Project Report

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Introduction

1.1 Identify the Requirements for Real World Problems

What are wireless sensor networks?
Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure-less wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analysed. A sink or base station acts like an interface between users and the network. One can retrieve required information from the network by injecting queries and gathering results from the sink. Typically, a wireless sensor network contains hundreds of thousands of sensor nodes. The sensor nodes can communicate among themselves using radio signals. A wireless sensor node is equipped with sensing and computing devices, radio transceivers and power components. The individual nodes in a wireless sensor network (WSN) are inherently resource constrained: they have limited processing speed, storage capacity, and communication bandwidth. After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them. Then the onboard sensors start collecting information of interest. Wireless sensor devices also respond to queries sent from a "control site" to perform specific instructions or provide sensing samples. The working mode of the sensor nodes may be either continuous or event driven. Global Positioning System (GPS) and local positioning algorithms can be used to obtain location and positioning information. Wireless sensor devices can be equipped with actuators to "act" upon certain conditions. These networks are sometimes more specifically referred as Wireless Sensor and Actuator Networks.

Architecture

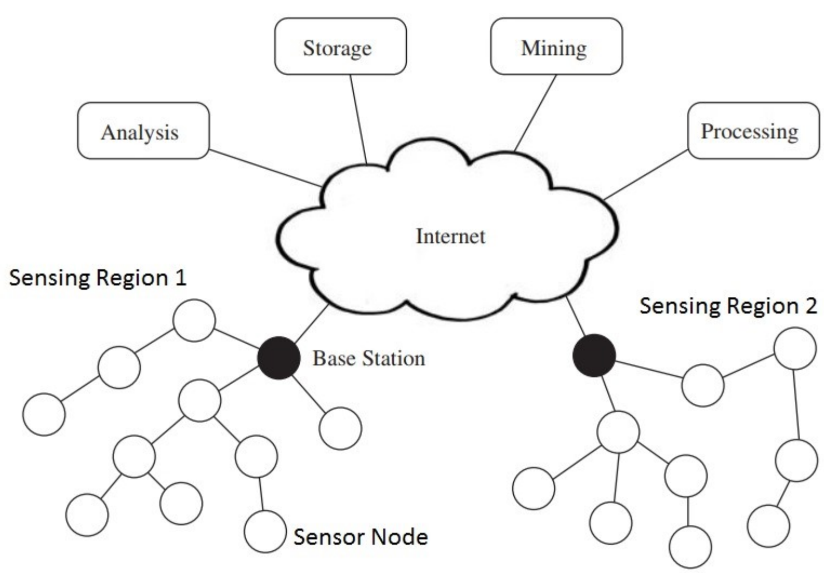

Figure 1.1: Architecture

A Wireless Sensor Network consists of Sensor Nodes that are deployed in high density and often in large quantities and support sensing, data processing, embedded computing and connectivity.

- 'Sensors' connected to each node by a wired connection. In our case, we use sensors that can measure soil moisture, electrical conductivity, soil temperature, water pressure, flow rate, or a range of weather variables (light, air temperature, wind, humidity, etc.).
- 'Nodes' collect the data from sensors and transmit that to a 'base station' computer using a one way (in the case of monitoring) or two-¬-way (in the case of monitoring and control) radio. Nodes can simply monitor environmental and soil conditions or can be used to make control decisions. For example, some nodes have the capability to control an electric valve, such as an irrigation valve.
- 'Base Station' computer connects the system to the internet, so that data collected by the nodes, then transmitted to the base station computer, can be viewed anywhere an internet connection is available.
- 'Graphical User Interface' is the web-¬-based software package, that allows the data collected by sensors to be viewed. The software is also used to set irrigation parameters.

1.1.1 Different Sensors

The following is a list of different types of sensors that are commonly used in various applications. All these sensors are used for measuring one of the physical properties like Temperature, Resistance, Capacitance, Conduction, Heat Transfer etc.

- Temperature Sensor: One of the most common and most popular sensor is the Temperature Sensor. A Temperature Sensor, as the name suggests, senses the temperature i.e. it measures the changes in the temperature.
- Proximity Sensor: A Proximity Sensor is a non-contact type sensor that detects the presence of an object. Proximity Sensors can be implemented using different techniques like Optical (like Infrared or Laser), Ultrasonic, Hall Effect, Capacitive, etc.
- IR Sensor (Infrared Sensor): IR Sensors or Infrared Sensor are light based sensor that are used in various applications like Proximity and Object Detection. IR Sensors are used as proximity sensors in almost all mobile phones.
- Pressure Sensor: A pressure sensor is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical.
- Light Sensor: The light sensor is a passive devices that convert this "light energy" whether visible or in the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly known as "Photoelectric Devices" or "Photo Sensors" because the convert light energy (photons) into electricity (electrons).
- Ultrasonic Sensor: An Ultrasonic Sensor is a non-contact type device that can be used to measure distance as well as velocity of an object. An Ultrasonic Sensor works based on the properties of the sound waves with frequency greater than that of the human audible range.
- Smoke, Gas and Alcohol Sensor: A smoke detector is a device that senses smoke, typically as an indicator of fire. Commercial smoke detectors issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarms, generally issue an audible or visual alarm from the detector itself or several detectors if there are multiple smoke detectors interlinked.

1.1.2 Applications of Wireless Sensor Networks

- Military applications: Wireless sensor networks be likely an integral part of military command, control, communications, computing, intelligence, battlefield surveillance, reconnaissance and targeting systems.
- Area monitoring: In area monitoring, the sensor nodes are deployed over a region where some phenomenon is to be monitored. When the sensors detect the event being monitored (heat, pressure etc), the event is reported to one of the base stations, which then takes appropriate action.
- Transportation: Real-time traffic information is being collected by WSNs to later feed transportation models and alert drivers of congestion and traffic problems.
- Health applications: Some of the health applications for sensor networks are supporting interfaces for the disabled, integrated patient monitoring, diagnostics, and drug administration in hospitals, tele-monitoring of human physiological data, and tracking & monitoring doctors or patients inside a hospital.
- Environmental sensing: The term Environmental Sensor Networks has developed to cover many applications of WSNs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests etc. Some other major areas are listed below:
  - Air pollution monitoring
  - Forest fires detection
  - Greenhouse monitoring
  - Landslide detection
- Structural monitoring: Wireless sensors can be utilized to monitor the movement within buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc enabling Engineering practices to monitor assets remotely with out the need for costly site visits.
- Industrial monitoring: Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionalities. In wired systems, the installation of enough sensors is often limited by the cost of wiring.
- Agricultural sector: using a wireless network frees the farmer from the maintenance of wiring in a difficult environment. Irrigation automation enables more efficient water use and reduces waste.

1.1.3 Limitations of Wireless Sensor Networks

- Energy Consumption: In WSN, power consumption is one of the main issues. As an energy source, the battery is used by equipping with sensor nodes. The sensor network is arranged within dangerous situations, so it turns complicated for changing otherwise recharging batteries. The energy consumption mainly depends on the sensor nodes' operations like communication, sensing & data processing. Throughout communication, the energy consumption is very high. So, energy consumption can be avoided at every layer by using efficient routing protocols.
- Localization: For the operation of the network, the basic, as well as critical problem, is sensor localization. So sensor nodes are arranged in an ad-hoc manner so they don't know about their location. The difficulty of determining the sensor's physical location once they have been arranged is known as localization. This difficulty can be resolved through GPS, beacon nodes, localization based on proximity.
- Coverage: The sensor nodes in the wireless sensor network utilize a coverage algorithm for detecting data as well as transmit them to sink through the routing algorithm. To cover the whole network, the sensor nodes should be chosen. There efficient methods like least and highest exposure path algorithms as well as coverage design protocol are recommended.

- Clocks: In WSN, clock synchronization is a serious service. The main function of this synchronization is to offer an ordinary timescale for the nodes of local clocks within sensor networks. These clocks must be synchronized within some applications like monitoring as well as tracking.

- Computation: The computation can be defined as the sum of data that continues through each node. The main issue within computation is that it must reduce the utilization of resources. If the life span of the base station is more dangerous, then data processing will be completed at each node before data transmitting toward the base station. At every node, if we have some resources then the whole computation should be done at the sink.

- Production Cost: In WSN, the large number of sensor nodes is arranged. So if the single node price is very high then the overall network price will also be high. Ultimately, the price of each sensor node has to be kept less. So the price of every sensor node within the wireless sensor network is a demanding problem.

- Hardware Design: When designing any sensor network's hardware like power control, micro-controller & communication unit must be energy-efficient. Its design can be done in such a way that it uses low-energy.

- Quality of Service: The quality of service or QoS is nothing but, the data must be distributed in time. Because some of the real-time sensor-based applications mainly depend on time. So if the data is not distributed on time toward the receiver then the data will turn useless. In WSNs, there are different types of QoS issues like network topology that may modify frequently as well as the accessible state of information used for routing can be imprecise.

1.1.4 Requirements for real world problem

Robust, reliable and efficient data collection in embedded wireless multi-hop networks are essential elements in creating a true deploy-and-forget user experience. Maintaining full connectivity within a WSN, in a real-world environment populated by other WSNs, WiFi networks or Bluetooth devices that constitute sources of interference is a key element in any application, but more so for those that are safety-critical, such as disaster response.

Awareness of the effects of wireless channel, physical position and line-of-sight on received signal strength in real-world, outdoor environments will shape the design of many outdoor applications. Thus, the quantification of such effects is valuable knowledge for designers. Sensors' failure detection, scalability and commercialization are common challenges in many long-term monitoring applications; transferable solutions are evidenced here in the context of pollutant detection and water quality.

Innovative, alternative thinking is often needed to achieve the desired long-lived networks when power-hungry sensors are foreseen components; in some instances, the very problems of wireless technology, such as RF irregularity, can be transformed into advantages.

The importance of an iterative design and evaluation methodology—from analysis to simulation to real-life deployment—should be well understood by all WSN developers. The value of this is highlighted in the context of a challenging WPAN video-surveillance application based on a novel Nomadic Access Mechanism.

Cost benefits to be drawn from devising a WSN based solution to classic application areas such as surveillance are often a prime motivator for WSN designers; an example is offered here based on the use of intelligent agents for intrusion monitoring.

Last but not least, the practicality and usability of the WSN solutions found for novel applications is key to their adoption. This is particularly true when the end-users of the developed technology are medical patients. The importance of feedback, elegant hardware encapsulation and extraction of meaning from data is presented in the context of novel orthopedic rehabilitation aids.

Introduction to Smart Blind Tracker

2.1 Problem Definition

Every alternate day we hear news about person missing. Many of these include blind person who can't tell the whereabouts when they gone missing. Some of these blind people are never traced. However, with the use of the advanced GPS blind person tracker system, family members can find blind person in few minutes. GPS based tracker for blind person project solves this problem. This project has GPS modem and GSM modem and it sends SMS to the family members of the Blind person which contains the Longitude and Latitude of the person. This project is scalable; it can also be used for tracking senior citizens or people who are partially blind.

This project also has 4 pushbuttons. 3 buttons can be used by visually impaired person to send emergency messages to the family members with respective 3 emergency messages. GPS modem continuously sends data string to the Microcontroller. It includes Longitude Latitude of the place where project is currently situated. Thus Microcontroller gets co-ordinates of the place. The 4th button is connected to the buzzer. When the person wants to alert people around him if he comes across a dangerous situation, he could press the button and the buzzer will emit sound.

2.2 Aims & Objectives of the Project

- To be able to easily track blind people so that they are not lost.
- To come to the rescue of the blind person when required during unavoidable situations or emergencies.
- To make a system which is easy to use and install.

2.3 Scope of the Project

This project can be implemented for current use as it uses rapidly growing and reliable wireless technology. It can be easily used for tracking people who are visually impaired. It can be used to attend to sensitive matters like emergencies, medical attention, as soon as possible without any delays.

2.4 Features of the Project

- GPS modem and GSM modem which sends SMS to the family members of the Blind person which contains the Longitude and Latitude of the person.
- It has 4 pushbuttons. 3 buttons can be used by visually impaired person to send emergency messages to the family members with respective 3 emergency messages.
- The 4th button is connected to the buzzer to alert the nearby people.
- Simple and easy to install and use.

Review of Literature

The current state of research and development on global positioning systems (GPS)-based navigation systems for the visually impaired. In this project, a walking stick has been designed to help the blind person to detect obstacles and navigate towards the destination. The proposed walking stick consists of a microcontroller, infrared sensors, a GPS receiver, label surface detection, a buzzer and a vibrating motor. The detection of obstacles is done by an array of infrared sensors. The GPS receiver has been used for navigation purpose as well GSM will act as a mobile phone which informed about the danger of blind person. In order to make this stick useful for a blind as well as a deaf person a vibrating motor is used to generate vibrations near the handle of the stick to detect the presence of obstacles. This whole setup will be mounted on the cane. Every effort is being made to make this cane cheaper as well as user friendly.
As the technology is advancing day to day, the human machine interaction has become a must in our daily life. The primary objective of this work is to permit blind persons to explore autonomously in the outside environment. The proposed work is to use a stick including a GPS Navigator. Now a days a stick are used with some features but in our project we are using GPS module with some other advance features. This work goes for giving the route to blind person by designing a cost effective and more flexible navigation system. The proposed system consists of hardware and software. Here the components we are using are Microcontroller, GPS module, etc. This project will help the blind people in improving their communication ability and not to depend on none during walking in even unknown areas.

System Description

4.1 Design

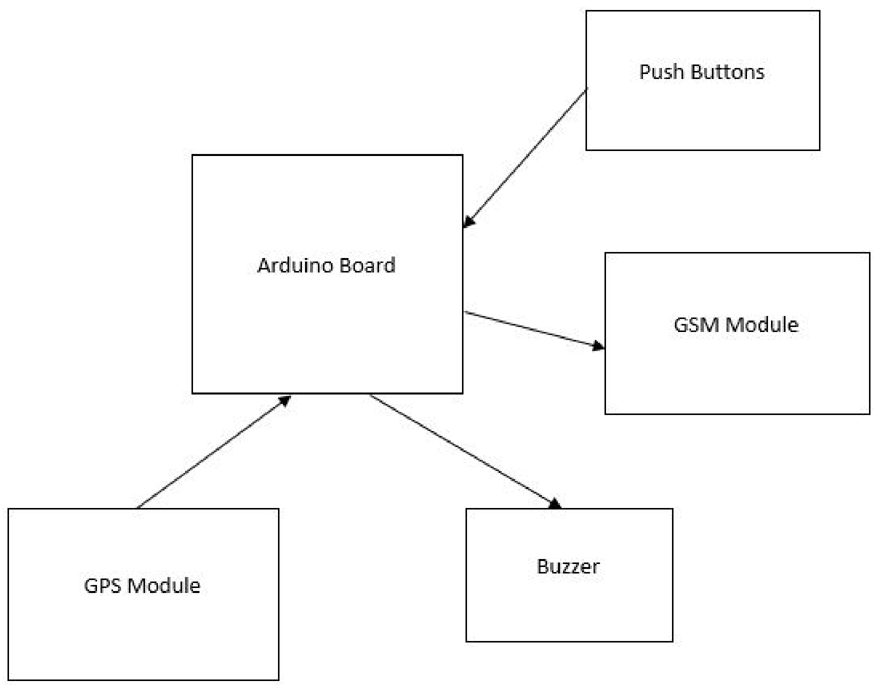

Figure 4.1: Block Diagram

4.2 Software Used

Proteus
The Proteus Professional demonstration is intended for prospective customers who wish to evaluate our professional level products. It includes all features offered by the professional system including netlist based PCB design with auto-placement, auto-routing and graph based simulation. The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. It was developed in Yorkshire, England by Labcenter Electronics Ltd and is available in English, French, Spanish and Chinese languages.

Arduino IDE
Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC-BY-SA license, while software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors.
Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the "Arduino language". In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) and a command line tool (arduino-cli) developed in Go.
The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors.

4.3 Implementation & Methodology

After defining the problem statement, we analysed the requirement of the project and accordingly started implementing step by step, which includes proper working code for each sensor. Testing each sensor at a time and checking desired output. The project is implemented in Proteus as follows:

1. We first gathered all the components required for the project.
2. GPS sensor is used to continuously send the co-ordinates of the project or the person carrying the stick to the arduino board.
3. GSM module is used to send the SMS to the respective family member of the blind person when he pushes any of the push buttons in which messages are already stores.
4. The fourth push button is used to turn on the buzzer when the blind person wants to alert the people nearby.
5. The system is designed in such a way that as soon as the blind person pushes any of the button the gps module locates the person and immediately sends the sms to the number stored(of the family member) with the desired message and co-ordinates of the person.

4.4 Code

```
#include < TinyGPS.h >
#include < SoftwareSerial.h >
#include< string.h >

SoftwareSerial gsm(7, 8);
TinyGPS gps;

String PhoneNumber=”+919022061307”;
String message1=”I am in danger! My location is :”;
String message2=”I am robbed off! My location is:”;
```

```
String message3=”I am lost! My location:”;

void setup() {
pinMode(13,INPUT);
pinMode(12,INPUT);
pinMode(11,INPUT);
pinMode(10,INPUT);
pinMode(9,OUTPUT);
Serial.begin(9600);
gsm.begin(9600);
}

void loop() {
bool newData = false;
float flat, flon;
unsigned long age;

for (unsigned long start = millis(); millis() - start ¡ 1000;)
{
while (Serial.available())
{
char c = Serial.read();
if (gps.encode(c))
newData = true;
}
}
if (newData)
{
gps.f_get_position(&flat, &flon, &age);
Serial.print(”LAT=”);
Serial.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
Serial.print(” LON=”);
Serial.print(flon == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
}

if(digitalRead(10)== HIGH){
tone(9,700,1000);
delay(1000);
noTone(9);
}
if(digitalRead(13) == HIGH){
String lat, lon;
lat= String(flat,8);
lon= String(flon,8);
gsm.println(”AT+CMGF=1”);
delay(500);
gsm.println(”AT + CMGS = ¨+919022061307”);// recipient’s mobile number with country code
gsm.println(”SENDING MESSAGE.........”);
delay(500);
gsm.print(”Latitude:”);
gsm.println(lat);
gsm.print(”Longitude:”);
gsm.println(lon);
gsm.print(message1);
```

```
gsm.println(”Google Maps - https://www.google.co.in/maps/place/”);
delay(1000);
gsm.println((char)26);
Serial.println((char)26);
delay(1000);
}
else if(digitalRead(12) == HIGH){
String lat, lon;
lat= String(flat,8);
lon= String(flon,8);
gsm.println(”AT+CMGF=1”);
delay(500);
gsm.println(”AT + CMGS = +̈919022061307”);// recipient’s mobile number with country code
gsm.println(”SENDING MESSAGE.........”);
delay(500);
gsm.print(”Latitude:”);
gsm.println(lat);
gsm.print(”Longitude:”);
gsm.println(lon);
gsm.print(message2);
gsm.println(”Google Maps - https://www.google.co.in/maps/place/”);
delay(1000);
gsm.println((char)26);
Serial.println((char)26);
delay(1000);
}
else if(digitalRead(11) == HIGH){
String lat, lon;
lat= String(flat,8);
lon= String(flon,8);
gsm.println(”AT+CMGF=1”);
delay(500);
gsm.println(”AT + CMGS = +̈919022061307”);// recipient’s mobile number with country code
gsm.println(”SENDING MESSAGE.........”);
delay(500);
gsm.print(”Latitude:”);
gsm.println(lat);
gsm.print(”Longitude:”);
gsm.println(lon);
gsm.print(message3);
gsm.println(”Google Maps - https://www.google.co.in/maps/place/”);
delay(1000);
gsm.println((char)26);
Serial.println((char)26);
delay(1000);
}
}
```

4.5 Final Prototype

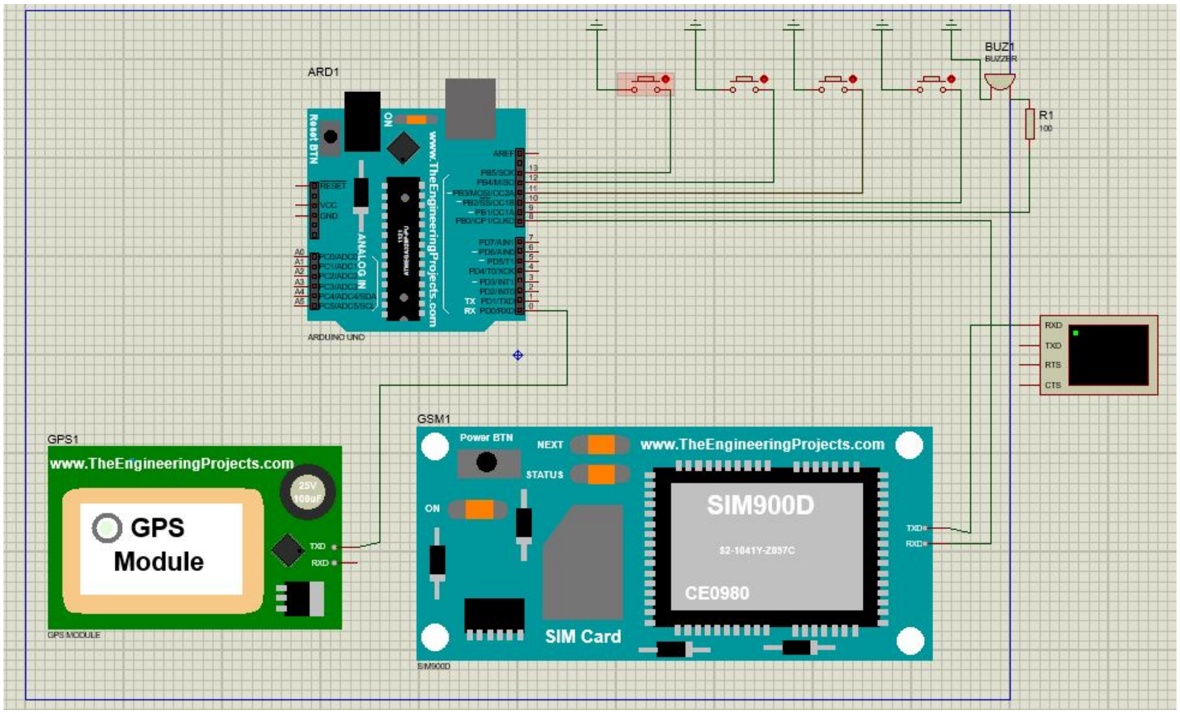

Figure 4.2: Final Prototype

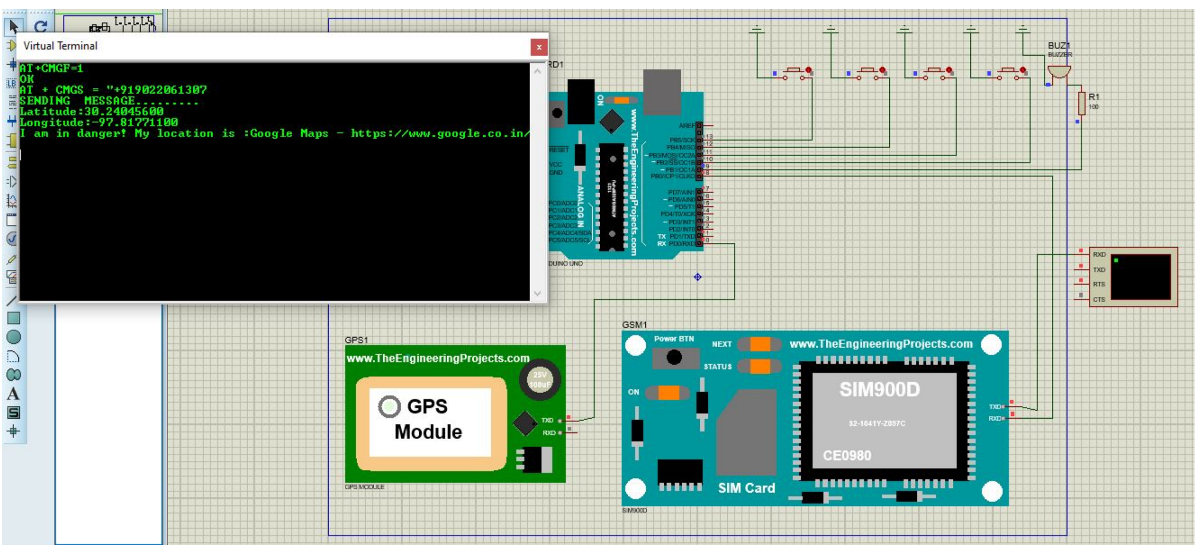

Figure 4.3: Output when button 1 is pressed

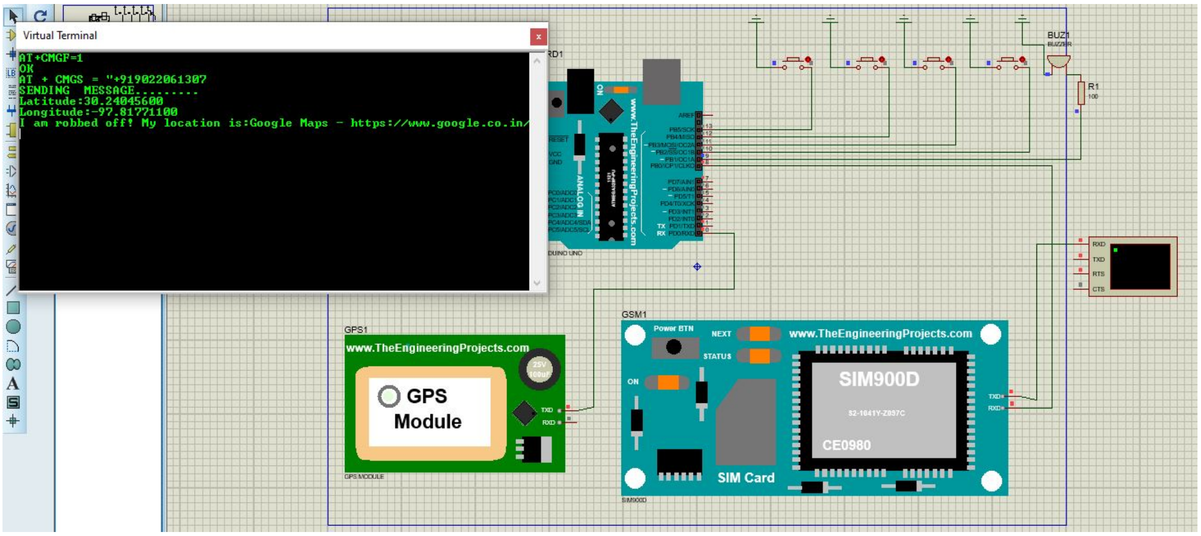

Figure 4.4: Output when button 2 is pressed

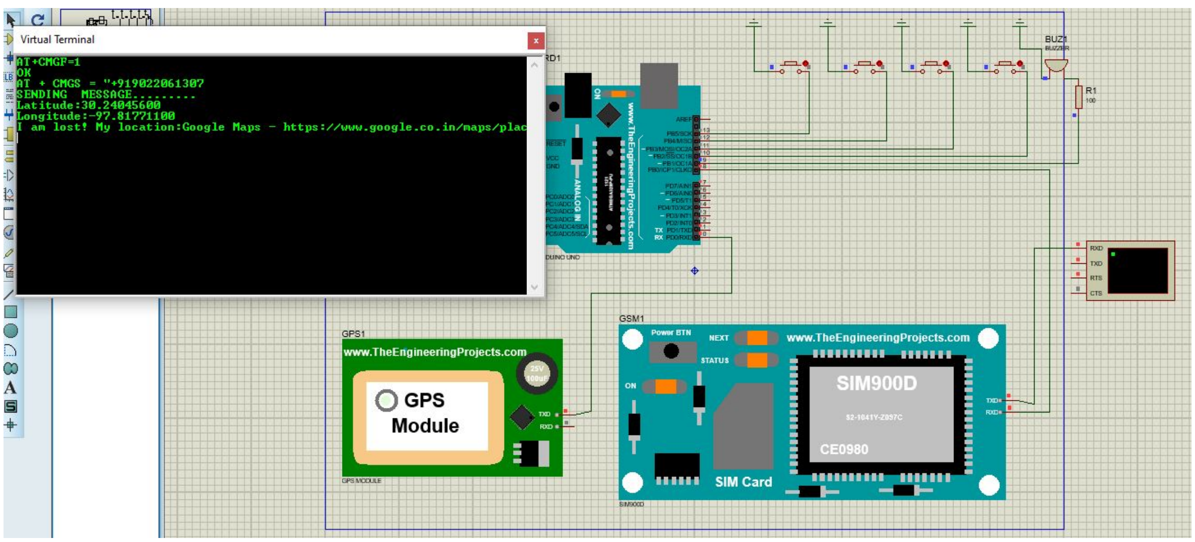

Figure 4.5: Output when button 3 is pressed

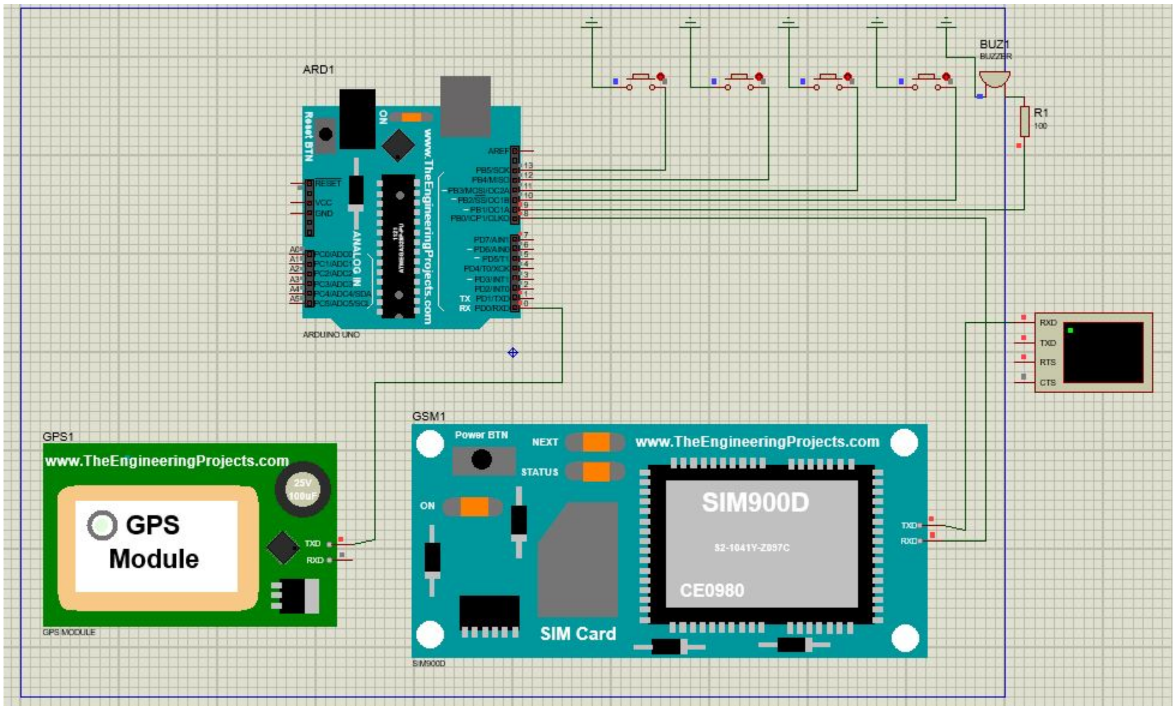

Figure 4.6: Output when button 4(connected to buzzer) is pressed

4.6 Future Scope

- It is easily scalable and more features can be added to it.
- Other sensors such as the distance sensor, infrared sensor, etc can be added to it and object detection can be done.
- Other advanced features can be implemented for the easy of the visually impaired person.
- It can be used for general tracking in security purposes.

Conclusion

We were able to successfully implement our idea and track visually impaired people using this project. It proved to be very handy and easy to use for the visually impaired. Our aims and objectives were met, and were able to successfully simulate the project. Every module was working as intented.

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