GSM Based Tracking by the means of SMS

BS

Aug. 2009

GSM Based Tracking by the means of SMS

Session 2004 – 2009

Project Advisor
Mr. Khan Asmar Azar

Submitted By:

Rehan Amjad Ahad	040420-010
Talha Zaryab Farooq	040420-030
Junaid Majid Bhullar	040420-087

Department of Electrical Engineering

University of Management and Technology
Lahore

A report submitted to the

Department of Electrical Engineering

in partial fulfillment of the requirements for the

degree

Bachelor of Science

in

Telecommunication Engineering

by

Rehan Amjad Ahad

Talha Zaryab Farooq

Junaid Majid Bhullar

University of Management of Technology

August 22, 2009

Acknowledgements

We truly acknowledge the cooperation and help make by Mr. Khan Asmar Azar, Co-Manager BS Capstone Projects, Department of Electrical Engineering, University of Management and Technology. He has been constant source of guidance throughout the course of this project. We would also like to thank Dr. Khalid H. Qamar, head Department of Electrical Engineering and Mr. Mudathir Qamar for his help and guidance in understanding the project concept and recommendation. We are also thankful to our friends and families whose silent support led us to complete our project.

(Signed)

Rehan Amjad Ahad 040420-010

Talha Zaryab Farooq 040420-030

Junaid Majid Bhullar 040420-087

Date

August 22, 2009

Dedication

We dedicate this project to all those people who are related to us in our lives and especially to our PARENTS and TEACHERS from our school life till university level, who made us so capable to make this project to completion.

Abstract

This report describes technical details about microcontroller architecture, assembly language, GSM modem and GPS module. In this project we are controlling the GSM modem and GPS module through 8051 microcontroller which proves the cell location and the coordinates of the device and sends it to the owner's cell phone.

List of Figures

List of Tables

Table of Contents

Chapter 1

Introduction

1.1 Project Description:

This project is based on a positioning solution (Cell Location) for locating the position and the exact global coordinates of a vehicle or any other thing via an SMS (Short Message Service), sent to the owner's device. The system uses the GSM cell IDs and GPS Coordinate to obtain the position of the vehicle.

The project is a detailed study on the microcontroller 8051, the assembly language, GSM modems, and GPS Module. GSM network operations and SIM (Subscriber identity Module). It will be connected to GSM network through SIM card and we will connect it with the microcontroller and also the GPS Module. We will use the SIM of the operator that shows the cell location on the cellular phone. In Pakistan "Telenor Pakistan" is the only telecom company which is providing the cell broadcast message.

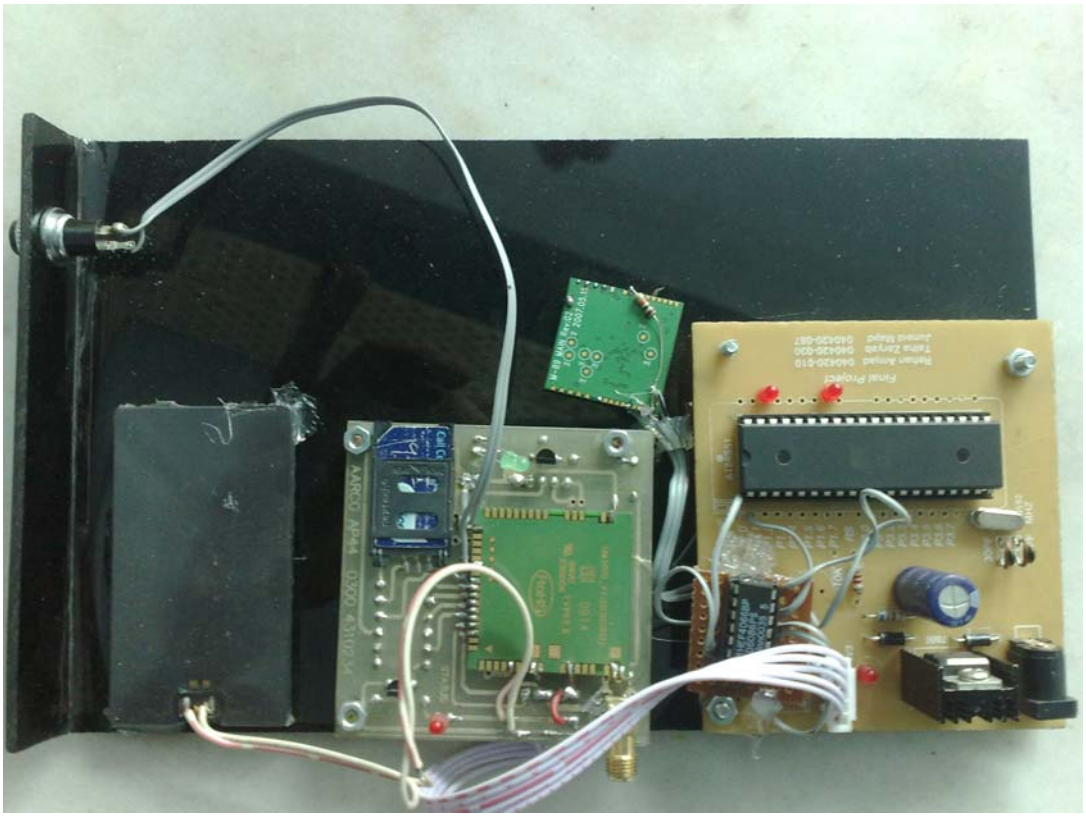
We will program the microcontroller according to our requirements that will send AT commands to GSM modem to work accordingly. GSM modem will fetch cell I.D from the network, will get instructions from microcontroller and then it will send message to required number containing the location (cell) name and for global coordinates, GPS Module is used.

Security and efficiency in every aspect of life is an integral part and requirement of everybody. As the functionality of the project is described in introduction, it can be used in many ways and in many companies that require location updates. But we are focusing it on the courier companies because there is a very vast competition and growth in this company. Investors are investing a lot into this industry but only that organization will succeed that has fastest and accurate deliveries. The scope of this industry is throughout all cities of the country and some companies deal inter-country also. When the delivery vehicles are out for delivery them concerned person who is responsible for making the deliveries possible in time may require the information that where the vehicle has been reached. So instead of taking some manual actions to get this information, he/she will be automatically updated regarding the location by an SMS that he will receive from our project hardware that will be installed into the vehicle.

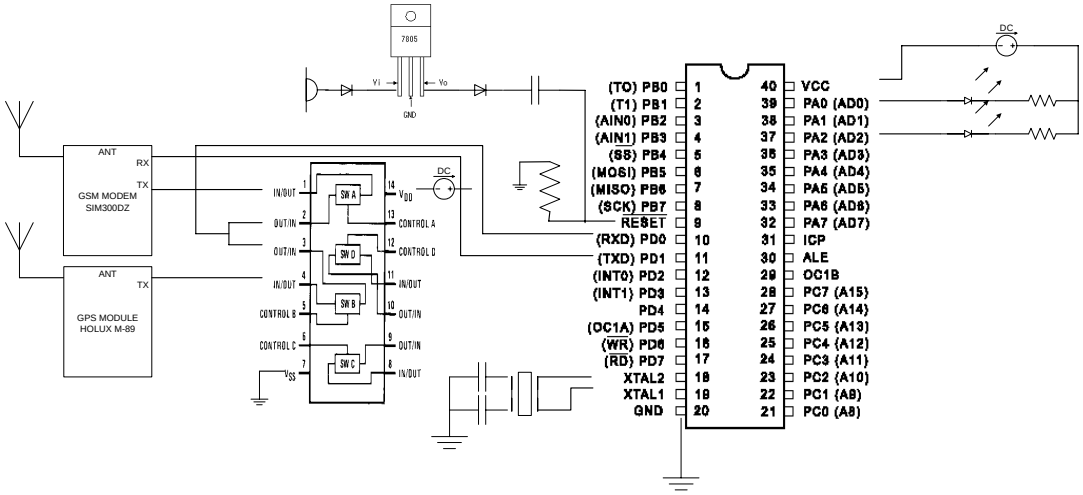
Similarly if we generalize it then it can be used as a tracker system for vehicles. And it is very cheaper and low cost as an SMS costs which is very cheaper in our country.

.

1.2 Circuit Diagram:



(Fig 1.1: Hardware for Tracking)



(Fig 1.2: Circuit Diagram)

1.3 Working Scenario:

As we know this project is about the location management and we have two devices connected to microcontroller from which we are having our input. GSM modem gives us the location area of the BTS and the GPS module gives us the coordinates.

When we want to have the location area i.e. the cell broadcast message we send sms to the device with a specific code and it will reply on the specific number of the device holder. The location area we get is the name of the BTS (Base transmission Station) which is sent by BSC (Base Station Controller) which broadcast the cell ID or site name. for example if the device is in the range of the BTS of Johar Town, it will send the cell ID or the named assigned to it like “Johar Town Lhr”. In Pakistan Telenor gives the services of cell broadcast message. The GSM modem enables to get the information using the AT commands and sends it to the microcontroller via serial communication which is an easy way to communicate between the devices and for which low level assembly language is used. The microcontroller then send the cell broadcast message to the GSM modem which replies with the location area to the sender which has requested for the location area.

And when we want the geographical coordinates, we send a specific message to the device and it will give us the coordinates in latitude and longitude. This process includes the fetching of geographical coordinates from the GPS module and sending it to the GSM modem using a microcontroller which replies on the specific number with the geographical coordinates.

Chapter 2

Global Positioning System (GPS)

2.1 Basic concept of GPS:

A GPS receiver calculates its position by precisely timing the signals sent by the GPS satellites high above the Earth. Each satellite continually transmits messages containing the time the message was sent, precise orbital information (the ephemeris), and the general system health and rough orbits of all GPS satellites (the almanac). The receiver measures the transit time of each message and computes the distance to each satellite. Geometric trilateration is used to combine these distances with the location of the satellites to determine the receiver's location. The position is displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units also show derived information such as direction and speed, calculated from position changes.

It might seem three satellites are enough to solve for position, since space has three dimensions. However, even a very small clock error multiplied by the very large speed of light the speed at which satellite signals propagate—results in a large positional error. Therefore receivers use four or more satellites to solve for *x*, *y*, *z*, and *t*, which is used to correct the receiver's clock. While most GPS applications use the computed location only and effectively hide the very accurately computed time, it is used in a few specialized GPS applications such as time transfer, traffic signal timing, and synchronization of cell phone base stations.[2]

2.2 NMEA Protocol:

NMEA is a standard protocol, use by GPS receivers to transmit data. NMEA output for most purposes is RS-232 compatible. Use 4800 bps, 8 data bits, no parity and one stop bit (8N1). NMEA 0183 sentences are all ASCII. Each sentence begins with a dollar sign ($) and ends with a carriage return linefeed (<CR><LF>). Data is comma delimited. All commas must be included as they act as markers. Some GPS do not send some of the fields. A checksum is optionally added (in a few cases it is mandatory). [5]

2.3 GPS Message Strings and Terminal Programs:

The National Marine Electronics Association (NMEA) defined a RS-232 communication standard for devices that include GPS receivers. The GPS receivers can output geospatial location, time, headings and navigation-relevant information in the form of ASCII comma-delimited message strings. Hyper-terminal, bundled with Windows, can be used to view these message strings.

2.4 GPS and Hyper-terminal:

Handheld GPS receivers, like the Garmin eMap, come equipped with a cable that plugs into your PC's serial port. Hyper terminal is a communications program that comes with Windows 95/98/ME/NT/2K and XP. GPS receiver's probably describes the necessary

terminal settings; a typical port setting is 4800 baud, 8N1 (eight data bits, no parity, 1 stop bit) with no flow control.

2.5 Dissecting the GPS Message String:

The NMEA standard dictates how each string is formed with a dollar sign ($) leading each new GPS message.

Brief descriptions of the seven standard message strings are:

```
$GPGLL  Geographical position, latitude and longitude
$GPGSA  GPS dilution of precision and active satellites
$GPGSV  GPS satellite in view
$GPGGA  GPS fixed data
$GPRMC  Recommended minimum specific GPS/TRANSIT data
$GPVTG  Track made good and ground speed
$GPZDA  Time and date
```

$GPRMC,000605.026,V,8960.000000,N,00000.000000,E,0.00,0.00,060180,,,N*79

2.6 Extracting data from GPRMC:

2.6.1 The GPRMC Sentence

This sentence, known as the "Recommended Minimum" sentence, is the most common sentence transmitted by GPS devices. This one sentence contains nearly everything a GPS application needs: latitude, longitude, speed, bearing, satellite-derived time, fix status and magnetic variation.

2.6.2 Sentence Example

$GPRMC,040302.663,A,3939.7.N,10506.6,W,0.27,358.86,200804,,*1A

2.6.3 Sentence Contents

The GPRMC sentence consists of twelve comma-delimited words:

2.6.4 The Command Word

$GPRMC,040302.663,A,3939.7.N,10506.6,W,0.27,358.86,200804,,*1A

The command word indicates that the sentence is to be interpreted as a recommended minimum message.

2.6.5 Satellite-Derived Time

$GPRMC,**040302.663**,A,3939.7.N,10506.6,W,0.27,358.86,200804,,*1A

GPS devices are able to calculate the current date and time using GPS satellites (and not

the computer's own clock, making it useful for synchronization). This word stores the current time, in UTC, in a compressed form "HHMMSS.XXX," where HH represents hours, MM represents minutes, SS represents seconds, and XXX represents milliseconds. The above value represents 04:03:02.663 AM UTC.

2.6.6 Satellite Fix Status

$GPRMC,040302.663,**A**,3939.7.N,10506.6,W,0.27,358.86,200804,,*1A

When the signals of at least three GPS satellites become stable, the device can use the signals to calculate the current location. The device is said to be "fixed" when calculations of the current location are taking place. Similarly, the phrases "obtaining a fix" or "losing a fix" speak of situations where three signals become stable or obscured, respectively.

A value of "A" (for "Active") indicates that a fix is currently obtained, whereas a value of "V" (for "inValid") indicates that a fix is not obtained.

2.6.7 Latitude Decimal Degrees

$GPRMC,040302.663,A,**3939.7**.N,10506.6,W,0.27,358.86,200804,,*1A

The latitude represents the current distance north or south of the equator. This word is in the format "HHMM.M" where HH represents hours and MM.M represents minutes. A comma is implied after the second character. This value is used in conjunction with the longitude to mark a specific point on Earth's surface. This sentence says that the current latitude is "39°39.7'N".

2.6.8 Latitude Hemisphere

$GPRMC,040302.663,A,3939.7.**N**,10506.6,W,0.27,358.86,200804,,*1A

This word indicates if the latitude is measuring a distance north or south of the equator. A value of "N" indicates north and "S" indicates south. This sentence says that the current latitude is "39°39.7'N".

2.6.9 Longitude Decimal Degrees

$GPRMC,040302.663,A,3939.7.N,**10506.6**,W,0.27,358.86,200804,,*1A

The longitude represents the current distance east or west of the Prime Meridian. This word is in the format "HHHMM.M" where HHH represents hours and MM.M represents minutes. A comma is implied after the third character. This value is used in conjunction with the latitude to mark a specific point on Earth's surface. This sentence says that the current longitude is "105°06.6'W".

$GPRMC,040302.663,A,3939.7.N,10506.6,**W**,0.27,358.86,200804,,*1A

This word indicates if the longitude is measuring a distance east or west of the Prime Meridian. A value of "E" indicates east and "W" indicates west. This sentence says that the current longitude is "105°06.6'W".

2.6.10 Speed

$GPRMC,040302.663,A,3939.7.N,10506.6,W,**0.27**,358.86,200804,,*1A

This word indicates the current rate of travel over land, measured in knots.

2.6.11 Bearing

$GPRMC,040302.663,A,3939.7.N,10506.6,W,0.27,**358.86**,200804,,*1A

This word indicates the current direction of travel over, measured as an "azimuth." An azimuth is a horizontal angle around the horizon measure in degrees between 0 and 360, where 0 represents north, 90 represents east, 180 represents south, and 270 represents west. This word indicates that the direction of travel is 358.86°, or close to north.

2.6.12 UTC Date

$GPRMC,040302.663,A,3939.7.N,10506.6,W,0.27,358.86,**200804**,,*1A

GPS devices maintain their own date and time calculated from GPS satellite signals. This makes GPS devices useful for clock synchronization since the date and time are independent of the local machine's internal clock. This word contains two-digit numbers for days, followed by months and years. In the example above, the date is August (08) 20th (20), 2004 (04). The two-digit year is added to 2000 to make a full year value.

2.6.13 The Checksum

$GPRMC,040302.663,A,3939.7.N,10506.6,W,0.27,358.86,200804,,***1A**

The checksum is used to identify errors in the data which may have occurred during transmission. [7]

Chapter 3

Microcontroller 8051