FINAL PROJECT REPORT

GPS Based Automobile Anti Collision System

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Introduction

1.1 Project Introduction.

The fatalities attributed to collision of automobiles have been in play since from the very beginning of automobile industry. A major cause of these accidents is that vehicles are not equipped with collision avoidance systems due to their cost. These vehicles rely solely on visual acquisition to avoid collisions.

There are limitations to using visual acquisition as a means of collision avoidance even for slow moving automobiles such as. Human vision can also be limited due to many reasons and many conditions such as zero visibility sue to fog, rain or snow etc.

As can be seen, there is a need for vehicles to have a small, reliable and cost effective system for collision avoidance that does not rely heavily on visual acquisition.

1.2 Aim of the Project

The aim of this project is to develop a low-cost GPS based system to be installed in vehicles that will improve the safety of the passengers. The system must be small and light weight as it needs to fit into the vehicle's dashboard.

. The system must also be able to be used by amateur drivers with very little technical expertise and require slight or no interaction

Moreover this system is not only bound for use in automobiles. It can also be used in any kind of vehicles including marine vessels. Its main focus is to generate an alarm in case of any kind of collision which is likely to happen. The system should be low cost and small in size.

1.3 Concept of operation.

The system uses the satellite based Global Positioning System to determine its position and co-ordinates. These co-ordinates are then sent to the co-responding system. This system receives the co-ordinates and processes them against its own GPS co-ordinates. In this way the system is able to judge if a collision is likely to happen or not, and it will set off an alarm accordingly.

1.4 System Design

All systems depend on the satellite based Global Positioning System (GPS) to determine their position. The Hollux M89 is used to obtain the position. This information is then sent to the microcontroller which in this case is Atmel 89S52. The microcontroller is also interfaced with SIM 300DZ which is a GSM module. This module is used to exchange co-ordinates between

the two systems. Once a system has its own, as well as the other system co-ordinates. It can perform the risk calculations needed to avoid a collision. A 16-bit LCD is also used in both systems which displays the respective co-ordinates all the time. A graphical representation of the overall system design is shown below.

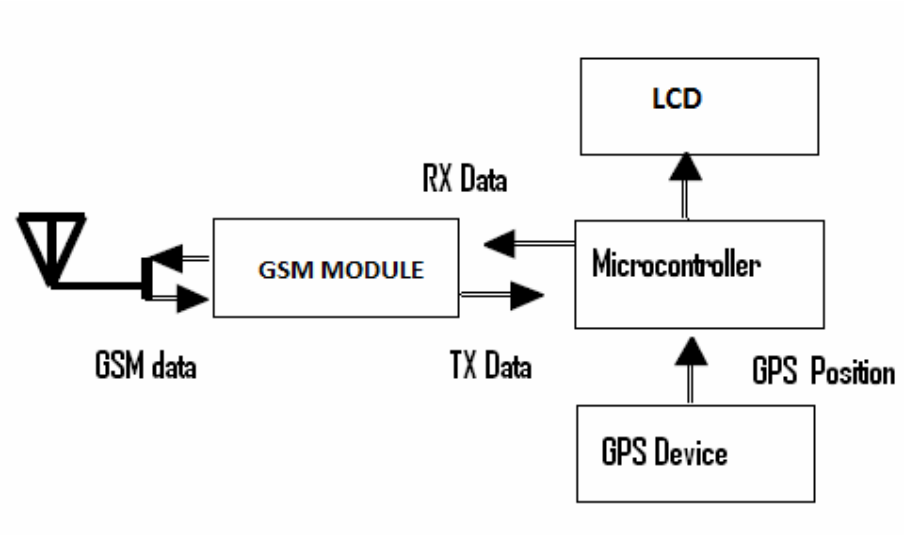


Fig 1.1 Overall System Design

Chapter 2

Project Description

2.1 Problem Statement

Problem statement defines problems in existing system and reasons to propose a new system. As one can see that the existing systems capable of handling this problem are quite expensive. The TCAS 1, TCAS 2 and ADB Surveillance etc are in fact quite efficient systems but at the same time they are very expensive.

2.2 Proposed system

as a solution to the above problem we propose an efficient and low cost system that. The system is durable and is capable to work in any scenario. It also does not involve any technical knowledge to use this system. An alarm is sounded in case of a probable collision. Moreover this system has a capability of detecting the collision from any direction.

The proposed system is composed of the following components.

- GPS (Global positioning System) Receiver
- GSM (Global System for Mobile communication) Transceiver
- Micro-controller. Processor

2.3 Theories

2.3.1 GPS

a. Introduction

The Global Positioning System (GPS) is a U.S. space-based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis and is freely available to all. For anyone with a GPS receiver, the system will provide location and time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world. The GPS is made up of three parts: satellites orbiting the Earth; control and monitoring stations on Earth; and the GPS receivers owned by users. GPS satellites broadcast signals from space that are picked up and identified by GPS receivers. Each GPS receiver then provides three-dimensional location (latitude, longitude, and altitude) plus the time. [1]

The GPS is made up of three segments

i. Space Segment

The Space Segment of the system consists of the GPS satellites. These space vehicles (SVs) send radio signals from space. The nominal GPS Operational Constellation consists of 24 satellites that orbit the earth in 12 hours. There are often more than 24 operational satellites as new ones are launched to replace older satellites. The satellite orbits repeat almost the same ground track (as the earth turns beneath them) once each day. The orbit altitude is such that the satellites repeat the same track and configuration over any point approximately each 24 hours (4 minutes earlier each day). There are six orbital planes (with nominally four SVs in each), equally spaced (60 degrees apart), and inclined at about fifty-five degrees with respect to the equatorial plane. This constellation provides the user with between five and eight SVs visible from any point on the earth. [2]

ii. Control Segment

The Control Segment consists of a system of tracking stations located around the world. The Master Control facility is located at Schriever Air Force Base (formerly Falcon AFB) in Colorado. These monitor stations measure signals from the SVs which are incorporated into orbital models for each satellites. The models compute precise orbital data (ephemeris) and SV clock corrections for each satellite. The Master Control station uploads ephemeris and clock data to the SVs. The SVs then send subsets of the orbital ephemeris data to GPS receivers over radio signals. [2]

iii. User Segment

The GPS User Segment consists of the GPS receivers and the user community. GPS receivers convert SV signals into position, velocity, and time estimates. Four satellites are required to compute the four dimensions of X, Y, Z (position) and Time. GPS receivers are used for navigation, positioning, time dissemination, and other research. Navigation in three dimensions is the primary function of GPS. Navigation receivers are made for aircraft, ships, ground vehicles, and for hand carrying by individuals. Precise positioning is possible using GPS receivers at reference locations providing corrections and relative positioning data for remote receivers. Surveying, geodetic control, and plate tectonic studies are examples.

Time and frequency dissemination, based on the precise clocks on board the SVs and controlled by the monitor stations, is another use for GPS. Astronomical observatories, telecommunications facilities, and laboratory standards can be set to precise time signals or controlled to accurate frequencies by special purpose GPS receivers. Research projects have used GPS signals to measure atmospheric parameters. [2]

2.3.2 Working of GPS:

The Global Positioning System (GPS) is a technical marvel made possible by a group of satellites in earth orbit that transmit precise signals, allowing GPS receivers to calculate and

display accurate location, speed, and time information to the user. By capturing the signals from three or more satellites (among a constellation of 31 satellites available), GPS receivers are able to use the mathematical principle of trilateration to pinpoint the location. With the addition of computing power, and data stored in memory such as road maps, points of interest, topographic information, and much more, GPS receivers are able to convert location, speed, and time information into a useful display format. The United States Department of Defense (DOD) as a military application originally created GPS. The system has been active since the early 1980s, but began to become useful to civilians in the late 1990s. Consumer GPS has since become a multi-billion dollar industry with a wide array of products, services, and Internet-based utilities. [2]

2.3.4 Position calculation introduction

To provide an introductory description of how a GPS receiver works, errors will be ignored in this section. Using messages received from a minimum of four visible satellites, a GPS receiver is able to determine the times sent and then the satellite positions corresponding to these times sent. The x, y, and z components of position, and the time sent, are designated as $[x_i, y_i, z_i, t_i]$where the subscript *i* is the satellite number and has the value 1, 2, 3, or 4. Knowing the indicated time the message was received tr, the GPS receiver can compute the transit time of the message as $(tr-t_i)$. Assuming the message traveled at the speed of light, c, the distance traveled or pseudo range, $p_i$can be computed as $(tr-t_i)c$.

A satellite's position and pseudo range define a sphere, centered on the satellite with radius equal to the pseudo range. The position of the receiver is somewhere on the surface of this sphere. Thus with four satellites, the indicated position of the GPS receiver is at or near the intersection of the surfaces of four spheres. In the ideal case of no errors, the GPS receiver would be at a precise intersection of the four surfaces. [3]

2.3.5 GPS triangulation

- The distance (x) from one satellite tells us we're located somewhere on the surface of an imaginary sphere centered on that satellite with a radius of x.

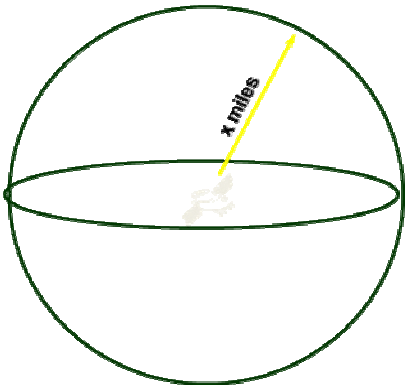


Fig2.1 GPS Triangulation 1 [4]

- Distance measurements from two satellites limits our location to the intersection of two spheres, which is a circle.

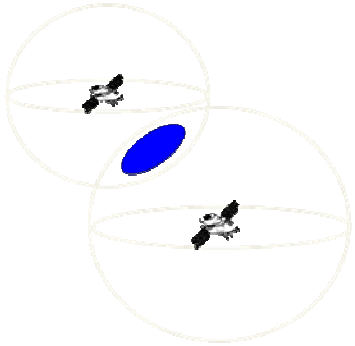


Fig 2.2 GPS Triangulation 2 [4]

- A third measurement narrows our location to just two points.

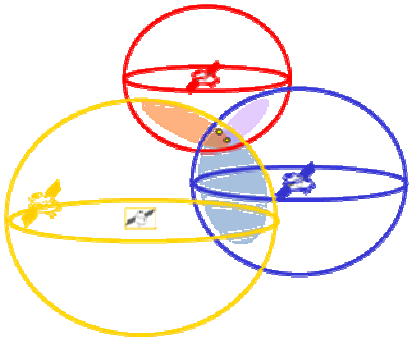


Fig 2.3 GPS Triangulation 3 [4]

- A fourth measurement determines which point is our true location

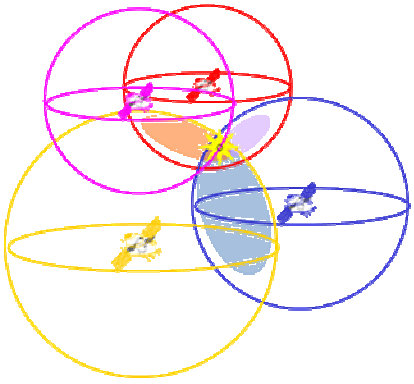


Fig 2.4 GPS Triangulation 4 [4]

2.3.6 Signals:

In order for GPS to work, a network of satellites was placed into orbit around planet Earth, each broadcasting a specific signal, much like a normal radio signal. This signal can be received by a low cost, low technology aerial, even though the signal is very weak. Rather than carrying an actual radio or television program, the signals that are broadcast by the satellites carry data that is passed from the aerial, decoded and used by to the GPS software. The information is specific enough that the GPS software can identify the satellite, it's location in space, and calculates the time that the signal took to travel from the satellite to the GPS receiver. [3]

2.3.7 Applications

i. Civilian

Many civilian applications use one or more of GPS's three basic components: absolute location, relative movement, and time transfer.

- Surveying: Surveyors use absolute locations to make maps and determine property boundaries
- Map-making: Both civilian and military cartographers use GPS extensively.
- Navigation: Navigators value digitally precise velocity and orientation measurements.

ii. Military

As of 2009, military applications of GPS include:

Navigation: GPS allows soldiers to find objectives, even in the dark or in unfamiliar territory, and to coordinate troop and supply movement

Target tracking: Various military weapons systems use GPS to track potential ground and air targets before flagging them as hostile

Missile and projectile guidance: GPS allows accurate targeting of various military weapons including ICBMs, cruise missiles and precision-guided munitions. Artillery projectiles [3]

2.4 GSM (Global System for Mobile Communication)

2.4.1 Introduction

Global System for Mobile Communication. A network which generally covers a fairly broad geographic area and which offers customized travel, financial, reference and commercial information to smart-phone subscribers.

GSM or global system for mobile communication is a digital cellular system. It was originated in Finland Europe .however now it is throughout the world. GSM (Global System for Mobile Communication) accounts for 80% of total mobile phone technologies market. There are over more than 3 billion users of GSM (Global System for Mobile Communication) now. GSM technology got its popularity, when people used it to talk to their friends and

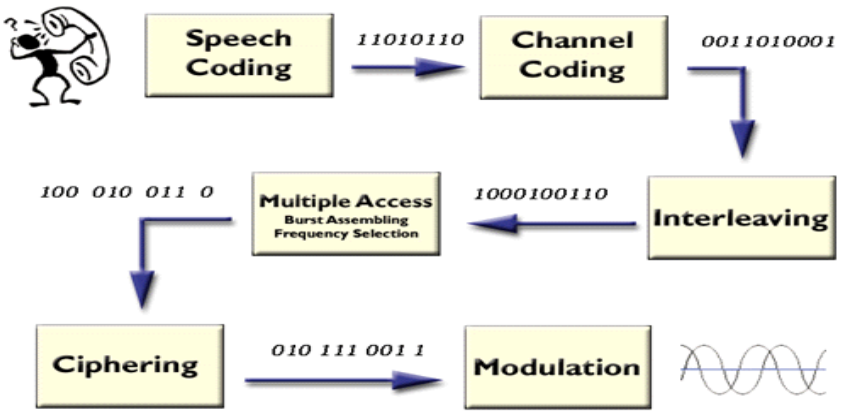
relatives. The use of GSM (Global System for Mobile Communication) is possible due to the SIM **(**subscribers identity module**)** GSM (Global System for Mobile Communication) is easy to use, affordable and helps you carry your cell phone everywhere. GSM (Global System for Mobile Communication) is a 2G technology. There are many frequency ranges for GSM (Global System for Mobile Communication) however 2G is the most used frequency. GSM (Global System for Mobile Communication) offers moderate security. It allows for encryption between the end user and the service base station. The use of various forms of cryptographic modules is part of GSM technology. [5]

2.4.2 GSM technology

A technology started development in 1985 by a French company formerly known as Group Special Mobile. Its main competitor is CDMA, currently in use by Bell Mobility, TELUS Mobility and Mobility Canada carriers.

GSM operates on 4 different frequencies worldwide. However, only two are which are used in Canada, which are GSM-850 and GSM-1900.GSM-850 and GSM-1900 which operate at 1.9Ghz.

GSM calls are either based on data or voice. Voice calls use audio codec called half-rate, full-rate and enhanced full-rate. Data calls can turn the cell phone into a modem operating at 9600 bps. An extended GSM feature is high speed circuit switched data, allowing the phone to transmit up to around 40 kbps. [6]



Figs 2.5 BLOCK DIAGRAM OF GSM [7]

2.4.3 GSM Modem

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

A GSM modem can be an external device or a PC Card / PCMCIA Card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a PC Card / PCMCIA Card is designed for use with a laptop computer. It should be inserted into one of the PC Card / PCMCIA Card slots of a laptop computer. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate. Computers use AT commands to control modems. Both GSM modems and dial-up modems support a common set of standard AT commands. One can use a GSM modem just like a dial-up modem.

In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, one can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength.
- Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low, only about six to ten SMS messages per minute. [8]

2.5 Introduction to AT Commands:

AT commands are instructions used to control a modem. AT is the abbreviation of Attention. Every command line starts with "AT" or "at". That's why modem commands are called AT commands. Many of the commands that are used to control wired dial-up modems, such as ATD (Dial), ATA (Answer), ATH (Hook control) and ATO (Return to online data state), are also supported by GSM/GPRS modems and mobile phones. Besides this common AT command set, GSM/GPRS modems and mobile phones support an AT command set that is specific to the GSM technology, which includes SMS-related commands like AT+CMGS (Send SMS message), AT+CMSS (Send SMS message from storage), AT+CMGL (List SMS messages) and AT+CMGR (Read SMS messages).

Note that the starting "AT" is the prefix that informs the modem about the start of a command line. It is not part of the AT command name. For example, D is the actual AT command name in ATD and +CMGS is the actual AT command name in AT+CMGS. However, some books and web sites use them interchangeably as the name of an AT command.

Here are some of the tasks that can be done using AT commands with a GSM/GPRS modem or mobile phone:

- Get basic information about the mobile phone or GSM/GPRS modem. For example, name of manufacturer (AT+CGMI), model number (AT+CGMM), IMEI number (International Mobile Equipment Identity) (AT+CGSN) and software version (AT+CGMR).
- Get basic information about the subscriber. For example, MSISDN (AT+CNUM) and IMSI number (International Mobile Subscriber Identity) (AT+CIMI).
- Get the current status of the mobile phone or GSM/GPRS modem. For example, mobile phone activity status (AT+CPAS), mobile network registration status (AT+CREG), radio signal strength (AT+CSQ), battery charge level and battery charging status (AT+CBC).
- Establish a data connection or voice connection to a remote modem (ATD, ATA, etc).
- Send and receive fax (ATD, ATA, AT+F*).
- Send (AT+CMGS, AT+CMSS), read (AT+CMGR, AT+CMGL), write (AT+CMGW) or delete (AT+CMGD) SMS messages and obtain notifications of newly received SMS messages (AT+CNMI).
- Read (AT+CPBR), write (AT+CPBW) or search (AT+CPBF) phonebook entries.
- Perform security-related tasks, such as opening or closing facility locks (AT+CLCK), checking whether a facility is locked (AT+CLCK) and changing passwords (AT+CPWD).
  (Facility lock examples: SIM lock [a password must be given to the SIM card every time the mobile phone is switched on] and PH-SIM lock [a certain SIM card is associated with the mobile phone. To use other SIM cards with the mobile phone, a password must be entered.])
- Control the presentation of result codes / error messages of AT commands. For example, you can control whether to enable certain error messages (AT+CMEE) and whether error messages should be displayed in numeric format or verbose format (AT+CMEE=1 or AT+CMEE=2).
- Get or change the configurations of the mobile phone or GSM/GPRS modem. For example, change the GSM network (AT+COPS), bearer service type (AT+CBST), radio link protocol parameters (AT+CRLP), SMS centre address (AT+CSCA) and storage of SMS messages (AT+CPMS).
- Save and restore configurations of the mobile phone or GSM/GPRS modem. For example, save (AT+CSAS) and restore (AT+CRES) settings related to SMS messaging such as the SMS centre address.

Note that mobile phone manufacturers usually do not implement all AT commands, command parameters and parameter values in their mobile phones. Also, the behaviour of the implemented AT commands may be different from that defined in the standard. In general, GSM/GPRS modems designed for wireless applications have better support of AT commands than ordinary mobile phones.
In addition, some AT commands require the support of mobile network operators. For example, SMS over GPRS can be enabled on some GPRS mobile phones and GPRS modems with the +CGSMS command (command name in text: Select Service for MO SMS