GPS and GSM Based Vehicle Tracking System

Final Year Project Report

Presented

By

Muzammil Behzad
CIIT/ FA09-BET-067/ISB

Muhammad Mahboob Alam
CIIT/ FA09-BET-056/ISB

In Partial Fulfillment

Of the Requirement for the Degree of

Bachelor of Science in Electrical (Telecommunication) Engineering

DEPARTMENT OF ELECTRICAL ENGINEERING

COMSATS INSTITUTE OF INFORMATION TECHNOLOGY, ISLAMABAD

MAY 2013

GPS and GSM Based Vehicle Tracking System

Final Year Project Report

Presented

By

Muzammil Behzad
CIIT/ FA09-BET-067/ISB

Muhammad Mahboob Alam
CIIT/ FA09-BET-056/ISB

In Partial Fulfillment

Of the Requirement for the Degree of

Bachelor of Science in Electrical (Telecommunication) Engineering

DEPARTMENT OF ELECTRICAL ENGINEERING

COMSATS INSTITUTE OF INFORMATION TECHNOLOGY, ISLAMABAD

MAY2013

Declaration

We, hereby declare that this project neither as a whole nor as a part there of has been copied out from any source. It is further declared that we have developed this project and the accompanied report entirely on the basis of our personal efforts made under the sincere guidance of our supervisor. No portion of the work presented in this report has been submitted in the support of any other degree or qualification of this or any other University or Institute of learning, if found we shall stand responsible.

Signature: _____
Name: Muzammil Behzad

Signature: _____
Name: Muhammad Mahboob Alam

COMSATS INSTITUTE OF INFORMATION TECHNOLOGY, ISLAMABAD
MAY 2013

GPS and GSM Based Vehicle Tracking System

An Undergraduate Final Year Project Report submitted to the
Department of
ELECTRICAL ENGINEERING

As a Partial Fulfillment for the award of Degree

Bachelor of Science in Telecom Engineering

By

Name	**Registration Number**
Muzammil Behzad	CIIT/FA09-BET-067/ISB
Muhammad Mahboob Alam	CIIT/FA09-BET-056/ISB

Supervised by

Dr. Mahmood Ashraf Khan
Director CAST
CIIT Islamabad

COMSATS INSTITUTE OF INFORMATION TECHNOLOGY, ISLAMABAD
MAY 2013

Final Approval

GPS and GSM Based Vehicle Tracking System
Submitted for the Degree of
Bachelor of Science in Telecom Engineering

By

Name	**Registration Number**
Muzammil Behzad	CIIT/FA09-BET-067/ISB
Muhammad Mahboob Alam	CIIT/FA09-BET-056/ISB

Has been approved for

COMSATS INSTITUTE OF INFORMATION TECHNOLOGY, ISLAMABAD

_____
Supervisor
Dr. Mahmood Ashraf Khan
Director CAST, CIIT

_____ _____
Internal Examiner-1 *Internal Examiner-2*
Dr. Syed Junaid Nawaz *Dr. Naveed Ur Rehman*
Assistant Professor *Assistant Professor*

_____
External Examiner
Dr. Haroon-Ur-Rashid
Head Department of Electrical Engineering
Pakistan Institute of Engineering and Applied Sciences (PIEAS)

_____
Head
Department of Electrical Engineering

Dedication

This thesis is dedicated to our parents

Who introduced us to the joy of reading from birth

Enabling such a study to take place today

For the understanding and encouragement they provided during all these years of study.

We love you.

Acknowledgements

We pay foremost gratitude to the Almighty, the Omnipotent Allah; by the grace of his blessings this project milestone has been successfully achieved.

We wish to express our Thank to our supervisor, Dr. Mahmood Ashraf Khan. This thesis would not have been completed without his expert advice and unfailing patience. Dr. Mahmood Ashraf has been the ideal supervisor. His sage advice, insightful criticisms, and patient encouragement aided the writing of this thesis in innumerable ways. We would also like to thank Mr. Tayyab Rasul and Mr. Adnan Qureshi whose steadfast support of this project was greatly needed and deeply appreciated.

Special thanks to all the staff of CIIT including faculty members and lab in charges who motivated us all the way during this project.

Deep and unpaid gratitude to our parents whose motivation kept our souls in perfect theme and prayers which helped us pass through hardships.

Abstract

It is a Vehicle Tracking System in which vehicles are tracked and controlled through a mobile phone just by sending an SMS. To trace the location of the car the owner of the vehicle simply sends an SMS to the tracking system installed in the vehicle. The tracking system in the vehicle contains a GPS receiver module and a GSM modem interfaced to a microcontroller. On receiving the SMS from the owner, the GSM modem acknowledges the controller, the controller takes location's longitude and latitude coordinates from the GPS receiver module, packs it in to an SMS and sends back to the owner through the GSM modem. The SMS is also sent to a GSM modem which is connected to a web SERVER. When the web SERVER receives the SMS containing the location coordinates of the vehicle it shows the location of the vehicle in the form of an image taken from Google maps. The owner can also turn off the main ignition simply by sending an SMS in case of any vehicle theft.

Muzammil Behzad
Muhammad Mahboob Alam

Table of Contents

List of Figures

1 INTRODUCTION

The GPS & GSM based Vehicle Tracking System is developed by exploring the applications of various state-of-the-art technologies to overcome the problems of traffic organization, vehicles theft and surveillance. This is a relevant, effective and efficient system in order to enhance the vehicle security and tracking. This system is based on the (DLS) 'Data Logging System'. The DLS consists of four different elements.

- Measuring the vehicle parameters such as location, time, and speed and so on by the aid of sensors. The sensor in this system is GPS sensor.
- Recording the obtained parameters by the momentary logger unit.
- Microcontroller performs as momentary logger unit.
- Uploading / accessing the recorded data
- Finally, study and presentation of saved data through internet or through the response to the SMS request by the subscriber.

There will be two terminals namely the Mobile Station (e.g. Vehicle) and the user terminal. With the help of constant communication with the user terminal and the Mobile Station, the vehicle can be surveyed with information it sends to the server. User's terminal may either be the HTML page or an SMS response from the system. For the navigation purpose the LCD in the system displays the current location of the vehicle. The system invokes a PHP code in the web server using the standard HTTP request along with the location information. The code in turn saves the information in a text file. The user can interpret the data with the help of points plotted in the map. This has been performed with the help of JAVA applet and HTML code stationed at the web server. General concept of the project is illustrated with the help of Figure below.

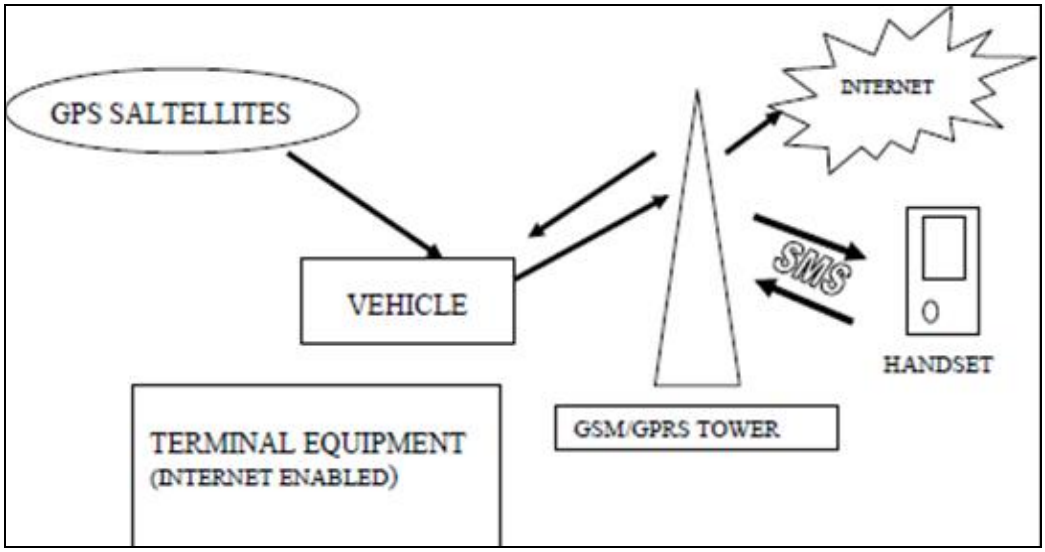


Figure 1 VTS Working

1.1 Background

These days the normal view of the communication is broadening. These days it is not only the people who use telecommunication and Internet technologies to communicate but the machines around us also have started to communicate with each other. This is the concept of new emerging M2M communications.

M2M communications is all about letting the machines to talk. It is a system that enables machines to communicate with information systems or with other machines and provide real-time data. A wireless information link is used for monitoring and managing, with data transportation occurring either by request or at predetermined intervals. The evolution of GSM has provided considerable benefits compared to other technologies. The extensive use of GSM means that the M2M product developed will be a global product. Advanced data provisions, security characteristics and some bearers such as GPRS, SMS, and HSCSD make GSM a striking option.

GPS originally made by the U.S. army for getting a tactical edge over the enemies by striking a position based attack have been recently accessible

to the civilians. After it was opened for the general public, the GPS system has been exploited for several position based services. The removal of selective availability by the U.S. government in 2001 provided more accurate positioning and since it has been used for many position based services. People around the globe can use this service free of cost which encourages GPS based positioning systems.

Internet on the other had is a widespread communication topology. Originally developed by the Department of Defence as ARPANET in 1969 for information exchange, Internet now has become the most used technology. This existing time is also referred to as the "age of the Internet". The concept of the WWW has evolved and provided user friendly interface to the common people. It is a cost useful means of wide area communication.

With the dawn of the modernization of the world, development of transportation system has also come up highly. Each day, new vehicles with different deluxe characteristics are being launched in the market. And as a result, the innumerable vehicles are being additional on the street daily. So, the rate of the vehicles on the street is definitely increasing tremendously.

With the increase in number of the vehicles plying in the street, the problems of traffic management, theft of the vehicles and trouble in navigation have increased in enormous fashion. These problems have been rocketing with time. To get rid of these problems, the idea of 'The Vehicle Tracking and Navigation System' was conceived. The use of cost effective technologies such as GPS, GPRS and Internet for the monitoring of vehicles or for other M2M communication system is quite justifiable.

1.2 Literature review

Although the M2M communication concept is quite a recent term, it is growing fast. In the context of foreign countries M2M solutions are created for rising the profits and competitiveness of a company through

more well-organized processes, better client service or new ways of doing things.

In overseas countries it has established its use in widespread areas such as-monitoring elevators in shopping centers, checking the temperatures of swimming pools, downloading new games into amusement machines, locating vehicles on the highways to name just a few.

The concept of position or location based-customized services is also in the rise these days. The use of GPS has been widespread in areas such as recreational boating, commercial fishing, and professional mariners, monitoring and surveying, hiking or other tasks etc. It has also been used in the emergency management.

2 Project Objectives

The main objective in this project is to develop a tracking system. The GPS vehicle tracking systems can track the movement and determine the exact location of the vehicle. This allows the owner/company to track the delivery objects like goods, cargo, vehicles, etc. Thus, the drivers would be unable to use the vehicle for personal objectives. This helps the company to save in expenses spent on fuel/petrol and increases their profit margin.

The GPS tracking system can be used as an added security to deter vehicle theft and in notifying the car owner once the vehicle has being stolen. For instance, the GPS tracker has a security feature which aid in tracking a stationed vehicle if it moves 50 meters out of the predefined radius. A SMS will be sent to notify the user that the vehicle is being stolen. Eventually, the satellite data which is received by the GPS tracker device will be transmitted to a computer, so as to plot out the traveled route of vehicle on a map. This allows the tracking of a moving vehicle.

2.1 Scope of the Project

This project requires basic understanding of GPS technology and GSM technology in order to implement the tracking system.

The plan out is as follows:

- SIMULATIONS
- GPS INTERFACING
- GSM INTERFACING
- INTEGRATION with Microcontroller
- FINAL HARDWARE
- INTERFACING WITH MOBILE
- RESPONDING TO OWNER
- WEB APP.

2.2 Project Planning Flow chart

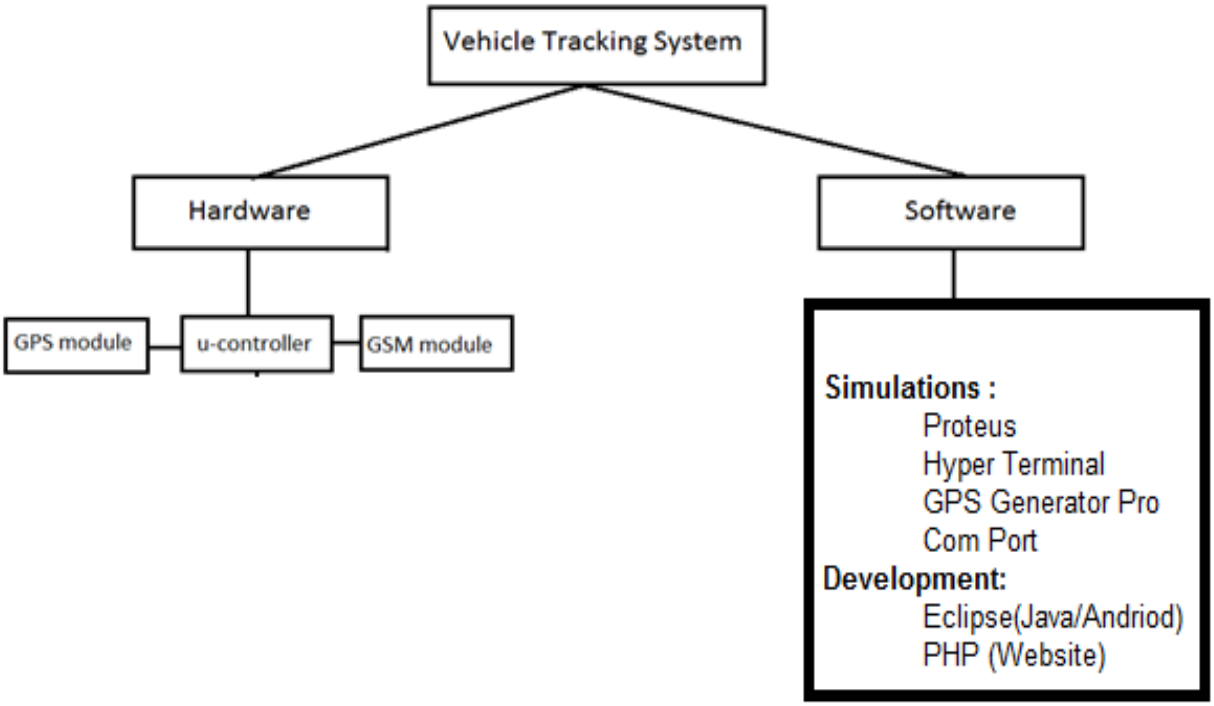


Figure 2 Planned System Flow Chart

2.2.1 Project Testing and Evaluation

Debugging will be done at any point of time when each module is tested and the functionality is verified, so that problems can be rectified instantly. Therefore testing for each of the components works before proceeding to next component is important. Once the code is completed, testing and evaluation will be conducted. Testing would be done from the end users viewpoint so as to gain a better understanding of what problem they will be facing and what kind of improvements can be made.

2.2.2 Results and Enhancement

Most importantly, delivery of the results to meet the project's objectives is needed. This depends on the testing results and review if there is any enhancement needed in order to fulfill the project objectives.

2.3 Functionalities

Following functionalities are to be added to the module:

- Remote Wireless Monitoring of speed and location of the mobile asset
- Day and Night automatic vehicle surveillance
- Fleet management;
- Driving pattern, behavior and understanding
- This could be worldwide Bulk containers, Important Containers (airlines, etc.), and several other such assets.
- Exact Location, Speed, Water Level Measurement, Battery status
- Wireless data transmission by GSM/GPRS network
- Worldwide Cover Operation
- Data availability through SMS or Web application

3 GLOBAL POSITIONING SYSTEM-GPS

The Global Positioning System (GPS) is a space base radio-navigation system consisting of a constellation of satellites and a network of ground stations used for checking and control. GPS is functioned and maintained by the Department of Defense (DOD). The GPS is a constellation of satellites in orbit around the Earth which transmit their positions in space as well as the accurate time. It is the receiver that gathers data from the satellites and computes its location anywhere in the world based on information it gets from the satellites.

3.1 History

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites. GPS was originally used for military purpose but from 1980s anybody can access it freely. Now anybody can use it from any location on earth in any weather at any time.

3.2 Applications of GPS

GPS has become an efficient tool in the field of scientific use, commerce engineering, surveillance of objects and tracking. GPS is used in all over the world and somewhere it does not work where it cannot detect the signal for example, underwater, forests, inside the building and caves in mountains.

3.2.1 Civilian Applications of GPS

Navigation – Used by navigators for orientation/velocity measurements.
Geo-tagging – Used in making of maps using location coordinates.
Surveying – Used by surveyors for verifying the boundaries of property.
Geo-fencing – Used to detect the vehicle's position, person using tracking system.

3.2.2 Military Applications

Navigation – Used by soldiers to find out unknown regions using GPS.

Search and Rescue – Used to detect the position of pilot.

Missile guidance – Used to guide the missile.

3.3 Structure

The GPS system consists of the following segments:

- Space segment
- User segment
- Control segment

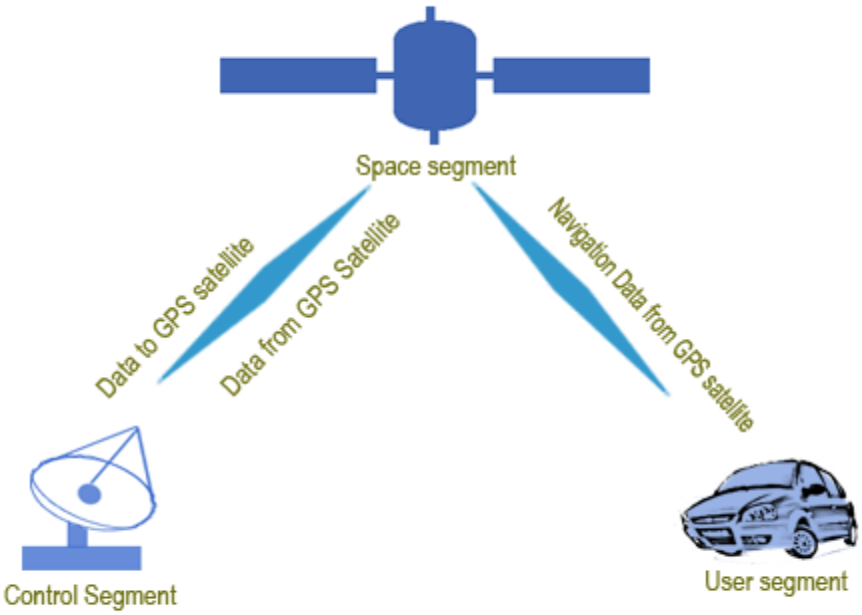


Figure 3 GPS Block Diagram

3.3.1 Space Segment

Space segment consists of the satellite system which helps to locate the position by broadcasting signals. When the GPS device is inside the buildings or mountains, the signals are blocked and GPS device do not detect any position because there is no connection between device and

satellites. You need to lock the signals of four satellites for calculating the position.

3.3.2 User Segment

This segment contains military or civilian users. A receiver is used by user which can detect the signals. GPS device can locate its own position but cannot be tracked by someone else.

3.3.3 Control Segment

It helps the entire system to work efficiently. It controls the satellites. Signals should be updated in this phase.

3.4 Types of GPS receivers

Coarse Acquisition (C/A) code receiver

This device offers 1-5 meter accuracy.

Carrier Phase receiver

This device offers 10-30 meter accuracy.

Dual Frequency receivers

These devices accept signals on two different frequencies and calculate accurate position.

3.5 Working of GPS Device

As we know that there are 24 satellites which are used by GPS in six orbits (a path in which satellite travels around the earth) at an altitude of 18000Km as shown in figure.

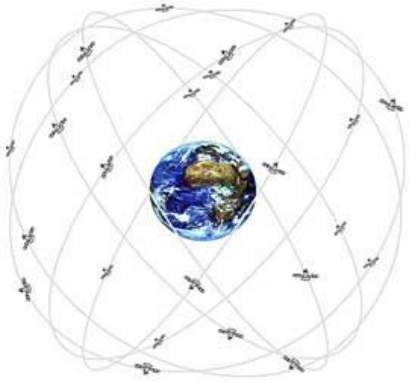


Figure 4 GPS Satellites around the earth.

These satellites are designed in such a way that at any time four of them are visible from any point on Earth. GPS works on the principle called trilateration. It is a mathematical method from which we can calculate our position at any point on the earth.

GPS device on ground receives signals from GPS satellite. GPS device passively receive satellite signals. GPS device require a clear view of the sky, so they do not work in front of tall buildings and in forests. GPS operations depend on accurate time reference to get accurate location. Each GPS satellite transmits data. This data contains location and time of satellite. When GPS device receives this data it estimate the distance to at least four GPS satellites and then calculate its position in three dimensions. If we want to determine our 2-D position (Longitude and Latitude), we need at least three satellites. But if we want to determine our 3-D position (Longitude, Latitude and Altitude), we need at least four satellites. Consider the following figure intersecting point of three circles is our 2-D position.

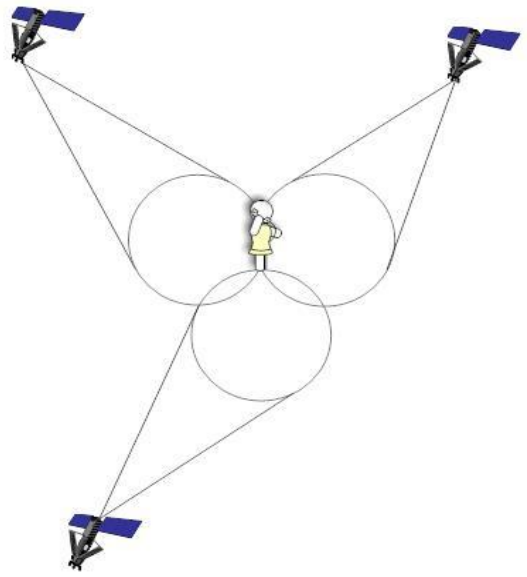


Figure 5 Trilateration Position

3.6 Device used

EM-406A

Figure 6 EM406-A GPS Hardware Module

- 20 Channel Receiver
- Built-in antenna
- High sensitivity: -159dBm
- 30′ Positional Accuracy: 5m
- Hot Start : 1 seconds
- Warm Start : 38 seconds
- Cold Start : 42 seconds
- 44mA power consumption
- 4.5 – 6.5 volt DC operation
- Outputs of the used NMEA 0183 and SiRF binary protocols
- Small foot print : 30mm x 30mm x 10.5mm
- Built-in LED status indicator
- 6-pin interface cable included

3.7 Pin Configuration

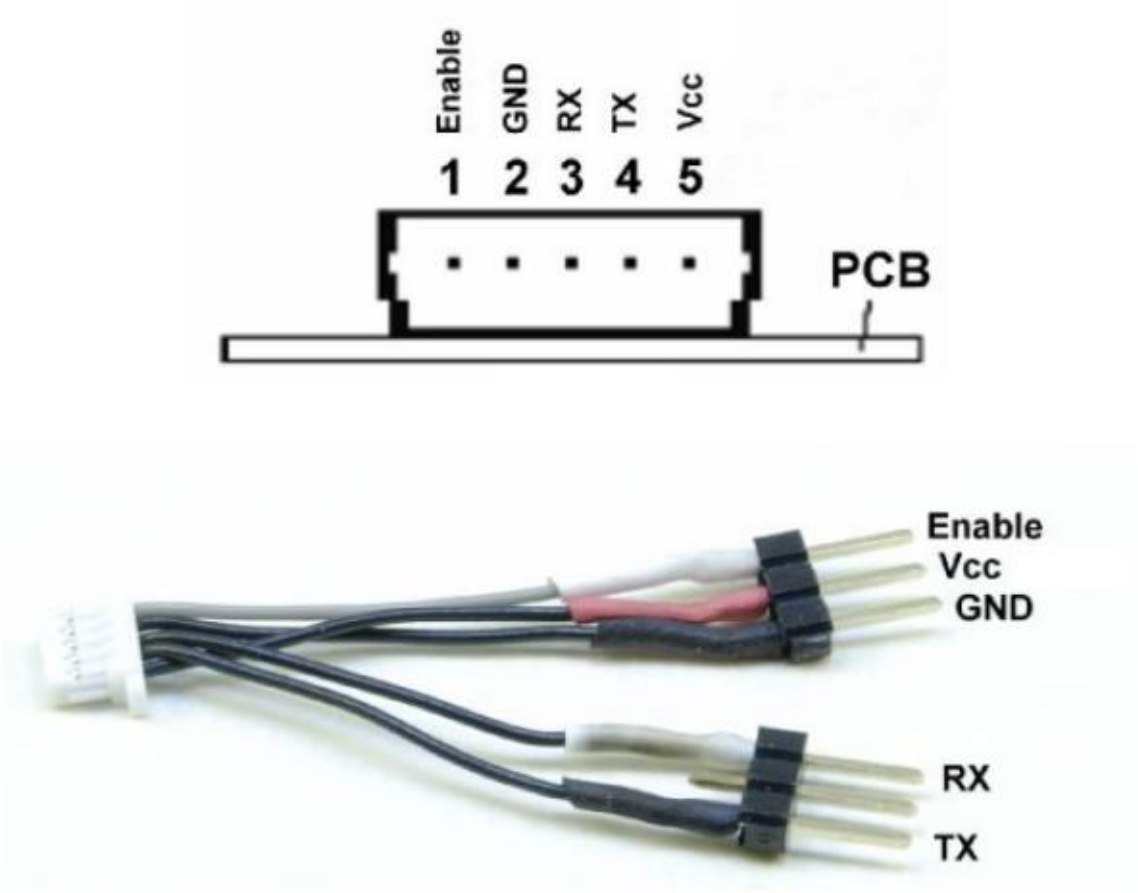


Figure 7 EM406-A Pin Configuration

3.8 Module Structure

Figure 8 EM406-An Integrated Module

3.9 How it Works

Working of GPS Modem is shown in the following figure.

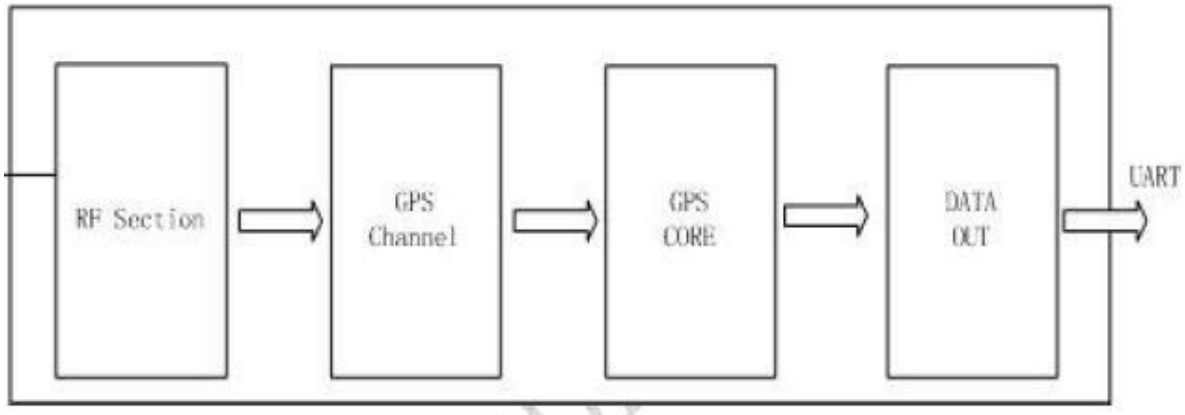


Figure 9 Working of GPS

3.9.1 RF Section

GPS signal which is checked by the antenna is amplified, cleaned and transformed to intermediate frequency in RF Section. RF section also has a ADC converter which converts this analogue intermediate frequency into digital Intermediate frequency signal.

3.9.2 GPS channel

Baseband section receives the digital intermediate frequency signal bit stream and passed it to correlates. Now correlator attains and tracks the satellite signal. 12 channels are used in parallel and correlator looking for characteristic PNR code sequence in bit stream with each channel. When correlator has found a valid signal, carrier phase, pseudo range and orbit information can take out from GPS signal.

3.9.3 GPS Core

An algorithm is running that calculate the velocity, position and time, this is called navigation solution. When navigation solution is calculated it can be changed into required coordinate system.

3.10 Protocol used by device

3.10.1 NMEA-0183

It is a protocol defined by national marine electronics association. It defines that how data is transmitted with baud rate of 4800 from one talker to multiple listeners at a time in a sentence. This data contains position, velocity and time. We receive a line of data that is called a sentence. In NMEA all sentences start with a dollar sign ($) and a carriage return in the end. The length of sentence is 80 characters and data is separated by commas. Any particular sentence is independent from others.

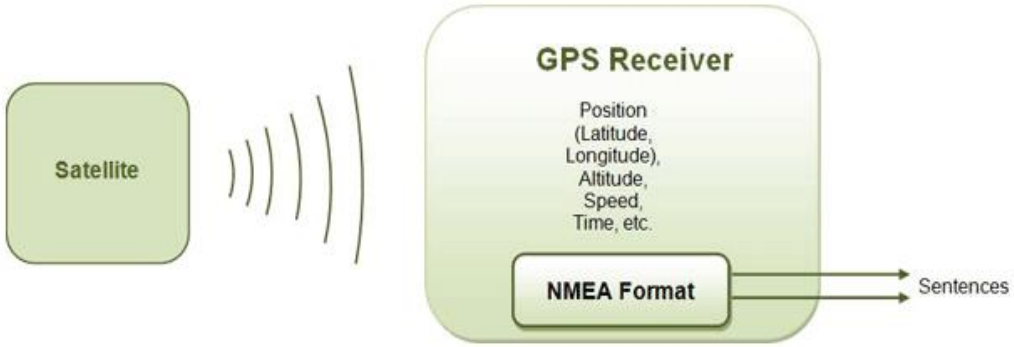


Figure 10 GPS Receiving

Data bits used by NMEA are 8, 1 stop bit and no parity bit. Following is the format of sentence used by NMEA.

Figure 11 NMEA Sentence Format

3.11 Power on GPS

For power on GPS device, GPS_VCC should be kept higher than 2.3V and kept it at least 220ms. From following Figure you can easily understand it.

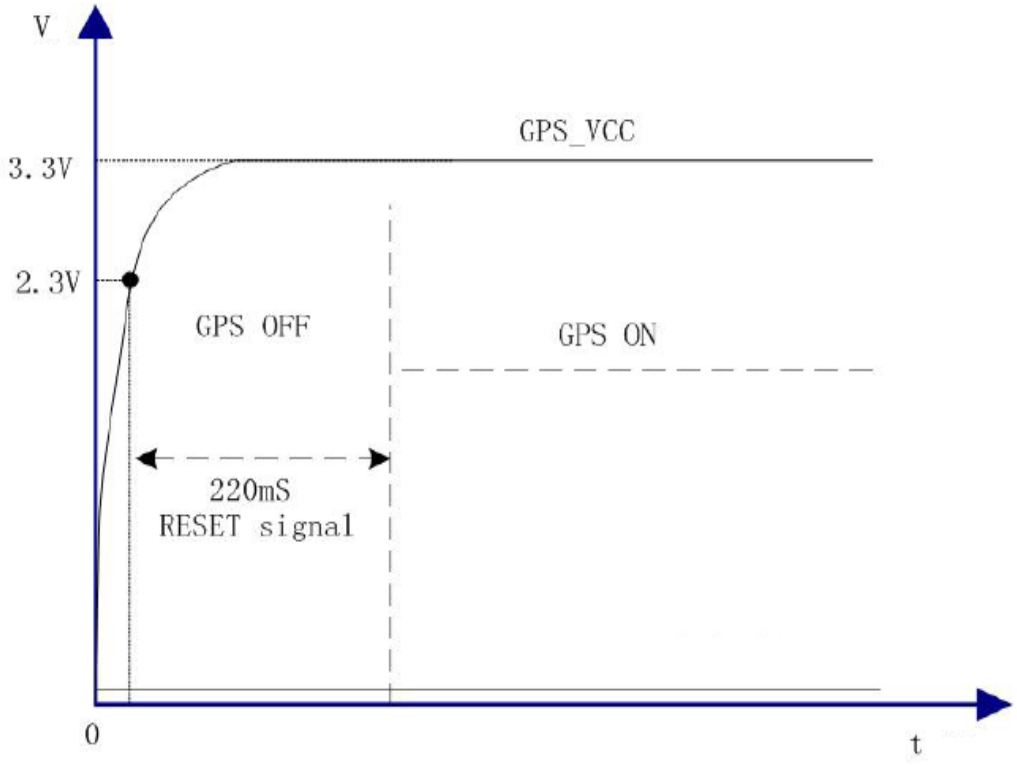


Figure 12 Power on GPS Device

3.12 Operation modes of GPS

There are three operation modes of GPS device.

- Normal Operation
- Power down Mode
- Push-To-Fix Mode

3.12.1 Normal Operation

When we apply operating voltage Vcc then device run in normal mode. In this mode device generates position fixes with maximum update rate. Main function of this mode is that it enables the warm and hot-start.

3.12.2 Power down Mode

In this mode VRTC must be on and user can cut off the GPS_Vcc to save power consumption. When GPS_Vcc is cut off then a valid position is calculated by the device in the normal hot-start time.

3.12.3 Push-To-Fix Mode

In this mode user can adjust the on timing of device. If user adjusts the time for 2 minutes then after passing every 2 minutes device will be on and calculate the position.

3.12.4 PIN Names and Description

PIN NAME	PIN NUMBER	DESCRIPTION
GPS_GND	I	This pin is used to connect the supply's GROUND.
GPS_VCC	2	This pin is used to connect the supply voltage.
GPS_RX	3	This pin is used for dual serial interface. This pin takes serial data from controller.
GPS_TX	4	This pin is used for dual serial interface. This pin provides serial data at controller's port.
GPS_GND	5	This pin is used to connect the supply's GROUND.

4 GPS SIMULATION

4.1 Softwares Used

- GPS Generator PRO
- Proteus
- Hyper Terminal

The GPS Generator PRO application is designed for providing aid in developing, testing and debugging programs and tools working with the NMEA-0183 protocol. This application can also be used for testing navigation applications and equipment before purchasing.

This virtual GPS receiver can work without noticing GPS satellites, thus it's much more resourceful when used indoors. This is cost effective as it is lesser in cost. The program emulates the operation of a GPS receiver (position, speed of relocation, receiving quality, and satellite collection) and gives out GPS data based on the NMEA-0183 protocols v.2.0, v.2.1, v. 2.3 or v. 3.0. The program can be configured for getting certain NMEA protocol messages in a certain sequence with a certain frequency.

The output NMEA protocol can be written to a file or transmitted via COM port. Any program or equipment working with the NMEA protocol will check transmitted messages, made by the GPS Generator, as data from a real receiver. A certain amount of parity errors (CRC) can be introduced in the generated protocol. This is used to test steadiness of operation in navigation programs. The program supports several operation modes and the output data is given to a COM port (including a virtual one) or save to a file. This saved file is to be re-played providing an opportunity for creating repeatable work scenarios, which is tiresome to do with an actual GPS receiver.

4.2 The main program window

The top part of the window contains the main menu and the toolbar. The below part has the NMEA protocol resulting output. The maximum portion of the window is dedicated for the map. In the window there are operation mode tabs (map mode, file mode and route mode).

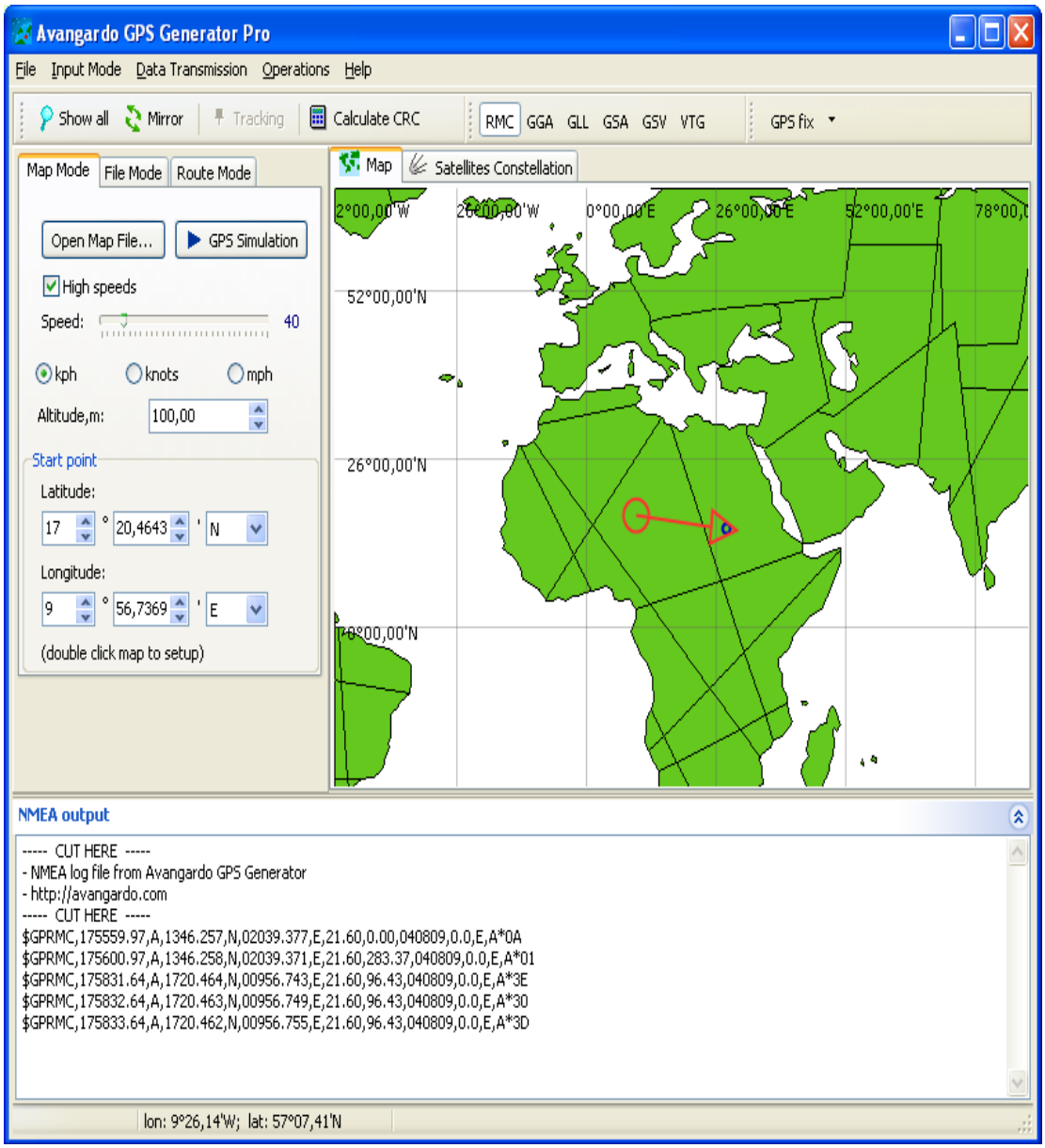


Figure 13 GPS Generator Pro Interface

4.3 Setting up a COM port for the NMEA protocol output

To set up a COM port, in the main menu select the Communication Port Settings option in the Data Transmission menu. The port settings dialog window will be displayed in it.

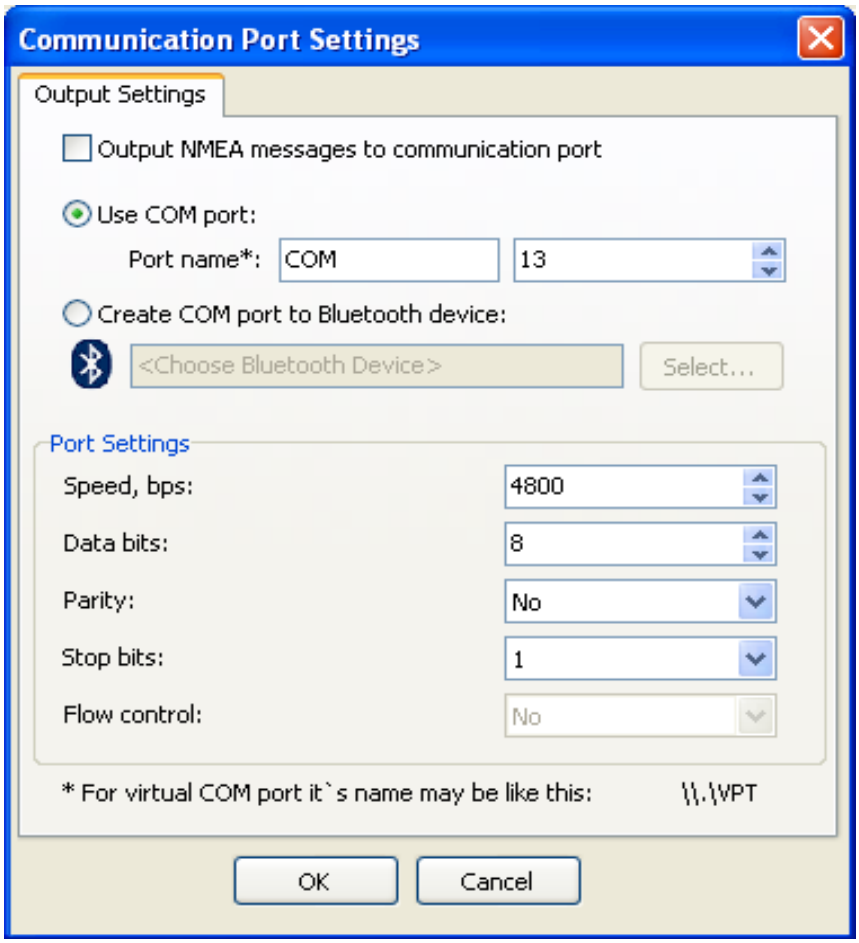


Figure 14 Com Port Setting

4.4 Simulations in Proteus

When GSM device receive a message from a valid given number then a signal send to microcontroller. When microcontroller receive signal from GSM device he send a signal to GPS. Now GPS device gets coordinate from satellites. This data given to microcontroller and microcontroller

send this data to GSM device and GSM send it back to Mobile application.

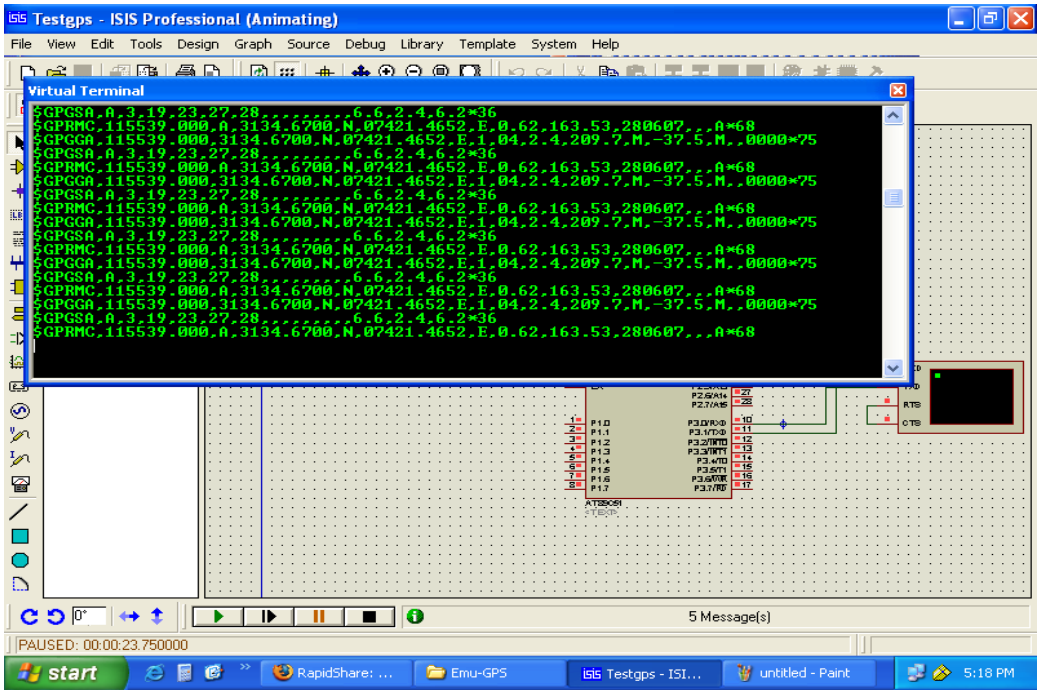


Figure 15 Proteus Simulation for GPS testing

4.5 HYPER TERMINAL

Connect GPS antenna. Connect the serial cable to the GPS serial port A and computer.

Now open the hyper terminal.

Go to "start>All Programs>accessories>communication>hyper terminal"

The following connection dialogue box will appear as shown below.

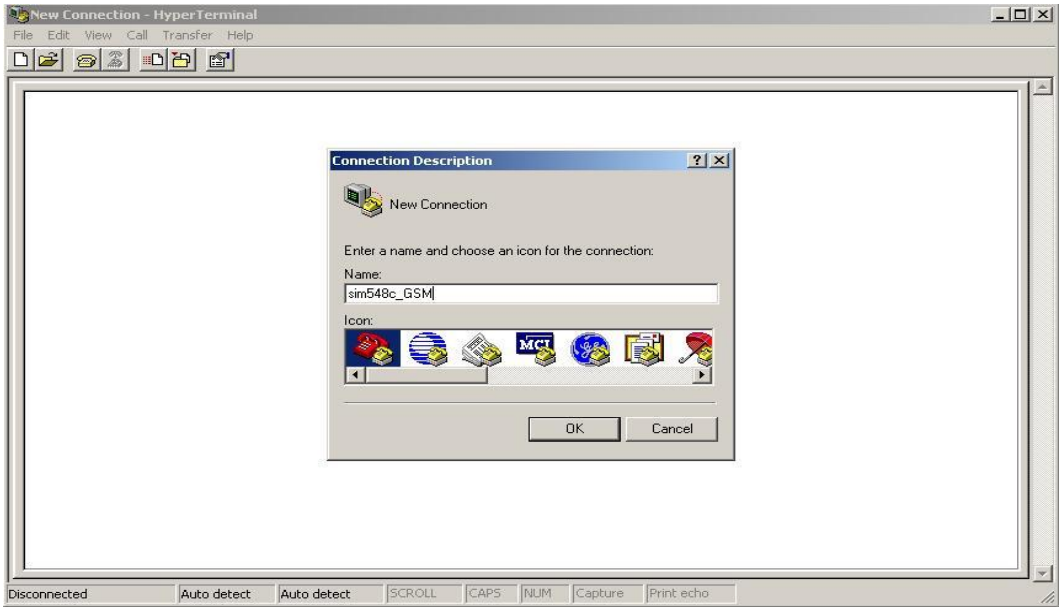


Figure 16 Hyper Terminal Interface

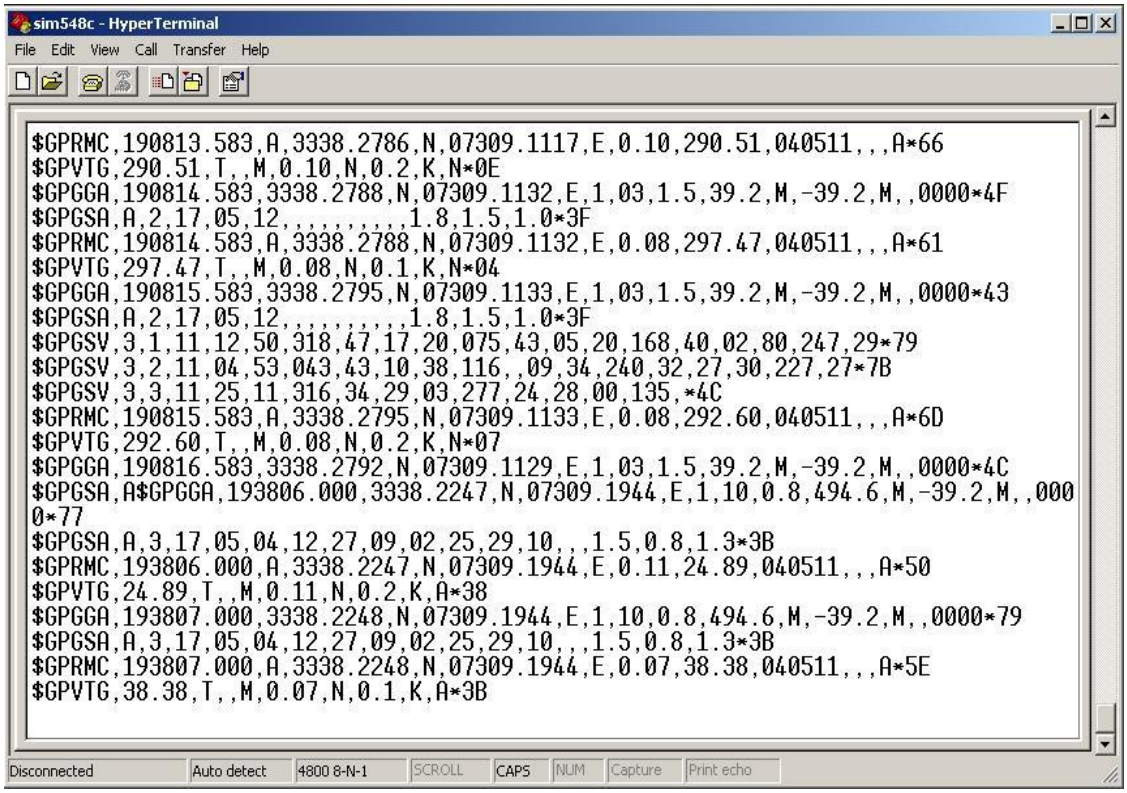


Figure 17 GPS String received

4.6 Commands we used

We used AT commands. It is an abbreviation of Attention. These are instructions which are used to control GPS devices. AT commands start with a keyword "AT". This keyword tells the modem about the start of command line.

4.6.1 GPS Power management commands

AT$GPSP=<status>

If status is 0 then GPS is power down

If status is 1 then GPS is power up.

If command is AT$GPSP? Then it will return the current state.

4.6.2 GPS Reset commands

AT$GPSR=<reset type>

If reset type is 0 Hardware reset

If reset type is 1 then GPS mode is Cold start (No Almanac, No Ephemeris)

If reset type is 2 then GPS mode is Warm start (No ephemeris)

If reset type is 3 then GPS mode is Hot start (with stored Almanac and Ephemeris)

AT$GPSR? It will provide the range of valid values.

s

Hardware Reset

In this mode GPS device is reset and restarts using the values stored in internal memory of device.

Hot Start

In this mode GPS device restart and used the old values which are stored in internal memory of device, validated ephemeris and almanac.

Warm Start

In this mode all initialized data is cleared and reload the data that is currently used by GPS device. The ephemeris is cleared and the almanac is retained.

Cold Start

In this mode all data that is stored in GPS device is cleared.

5 GLOBAL SYSTEM FOR MOBILE COMMUNICATION-GSM

5.1 What is mean by GSM?

GSM means global system of mobile communication. GSM association estimates that 80% of the people use this technology about, 1.5 billion people, and almost 212 countries uses this. GSM considered that it is the 2nd generation (2G) due to its predecessor signaling and speech channel. This facilitate the users that user can switch easily.

Europe	North America	Latin American	Asia Pacific	Africa
GSM: 89%	AMPS, other: 60%	AMPS, other: 55%	GSM: 35%	GSM: 88%
Other: 11%	TDMA: 27%	TDMA: 39%	CDMA: 14%	Other: 12%
	CDMA: 9%	CDMA: 5%	TDMA: 3%	
	GSM: 4%	GSM: 1%	Other: 48%	

WORLD CELLULAR SUBSCRIBERS OF GSM OF 2001

The big thing about the GSM is that it is the pioneer of SMS (short messaging service) also called the text messaging. This is also supported to mobile phones.

5.2 THE NETWORK STRUCTURE OF GSM

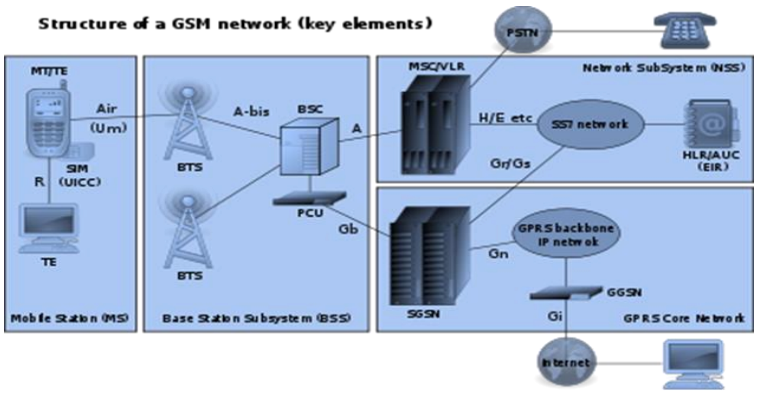


Figure 18 Network Structure of GSM

Now we move to forward as we know what is GSM? Now the question is that how is it working and what is its architecture?

5.3 GSM Working

There are three main parts of gem.

1) The switching system
2) The base station
3) The operation and support system

5.3.1 The switching system

The switching is also known as SS.it done five operations

1) Home location register(hlr)
2) Mobile services switching center(msc)
3) Visitor location register(vlr)
4) Authentication center(ac)
5) Equipment identity register(eir)

The main thing that SS do is the processing of call and functions related subscriber.

5.3.2 The Base Station

It plays important role in mobile communication it have also two parts.

1) Base station controller(bsc)
2) Base transceiver station(bats)

The main working of BSS is to connect the mobile phone to base station.

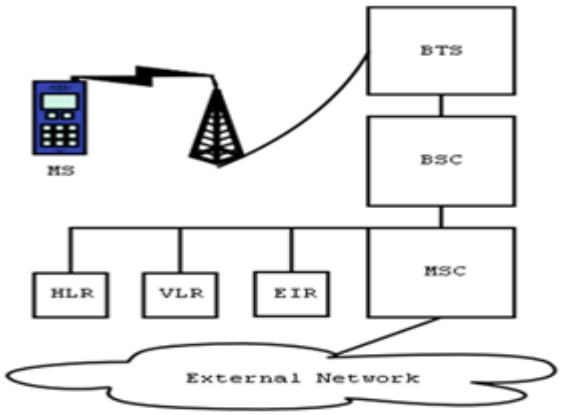


Figure 19 Working of GSM Network

5.3.3 The Operation and Support System

It is basically for facilitation of customer. It provides the consumer cost effective and solutions of mobile network.

5.4 How to work GSM?

GSM working is basically so simple you can say that it is just to send or receive a message. In our application its working is to receive a message from consumer application and after receive this message send to GPS and get the location then send back to consumer application. So finally we saw a map on application. So you can say that GSM is our basic part of receiving message and delivering message.

What is in backhand in GSM to receiving or sending SMS?

There are basically five parts in GSM

1. baseband of GSM
2. Flash and SRAM
3. Frequency part of GSM radio
4. The antenna interface
5. The board to board interface

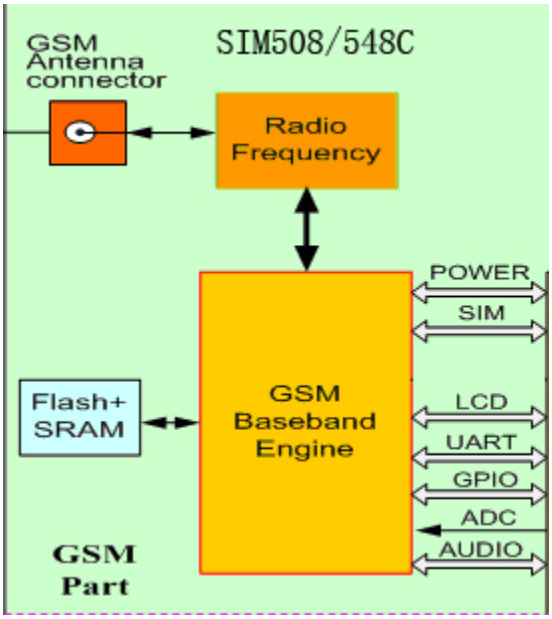


Figure 20 Working of GSM

5.4.1 3-Baseband of GSM

There are three things which manage the base band of GSM.

1) Transmitter
2) Receiver
3) Controller

Below is a block diagram of transmitter part of GSM

Transmitter

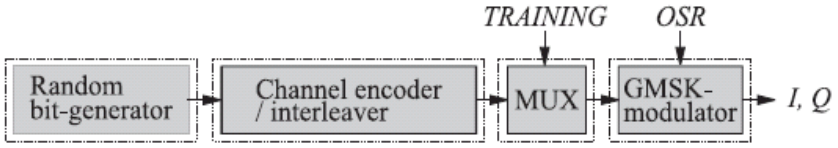


Figure 21 GSM Transmission section

First of all our transmitter generates a random bits. Then our channel encoder encoded the bits for giving to mux. Now mux have the responsibility to create a normal burst for GSM. Mux also have a responsibility to send this burst to GMSK.GMSK performs encoding on this incoming burst to form a NRZ (not return to zero) sequence.

Receiver

Figure 22 GSM Receiving Section

Our demodulator accepts the GSM burst and make a complex baseband representation to determine the most probable sequence. This sequence is going to input to DEMUX now the bits are spilt in order to receive the actual data.

5.4.2 3-Frequency Part of GSM

GSM is working on different frequencies. According to generation

1	1st generation	(1G)	450 MHZ
2	2nd generation	(2G)	900-1800 MHZ
3	3rd generation	(3G)	2100 MHZ

Now a day's some countries uses 450 MHZ frequencies but most of the countries use 900-1800 MHZ frequencies but some advanced countries use 2100 MHZ.

5.5 GSM Antenna

About 50Ω has the interface the RF. module is offering design for application.

Connect the antenna to side of the PCB

Antenna pad and grounding plan is adjusted on bottom side.

If you are interested to RF have the minimum loss we are recommended to you use

GSM 850/ 900 ≤ 0.5 dB

DCS 1800/PCS1900 ≤1.0db

There are two things in GSM antenna

5.5.1 Antenna connector

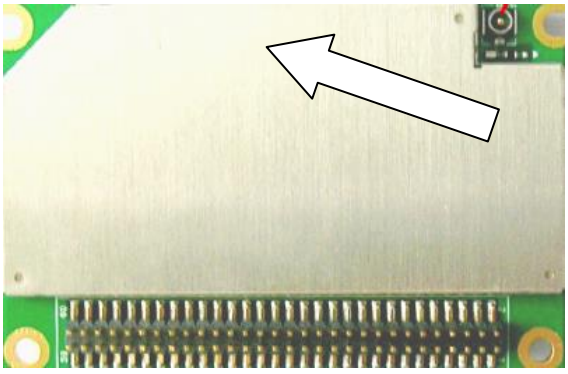


Figure 23 GSM Antenna Connector

5.5.2 Antenna pad

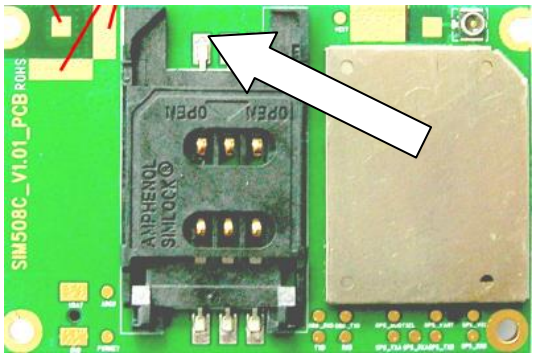


Figure 24 GSM SIM Module

5.6 Board To Board Connecter

Except RF Interface all hardware interfaces connect to 60-pin 1.27 mm pitch board to board connector.

1. Power supply
2. GSM serial interface
3. Two audio interface
4. SIM interface

Below we just show you a pin description of board to board connector

POWER SUPPLY			
PIN NAME	**I/O**	**DESCRIPTION**	**DC CHARACTERRISTICS**
VBAT		There are 4 pins of input voltage to board to board connector	"Vmax =4.5 V Vmin = 3.4V Vnorm = 4.0v"
VRTC	I/O	VRTC is used as a input current when vbat is not supplied to to system and not used when backup battery is below voltage state.	"Vmax =2.0 V Vmin = 1.2V Vnorm = 1.8V Inorm=20uA
VCHG	I	This is input voltage to detect the charger	Vmax =5.25 V Vmin = 1.1V
SIM INTERFACE			

PIN NAME	**I/O**	**DESCRIPTION**	**DC CHARACTERISTICS**
SIM-VDD	O	voltage supply for SIM card	The Voltage Can Be select by software automatically either I SV or 3V
SIM-DATA SIM-CLK SIM-Presence SIM-RST	I/O 0 I 0	SIM data output SIM clock SIM card detection SIM reset	"VILmin=0V VILmax=0.3* SIM-VDD VIHmin=0.7* SIM-VDD VIH-max=SIM- VDD+0.3 VOLmin=GND VOLmax=0.2V VOHmin=SIM-VDD-0.2 VOHmax=SIM-VDD"
AUDIO INTERFACE			
PIN NAME	I/O	DESCREPTION	DC CHARACTREISTICS
MICIP MICIN	I	Voce-band input of positive and negative	Audio DC
MIC2P MIC2N	I	Auxiliary positive and negative voice-band input	
SPKIP SPKIN	O	Voce-band input of positive and negative	

How to power on and off the GSM

There are four ways to power on GSM

1. BY using PWRKEY pin
2. By using VCHG pin
3. By using RTC interrupt pin

When your module is power after that you put AT-commands on serial port and unsolicited result code "RDY" is received from serial port. When your GSM is on after the 3 sec you can put your AT-commands.
NOTE: - if auto-baud is set on your module you will receive nothing.

5.7 By Using PWRKEY PIN

Here is the pictorial view of by using PWRKEY pin.

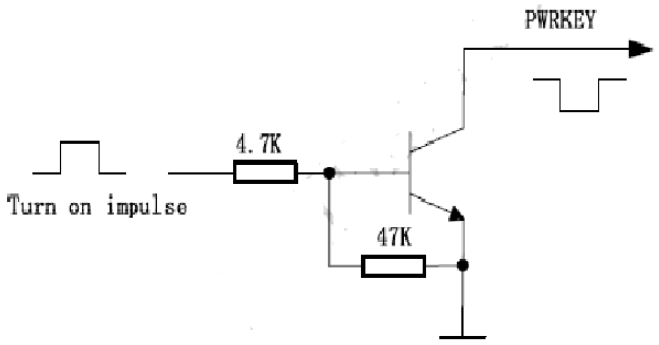


Figure 25 Using PWRKEY Pin

5.7.1 Turn on your GSM by using PWRKEY

For some time you are driven the PWRKEY and then release to a low voltage level this will PULLUP the VBAT in the module. Maximum current is 0.4 drained from the power key. When the above procedure is completed the GSM will on you can see from the result "RDY". That result will be on your serial port.

5.7.2 By Using VCHG Pin

There is VCHG pin in module. So we connect our charger to that VCHG pin regardless of its operating mode, so what happened to the module now? When you connect your battery to VCHG pin rather your module is in power down mode will go into the ghost mode (off and charging) so few at-commands are working.
So due to this a signal is created which is called VCHG signal. That will turn on the GSM part and result code is

RDY
Ghost mode
+cfun: 0

5.7.3 By Using RTC Interrupt Pin

RTC (real time clock) is used to power on in alarm mode. RTC alerts the GSM part when the module is in power off mode now if we use the at-commands, our GSM is not recognized it because the GSM network stack is close.

For setting alarm we uses AT+CALARM command. RTC remains in alarm mode for GSM is in power off mode. So when the time is expired the GSM part will go into the alarm mode. So after that our GSM part of module will send the following result.

RDY
ALARM MODE

So above result shows that our GSM is in alarm mode. So now we check our protocol stack. For this we sent the ct fun command if that command send back 0 this means our protocol stack is closed after 90 sec it will be on automatically.

Some of these commands are

AT command	USE
AT+CALARM	Set alarm time
AT+CCLK	Set data and time of RTC
AT+CPOWD	Power down
AT+CFUN	Start or close the protocol stack

5.8 Turn of the GSM Part

Below are some techniques to use to turn off the GSM part of our module SIM 548c/508c

Normal power down

We are normally power down the GSM part using PWRKEY pin.

There is another way to power off the GSM part is to use AT-COMANDS.

Automatic shutdown by low voltage or temperature

If there is low voltage or low temperature in any stage your gm is powered off.

5.9 Turn Off By Using PWRKEY

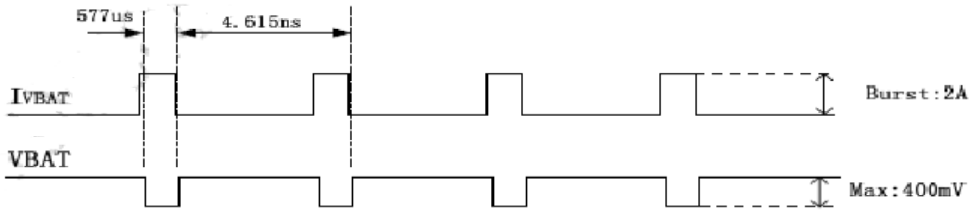


Figure 26 PWRKEY Working

By using power key pin you can turn off your GSM by sending the low voltage. Before the normal power off your GSM your screen will show you these commands

Normal power down

After this you can't put your AT-COMMANDS only your RTC is still alive like status pin which is shown below in figure.

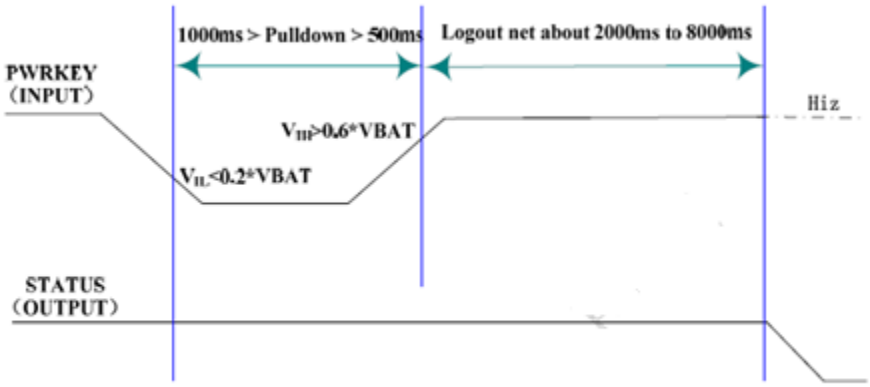


Figure 27 Signal generation

5.10 Turn Off GSM Part by Using AT-COMMANDS

We can power off the GSM using at commands.

"AT+CPOWD=1"

By using this command your GSM is power off and will go into the save mode and saving your data. So at the end when power off procedure is completed the following output sanded by your module

5.10.1 Normal Power Down

After this you can't put your commands and you didn't reply but only your RTC is alive

5.10.2 Automatic Shutdown Under or Over Voltage

Our module is constantly seeing the voltage which is applied to the VBAT if the voltage goes less than 3.5 volts or greater to 4.5 volts then our module sanded a warning

If vbat≤3.5

UNDER VOLTAGE WARNING

If vbat≥4.5

If voltage goes less than 3.4 or greater than 4.6 then our module will automatically shut down.

5.10.3 Automatic Shutdown Under or Over Temperature

Our GSM part will continuously checking the temperature, below there is some temperature if they come respectively commands as sanded our module

if the temperature is going to 85 °C or higher from 85 °C

"CMTE=1"

if the temperature is less than 40 °C

"CMTE= -1"

if the temperature is greater than 90 °C

"CMTE= +2"

if the temperature is less than 45 °C

"CMTE= -2"

if the temperature is 45 °C to 90 °C then our module is in uncritical situation after this you can't put your commands.

5.11 Current and Voltages Consumption of GSM

PARAMETER	DISCRIPTION	CONDITION	MIN	TYP	MAX	UNIT
VBAT	supply voltage	Our voltage should lie between min and max values	3.0	4.0	4.5	V
	During burst transmission voltage drop	Normal condition			400	mV
	Ripple voltage	Normal condition F<200khz F<200khz			50 2	mV
IBAT	Average current supply	Power down mode Sleep mode		3.5 2.5		uA° mA
		Idle mode(when not connect) EGSM 900 DCS1800/pcs1900		23 23		mA
		Idle mode(when connect) EGSM 900 DCS1800/pcs1900		33 33		mA

6 MICROCONTROLLER AND OTHER COMPONENTS

A microcontroller is a computing device consisting of built in peripherals. It usually consists of CPU, USART (Universal Synchronous Asynchronous Receiver Transmitter), timer, counters and other input output devices. They come in category of Application Specific Processors. They can be reprogrammable but usually designed for a specific embedded application in use.

6.1 FEATURES

- **High recital , little power AVR 8bit Microcontroller**
- **RISC Architecture(Advanced)**
    - Power full single cycle 131 instructions
    - General purpose 32 x8 registers
    - Entirely Static function
    - 16MHz have up to 16 MIPS throughput
    - cycle on-chip Multiplier
- **Non-volatile Programming and Data Memory**
    - 32K Bytes of ISPF(In-system Self-Programmable Flash)
- **Endurance:10,000 Write/Erase Cycles**
    - OBCS(Optional Boot Code Section) with Independent Lock Bits
- **In-System compatible for Programming by On-chip Boot Program**
- **True Read-While-Write Operation**
- **1024 Bytes EEPROM**
- **Endurance:10,000 Write/Erase Cycles**
    - 2K Byte Internal SRAM

- Programming Lock for Software Security

- **JTAG(IEEE std.1149.1 Compliant)Interface**
  - Boundary-scan Capabilities which are According to the JTAG Standard
  - Extensive On-chip Debug Support
  - Programming of Flash, EEPROM, Fuses and Lock Bits through the JTAG Interface

- **Peripheral Features**
  - Two 8-bit Timer/Counters with the Separate Pre-scaler and Compare Modes in it
  - One 16-bit Timer/Counter with the Separate Pre-scaler, the Compare Mode and simple Capture
- **Mode**
  - Real Timer Counter with apart Oscillator
  - Four PWM Channels
  - 8-channel,10-bit ADC
  - 8-single ended Channels
  - Differential Channels with Programmable Gain at these values1x, 10x or 200x
  - Differential Channels in TQFP Pack
  - Byte-oriented Two-wire Serial Interface
  - Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with splited On-chip oscillator
  - On-chip Analog Comparator

- **Special Microcontroller Features**
    - Power-on Reset and Programmable Brown-out Detection
    - Internal Calibrated RC Oscillator
    - External and Internal Interrupt Sources
- **Six sleep modes:**
    - Idle
    - ADC Noise Reduction
    - Power-save
    - Standby
    - Extended Standby
    - Power-down
- **I/O and Packages**
    - 32 Programmable I/O Lines
    - 4-lead TQFP and 44-pad MLF
- **Operating Voltages**
    - 2.7-5.5V for ATmega32L
    - 4.5-5.5V for ATmega32
- **Speed Grades**
    - 0-8 MHz for ATmega32L
    - 0-16 MHz for ATmega32

Power Consumption at 1 MHz,3V,25 degree C for ATmega32L

- Active: 1.1 mA
- Idle Mode: 0.35 mA
- Power-down Mode: <1 μA

In communication between devices, RS-232(Recommended Standard 232) is a standard that is followed. This standard provides a way of serial communication between two end devices such as DCE (data circuiting device) and DTE (data determining equipment).

It is a common type of connector between the communicating devices. It consists of parallel rows of pins usually in upper row 5 pins are present in bottom row 4 pins are present. It is surrounded by a mechanical body which provides support to the pins, giving it a shape and protecting from electrical and other interferences.

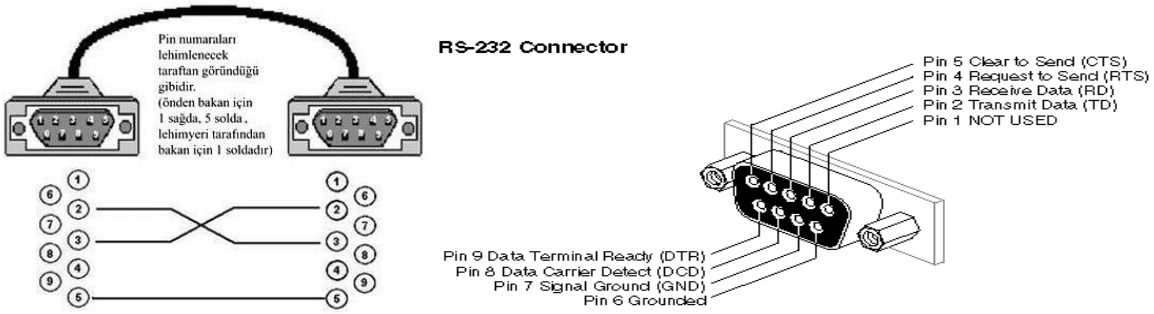


Figure 28 RS-232 Connector

6.2 MAIN SERIAL PORT MALE DB9

This is a figure of male DB9 port showing male style of pins. It is called male connector as it fits inside the female serial connector.

Figure 29 DB9 Port

6.3 MAX 232 IC

The MAX 232 IC is a IC which provides compatibility between devices supporting RS 232 protocol and TTL (Transistor Transistor Logic) supporting devices.

The MAX232 is a two way transmitter/receiver that inherits a capacitive voltage generator to supply EIA-232 voltage levels from a single 5-Volt supply. Each receiver in max 232 converts EIA-232 inputs to 5-Volts TTL (Transistor Transistor Logic)/CMOS (Complementary Metal Oxide Semiconductor) levels. All receivers are having a threshold voltage of 1.3 volts and have a typical hysteresis of 0.5 volts and can accept ±30-volts inputs.

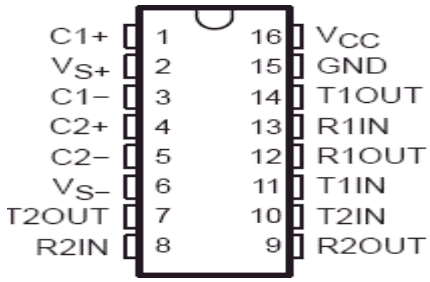


Figure 30 MAX 232 IC

- Meet or Exceed TIA/EIA-232-F and ITU Recommendation V.28
- Operate with single 5 V power supply
- Operate up to 120 Kbits/s
- Two drivers and two receivers
- ±30-volts input levels
- Low supply current…8 mA Typical
- considered to be similar with maxim max232
- ESD protection jumps ahead of JESD 22-2000-V human-body model(A114-A)

6.4 Applications

- TIA/EIA-232-F
- Battery-Powered Systems
- Terminals
- Modems
- Computers

6.5 Voltage Regulators We used

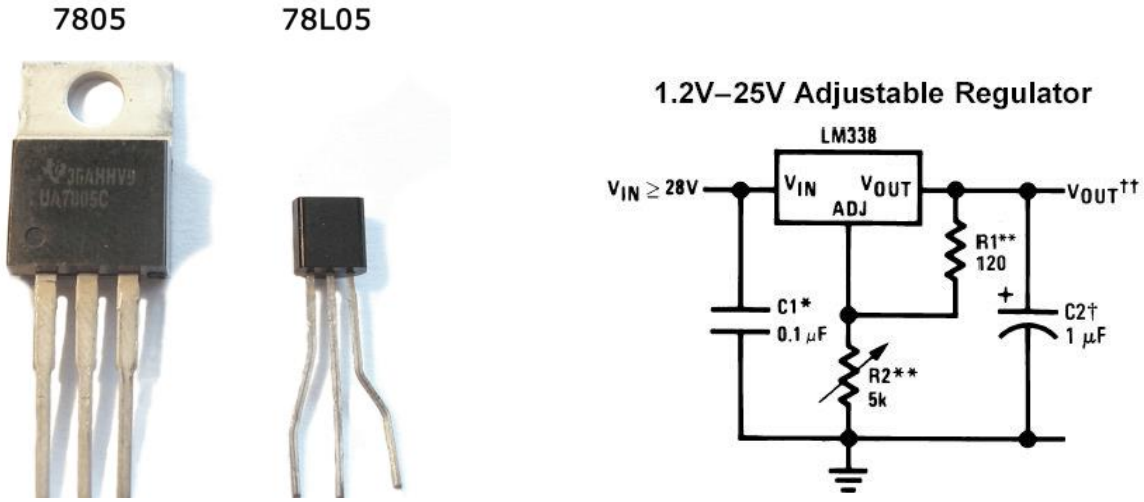


Figure 31 Adjustable Regulators

6.6 Working Block Diagram of Microcontroller

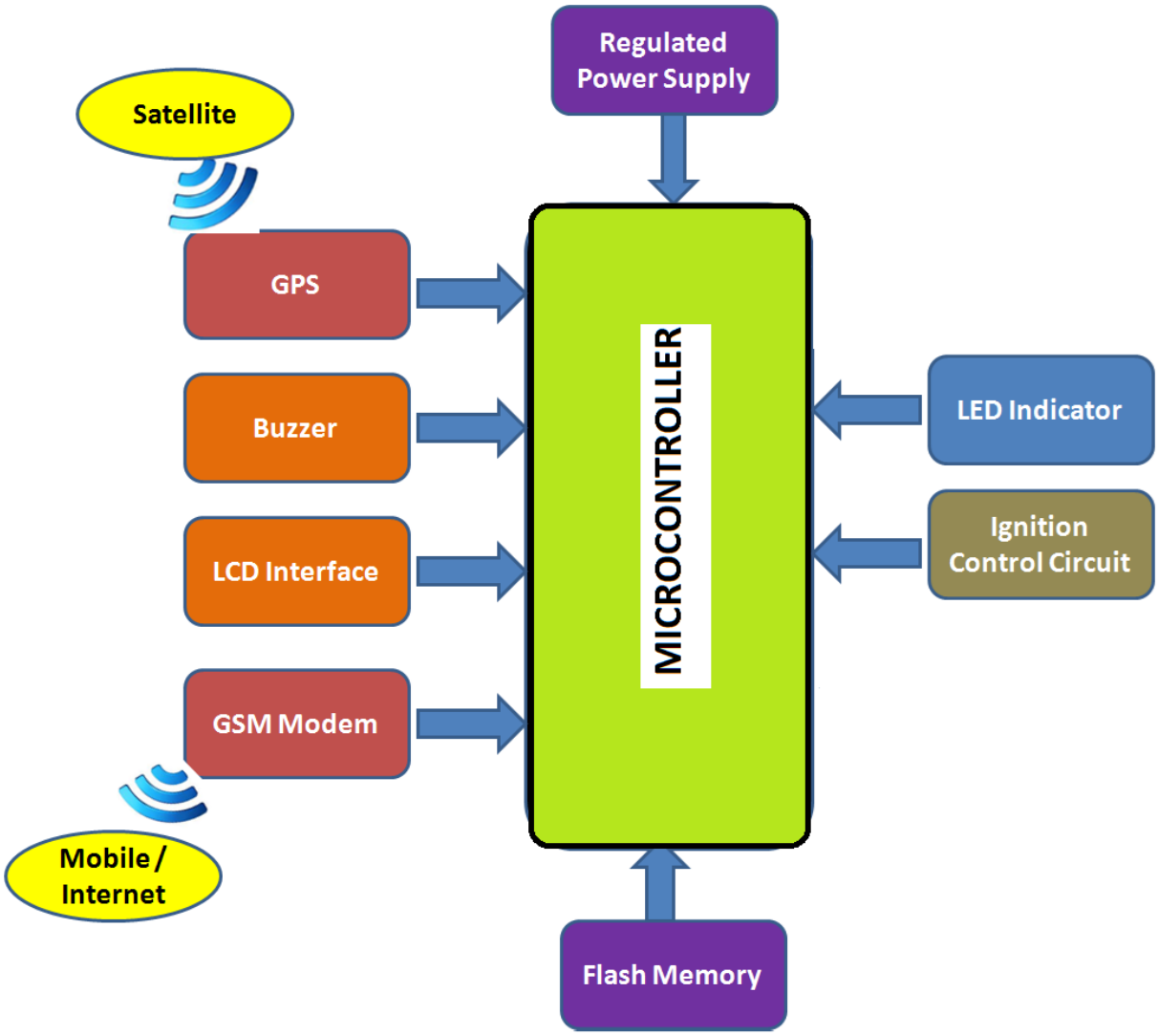


Figure 32 Interfacing Model of Microcontroller

7 SYSTEM PROGRAMMING

7.1 Programming language

The programming language that we use in our final year project is the C++ programming language. C++ is a general purpose programming language that is designed to make the programming more enjoyable for the serious programmer working on programming tasks. C++ is the ideal programming language for the programmers because it can link to almost any compiler used for coding as C++ has the capability to interface with libraries of almost all the compilers.

It should not be considered as an accident that C++ can be interfaced with almost any language interpreter or library you find. It is very rare that you find a big program written all in one language, or without using any libraries, so easy integration with other languages and libraries was a key design goal.

Most of the programming problems have no specialized language to solve them; some because of the reason that none has (yet) been worth creating, and others because an interpreter would add too much overhead into it. When you can't afford a specialized language for part of a problem, under observation, a library may serve the purpose of solving it. C++ programming language was designed with libraries always in mind, and its most useful features are those that help you write easily-implementable, portable, efficient, easy-to-use libraries.

7.2 Introduction to compiler

CodeVisionAVR compiler is a C cross-compiler, Integrated Development Environment (IDE), and automatic Program Generator designed for the Atmel microcontroller series made AVR. CodevisionAVR can be run on Operating System Windows 95, 98, Me, NT4, 2000 and XP, 7.

C cross-compiler is able to translate almost all orders of ANSI C language, to the extent permitted by the architecture of the AVR, with the addition of some special features to take advantage of the AVR architecture and the needs of the embedded system. COFF object files compiled the results can be used for debugging purposes at the level of C, with the observation variables, use the Atmel AVR Studio debugger.

The compiler that we used in our final year project is CodeVisionAVR. It's one of the best compilers for programming any micro-controller. It contains almost all of the micro-controllers and programming can be done very easily. It has a number of built-in functions which provides ease of programming by simply using them.

7.2.1 Features of CodeVisionAVR

High Performance ANSI C/C++ Compiler for the Atmel AVR microcontrollers and for a number of other microcontrollers includes:

- Integrated Development Environment
- Automatic Program Generator
- Graphic Library with support for the X-Graph XG7100 TFT LCD modules
- In-System Programmer for the Atmel AVR family of microcontrollers

7.3 Why CodeVisionAVR

- CodevisionAVR compiler has a great advantage over others, namely the codewizard; this compiler allows us to initialize the microcontroller that will be used.
- CodevisionAVR compiler provides configurations that can be set on each chip microcontroller that will be used for programming, so we do not need to see the datasheet to simply configure the microcontroller chip.
- CodevisionAVR compiler Using the IDE (Integrated Development Environment) that is easy you to use it.
- CodevisionAVR compiler having the facility to download programs directly from CodeVisionAVR

using special hardware such as Atmel STK500, Kanda Systems STK200 + / 300 and other several hardware been defined by CodeVisionAVR.

- CodevisionAVR compiler having an integrated serial communications terminal in CodeVisionAVR so it can be used to help check the programs that have been created especially using facilities USART serial communication.

7.3.1 CodeVisionAVR Compiler Interface

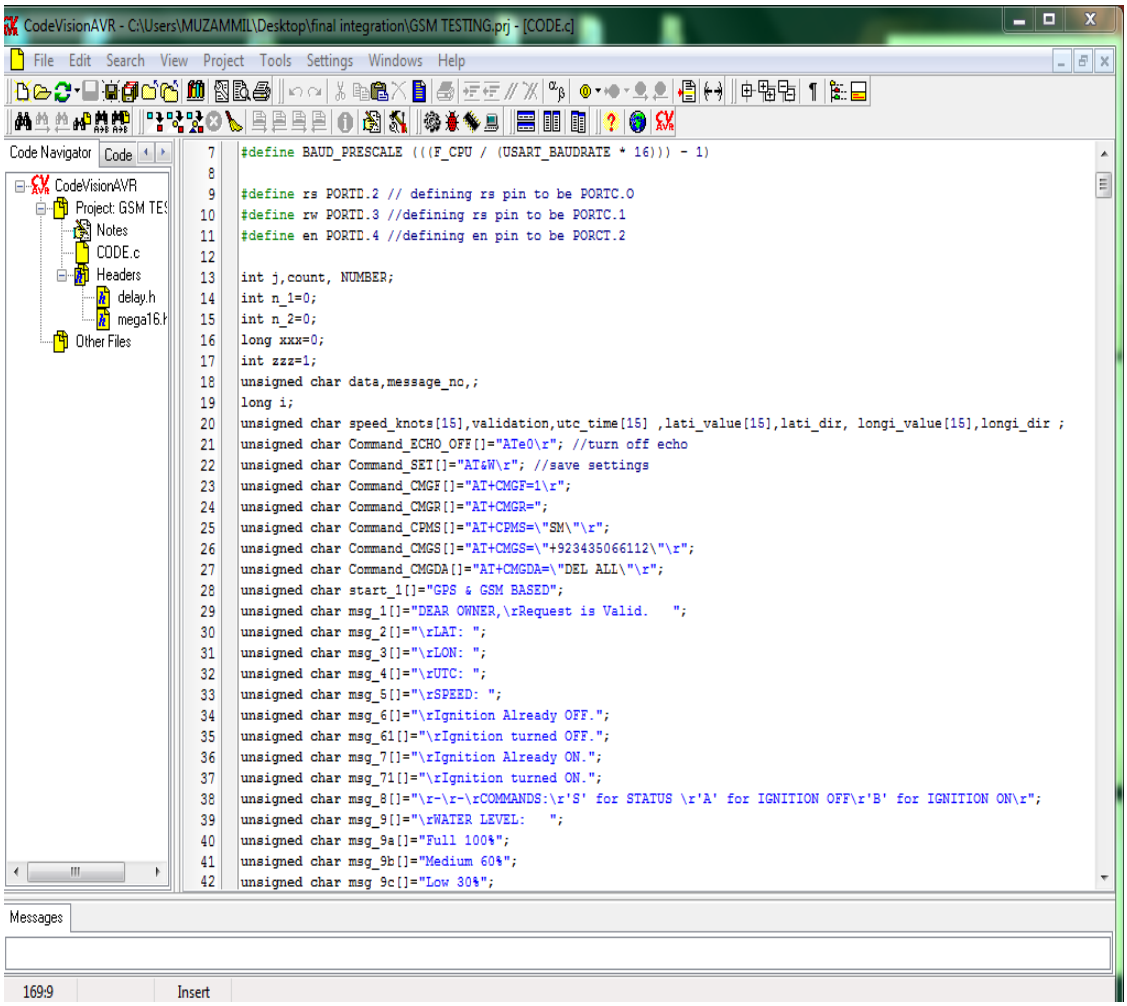


Figure 33 CodeVision AVR Interface

7.4 Functions used in our System

We have used a number of functions in our code for performing a number of different functions. Each function is assigned a specific task to do. The use of function helped us to make the programming easy by reusability of the functions. All of the functions are written above the main function hence there is no need of defining the function. The functions that we use are described below:

- Init_USART()
- lcd_cmd()
- lcd_data()
- init_lcd()
- USART_Rx()
- USART_Tx()
- SEND_SMS()
- RECEIVE_SMS()
- GSM_DECODING()
- GPS_DECODING()
- display_GPS()
- startup_msg()
- CHECKING()

These are the list of the functions that we have used for our system. Each of the function is described in detail below.

7.4.1 Init_USART()

This function includes the programming code for the initialization of the Universal Synchronous Asynchronous Receive Transmit. Microcontroller Atmega16 has a USART for sending and reception of serial data and as we have to communicate our GPS and GSM with atmega16 so we have to use this communication function of the Atmega16 and that's why we have used this function. This function activates the serial port of the controller and set the values, which we assign it, to the specific registers

for communication settings. The function contains code for the baud rate settings according to our components.

7.4.2 Lcd_cmd()

This function is used for the LCD that we have used in our project. The function contains code for different command that is given to LCD for performing specific functions. The function receives any character input, processes the input and performs the task related to the given input.

7.4.3 Lcd_data()

This function is used for printing any data on LCD. In our project we have to display latitude, longitude, time, speed and many other things on LCD so we have to use this function. This function serves the purpose of displaying anything that we want on LCD. The function receives any character input, processes the input and displays the given input on LCD.

7.4.4 Init_lcd ()

This function basically initializes the LCD. Before using anything we first have to initialize it so for the initialization of LCD this function is used. The function contains code for activating the LCD, activating two line display, activating cursor and other basic features of LCD. This function is used at the very start of the main() program because we later have to use the LCD functions in our program so we have initialize the LCD so that it can be ready for using.

7.4.5 USART_Rx()

This function contains programming code for receiving and serial data that may come on to the serial port of the controller. When the function is called, the receiver flags in the controller are checked and when the data is ready to copy the data is copied in a variable that we defined. Then the data stored in the variable is further processed as per the requirement of the program. The controller in our system has to receive data from both GPS and GSM so for that this function is very useful we have to call this function and we can have the data that was transmitted either by GPS or GSM.

7.4.6 USART_Tx()

This function serves the purpose of transmitting the data from microcontroller to GSM that we have used in our project. For reading messages and also for sending messages to the owner of the vehicle, this function is used. We simple give a character input to his function and it transmits that character through it serial port to the GSM.

7.4.7 SEND_SMS()

This function contains the code for sending an SMS on number from which it was received provided it was valid owner. The function when called checks the inputs being given, processes them and take the actions based on the processed result. It contains a number of messages to be sent. It first checks what exactly has to be sent. After checking it selects the message, which is already defined, and sends them on the owner's number.

7.4.8 RECEIVE_SMS()

This function serves the purpose of receiving and authenticating a message. The function takes parameter for the number of messaged received. It checks all the message by individually calling them. After that, it checks whether the message received is a valid number or not. If the number is already registered with us, then it authenticates it and forward the request stores in that message to SEND_SMS() function and if the number is unknown then it simply discards it.

7.4.9 GSM_DOCODING()

This function is very critical function because it's the heart of the GSM programming. Whenever this function is called it checks the memory location of the SIM if any message has received or not. This function runs continuously every thirty seconds to checking if any message request from the vehicle's owner has received. If there is any message that is received then it forwards the message to the RECEIVE_SMS() function for authentication and for further processing.

7.4.10 GPS_DECODING()

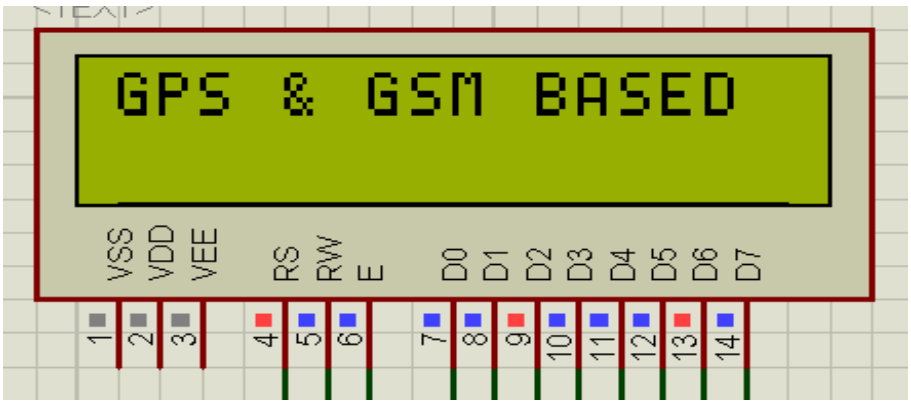
This function is the heart of the programming for the GPS data that is received. In this function a loop runs to catch a $GPRMC stream from the GPS and when it catches that stream it stores all the values from it to the variables so that they can be displayed on LCD as well as send to the owner of the vehicle incase asked. Once the values are stored it came out of the loop and switch to the GSM_DECODING() function to check any newly received SMS. This function, like GSM_DECODING(), also runs every thirty seconds to update the values of the current position. It keeps the location of the system updated.

7.4.11 Display_GPS()

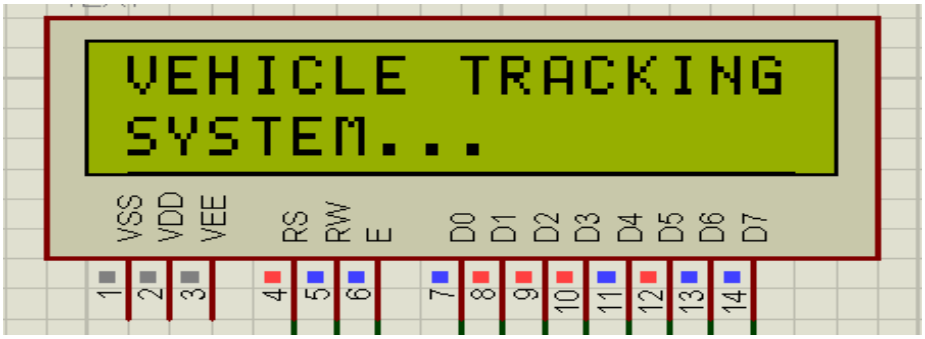
This function serves the purpose of displaying the data on the LCD so that driver driving the vehicle can also see the readings. It displays UTC Time, Speed of the vehicle in knots, Latitude coordinates of the system position, Longitude coordinates of the system position, Water level of the vehicle etc.

7.4.12 Startup_msg()

This function is called at the start of main() function. This is the first function whish displays characters on LCD. The function is used to display a startup message on LCD for the user who uses the system. This function basically displays three lines on LCD. The first line is “GPS & GSM BASED”



The Second line is "VEHICLE TRACKING SYSTEM…"



The Third line is "DEVICE READY!!!"

After this, the LCD displays the technical parameters and the values of each of the feature used by the system.

7.4.13 CHECKING()

This function is used for some of the features of the vehicle's parameters. It checks the water level of the vehicle's radiator. The water level is being divided in four levels 0%, 30%, 60%, 100% which stands for EMPTY, LOW, MEDIUM and FULL respectively. It continuously checks the water level of the vehicle and keeps the owner of the vehicle alert about the water level. In case the water level becomes too loo i.e. EMPTY which corresponds to 0% then the system has a buzzer installed on the board which start producing sound so that the sound can alert the owner that water level is low. Besides sounding buzzer it also turn a red light ON for

the purpose of alerting and it also sends the owner an SMS that the water level of the vehicle has gone too low so that he may refill the water tank. Besides checking water level, this function also checks if the system is connected to vehicle's battery or backup battery; if, for any reason, the main vehicle's battery is cut off then an SMS is sent to the owner alerting him that main supply of the vehicle has cut off for whatever the reason may be.

7.5 Baud Rate Settings of the System

The setting of the baud rate was a very critical problem in the start days of the project. We spent almost 3-4 months on correcting the baud rate (4800) for successful communication. Sometime one setting of the baud rate used to work on simulation but it failed on practical hardware and other times the vice versa.

Then we put a number of threads on the open forums to solve the issue of baud rate setting. We checked a number of external crystal clocks including 2MHZ, 4MHZ, 11.0592MHZ, 12MHZ and a number of others but none of it worked. But then we removed the external crystal from our system and tried a number of times by using the atmeag16's own internal cloak and then finally we figured it out where the problem was. There was problem in coding of the microcontroller.

The corrected working baud rate while simulations on Proteus are given below:

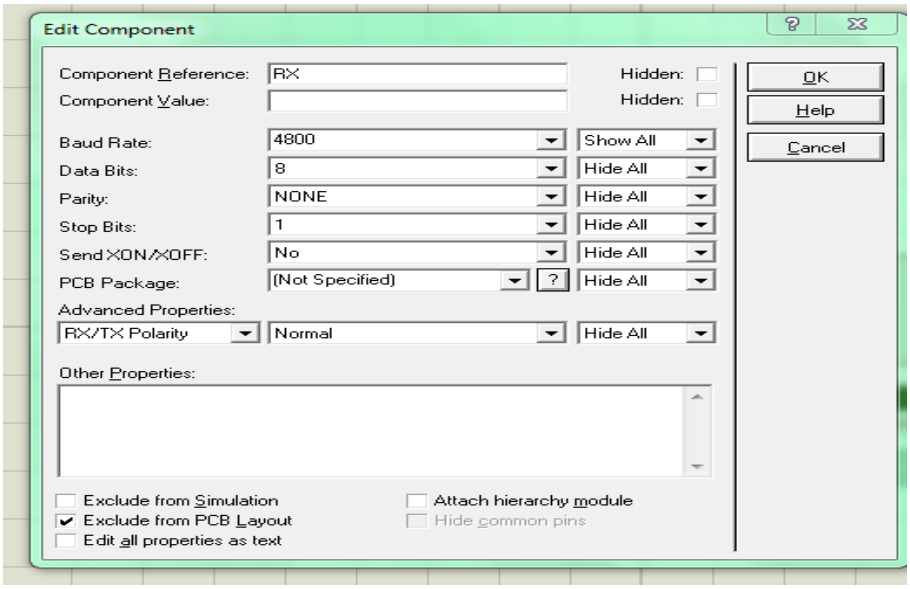


Figure 34 Proteus Baud Rate Setting

Our system has a GPS which works on 4800baud by default and a GSM which works on 9600baud by default so we set the baud rate of our GSM module to 4800 so that both can work fine with the same baud rate.

The code for the setting of the baud rate to 4800 to run on hardware is given below:

```
#define F_CPU 1000000
#define USART_BAUDRATE 4800
#define BAUD_PRESCALE (((F_CPU / (USART_BAUDRATE * 16))) - 1)
```

By setting baud rate of the microcontrollers communication port using this code, the baud rate sets to 4800 which works very fine on hardware and the communication is very smooth using this. This is an error removed code which makes the hardware run on the specified baud rate.

8 HARDWARE DESIGN & SYSTEM INTEGRATION

8.1 GSM Board

8.1.1 Introduction

The GSM board is the first major hardware block of our system design. The GSM Board includes a GSM modem SIM900D mounted and soldered on a PCB. The PCB on which GSM modem is fabricated also have a SIM rack where the SIM is to be inserted. Some other electronic components are also present through which the communication is being done on hardware. This GSM modem PCB is then adjusted on another PCB which us the base of GSM modem PCB. The base PCB has slots in which the GSM modem fits. The base PCB also has some other components for performing different purposes. It has a communication serial port DB9 for interfacing the GSM Board with PC.

8.1.2 Components of GSM Board

- GSM SIM900-D
- SIM RACK
- GSM STICK ANTENNA
- GSM MODEM PCB
- GSM BASE PCB
- SERIAL DB9 COM PORT
- 12V ADAPTOR
- FUSE
- 4V SILS
- 12V SILS
- LM317T IC
- RESIRTORS
- CAPACITORS
- INDICATION LEDS
- GSM MODEM PCB'S ADJUSTMENT SLOTS
- TRANSISTORS

- POWER DIODES
- Tx / Rx PINS

8.1.3 Schematic of GSM BOARD

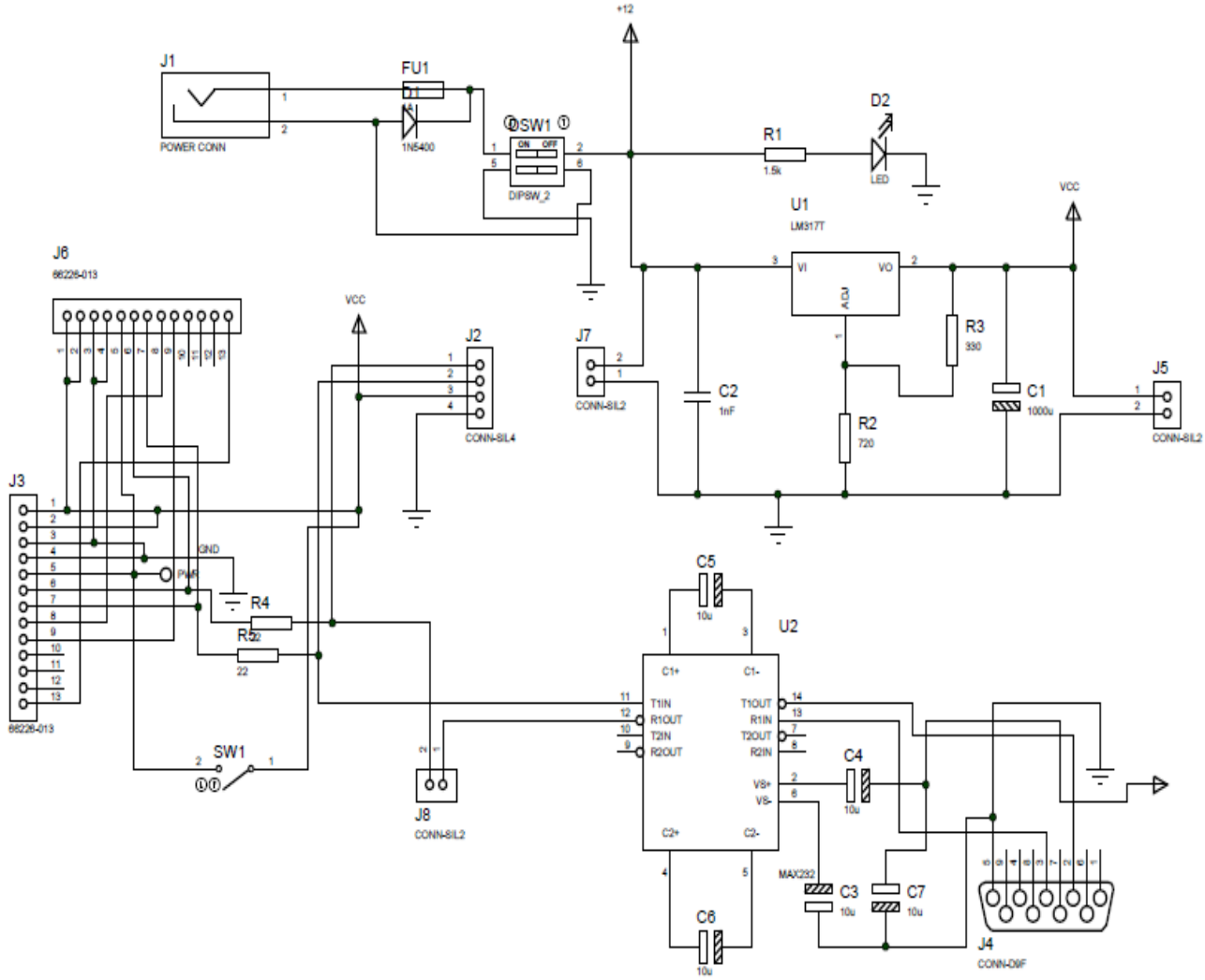


Figure 35 GSM Board Schematic

8.1.4 PCB layout of GSM BOARD

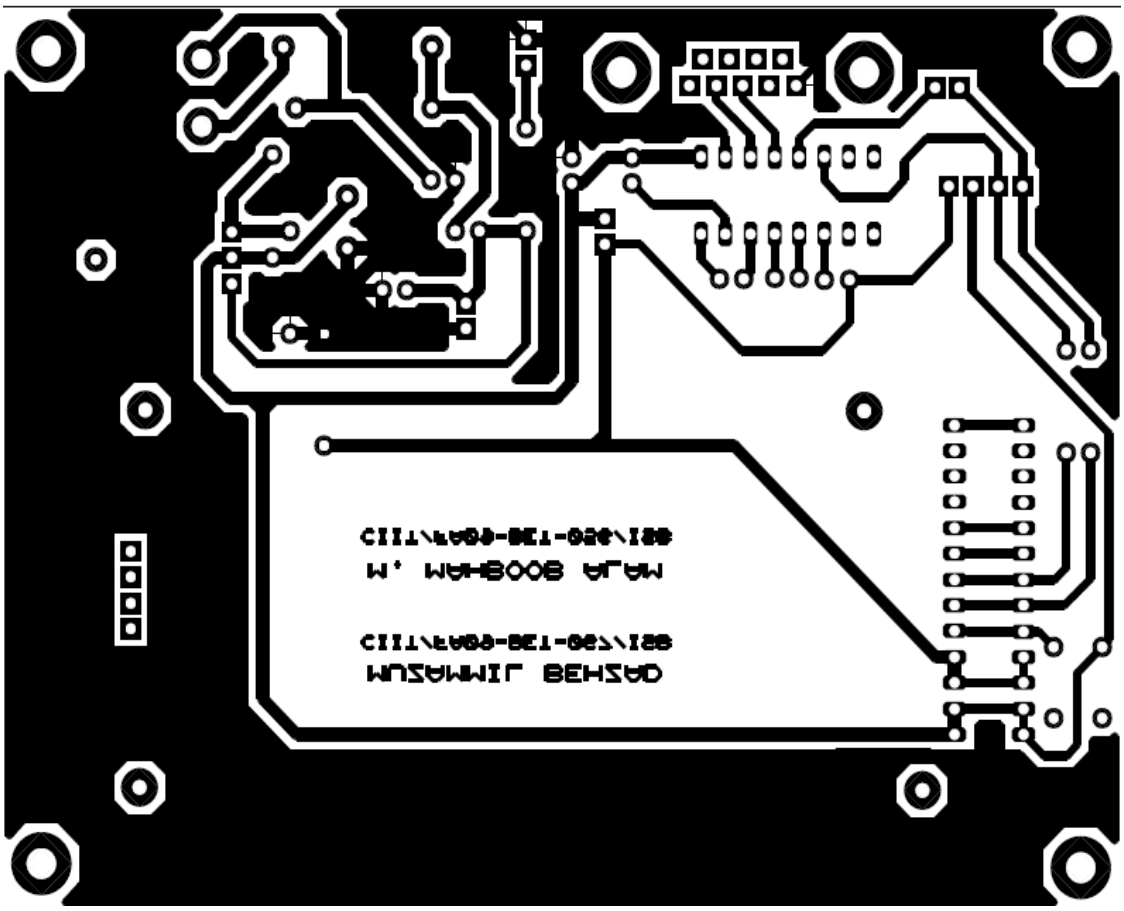


Figure 36 GSM Board Layout

8.1.5 Working of GSM BOARD

The working of the GSM board is such that it has receive and transmit pins that are connected to the microcontroller. When the power is given to the GSM board it takes almost 15seconds to get ready for communication. After 15seconds, commands from microcontroller can be sent to check the working of GSM board. In our project, we send command for sending and receiving SMS to GSM modem and read the response.

8.2 GPS Board

8.2.1 Introduction

The GPS board is the second major hardware block of our vehicle tracking system. The GPS board has the GPS receiver module EM-406A mounted on it. The GPS receiver is the key component which is used to give the coordinates of the position. The GPS board also has the base for the microcontroller Atmega16 that we are using in our project. Atmega16 is the brain of our tracking system and all the decisions are programmed in it.

Other than that, GPS board has slots for connecting LCD on it which is used for displaying data on it. The placement of the LCD is in the center of the Board. There is a relay fabricated on the PCB which is used for cutting of the ignition switch of the vehicle in case of theft.

8.2.2 Components of GPS Board

- GPS receiver module EM-406A
- Microcontroller Atmega16
- LCD 16x2
- 5v 5pin Relay
- RESIRTORS
- CAPACITORS
- INDICATION LEDS
- LCD ADJUSTMENT SLOTS
- TRANSISTORS
- POWER DIODES
- Tx / Rx PINS
- FUSE
- 5V SILS
- 12V SILS
- 7805 REGULATOR IC
- 74157 MUX IC

8.2.3 Schematic of GPS BOARD

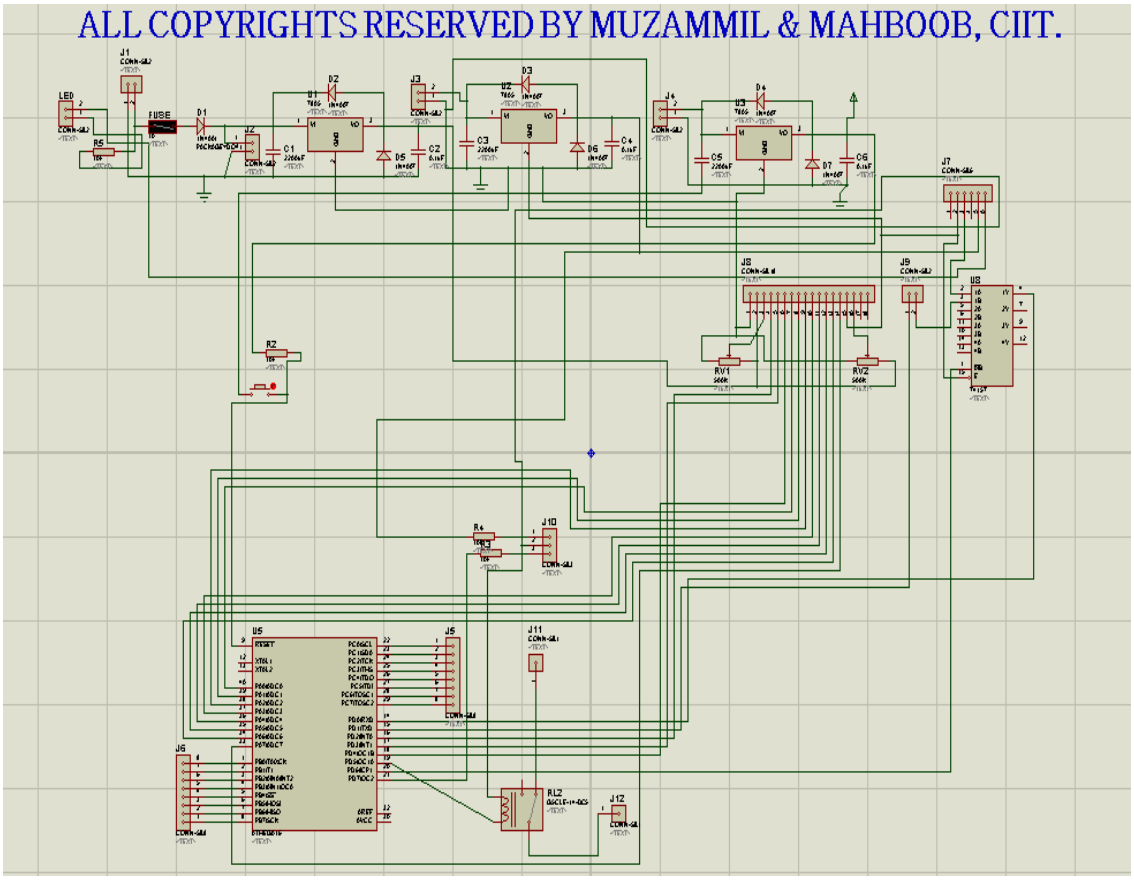


Figure 37 GPS Board Schematic

8.2.4 PCB layout of GPS BOARD

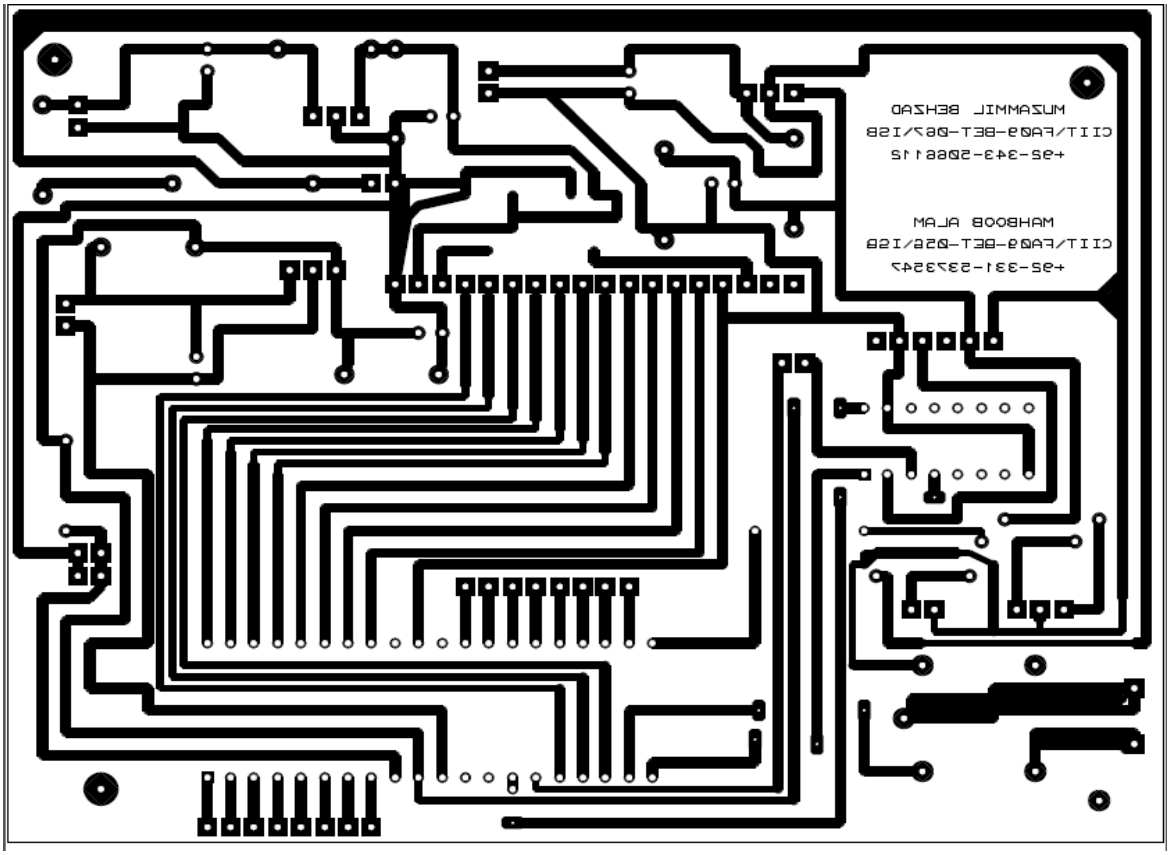


Figure 38 GPS Board LAYOUT

8.2.5 Working of GPS BOARD

The working of the GOS is board is such that the microcontroller is connected to GPS receiver through a MUX IC. A multiplexer is used because atmega16 has only one RX pin while we have to receive both from GPS and GSM so for that we have used multiplexer. Atmega16 first connects the GPS through MUX IC, receives data from it then switches the connection to GSM, receives data from it and continues it. At the same time, the controller displays the data and other features of the vehicle on LCS. The power to this board comes from the GSM board.

8.3 SWITCHING/CONTROL Board

8.3.1 Introduction

The switching board is another major block of our tracking system. This board contains circuitry for charging the backup battery using a relay model. There is a charging circuit in the board too which will charge a backup battery. The purpose of the charging circuit is that there will be a backup battery connected to our system so if in case the main supply cuts off then the system will switch to backup battery. Also the battery will be charging so that incase of usage the battery charging will be full.

The board also has circuit for measuring the water level of the vehicle. This is another feature of our system which will measure the water level and will display it on LCD as well as will tell the owner on request. There are indication LED's used for indicating various symbols and there is a buzzer too which will produce sound when the water level fall goes down to EMPTY i.e. 0%

8.3.2 Components of Switching/Control Board

- 12V 5pin Relays
- RESIRTORS
- CAPACITORS
- INDICATION LEDS
- TRANSISTORS
- POWER DIODES
- FUSE
- 5V SILS
- 12V SILS
- 7805 REGULATOR IC
- BUZZER
- COMPARITOR LM324 IC

8.3.3 Schematic of Switching/Control BOARD

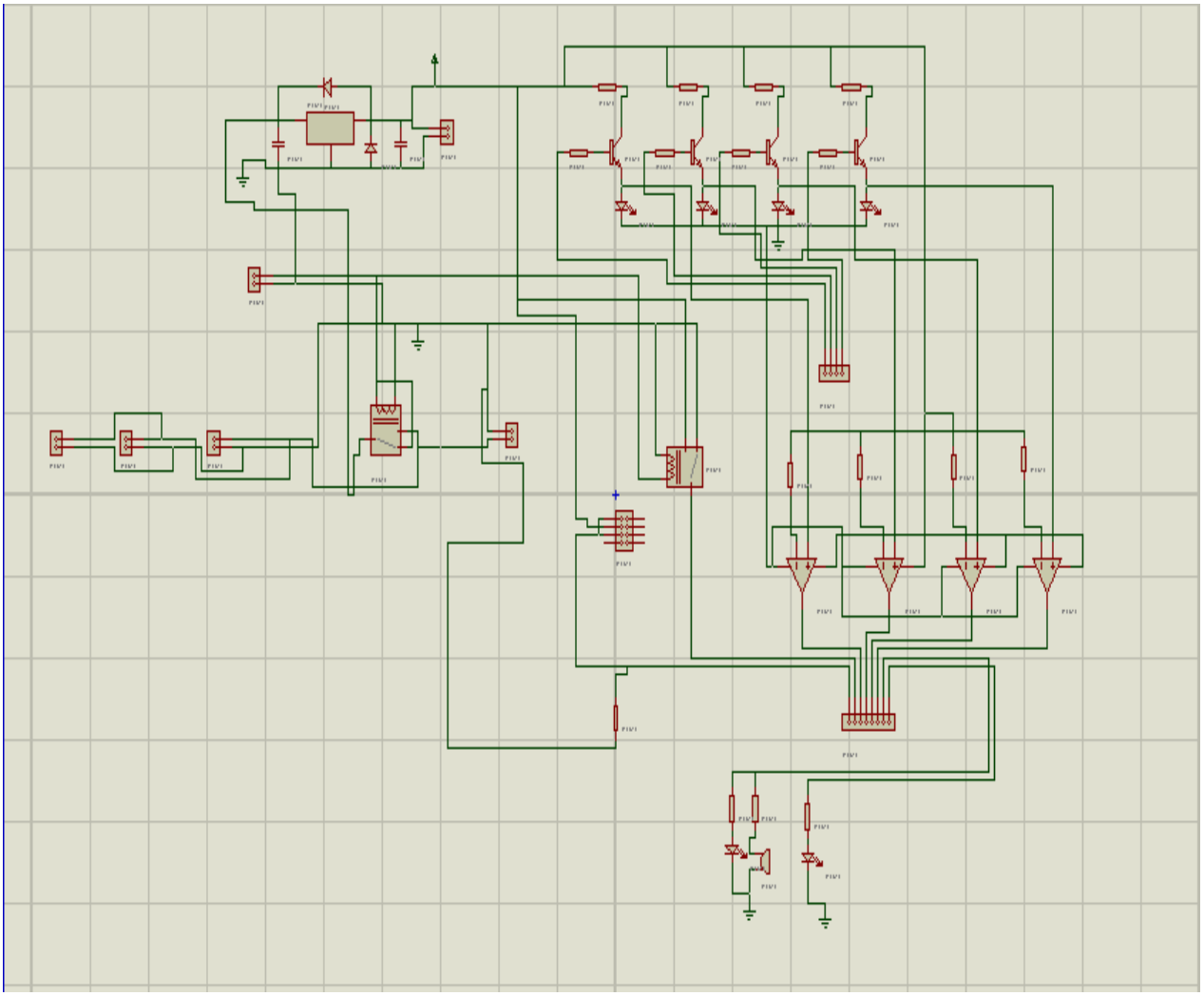


Figure 39 Switching/Control Board Schematic

8.3.4 PCB layout of Switching/Control BOARD

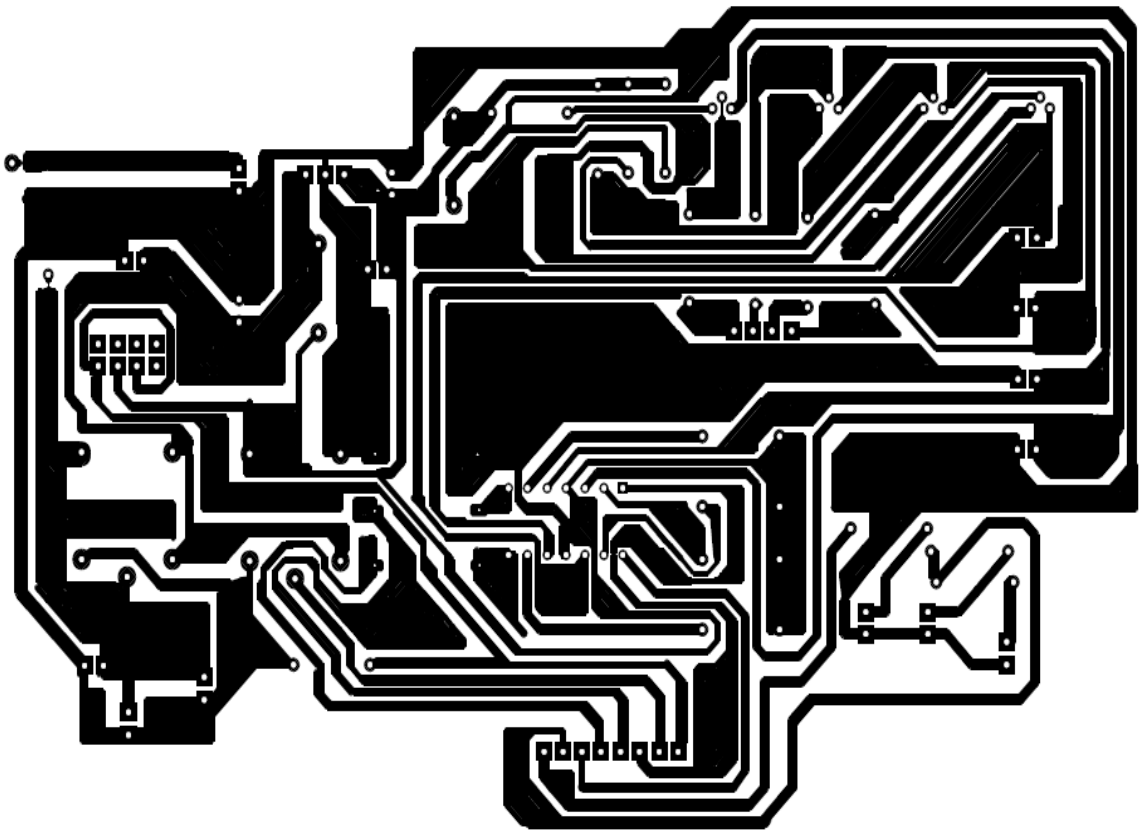


Figure 40 Switching/Control Board Layout

8.3.5 Working of Switching/Control BOARD

The working of this board is such that it has two input 12V SILs. One SIL will be connected to the vehicle battery terminal while the other will connect to the backup battery terminals. Then there is a relay which checks if the vehicle battery is connected or not. If the vehicle battery is connected the relay will turn ON and will forward the same supply to all the boards and if the main power is not connected then the boards will run on backup battery's power. Other than that the water level circuit will check the water level and will correspondingly give the values to microcontroller. The microcontroller will check the values and will process them correspondingly. The microcontroller depending upon the inputs will further ON/OFF the LEDs/Buzzer. The board will be

displaying the water level in terms of LEDs too as well as inputting them to microcontroller.

8.4 Integrated System

All these boards are, in the end, connected with each other to integrate the whole system. The power to Switching/Control Board comes directly from either vehicle's battery or backup battery.

The switching board, through its SILs, forwards the power to GSM board which then forwards it to the GPS board. All the boards are connected with each other and the three boards are connected with each other mechanically using nuts and bolts. The GSM board is kept at the lowest rack.

Above it, the Switching/Control Board is placed which acts like a connector board too. And then at the top, the GPS board is kept because the GPS board has the base for microcontroller which is used to burn again and again so for easiness it is place at the top. Also the GPS board has the LCD mounted on it so it's therefore placed at the top.

The backup batter is connected separately from the integrated board as it will be kept in a place where it can hide so that upon theft the battery can't be recognized. It'll be having wires connected to the integrated board but the placement of the backup battery will be very separate.

8.5 View of the System Final Hardware Design

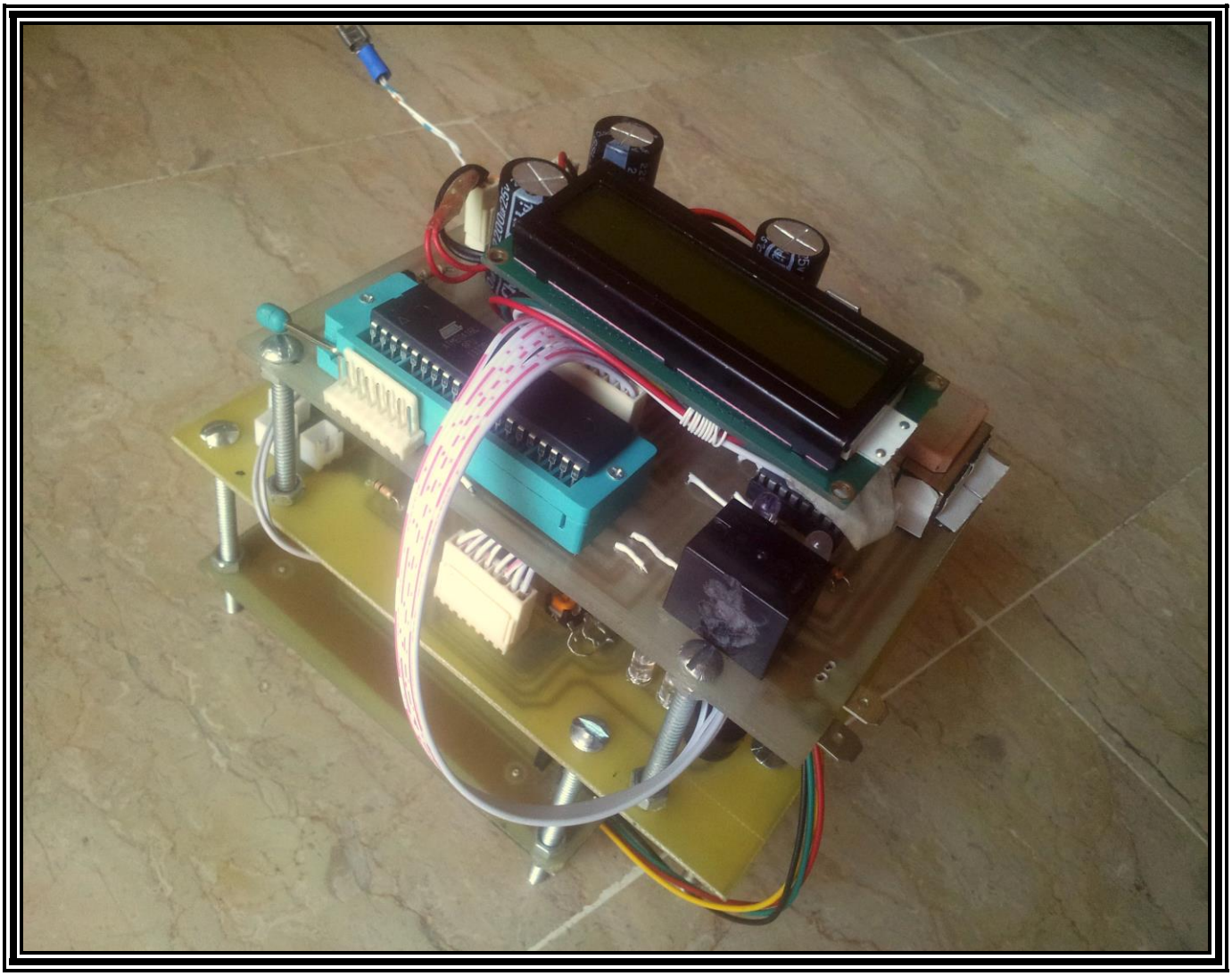


Figure 41 Integrated System Final Hardware

9 WEB PORTAL

9.1 Introduction

The message received through our tracking system on the mobile contains scientific codes i.e. latitude and longitude so we also designed a website for our tracking system which will act as a web portal for each owner of the vehicle and the owner of the vehicle will be having a complete track of the vehicle movements.

For giving a complete view of the vehicle's movement we have developed a website in which only authenticated user will be having access to his/her vehicle. The user can see the location, movement and track of his vehicle and the parameters like water level and other sensor measurements which can be interfaced with the system later on.

9.2 Tools and Techniques

The tools and techniques that we used in designing this website are the following:

- Adobe Dreamweaver
- HTML
- CSS
- PHP
- WAMP SERVER

9.2.1 Adobe Dreamweaver

Adobe Dreamweaver is one of the best tools for website development. It is very developer-friendly software and provides developers with a number of readymade blocks and many other features. It contain environment where a beginner can code very easily for whichever programming language is used. The developer can code in C, PHP,

HTML, CSS, JAVA etc. the software contains code design modes where in one block you can write your code and simultaneously in the second block you can see your code being implemented and having the shape of a website. Following is the interface of the Adobe Dreamweaver:

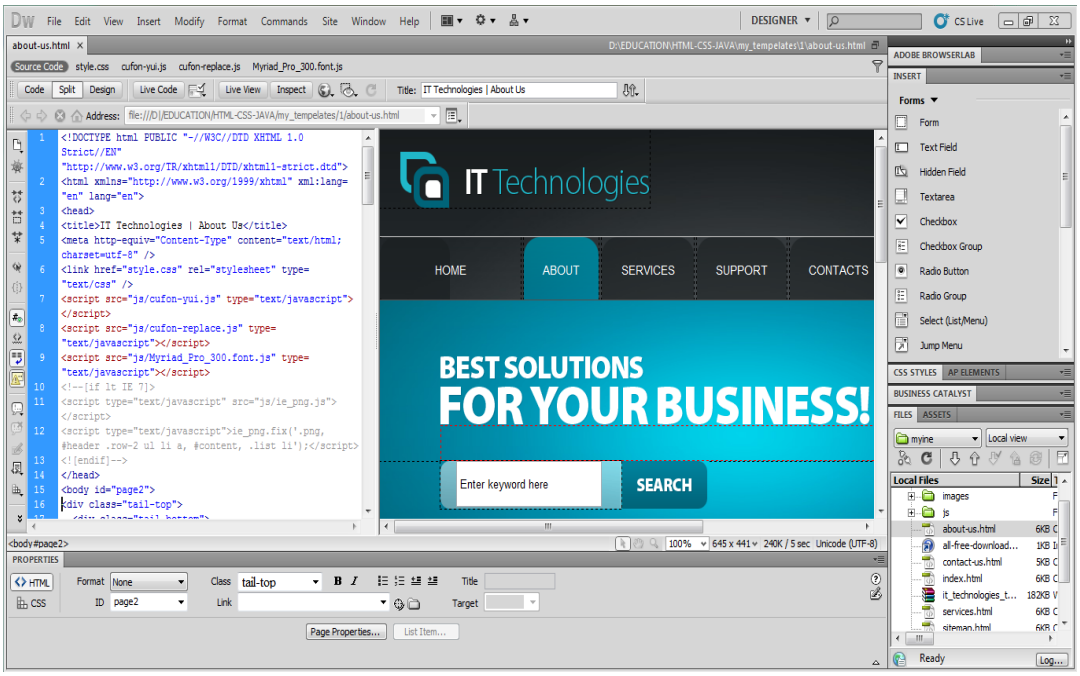


Figure 42 Interface of Adobe Dreamweaver

9.2.2 HTML/CSS/PHP

HTML is the programming language which is being used mainly in the layout making of the web portal. This is language mainly focuses on the appearance of the webpage. In our case we picked up a readymade HTML/CSS template and did some beginner level modification to the template to make it in accordance with our system and idea.

PHP on the other hand is a very trick language and is used for performing specific functions according to the website being designed. In our system, the main coding of the PHP was in the login-system where only authenticated user will be given services, other than that PHP coding was done in the map displaying in which the vehicle movement has been displayed on the map. For the map we used Google API.

9.2.3 WAMP Server

WAMP Server is another major tool that has been very helpful in developing our web portal. It is basically a combination of some technologies. In the word WAMP W stands for Windows, A stands for Apache, M stands for MYSQL and P stands for PHP. So this tool is basically designed for the windows operating system using Database and a server for management the data from database to the server and PHP language which is being implemented in the Website.

Following is the interface of the WAMP Server:

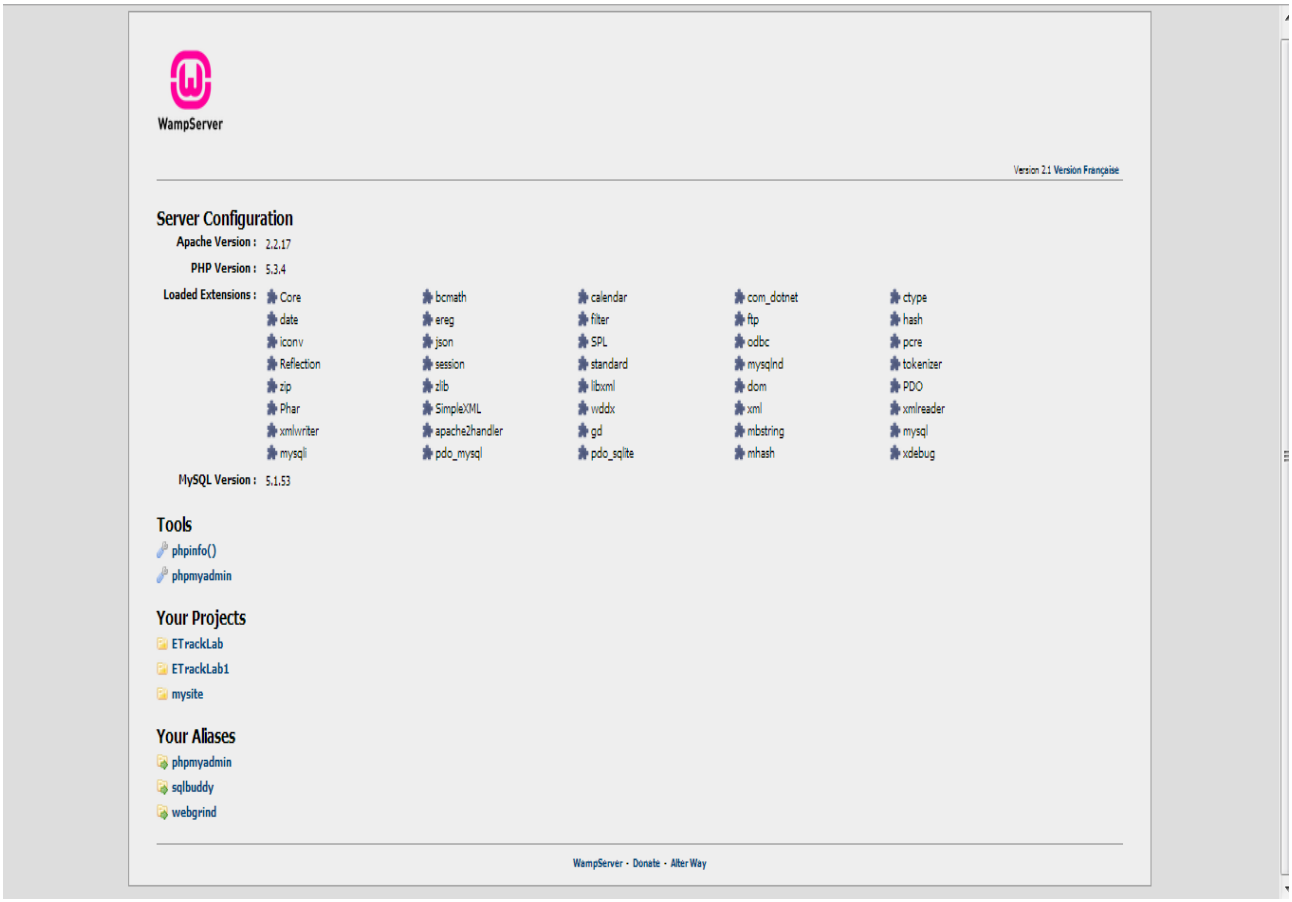


Figure 43 Interface of WAMP Server

9.3 Web Portal Interface

Following is the Interface of the web portal that we have designed for our project and where the owner will be given services:

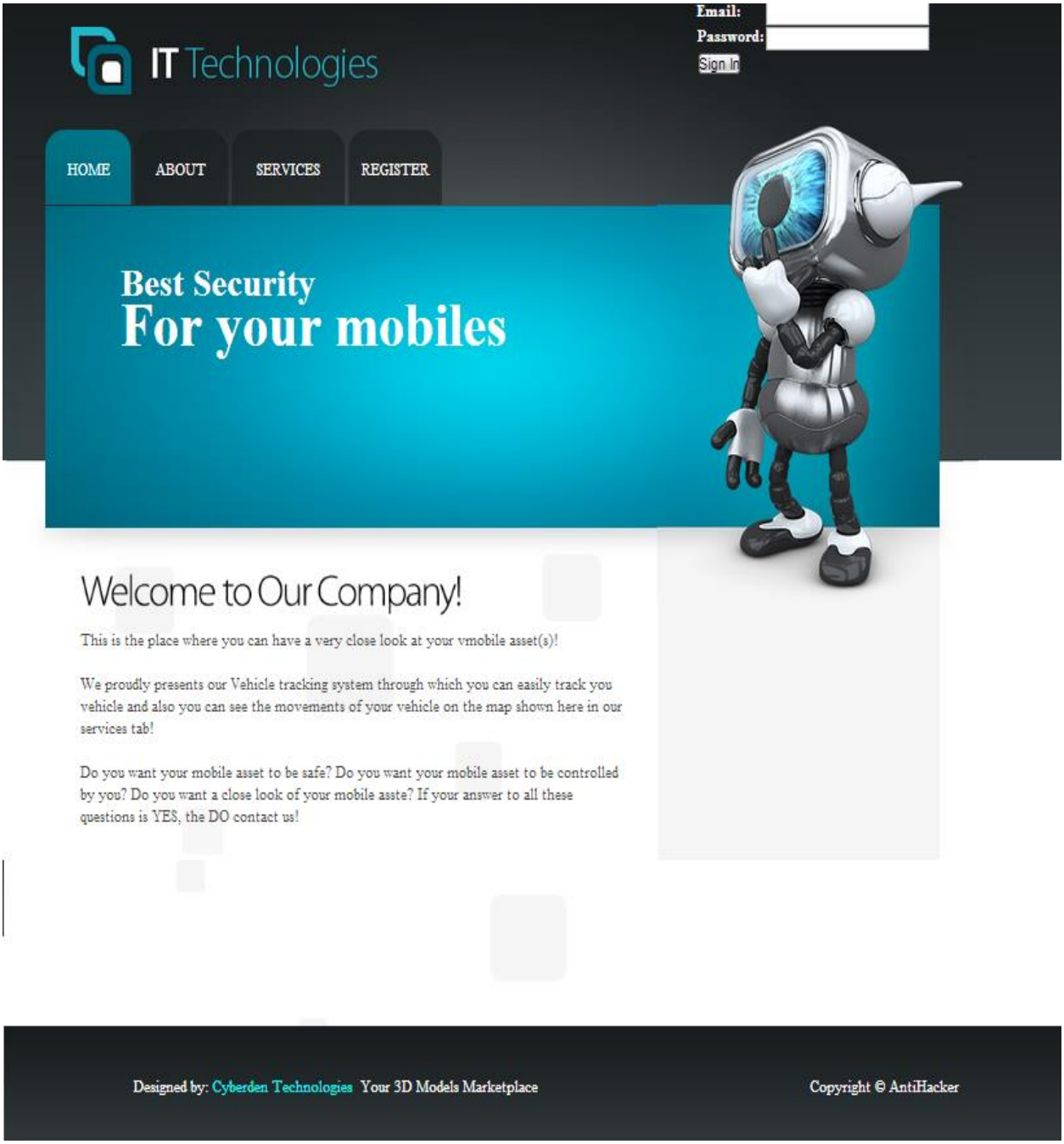


Figure 44 Interface of our Web Portal

9.4 Map Display on the Web Portal

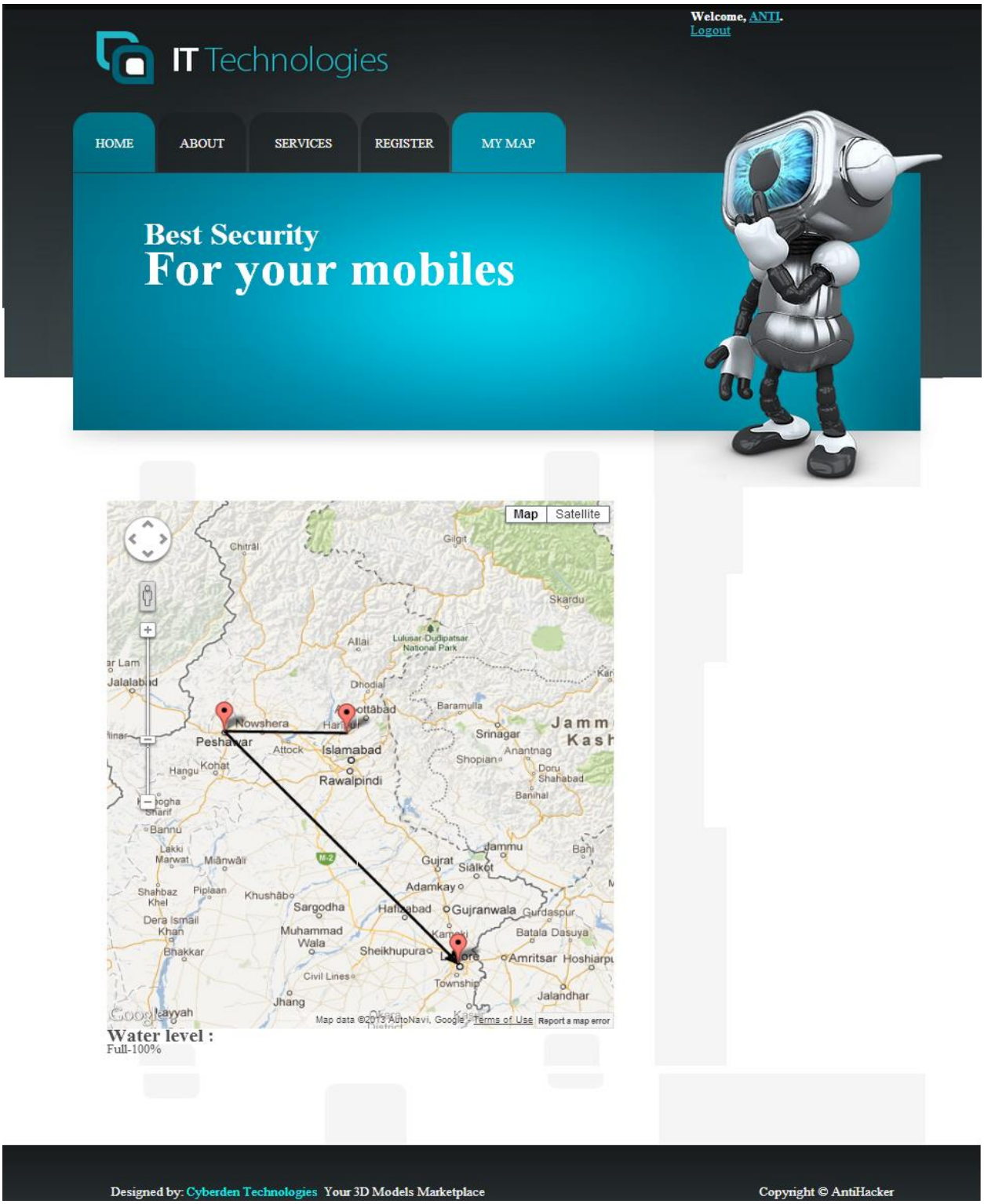


Figure 45 Display of the vehicle's track on the map

WORK BREAK DOWN STRUCTURE

1. GPS and GSM Based Vehicle Tracking System
    1.1 Initiation
        1.1.1 Research and thorough study of the project
            1.1.1.1 Browsing about the Project title
            1.1.1.2 Finding out if the project has any history
            1.1.1.3 Extent of work done on this project
            1.1.1.4 Extent of work done in Pakistan
            1.1.1.5 Make a list containing basic features of projects done by other
        1.1.2 Finding out the Related Thesis done
            1.1.2.1 Browsing about any thesis written about this or related project
            1.1.2.2 Downloading the Thesis
            1.1.2.3 Finding related Thesis from the university
            1.1.2.4 Issuing the Thesis for study purpose
            1.1.2.5 Putting all the Thesis and research material together
        1.1.3 Deeply studying the Thesis
            1.1.3.1 Study of the Thesis and research material
            1.1.3.2 Make a table for each thesis
            1.1.3.3 Record features(components, cost, feasibility, acceptability etc.) in table
            1.1.3.4 Make a list containing features of all the thesis work done
            1.1.3.5 Comparing the Thesis
            1.1.3.6 Initial Decision finalizing the components
        1.1.4 Discussing with supervisor
            1.1.4.1 Giving briefing about the project work done
            1.1.4.2 Giving briefing about the components
            1.1.4.3 Discussing and comparing the price and efficiency of components
            1.1.4.4 Finalize selecting components for the project
        1.1.5 Writing a Report
            1.1.5.1 Writing a report on the research work done so far
            1.1.5.2 Writing the work done by others
            1.1.5.3 Writing about the innovation and extensions we'll bring
            1.1.5.4 Explain the benefits of our hardware in comparison with other
            1.1.5.5 Completing the report
            1.1.5.6 Printing the report and giving it a proper official look
        1.1.6 *Deliverable:* Submit first Project Report
            1.1.6.1 Submitting the report to the supervisor
        1.1.7 Project Report Signed/Approved
            1.1.7.1 Getting the approval of the Project Report from the supervisor
            1.1.7.2 Submitting one copy of the Project report to PMC
    1.2 Planning

1.2.1 Search for the hardware requirements(GPS, GSM, MC) and their possible dealers
- 1.2.1.1 Browse for the components(GPS, GSM, MC) availability
- 1.2.1.2 Browse for the alternatives
- 1.2.1.3 Search and compare the prices, efficiency
- 1.2.1.4 Select dealer(s) for the hardware requirements(GPS, GSM, MC)

1.2.2 Create Preliminary Project Demonstration
- 1.2.2.1 Start making a Presentation on the project
- 1.2.2.2 Include the possible ways of doing the project
- 1.2.2.3 State a way the project should work on
- 1.2.2.4 Include the dealer(s) for the hardware requirement(GPS, GSM, MC)
- 1.2.2.5 Include a list of the components and their features according to the dealer
- 1.2.2.6 Complete Making the Presentation

1.2.3 Project Team Kickoff Meeting
- 1.2.3.1 Schedule a meeting with the team members
- 1.2.3.2 Coming for first Presentation
- 1.2.3.3 Giving the Presentation

1.2.4 Develop Project Plan
- 1.2.4.1 Present the different Project plans
- 1.2.4.2 Present the plan the project should work on

1.2.5 Submit Project Plan
- 1.2.5.1 Submit the project plan to the supervisor
- 1.2.5.2 Make sure the plan has been clearly explained

1.2.6 *Milestone:* Project Plan Approval
- 1.2.6.1 Getting approval of the project plan from the supervisor

1.3 Execution

1.3.1 Project Kickoff Meeting
- 1.3.1.1 Schedule a meeting with the supervisor
- 1.3.1.2 Coming for first Presentation
- 1.3.1.3 Giving the Presentation

1.3.2 Getting approval of the dealers
- 1.3.2.1 Explain the hardware availability and the possible dealer(s)
- 1.3.2.2 Explain the selecting criteria used for the dealer(s)
- 1.3.2.3 Getting the approval for dealers

1.3.3 Call for Hardware requirements(GPS, GSM, MC)
- 1.3.3.1 Contact the dealer(s) for the hardware
- 1.3.3.2 Giving the information about all the components(GPS, GSM, MC)
- 1.3.3.3 Booking of GPS module EM-406A
- 1.3.3.4 Booking of GSM module SIM900D
- 1.3.3.5 Booking of MICRCONTROLLER ATMEGA16

1.3.4 Receiving the shipment of the ordered components
- 1.3.4.1 Receiving the components through courier

1.3.4.2 Making sure the components are complete

1.3.5 Starting Simulation on GPS EM-406A
- 1.3.5.1 Start simulation work on GPS-software
- 1.3.5.2 Make a test circuit and connecting it to the GPS-software
- 1.3.5.3 Taking the GPS data into MC through Proteus-software
- 1.3.5.4 Displaying the GPS data on LCD in Proteus
- 1.3.5.5 Coding of the MC in CodeVisionAVR-software
- 1.3.5.6 Decoding the Location values from the GPS stream
- 1.3.5.7 Displaying the Latitude, Longitude on LCD
- 1.3.5.8 Complete simulation of GPS

1.3.6 Starting Simulation on GSM SIM900D
- 1.3.6.1 Start simulation work on GSM-software
- 1.3.6.2 Make a test circuit and connecting it to the GSM-software
- 1.3.6.3 Connect the GSM module to PC comport
- 1.3.6.4 Test the AT-COMMANDS in HyperTerminal
- 1.3.6.5 Connect the GSM to MC in Proteus
- 1.3.6.6 Send and Receive SMS through MC in Proteus

1.3.7 Design System
- 1.3.7.1 Design a hardware for interfacing GPS with MC
  - 1.3.7.1.1 Make a schematic of GPS connection with MC in ISIS-Proteus
  - 1.3.7.1.2 Carefully adjust all the components
  - 1.3.7.1.3 Make a PCB layout of the schematic in ARES-Proteus
  - 1.3.7.1.4 Print the PCB layout on PCB
  - 1.3.7.1.5 Etch the PCB
  - 1.3.7.1.6 Sold the components
  - 1.3.7.1.7 Test the working of GPS and MC
- 1.3.7.2 Design a hardware for interfacing GSM with MC
  - 1.3.7.2.1 Make a schematic of GSM connection with MC in ISIS-Proteus
  - 1.3.7.2.2 Carefully adjust all the components
  - 1.3.7.2.3 Make a PCB layout of the schematic in ARES-Proteus
  - 1.3.7.2.4 Print the PCB layout on PCB
  - 1.3.7.2.5 Etch the PCB
  - 1.3.7.2.6 Sold the components
  - 1.3.7.2.7 Test the working of GSM and MC

1.3.8 Procure Hardware/Software
- 1.3.8.1 Obtain the final integrated hardware
- 1.3.8.2 Test the integrated board
- 1.3.8.3 Test all the values on the LCD
- 1.3.8.4 Test the values of location shown on LCD
- 1.3.8.5 Test for different locations

1.3.9 Install Development System

- 1.3.9.1 Install the system in the vehicle
- 1.3.9.2 Carefully adjust the system in the vehicle's front portion

1.3.10 Testing Phase

- 1.3.10.1 Test the running of the system
- 1.3.10.2 Test for vehicle's location

1.3.11 Install Live System

- 1.3.11.1 Finalize the installation of the system and go live
- 1.3.11.2 Take a test drive
- 1.3.11.3 Observer the location of the vehicle on internet and cell phone

1.3.12 Go Live

- 1.3.12.1 Permanently install the system in the vehicle
- 1.3.12.2 Observer vehicle's motion and location

1.4 Control

1.4.1 Project Management

- 1.4.1.1 Check the scheduled work
- 1.4.1.2 Manage the data from the vehicle on website
- 1.4.1.3 Reset the system in case of any error

1.4.2 Project Status Meetings

- 1.4.2.1 Schedule a meeting with Supervisor
- 1.4.2.2 Explain the work done so far

1.5 Closeout

1.5.1 Audit Procurement

- 1.5.1.1 Combining together all the receipts
- 1.5.1.2 Calculating overall cost of the project
- 1.5.1.3 Submitting the receipts to the concerned departments

1.5.2 Update Files/Records

- 1.5.2.1 Update the files containing the monitory records
- 1.5.2.2 Update the files containing the technical records
- 1.5.2.3 Update other files

1.5.3 Gain Formal Acceptance

- 1.5.3.1 Submit the Final Project Report
- 1.5.3.2 Give the final presentation
- 1.5.3.3 Defend your project
- 1.5.3.4 Gain the Acceptance of the project from the supervisor

1.5.4 Archive Files/Documents

1.5.5 Project Completion

BIBLIOGRAPHY

[1]. How GPS works
http://www.cmtinc.com/gpsbook/

[2]. GPS Technology
http://www.beaglesoft.com/gpstechnology.htm

[3]. Short message service: What, How and Where?
http://www.wirelessdevnet.com/channels/sms/features/sms.html

[4]. what is GPS?
http://www.cmtinc.com/gpsbook/

[5]. Structure of GPS
http://www.engineersgarage.com/articles/global-positioning-system-gps?page=2

[6]. How does GPS works
http://airandspace.si.edu/gps/work.html

[7]. Commands of GPS
M-89 datasheet

[8]. Introduction to GSM
http://gsmfordummies.com/intro/intro.shtml

[9]. GSM: Network Architecture
http://www.cs.ucl.ac.uk/staff/t.pagtzis/wireless/gsm/arch.html

[10]. GSM Network Architecture –Working of GSM Networks
http://www.wifinotes.com/mobile-communication-technologies/gsm-architechture.html

[11]. Network Switching Subsystem
http://www.tutorialspoint.com/gsm/gsm_network_switching_subsystem.htm

[12]. GSM Baseband Implementation
komrad.pbworks.com/f/GSM+Baseband+Implementation.doc

[13]. SIM900 Data Sheet
http://ebookbrowse.com/sim900-data-sheet-pdf-d43669597

[14]. ATmega32 Data Sheet
http://www.atmel.com/Images/doc2503.pdf

[15]. RS232 Connections
http://airborn.com.au/serial/rs232.html

[16]. RS232 DB9 connector
www.larkfield.org/pdf/RS232_DB9_Connector.pdf

[17]. MAX232 IC Data Sheet
http://www.datasheetcatalog.org/datasheet/texasinstruments/max232.pdf

[18]. LM338 Data Sheet
www.datasheetcatalog.org/datasheet2/8/0ujhh2scud4dfop1xfyut2u2qopy.pdf

[19]. How SPI work, programming steps
AVR SPI tutorial.htm

[20]. Multipath error in GPS
http://www.gpsinformation.net/multipath.h