as an output voltage.
7. **5V pin:** It supply 5 volts DC as an output voltage.
8. **GND:** There are various GND pin on the Arduino UNO R3 board. Any of which can be used to ground the circuit.
9. **Vin pin:** This pin also can be used to power the Arduino UNO R3 board from an external power source, like AC main supply. This pin can be a better alternative of Power Port.
10. **Analog Input Pins:** The Arduino UNO R3 board has 6 analog input pins, marked "Analog 0 to 5". These pins can study the signal from an analog signal like Humidity Sensor, Temperature Sensor, Motion Sensor and so many. While studying it convert that analog signal into a digital value in order that can be understood by the microprocessor. This pin just measured voltage rather than measuring the current for the reason that they have very high internal resistance. Hence, only a minor amount of current flows through these pins. In spite of the fact that these pins are marked analog are analog input by default, these pin can additionally be used for digital input or output.
11. **Microcontroller:** It is the most conspicuous black rectangular chip with 28 pins. It can be presumed as the brain of the Arduino board. The microcontrollers are usually from a major microcontroller manufacturer company named ATMEL. And used on the UNO R3 board is "Atmega328P". Atmega382P has the following components in it:
    - **Flash Memory:** It has flash memory of 32KB. After uploading a program from Arduino IDE software Flash Memory stored that.
    - **RAM:** It has 2KB RAM (random-access memory). This is a runtime memory.

- **CPU:** It check and control everything that goes on within the device. It retrieves the program instructions from the Flash Memory and runs them by means of RAM.
- **Electrically Erasable Programmable Read Only Memory (EEPROM):** It has EEPROM of 1KB. This is a kind of non-volatile memory, and it keeps the data even after device restart and reset.

Atmega328P is pre-programmed with bootloader. This provides an opportunity to upload a new Arduino program into the device directly, unless using any kind of external hardware programmer, making the Arduino UNO board easy to use.

12. **ICSP Pin:** Basically, ICSP pin is an AVR (Advance Virtual RISC) (RISC – Reduced Instruction Set Computing), a tiny programming header for Arduino UNO consisting of MISO, SCK, RESET, VCC, and GND. The ICSP pins is also known as programmer pins. In essence, these pin are used to burn the program on the Arduino UNO board.
13. **Power LED Indicator:** There is a small LED on the Arduino UNO board. The LED must light up when Arduino UNO plugged into a power source. This indicates that the board is powered up properly. When the light does not turn on, then it can be assumed that there is something wrong with the connection.
14. **TX and RX LEDs:** On the Arduino UNO board, the two marks TX (transmit) and RX (receive) can be noticed. The shown up two different places on the Arduino UNO board. Early, at the digital pins 0 and 1, to indicate the pins responsible for the serial communication. Later, the TX and RX led (13). The TX led light blinks with different speeds when it transmits serial data. The speed of blinking is influenced by the baud rate that is using the Arduino UNO board. Similarly, the RX blinks during the receiving period.
15. **Digital Input/output Pin:** There is 14 number of digital input/output pins in the Arduino UNO board. Of which 6 offer PWM (Pulse Width Modulation) output. The pins marked "~" may be used to generate PWM. These pin are designed to work for digital output pins to lead different types

of modules like LEDs, relays, etc. These pins can also be adapted to operate as input digital pins to observe logic value (0 or 1).

16. **AREF pin:** AREF refers to Analog Reference. It is used to include an external reference voltage (from 0V to 5V) as the upper limit for the analog input pins.

3.2.1.2 Arduino NANO

Arduino NANO is another most popular Arduino Board manufactured by Arduino.cc. Atmega328 is also used in Arduino NANO as a microcontroller like Arduino UNO. Arduino NANO is smaller than Arduino UNO discussed in the previous sub-section. Arduino NANO has a big range of applications and is being popular as a major microcontroller board for his small size and flexibility. So, not let's take a look at some main feature of its.

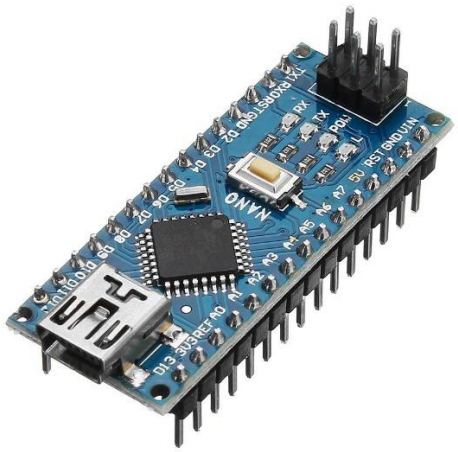

Fig 3.2(a) Front view of Arduino NANO

Main features of the Arduino NANO:

- The total pin number of Arduino Nano is 22.
- 14 out of total 22 pins are digital pins.
- It has 8 analog pins.
- 6 out of 14 digital pins are PWM (Pulse-width modulation).
- The crystal oscillator of Arduino Nano is 16MHz.
- The operating voltage of this board is varies from 5 Volts to 12Volts.
- It also agrees with different ways of communication, those are,

- Serial Protocol
- I2C Protocol
- SPI Protocol

- A mini USB port is adjusted in the board for uploading the code
- Moreover, it has a Reset button on it.

Board Description of Arduino NANO:

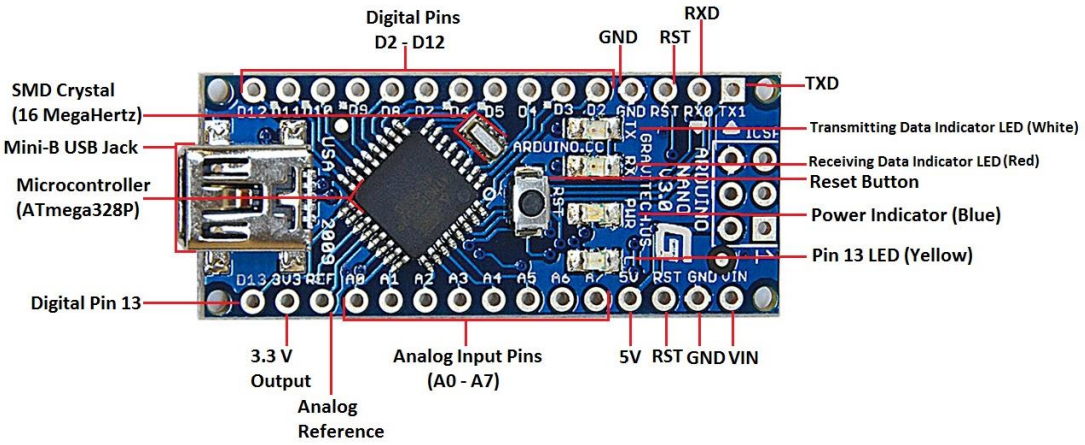

Fig 3.2(b) Arduino NANO board breakdown

As we discussed all of the portions of Arduino UNO in section 3.2.1.1 and know that Arduino Nano is not so differ from Arduino UNO, we are not going to describe the parts of it.

3.2.2 NEO-6M GPS module

One of the prominent module that used to determine position, time, and speed of an object with the help of satellite is NEO-6m GPS Module. Abbreviated name of GPS is Global Positioning System. By using NEO-6M GPS module the Arduino can obtain GPS data.

Fig 3.3(a) NEO 6M GPS module

NEO-6M GPS Chip

In the heart of the module there is chip from u-blox named NEO-6M GPS chip. The size of the chip is very small like a postage stamp but into its little frame it has a breathtaking number of features. It is able to track up to 22 satellites on 50 channels and it is able to achieves the industry's maximum level of sensitivity i.e. -161 dB tracking, while consuming a negligible amount of supply current of only 45mA.

Fig 3.3(b) NEO-6M GPS Chip

It is not like others GPS module. With 2.5m Horizontal position accuracy it is able to obtain 5 location updates within a second. The NEO-6M GPS chip is also able to boast a Time-To-First-Fix (TTFF) of under 1 second only.

Main Specification of NEO-6M GPS Module:

- Supply voltage is 3.3 Volts
- Receiver Type : 50 channels, GPS L1(1575.42MHz)
- Horizontal Position Accuracy is 2.5 meter only
- It has the average navigation update rate of 1Hz. Maximum rate is 5Hz

- Capture Time:
    - Cool start time in open space is about 30 second.
    - Hot start time is about 1~3 second only.
- It has the navigation sensitivity of -161dBm
- Communication Protocol
    - NMEA – National Marine Electronics Association
    - UBX Binary -
    - RTCM – Radio Technical Commission for Maritime Services
- The default serial baud rate is 9600. Additionally it is able to obtain the baud rate of 4800~ 230400.
- It can perform if operation at the temperature from -40°C to 85°C
- The operating voltage of this module is only 45mA
- There is a bright position Fix LED indication on its body that can helps to identify the status of the module.
    - No Blinking – It's searching for satellites.
    - Blinks every 1sec – Connected to satellites and position fix is found
- Module Size: 25 × 25 mm

Pin description of NEO-6M GPS module:

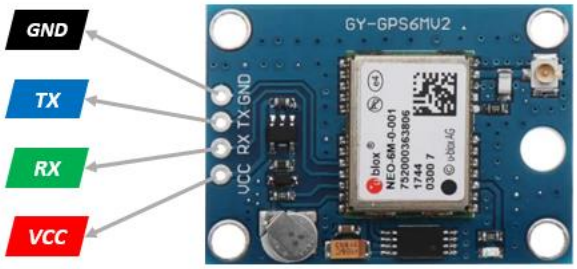

Fig 3.3(c) NEO-6M GPS module pin out

- **GND:** This is the ground pin of NEO-6M module. GND pin should be connected to the GND pin of the Arduino.

- **TX:** The transmitter pin of this module is marked as TX on the board. This pin is used for serial communication. This pin should be connected to the digital pin #2 of Arduino board.
- **RX:** The receiver pin if this module is marked as RX on the board. This pin is used for serial communication. This pin should be connected to the digital pin #3 of Arduino board.
- **VCC:** Power supply pin of the module. It can be directly connected to the 5 Volts pin of the Arduino.

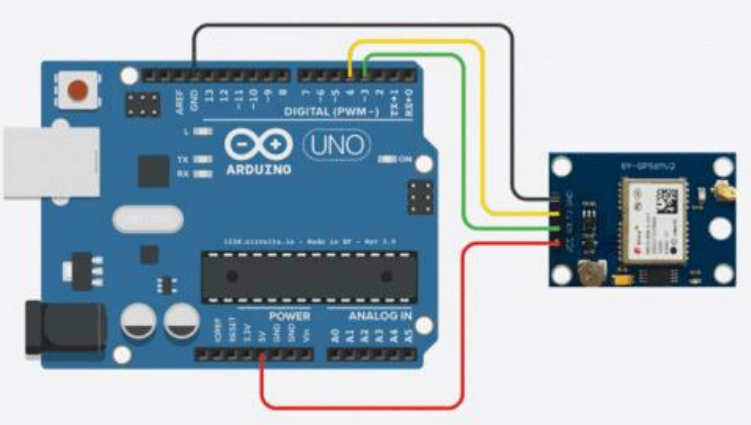

Fig 3.3(d) Connection diagram of NEO 6M GPS module to Arduino

3.2.3 SIM 800L Mini GPRS Module

SIM 800L is a small cellular module which makes a way for GPRS transmission, sending and receiving and making and receiving voice calls. Characteristics that made this module as a perfect choice of any project that requires long-range connectivity are this is a low cost and small footprint and quad-band frequency support module. After connecting the power this module searches network and login auto systematically. There is an LED that blinks fast when there is no network coverage and blinks slowly when it has logged in.

Fig 3.4 SIM 800L Mini GPRS GSM Module.

Main features of SIM 800L Mini GPRS GSM Module:

- Supply volatge is 3.8Volts to 4.2V
- The recommended power supply voltage is 4 Volts
- Size of the module is 25mm × 23 mm
- Interface is UART (maximum 2.8 volts) and AT commands
- It supports micro-SIM card at the bottom
- It can connect onto any GSM network with any 2G SIM
- It is able to scan and receive FM radio broadcast signal
- Can make and receive calls using an external 8ohm speaker and electret microphone
- It supports Quad-band frequencies. Quad-band (GSM850, EGSM900, DCS1800, PCS1900)
- It has an LED indicator which helps to know about the status of the module.
- It is able to work with the surrodunding temparature of -40 degree celcious to +85 degree celcious.
- External antenna can be inserted to the module as required.

Pinout of SIM 800L Mini GPRS GSM Module:

The SIM 800L Mini GPRS GSM Module has total 12 pins that interact this module to the outer world. The connection are as follows:

Fig 3.5 Pinout of SIM800L Mini GPRS GSM Module.

- **NET(Antenna):** This is the pin where provided Helical Antena can be soldered with a soldering iron. This pin also allows to insert an external Antena as required.
- **VCC:** This is the supply power pin of the module. The supply voltage can be anywhere from 3.4 Volts to 4.4 Volts. Connecting this module with more than the recommended voltage can demolish the module! On the other hand it doesn't even run on less than the require voltage. Li-Po battery or DC-DC buck converter rated 3.7V 2A can be used to this module as an external power source
- **RST (Reset):** This is a hard reset pin. By pulling this pin low for 10ms it will perform a hard reset if the module in an awful space.
- **RXD(Receiver):** works for receive the signal as serial communication.
- **TXD(transmitter):** works for transmit the signal as serial communication.
- **GND:** This is the ground pin and this module must be grounded for working. The Ground pin needs to be connected to Ground Pin on the Arduino board.
- **RING:** The RING pin operates as a Ring Indicator. Basically, it is known as the 'interact' output pin of the SIM800L Mini GPRS GSM Module. It remains in high by default and will turn onto low for 120ms when there is a call that has been received. Besides, when an SMS is received it can also be designed to turn low.
- **DTR:** This pin works to activate or deactivate the sleep mode. The module will turn to the sleep mode when the DTR pin is HIGH and will turn to the active mode when the DTR pin is LOW. It works by disabling the serial communication.

- **MIC±:** It is a differential microphone input pin. In these pins there are two microphone can be connected directly.
- **SPK±:** It is a differential speaker interface. In these pins there are two speaker can be connected directly.

3.2.4 LCD Display (16×2)

The abbreviation of LCD is Liquid Crystal Display. It uses liquid crystal to produce a visible massage. It turns dark blocking the backlight that was lives backside the screen when the current is being applied to this particular type of crystal. As a result that specific area becomes dark in comparison to others. And that is how characters are displayed on the screen.

It is a type of electronic display module that used in a wider range of applications like a different type of circuits like so many projects and devices like mobile, calculators, computers, etc. These displays are preferable for multi-segment light-emitting-diodes and seven segments. Some advantage is like inexpensive, simply programmable, animations, and no limitation for displaying custom characters, special and even animation made this device as the first choice of not only the beginners but also experts.

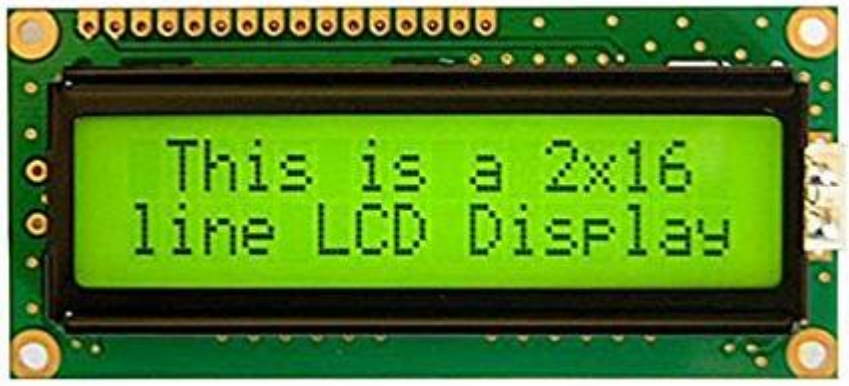

Fig 3.6 LCD Display (16×2)

Main features of LCD Display (16×2):

- Operating voltage of LCD Display (16×2) is 4.7 Volts to 5.3 Volts.
- It contains 2 row where each row can generate 16 charecters.
- This LCD Display can be operated on two modes like 4 bit and 8 bit
- The consumption of current is 1 mili apmare in absence of backlight

- It is a Alphanumeric LCD display module, that means it is able to display not only alphabets and but also numbers.
- Each character shown in LCD Display (16×2) is established by a 5×8 pixel box.
- It is also capable of displaying different types of custom generated charecters.
- It is available in two colour, Green and Blue Backlight.

Pinout of LCD Display (16×2):

The LCD Display (16×2) module has total 16 pins. With the proper connection of these pins the module interact with the others nessery devices.

- **GND(Ground):** The ground pin of LCD Display (16×2) should be connected to the ground pin of Arduino.
- **VCC:** This is the power supply pin of LCD Display module. To the 5 Volts pin of Arduino the VCC pin should be connected.

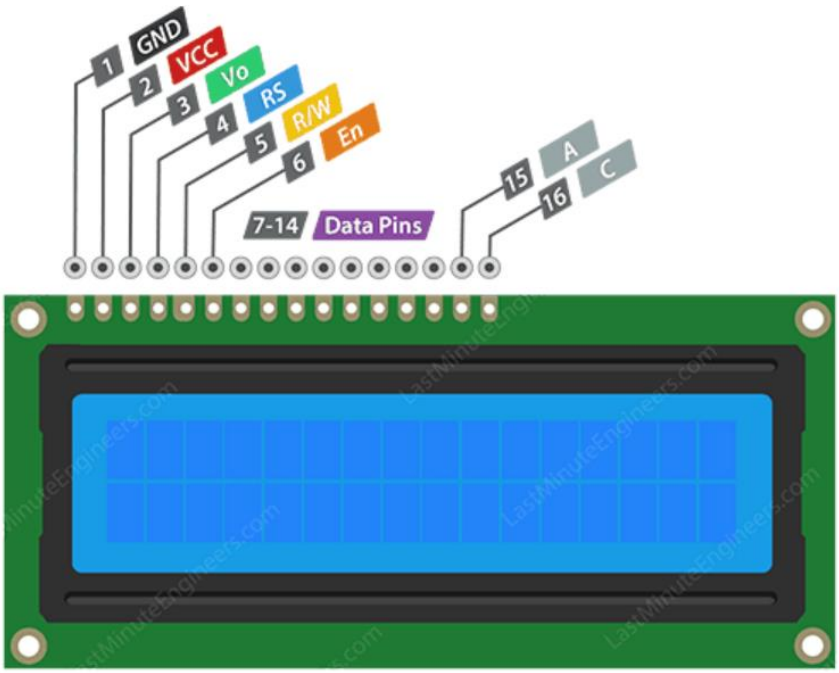

Fig 3.7 Pinout diagram of LCD Display (16×2)

- **Vo:** This pin is use for controls the contrast and brightness of the LCD Display module. For making a well adjustment to the contrast there is need to use a potentiometer.

- **RS:** This pin is known as Register Select. This pin improvise Arduino to say the LCD whether it is sending command or the data.
- **R/W:** This is the Read/Write pin. On LCD this pin operates as controller of reading or writing data from it. When the LCD is working as an output device the R/W pin should be connected to LOW. On the other hand, when it is working as an input device R/W pin should be connected to HIGH. When R/W pin is LOW as an output device this forces it into the WRITE mode.
- **E:** The name of this pin is Enable pin. This pin works for enabling the display. This means when E is LOW, the LCD Display will not work whatever happening in R/W, RS, and the data lines. But when it turns to HIGH the LCD will be capable of caring status these pins. And then the LCD Display module will process the incoming data from other devices.
- **D0 ~ D7 Pins:** This pin is known as Data Pins. For sending data to the LCD Display these pins are used. These pins basically carries the 8-bit data that has been sent to the Display.
- **A & K :** These labeled are denoting Anode and Cathode pin. These pins are basically used for controlling the backlight of the LCD Display. A should be connected to the +5 Volts where K should be connected to the GND.

3.2.5 IIC/ I2C Interface LCD module

As we know LCD Display is now the first choice of all for doing various types of projects, IIC/ I2C Interface LCD module is also the first choice for interfacing the LCD module with Arduino. To use the LCD module directly to the Arduino that would need at least 6 pins marked as RS, E, D7, D6, D5, and D4 with R/W pin must be connected to ground for WRITE operation. While doing a complex project interconnected with a large number of components or modules it is so difficult to make room and connect each other with a limited number of pins of Arduino. In that kind of stage, IIC/ I2C Interface LCD module can be a better solution. IIC/ I2C Interface LCD module became so acceptable to all because this can make communication to MCU with only 2 pins (SDA and SCL). Thus results in savings of 4 pins.

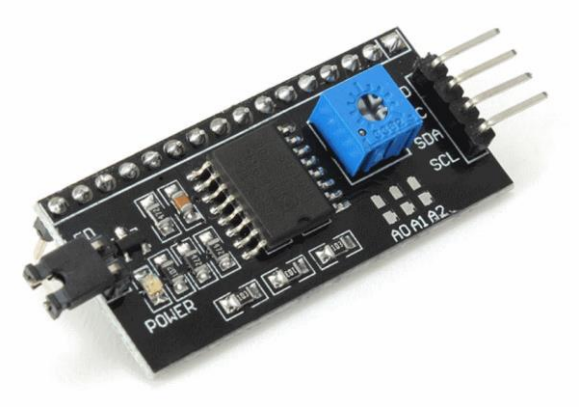

Fig 3.8 IIC/ I2C Interface LCD module.

Specificaiton of IIC/ I2C Interface LCD module

- This module is compatible with all tyrpes of Arduino board.
- Capable of interfacing to 16×2 and 20×4 LCD Display module
- Supply voltage of this module is 5 volts
- Contrast is adjustable here
- Size of this module is not big: 80×36×20mmz (3.1×1.40×0.7in)

Pinout of IIC/ I2C Interface LCD module

This module has 4 pins marked as GND, VCC, SDA and SCL. These pin are used to interface this module to the Arduino and LCD Display.

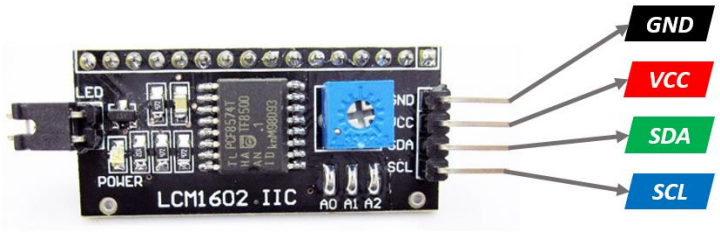

Fig 3.9 Pinout diagram of IIC/I2C Interface LCD module

- **GND:** The ground pin of IIC/I2C Interface LCD module should be connected to the ground pin of Arduino
- **VCC:** This the supply voltage pin of this module. The recommended supply voltage for this module is +5 Volts.
- **SDA:** In Arduino UNO, SDA pin shoud be connected to the analog pin 4. This pin basically works for transmitting the data

- **SCL:** In Arduino UNO, SCL pin should be connected to the analog pin 5. This pin basically works for reiceiving the data.

3.2.6 HW-133 Micro DC-DC Buck Converter:

This is a DC-DC 3A Adjustable Micro step-down power supply module and named as DC-DC Buck converter. Nowadays these things are very commonly used in various areas like DIY mobile power, communications equipment, different power supply, and all kind of size and weight for demanding occasion.

Fig 3.10 HW-133 Micro DC-DC Buck Converter

Specification of HW-133 Micro DC-DC Buck Converter

- The input voltage range of this converter is DC 4.5V to 28V. The input voltage should be greater than the output voltage above 1.5V.
- The output voltage range of this converter is DC 0.8V to 20V. and it is continuously adjustable.
- This is a converter of high efficiency (96%) with the maximum peak output current of 3A
- Output ripple is less than 30mV
- Switching frequency is generally 1MHz. Besides, it can operate in the 1.5MHz frequency maximum.
- It is able to work with the surrounding temperature of -45 degrees celsius to +85 degrees celsius.
- The size of this converter is 22mm × 17mm × 4mm. (Length, Width, and Height is respectively 22mm, 17mm, and 4mm)

3.2.7 Batteries

3.2.7.1 Li-ion Battery

The lithium-ion battery is a kind of rechargeable battery. This type of battery is commonly used for various types of portable electronic devices and so many electronic projects. Basically, the Lithium-ion moved to a negative electrode from a positive electrode while discharging and return to the positive electrode while charging. This behavior of lithium-ion made this battery rechargeable.

Fig 3.11(a) Li-ion Battery

Specification of Li-ion Battry

- Voltage: 3.7 Volts
- Mark Capacity: 1200mAh
- Measured Capacity: 900mAh
- Rechargeable Time: 1000 (manufacturer declaration)
- Working temperature: 0 to 60 degrees centigrade
- Dimensions: 65mm × 18 mm

3.2.7.2 Li-Po Battery

A Lithium polymer Battery is a rechargeable battery of lithium-ion technology using a polymar electrolyte instead of a liquid electrolyte. High conductivity semisolid polymers from this electrolyte. These battery provides higher specific energy than other lithium-ion battery and are used in application where and space is a critical feature.

Fig 3.11(b) Li-Po Battery

Specification of Li-Po Battry

- Voltage: 3.7 Volts
- Mark Capacity: 800mAh
- Measured Capacity: 760mAh
- Rechargeable Time: 1000 (manufacturer declaration)
- Working temperature: o to 80 degrees centigrade
- Dimensions: 9.3mm × 25mm × 42 mm

3.2.8 Breadboard

The breadboard is a device that is suitable for build a temporary prototype circuit with electronics without soldering. Most of the electronic components can be inserted into the Breadboard and making a connection with other equipment is so easy in Breadboard.

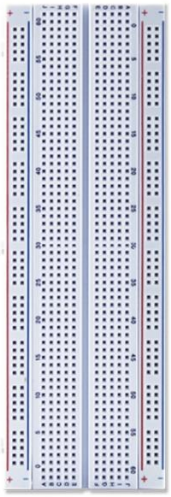

Fig 3.12 Top view of a Breadboard

There are a huge number of underneath strips in this board and connect the holes on the top of the board. The top and bottom rows of the hole are linked horizontally and split in the middle while the remaining holes are linked vertically.

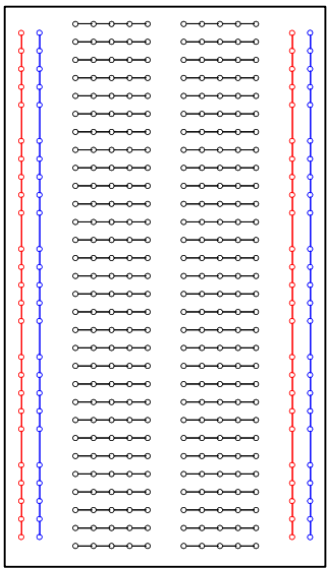

Fig 3.13 Inside series-parallel connection of a Breadboard.

3.2.9 Switches

Fig 3.14(a) 2 pin Rocker Switch

Fig 3.14(b) 2 pin mini Push Button

- **Rocker Switch:** The type of switch which rocks when it pressed is known as Rocker switch. Which means much like a rocking horse rocks back and forth, one edge of the switch is lifted while the other edge is lowered.
- **Mini Push Button:** Push Button switch is a simple type of switch than operates as an action of a machine or a process. Pressing for the first time the connection of two pins become closed and pressing for the second time the connection opened.

3.2.10 LEDs (Light-Emitting Diode)

Fig 3.15 Light Emitting Diode (LED)

When current flows through a Light-emitting diode, that emits light. The light is not specifically bright. But in most LEDs it is monochromatic, happening at a single wavelength. This type of light is mostly used as an indicator light.

Some benefits of Light Emitting Diode (LED) are as follow,

- The power requirement for this type of LED is very low. Most types can be work with battery power supply.

- Efficiency is high for the LED. Most of the power supply covert into radiation in the desired form.
- The heat production is low enough
- When the LED is properly connected and used, result in a long time service

3.2.11 Mini piezo Buzzer (5V continuous tone buzzer)

A buzzer is an audio generating device which can be mechanical, electromechanical or piezoelectric. When this Buzzer is active it produces audio sound continuously and can be completed with simple circuit design, to “plug and play”.

Fig 3.16 Mini Piezo Buzzer

3.2.12 Resistors

An electric component with two terminal that is used to reduce the electrical current flow in an electric circuit is known as a Resistor. Resistors are also used to lower the voltage level in its natural vicinity and also for partitioning the circuit.

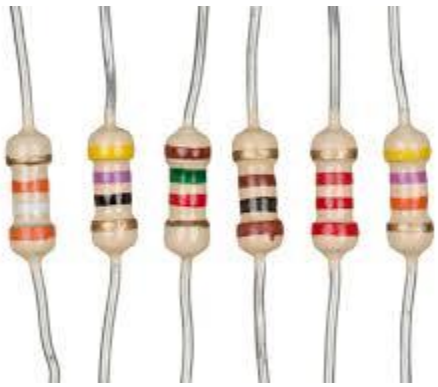

Fig 3.17 Axial-Lead Resistors

A resistor is intended to control and adjust the actual load on the system. This means, it spends electricity and consumes it as heat, In this way effectively reducing the quantity of electricity flowing out of it by specified amounts.

3.2.13 Coin Vibration Motor

Fig 3.18 Coin Vibration Motor

A coreless coin shaped DC motor that vibrate is reknowned as Coin Vibration Motor. The size of this motor is compact. The objective of this motor is to alert the user when necessary. These motors are used for various type of purpose like pagers, handsets, cellphone and also various type of alertring device etc. The main advantage of this motor is, it has magnetic properties, lightweight, and the size of this motor is so small. For these features, the demand of this motor is very high.

Specification of Coin Vibration Motor

- Rated Voltage: DC 3 ~ 5 Volts
- Rated Speed: 11000 rpm
- Rated Power: 3W
- Rated Current: 0.75 A
- Rated Torque: 3NM
- Eficiency: 85%
- Working temperature: -20 to +60 degrees centigrade
- Storage environment: -30 to +70 degrees centigrade
- Dimensions: 10mm x 3mm/ 0.39in x 0.12in(D*H)
- Weight:

3.2.14 Schottky Diode

Fig 3.19 Schottky Diode

A bi-terminal electronics components that just only carries out current in one direction until it is operated under a particular voltage level is known as diode. Characteristics of an ideal diode is it will have zero resistance in one direction, and resistance will be infinite in the reverse direction. In which direction the resistance is infinite, current flow is zero. On the other hand current flow is high in which direction resistance is zero. There are various kind of diode are available in the market for different purpose. We use Schottky Barrier Diode for stopping the reverse flow of current.

Specification of Schottky Barrier Diode

- Forward voltage drop: the voltage across the diode varies according to the current being carried.
- Reverse breakdown: it doesnot allow a chance of reverse current flow in a circuit.
- Capacitance: it has a capacitive caecteristics to hold power.
- Reverse recovery time: 100 ps
- Peak Repet. Reverse Voltage (Vrrm): 40V
- Max. RMS Reverse Voltage (Vr): 28V
- Average Rectified Current (Io): 1.0A
- Max. Reverse Current (Ir): 1.0mA
- Max. Forward Voltage Drop (Vf): 0.60V

3.2.15 Jumper Wires

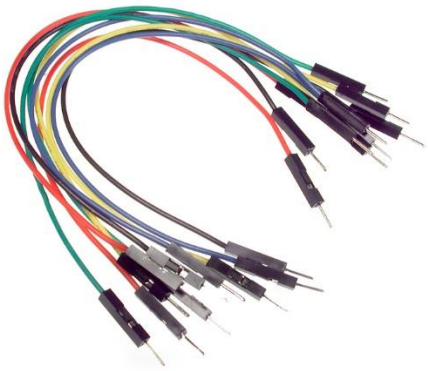

Fig 3.20 Jumper Wires

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn't get much more basic than jumper wires.

3.3 Summary

This chapter talks about about the components that are used to desigen the prototype of system. The main component of this is Arduino. Here we use two type of Arduino and that are Arduino UNO R3 and Arduino NANO. Also the GPS module and GSM module are one of the crutial component of this project. The external supportive component like Batteries, Switches, LCD Display module, Buzzer, Resistance, Diode, and so many are also used in it. In a word, this chapter helps to gather knowledge and information about all the components and their specifications. In next chapter we will know how and where we use these component to desing our system with the help of Block diagram and Wiring diagram and description of them.

CHAPTER 4
HARDWARE DEVELOPMENT

4.1 Introduction

This chapter describes the methode of hardware designing with the help of system block diagram and the wiring diagram of the system named Autonomous Boundary Alert System for Child/Criminal Monitoring. Because it is very important to know how the "Target Unit" and the "Base Unit" are working and their building function. With the help of Arduino. GPS module, GSM module, the "Target Unit" sent information to the "Base Unit" and that can be understand perfectly with the help of Block Diagram and their connection can be understand by the wiring diagram.

The main learning thing of this chapter is how the components keep communication with cach other and how they actually are interconnected in the circuit. By learning the diagrams one can easly understand the process of communication.

4.2 Block Diagram

Block diagram is a visible representation of a system that uses some simple, marked blocks and that are connected by lines to indicate the relationship between them. For so many engineering and designing of diagrams for hardware and software block diagrams are used strongly.

As we know this system has two unit in hardware section. One is "Target Unit" and another is "Base Unit". This section will describe the two major unit respectively.

4.2.1 Block Diagram of "Target Unit"

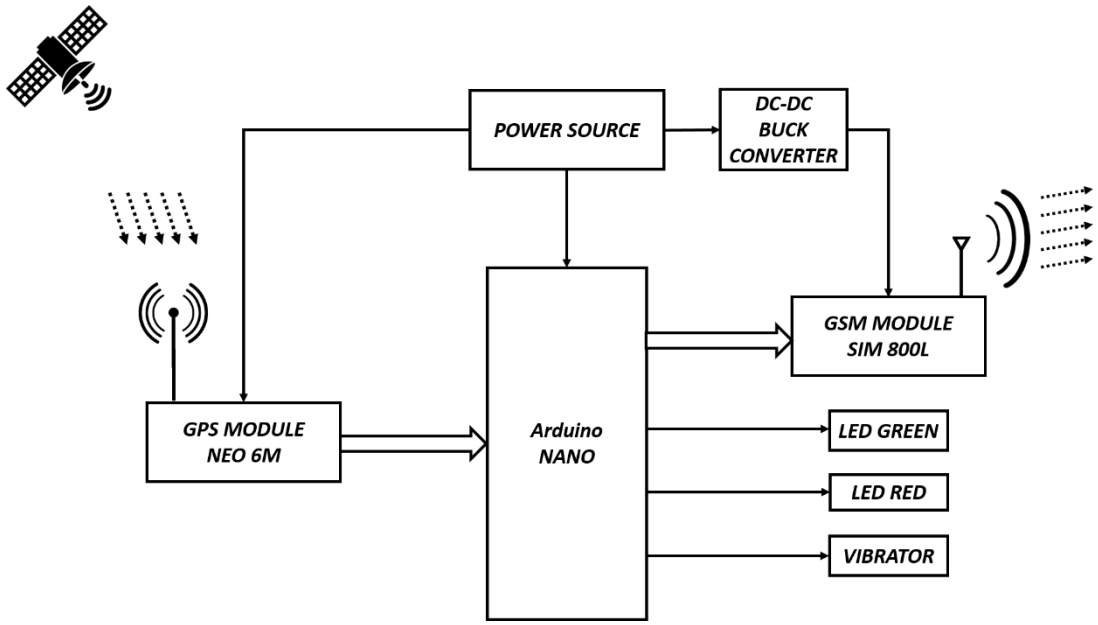

Fig 4.1 Block Diagram of "Target Unit"

Description of the Block Diagram of "Target Unit"

In this diagram, we can see Arduino NANO as the main controller of this part of the system. Arduino NANO is controlling the whole part of the system by using the power from the POWER SOURCE. GPS MODULE continuously measures the Lattitude and Longitude value with the help of satellite and Arduino NANO receives the data from the GPS MODULE. After studying the value, Arduino NANO takes its next steps as the instruction was given to Arduino NANO by previously uploaded code to it. If the Lattitude and Longitude value becomes unexpected then Arduino NANO sent information to the GSM Module, LED GREEN, LED RED and the VIBRATOR. DC-DC BUCK CONVERTER provides the required power to the GSM Module for its operation. And then LEDs and the VIBRATOR changes their status depending on the Arduino NANO's instruction. When Arduino NANO allows, GSM module to sent messages to another GSM Module structured in the "Base Unit" for further process.

4.2.2 Block Diagram of "Base Unit"

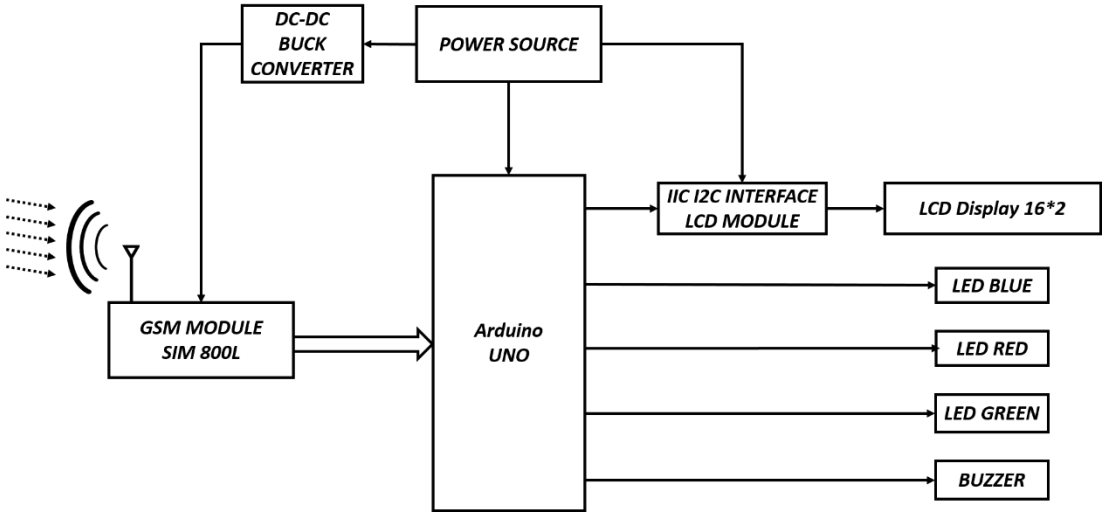

Fig 4.2 Block Diagram of "Base Unit"

Description of Block Daigram of "Base Unit"

When the GSM Module of "Base Unit" receives messages from the GSM Module structured in the "Target Unit" it forwards those messages to Arduino UNO. Here, Arduino UNO is the main controller of this part of the system. By taking power from the POWER SOURCE it runs all the system. After studying the messages from the GSM module, Arduino UNO gives instructions to all the output components are LCD Display, LED BLUE, LED GREEN, LED RED to change their status as the programmed was uploaded. Here, DC-DC BUCK CONVERTER provides the required power to the GSM Module for its operation and the IIC I2C INTERFACE LCD Module is used to interface LCD to Arduino UNO. Arduino UNO displays messages to the LCD through these Interface Module.

4.3 Wiring Diagram

A wiring diagram is principally intented to introduce the wiring connection betwwen the components in a appropiate way with the absence of any confusion, so that one can create and understand a prototype system easily. We will present both wiring diagram of the “Target Unit” and “Base Unit” gradually.

4.3.1 Wiring Diagram of “Target Unit”

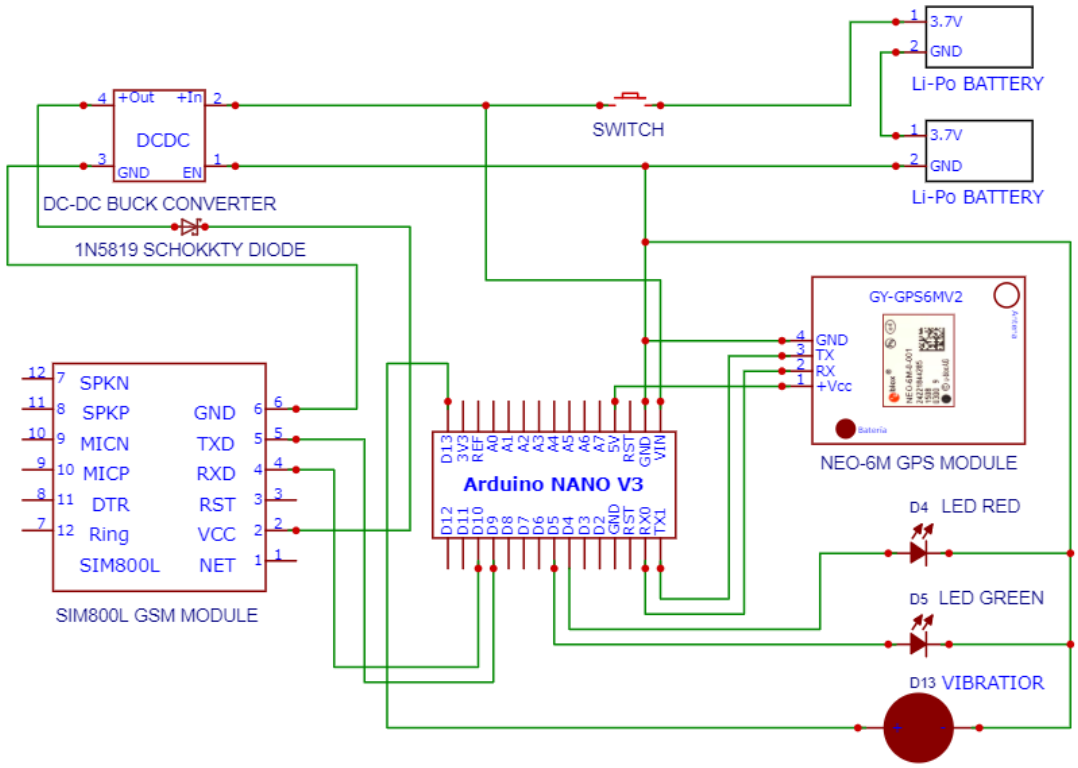

Fig 4.3 Wiring Diagram of “Target Unit”

Description of the Wiring Daigram of "Target Unit"

- Two 3.7V Li-Po battery of 800mah are interconnected connected in series and the +V pin is connected to the +In pin of DC-DC Buck Converter with an externan Switch.
- EN pin of DC-DC Buck Converter is connected to the GND pin of the Li-Po Battery for drain purpose.
- +Out pin of DC-DC Buck convertetr is connected to the VCC pin of SIM800L GSM Module.
- GND pin of DC-DC Buck converter is connected to the GND pin of SIM800L GSM Module.
- TX and RX pin of SIM 800L is connected to the D9 and D10 pin of Arduino NANO respectively.
- +VCC and GND pin of NEO-6M GPS Module is connected to the 5V and GND pin of Arduino NANO respectively.
- TX and RX pins of NEO-6M GPS Module is connected to the TX1 and RX0 pin of Arduino NANO respectively.
- Positive pins of LED RED, LED GREEN, and VIBRATOR are connected respectively to the D4, D5 and D13.
- Negative pins of LED RED, LED GREEN, and VIBRATOR are connected to the GND pin of Arduino NANO board.

4.3.2 Wiring Diagram of "Base Unit"

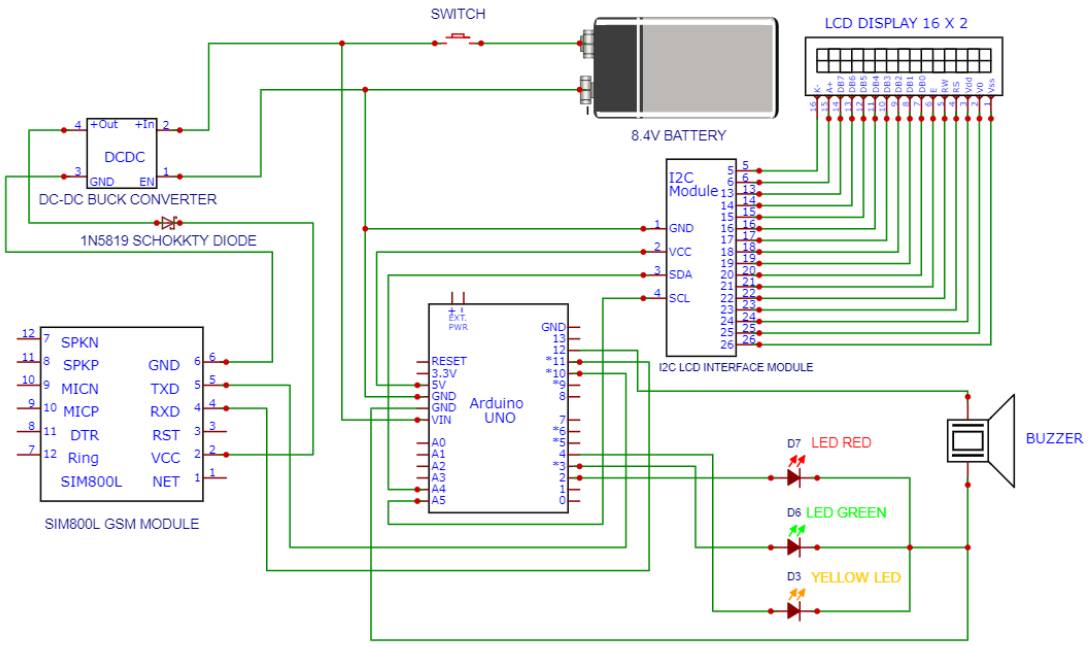

Fig 4.4 Wiring Diagram of "Base Unit"

Description of the Wiring Daigram of "Base Unit"

- The +V pin of a 8.4V Li-ion battery of 1200mAh is connected to the +In pin of DC-DC Buck Converter with an external Switch.
- The EN pin of DC-DC Buck Converter is connected to the -V pin of the Li-Po Battery for drain purpose.
- +Out pin of DC-DC Buck convertet is connected to the VCC pin of SIM800L GSM Module.
- GND pin of DC-DC Buck converter is connected to the GND pin of SIM800L GSM Module.
- TX and RX pin of SIM 800L is connected to the digital pin 10 and 11 of Arduino NANO respectively.

- For interfacing the LCD Display with Arduino UNO, connections of the pins between I2C LCD INTERFACE Module and The 16×2 LCD DISPLAY are as follow,

Table 4.1 Pins connection of LCD DISPLAY to I2C INTERFACE Module

LCD DISPLAY	I2C INTERFACE
Vss	26
V0	25
Vdd	24
RS	23
RW	22
E	21
DB0	20
DB1	19
DB2	18
DB3	17
DB4	16
DB5	15
DB6	14
DB7	15
A+	6
K-	5

- VCC and GND pin of I2C Module are connected to the 5V and GND pin respectively of Arduino UNO Board.
- SDA pin is connected to A4 pin and SCL pin is connected to A5 pin of Arduino UNO Board.
- Positive pins of LED RED, LED GREEN, LED YELLO and Piezo BUZZER are connected respectively to the digital pin 2, 3, 4, and 13 of Arduino UNO Board.
- Negative pins of LED RED, LED GREEN, LED YELLO and Piezo BUZZER are connected to the GND pin of Arduino UNO Board.

4.4 Summary

The main content of this chapter was designing the model of the system arcitecture. As there is two unit, so the designing work is divided into two part. This shows that scheming the Autonomous Boundary Alert System by Location Tracking that satisfies all the standards at the same time is not an easy task. With our patience and hard work, we successfully designed a prototype foundation and that will be able to perform after the next part of Code installation to the structure.

CHAPTER 5

IMPLEMENTATION OF THE SYSTEM

5.1 Introduction

This chapter will teach the implementation of working principle of the system. At that point we will learn quickly about the working procedure of this system.

5.2 Flowchart

A flowchart is a type of diagram that graphically represents a logic sequence, working procedure, manufacturing process, organization chart, or similar formalized design. The main objective of a flowchart is to offer people with a regular language or reference point when dealing with a project or working process.

Flowchart exercise with some basic geometric symbols like Oval, Rectangle, Diamon, Parallelogram, Cloud, and Arrows, etc. In the programming, the Beginning or End of a program marked as Terminator is represented by Oval. A Processing is represented by Rectangle, Decision is represented by Dimond and Input/Output is represented by Parallelogram and Internet is represented by Cloud. Arrows are used to show the flow of works and steps of the system.

From the previous discussion, we already know this system has two units in hardware section marked as “Target Unit” and “Base Unit”. So flowcharts will be shown separately for the two major units of the system

.5.2.1 Flowchart of the “Target Unit”

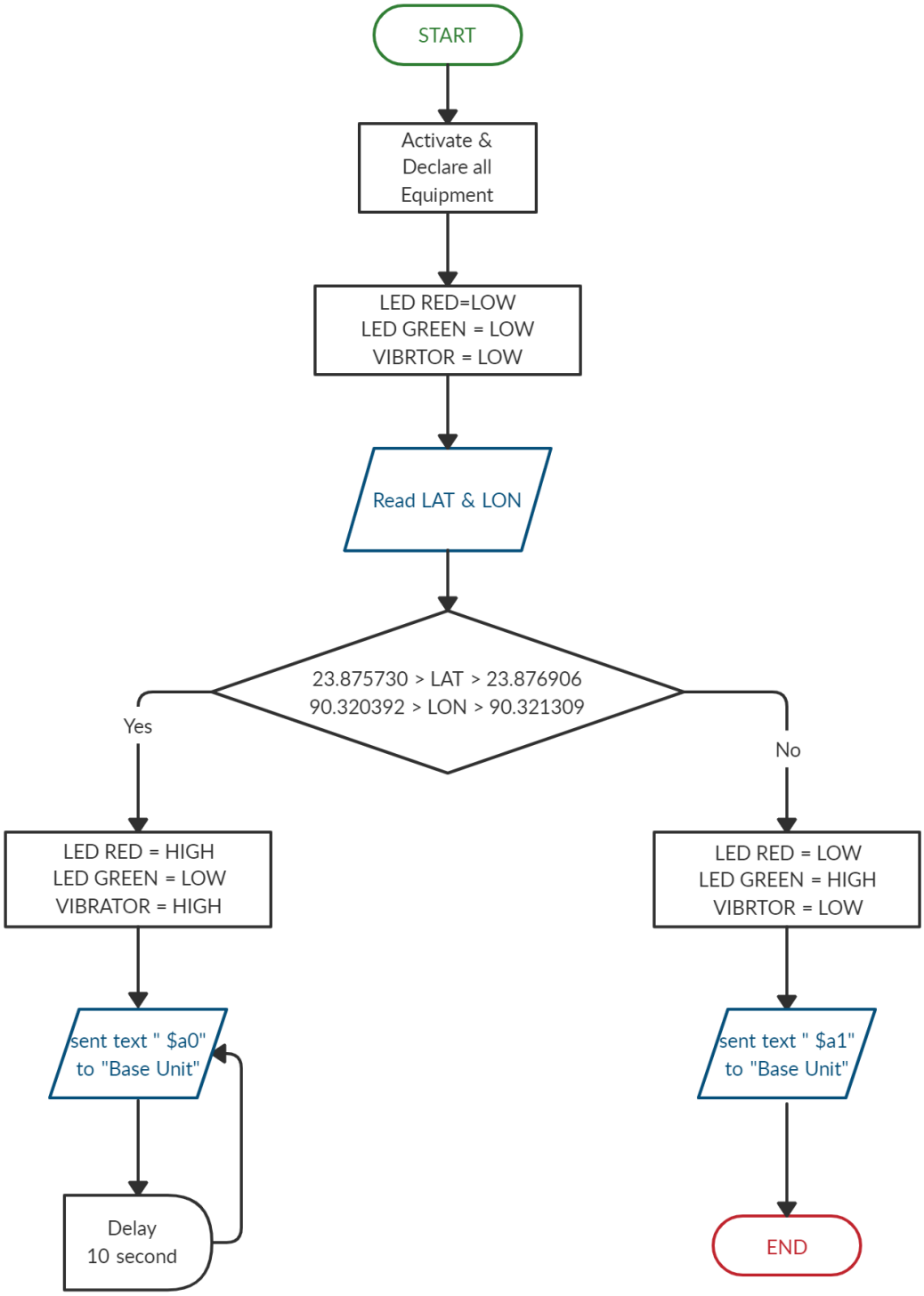

Fig 5.1 Flowchart diagram of “Target Unit”

5.2.1.1 Algorithm of "Target Unit" of the System

- **Step 1:** Start the system
- **Step 2:** Activate and Declare all components
- **Step 3:** As an initial state LED RED and VIBRATOR will remain LOW where LED GREEN remains HIGH
- **Step 4:** Read the Lattitude and the Longitude Value
- **Step 5:**
    - If the value of Lattitude and Longitude are " 23.875730 < Lattitude < 23.876906 " and " 90.320392 < Longitude < 90.321309 " then follow the next instruction,
        - LED RED turn to LOW
        - LED GREEN turn to HIGH
        - VIBRATOR turn to LOW
        - Sent TEXT " $a1" to the "Base Unit" of the system
        - Sent Text continuosly with a delay of 10 seconds
        - Return to the **Step 4**
    - If the value of Lattitude and Longitude are " 23.875730 > Lattitude > 23.876906 " and " 90.320392 > Longitude > 90.321309 " then follow the next instruction,
        - LED RED turn to HIGH
        - LED GREEN turn to LOW
        - VIBRATOR turn to HIGH
        - Sent TEXT " $a0" to the "Base Unit" of the system
        - Sent Text continuosly with a delay of 10 seconds

- Return to the **Step 4**

➢ **Step 6:** END

5.2.2 Flowchart of the "Base Unit"

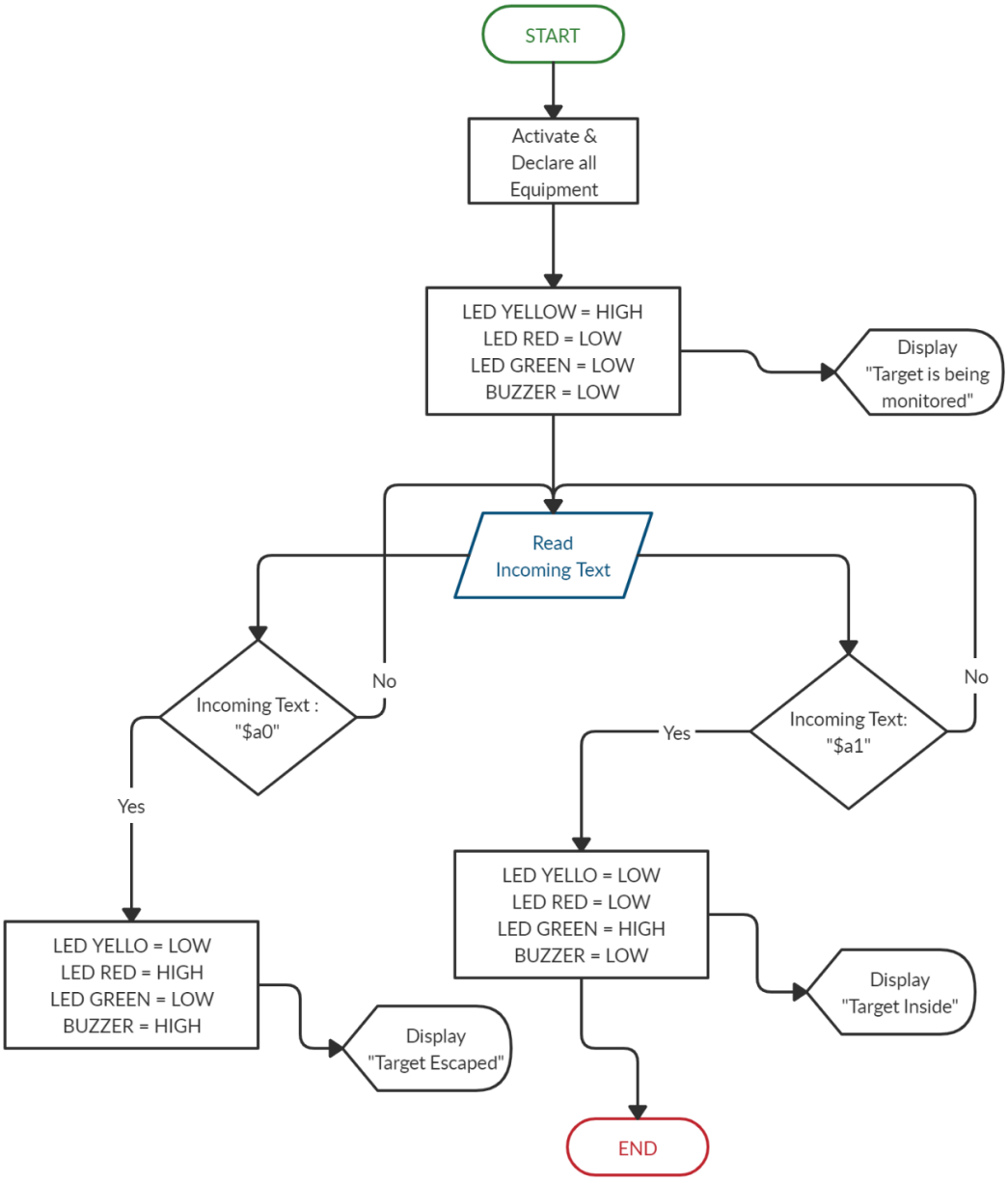

Fig 5.2 Flochart Diagram of "Base Unit"

5.2.1.1 Algorithm of "Base Unit" of the System

- **Step 1:** Start the system
- **Step 2:** Activate and Declare all components
- **Step 3:** As an initial state LED RED, LED GREEN and BUZZER will remain LOW where LED YELLOW remains HIGH and LCD shows "Target is Being Monitored".
- **Step 4:** Read incoming Text
- **Step 5:**
    - If the incoming Text " $a0" arrives then follow the next instruction,
        - LED RED turn to HIGH
        - LED GREEN turn to LOW
        - LED YELLOW turn to LOW
        - BUZZER turns HIGH
        - Display " Target Escaped "
    - If the incoming Text " $a1" arrives then follow the next instruction,
        - LED RED turn to LOW
        - LED GREEN turn to HIGH
        - LED YELLOW turn to LOW
        - BUZZER turn to LOW
        - Display " Target Inside "
- **Step 6:** END

5.3 Programming

The implementaion of logic to assist specified computing operations and functionality. It can be done by one or more languages, which differ by system, module, application, domain and programming model. In the time of constrcting a system, programming language semantics and syntax are used.

5.4 Programming with Arduino

In the reason that the Arduino IDE work with **C** language, it is the most common and populer language for Arduino. The Arduino IDE is capable of working **C** and **C++** by following some special rules of code structuring. As Arduino operates with ATmega328 microcontrolller, there is need to choosen language by keeping that in mind. C lanuge is choosen for coding of the system because it is familiar with bussiness, mordern and educational society.

5.4.1 Introduction to Arduino IDE

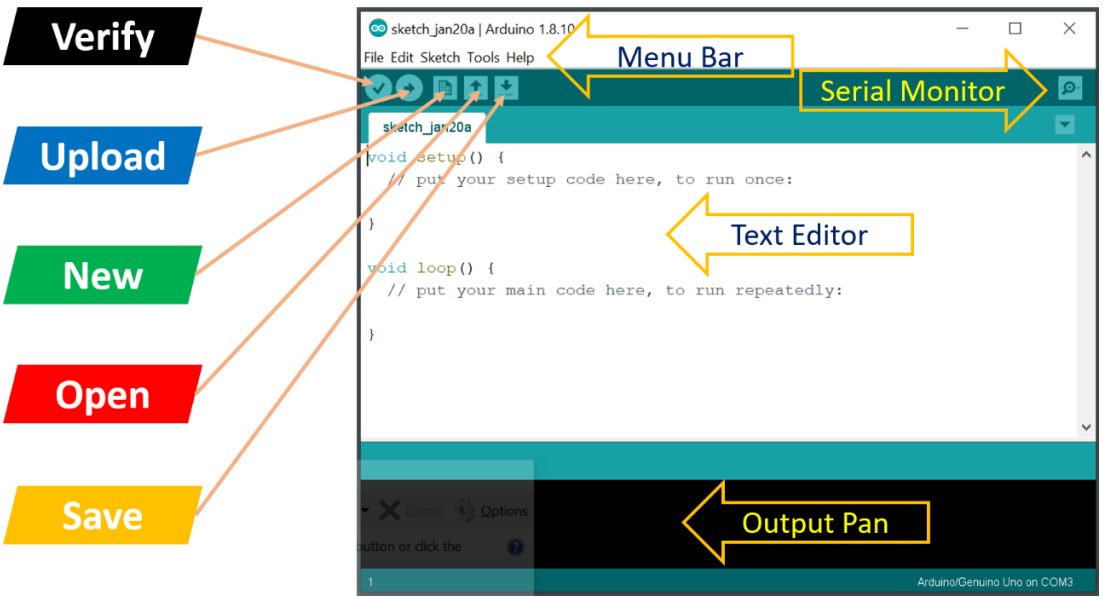

Fig 5.3 Front page view of Arduino IDE

Description of Arduino IDE page

- **Menu Bar:** For various kind of operational work, and modyfing the window this button is used.
- **Serial Monitor:** When there is a need to monitor some data contineously this buttion is used. It has a number of useful freactures

- **Text Editor:** A place where the code has to written.
- **Output Pan:** After clicking the Verify Button the verification results are appear here.
- **Verify :** By clicking this, the written program can be verified if there is any error or not.
- **Upload:** After completing code writing, the code can be uploaded to the Arduino Board by this button.
- **New:** For writing new code, a new page can be chosen by this button.
- **Open:** This button is used for openning a previously written code.
- **Save:** After writing a new code, this button is used to save the document.

5.4.2 Code Writing

Opening the IDE front page there is two function named **void setup** and **void loop** has appear automatically. At the beginning of writing Programmer need to declare all the **integer** and **variable** one by one and after that further commands and instructions should be written.

- **"void setup ( ) { }"** is technically a function that should be created basically at the top of each Arduino program. Inside the curly brackets is the code that programmer want to run one time immediately the program starts running. Programmer sets things like **pinMode** in this section.
- **"void loop ( ) { }"** is another function that programmer use as a part of its structure. The code inside the loop function runs again and again repeatedly as long as the Maker Board is turned on.
- **; (Semicolon)** denotes the end of a command or statement. The compiler never looks for space in IDE. It looks for Semicolon.
- **{ } Curly Braces** is a set of code statement. Programmer always need to close Curly Brace to match opening Curly Brace.
- **( ) Parentheses** is a set of arguments for a function, a method, or a code statement.

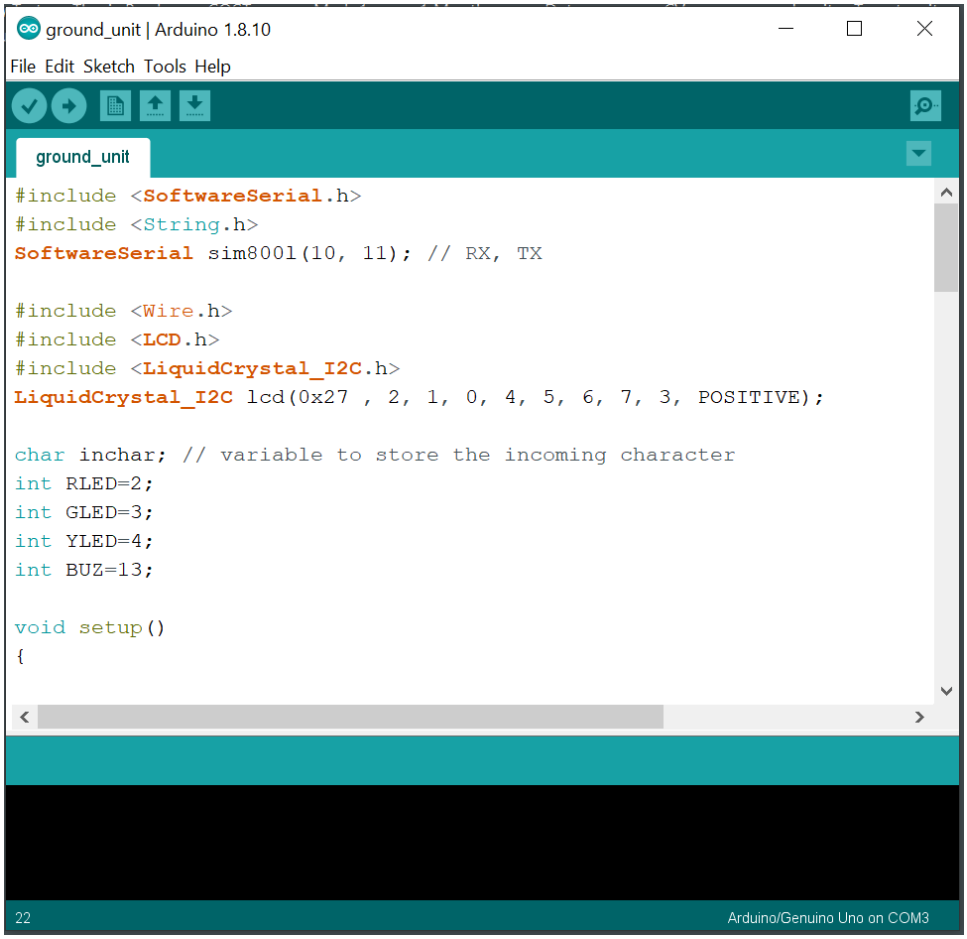

Fig 5.4 Writing the Code in Arduino IDE Software

5.4.2.1 Code Compilation

Written Code must be verify to use it and this work can be done by clicking Verity Button of Arduino IDE.

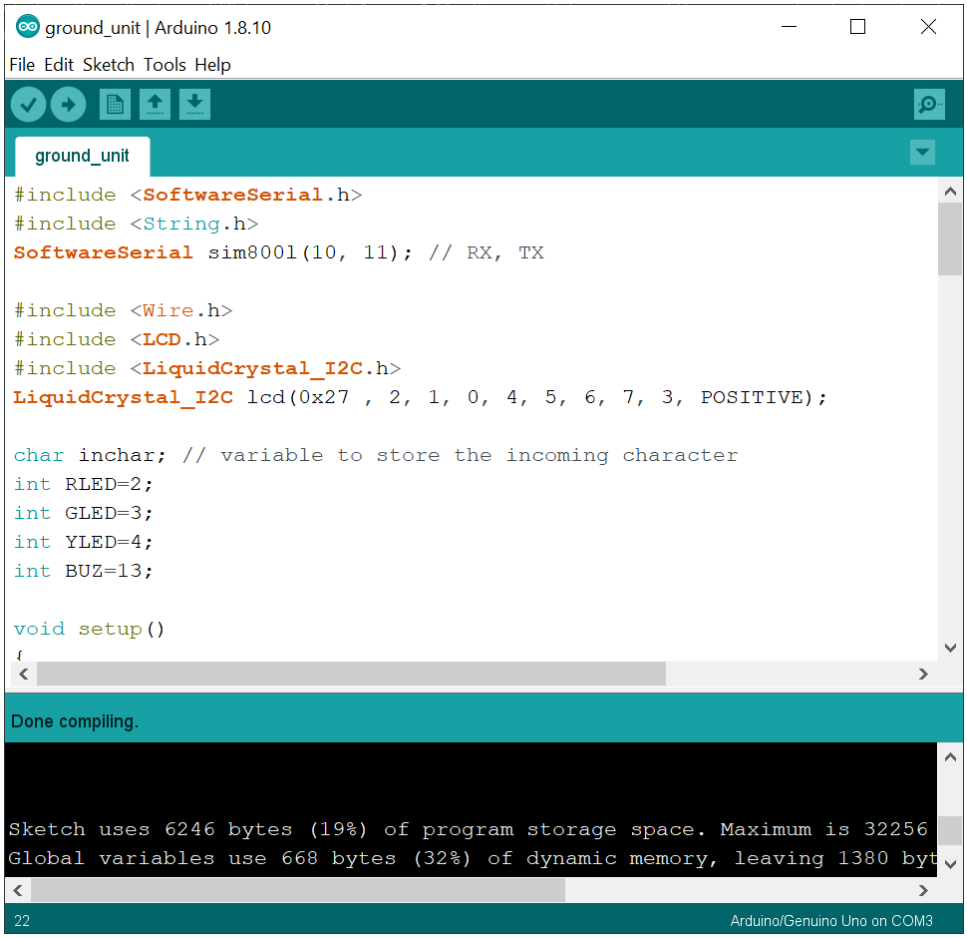

Fig 5.5 Compiling the Code in Arduino IDE

5.4.2.2 Board and Port Selection

For uploading the verified code into an Arduino Board, there is a need to select the Board and Port in IDE software. This is a necessary because a couple of Arduino Board can be ported to the IDE software at a time. So in which Board programmer wants to upload the code it should be selected. And Board should be selected because there is number of types Arduino Board like, UNO, NANO, MEGA, PRO MINI are available now. In which type of Board the Programmer is working should be known to IDE software for compiling the program.

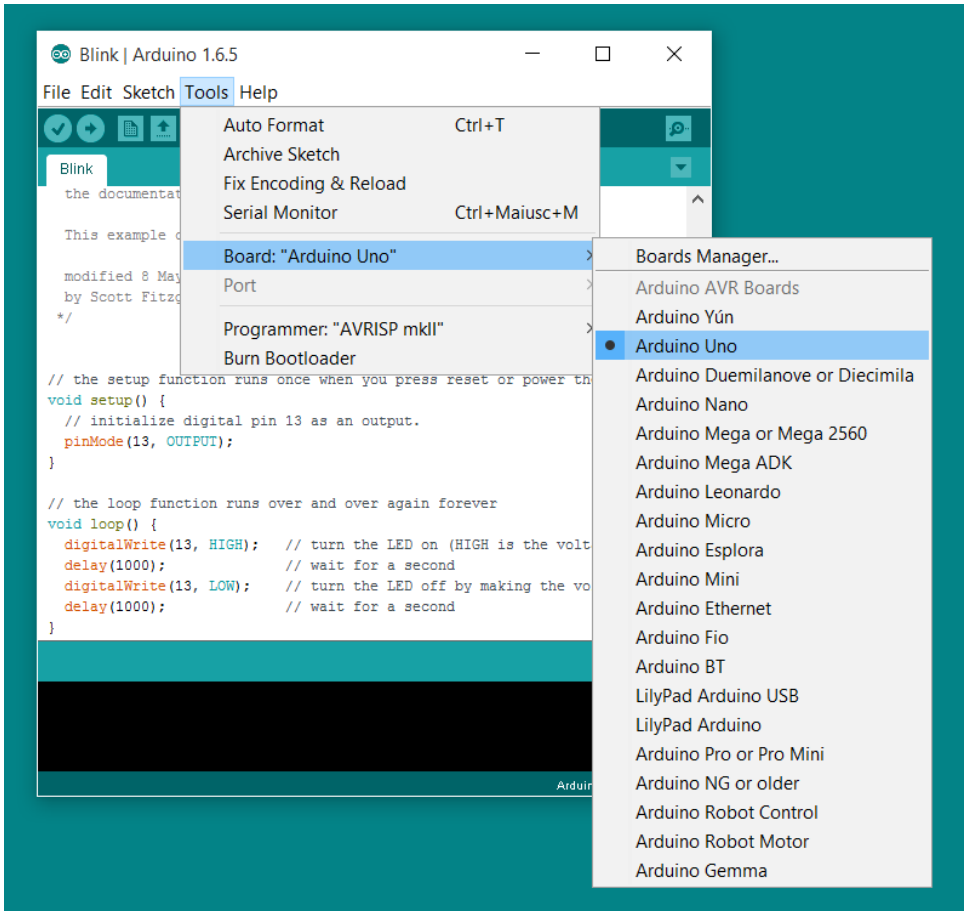

Fig 5.6 Board Selection of Arduino IDE

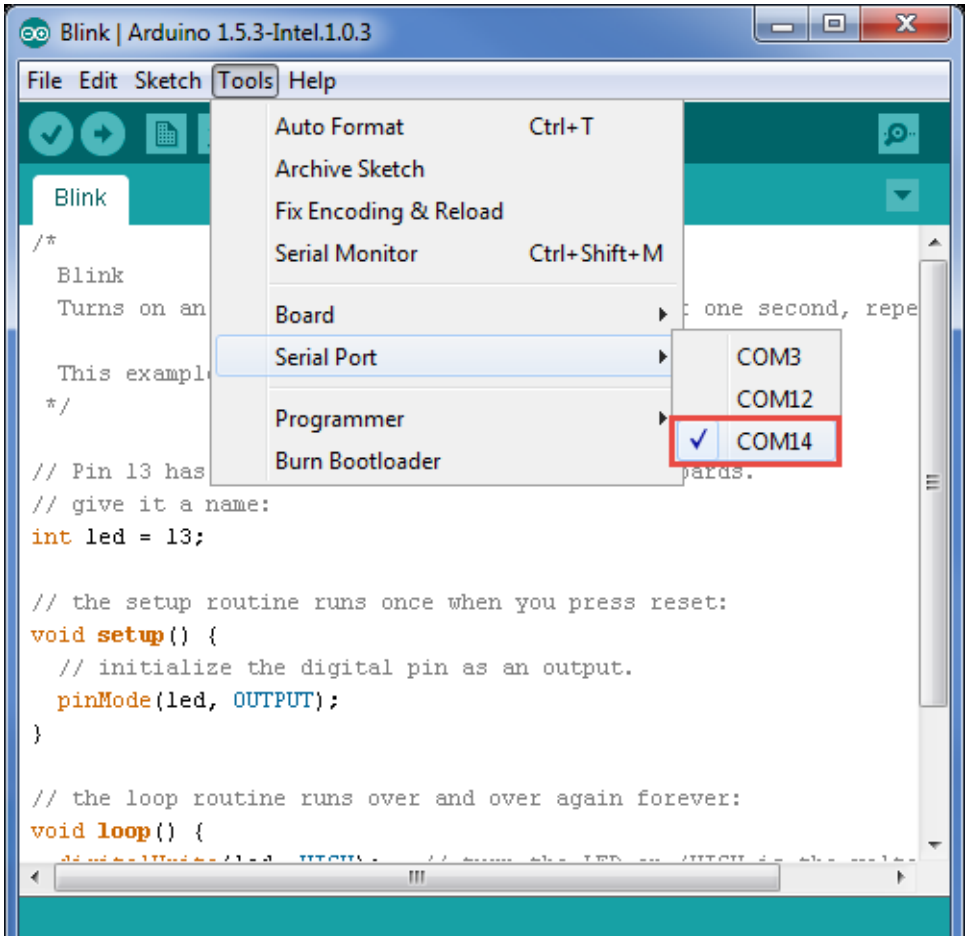

Fig 5.7 Port selection of Arduino IDE

5.4.2.3 Code Uploading

After finishing all the previous task of IDE software programmer need to upload the Code in Arduino Board. For doing this Programmer have to connect the Arduino Board to the computer with a USB cable. After connecting the Board programmer should have to recheck the Board and Port selection for surety. After that Programmer just need to click the Upload Button and the work is done in a short time.

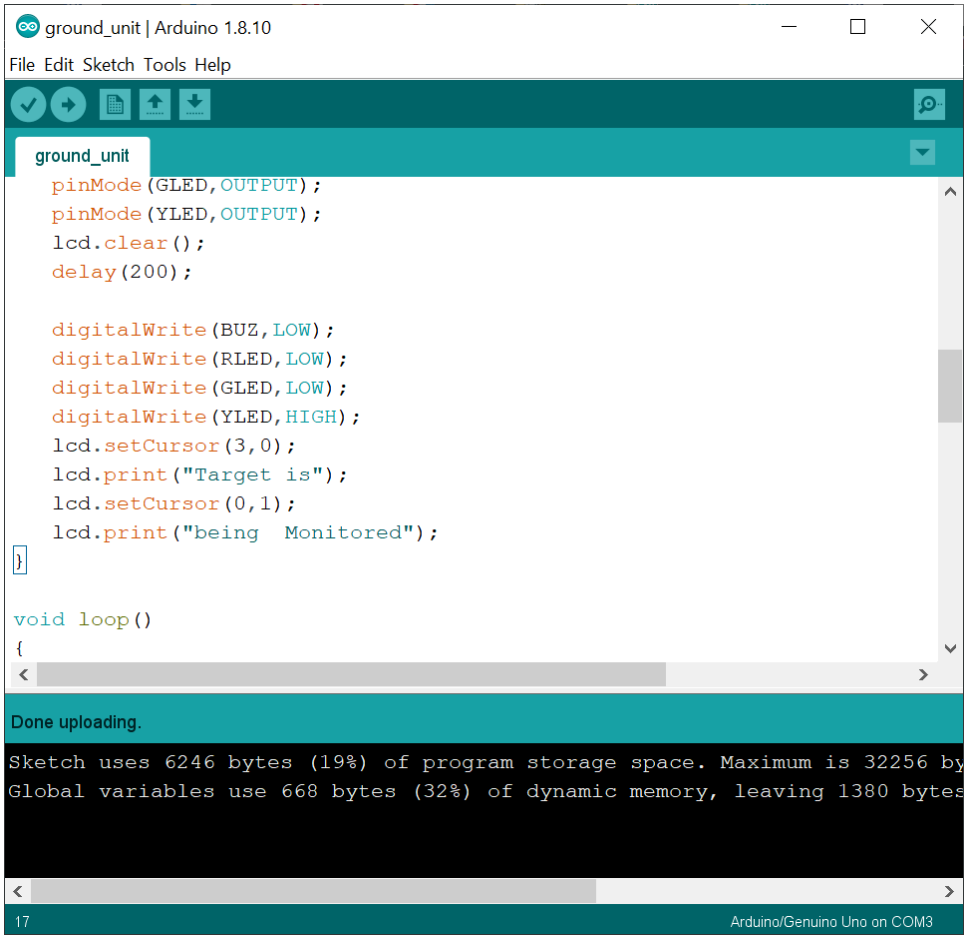

Fig 5.8 Code uploading in Arduino Board

5.5 Summary

After discussing about the designing methodology structure of our system in previous chapter, the main intension of this chapter was to about implementation of the design with programming. The flowchart was one of the crucial content of this chapter and that helps reader to understand how the algorithm of this system actually performs. We hope this chapter has successfully discussed the Implementation of the System. After completing all this task the system seems to ready for performing.

CHAPTER 6

RESULT AND DISCUSSION

6.1 Introduction

After finishing all the task one after another we have successfully made the prototype structure of Autonomous Boundary Alert System. In this chapter we will see the Final Result of our system and will analyzed some of its criteria.

6.2 Result

6.2.1 Project Analysis

After connecting all the equipment according to the circuit diagram and uploading the code to the Arduino Board of the two part named as “Target Unit” and “Base Unit” we had tried to experiment that our system is working or not. We saw that our system is working perfectly.

Photo of “Target Unit”:

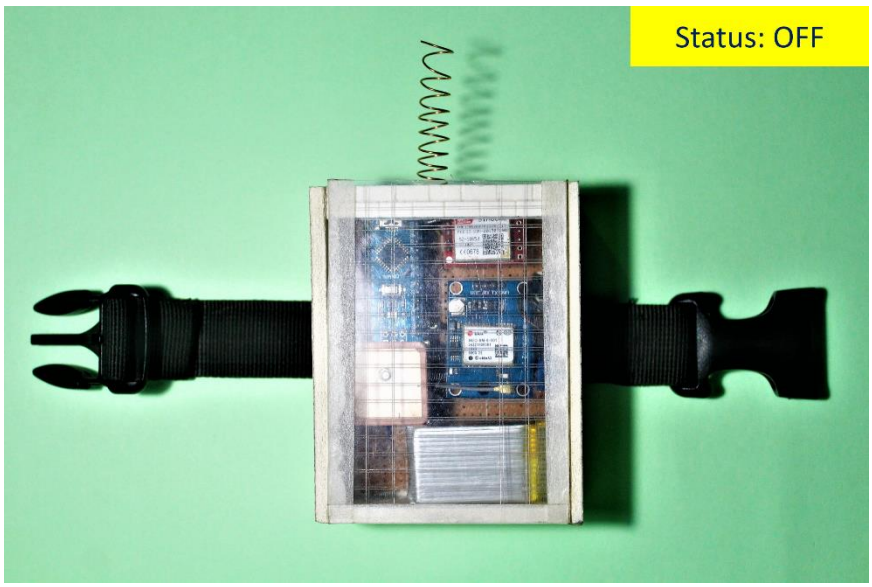

Fig 6.1(a) Top view of the “Target Unit”

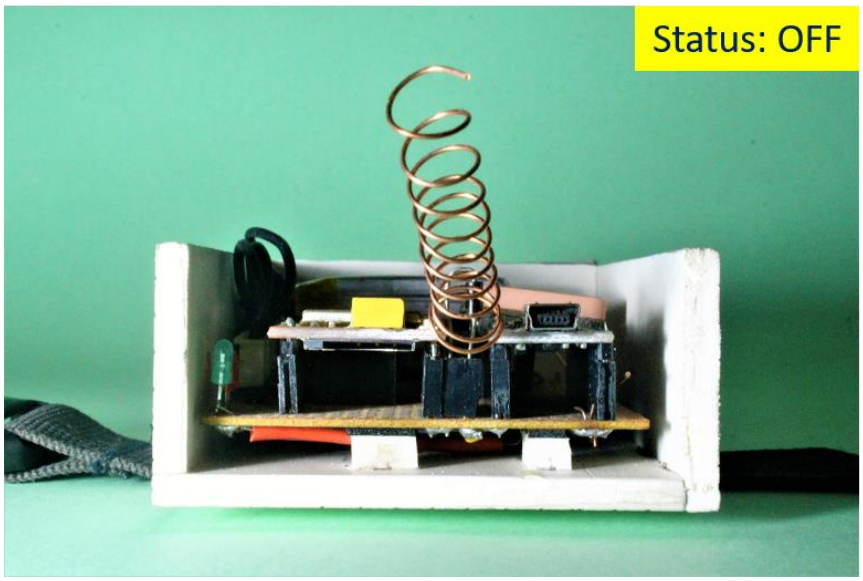

Fig 6.1(b) Front view of the “Target Unit”

Fig 6.1(c) Bottom view of the “Target Unit”

Photos of "Base Unit":

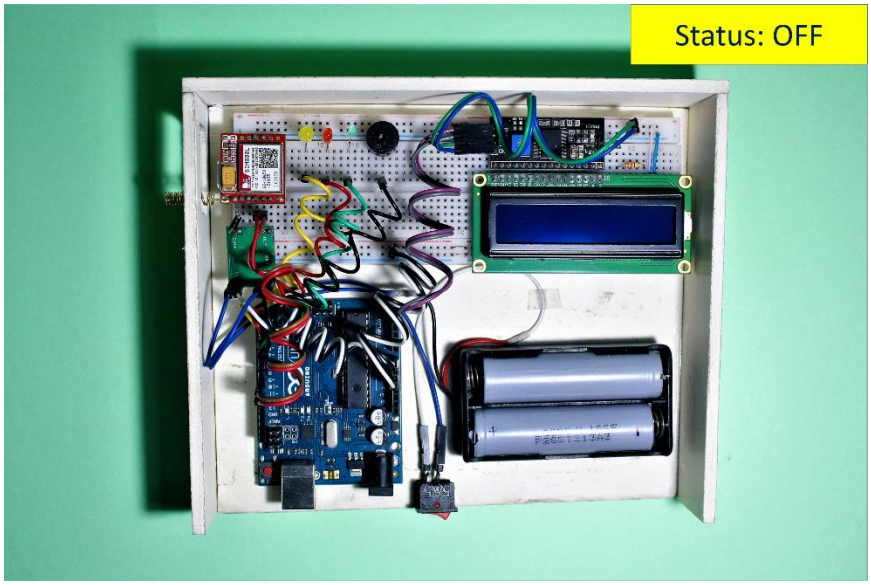

Fig 6.2(a) Top view of the "Base Unit"

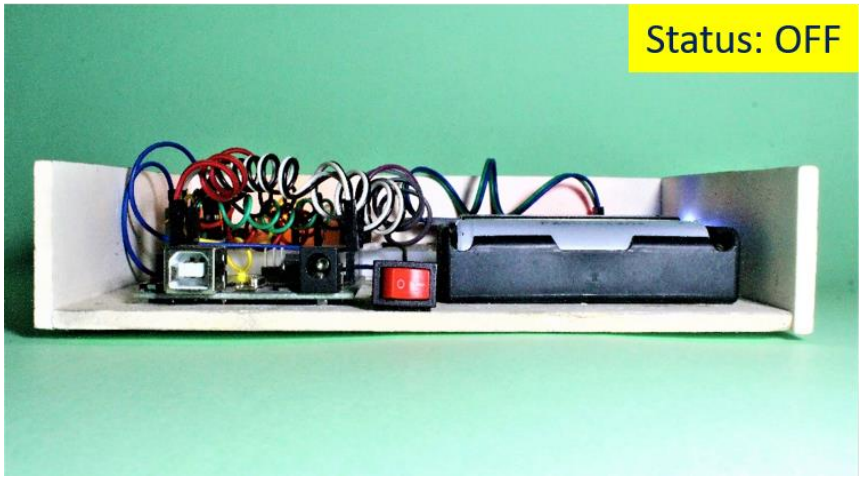

Fig 6.2(b) Front view of the "Base Unit"

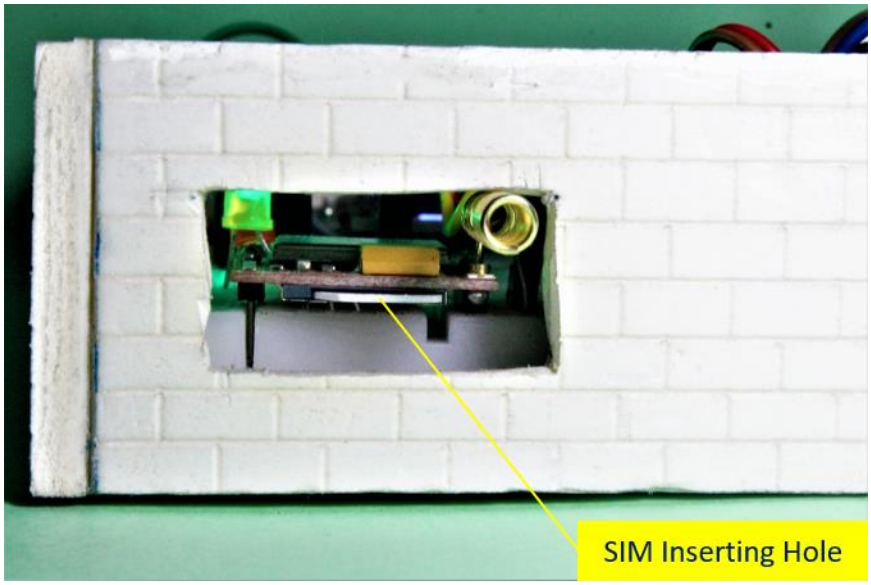

Fig 6.2(c) Right side view of the "Base Unit"

The Top and Front view of two unis can be showed in the above figures. The two unit named "Base Unit and "Target Unit" are shown in OFF status. Now we will see a number of figures of the system in running condition.

When Devices are turned on:

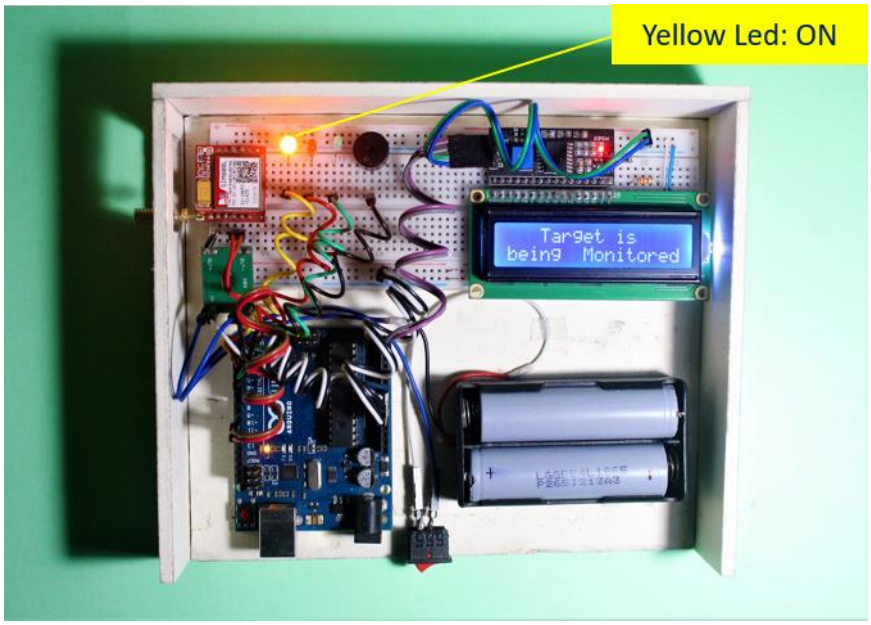

Fig 6.3(a) Base Unit's Status when the Target is being monitored

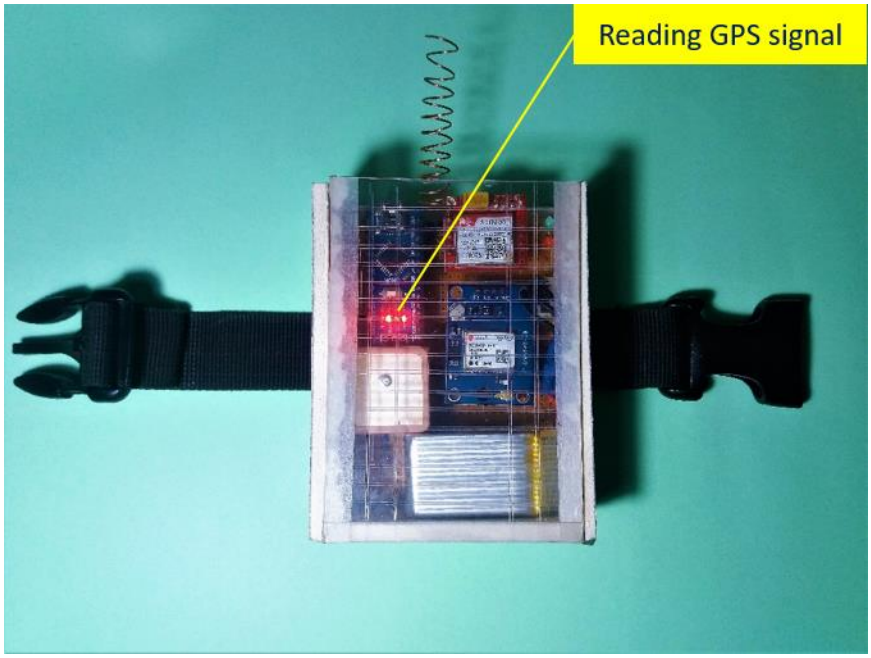

Fig 6.3(b) Target Unit's Status when the Target is being monitored

In the above figure 6.3(a) we can see that when the Yellow Led is runs High. It occurs when the Target is being monitored. And one things must be mentioned that the Base Unit has already start waiting for getting information from the "Target Unit". The LCD Display is describing the Targeted person's real time status that "Target is being Monitored".

Figure 6.3(b) shows that the Arduino NANO has been start reading the GPS data from the GPS module and for that the TX LED and RX LED of Arduino NANO are blinking.

When Target is Inside the Boundary:

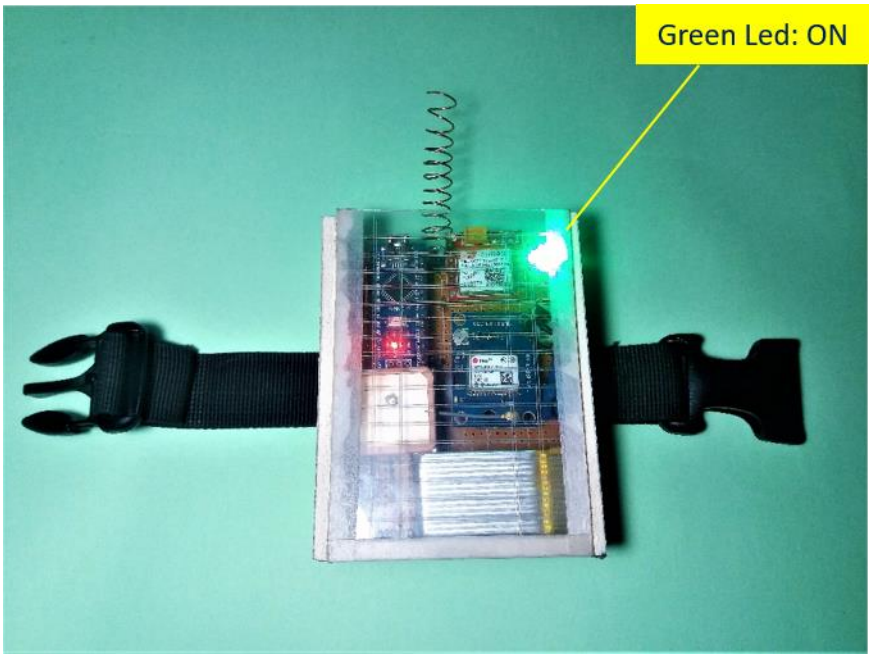

Fig 6.4(a) Target Unit's Status when the Target is Inside the Boundary

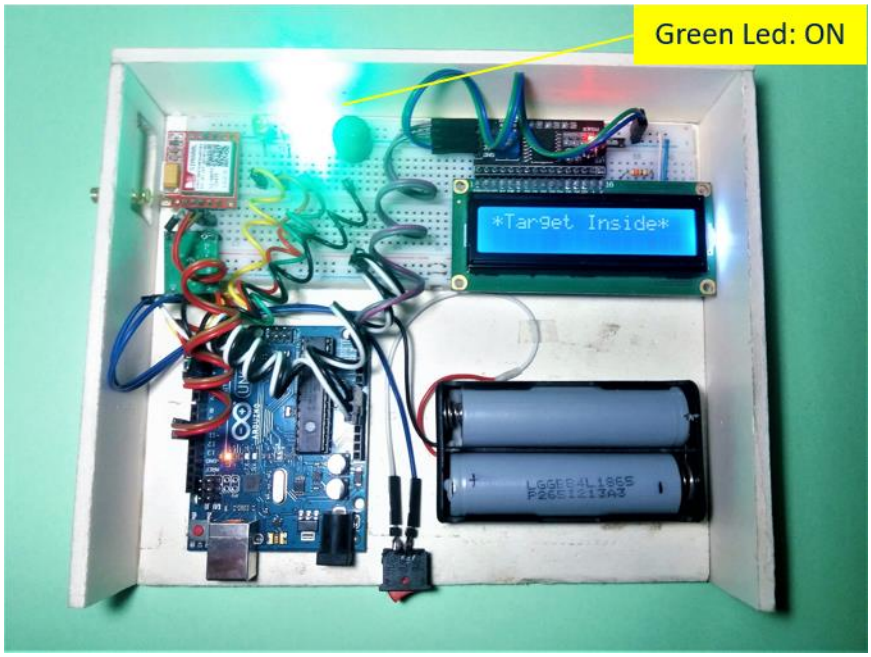

Fig 6.4(b) Base Unit's Status when the Target is Inside the Boundary

As we can see in Fig 6.4(a), when the Target is inside the specified area or boundary the Green Led is runs High and defining that the Target is inside. In this condition,

“Target Unit” will sent this information to the “Base Unit” which is waiting for receiving the information.

In Fig 6.4(b) the LCD Display is describing the Targeted person’s real time status that “*Target Inside*”. And we can also see that the Green Led is runs High. It occurs when the Target remains within the boundaries.

When Target is Outside the Boundary:

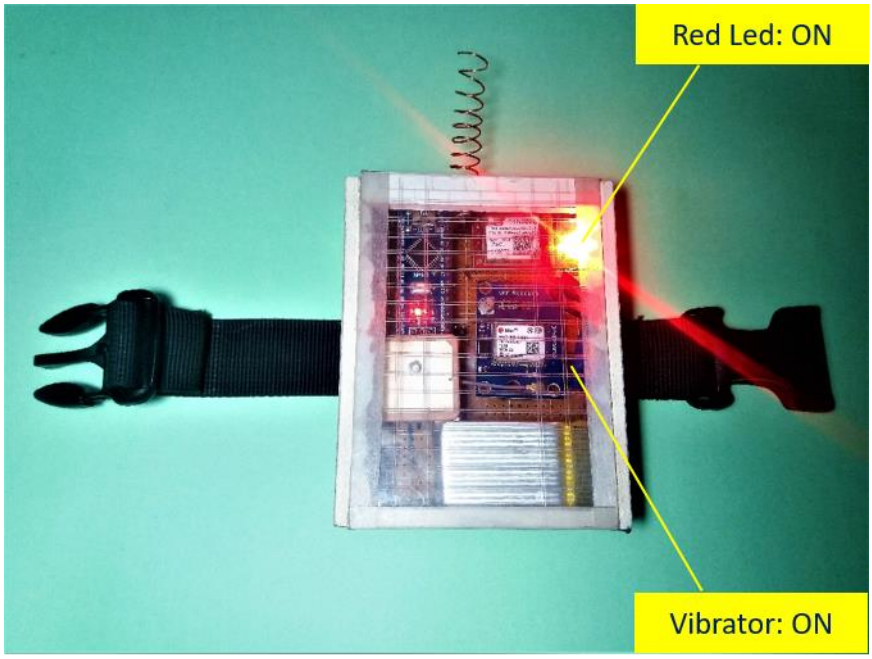

Fig 6.5(a) Target Unit’s Status when the Target is Outside the Boundary

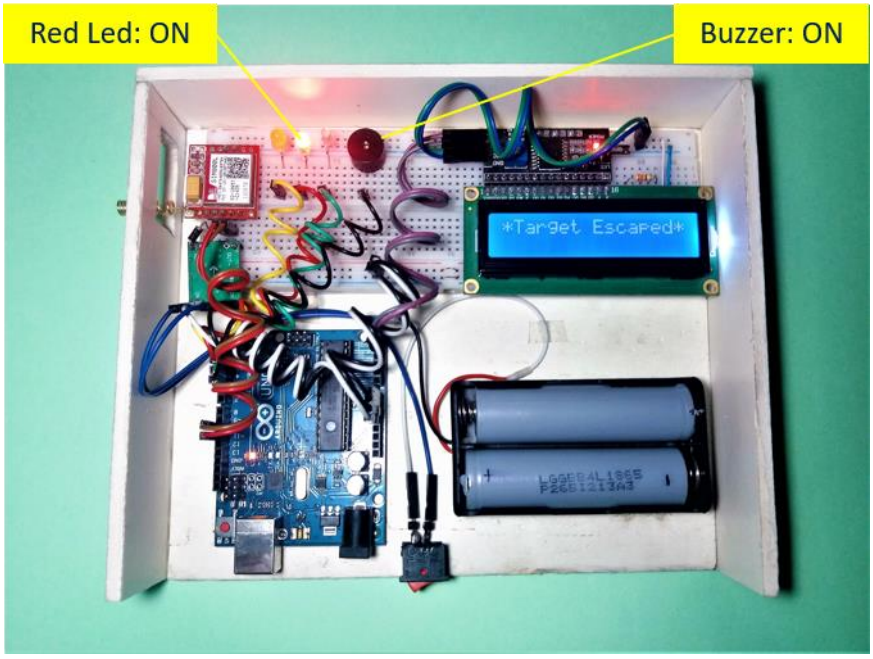

Fig 6.5(b) Base Unit's Status when the Target is Outside the Boundary

As we can see in Fig 6.5(a), when the Target is Outside of its specified area or boundary the Red Led and Vibration motor runs High and defines that the Target is outside. In this condition, "Target Unit" will sent this information to the "Base Unit" which is waiting for receiving the information.

In Fig 6.4(b) the LCD Display is describing the Targeted person's real time status that "*Target Escaped*". And we can also see that the Red Led is runs High and Buzzer is tuning restlessly. It occurs when the Target remains not within the boundaries.

So from the all above analysis of the system with the figures and discussion we can easily understand and declare that our devise is properly working.

6.2.2 Data Analysis

In this section of data analysis of the system we will obsereve that how the value of real time Latitude and Longitude comes to the “Target Unit” from satellite and how the internal data processing work goes on. We can get real time data of Latitude and Longitude data of GPS module with the help of Arduino IDE software. In this useful software we have a very essential window named Serial Monitor. We can get and obsereve the Latitude and Logitude value defined by GPS satellite around the Earth.

First of all we need to connent the Target Unit with the Arduino IDE Software and after communiacting the GPS module with Satellite we need to click the Serial Monitor button on the Arduino IDE software. When data will come from the Satellite, Seial Monitor window will show that automatically.

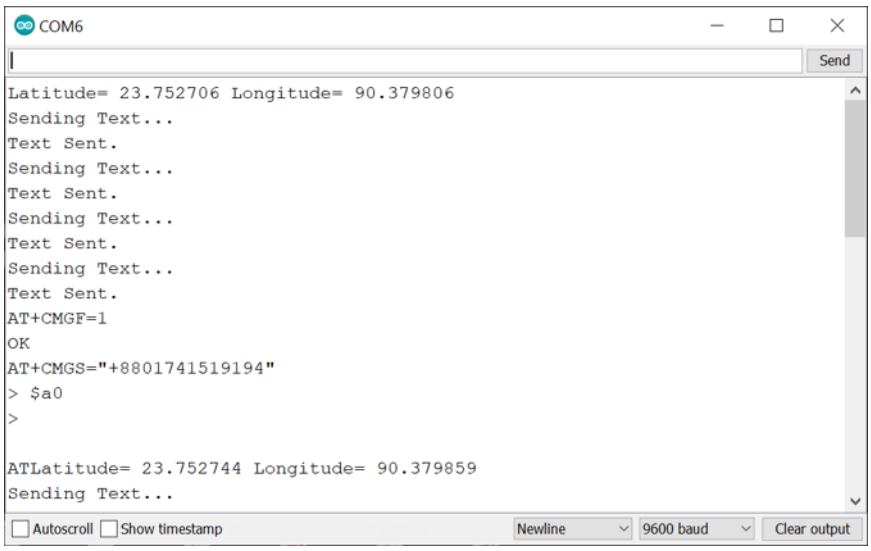

Fig 6.6(a) Incoming data from Satellite without timestamp

In figure 6.6(a) we can see the Incoming data without timestamp that was sent from Satellite after fixing the Latitude and Longitude of “Target Unit”. With this value of Latitude and Longitude Satelite fix the position of Target Unit. Arduino read this Latitude and Longitude values and then it compare that with the Latitude and Longitude values prefined by the programmer. As we programmed the Latitude and Longitued values as a range or area, if the values are not as programmed Arduino declare it as an indiscipline status. Then Arduino sent information about indisipline activities to the “Base Unit”. In this figure we are actually seeing that Arduino consider this as an indisipline status and then it sending this information and in Serial Monitor Window “Sending Text…” has been appear. After completing the process of sending

information the window write “Text Sent” as a clearence statement. Data comes from satellite contineously and Arduino continiousy read it and keep the process going on.

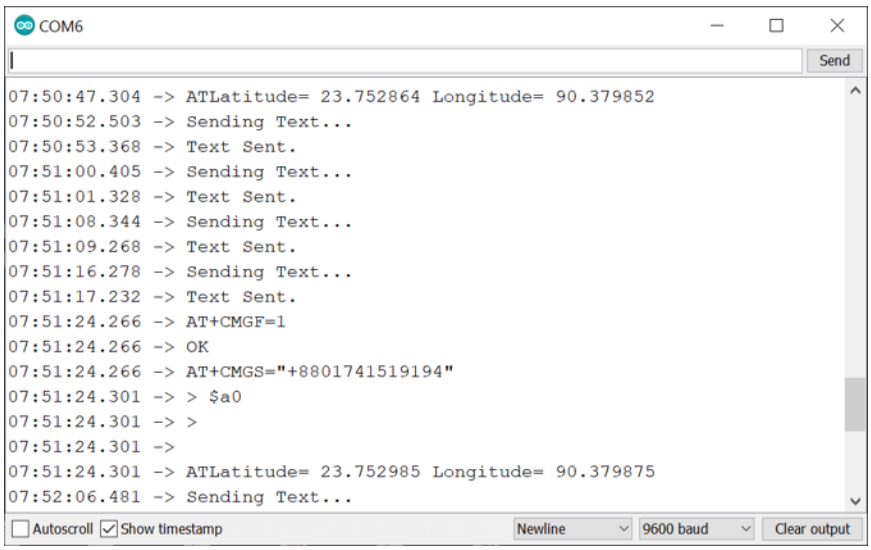

Fig 6.6(b) Incoming data from Satellite with timestamp

Timestamps shows the time of each function done by the system. In fig 6.6(b) if we consider the first function is data incoming and compare the time difference with next function it will be easier to learn about require time duration for the ongiong process. The analysis of the time can be understood properly with the a table of time analysis.

Table 6.1 Data Analysis Table about required time

Steps	**Time**	**Time gap**
Reading values of Latitude & Longitude	07:50:47.304	
Sending Text…	07:50:52.530	5.2 seconds
Text Sent.	07:50:53.368	0.8 seconds
	Total	**6 seconds**

As we see in table 6.1 the time required time for communicating between “Target unit and “Base Unit” is about 6 seconds. Then it can be said considered that the system is able to work as a much enough real time morinotoring system.

6.2.3 Cost Analysis

Table 6.2 Cost analysis table of the System

No.	Name	Product Code	Quantity	Unit Price (BDT)	Sub-total (BDT)
01.	Arduino UNO R3	5ARD328	1	370	370
02.	Arduino NANO	2ARDU328	1	320	320
03.	Ublox NEO-6M GPS Module	01GPS06	1	830	830
04.	SIM800L Mini GPRS GSM Module	1L800GSM	2	330	660
05.	HW133 Micro DC-DC Buck Converter	133BC3	2	85	170
06.	IIC I2C interface LCD Module	IIC-0001	1	70	70
07.	LCD Display 16×02 with Blue backlight	DIS-11602	1	130	130
08.	3.7V "1200mAh" Li-ion Battery	14500B1K2	2	95	190
09.	3.7V 800mAh 25C Li-Po Battery Tiger	JH 902540P	2	340	680
10.	Solder Less Bread board	1BB830	1	90	90
11.	Strip board	Vero-6-14	1	20	20
12.	3 mm LED Red Green	LED-10003	5	1	5
13.	3V Coin Shape Micro Vibration Motor	910-101	1	100	100
14.	Resistors	320Ω	2	2	4
15.	Diode	1N5819	2	2	4
16.	Jumper Wires	CBL-40102	16	1	16
17.	Others				100
				Total Amount	**3759**

From the observation of table 6.2 the system can be considered as a much valuable in comparison with the system cost. And working at a larger range of demand will reduce this cost further.

6.3 Discussion

This is the chapter of the final result and discussions. Where will be shown the result and also analysis of the project, data and cost. In this chapter we showed that we have successfully demonstrate the system with regarding the object of this system.

CHAPTER 7
CONCLUSION

7.1 Achievements

The Autonomous Boundary Alert System for Criminal/Child Monitoring is done with the help of Arduino board. This system is able to give the signal if the targeted person is out of the specified area. To find and monitor the targeted person, the user can use the Arduino code language and the software Arduino IDE. So many important mission like Criminal Monitoring, Suspicious people monitoring can find a new path and a new technology which increase the safety level of the society so high. For Child safety this technology can be a great solution. The probability of Child loss and the death rate of Children drowning in water can be reduce by using this technology. For dementia patient monitoring this technology can be an autonomous choice of a caretaker person. There are so many section in the society where this technology can be used. It is an achievement of increasing the safety level of the society.

7.2 Conclusion

Today we are in the realm of mechanical technology and every sector of our society is being digitalized. In this digital era of society there is no alternative to give an autonomous system to the society for keeping it safe from its huge number of problems or risks. In this advance and digital generation, the main objective of this project was to successfully monitor a Criminal automatically in a case of emergency like escaping. With this technology we can get the signal or indication when the criminal is out of the specified area. We have to create a new dimension in this section. Though our technology is tested and implemented successfully it is difficult to continue the project without good quality of hardware support. The real benefit will come and our technology will find the path of success when it will be used in so many sector to increase the society safety.

7.3 Limitation of the System

Although we have tried our best to keep our technology less fault able, the Autonomous Boundary Alert System might not be able to work for a number of unexpected issues and that issues are becomes the limitation of this system. Some limitations of the project is given below,

- **Performance of GPS Module:** The GPS module we have used in our system is Ublox NEO-6m. The manufacturer UBlox of this module have declared that, this module is unable to connect and communicate with satellite for getting the Latitude and Longitude values when it faces big obstacle like Roofs, Under construction Buildings, Big Trees and the mountains. It work perfectly in a free space. For this type of barrier the system could not be work.
- **Weak Network Condition:** Target Unit communicate with Base unit through the telecommunication network of the area where the system is being used. If the telecommunication network becomes week or unavailable to use then the alerting system will not perform.
- **Bad Working Weather:** The prototype of our system we have made is not water and fire resistance. The components used to build the prototype are all water and heat sensitive. Studying all of their specification is clear that system is not water resistance and the fine working temperature range is -40° Celsius to + 85° Celsius. So if the devices caught fire the components of the system can be damaged permanently.

7.4 Future Scope

The main purpose of this project is to increase the security system of a society for human or object. There is a lot of future scope of this system. It can be used in so many sector of a society. The target be so many types of things over human. This system can be implemented in many applications. In the basis of need and demand this system can be modify and developed. So we can declare that In future security level of a society can be increased with its proper use.

7.5 Discussion

In this work we have attempted to create a new security system remarked Autonomous Boundary Alert System for Criminal/Child monitoring. We have tried a little to provide a new and extra current of security to the society by automatically solving some basic problem like Criminal Escaping, Children losing, and Patient losing and so many. With some enhancements the system can be used for real time purpose.

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APPENDIX

Target Unit Code

```
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
#include <String.h>

      SoftwareSerial sim800l(9, 10);
      static const uint32_t GPSBaud = 9600;
      TinyGPSPlus gps;
      float LAT;
      float LON;

      int RLED=4;
      int GLED=5;
      int VIB=13;

void setup()
     {
      pinMode(RLED,OUTPUT);
      pinMode(GLED,OUTPUT);
      pinMode(VIB,OUTPUT);
      Serial.begin(9600);
      sim800l.begin(9600);

      digitalWrite(RLED,HIGH);
      digitalWrite(GLED,HIGH);
      digitalWrite(VIB,HIGH);
      delay(700);
      digitalWrite(RLED,LOW);
      digitalWrite(GLED,LOW);
      digitalWrite(VIB,LOW);
```

```
      }                                                  // void setup closed

 void loop()
      {
       while (Serial.available() > 0)
       {
       gps.encode(Serial.read());

       if (gps.location.isUpdated())
          {
           Serial.print("Latitude= ");
           Serial.print(LAT=  gps.location.lat(),6);
           Serial.print(" Longitude= ");
           Serial.println(LON=gps.location.lng(),6);

////////////////Inside Boundary/////////////////////

       if ( LAT < 23.876850)
          {
           SendTextMessage1();
           digitalWrite(RLED,LOW);
           digitalWrite(GLED,HIGH);
           digitalWrite(VIB,LOW);
          }

       if ( LAT > 23.875750)
          {
           SendTextMessage1();
           digitalWrite(RLED,LOW);
           digitalWrite(GLED,HIGH);
           digitalWrite(VIB,LOW);
          }

       if ( LON < 90.321220)
```

```
           {
            SendTextMessage1();
            digitalWrite(RLED,LOW);
            digitalWrite(GLED,HIGH);
            digitalWrite(VIB,LOW);
           }

       if ( LON > 90.320460)
           {
            SendTextMessage1();
            digitalWrite(RLED,LOW);
            digitalWrite(GLED,HIGH);
            digitalWrite(VIB,LOW);
           }

////////////Outside Boundary////////////////

       if ( LAT > 23.876850)
           {
            SendTextMessage2();
            digitalWrite(RLED,HIGH);
            digitalWrite(GLED,LOW);
            digitalWrite(VIB,HIGH);
           }

       if ( LAT < 23.875750)
           {
            SendTextMessage2();
            digitalWrite(RLED,HIGH);
            digitalWrite(GLED,LOW);
            digitalWrite(VIB,HIGH);
           }

       if ( LON > 90.321220)
```

```
          {
          SendTextMessage2();
          digitalWrite(RLED,HIGH);
          digitalWrite(GLED,LOW);
          digitalWrite(VIB,HIGH);
          }

       if ( LON < 90.320460)
          {
          SendTextMessage2();
          digitalWrite(RLED,HIGH);
          digitalWrite(GLED,LOW);
          digitalWrite(VIB,HIGH);
          }

        }

       }

       if (sim800l.available())
          {
           Serial.write(sim800l.read());
          }

     }                                          // void loop closed


////////////// FOR GSM COMMUNICATION ///////////////


 void SendTextMessage1()                       // Text Message Type 1
     {
      Serial.println("Sending Text...");
```

```
 sim800l.print("AT+CMGF=1\r");    // Set the shield to SMS mode
 delay(100);
 sim800l.print("AT+CMGS=\"+8801979119671\"\r");
                                          // BASE UNIT PHONE NUMBER
 delay(200);
 sim800l.print("$a1\r");
 delay(500);
 sim800l.print((char)26);
 delay(100);
 sim800l.println();
 Serial.println("Text Sent.");
 delay(7000);
}                                          // END OF OPERATION 1



void SendTextMessage2()                    // Text Message Type 2
{
 Serial.println("Sending Text...");
 sim800l.print("AT+CMGF=1\r");     // Set the shield to SMS mode
 delay(100);
 sim800l.print("AT+CMGS=\"+8801741519194\"\r");
                                          // BASE UNIT PHONE NUMBER
 delay(200);
 sim800l.print("$a0\r");
 delay(500);
 sim800l.print((char)26);
 delay(100);
 sim800l.println();
 Serial.println("Text Sent.");
 delay(7000);
}                                          // END OF OPERATION 2
```

Ground Unit Code

```
#include <SoftwareSerial.h>
#include <String.h>
SoftwareSerial sim800l(10, 11);                                    // RX, TX

#include <Wire.h>
#include <LCD.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27 , 2, 1, 0, 4, 5, 6, 7, 3, POSITIVE);

char inchar;              // variable to store the incoming character
int YLED=2;
int RLED=3;
int GLED=4;
int BUZZ=5;

void setup()
{

 lcd.begin(16, 2);

                                                  // wake up the GSM shield
  sim800l.begin(9600);
  Serial.begin(9600);
  delay(2000);
  sim800l.println("AT+CMGF=1");                 // set SMS mode to text
  delay(100);
  sim800l.println("AT+CNMI=2,2,0,0,0");   // just to get a notification
                                       when SMS arrives &direct out SMS
                                     upon receipt to the GSM serial out
  delay(100);


   pinMode(YLED,OUTPUT);
   pinMode(RLED,OUTPUT);
```

```
    pinMode(GLED,OUTPUT);
    pinMode(BUZZ,OUTPUT);



    digitalWrite(YLED,HIGH);
    digitalWrite(RLED,HIGH);
    digitalWrite(GLED,HIGH);
    digitalWrite(BUZZ,HIGH);
    lcd.clear();

    delay(700);

    digitalWrite(YLED,LOW);
    digitalWrite(RLED,LOW);
    digitalWrite(GLED,LOW);
    digitalWrite(BUZZ,LOW);

    delay(1500);

    lcd.setCursor(3,0);
    lcd.print("Target is");
    lcd.setCursor(0,1);
    lcd.print("being  Monitored");
    digitalWrite(YLED,HIGH);

}

void loop()
{

  if(sim800l.available() >0)                    //If a character comes
                                                    in from the GSM...
    {
     inchar=sim800l.read();
     if (inchar=='$')
```

```
  {
    delay(10);

    inchar=sim800l.read();
    if (inchar=='a')
    {
      delay(10);
      inchar=sim800l.read();
      if (inchar=='0')
      {

{
 digitalWrite(YLED,LOW);
 digitalWrite(RLED,HIGH);
 digitalWrite(GLED,LOW);
 digitalWrite(BUZZ,HIGH);
lcd.clear();
delay(100);
lcd.print("*Target Escaped*");
}

                                          //asm volatile ("jmp 0");
      }
      else if (inchar=='1')
      {
 digitalWrite(YLED,LOW);
 digitalWrite(RLED,LOW);
 digitalWrite(GLED,HIGH);
 digitalWrite(BUZZ,LOW);
 lcd.clear();
 delay(100);
 lcd.print("*Target Inside*");

                                          //asm volatile ("jmp 0");
      }
      delay(100);
```

```
        sim800l.println("AT+CMGD=1,4");              // delete all SMS
        delay(2000);
       }
     }
   }
}                                                                  // END
```