Abstract

In highly populated Countries, everyday people lose their lives because of accidents and poor emergency facilities. These lives could have been saved if medical facilities are provided at the right time. This project implies a system which is a solution to this drawback, when a vehicle meets with an accident immediately a gyro sensor will detect the signal, and sends it to the Arduino microcontroller. Microcontroller will send an alert message through the GSM modem including the location to the police station or a rescue team. So the police can immediately trace the location through the GPS modem after receiving the information. The proposed systems have been simulated and practically design by the use of hardware components and the results are satisfied with the expectation.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Motivations

In Bangladesh, there are some company provides vehicle tracking system. Every VTS do the same thing like speed check, track vehicle. Some VTS can detect an accident. But there is no VTS reports nearest hospital and police station if any accident occurs. In Bangladesh, where a person who faces an accident get less facility in treatment there need a system that can communicate to the nearest hospital and police station. Statistics shows, there are more than 3,000 people die on Bangladesh's roads every year. The country has one of the highest rates in the world, with more than 85 deaths for every 10,000 registered motor vehicles. That's around 50 times higher than the rate in most western countries. According to the World Health Organization (WHO), road traffic injuries cause a loss of about 2 percent of GDP in Bangladesh, or about 1.2bn annually. This is almost equal to the total foreign aid received in a fiscal year. The losses include direct and indirect expenses, such as medical costs, insurance loss, property damage, family income losses and traffic congestion [3].

Now-a-days lots of accidents happen on highways due to increase in traffic

Year	Number Of Accident	Death	Injury
2009	3381	2958	2686
2010	2827	2646	1803
2011	2667	2546	1641
2012	2636	2538	2134
2013	2029	1957	1396
2014	2027	2067	1535
2015	2394	2376	1958
2016	2998	3412	8572
2017	3472	4284	9112
2018	6048	7796	15980

Table 1.1: Road Accident and Casualties Statistics (2009-2016) (Source:Bangladesh Police)

and also due to rash driving of the drivers. And in many situations the family members or the ambulance and police authority is not informed in time. This result in delaying the help reached to the person suffered due to an accident. A serious accident occurs at nightmare and it might be not caught sight of other people then the victim is unable to call some emergency services by himself dont get help at the right time. If other may see the accident but they dont have the number of hospital or police station. So It takes lots of time to inform a nearest hospital or police station. That increase the vulnerability of life of the people who got into accident. Besides, Many people died on the way to the hospital due to lack of information about nearest hospital or delay for waiting for the ambulance. This project will implement a system that can detect accident and show the nearest hospital to the car passengers, also a hospital and police station will get notified about any accident occurred near to the hospital and police station. So that, the hospital and police station can send rescue team in very short time. This project will help to reduce the greater loss and damage for any accident.

1.2 Objectives and Contributions

Here the following objectives are set, in the view of above mentioned research background for the present work in VTS, accident detection and rescue information system.

1. To design a vehicle accident detection and rescue information system based on GSM/GPRS/GPS technology.

2. To implement a web service for the vehicle owner, nearest police station and hospital to receive notification about the accident occurance and its location.

1.3 Overview of the Thesis

The outline of the rest of this report has been structured as follows.

- **Chapter 2** presents the background study for the project and hardware specification of the components used in the project it also describes the technical previous related works on the topic of VTS and IoT..

- **Chapter 3** explains methodology of the project that how the project being implemented.

- **Chapter 4** presents the real implementation of the project. The hardware, web services including website and mobile application.

- **Chapter 5** outlines conclusion of this work precisely and also describes the scope of future work for possible extended application of the project.

Chapter 2

BACKGROUND STUDY

2.1 IoT : The revolution of Technology

The Internet of things (IoT) is the between systems administration of physical gadgets, vehicles, structures, and different things installed with hardware, programming, sensors, actuators, and system availability which empower these items to gather and exchange data. The IoT enables items to be detected or controlled remotely across existing system infrastructure creating open doors for more straightforward of the physical world into computer-based systems and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Only IoT can connect physical world to the web. The IoT is more than internet connected consumer gadgets. Sooner or later every IT organization will need to create an framework to support it. Energy companies already use networked sensors to measure vibrations in turbines. They feed that data through the network to computing systems that analyse it to predict when machines will need maintenance and when they will fail. Jet engine manufacturers embed sensors that measure temperature, pressure, and other conditions to improve their products. Even a gift basket business can deploy sensors to

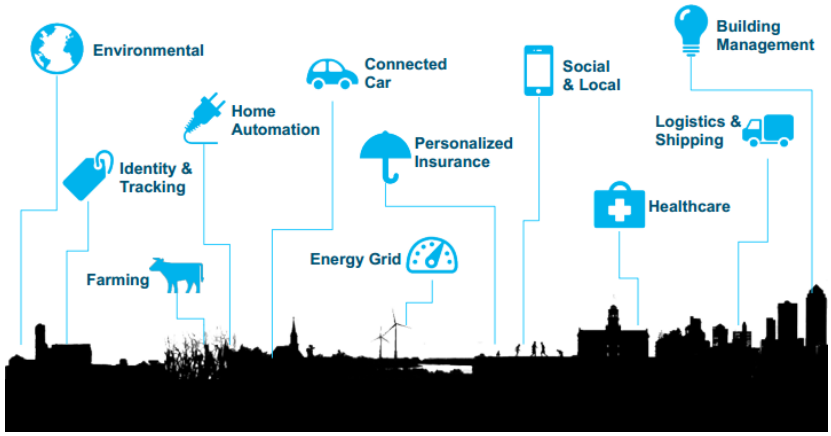

Figure 2.1: IoT connecting the physical world to the web

constantly monitor the temperature of perishable products [4].

2.2 Architecture of IoT

To do any project or research about IoT having knowledge of architecture of IoT is required. There are four layers of IoT architecture. They are Interface layer, Service layer, Networking layer, Service layer.

2.2.1 Interface Layer

The first layer of IoT is interface layer. This layer provides the interaction methods between users and application. This section looks how user can easily used the system. This includes three main approaches. Firstly, we need the ability to create web-based front-ends and portals that interact with devices and with the event-processing layer. Secondly, we need the ability to create dashboards that offer views into analytics and event processing. Finally, we need to be able to interact with systems outside this network using machine-to-machine communications (APIs). The recommended approach to building the web front end is to

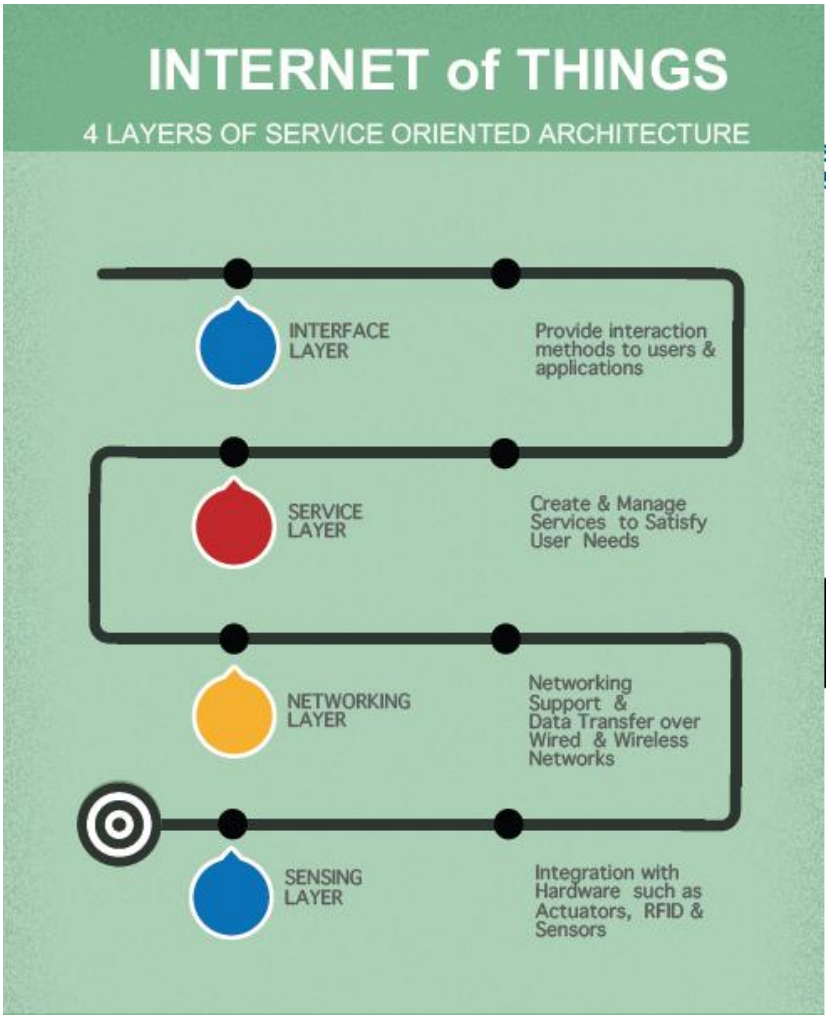

Figure 2.2: IoT Basic layer architecture

utilize a modular frontend architecture, Web server-side technology, such as Java Servlets/, JSP, PHP, Python, Ruby, etc.

2.2.2 Service layer

This layer is used to create and manage services to satisfy users needs. To do so, it process data deep processing. To make more userfrindly application, it provides database with different data and devides work. This is an important

layer for three reasons:

1. The ability to support an HTTP server and/or an MQTT broker to talk to the devices.

2. The ability to aggregate and combine communications from different sensing devices and to route communications to a specifc device (possibly via GSM/GPRS).

3. The ability to bridge and transform between different protocols that is to offer HTTP based APIs that are mediated into an MQTT message going to the device.

2.2.3 Networking or Communication Layer

The Networking or Communication layer supports the connectivity of the devices. There are multiple potential protocols for communication between the devices and the cloud. The most wellknown three potential protocols are:

1. HTTP/HTTPS (and RESTful approaches on those)

2. MQTT 3.1/3.1.1

3. Constrained application protocol (CoAP)

Lets take a quick look at each of these protocols in turn HTTP is well known, and there are many libraries that support it. Because it is a simple textbased protocol, many small devices such as 8-bit controllers can only partially support the protocol for example enough code to POST or GET a resource. The larger32-bit based devices can utilize full HTTP client libraries that properly implement the whole protocol. There are several protocols optimized for IoT use. The two best known are MQTT6 and CoAP7. MQTT was invented in 1999 to solve issues in

embedded systems and SCADA. It has been through some iterations and the current version (3.1.1) is undergoing standardization in the OASIS MQTT Technical Committee8. MQTT is a publish-subscribe messaging system based on a broker model. The protocol has a very small overhead (as little as 2 bytes permessage), and was designed to support lossy and intermittently connected networks.MQTT was designed to flow over TCP. In addition there is an associated specification designed for ZigBee-style networks called MQTTSN (Sensor Networks). CoAP is a protocol from the IETF that is designed to provide a RESTful application protocol modeled on HTTP semantics, but with a much smaller footprint and a binary rather than a text-based approach. CoAP is a more traditional client-server approach rather than a brokered approach. CoAP is designed to be used over UDP [5].

2.2.4 Sensing Layer

Sensors collect data from the environment or object under measurement and turn it into useful data. This layer covers everything from legacy industrial devices to robotic camera systems, water-level detectors, air quality sensors, accelerometers, and heart rate monitors. And the scope of the IoT is expanding rapidly, thanks in part to low-power wireless sensor network technologies and Power over Ethernet, which enable devices on a wired LAN to operate without the need for an A/C power source.

2.3 IoT Platforms and Security

Even with the recent attention given to security for IoT devices, it can be easy to overlook the need for end-to-end security for an IoT platform. Every part of a platform should be analysed for security prospects. From internet connections

to the applications and devices to the transmitted and stored data, there is a potential for an attack vector. Without question, the single most important non-functional requirement of an IoT platform is that it offers robust security.

2.4 Hardware specification

2.4.1 Arduino UNO REV3

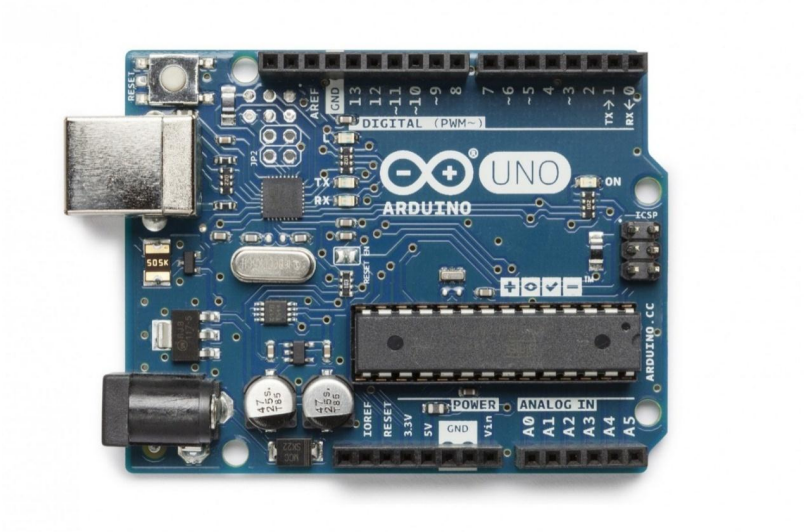

Figure 2.3: Arduino UNO

Name	Type
Microcontroller	ATmega328P
Operating Voltage	5v
Voltage(recommended)	7-12V
Voltage (limit)	6-20V
Digital I/O Pins	14
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
LED BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Table 2.1: Arduino Uno Hardware specification [6].

2.4.2 GSM, GPS, GSRM Shied (SIM808)

Features

General:

1. Arduino connectivity, compatible with UNO, Leonardo, NUCLEO, XNUCLEO
2. On board USB TO UART converter CP2102 for UART debugging
3. 5 x LEDs for indicating the module working status
4. On board voltage level converter, supports both 3.3V and 5V systems
5. SIM card slot for 1.8V/3V SIM card
6. Baud rate auto detection (1200bps 115200bps)

Figure 2.4: GSM/GPRS/GPS/Bluetooth SIM808 Shield (B).

7. Bluetooth 3.0, supports data transferring through Bluetooth
8. RTC with power supply interface
9. Firmware upgradable via USB
10. Control via AT commands (3GPP TS 27.007,27.005, and SIMCOM enhanced AT Commands)
11. Supports SIM application toolkit: GSM 11.14 Release 99
12. Operating voltage: 6 12V
13. Operation temperature: -40 C +85 C
14. Storage temperature: -45 C +90

Board Description:

1. SIM808 module

Name	Type
Band	Quad-band auto search
Emitting power	Class 4(2W@GSM 850/EGSM 900MHz)
GPRS connectivity	GPRS multi-slot class 1 12
GPRS data feature	Downlink speed: max 85.6kbps
SMS	SMS storage: SIM card
Audio	Voice encode/decode mode
Receiver type	22 tracking channels
Sensitivity	Tracking: -165 dBm
Time-To-First-Fix	Cold starts : 30s (typ.)
Accuracy	Horizontal position :¡2.5m CEP

Table 2.2: Technical Specification on GSM/GPRS of GSM/GPRS/GPS/Bluetooth

2. MIC29302 power chip
3. CP2102: USB TO UART converter
4. SMF05C: TVS diode
5. 1N5408: on board rectifier
6. SIM808 functional pins
7. Arduino expansion connector
8. USB TO UART interface
9. DC power jack
10. GPS antenna connector
11. Bluetooth antenna connector
12. Firmware upgrade interface
13. GSM antenna connector

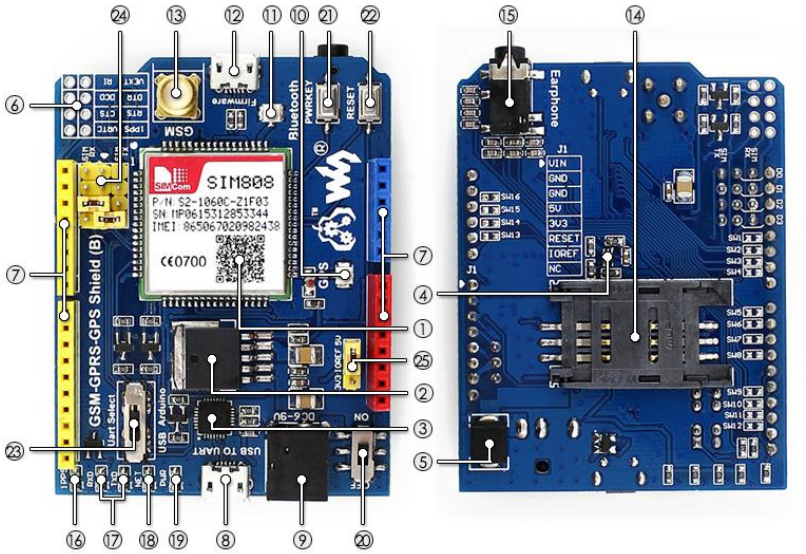

Figure 2.5: GSM/GPRS/GPS/Bluetooth SIM808 Shield

14. 3.5mm earphone/mic jack
15. GPS status indicator
16. CP2102 UART Tx/Rx indicator
17. Power indicator
18. Power switch
19. SIM808 control button: press the button and hold for 1s, to startup/shutdown the SIM808
20. Reset button
21. UART selection switch, select controlling the SIM808 via: a. CP2102 b. UART pins of Arduino interface
22. SIM808 UART configuration: a. SIM TX: SIM808 UART TX b. SIM RX: SIM808 UART RX

23. IOREF power selection: configure the UART voltage level
24. SIM808 module
25. SIM808 module

2.4.3 IIC / I2C 1602 Blue Backlight LCD Display Module:

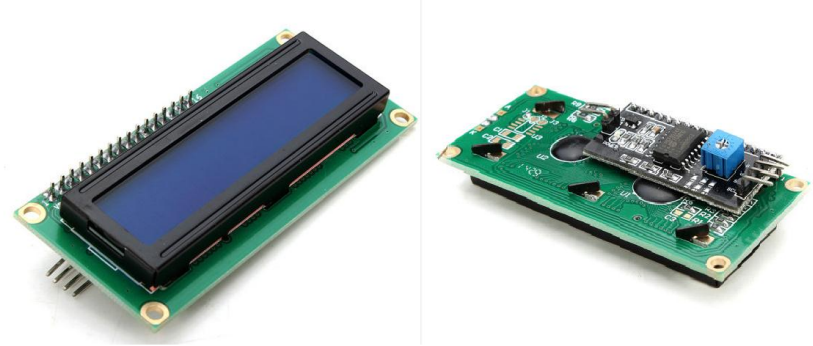

Figure 2.6: IIC / I2C 1602 Blue Backlight LCD Display Module.

1. LCD display module with blue backlight.
2. Wide viewing angle and high contrast.
3. Built-in industry standard HD44780 equivalent LCD controller.
4. Commonly used in: copiers, fax machines, laser printers, industrial test equipment, networking equipment such as routers and storage devices.
5. LCM type: Characters
6. Can display 2-lines X 16-characters.
7. Voltage: 5V DC.

8. Module dimension: 80mm x 35mm x 11mm.

9. Viewing area size: 64.5mm x 16mm.

2.4.4 GY-521 MPU6050 3-Axis Acceleration Gyroscope 6DOF Module

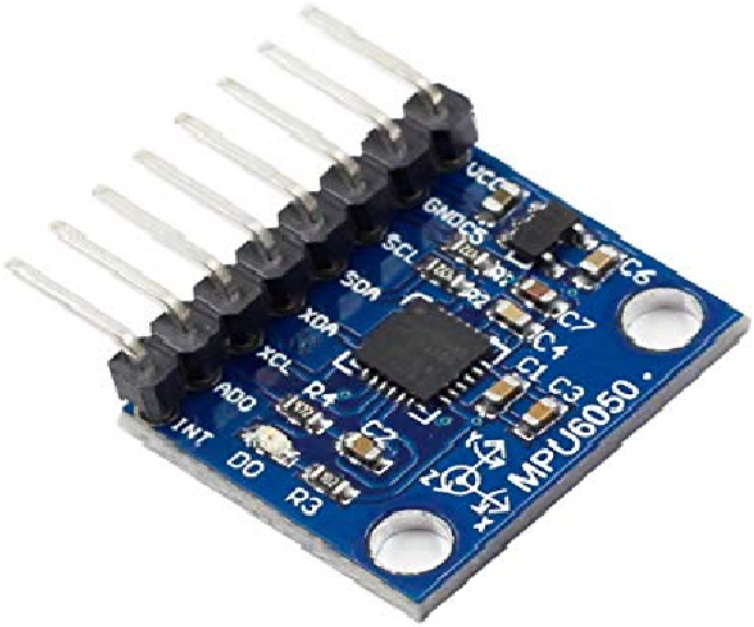

Figure 2.7: 3-Axis Acceleration Gyroscope 6DOF Module.

The MPU6050 contains both a 3-Axis Gyroscope and a 3-Axis accelerometer allowing measurements of both independently, but all based around the same axes, thus eliminating the problems of cross-axis errors when using separate devices.

Specification:

1. Accelerometer ranges: 2, 4, 8, 16g.
2. Gyroscope ranges: 250, 500, 1000, 2000 /s.
3. Voltage range: 3.3V - 5V (the module include a low drop-out voltage regulator).

This simple module contains everything required to interface to the Arduino and other controllers via I2C (use the Wire Arduino library) and give motion sensing information for 3 axes - X, Y and Z.

2.5 Previous Related Works:

In many research IoT has been used in vehicle tracking system to find the vehicle location. In [10], the hardware and software of the GPS and GSM network were developed. The proposed GPS/GSM based System has the two sections, first is a mobile unit and another is controlling station. The system forms, interfaces, connections, data transmission and gathering of information among the mobile unit and control stations are working effectively. These outcomes are good with GPS technologies.

In [11], a vehicle tracking system is an electronic device, installed in a vehicle to enable the owner or a third party to track the vehicle's place. This paper proposed to design a vehicle tracking system that works using GPS and GSM technology. This system built based on embedded system, used for tracking and positioning of any vehicle by using Global Positioning System (GPS) and Global system for mobile communication (GSM). This design will continuously watch a moving Vehicle and report the status of the Vehicle on demand.

In [12], Face Detection System used to detect the face of the driver, and compare

with the predefined face. The car owner is sleeping during the night time and someone theft the car. At that point Face Detection System obtains pictures by one little web camera, which is hidden easily in somewhere in the car. Face Detection System compared the obtained images with the stored images. If the images don't match, then the information sends to the owner through MMS. The owners get the pictures of the criminal in cell phone and follow the place through GPS. The place of the car and its speed displayed to the owner through SMS. The owner can recognize the thief images as well as the place of the car and can easily find out the hijackers image. This system applied in day-today life.
In [13], this system provided vehicle cabin safety, security based on embedded system by modifying the existing modules. This technique screens the level of the poisonous gasses, for example, CO, LPG and alcohol inside the vehicle provided alert information as alarm during the dangerous situations. The SMS sends to the authorized person through the GSM. In this technique, the IR Sensor used to identify the static obstacle in front of the vehicle and the vehicle stopped if any obstacle detected. This is avoiding accidents due to collision of vehicles with any static obstacles. [14], Kai-Tai Song and Chih-Chieh Yang have a designed and built on a real-time visual tracking system for vehicle safety applications. In this paper manufactured a novel element based vehicle-tracking algorithm, consequently identify and track a few moving articles, like cars and motorcycles, in front of the following vehicle. Joint with the concept of focus of expansion (FOE) and view investigation, the built system can fragment elements of moving articles from moving background and offer a collision word of warning on real-time. The proposed algorithm using a CMOS image sensor and NMOS embedded processor architecture. The constructed stand-alone visual tracking system validated in real road tests. The developed remain solitary visual following framework approved in genuine street tests. The results provided information of collision warning in

urban artery with speed about 60 km/hour both at night and day times. In [15], the remote monitoring system based on SMS and GSM was implemented. In view of the total design of the system, the hardware and software designed. In this paper, the GSM network is a medium for transmitting the remote signal. This consists of two sections that are the checking focus and the remote observing station. The observing centers consists of a PC and correspondence module of GSM. The software monitoring center and the remote observing station executed by utilizing VB. The result of this demonstration shows that the system can watch and control the remote communication between the monitoring center and the remote checking station. In [16], the proposed tracking system based on cloud computing infrastructure. The sensors are used to monitor the fuel level, driver conditions, and speed of the vehicle. All data exchanged to cloud server using GSM empowered device. All the vehicles equipped with GPS antenna to find the place. To stay away from the alcoholic and drive, the alcohol sensor introduced to monitor the driver status. The proposed technology significantly avoids the accident in highways.

Chapter 3

DESIGN AND METHODOLOGY

3.1 Decisions of design specification and hardware:

The project is combined an accident detection mechanism with a VTS. Hardware used in this project are listed below:

1. Arduino UNO REV3.
2. GSM, GPS, GSRM Shied (SIM808).
3. Acceleration Gyroscope (GY-521).
4. LCD Display.

The above block diagram explains the working procedure of the system which can be designed for this project. An Arduino UNO is used here for automation and controlling of the other supporting devices those are GPS, GSM, vibration

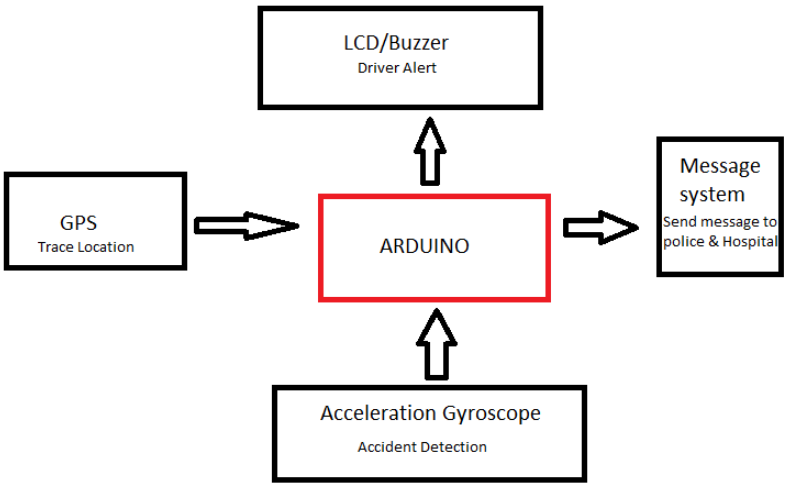

Figure 3.1: Block Diagram of the project.

sensor, LCD display, puss switch, buzzer etc. Actually this paper gives a practical model of a vehicle accident detection and rescue information system which can do routing, tracking of moving vehicle as well as detect accident in large area. Actually this system consists of two section, the first one is tracking location which is done by GPS in it and as the car moves the location of the car change continuously, the GPS finds the location in terms of two co-ordinates that are longitude and latitude. These two co-ordinates communicate with GSM modem which is shown in the block diagram.

The second one is detection of accident through Gyro sensor. To detect accident, a threshold is set to a highest vibration value. If the vibration value is greater than the threshold value, then it will consider that accident occur and wait 60 second for a confirmation. After detection of an accident the system send the accident location to nearest Hospital and police station using mobile SMS.

3.1.1 Hardware Connection:

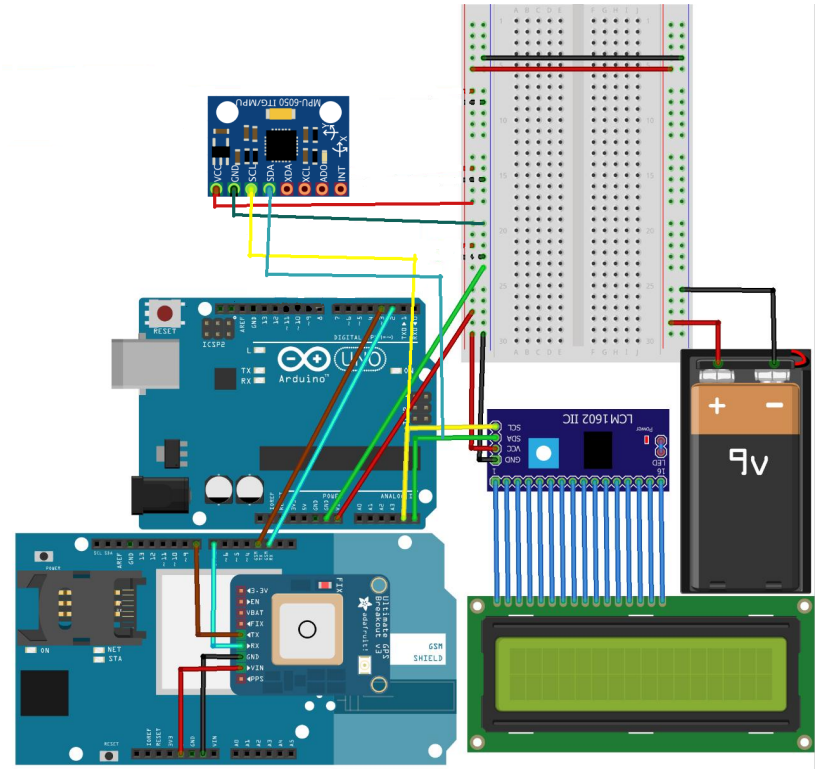

Figure 3.2: Block Diagram of the Hardware.

3.2 Algorithm for Accident Detection:

Flow chart for accident detection is given below:

Step 1: Start the program.

Step 2: Read Gyro sensor data

Step 3: If sensor value is more than limit go to step 4, otherwise go to step 2.

Step 4: Ask Driver for confirm accident. Set wait time 60 second.

Step 5: If Driver confirm accident go to step 6, otherwise go to step 7.

Step 6: Send SMS to nearest police station, hospital. .Go to step 2.

Step 7: Decrement wait time each second.

Step 8: if wait time = 0 second go to step 9, otherwise go to step 5

Step 9: go to step 6.

Step 10: Stop.

Chapter 4

IMPLEMENTATION

Embedded device

4.1 Circuit connection:

The project is developed by using GSM/GPRS/GPS/Bluetooth Shield SIM808 directly connected to all the pins of Arduino. Pin 2 of Arduino is used for RX and pin 3 for TX. Gyro sensors are connected with Arduino in pin number A4,A5. A LCD display is connected at pin number A5, A4. A confirmation switch is connected in pin 6, and a warning buzzer is added in pin 7.

4.1.1 Arduino Programming:

Arduino IDE is used to write program for Arduino Uno Board and to upload the program to the board.

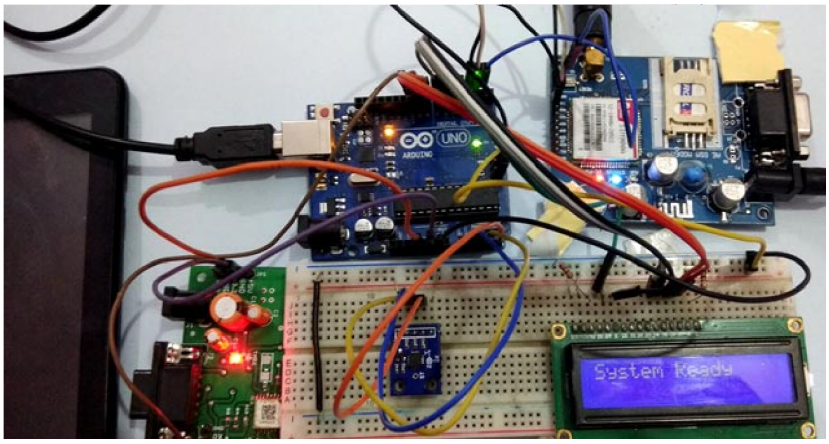

Figure 4.1: Actual Picture of the Embedded Device.

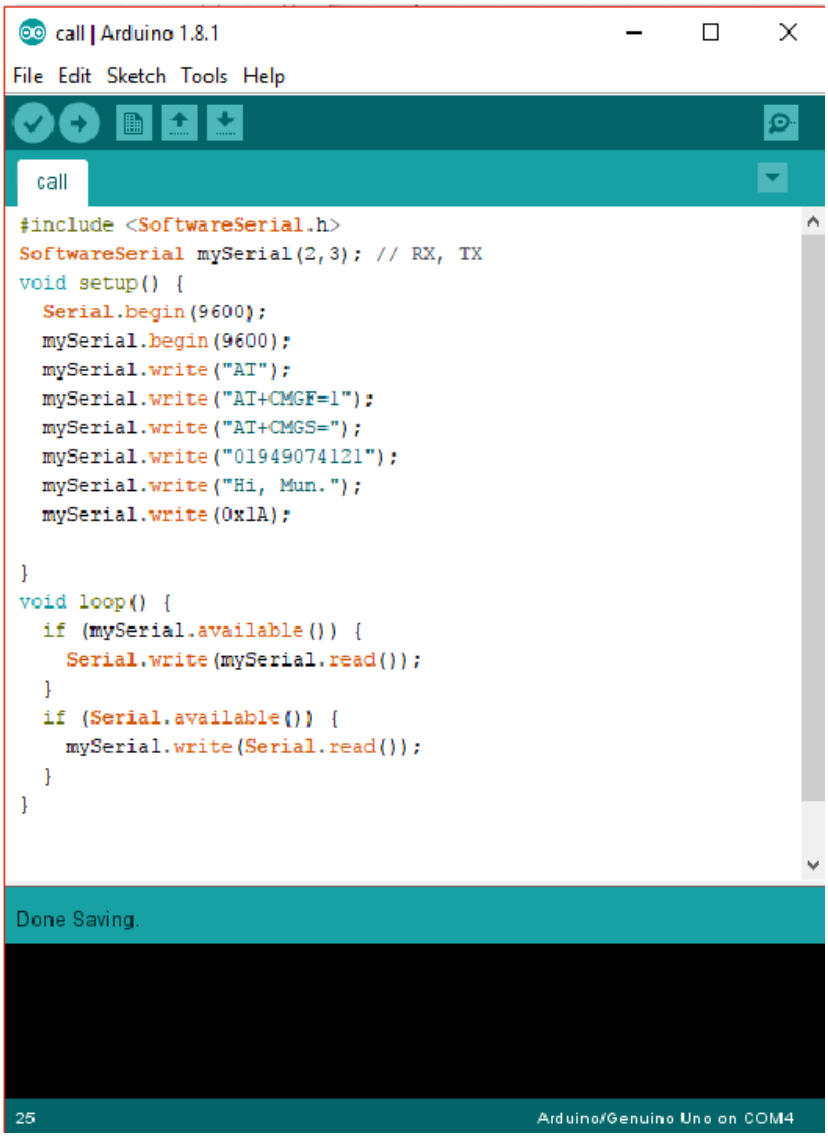

Figure 4.2: Arduino IDE Program.

Chapter 5

Conclusions

5.0.1 Overall Conclusion:

The IoT Based Vehicle Accident detection and rescue system is successfully implemented using database server and API and fulfils all the requirements to be an IoT based framework. This device is capable of reading and collecting the required data and sends them securely to the database stored in server. This system can do tracking of a vehicle which have this device. Besides, if an accident occur this system can communicate nearest hospital and police station. Police station and hospitals authority can see the shortest route to reach the accident spot using this system which have a web application and mobile application. Web based real time data visualization makes this system more convenient to see all the data in a clean, formatted and user friendly way.

5.0.2 Future Work

So far, it has been implemented that the system can collect data successfully from sensors and communicate with web server. In near future, the system can be improved by using more sensor to detect accident with more accuracy and more different way of accident detection. This system will try to communicate at least three nearest hospitals if any major accident occurs and show the shortest path to

reach the accident spot. Moreover, the system will integrate with other system. For example, an insurance company can use the project database to inquiry about an accident and provide money to the owner in time. In Bangladesh, traffic jam is very popular word. If people use this system, the system can collect traffic data and notify the driver about traffic and find out a way which have less traffic jam.

References

[1] Trackyourtruck.com, "A brief history of gps vehicle tracking," 7 2017.

[2] En.wikipedia.org, "Vehicle tracking system," 07 2017.

[3] S. Al-Mahmood, ""Bangladesh's road accidents take heavy toll on poor and on economy," 07 2017.

[4] TechBeacon, ""How to design an IoT-ready infrastructure: The 4-stage architecture," 08 2017.

[5] Arduino.org, "Cite a Website - Cite This For Me," 07 2017.

[6] Waveshare.com, "GSM/GPRS/GPS Shield (B), Arduino Shield Based on SIM808," 07 2017.