Development of Microcontroller based Vehicle Monitoring System

by

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A comprehensive project report has been submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology

in

ELECTRONICS & COMMUNICATION ENGINEERING

Under the supervision of

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May, 2018

CERTIFICATE OF APPROVAL

This is to certify that the project titled "**Development of Microcontroller based Vehicle Monitoring System**" carried out by

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for the partial fulfillment of the requirements for B.Tech degree in **Electronics and Communication Engineering** from **Maulana Abul Kalam Azad University of Technology, West Bengal** is absolutely based on his own work under the supervision of **Mrs. Saraswati Saha**. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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DECLARATION

"We Do hereby declare that this submission is our own work conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute and that, to the best of our knowledge and belief, it contains no material previously written by another neither person nor material (data, theoretical analysis, figures, and text) which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text."

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CERTIFICATE of ACCEPTANCE

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Name of the Examiner Signature with Date

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The completion of the project brings with it a sense of satisfaction, but it is never complete without thanking those people who made it possible and whose constant support has crowned our efforts with success. It is our pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced our thinking, behavior, and acts during the course of project.

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ABSTRACT

In the era of Artificial Intelligence, self-driving cars are going to be the future where autonomy will lie in the hands of the circuits of the autonomous vehicles. Along with autonomous vehicles, there will be manually-driven vehicles on the road too. So to ensure safety and security, check condition and improve vehicular efficiency, the implication of vehicle monitoring in businesses today is really impressive. Vehicle tracking allows us to see where a vehicle is at all times. GPS fleet tracking is successfully used by many companies associated with transport industry as well as by individuals for tracking and managing vehicles. There are enormous advantages of GPS tracking for transport industry, not only for the large but also for the small businesses. Also Carbon monoxide (CO) is a very poisonous gas and continuous inhalation may even choke a human to death. It is an odorless, invisible, and extremely dangerous gas, which can be given off by the most common appliances in vehicle, home or workplace. CO detector serves as an early warning if any CO is leaking into the surrounding air we breathe in. Also when an accident occurs with the vehicle, the emergency services and the family members need to be notified as soon as possible so that rescue and emergency support services can be pressed into action promptly. After an accident, the driver and passengers of the vehicle may faint or lose consciousness, thus they will be unable to report their condition to the emergency services or family members. So a system is needed which will immediately inform the family members about the accident status of the vehicle and also send the accident location of the vehicle. Thus our project objective focuses on building an efficient system which integrates vehicle location tracking system, accident detection system and CO level detection system to monitor the current location, status, safety and security of a vehicle or a transport medium in which this system can be integrated into.

CONTENTS

LIST OF ABBREVIATIONS

G.P.S.	**Global Positioning System**
C.O.	**Carbon Monoxide**
V.M.S.	**Vehicle Monitoring System**
S.M.S.	**Short Message Service**
S.I.M.	**Subscriber Identity Module**
L.C.D.	**Liquid Crystal Display**
S.M.A.	**Sub Miniature version A**
T.T.L.	**Transistor-Transistor Logic**
U.S.B.	**Universal Serial Bus**
I.D.E.	**Integrated Development Environment**
A.V.R	**Alf and Vegard's RISC**
G.C.C.	**GNU Compiler Collection**
P.W.M.	**Pulse Width Modulation**
I.C.S.P.	**In Circuit Serial Programming**
D.C.	**Direct Current**
S.R.A.M.	**Static Random-Access Memory**
L.E.D.	**Light Emitting Diode**
A.C.	**Alternating Current**
S.P.I.	**Serial Peripheral Interface**
T.W.I.	**Two Wire Interface**
A.R.E.F.	**Analog REFerence**
D.T.R.	**Data Terminal Ready**
C.P.U.	**Central Processing Unit**
M.I.P.S.	**Million Instructions Per Second**
T.Q.F.P.	**Thin Quad Flat Package**
P.P.M.	**Parts Per Million**

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Chapter 1

Introduction

The Vehicle Monitoring System (V.M.S.) developed, focuses on monitoring a vehicle which is fitted with this system inside it. Once this system is activated, it will keep on continuously monitoring the location, co content and accident scenarios inside the vehicle. As long as the V.M.S. is up and running and is powered on, it will keep on doing its specified activities as has been tasked to do so. The V.M.S. currently as designed in the project has the capabilities to do three main functions:-

a) Vehicle location tracking
b) Vehicle CO monitoring
c) Vehicle accident detection

The V.M.S. monitors and collects data and then the information is communicated with the user via SMS. The SMS contains specified information related to the respective incidents, the location of the V.M.S. at which the incident occurred and a link to the Google Map app to display the location in the Google Maps which is preinstalled in the user's mobile. Thus the user is notified and can also keep track of his or her vehicle or any other device in which the V.M.S is installed. Any need of the Internet connection is not required anywhere at all in this system. Thus all the features of the system can be accessed and interacted with very easily just by using the sending and receiving features of SMS. So a user, with even a very basic mobile phone, access to a sim card and having the facility to send and receive SMSs, can easily operate and interact with the vehicle monitoring system. As the communicative device requirement to interact with the system is very less, the user base of this system becomes very large as availability of the basic requirements to operate the system is greatly amongst all users.

1.1 Objectives

The V.M.S. performs three main objectives as stated below:

1) Determination of the current location of the vehicle
2) Determination of the CO content in the air inside the vehicle
3) Detection of the accident status of the vehicle

Along with all these above three objectives, the V.M.S. also performs a common objective of sending S.M.S. which contains the vehicle status details and location details in the form of Google Maps link to the user's or the operator's mobile phone. The V.M.S. also has an inbuilt LCD display where the status, co content value and other necessary details are displayed to the viewer.

1.2 Purposes

The vehicle monitoring system serves a lot of purposes based on the environment in which it is deployed in. It can be configured, modified or redesigned with ease to act accordingly, as and when needed, based on the requirements of the environment. The following stated purposes are few of the many purposes that can be served using the V.M.S. in a vehicular environment:

i. Alerting the owner about the increased presence of carbon monoxide (CO) gas inside the vehicle
ii. Detecting fire in the vehicle
iii. Tracking of the vehicle fleet locations by companies
iv. Detecting whether an accident has occurred with the vehicle
v. Informing the emergency services with the locations and status of the emergency situations associated with the vehicle
vi. Locating parked cars in car parking areas
vii. Finding stolen vehicles by tracking the location of the V.M.S.

Chapter 2

Components

2.1 Hardware

The Vehicle Monitoring System is developed using the minimum quantity and amount of hardware, materials and items to keep the entire asset worth value of the system as low as possible so that system can be made available to the greater user base with even low financial situations of the client.

Table 2.1. Hardware used for the development of the Vehicle Monitoring System

S.L. No.	Name	Quantity	Manufacturer	Model Number
1	Arduino Uno Rev3 board based on the ATmega328P	1	Generic	R3
2	LCD 16x2 Alphanumeric Display	1	Silicon TechnoLabs	JHD162A
3	SIM800 Quad Band GSM Module with SMA Antenna	1	Maker and Hacker	SIM800SMA-1
4	GPS Module to Serial TTL SD014	1	U-BLOX	NEO-6M
5	Carbon Monoxide Coal Gas Sensor Module SR044	1	REES52	MQ-7
6	Collision Sensor Switch Module	1	Keyestudio	KS0021
7	Buzzer	1	Robo India	PBUZZ5
8	Mini Bread board	1	Simple Labs	SLITD021
9	Resistor	1	Electrobot	1KOHM
10	Preset	1	Robo India	10KMB
10	USB Cable	1	Generic	1FT
11	Jumper Wires Male to Male, Male to Female and Female to Female	35	Generic	DPNT

2.1.1 Arduino Uno R3

Arduino Uno is a microcontroller board based on the ATmega328P. It has

a) 14 digital input/output pins (of which 6 can be used as PWM outputs),
b) 6 analog inputs,
c) 16 MHz quartz crystal,
d) USB connection,
e) power jack,
f) an ICSP header and
g) reset button.

It contains everything needed to support the microcontroller. "Uno" means one in Italian and is chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.

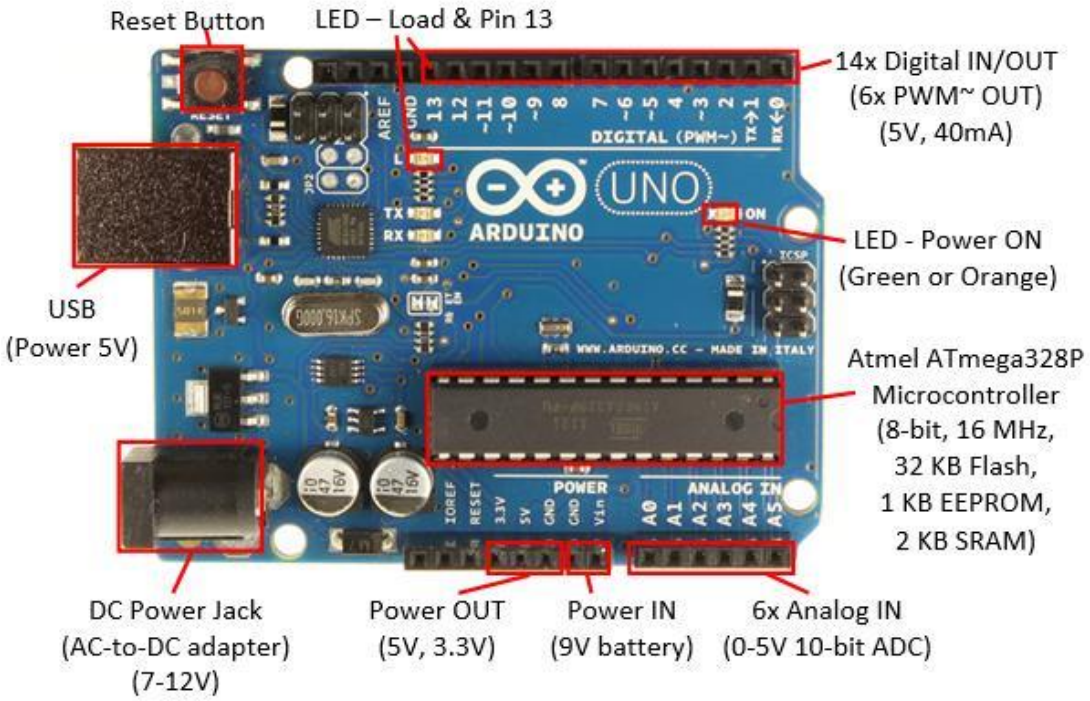

Fig. 2.1. Arduino Uno R3

Table 2.2. Specifications of the Arduino Uno R3

S.L. No.	Name	Details
1.	Microcontroller	ATmega328P
2.	Operating Voltage	5V
3.	Input Voltage (recommended)	7-12V
4.	Input Voltage (limit)	6-20V
5.	Digital I/O Pins	14 (of which 6 provide PWM output)
6.	PWM Digital I/O Pins	6
7.	Analog Input Pins	6
8.	DC Current per I/O Pin	20 mA
9.	DC Current for 3.3V Pin	50 mA
10.	Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
11.	SRAM	2 KB (ATmega328P)
12.	EEPROM	1 KB (ATmega328P)
13.	Clock Speed	16 MHz
14.	LED_BUILTIN	13
15.	Length	68.6 mm
16.	Width	53.4 mm
17.	Weight	25 g

2.1.1.1 Power

The Arduino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.

The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The power pins are as follows:

1) Vin: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). Voltage can be supplied through this pin, or, if supplying voltage via the power jack, access it through this pin.

2) 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 – 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage board.

3) 3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

4) GND: Ground pins.

5) IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

2.1.1.2 Memory

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

2.1.1.3 Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.

In addition, some pins have specialized functions:

1. Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
2. External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
3. PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
4. SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
5. LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
6. TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. There are a couple of other pins on the board:

1. AREF. Reference voltage for the analog inputs. Used with analogReference().
2. Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

2.1.1.4 Communication

Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A SoftwareSerial library allows serial communication on any of the Uno's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino Software (IDE) includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library.

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip. The Arduino Software (IDE) uses this capability to allow you to upload code by simply pressing the upload button in the interface toolbar. This means that the bootloader can have

a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data.

The Uno board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line.

2.1.1.5 Revisions

Revision 3 of the board has the following new features:

1) 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin, that is reserved for future purposes.
2) Stronger RESET circuit.
3) Atmega 16U2 replace the 8U2.

2.1.2 ATmega328

The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family. The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts and achieves throughput approaching 1 MIPS per MHz.

Fig. 2.2. ATmega328P in a 28-pin dual inline package

The ATmega328 is commonly used in many projects and autonomous systems where a simple, low-powered, low-cost micro-controller is needed. Perhaps the most common implementation of this chip is on the popular Arduino development platform, namely the Arduino Uno and Arduino Nano models.

Reliability qualification shows that projected data retention failure rate is much less than 1 PPM over 20 years at 85 °C or 100 years at 25 °C. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

Table 2.3. Key parameters of ATmega328

S.L. No.	Parameter	Value
1.	CPU type	8-bit AVR
2.	Performance	20 MIPS at 20 MHz
3.	Flash memory	32 kB
4.	SRAM	2 kB
5.	EEPROM	1 kB
6.	Pin count	28-pin PDIP, MLF, 32-pin TQFP, MLF
7.	Maximum operating frequency	20 MHz
8.	Number of touch channels	16
9.	Hardware QTouch Acquisition	No
10.	Maximum I/O pins	23
11.	External interrupts	2
12.	USB Interface	No

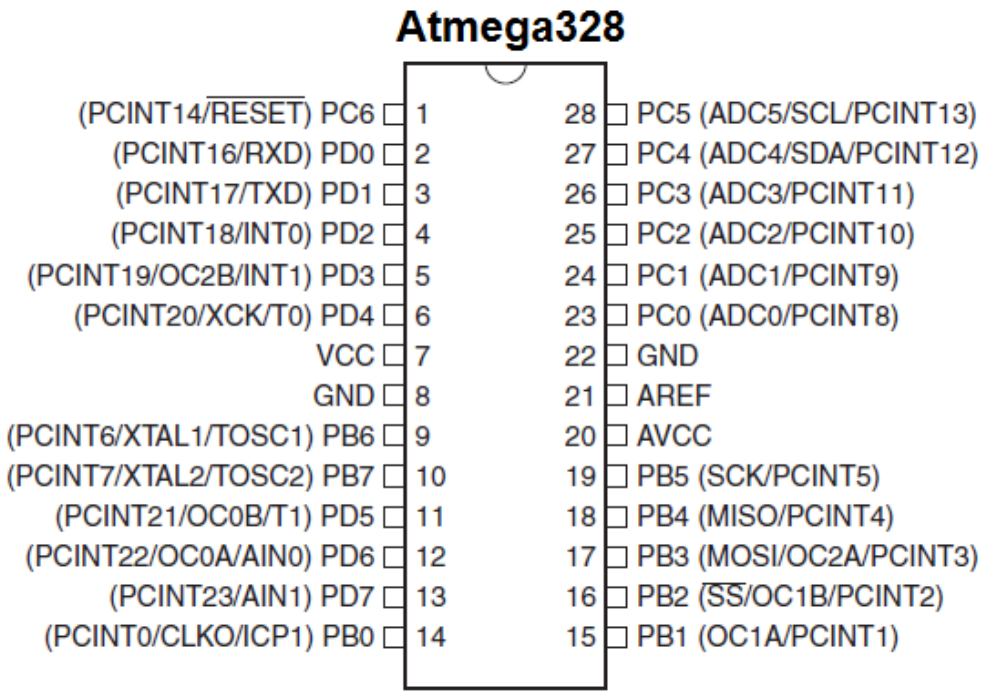

Fig. 2.3. Pinout of ATmega328P

2.1.3 Liquid-Crystal Alphanumeric Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being:

1. LCDs are economical;
2. Easily programmable;
3. Have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

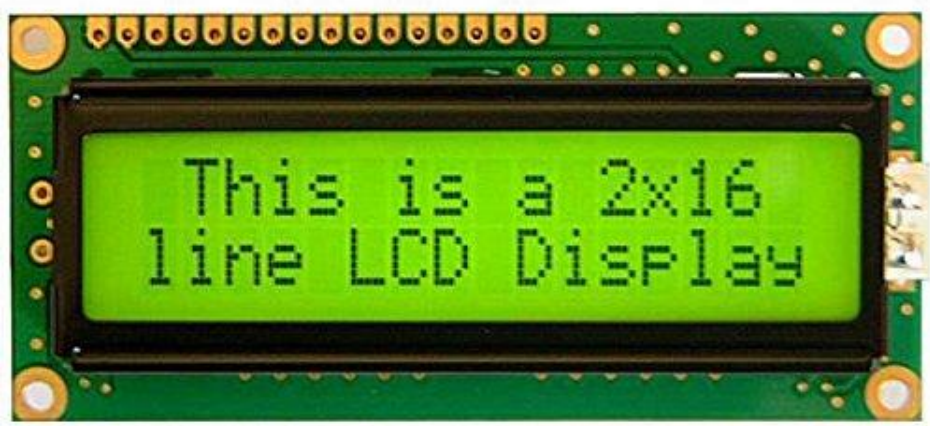

Fig. 2.4. LCD 16x2 Alphanumeric Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

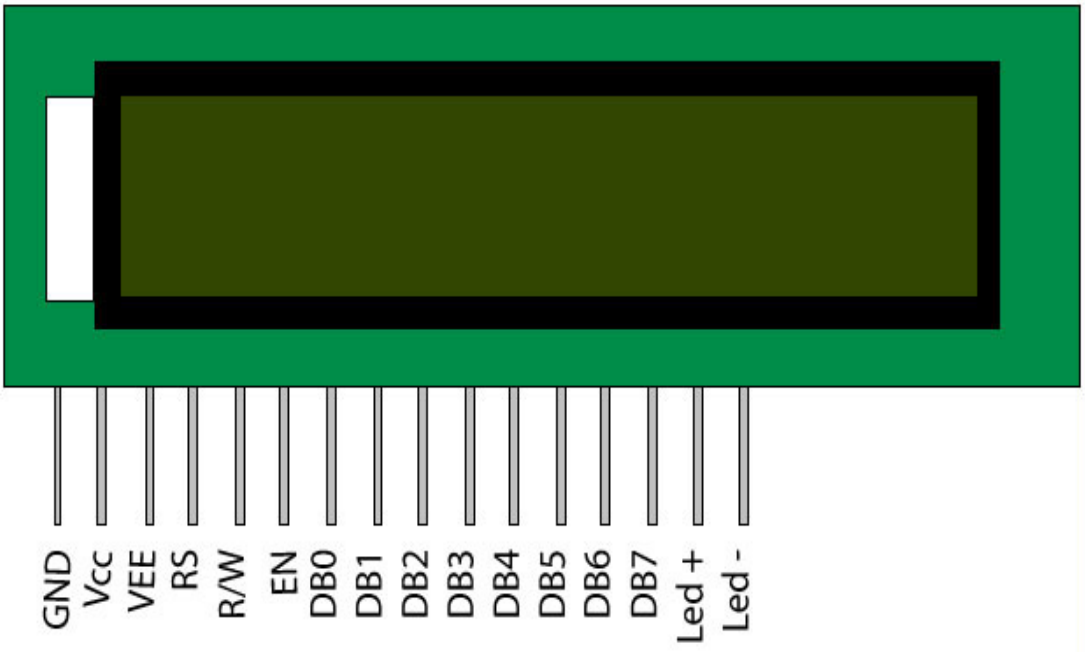

Fig. 2.5. Pin Diagram of LCD 16x2 Alphanumeric Display

Table 2.4. Pin Description of LCD 16x2 Alphanumeric Display

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

2.1.4 GSM Module

2.1.4.1 Product Description:

This SIM800 Quad Band GSM Module with SMA Antenna can accept any GSM network act as SIM card and just like a mobile phone with its own unique phone number. Advantage of using this modem will be that we can use its RS232 port to communicate and develop embedded applications. The SIM800 is a complete Dual-band GSM/GPRS solution in a SMT module featuring an industry-standard interface; the SIM800 delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM800 can fit almost all the space requirements in our applications, especially for slim and compact demand of design.

2.1.4.2 Features:

1. High Quality Product
2. RS232 interface @ RMC Connector for direct communication with computer or MCU kit Configurable baud rate
3. SMA connector with GSM Antenna
4. SIM Card holder
5. Normal operation temperature: -20 °C to +55 °C
6. Input Voltage: 4.5V-12V DC

2.1.4.3 Applications:

1. Short Message Service(SMS)
2. Internet
3. Incoming /outgoing calls

Fig. 2.6. SIM800 Quad Band GSM Module with SMA Antenna

2.1.5 GPS Module

A GPS navigation device, GPS receiver, or simply GPS is a device that is capable of receiving information from GPS satellites and then to calculate the device's geographical position. Using suitable software, the device may display the position on a map, and it may offer directions.

A GPS device can retrieve from the GPS system location and time information in all weather conditions, anywhere on or near the Earth. A GPS reception requires an unobstructed line of sight to four or more GPS satellites, and is subject to poor satellite signal conditions. In exceptionally poor signal conditions, for example in urban areas, satellite signals may exhibit multipath propagation where signals bounce off structures, or are weakened by meteorological conditions. Obstructed lines of sight may arise from a tree canopy or inside a structure, such as in a building, garage or tunnel. Today, most standalone GPS receivers are used in automobiles. The GPS capability of smartphones may use assisted GPS (A-GPS) technology, which can use the base station or cell towers to provide the device location tracking capability, especially when GPS signals are poor or unavailable. However, the mobile network part of the A-GPS technology would not be available when the smartphone is outside the range of the mobile reception network, while the GPS aspect would otherwise continue to be available.

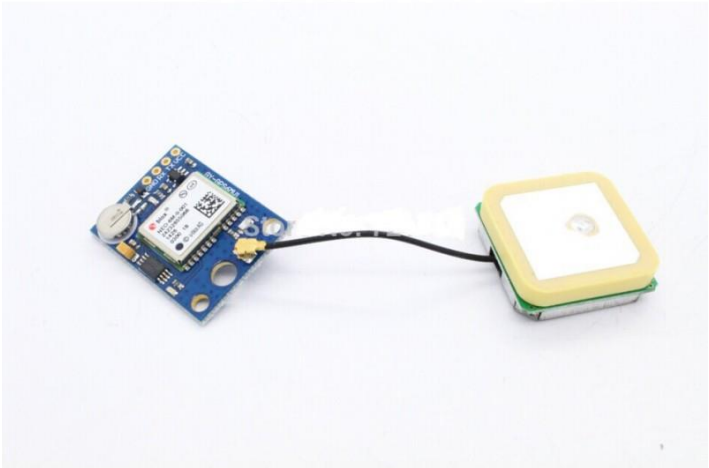

Fig. 2.7. GPS Positioning Module to Serial TTL SD014

2.1.5.1 Specifications

1. Name: GPS Positioning Module to Serial TTL SD014
2. Module: GY-GPS6MV2
3. Power supply: 3V-5V
4. With ceramic active antenna, stronger signal
5. EEPROM power off saving function
6. With data backup battery
7. With LED signal indicator
8. Antenna size: 25*25mm
9. Module size: 25*25mm
10. Install size" 3mm
11. Default baud rate: 9600
12. Compatible with different flight controller module and offer GPS PC Test software.

Fig. 2.8. GPS Module with antenna attached

2.1.6 Carbon Monoxide Gas Sensor Module

The Carbon Monoxide (CO) gas sensor detects the concentrations of CO in the air and gives its output reading as an analog voltage. The sensor can measure concentrations of 10 to 10,000 ppm. The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

2.1.6.1 Connections

Connecting five volts across the heating (H) pins keeps the sensor hot enough to function correctly. Connecting five volts at either the A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. The resistive load should be calibrated for your particular application using the equations in the datasheet, but a good starting value for the resistor is 10 kΩ.

2.1.6.2 Features

1. High sensitivity to carbon monoxide
2. Stable and long life

2.1.6.3 Application

They are used in gas-detecting equipment for detection of carbon monoxide (CO) in car, industry or family.

Fig. 2.9. Carbon Monoxide Coal Gas Sensor Module

2.1.6.4 Technical data

Table 2.5. Technical Details of CO sensor

Model No.			MQ-7
Sensor Type			Semiconductor
Standard Encapsulation			Plastic
Detection Gas			Carbon Monoxide
Concentration			10-10000ppm CO
Circuit	Loop Voltage	V_c	≤10V DC
	Heater Voltage	V_H	5.0V±0.2V ACorDC（High） 1.5V±0.1V ACorDC（Low）
	Heater Time	T_L	60±1S（High）90±1S（Low）
	Load Resistance	R_L	Adjustable
Character	Heater Resistance	R_H	31Ω±3Ω（Room Tem.）
	Heater consumption	P_H	≤350mW
	Sensing Resistance	R_s	2KΩ-20KΩ(in 100ppm CO)
	Sensitivity	S	Rs(in air)/Rs(100ppm CO)≥5
	Slope	α	≤0.6 (R_{300ppm}/R_{100ppm} CO)
Condition	Tem. Humidity		20℃±2℃；65%±5%RH
	Standard test circuit		Vc:5.0V±0.1V; V_H（High）：5.0V±0.1V; V_H（Low）：1.5V±0.1V
	Preheat time		Over 48 hours

2.1.7 Collision Sensor Switch Module

Collision sensor, also known as electronic switch, is a digital on-off input module necessary for elementary electronic learning. By programming, it can realize control over light, sound device, key choice function of LCD display etc. Using 3P sensor cable to connect it to sensor shield, it can be installed to 4WD AL alloy mobile robot platform to realize collision detection function. It is both convenient and efficient.

2.1.7.1 Specification

1. If collision happens upfront of where collision module is installed, module outputs low level signal; no collision, outputs high level signal.

2. Module reserves M3 mounting hole, convenient for fixation on a car.

3. Module size: 3.1cm * 2.1cm

4. With switch indicator light, if there is collision, light is on; no collision, light is out.

2.1.7.2 Pin definition

1. \+ : 3v-12v power supply
2. \- : GND
3. S : High-low level output

Fig. 2.10. Keyestudio Collision Sensor Module

2.2 Software

Table 2.6. Software details used for the development of the Vehicle Monitoring System

S.L. No.	Name	Details
1.	Software Programming IDE	Arduino 1.8.5
2.	Programming Language	Embedded C
3.	Compiler	AVR GCC
4.	Programmer	Arduino Bootloader

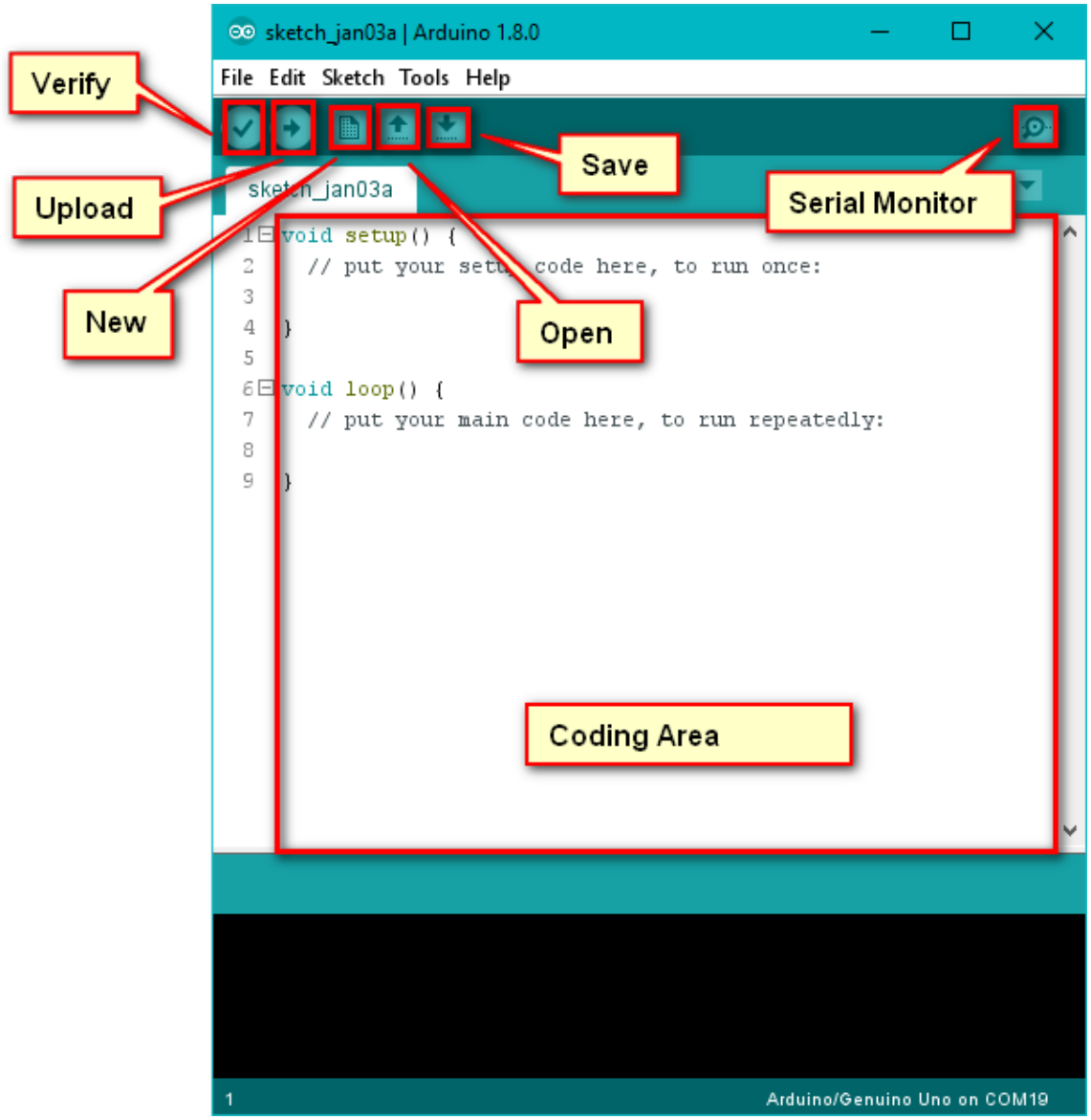

Fig. 2.11. Software Programming IDE

Chapter 3

Working Principle

Arduino UNO R3 is used for controlling the entire system process with sensor modules such as a GPS receiver module, Carbon Monoxide (CO) Gas Sensor Module, Crash Collision Sensor Switch Module and a SIM800 Quad Band GSM Module with SMA Antenna. GPS Receiver is used for detecting coordinates of the vehicle, GSM module is used for sending the coordinates to user via SMS. A 16x2 LCD is used for displaying the status messages or coordinates. The CO sensor detects the CO content in the air inside the vehicle or the environment in which the system is installed. The Crash Collision Sensor Switch Module detects whether an accident has occurred with the vehicle. After the setup is complete and installed inside the vehicle, it is then booted up. Once the system is up and running, the Vehicle Monitoring System starts monitoring the location, CO content and accident status on a real-time basis.

3.1 Block Diagram

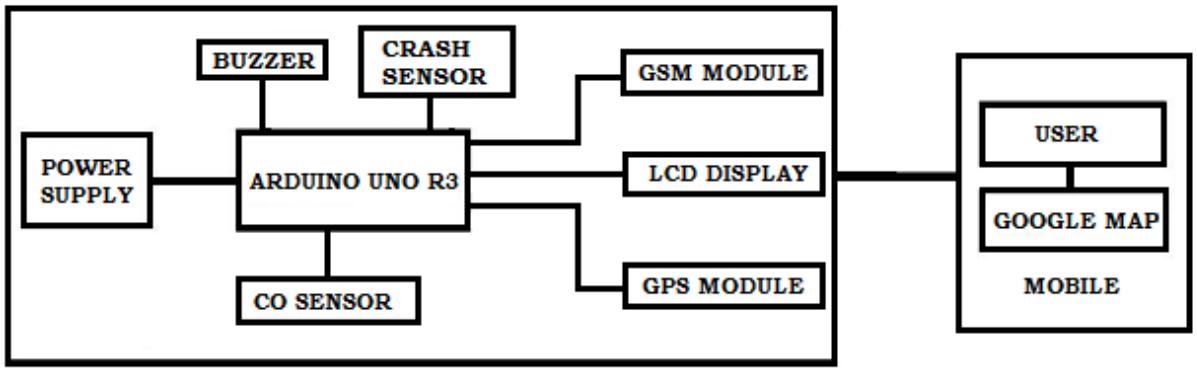

Fig. 3.1. Block Diagram of Vehicle Monitoring System

3.2 Circuit Diagram

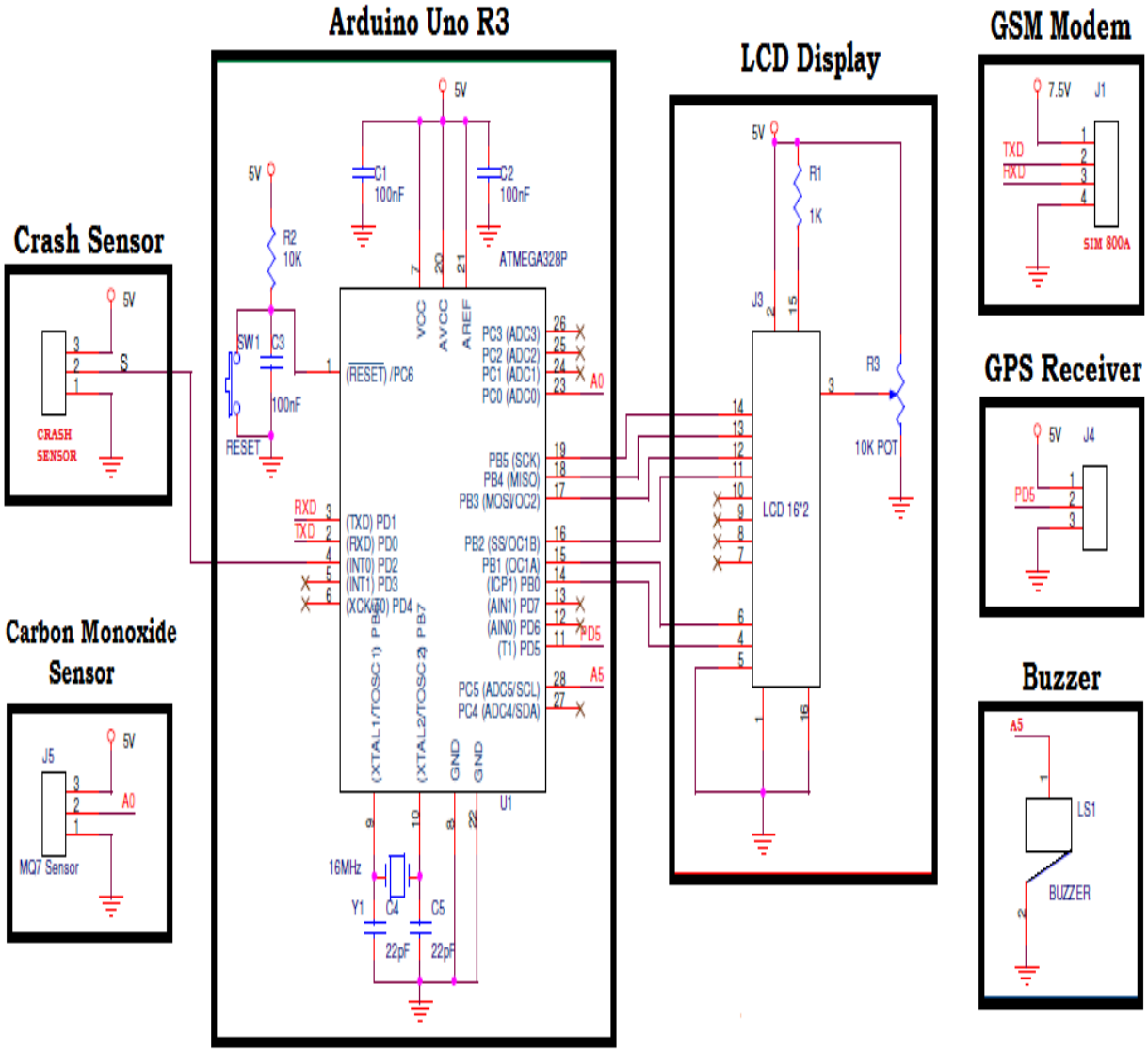

Fig. 3.2. Circuit Diagram of Vehicle Monitoring System

Chapter 4

Vehicle Monitoring System

The below picture depicts the Vehicle Monitoring System after it has been turned on and all the sensor modules have been initialized. Now after the system is on, the system will keep on doing its designated activities, like tracking locations, monitoring CO content and accident detection, till the time the system is switched off.

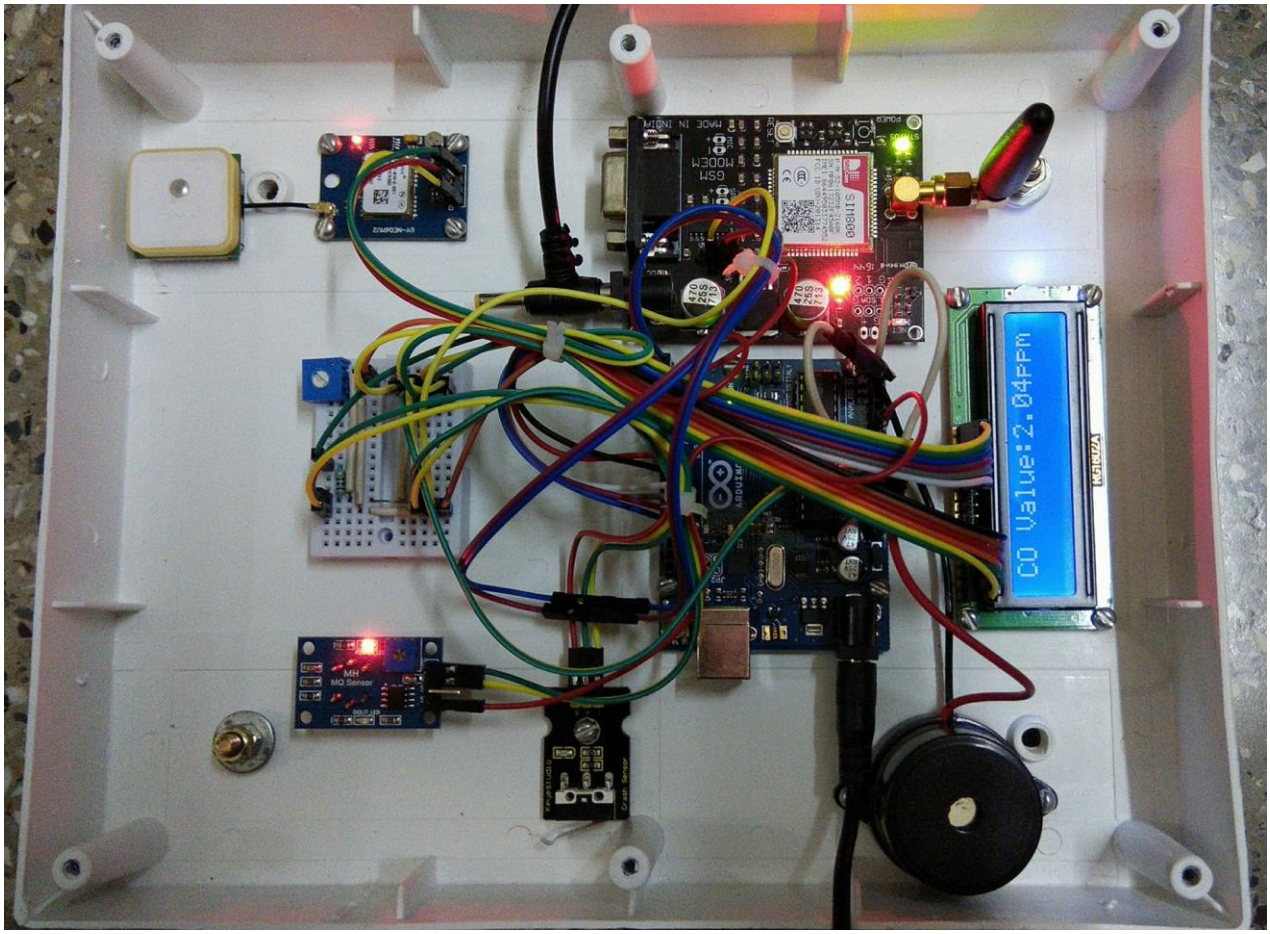

Fig. 3.3. The Vehicle Monitoring System

4.1 Functions

The Vehicle Monitoring System performs three main functions as stated below:

1) Determination of the current location of the vehicle
2) Determination of the CO content in the air inside the vehicle
3) Detection of the accident status of the vehicle

Along with all these above three functions, the V.M.S. also performs a common objective of sending S.M.S. which contains the vehicle status details and location details in the form of Google Maps link to the user's or the operator's mobile phone. The V.M.S. also has an inbuilt LCD display where the status, co content value and other necessary details are displayed to the viewer.

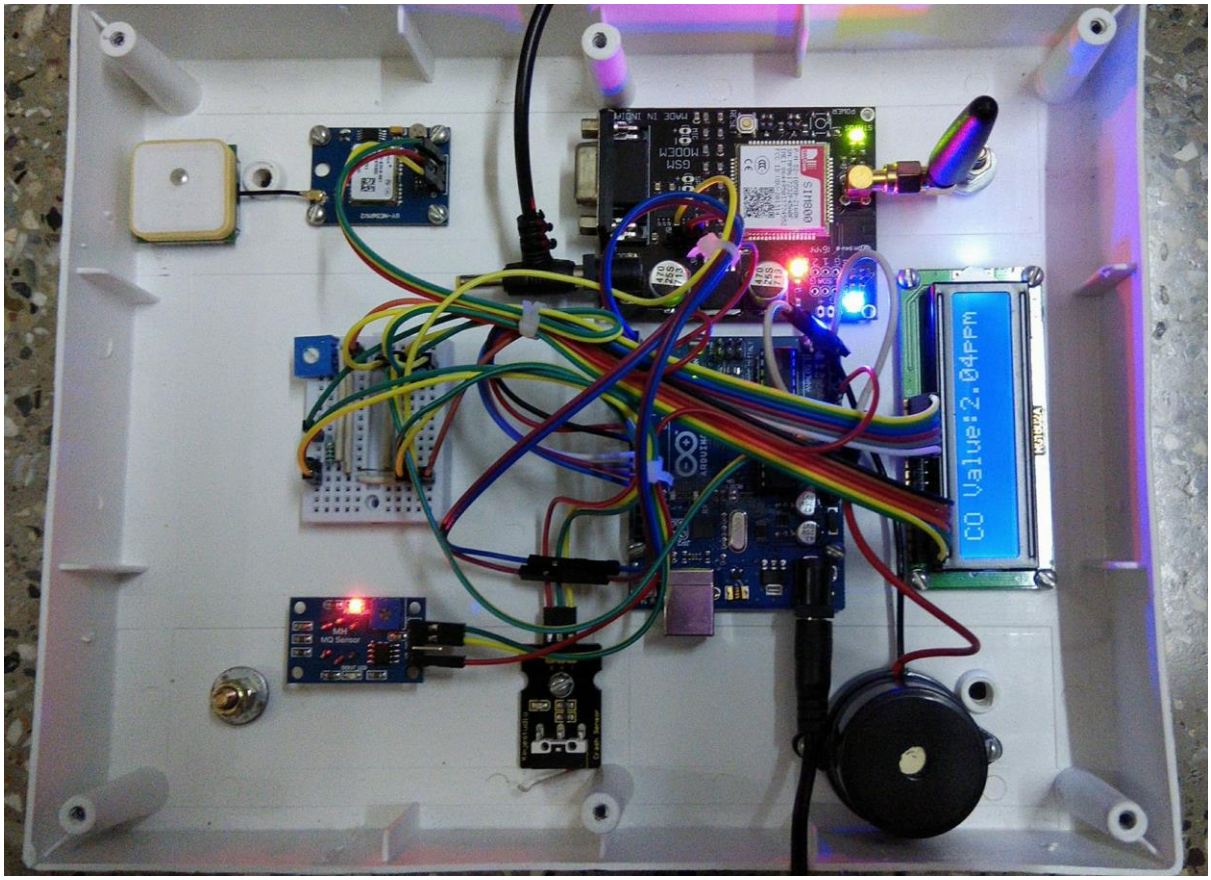

Fig. 3.4. The Vehicle Monitoring System with enabled Network Light

4.2 Scenario 1

Vehicle Location Tracking

The Vehicle Monitoring System can track and determine the location of the vehicle when it receives SMS from the user. The user sends a SMS requesting the location of the vehicle and the V.M.S., upon receiving the SMS, immediately determines the current location and sends a SMS back to the user. The V.M.S. sent SMS contains the location details along with a Google Maps link so that the user can also see the location in the Google Maps. Upon selecting the link, the installed Google Map application opens up automatically and the location is displayed on the map in the form of a red balloon pointing on the coordinates.

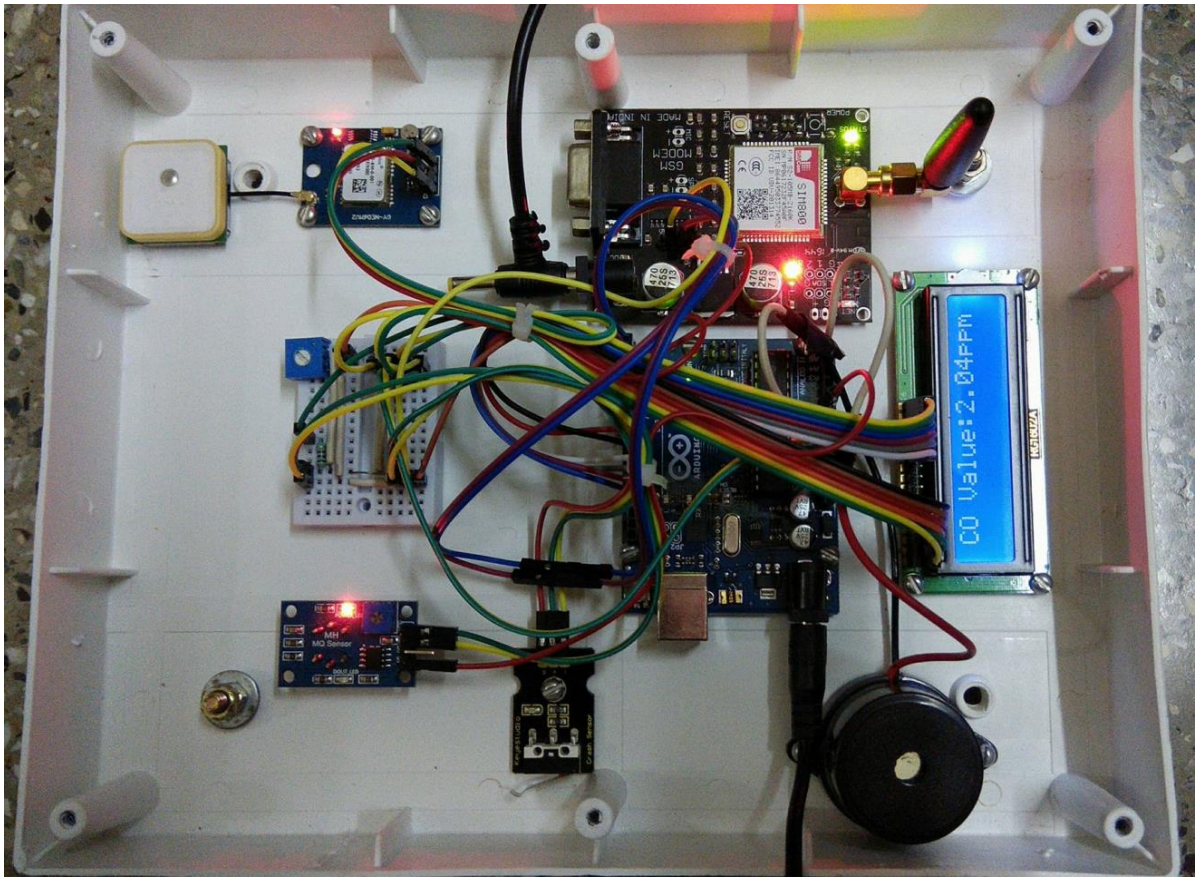

Fig. 3.5. Location Tracking Scene

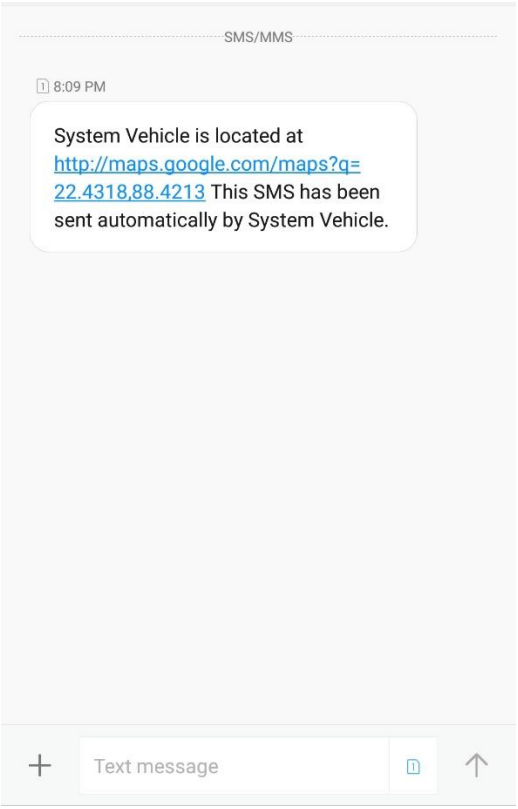

Fig. 3.6. Received location S.M.S. from V.M.S.

Fig. 3.7. Location displayed in Google Maps

4.3 Scenario 2

CO Content Monitoring

The Vehicle Monitoring System monitors the Carbon Monoxide content in the air continuously in real-time basis. The amount of CO is then displayed in the LCD with values in ppm. Also when the value of CO exceeds the preset value, the V.M.S. immediately activates the buzzer and also sends SMS, containing the status and location of the vehicle in the form of Google Map link, to the mobile number set inside the system.

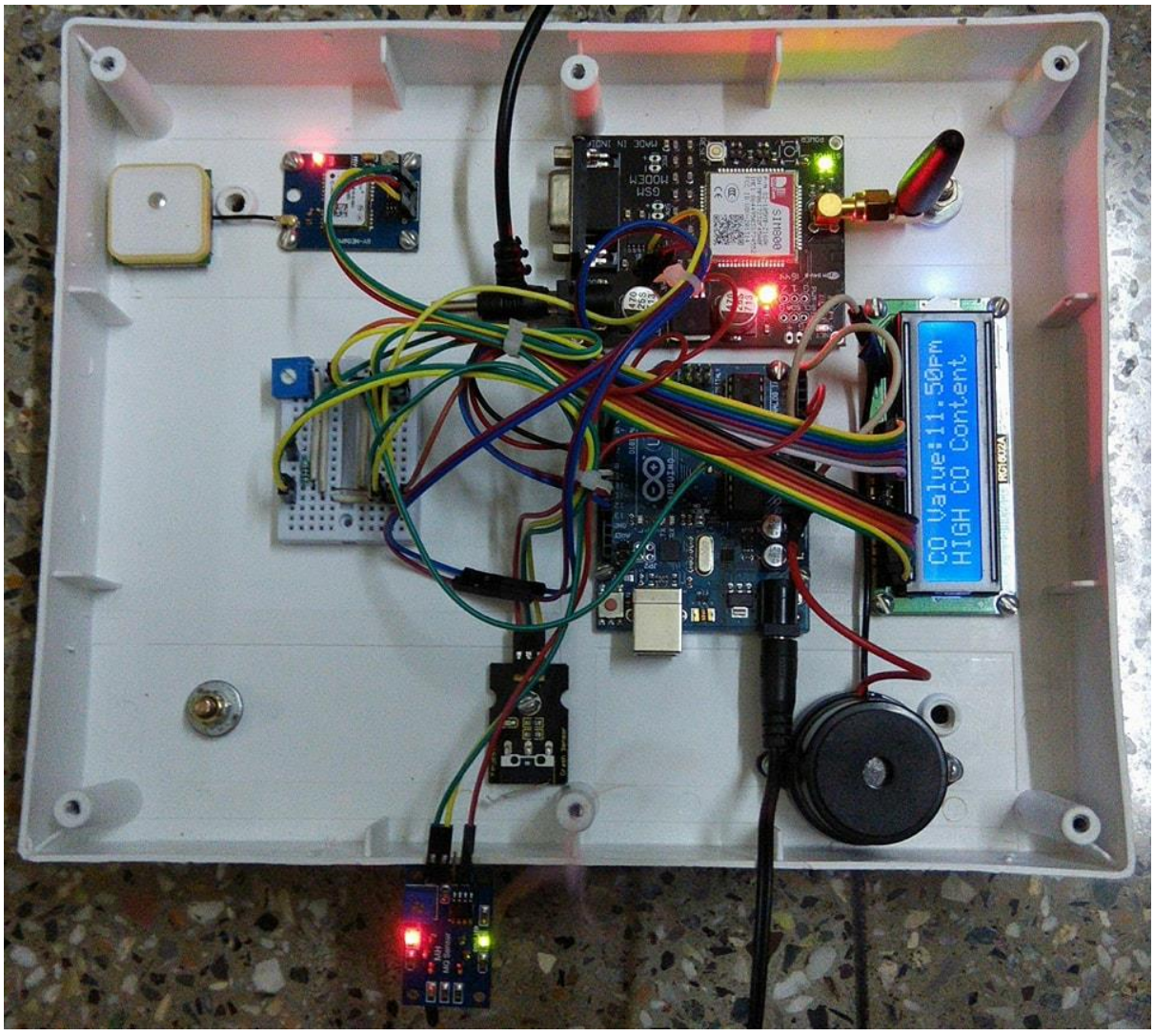

Fig. 3.8. High CO Content Detection Scene

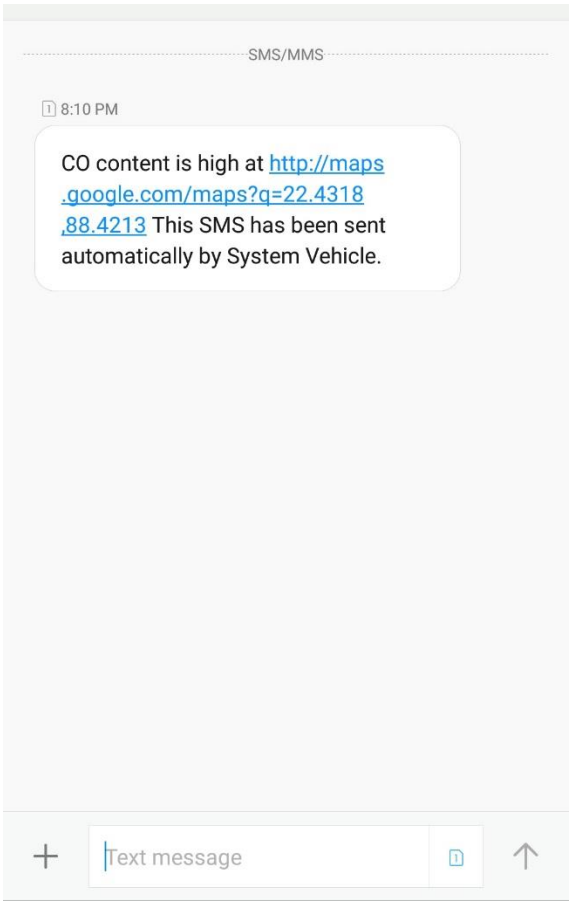

Fig. 3.9. Received high CO content location S.M.S. from V.M.S

Fig. 3.10. High CO content location displayed in Google Maps

4.4 Scenario 3

Accident Detection

The Vehicle Monitoring System tracks the vehicle accident status and as soon as collision happens, the system immediately activates the buzzer and sends an SMS, containing the vehicle accident status and the location of the vehicle in the form of Google Maps link, to the user.

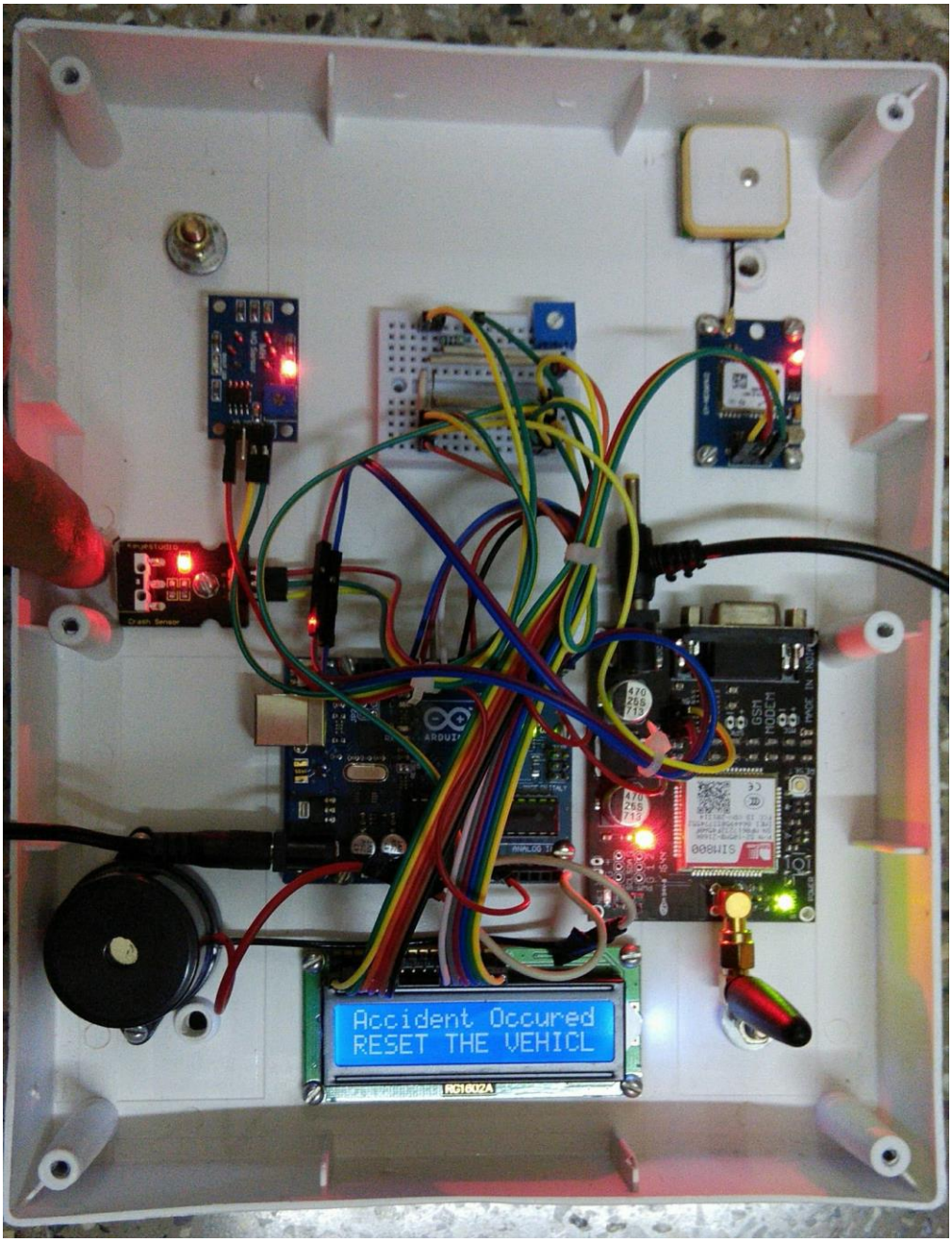

Fig. 3.11. Accident Detection Scene

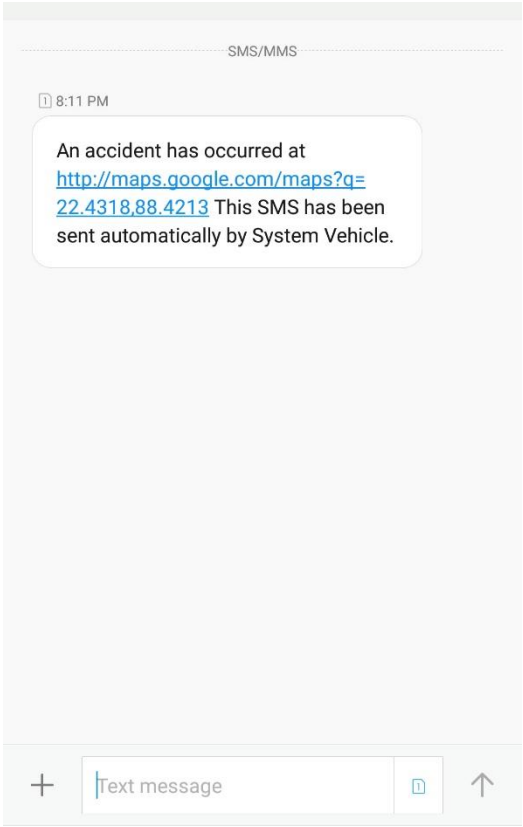

Fig. 3.12. Received accident location S.M.S. from V.M.S

Fig. 3.13. Accident location displayed in Google Maps

Conclusion

Vehicle tracking systems are becoming increasingly important nowadays in large cities. Vehicle theft is rapidly increasing, and with the help of our project we can have a good control in it. This technology can also help many organizations to track and secure their vehicles. With the use of carbon monoxide detection system, the health safety issue of a vehicle occupants can be verified. Thus, owner of the vehicle can track the safety standard and take necessary action to avert fatal mishaps. The accident detection part of the system is very useful as time is the most valuable factor after the occurrence of an accident. Slight delay of the arrival of the emergency services can create life or death situations for the injured inside the collided vehicle. So the accident detection part of the vehicle monitoring system helps a lot by reducing notify time to the minimum so that help can come more swiftly when required. Thus the vehicle monitoring system acts as a helping hand to the user and all the others associated with it in its environment by keeping an eye on health, safety and security of the vehicle at all times on behalf of the user.

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