**GPS TRACKING SYSTEM**

**A**

**MAJOR PROJECT**

**Submitted for the partial fulfillment of the requirement for the award of Degree of**

**BACHELOR OF ENGINEERING**

**IN**

**COMPUTER SCIENCE & ENGINEERING**



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**CERTIFICATE**

This to certify that **Prashant Rajan, Rahul Sharma, Rohit Gautam** and **Vaishali Kumre** of B.E. final year Computer Science and Engineering have completed the major project “**GPS Tracking System**” during the academic year 2012-2013 under our guidance and supervision.

We approve the project for the partial fulfilment of the requirement for the award of Degree in Computer Science and Engineering**.**

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**Project Guide**

**ACKNOWLEDGEMENT**

We are thankful to all individuals who have lent us support and guidance without which we could not have completed our project in the stipulated period of time.

First and foremost, we would like to express our profound sense of gratitude to our project guides, **Dr. Sanjay Silakari, Head of Department of Computer Science & Engineering** and **Prof. Shikha Agrawal, Department of Computer Science & Engineering,** for their invaluable support, guidance, motivation and encouragement throughout the period. Their incisive inputs and concern have been extremely helpful. It was their enthusiastic and progressive outlook towards the project which inspired us throughout our work during this period. They closely followed the progress of the project. At last, we would like to express our gratitude towards **Joshua Chohan, final year BE student, Department of Electrical Engineering** for helping us with the design, fabrication and testing of the GPS tracking device.

Last but not the least we would like to extend our thanks to our fellow students for their friendly co-operation.

Prashant Rajan

Rahul Sharma

Rohit Gautam

Vaishali Kumre

**DECLARATION BY THE CANDIDATE**

We hereby declare that the work which is being presented in the Major Project **“GPS Tracking System”**, submitted in partial fulfilment of the requirement for the award of Bachelor Degree in Computer Science & Engineering, has been carried out in University Institute of Technology, RGPV, Bhopal and is an authentic work carried under the guidance of **Dr. Sanjay Silakari and Prof. Shikha Agrawal**, Department of Computer Science and Engineering, UIT - RGPV, Bhopal.

The matter written in this project has not been submitted by us for the award of any other Degree.

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**Abstract**

The Global Positioning System (GPS) is a location system based on a constellation of 24 to 32 satellites, orbiting round the earth at altitudes of 11,000 miles. In its earlier years, GPS was developed in the US, for the military Department of Defense (DOD). Through the years of development and improvement, we have advanced to being able to use GPS for the purpose of tracking our precise location worldwide, and as an aiding tool for non-military usage. Currently, GPS device is used as a navigation tool that assists the user on finding directions and navigating to the destination. It saves our time, energy and overall improves efficiency in our life.

Basically, most GPS devices found in the market are used for vehicle tracking as they include a monitor display to navigate to their destination. The GPS Tracking system can be used for companies like logistics and dispatch services for real time status of the post or good delivery. This will ensure that the delivery is on schedule and accountable to the customer on the current status of the delivery. In addition, it can be used for improved customer service. For instance, the customer service officer can locate and plan the service repairman near the customer’s area for any urgent case of repair request accordingly. This will speed up the response time to customer and eventually improve the efficiency.

There are many GPS tracking devices available in the market today. Nowadays, these devices are integrated in vehicles for navigation and tracking. These devices are expensive and hence are not affordable for everyone. Therefore, the main objective of this project is to develop a low cost object tracking system using limited resources. The low cost GPS tracking system would track the movement and determine the exact location of an object. This in turn would allow the user to track objects like goods, cargo, vehicles, etc. In a transport organisation scenario, the drivers would not be able to use the vehicle for personal usage, which in return would increase the efficiency of the organisation. This would help the company save money spent on fuel and thus increase its profits. The GPS tracking system can also be used as an added security to deter vehicle theft and notify the vehicle owner about it.

**TABLE OF CONTENTS**

**S. No. Topic Page no.**

1. **INTRODUCTION………………………………………………………….………..…1-9**
   1. Global Positioning System (GPS)………………………………………….……......1 1.1.1 Operation of GPS ……………………………………………………..……......1

1.1.2 Trilateration ………………………………………………….…...…....……....2

1.1.3 GPS Applications ………………………………………………………..….…4

1.2. GSM Technology……………………………….......................................................4

1.2.1 Base Station subsystem…………………..………………………………...…..5

1.2.2 GSM carrier frequencies………………………………………………….........6

1.2.3 Voice codecs……………………………………………………………………6

1.2.4 Subscriber Identity Module (SIM)…………………………………………......6

1.3. General Packet Radio Service (GPRS) …………...………..……………………….7

1.3. 1 Protocols supported …………………………………..………………………8

1.3.2 Hardware …………………....…………………...……………………………8

1.4 Short Message Service (SMS) Technology……………..…………………….......…8

1. **LITERATURE REVIEW…………………………………………..…………........10–16**
   1. Research paper 1……………………………..…………………....………..……...10
   2. Research Paper 2………………………………………………..…..…….….........10
   3. Research Paper 3…………………..…………………..……………………..........11
   4. Related Work…………………….…………………..…………………….............11

2.4.1 Global Positioning System (GPS)………………………………………........11

2.4.1.1 GPS Segments……………………………………………………………...12

**3. PROBLEM DESCRIPTION……………………………………………………….....17**

**4. PROPOSED WORK………………………………………………………………..18-20**

4.1 Phase 1………………………………………………………………….……..........18

4.2 Phase 2…………………………………………………………………..…….........19

**5. DESIGN & DEVELOPMENT…………………………………………...………...21-24**

5.1 GPS tracking device.……………………………………….………………..….......21

5.2 Web server……………………………..………..………………….……………....23

**6. IMPLEMENTATION & CODING……………………………………………...…25-46**

6.1 GPS Tracking Device programming ………………………….…………………....25

6.2 GPS Tracking Device Monitoring and Testing ………….……….………………...34

6.3 TCP Server ……………………………………………………..…….…..………...35

6.4 MySQL Database…………………..…………………..…………….….………....39

6.5 Plone………………..…………………..………………….…….………………....40

**7. RESULTS………………………………………………….…………………..…….47-48**

**8. CONCLUSION & FUTURE WORK………………………………………..…….49-50**

8.1 Conclusion………………………………………………………………………….49

8.2 Future Work………………………………………………………………………...50

**REFERENCES…………………………………………………..……………..…...51-52**

**LIST OF FIGURES**

Figure 1.1: Trilateration

Figure 1.2: Use of trilateration in GPS

Figure 1.3: Structure of GSM network

Figure 1.4: A typical SIM card

Figure 1.5: E.161, the most common mobile keypad alphabet layout.

Figure 2.1: The Three segments of GPS

Figure 2.2: Ground monitor station used from 1984 to 2007, on display at the [Air Force Space & Missile Museum](http://en.wikipedia.org/wiki/Air_Force_Space_%26_Missile_Museum)

Figure 2.3: A typical GPS receiver with integrated antenna.

Figure 4.1: Sample of a PCB design

Figure 4.2: System overview

Figure 4.3: Communication between the GPS device and TCP server

Figure 5.1: PCB design of the microcontroller

Figure 5.2: PCB design of the GPS reciever

Figure 5.3: PCB design of the GSM module

Figure 5.4: Front view of the device

Figure 5.5: Back view of the device

Figure 5.6: Working of the server end

Figure 6.1 AVR Studio

Figure 6.2 Khazama AVR Programmer

Figure 6.3: RealTerm displaying GPS data

Figure 6.4: TCP server listening for incoming packets

Figure 6.5: Plone main screen

Figure 6.6: SQL database connection

Figure 6.7: Z SQL Method

Figure 6.8: Initial Google map screen

Figure 6.9 Zoomed out view of the initial Google Maps screen

Figure 7.1: Google Maps test output in "Map" view

Figure 7.2: Google Maps test output in "Satellite" view

**LIST OF TABLES**

Table 1: List to databases

Table 2: Tables in gmap

Table 3: Fields in gmaptracker

**CHAPTER - 1**

**1. INTRODUCTION**

* 1. **Global Positioning System (GPS)**

Global Positioning System (GPS) is a U.S. space-based global navigation satellite system made of a network of 24 NAVSTAR satellites orbiting around the globe which offers real-time positioning, navigation, velocity and timing services regardless of weather, day and night, anywhere on the Earth with open space. Each satellite orbits approximately 10,900 miles above the earth. Each satellite weights as much as 4,000 pounds with 17 feet long solar panel extended to collect power from the sun. This allows GPS to operate 24 hours a day. The life span of each satellite is approximately 7.5 years. New satellites are planned and the system will be maintained. There will be 5 ground stations to ensure that each satellite functions correctly and maintain its exact position in space.

**1.1.1 Operation of GPS**

At any point of time, there are about 24 operational GPS satellites orbiting around our globe, which takes a period of 12 hours to orbit complete one full round. At any one point of time, only 12 satellites can be detected as another 12 is at another side of the earth. Thus, the satellite orbits the earth twice in a day. The satellites is operated and belonged to the U.S. Air Force. Ground stations are used to precisely track each and every satellite's status and health.

Theoretically, the satellites broadcast microwave radio signal to earth to determine positioning in the Ultra High Frequency band. The GPS receiver will pick up the GPS signal. The GPS signal is made up of 3 different bits of data which are known as pseudo random code, almanac data and ephemeris data as follows:

1. **Pseudorandom code**: ID code that detect which satellites are broadcasting information. The ID code can be view from the GPS’s unit satellite information screen. We used a string of binary numbers to differentiate which satellite the signal is from. It also tells the time difference between the transmitter and receiver. GPS satellites are around 20,000,000 meters above the Earth. The shift, which due to propagation delay is the so-called “Time difference”. Time difference can be computed using the formula as shown below:

Time Difference (in seconds) \* 2.99792458 108 meters/second = Distance (in meters)

1. **Almanac data**: Data which has orbital parameters to differentiate between which satellite is to be seen on the GPS receiver in the unobstructed sky. As such, the receiver will know which satellite to follow. However, this Almanac data is not accurate as it can be valid for several months.
2. **An Ephemeris data**: It allows the receiver to know where the GPS satellite is at any point of time in the day. Conversely, this Ephemeris data can be only valid for 2 to 4 hours. Essentially, it is quite accurate as the GPS receiver receives the signal to provide the orbital information that interprets the path which the satellite is following as its orbits around.

With the aid of pseudorandom code, almanac data and ephemeris data, the GPS receiver can easily determine the time, date, distance from satellite, velocity and satellite status and coordination. For the GPS receiver’s location, a process called trilateration is used. And there will a shift in frequency called Doppler Effect.

**1.1.2 Trilateration**

In geometry, trilateration is the process of determining absolute or relative locations of points by measurement of distances, using the geometry of circles, spheres or triangles. In addition to its interest as a geometric problem, trilateration does have practical applications in surveying and navigation, including global positioning systems (GPS). In contrast to triangulation it does not involve the measurement of angles.

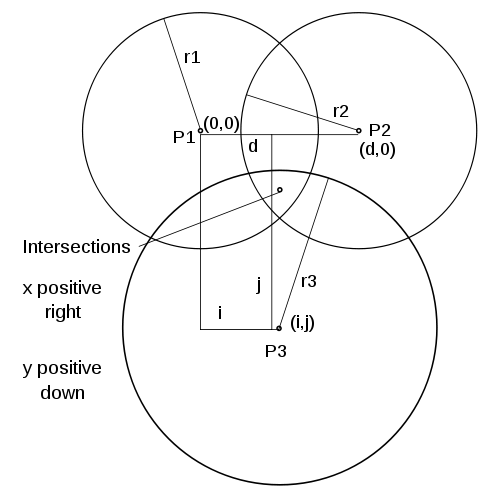
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Figure 1.1: Trilateration-The plane z = 0, showing the three sphere centers, P1, P2, and P3; their x, y-coordinates; and the three sphere radii, r1, r2, and r3. The two intersections of the three sphere surfaces are directly in front and directly behind the point designated intersections in the z = 0 plane.

In two-dimensional geometry, it is known that if a point lies on two curves such as the boundaries of two circles then the circle centres and the two radii provide sufficient information to narrow the possible locations down to two. Additional information may narrow the possibilities down to one unique location.

In three-dimensional geometry, when it is known that a point lies on three surfaces such as the surfaces of three spheres then the centres of the three spheres along with their radii provide sufficient information to narrow the possible locations down to no more than two. If it is known that the point lies on the surface of a fourth sphere then knowledge of this sphere's centre along with its radius is sufficient to determine the one unique location.

GPS receiver can use trilateration process to determine the exact position by calculating 3 or more distance of satellites. For instance, the 1st satellite is 11,000 miles to a point in space. The 1st satellite is centred in a sphere which has a radius of 11, 000 miles to the surface. There is a 2nd satellite which has a radius of 12,000 miles to the surface of the sphere. The point where 2 spheres intersect can define some location points. However, the true location still cannot be defined as the area coverage is too large. By using the same logic, there is 3rd satellite which has about 13,000 miles radius to the surface of the sphere. 2 points can be determined where the 3 satellites spheres intersect. Theses 2 points are far apart which is not accurate. In order to find the true location, we need a 4th satellite. The in-built clock in the GPS receiver will need to synchronise with the satellites atomic clocks to accurately calculate the distance of the satellites to the GPS receiver. This is important as a small difference in the time for these 2 clocks can cause hundred miles of error. By having 4th satellite predicted point, we can determine the clock discrepancy between the locations predicted by initial 3 satellites since the GPS receiver clock is imperfect. The 4th satellite can also determine the elevation.

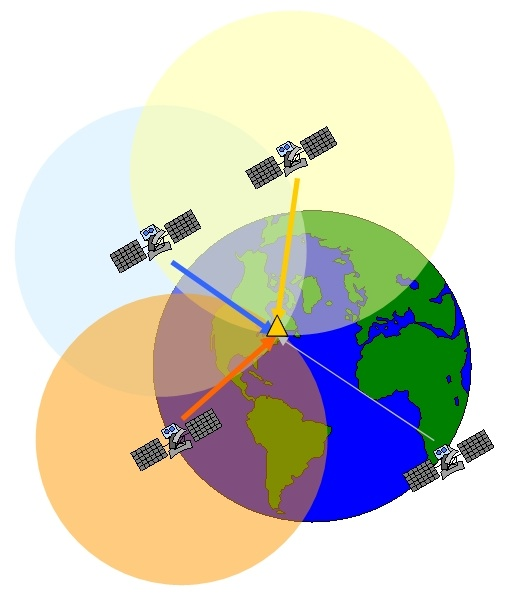


Figure 1.2: Use of trilateration in GPS

**1.1.3 GPS Applications**

Global Positioning System (GPS) was originally designated for military use. The original purpose for development of the system is the need for Submarines to accurately locate their position before launching missiles.

All GPS receivers make use of orbiting satellites to determine their location. As the technology advances, there is an increase of usage of GPS. Handheld GPS units can be used for outdoor sports like hiking, boating, fishing, navigating at Sea, etc. For instance, GPS receiver can be used to guide the user on the current position when they are lost and navigate the way out from the woods or sea. GPS receiver can also be used to measure the distance of ball from the hole for golfers and keeping on the right path for bicyclists.

GPS can be used at work for delivery and courier services, construction, aviation, etc. As such, the delivery truck and courier services can determine the safest and shortest route to save time and petrol. Construction companies can accurately mark the point where the building or underground tunnel is located. Aviator uses GPS receiver to navigate in bad weather.

There are too many applications for usage of GPS. Most common GPS application is vehicle navigation. Nowadays, most vehicles install GPS receiver with a monitor to show the user the shortest route to the destination on the road. Currently cell phones come with integrated GPS receiver too. In addition, GPS can be used as an emergency locator and security feature to track vehicles location. The GPS is one way that satellites have becomes part of everyday lives.

**1.2 GSM Technology**

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It became the de facto global standard for mobile communications with over 80% market share.

The GSM standard was developed as a replacement for first generation (1G) analog cellular networks, and originally described a digital, circuit switched network optimized for full duplex voice telephony. This was expanded over time to include data communications, first by circuit switched transport, then packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS).

The GSM network is structured into a number of discrete sections:

* The Base Station Subsystem (the base stations and their controllers).
* The Network and Switching Subsystem (the part of the network most similar to a fixed network). This is sometimes also just called the core network.
* The GPRS Core Network (the optional part which allows packet based Internet connections).
* The Operations support system (OSS) for maintenance of the network.

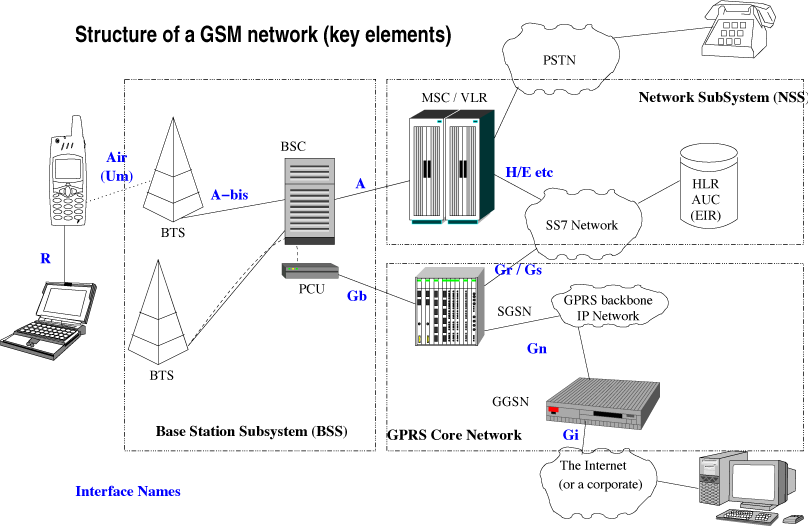
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Figure 1.3: Structure of GSM network

**1.2.1 Base Station subsystem**

GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, pico, femto and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a mast or a building above average roof top level. Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Picocells are small cells whose coverage diameter is a few dozen metres; they are mainly used indoors. Femtocells are cells designed for use in residential or small business environments and connect to the service provider’s network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

Cell horizontal radius varies depending on antenna height, antenna gain and propagation conditions from a couple of hundred metres to several tens of kilometres. The longest distance the GSM specification supports in practical use is 35 kilometres (22 mi). There are also several implementations of the concept of an extended cell, where the cell radius could be double or even more, depending on the antenna system, the type of terrain and the timing advance.

Indoor coverage is also supported by GSM and may be achieved by using an indoor picocell base station, or an indoor repeater with distributed indoor antennas fed through power splitters, to deliver the radio signals from an antenna outdoors to the separate indoor distributed antenna system. These are typically deployed when a lot of call capacity is needed indoors; for example, in shopping centres or airports. However, this is not a prerequisite, since indoor coverage is also provided by in-building penetration of the radio signals from any nearby cell.

**1.2.2 GSM carrier frequencies**

GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned in some countries because they were previously used for first-generation systems.

Most 3G networks in Europe operate in the 2100 MHz frequency band.

Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones to use. This allows eight full-rate or sixteen half-rate speech channels per radio frequency. These eight radio timeslots (or eight burst periods) are grouped into a TDMA frame. Half rate channels use alternate frames in the same timeslot. The channel data rate for all 8 channels is 270.833 kbit/s, and the frame duration is 4.615 ms.

The transmission power in the handset is limited to a maximum of 2 watts in GSM 850/900 and 1 watt in GSM 1800/1900.

**1.2.3 Voice codecs**

GSM has used a variety of voice codecs to squeeze 3.1 kHz audio into between 6.5 and 13 kbit/s. Originally, two codecs, named after the types of data channel they were allocated, were used, called Half Rate (6.5 kbit/s) and Full Rate (13 kbit/s). These used a system based upon linear predictive coding (LPC). In addition to being efficient with bitrates, these codecs also made it easier to identify more important parts of the audio, allowing the air interface layer to prioritize and better protect these parts of the signal.

GSM was further enhanced in 1997with the Enhanced Full Rate (EFR) codec, a 12.2 kbit/s codec that uses a full rate channel. Finally, with the development of UMTS, EFR was refactored into a variable-rate codec called AMR-Narrowband, which is high quality and robust against interference when used on full rate channels, and less robust but still relatively high quality when used in good radio conditions on half-rate channels.

**1.2.4 Subscriber Identity Module (SIM)**

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIM card. The SIM is a detachable smart card containing the user's subscription information and phone book. This allows the user to retain his or her information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM. Some operators will block this by allowing the phone to use only a single SIM, or only a SIM issued by them; this practice is known as SIM locking.



Figure 1.4: A typical SIM card

**1.3 General Packet Radio Service (GPRS)**

General packet radio service (GPRS) is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM). GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies. It is now maintained by the 3rd Generation Partnership Project (3GPP).

GPRS usage is typically charged based on volume of data transferred, contrasting with circuit switched data, which is usually billed per minute of connection time. 5 GB per month for a fixed fee or on a pay-as-you-use basis. Usage above the bundle cap is either charged per megabyte or disallowed.

GPRS is a best-effort service, implying variable throughput and latency that depend on the number of other users sharing the service concurrently, as opposed to circuit switching, where a certain quality of service (QoS) is guaranteed during the connection. In 2G systems, GPRS provides data rates of 56–114 kbit/second. 2G cellular technology combined with GPRS is sometimes described as 2.5G, that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate-speed data transfer, by using unused time division multiple access (TDMA) channels in, for example, the GSM system. GPRS is integrated into GSM Release 97 and newer releases.

**1.3.1 Protocols supported**

GPRS supports the following protocols:

1. Internet protocol (IP). In practice, built-in mobile browsers use IPv4 since IPv6 was not yet popular.
2. Point-to-point protocol (PPP). In this mode PPP is often not supported by the mobile phone operator but if the mobile is used as a modem to the connected computer, PPP is used to tunnel IP to the phone. This allows an IP address to be assigned dynamically (IPCP not DHCP) to the mobile equipment.
3. X.25 connections. This is typically used for applications like wireless payment terminals, although it has been removed from the standard. X.25 can still be supported over PPP, or even over IP, but doing this requires either a network-based router to perform encapsulation or intelligence built in to the end-device/terminal; e.g., user equipment (UE).

When TCP/IP is used, each phone can have one or more IP addresses allocated. GPRS will store and forward the IP packets to the phone even during handover. The TCP handles any packet loss (e.g. due to a radio noise induced pause).

**1.3.2 Hardware**

Devices supporting GPRS are divided into three classes:

1. Class A: Can be connected to GPRS service and GSM service (voice, SMS), using both at the same time. Such devices are known to be available today.
2. Class B: Can be connected to GPRS service and GSM service (voice, SMS), but using only one or the other at a given time. During GSM service (voice call or SMS), GPRS service is suspended, and then resumed automatically after the GSM service (voice call or SMS) has concluded. Most GPRS mobile devices are Class B.
3. Class C: Are connected to either GPRS service or GSM service (voice, SMS). Must be switched manually between one or the other service.

**1.4 Short Message Service (SMS) Technology**

Short Message Service (SMS) is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices.

SMS is the most widely used data application in the world, with 3.6 billion active users, or 78% of all mobile phone subscribers. The term "SMS" is used as an acronym for all types of short text messaging and the user activity itself in many parts of the world. SMS is also employed in direct marketing, known as SMS marketing.

SMS has been used on modern handsets originated from radio telegraphy in radio memo pagers using standardized phone protocols. These were defined in 1985 as part of the Global System for Mobile Communications (GSM) series of standards as a means of sending messages of up to 160 characters to and from GSM mobile handsets. Though most SMS messages are mobile-to-mobile text messages, support for the service has expanded to include such other mobile technologies as ANSI CDMA networks and Digital AMPS, as well as satellite and landline networks.



Figure 1.5: E.161, the most common mobile keypad alphabet layout.

**CHAPTER - 2**

**2. LITERATURE REVIEW**

**2.1 Implementation of a Real Time Passenger Information System –**

Authors: Ganesh K, Thrivikraman M, Joy Kuri, Haresh Dagale, Sudhakar G and Sugata Sanyal

Published In: Tata Institute of Fundamental Research (TIFR), Mumbai, India

Intelligent Transportation Systems (ITS) are gaining recognition in developing countries like India. This paper describes the various components of our prototype implementation of a Real-time Passenger Information System (RTPIS) for a public transport system like a fleet of buses. Vehicle-mounted units, bus station units and a server located at the transport company premises comprise the system. The vehicle unit reports the current position of the vehicle to a central server periodically via General Packet Radio Service (GPRS). An Estimated Time of Arrival (ETA) algorithm running on the server predicts the arrival times of buses at their stops based on real-time observations of the buses' current Global Positioning System (GPS) coordinates. This information is displayed and announced to passengers at stops using station units, which periodically fetch the required ETA from the server via GPRS. Novel features of our prototype include: (a) a route-creator utility which automatically creates new routes from scratch when a bus is driven along the new route, and (b) voice tagging of the stops and points of interest along any route. Besides, the prototype provides: (i) web-based applications for passengers, providing useful information like a snapshot of present bus locations on the streets, and (ii) web-based analysis tools for the transport authority, providing information useful for fleet management, like number of trips undertaken by a specific bus. The prototype has been demonstrated in a campus environment, with four-wheelers and two-wheelers emulating buses. The automatic real-time passenger information system has the potential of making the public transport system an attractive alternative for city-dwellers, thereby contributing to fewer private vehicles on the road, leading to lower congestion levels and less pollution.

**2.2 Real-Time Tracking Management System Using GPS, GPRS and Google Earth -**

Authors: Noppadol Chadil, Apirak Russameesawang and Phongsak Keeratiwintakorn

Published In: King Mongkut’s University of Technology North Bangkok, Thailand

Due to the high cost of fossil-based energy, several methods are proposed to reduce the usage of the energy in logistics and fleet management to be even more. GPS tracking system is a common approach to get vehicle location information in real-time for fleet planning. We proposed a GPS tracking system called Goo-Tracking that is composed of commodity hardware, open source software and an easy-to-manage user interface via a web server with Google Map or via Google Earth software. The system includes a GPS/GPRS module to location acquisition and message transmission, MMC to temporary store location information, and an 8-bit AVR microcontroller. Our system prototype is shown and tested on a trip from Bangkok to Chonburi.

It has shown great stability and also robust message transfer protocol that most of locations are accurately acquired and transmitted to the server in real-time.

**2.3 Public Transport Ticketing and monitoring System** –

Authors: V.Venkatakrishnan and R.Seethalakshmi

Published In: SASTRA University, Thanjavur, Tamil Nadu, India

Controlling the traffic is one of the important and the major issues. The purpose of the paper is to develop a public transportation system using GPS, GSM, RFID and Zigbee which acts as user friendly to the user. The entire network comprises of three modules; Base Station Module, In-Bus Modules and Bus Stop Module. The base station module consists of monitoring system which includes GSM and a PC. The In-Bus Modules consists of two Microcontrollers, GSM Modem, GPS, Zigbee, RFID, LCD and infrared sensor. RFID for ticketing purpose, GSM, GPS is used for mobile data transmission and tracking location. The Zigbee module is also interfaced with the microcontroller which is used to send the bus information to bus stop and to get the information from the bus stop to bus. The Bus Stop Module is fixed at every bus stop consists of zigbee node which is interfaced with the Microcontroller. The public transport service can be effectively implemented by deploying the concept of this paper and quality of the service can be improved.

**2.4 Related Work** –

**2.4.1 Global Positioning System (GPS)**

In 1957, the very first satellite which was sent to space was the Russian Sputnik 1. The purpose of this mock satellite was to test on its functionality. Sputnik 1would be transmitting radio signal (Doppler or frequency) which was monitored by researchers from Applied Physics Laboratory (APL) of the John Hopkins University. Based on the Doppler shifted of satellite motion, Dr. Frank T. McClure (of APL) discovered that the user’s location can be defined from the Doppler Shift measurement. In April 1960, trial satellite (known as Transit) built based on the Doppler Shift measurement was launched via rockets into space. Similarly, another satellite known as Cicada, was built based on the same Doppler system by the Union of Soviet Socialist Republics (USSR) after a short period of time. In 1988, the Transit launch program ended. Eventually, the Transit system was inactive in 1996.

In the early 1970s, the Transit system was being replaced by Global Positioning System (GPS) which was conceived by the U.S. Department of Defense (DoD). Global Positioning System (GPS) was originally designated for military use. The original purpose for development of the system is the need for Submarines to accurately locate their position before launching missiles. In 1973, the Air Force took all the information and put it together into a single program called the NAVSTAR (Navigation Signal Timing and Ranging) GPS. In 1980, GPS was made available to civilians. Until today, GPS can be accessed by both military and civilian users. GPS provides continuous positioning, timing and speed information anywhere in the world regardless of any weather condition. GPS is a one-way ranging (passive) system which provides usage by many users and can act as security features to track the users or objects.

**2.4.1.1 GPS Segments**

There are mainly 3 segments in GPS. They are - Space, Control and User.

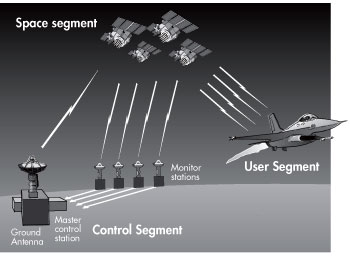


Figure 2.1: The Three segments of GPS

1. **Space Segment:** The space segment (SS) is composed of the orbiting GPS satellites or Space Vehicles (SV) in GPS parlance. The GPS design originally called for 24 SVs, eight each in three approximately circular orbits, but this was modified to six orbital planes with four satellites each. The orbits are centered on the Earth, not rotating with the Earth, but instead fixed with respect to the distant stars. The six orbit planes have approximately 55° inclination (tilt relative to Earth's equator) and are separated by 60° right ascension of the ascending node (angle along the equator from a reference point to the orbit's intersection). The orbital period is one-half a sidereal day, i.e., 11 hours and 58 minutes. The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface. The result of this objective is that the four satellites are not evenly spaced (90 degrees) apart within each orbit. In general terms, the angular difference between satellites in each orbit is 30, 105, 120, and 105 degrees apart which, of course, sum to 360 degrees.

Orbiting at an altitude of approximately 20,200 km (12,600 mi); orbital radius of approximately 26,600 km (16,500 mi), each SV makes two complete orbits each sidereal day, repeating the same ground track each day. This was very helpful during development because even with only four satellites, correct alignment means all four are visible from one spot for a few hours each day. For military operations, the ground track repeat can be used to ensure good coverage in combat zones.

As of March 2008, there are 31 actively broadcasting satellites in the GPS constellation, and two older, retired from active service satellites are kept in the constellation as orbital spares. The additional satellites improve the precision of GPS receiver calculations by providing redundant measurements. With the increased number of satellites, the constellation was changed to a non-uniform arrangement. Such an arrangement was shown to improve reliability and availability of the system, relative to a uniform system, when multiple satellites fail. About nine satellites are visible from any point on the ground at any one time, ensuring considerable redundancy over the minimum four satellites needed for a position.

1. **Control Segment:** The control segment is composed of -
   1. a master control station (MCS),
   2. an alternate master control station,
   3. four dedicated ground antennas and
   4. six dedicated monitor stations

The MCS can also access U.S. Air Force Satellite Control Network (AFSCN) ground antennas (for additional command and control capability) and NGA (National Geospatial-Intelligence Agency) monitor stations. The flight paths of the satellites are tracked by dedicated U.S. Air Force monitoring stations in Hawaii, Kwajalein, Ascension Island, Diego Garcia, Colorado Springs, Colorado and Cape Canaveral, along with shared NGA monitor stations operated in England, Argentina, Ecuador, Bahrain, Australia and Washington DC. The tracking information is sent to the Air Force Space Command MCS at Schriever Air Force Base 25 km (16 mi) ESE of Colorado Springs, which is operated by the 2nd Space Operations Squadron (2 SOPS) of the U.S. Air Force. Then 2 SOPS contacts each GPS satellite regularly with a navigational update using dedicated or shared (AFSCN) ground antennas (GPS dedicated ground antennas are located at Kwajalein, Ascension Island, Diego Garcia, and Cape Canaveral). These updates synchronize the atomic clocks on board the satellites to within a few nanoseconds of each other, and adjust the ephemeris of each satellite's internal orbital model. The updates are created by a Kalman filter that uses inputs from the ground monitoring stations, space weather information, and various other inputs.

Satellite maneuvers are not precise by GPS standards. So to change the orbit of a satellite, the satellite must be marked unhealthy, so receivers will not use it in their calculation. Then the maneuver can be carried out, and the resulting orbit can be tracked from the ground. Then the new ephemeris is uploaded and the satellite marked healthy again.

The Operation Control Segment (OCS) currently serves as the control segment of record. It provides the operational capability that supports global GPS users and keeps the GPS system operational and performing within specification.

OCS successfully replaced the legacy 1970’s-era mainframe computer at Schriever Air Force Base in September 2007. After installation, the system helped enable upgrades and provide a foundation for a new security architecture that supported the U.S. armed forces. OCS will continue to be the ground control system of record until the new segment, Next Generation GPS Operation Control System (OCX), is fully developed and functional.

The new capabilities provided by OCX will be the cornerstone for revolutionizing GPS’s mission capabilities, and enabling Air Force Space Command to greatly enhance GPS operational services to U.S. combat forces, civil partners and myriad of domestic and international users.

The GPS OCX program also will reduce cost, schedule and technical risk. It is designed to provide 50% sustainment cost savings through efficient software architecture and Performance-Based Logistics. In addition, GPS OCX expected to cost millions less than the cost to upgrade OCS while providing four times the capability.

The GPS OCX program represents a critical part of GPS modernization and provides significant information assurance improvements over the current GPS OCS program.

* OCX will have the ability to control and manage GPS legacy satellites as well as the next generation of GPS III satellites, while enabling the full array of military signals.
* Built on a flexible architecture that can rapidly adapt to the changing needs of today’s and future GPS users allowing immediate access to GPS data and constellations status through secure, accurate and reliable information.
* Empowers the warfighter with more secure, actionable and predictive information to enhance situational awareness.
* Enables new modernized signals (L1C, L2C, and L5) and has M-code capability, which the legacy system is unable to do.
* Provides significant information assurance improvements over the current program including detecting and preventing cyber-attacks, while isolating, containing and operating during such attacks.
* Supports higher volume near real-time command and control capabilities.

On September 14, 2011, the U.S. Air Force announced the completion of GPS OCX Preliminary Design Review and confirmed that the OCX program is ready for the next phase of development. The GPS OCX program has achieved major milestones and is on track to support the GPS IIIA launch in May 2014.



Figure 2.2: Ground monitor station used from 1984 to 2007, on display at the [Air Force Space & Missile Museum](http://en.wikipedia.org/wiki/Air_Force_Space_%26_Missile_Museum)

1. **User Segment:** The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service, and tens of millions of civil, commercial and scientific users of the Standard Positioning Service. In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly stable clock (often a crystal oscillator). They may also include a display for providing location and speed information to the user. A receiver is often described by its number of channels: this signifies how many satellites it can monitor simultaneously. Originally limited to four or five, this has progressively increased over the years so that, as of 2007, receivers typically have between 12 and 20 channels.

GPS receivers may include an input for differential corrections, using the RTCM SC-104 format. This is typically in the form of an RS-232 port at 4,800 bit/s speed. Data is actually sent at a much lower rate, which limits the accuracy of the signal sent using RTCM. Receivers with internal DGPS receivers can outperform those using external RTCM data. As of 2006, even low-cost units commonly include Wide Area Augmentation System (WAAS) receivers.

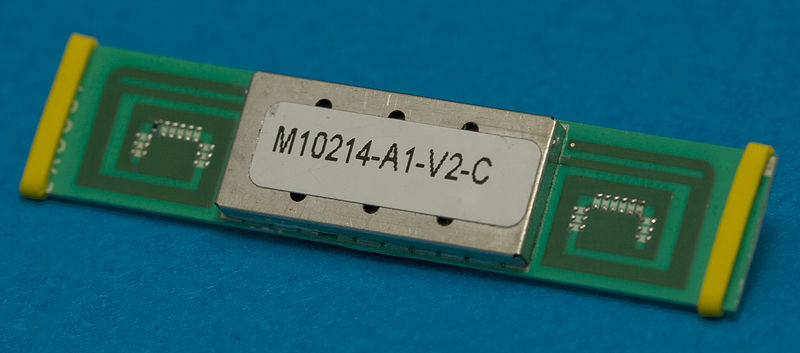


Figure 2.3: A typical GPS receiver with integrated antenna.

Many GPS receivers can relay position data to a PC or other device using the NMEA 0183 protocol. Although this protocol is officially defined by the National Marine Electronics Association (NMEA), references to this protocol have been compiled from public records, allowing open source tools like gpsd to read the protocol without violating intellectual property laws. Other proprietary protocols exist as well, such as the SiRF and MTK protocols. Receivers can interface with other devices using methods including a serial connection, USB, or Bluetooth.

**CHAPTER - 3**

**3. PROBLEM DESCRIPTION**

Modern tracking devices are usually data pushers. Two main concerns related to GPS tracking devices today are its cost and its ability to parse GPS data and send it to a remote server for further processing. Most of the GPS tracking devices in the market today fulfil one of these concerns and compromise on the other. Sometimes, the tracking devices send wrong coordinates or even freeze for a sometime while sending data through a GSM cellular network. Further, GPS errors are common among all devices; therefore, there is a need to reduce these errors too.

In order to provide accurate location information, a receiver must be in clear sight of at least three satellites. In most normal situations, a human being is likely in view of between five and eight satellites; however there are basic limitations in GPS technology that inhibit or block transmissions for brief or extended periods of time.

Another major concern is the cold start of a GPS receiver. When a GPS receiver is started for the first time, it must be placed in open air so that it can start receiving data from the satellites. But this problem can be solved by connecting an active antenna to the GPS receiver.

The communication between the GPS receiver and web server is also a major issue. Sometimes, data is not received correctly at the web server. To resolve this issue, we’ve coded a TCP server program which runs continuously on the web server. This program receives data from the device and keeps storing it to the database.

**CHAPTER - 4**

**4. PROPOSED WORK**

To solve the above mentioned problems effectively, this project focuses on the development of a low cost GPS tracking system. To achieve this goal, the device will be custom designed and fabricated rather than using a development board (like Arduino) which are expensive. Another goal is to design a PCB which will have the GPS receiver, the GSM module and the microcontroller on the same board. This reduces costs greatly and ensures compactness of the device. Further, the microcontroller will be programmed so that it sends the GPS data to the remote server through the GSM cellular network. The server in turn, would store the received data in a database. Finally, a web application will be used to fetch the GPS coordinates and plot them on a map.

The low cost GPS object tracking system would track the movement and determine the exact location of object. This in turn would allow the user to track the object like goods, cargo, vehicles, etc. In a transport organisation scenario, the drivers would not be able to use the vehicle for personal usage, which in return would increase the efficiency of the organisation. This would help the company save money spent on fuel and thus increase its profits. The GPS tracking system can also be used as an added security to deter vehicle theft and notify the vehicle owner about it.

To achieve the above stated goals effectively, the project has been divided into two phases:

**4.1 Phase 1**

**Design, fabrication and testing of the GPS tracking device**

Designing a GPS tracking device is a huge task in itself. Further, to ensure that the overall cost of the device is low, we have fabricated all the components on a single board and used both sides of the PCB to solder components. Finally, the microcontroller is coded along with the AT commands which will be used to send data through the GSM module.

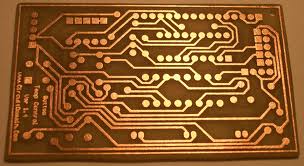


Figure 4.1: Sample of a PCB design

**4.2 Phase 2**

**Development of the web server**

The web server needs to have a program running at all times which can receive data from the GPS tracking device. This program will listen to a particular port on the server for incoming packets. We will use the python programming language to code this program. The data received will be stored in a MySQL database. Finally, Plone (an open-source Content Management System) which is built on top of Zope (an open-source web applications server) is used to host the GPS tracking web page. The web page will display the GPS coordinates on a Google Map using JavaScript.

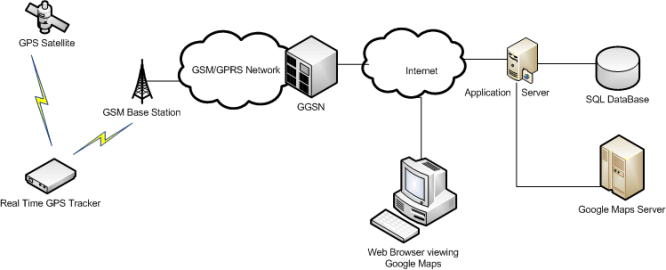


Figure 4.2: System overview

This is how the system works. The GPS chip outputs the positioning information which is transferred over a GPRS link to the mobile operator’s GGSN (Gateway GPRS Support Node) and then to a remote server over a TCP connection. The TCP server stores the incoming positional data in a mySQL database. When a user clicks on the tracking page, Zope, which is an open source web application server, serves up an HTML page with an embedded javascript code. The javascript would run in the user's browser and has instructions to retrieve the positional information from the mySQL database every second. It then integrates this information into Google Maps through Google Maps API which displays the position on a map. Since the positional information is retrieved every second and the maps updated at the same frequency, a real time GPS tracking effect is achieved.

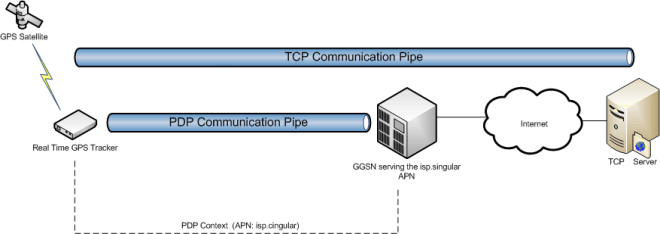


Figure 4.3: Communication between the GPS device and TCP server

This figure illustrates the communication between the GPS tracking device and the web server. The tracking device firsts establishes a PDP (Packet Data Protocol) context with GGSN (Gateway GPRS supporting node), this is done via a particular APN (Access Point Name) which is different for each ISP (Internet Service Provider). Then a TCP connection is established between the tracking device and the TCP server at a particular IP address and port number.

**CHAPTER - 5**

**5. DESIGN AND DEVELOPMENT**

**5.1 GPS tracking device**

To ensure proper functioning of the device, the PCM designs for the microcontroller, GSM module and GPS receiver are done separately and then integrated.

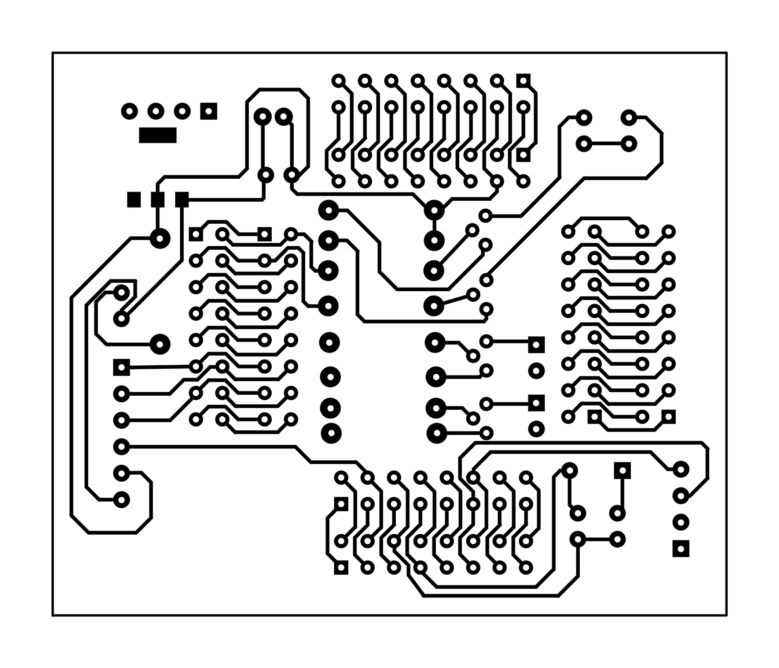
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Figure 5.1: PCB design of the microcontroller

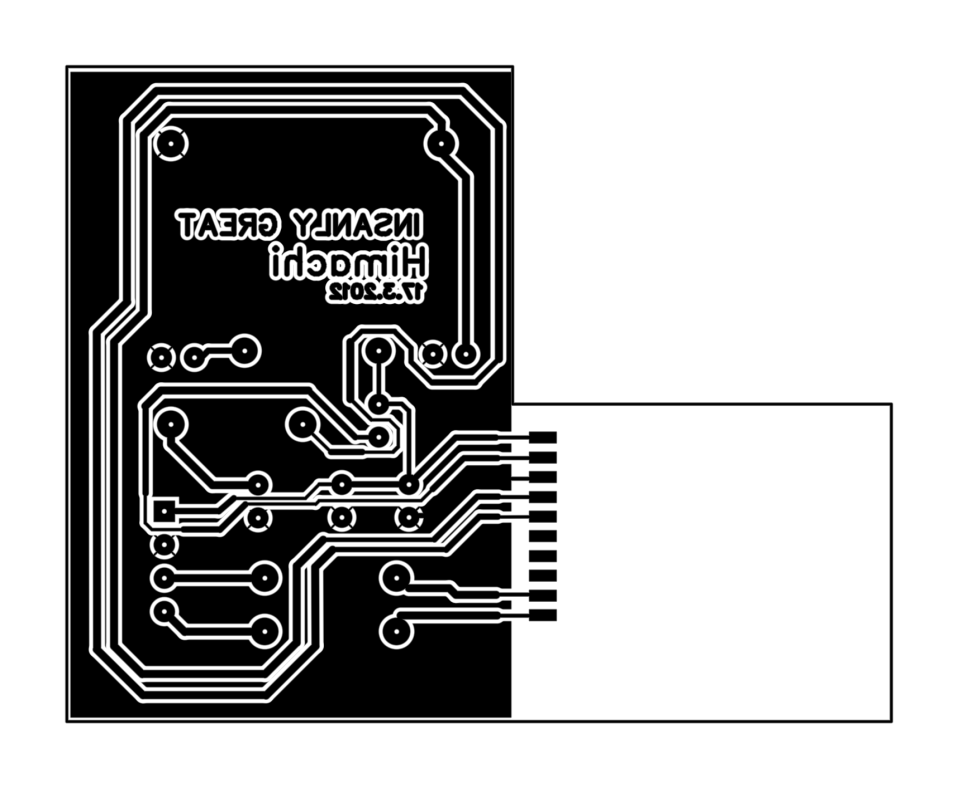
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Figure 5.2: PCB design of the GPS reciever

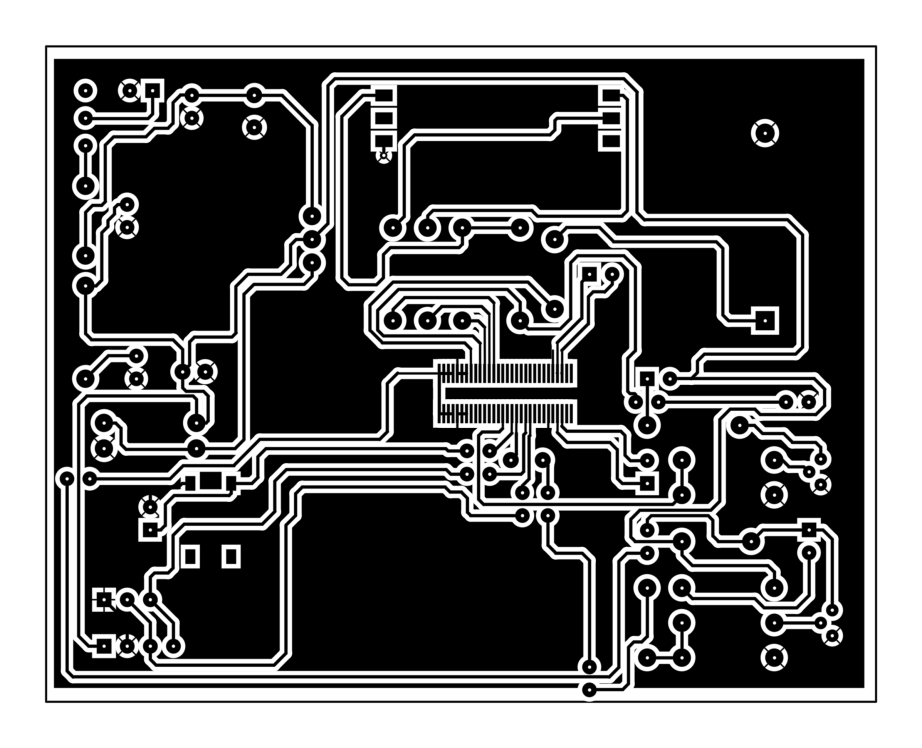
****

Figure 5.3: PCB design of the GSM module

Finally, the design is transferred on a substrate using the toner transfer method and a copper solution is used to obtain the final PCB. Etching is done to remove the unwanted copper from the board. Then the components are soldered to obtain the completed device.

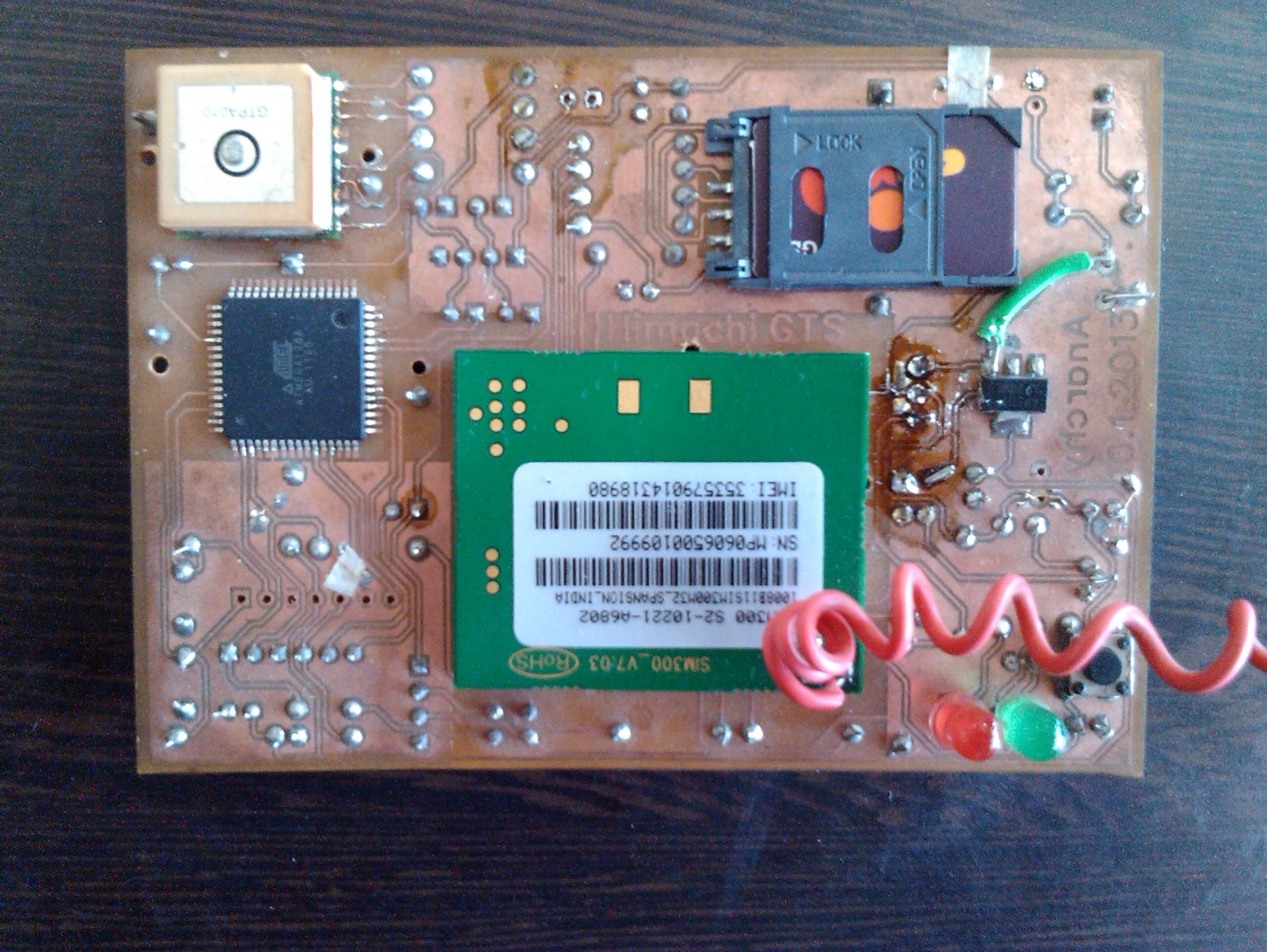
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Figure 5.4: Front view of the device

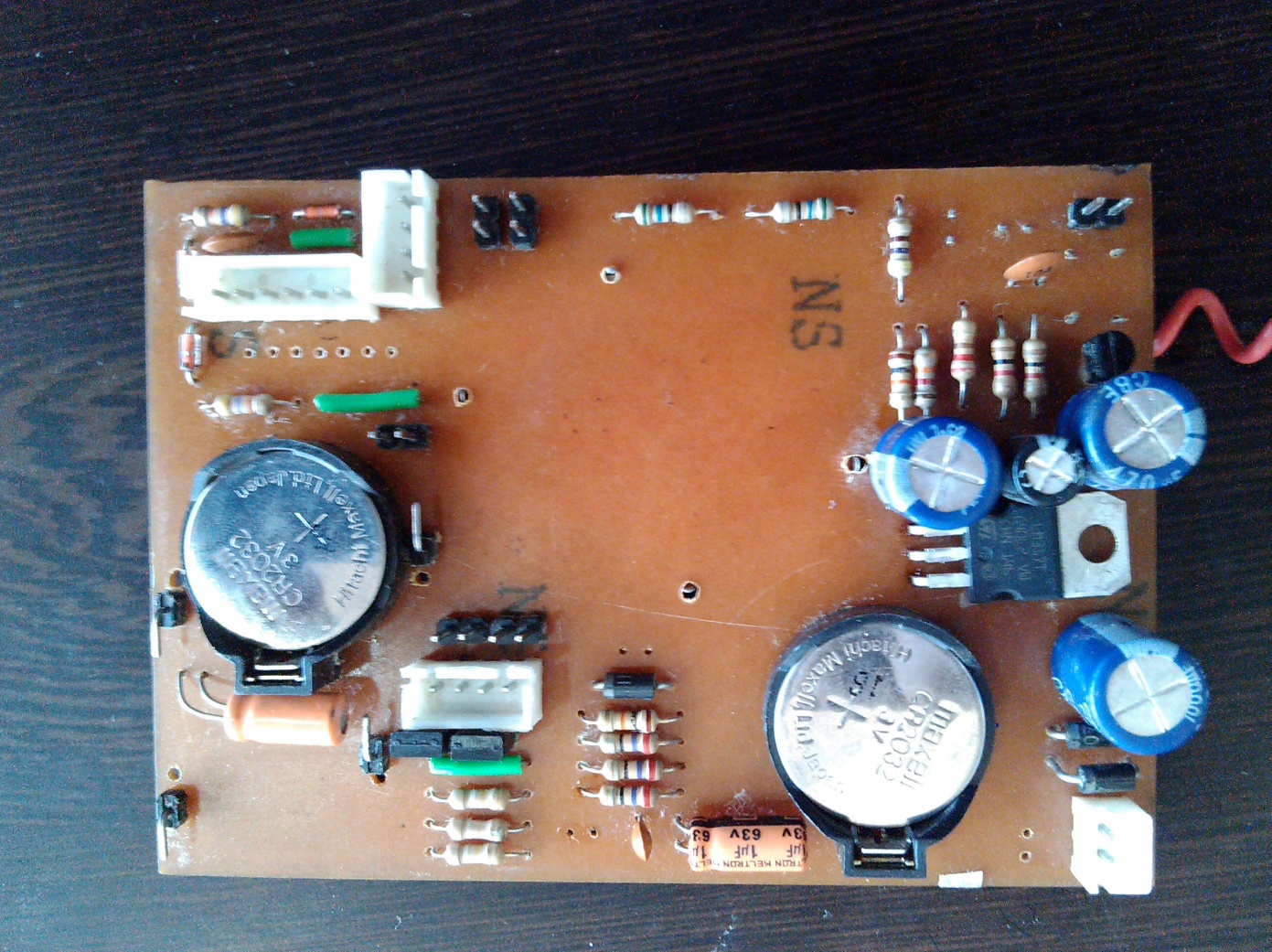
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Figure 5.5: Back view of the device

**5.2 Web server**

The web server has many components which work together. First, the TCP server application serves up the received data to the MySQL database through the mySQLdb (a MySQL database connector for Python programming) interface. Then, Zope (the application server) retrieves the data through a Z SQL method (Z SQL Methods are Zope objects that execute SQL code through a Database Connection). The Google Maps API is used to retrieve Google Maps from a Google server. Then, a HTML file with some embedded JavaScipt is used to put together the GPS data and Google Maps. Finally, a web browser is used to view the data plotted on the Google Maps.

Here, Zope serves as a connection between the data received from the GPS tracking system and the Google Maps. Plone (an open-source content management system) provides a GUI to perform all kinds of operations like adding a database connection, adding a database method and adding a web page.

The TCP server application runs continuously, and listens for incoming packets at a particular port on the web server. The GPS tracking system must send its data on the same port. The TCP server application also plays the important role of parsing the incoming GPS strings and separating the latitude and longitude from them.

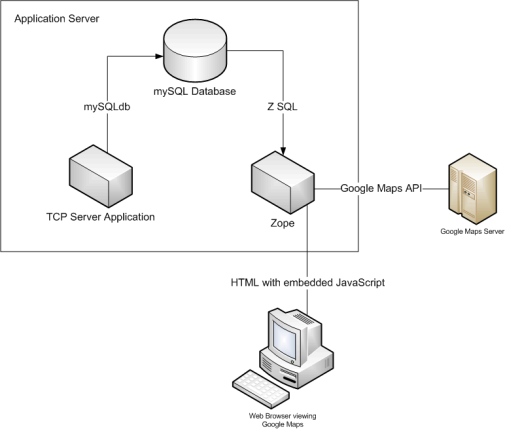


Figure 5.6: Working of the server end

**CHAPTER - 6**

**6. IMPLEMENTATION AND CODING**

All software and development utilities are used on a Windows Operating System (XP and Vista).

**6.1 GPS Tracking Device programming**

After the completion of the design and fabrication of the device, we used AVRStudio to create the microcontroller program. Then Khazama AVR Programmer was used to burn the program on the microcontroller memory.

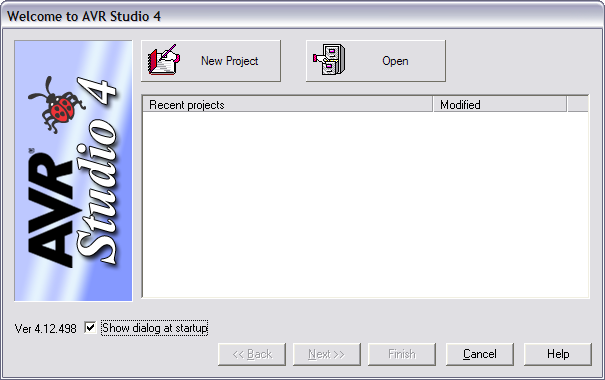


Figure 6.1 AVR Studio

****

Figure 6.2 khazama AVR Programmer

Following is the source code which was burnt on the microcontroller memory:

//Program to run GTS

//Use the send commands to send and get any string from GPS or GSM

#include <avr\io.h>

#include <util\delay.h>

#include <string.h>

#define FOSC 2000000// Clock Speed 2Mhz

#define BAUD 9600 //Baud Rate 9600 bps

#define MYUBRR FOSC/16/BAUD-1

char str[75];

char line\_gsm[75];

char line\_gps[75];

void wait(int n)

{

for(int i=0;i<n;i++)

{

\_delay\_ms(1000);

}

}

void init\_gps( unsigned int ubrr )

{

/\* Set baud rate \*/

UBRR1H = (unsigned char)(ubrr>>8);

UBRR1L = (unsigned char)ubrr;

/\* Enable receiver and transmitter \*/

UCSR1B = (1<<RXEN1)|(1<<TXEN1);

}

void init\_gsm( unsigned int ubrr )

{

/\* Set baud rate \*/

UBRR0H = (unsigned char)(ubrr>>8);

UBRR0L = (unsigned char)ubrr;

/\* Enable receiver and transmitter \*/

UCSR0B = (1<<RXEN0)|(1<<TXEN0);

}

void trns\_gsm( unsigned char data )

{

/\* Wait for empty transmit buffer \*/

while ( !( UCSR0A & (1<<UDRE0)) )

;

/\* Put data into buffer, sends the data \*/

UDR0 = data;

}

void trns\_gps( unsigned char data )

{

/\* Wait for empty transmit buffer \*/

while ( !( UCSR1A & (1<<UDRE1)) )

;

/\* Put data into buffer, sends the data \*/

UDR1 = data;

}

unsigned char rsv\_gsm( void )

{

/\* Wait for data to be received \*/

while ( !(UCSR0A & (1<<RXC0)) )

;

/\* Get and return received data from buffer \*/

return UDR0;

}

unsigned char rsv\_gps( void )

{

/\* Wait for data to be received \*/

while ( !(UCSR1A & (1<<RXC1)) )

;

/\* Get and return received data from buffer \*/

return UDR1;

}

void putstr\_gsm(char\* stringptr) //sending string to gsm

{

while(\*stringptr != 0x00)

{

trns\_gsm(\*stringptr);

stringptr++;

}

}

void putstr\_gps(char\* stringptr) //sending string to gps

{

while(\*stringptr != 0x00)

{

trns\_gps(\*stringptr);

stringptr++;

}

}

void clr\_gsm(void)

{

int i=0;

while(i<75)

{

line\_gsm[i]='\0';

i++;

}

}

void clr\_gps(void)

{

int i=0;

while(i<75)

{

line\_gps[i]='\0';

i++;

}

}

void getstr\_gsm(int n) //getting string from gsm

{

int i=0;

clr\_gsm();

if(n==0)

{

while(1)

{

if(line\_gsm[i]=='\n')

{

break;

}

line\_gsm[i]=rsv\_gsm();

i++;

}

}

else

{

while(i<n)

{

line\_gsm[i]=rsv\_gsm();

i++;

}

}

}

void getstr\_gps(int n) // getiing string from gps

{

int i=0;

clr\_gps();

if(n==0)

{

while(1)

{

if(line\_gps[i]=='\n')

{

break;

}

line\_gps[i]=rsv\_gps();

i++;

}

}

else

{

while(i<n)

{

line\_gps[i]=rsv\_gps();

i++;

}

}

}

void atc(char\* com) //use this function to send any at command to gsm

{

putstr\_gsm(com);

trns\_gsm(0x0D);

}

int atr(void)

{

atc("AT");

getstr\_gsm(6);

if(strcmp(line\_gsm,"\r\nOK\r\n")==0)

return 1;

return 0;

}

void sendmsg(char\* msg)

{

atc("AT+CMGF=1");

\_delay\_ms(200);

putstr\_gsm("AT+CMGS=");

trns\_gsm('"');

putstr\_gsm("9907214242");

trns\_gsm('"');

trns\_gsm(0x0D);

\_delay\_ms(200);

putstr\_gsm(msg);

\_delay\_ms(200);

trns\_gsm(0x1A);

\_delay\_ms(5000);

}

void sqsend\_gsm(void)

{

atc("AT+CSQ");

getstr\_gsm(6);

sendmsg(strcpy(str,line\_gsm));

}

void segmsg\_send(char\* smain)

{

{

getstr\_gps(0);

//if(strncmp(line\_gps,smain,strlen(smain))==0)

{

sendmsg(line\_gps);

}

}

}

int main(void)

{

wait(1);

init\_gsm(MYUBRR);

init\_gps(MYUBRR);

\_delay\_ms(10000);

while(1)

{

atc("AT");

\_delay\_ms(200);

sendmsg("himachi");

\_delay\_ms(10000);

//sqsend\_gsm();

segmsg\_send("$GPGGA");

segmsg\_send("$GPVTG");

\_delay\_ms(10000);

}

return 0;

}

**6.2 GPS Tracking Device Monitoring and Testing**

For monitoring and testing the device we used a terminal software named “RealTerm”. A terminal software can be used to send AT commands to the device and receive and display the GPS data from the device. The PDP context and TCP connection were tested using the same software.

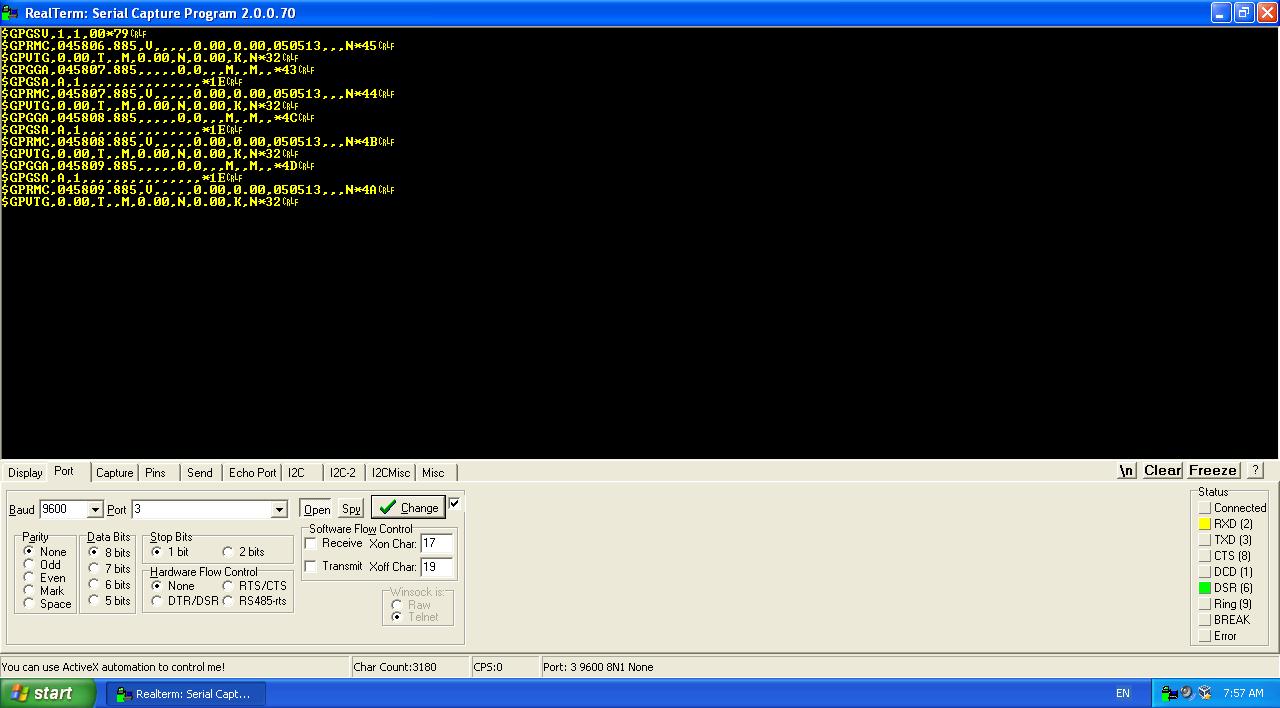
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Figure 6.3: RealTerm displaying GPS data

**6.3 TCP Server**

The TCP Server is coded in python. It basically opens up a TCP port and waits for the connection from the GPS Tracker’s GSM module. Once it receives the connection, it accepts it and as and when the GPS packet is received, it parses it out and stores the Latitude and Longitude in a MySQL table. Python 2.4.4 was downloaded from [http://www.python.org](http://www.python.org/) to run the TCP Server program. Also, the python library called MySQLdb was downloaded from installation.

To run the TCP server we first need to replace ‘your\_ip\_address’ in the tcpServer.py file with the IP Address of the machine you’re running the TCP Server on. To run it we need to type the following command - **python tcpServer.py** in the command prompt.

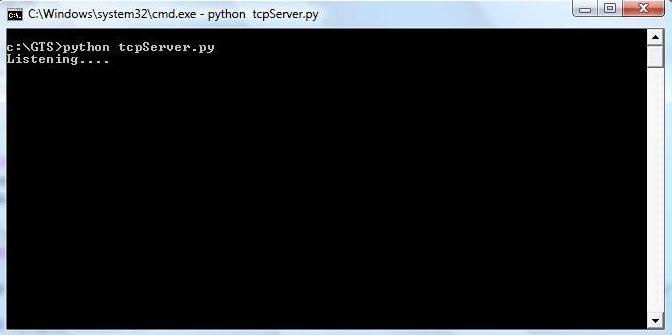


Figure 6.4: TCP server listening for incoming packets

Following is the TCP server program python code:

#!/usr/bin/env python

import socket

import MySQLdb

TCP\_IP = ‘your\_ip\_address"’

TCP\_PORT = 32000

BUFFER\_SIZE = 40

# ClearDB. Deletes the entire tracking table

def ClearDB(curs,d ):

curs.execute ("""

INSERT INTO gmaptracker (lat, lon)

VALUES (0.0,0.0)""")

d.commit()

# Connect to the mySQL Database

def tServer():

try:

db = MySQLdb.connect (host = "your\_host",

user = "your\_user",

passwd = "your\_password",

db = "gmap" )

except MySQLdb.Error, e:

print "Error %d: %s" %(e.args[0], e.args[1])

sys.exit(1);

cursor = db.cursor()

# Start with a fresh tracking table

ClearDB(cursor,db)

# Set up listening Socket

try:

s = socket.socket(socket.AF\_INET, socket.SOCK\_STREAM)

s.setsockopt(socket.SOL\_SOCKET, socket.SO\_REUSEADDR, 1)

s.bind((TCP\_IP, TCP\_PORT))

print "Listening...."

s.listen(1)

conn, addr = s.accept()

print 'Accepted connection from address:', addr

except socket.error:

if s:

s.close()

print "Could not open socket: "

cursor.close()

conn.close()

db.close()

sys.exit(1)

try:

while 1:

data = conn.recv(BUFFER\_SIZE)

if not data:break

str1,str2 = data.split("Long: ")

str1 = str1.split("Lat: ")[1]

latitude = float(str1)

longitude = float(str2)

cursor.execute ("""

INSERT INTO gmaptracker (lat, lon)

VALUES (%s,%s)""", (latitude,longitude))

db.commit()

except KeyboardInterrupt:

ClearDB(cursor,db);

cursor.close()

conn.close()

db.close()

if \_\_name\_\_ == '\_\_main\_\_':

tServer()

**6.4 MySQL Database**

A MySQL database is used to store the GPS Co-ordinates received. For Widows it can be downloaded from <http://dev.mysql.com/downloads/>. Then we need to log on using the username and password set earlier during the setup. Then enter **mysql -p -u user** at command prompt followed by the password for the user when prompted. Now we’ll create a database. We’ll call it gmap. Enter: **mysql> CREATE DATABASE gmap;** Now, we can see if the database has been created, by entering: **mysql> show databases;** The following is displayed:

|  |
| --- |
| Database |
| information\_schema |
| gmap |
| mysql |

Table 1: List to databases

This table shows the current databases in MySQL. Next, we change to the gmap database by entering: **mysql> use gmap;** To create a table to hold our lat/long in the gmap database we created, we enter the following command:

**mysql> CREATE TABLE gmaptracker (**

**-> id int(8) NOT NULL auto\_increment,            
-> lat double(13,10) NOT NULL default 0.0000000000,  
-> lon double(13,10) NOT NULL default 0.0000000000,  
-> PRIMARY KEY (id)            
-> )**;   
The table we created can be viewed by entering: **mysql> show tables;**

Following is the output which will show the table we just created:

|  |
| --- |
| Tables\_in\_gmap |
| gmaptracker |

Table 2: Tables in gmap

To see the fields in the gmaptracker table, we’ll enter: **mysql> desc gmaptracker;**  
The output will show the fields in the table gmaptracker which we created.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Field | Type | Null | Key | Default | Extra |
| Id | int(8) | NO | PRI | NULL | auto\_increment |
| Lat | double(13,10) | NO |  | 0.0000000000 |  |
| Lon | double(13,10) | NO |  | 0.0000000000 |  |

Table 3: Fields in gmaptracker

**6.5 Plone**

The next piece of software we need to install is Plone. Plone is a CMS (Content Management System) built on top of Zope, which is a popular web application server. We’ll be using only the Zope functionality of Plone and not its CMS features.

First we’ll download Plone 3.3.5 from <http://launchpad.net/plone/3.3/3.3.5/+download/Plone-3.3.5-UnifiedInstaller.tgz> and install it.

We’ll also download and install ZmySQLDA and MySQLdb. Now, we’ll start an instance of Plone from the Plone controller and open a browser and enter <http://localhost:8080/manage_main>. We’ll be required to enter the username and password which were entered during the installation process. This will display the main screen.

Next, we’ll create a SQL Database Connection. We’ll select the 'Z SQL Database Connecton' from the drop down list on the right. In the database connection string text box, enter gmap@host:port. Replace host and port with your hostname and port respecively. If the SQL database is running on the same machine as Plone, enter

**gmap <username> <password>**

After clicking the Browse tab of the Z MySQL Database Connection, we’ll see our table (gmaptracker).

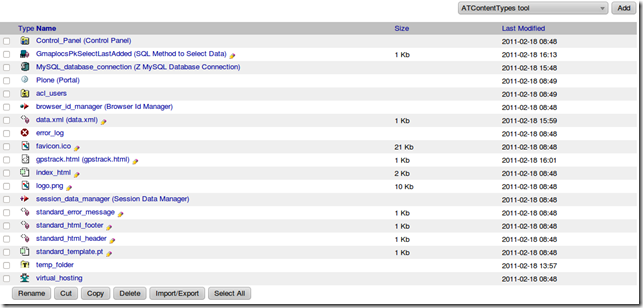
[](http://lh5.ggpht.com/_0oX4HkvjyvE/TWLItgBcNaI/AAAAAAAAAvU/1LrfX0mysZo/s1600-h/rootFolder3.png)

Figure 6.5: Plone main screen

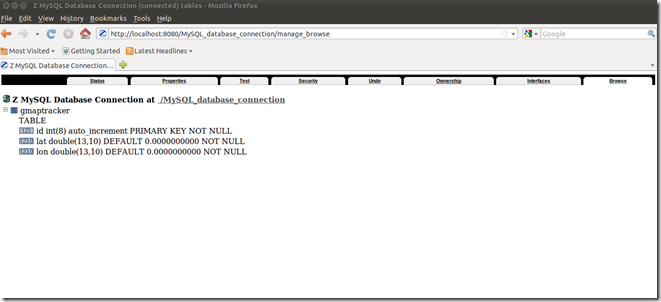
[](http://lh4.ggpht.com/_0oX4HkvjyvE/TWLIuQhgYlI/AAAAAAAAAvk/7cWkdJQOyjM/s1600-h/database3.png)

Figure 6.6: SQL database connection

Then we’ll add a Z SQL Method to retrieve the last row from the SQL table. Select the 'Z SQL Method' from the drop down list on the right. Enter "**GmaplocsPkSelectLastAdded**" for id and "**SQL Method to select Data**" for tile. Enter the code:

**select \* from gmaptracker order by id desc limit 1**

Then click Add. From the root folder view, Click the GmaplocsPkSelectLastAdded method from the root folder view and click the Advanced Tab.

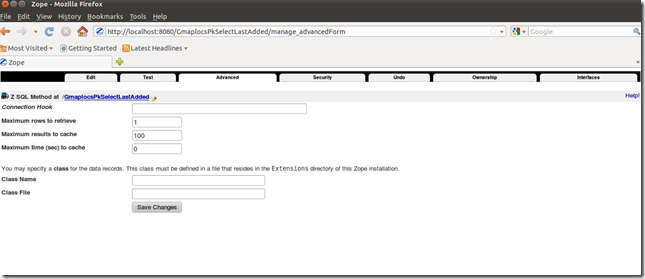
[](http://lh6.ggpht.com/_0oX4HkvjyvE/TWLIvbACJAI/AAAAAAAAAv0/6ILgDDWiYHQ/s1600-h/reducerows3.png)

Figure 6.7: Z SQL Method

Next, add a DTML Method. Go to the root folder view. Select the 'DTML Method' from the drop down list on the right. Enter **"data.xml"** for id. Click Add and Edit. Enter the code

<?xml version="1.0" encoding="UTF-8"?>

<markers>

<dtml-in GmaplocsPkSelectLastAdded>

<marker lat="&lt;dtml-var lat>" lng="<dtml-var lon>"/>

</dtml-in>

</markers>

Save the changes.

Finally, add a DTML Document. Go to the root folder view. Select the 'DTML Document' from the drop down list on the right'. Enter "gpstrack.html" for id and a descriptive name. Click Add and edit. Enter the code:

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"

"http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">

<html xmlns="http://www.w3.org/1999/xhtml">

<head>

<title>Real Time GPRS based GPS Tracker</title>

<script src="http://maps.google.com/maps?

file=api&v=1" type="text/javascript"></script>

 <!-- Make the document body take up the full screen -->

<style type="text/css">

v\:\* {behavior:url(#default#VML);}

html, body {width: 100%; height: 100%}

body {margin-top: 0px; margin-right: 0px; margin-left: 0px; margin-bottom: 0px}

</style>

<script type="text/javascript">

//<![CDATA[

function load(){

var map = new GMap(document.getElementById("map"));

var point = new GPoint(0,0);

map.addControl(new GLargeMapControl());

map.addControl(new GMapTypeControl());

map.centerAndZoom(point, 1);

window.setTimeout(function(){reloadMap(map)},1000);

}

function reloadMap(map) {

var request = GXmlHttp.create();

request.open("GET", "data.xml", true);

request.onreadystatechange = function() {

if (request.readyState == 4) {

var xmlDoc = request.responseXML;

var markers = xmlDoc.documentElement.getElementsByTagName("marker");

for (var i = 0; i < markers.length; i++) {

var point = new

GPoint(parseFloat(markers[i].getAttribute("lng")),

parseFloat(markers[i].getAttribute("lat")));

var marker = new GMarker(point);

map.clearOverlays();

map.addOverlay(marker);

map.centerAtLatLng(point);

}

}

}

request.send(null);

window.setTimeout(function(){reloadMap(map)},1000);

}

// Monitor the window resize event and let the map know when it occurs

if (window.attachEvent) {

window.attachEvent("onresize", function() {this.map.onResize()} );

} else {

window.addEventListener("resize", function() {this.map.onResize()} , false);

}

//]]>

</script>

</head>

<body onload="load()">

<div id="map" style="width: 100%; height:100%;"></div>

</body>

</html>

Save the changes. Open a browser to <http://localhost:8080/gpstrack.html>. Now, we’ll see a plain blue Google Map Screen.

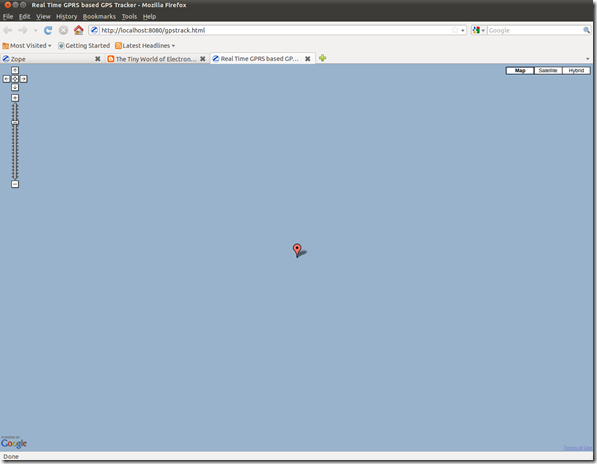
[](http://lh3.ggpht.com/_0oX4HkvjyvE/TWLIwFJM85I/AAAAAAAAAwE/cG6y6vqZcoI/s1600-h/defaultloc3.png)

Figure 6.8: Initial Google map screen

That's because the initialization co-ordinates are 0.0000000000 Lat and 0.0000000000 Long. That's in the Atlantic Ocean off the coast of Africa.

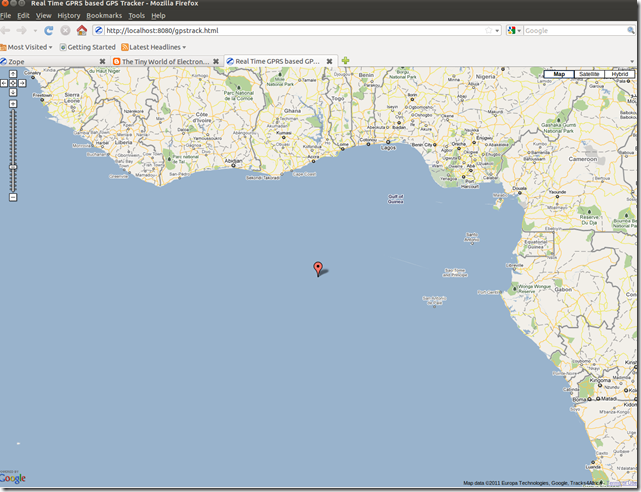
[](http://lh4.ggpht.com/_0oX4HkvjyvE/TWLIwznKjbI/AAAAAAAAAwU/k6MrWUpyzjI/s1600-h/africa3.png)

Figure 6.9 Zoomed out view of the initial Google Maps screen

Once we power on the device, we’ll see the marker move to the correct GPS co-ordinates and it’ll update every second.

**CHAPTER - 7**

**7. RESULTS**

The GPS tracking system transmits its coordinates to the TCP server which are then displayed on Google Maps.

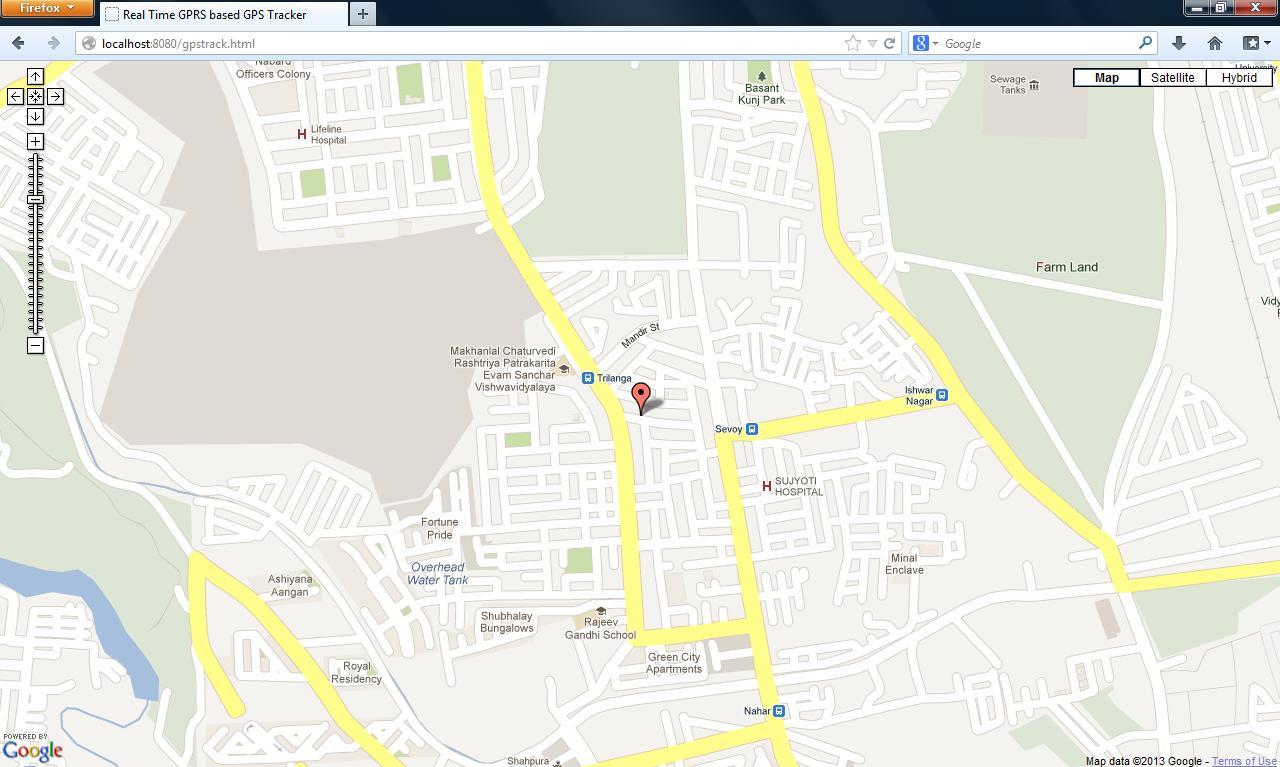
****

Figure 7.1: Google Maps test output in "Map" view

As an additional feature, the coordinates of the GPS tracking system can be forwarded on any mobile phone number. This proves as a backup option if the TCP server doesn’t work.

Following is the example of the strings received by the GPS tracking system on a mobile phone:

Himachi

$GPGGA,045809.885,,,,,0,0,,,M,,M,,\*4D

$GPGSA,A,1,,,,,,,,,,,,,,,,,,,,,\*1E

$GPRMC,045809.885,V,,,,,0.00,0.00,050513,,,N\*4A

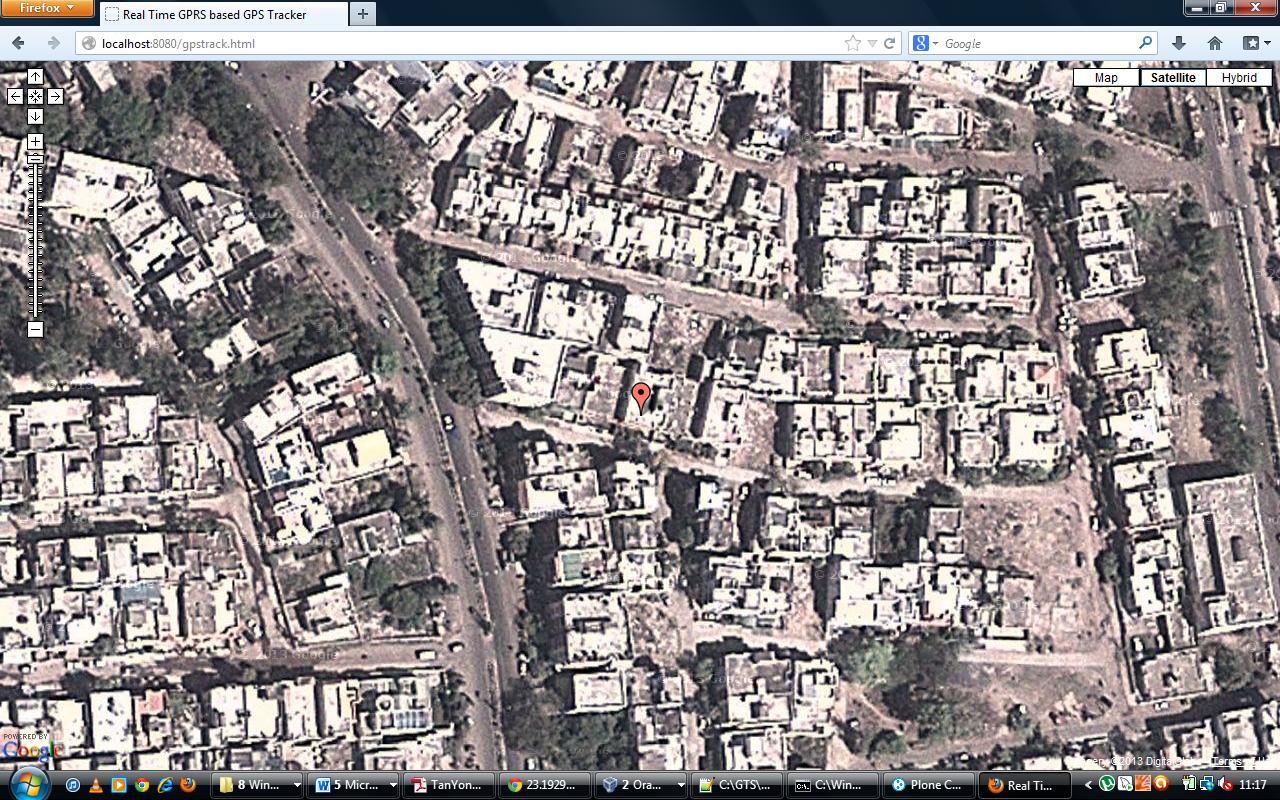
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N\*32

Figure 7.2: Google Maps test output in "Satellite" view

**CHAPTER – 8**

**8. CONCLUSION AND FUTURE WORK**

**8.1 Conclusion**

1. A GPS tracker essentially contains GPS module to receive the GPS signal and calculate the coordinates. If the data has to be logged in the tracking device itself, it must contain a large memory to store the coordinates such a tracker is called a data logger, while if data has to be logged remotely, additionally a GSM/GPRS modem has to be used to transmit this information to a central computer either via SMS or via GPRS in form of IP packets. This project is a data pusher type tracker.
2. There are many costly GPS tracking systems available in the market. However, this project has proved that low cost GPS tracking system can be effective as well. Total cost of the GPS tracking system is around INR 2500.
3. Most GPS devices found in the market are used for vehicle tracking; they include a monitor display to navigate to their destination having routes stored on board. In this project, we are using the GPS tracker mainly for tracking the vehicle’s location.
4. A finished circuit board (like Arduino) can make the job easier; however, a custom designed and fabricated board can significantly reduce the cost of the device, albeit it requires more work and time to be prepared.
5. The GPS tracking system is able to track the vehicle location and plot the travelled route on a map which fulfills all objectives of this project. This is done by establishing a server to which is connected with the tracking system using either SMS technology or GPRS technology. Hence remote monitoring of the GPS tracking system is functional and the vehicle can be monitored from anywhere.
6. The GPS tracking system can be implemented to accurately track the current location of the vehicles and the route travelled in order to ensure the vehicle is being used for work rather than for personal uses. The GPS Tracking system can be used for companies like logistics and dispatch services for real time status of the post or good delivery. This will ensure that the delivery is on schedule and accountable to the customer on the current status of the delivery. It can be used for improved customer service. For instance, the customer service officer can locate and plan the service repairman near the customer’s area for any urgent case of repair request accordingly. This will speed up the response time to customer and eventually improve the efficiency.

**8.2 Future Work**

* + 1. Further developments can be made to the tracking system to introduce more features for the convenience of the customer; like configuration of a movement alarm, which can act as a security feature to ensure that the vehicle is not moved out of a predefined area where it is parked. Once the vehicle moves out of the predefined area, a SMS will be sent to the user to notify that their vehicle is being stolen. The users can then use the GPS tracking system to efficiency track down and recover their vehicle. This will prevent vehicle theft.
    2. The device can be optimized to consume lesser power and produce more efficient coordinates. The device can be integrated with the electrical system of a vehicle and can be used for voice – based navigation.
    3. Further, the device can be used in conjunction with a various projects like weather balloon, traffic simulation and anti-theft security system.
    4. Algorithms like Kalman Filter or iterative techniques for optimization of nonlinear functions like particle Swarm Optimization (PSO) could be used for data processing to get an optimal estimate when predictions have to be made about the position and the estimated time of arrival at a specified position (like a bus stop or the terminal).

1. This device is a prototype; it can be scaled down in size and can also be programmed to process more information on-board rather than sending it to the server.

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