# Project Documentation

## Friend-Finder

**Project Title:** GSM and GPS

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**Team Mentor:** Mohit Agarwal, Vatsal Sharan

**Basic aim:**

To track a friend by merely an SMS.

### How did I get the Idea…??

Today we are living in a world where everything is so fast and perfect that we can't afford to lose our time on trivial things. Most of the recent ideas and inventions focus on making things easier and more comfortable. Keeping this in mind we wanted to develop something so that we could get a result on the click of some buttons. Therefore we developed a project whereby a person can get his distance from any landmark by just sending a message. This is implemented with the help of GPS and GSM.

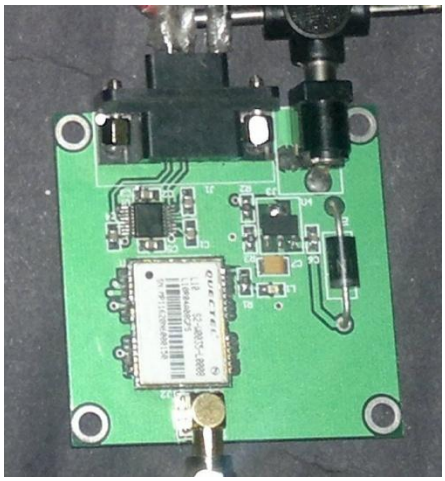
### Theory:

### GPS:

The GPS is a satellite-based navigation system made up of a network of 24 satellites placed into orbit. GPS works in any weather conditions, anywhere in the world, 24 hours a day. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

### How it works:

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is.Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map.

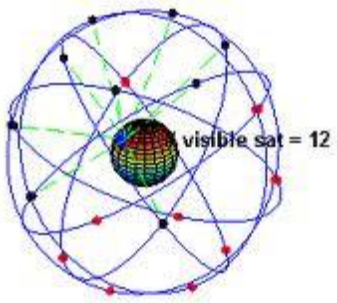


**Quectel l10**

A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more.

## The GPS satellite system:

The 24 satellites that make up the GPS space segment are orbiting the earth about 12,000 miles above us. They are constantly moving, making two complete orbits in less than 24 hours. These satellites are travelling at speeds of roughly 7,000 miles an hour.




GPS satellites are powered by solar energy. They have backup batteries onboard to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path.

The GPS module provided to us was **Quectel l10 .**

## GSM:

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access (TDMA) and is the most widely used of the three digital wireless telephony technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1800 MHz frequency band.


Using TDMA, a **narrow band** that is 30 kHz wide and 6.7 milliseconds long is split time-wise into three time slots. Narrow band means channels in the traditional sense. Each conversation gets the radio for one-third of the time. This is possible because voice data that has been converted to digital information is compressed so that it takes up significantly less transmission space. Therefore, TDMA has three times the **capacity** of an analog system using the same number of channels.

## Hardware configuration:

### Major components used are:

Atmega-16
Max-232
Quectel L10 GPSmodule
I300 GSM module
LCD

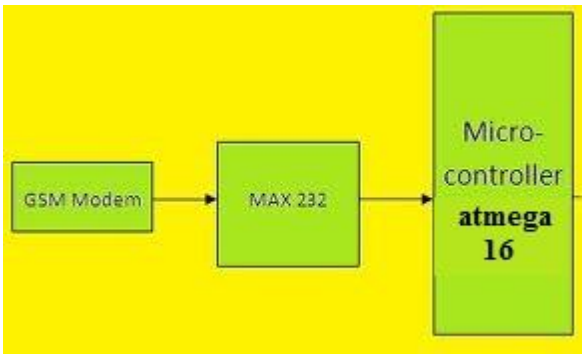
MCU used is AtMega16 clocked to 12MHz.

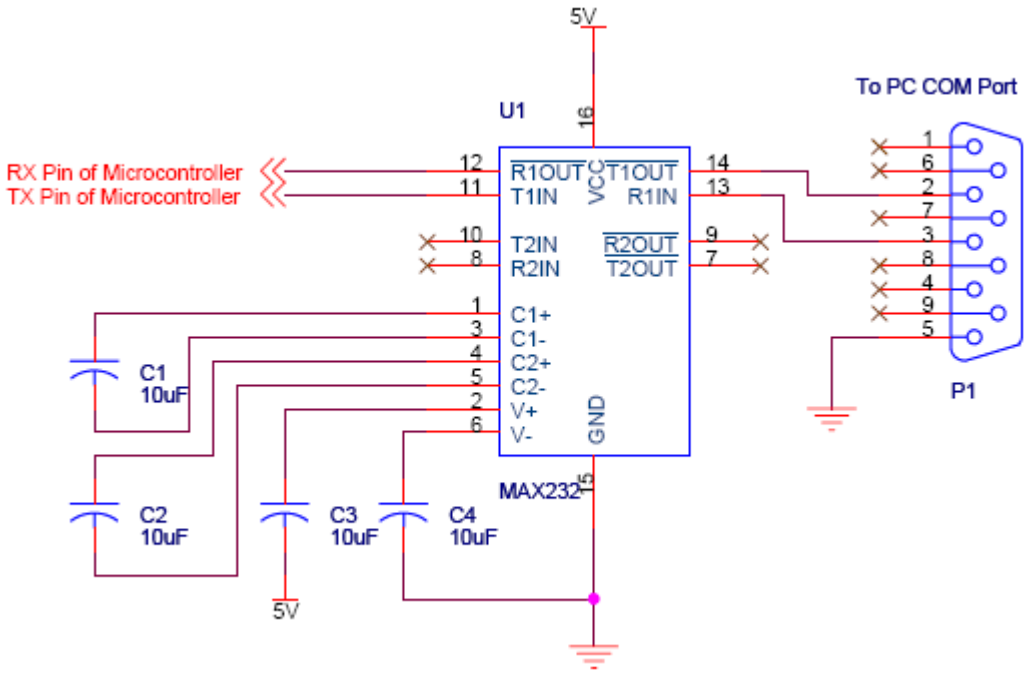
**Clocking of ATMEGA using external Crystal Oscillator:**

Simply attach the 12MHz Crystal Oscillator to the 12$^{th}$ and 13$^{th}$ pin of Atmega16 i.e. XTAL1 and XTAL2.If CPU frequency is defined change it to the frequency of external crystal i.e. 12MHz and finally while programming the MCU through AVR Studio go into fuse setting choose EXT Crystal with maximum delay time and Program it.

**Interfacing the modem and microcontroller:**

The GPS module gives us the latitude and longitude of a particular position. To access these values these values are transferred to a microcontroller-atmega16 through a MAX232.Similarly the GSM module is interfaced with the atmega through a MAX.
This communication between the module and MAX and MAX and Atmega takes place with the help of UART.




**Pin diagram for interfacing a microcontroller with a serial port through MAX 232**

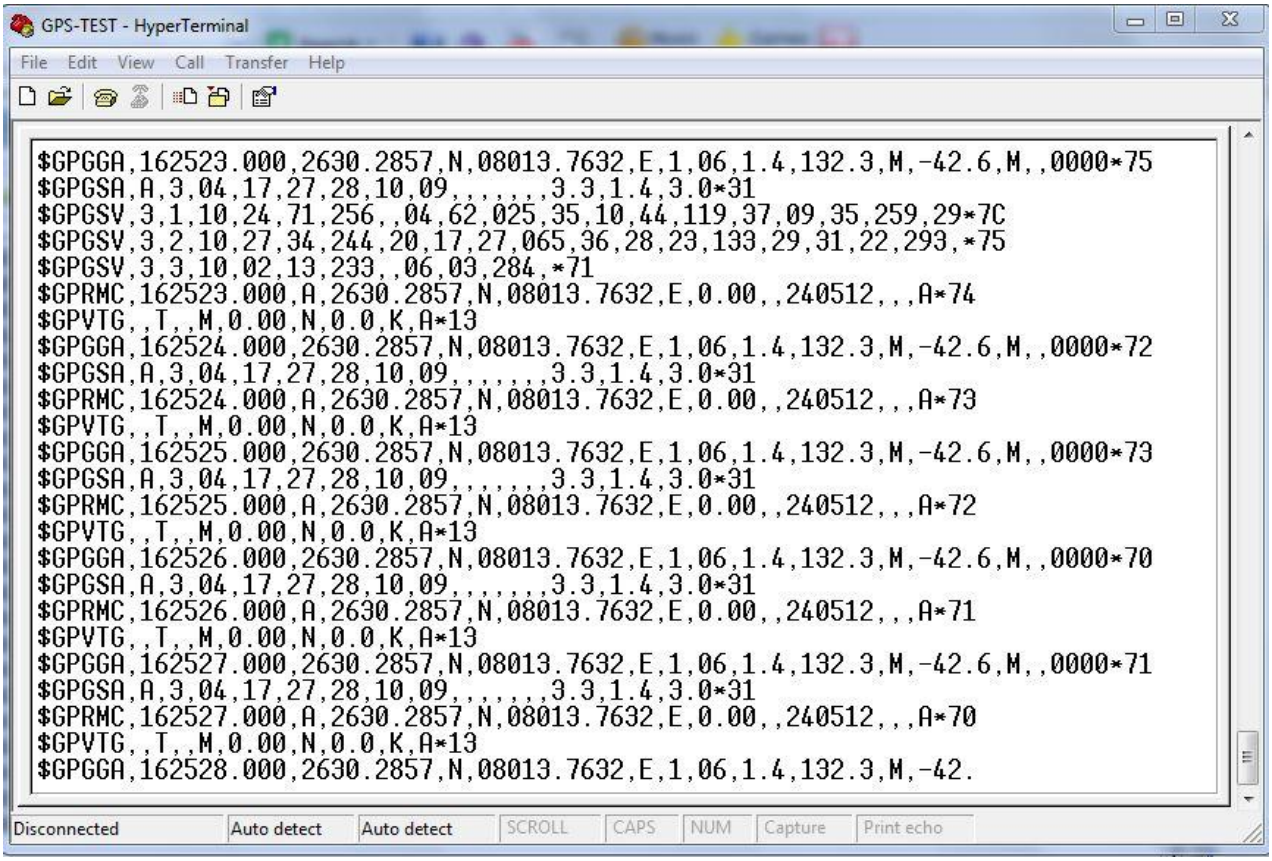
**The two atmega communicate with each other through SPI.**

| Pin NO. | Description |
|---|---|
| 6 | MOSI (SPI Bus Master Output/Slave Input |
| 7 | MISO (SPI Bus Master Input/Slave Output) |
| 8 | SCK (SPI Bus Serial Clock) |
| 9 | Reset |
| 10 | Vcc |
| 11 | Ground |

**Table-Atmega16 Pins**

**Using the GPS module:**

The gps module gives us data which we have to decode as per our requirement.




A screenshot of the GPS data on the hyperterminal.

**Decoding of selected position sentences:**

The most important NMEA sentences include the GGA which provides the current Fix data, the RMC which provides the minimum gps sentences information, and the GSA which provides the Satellite status data.

**GGA** - essential fix data which provide 3D location and accuracy data.

```
$GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47

Where:
     GGA          Global Positioning System Fix Data
     123519       Fix taken at 12:35:19 UTC
     4807.038,N   Latitude 48 deg 07.038' N
     01131.000,E  Longitude 11 deg 31.000' E
     08           Number of satellites being tracked
     0.9          Horizontal dilution of position
     545.4,M      Altitude, Meters, above mean sea level
     46.9,M       Height of geoid (mean sea level) above WGS84
                  ellipsoid
```

We extracted the data from the GPS module to give us the latitude and longitude of a position.

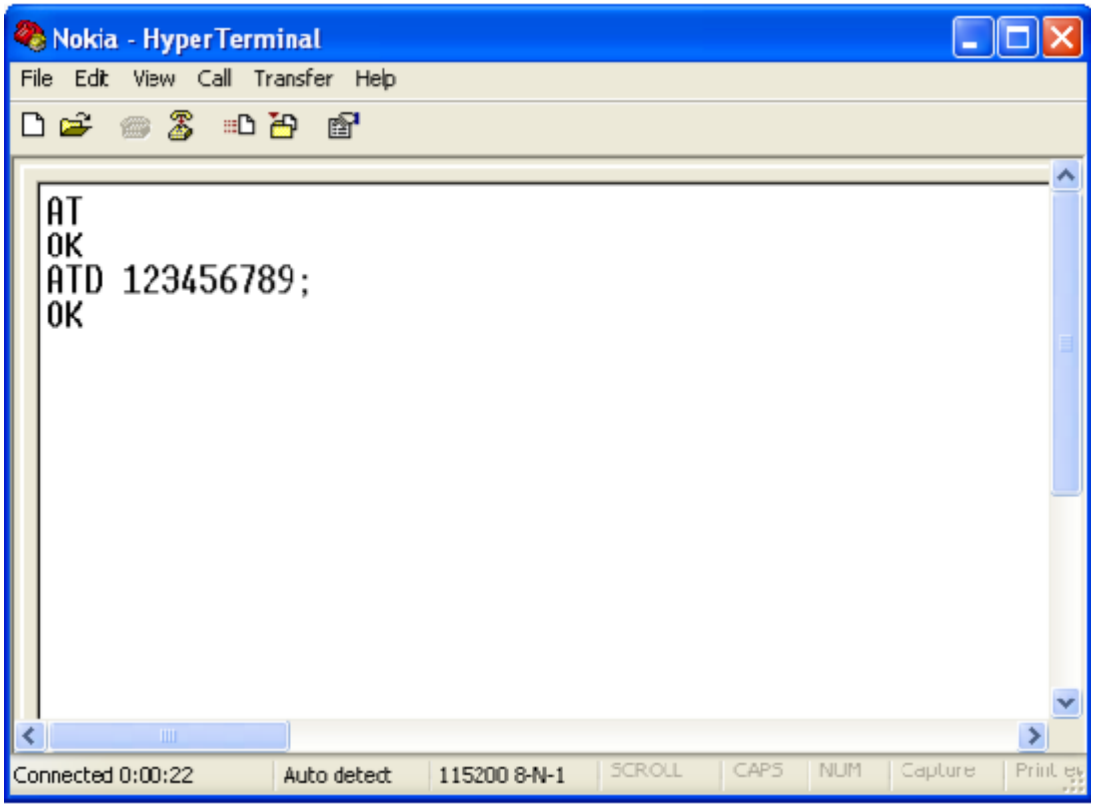
Further we used these values to calculate the distance between two points. For this purpose we used the **HAVERSINE FORMULA.**

Haversine formula:

$a = \sin^2(\Delta lat/2) + \cos(lat_1).\cos(lat_2).\sin^2(\Delta long/2)$
$c = 2.\arctan2(\sqrt{a} / \sqrt{(1-a)})$
$d = R.c$ *where R is earth's radius (mean radius = 6,371km)*
*( angles need to be in radians to pass to trig functions!)*

**GSM:**

With the help of the GSM module we can communicate between two sim cards.




**GSM module working on the hyperterminal.**

Commonly used commands for a GSM module:

1) AT - This command is used to check communication between the module and the computer.
For example,
AT
OK
The command returns a result code OK if the computer (serial port) and module are connected properly. If any of module or SIM is not working, it would return a result code ERROR.

2) +CMGF - This command is used to set the SMS mode. Either text or PDU mode can be selected by assigning 1 or 0 in the command.
SYNTAX: AT+CMGF=<mode>
0: for PDU mode
1: for text mode

The text mode of SMS is easier to operate but it allows limited features of SMS. The PDU (protocol data unit) allows more access to SMS services but the operator requires bit level knowledge of TPDUs. The headers and body of SMS are accessed in hex format in PDU mode so it allows availing more features.

For example,
AT+CMGF=1
OK

3) +CMGW - This command is used to store message in the SIM.
SYNTAX: AT+CMGW=" Phone number"> *Message to be stored* Ctrl+z
As one types AT+CMGW and phone number, '>' sign appears on next line where one can type the message. Multiple line messages can be typed in this case. This is why the message is terminated by providing a 'Ctrl+z' combination. As Ctrl+z is pressed, the following information response is displayed on the screen.

+CMGW: Number on which message has been stored

4) +CMGS - This command is used to send a SMS message to a phone number.
SYNTAX: AT+CMGS= serial number of message to be send.

As the command AT+CMGS and serial number of message are entered, SMS is sent to the particular SIM.
For example,
AT+CMGS=1
OK

5) ATD - This command is used to dial or call a number.
SYNTAX: ATD<Phone number>(Enter)
For example,
ATD123456789

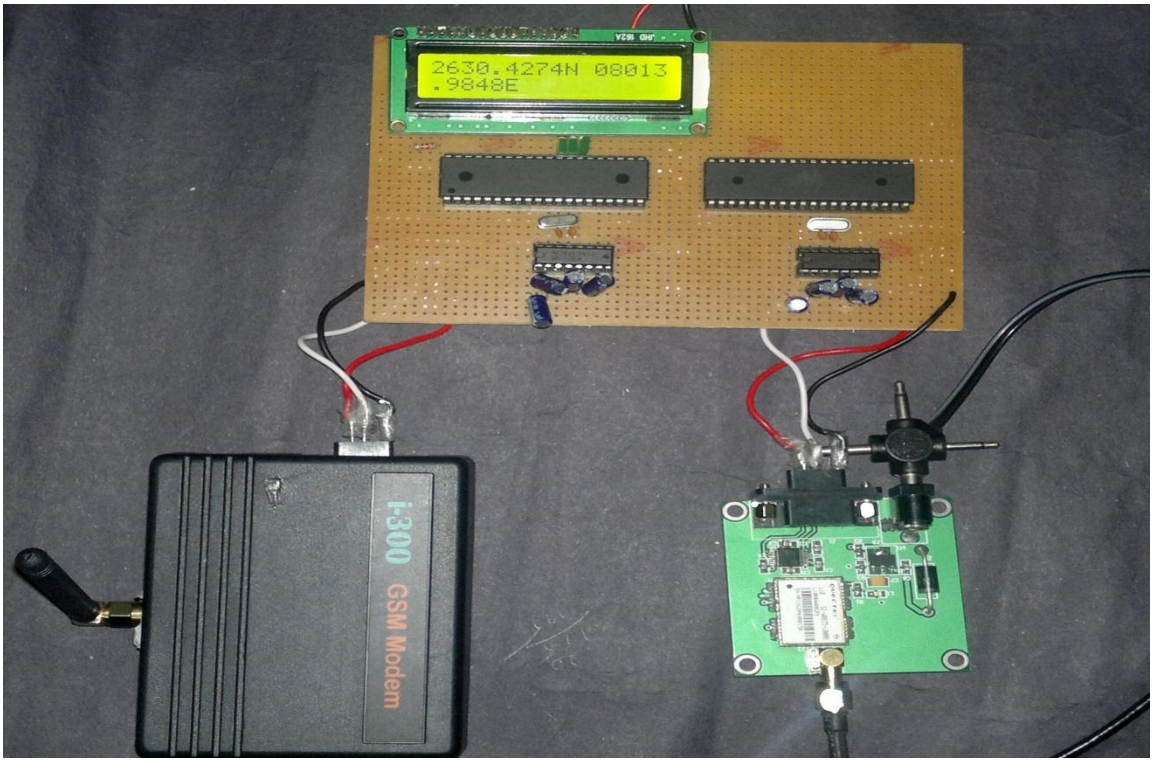
6) ATA - This command is used to answer a call. An incoming call is indicated by a message 'RING' which is repeated for every ring of the call. When the call ends 'NO CARRIER' is displayed on the screen.
SYNTAX: ATA(Enter)

As ATA followed by enter key is pressed, incoming call is answered.
For example,
RING
RING
ATA

7) ATH - This command is used to disconnect remote user link with the GSM module.
SYNTAX: ATH (Enter)

**Integration of the various components:**

The GPS module gave us the latitude and longitude. This was channeled to the microcontroller through Max-232(UART). The decoding of NMEA data was done by Atmega16 which was programmed in AVR studio. The code was written in CVAVR.
The GSM module was connected to atmega through Max-232. The microcontrollers communicate with each other through SPI.
When a user sends a message his number is extracted. The GPS data from the first microcontroller is sent to the microcontroller connected with the modem and a reply is sent to the extracted number.




**The Final Product**

## Utility:

- Friend Finder
- Vehicle Tracking
- Data Logging

## Useful Links:

- http://www.gpsinformation.org/dale/nmea.htm
- http://www.movable-type.co.uk/scripts/latlong.html
- http://www.winsystems.com/reprints/GSM%20AT%20Commands%20Rev.C.pdf

## Problems Faced:

At first we started with a different idea in mind. Our project was to move a bot from an initial point to a final point using GPS values and sending the commands through GSM. But due to problems of inaccuracy we had to abandon that part. Finally we came up with a Friend Finder which helps us to locate a friend by just sending a message.

## A word of thanks:

I would specially like to thank my team mentors MOHIT AGARWAL and VATSAL SHARAN , Club Coordinators RUDRA PRATAP SUMAN, ANURAG DWIVEDI and NIKHIL GUPTA for guiding us during the summers and for helping us learn new things….