Vehicle Anti-Theft Tracking System Based On GSM/GPS Technology

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ABSTRACT

This paper presents a secured and reliable anti-theft control system for vehicle using GSM/GPS technology which will have the ability to access vehicle from any location. The system is combined with GSM technology in form of AT command to notify the user through SMS once there is an intruder. The system comprises of microcontroller (PIC16F877) which is the major control for the system, MAX232 converter for conversion of voltage level on TTL devices that are interfaced with PC serial port and microcontroller, GPS/GSM for location tracking and messaging through SMS. The GSM Module is configured to be scanned by the microcontroller in such a way that if any AT command is prompted, it is quickly stored into the memory of the microcontroller, thus displaying its output on a 4 bit configured LCD. This work has proved to be very effective in vehicle recovery because messaging through GSM takes seconds.

Keywords: AT command, GSM, GPS, Microcontroller, Smart phone, MAX232 converter

1. INTRODUCTION

Transportation by road is by no means the most common form of transportation. As a result, both private and commercial vehicles are in the increase on daily basis. Likewise, the theft of vehicle by those who cannot afford to buy it is in the increase mostly in remote areas. Anti-theft control system for vehicle using GSM/GPS technology ensures that your vehicle is protected from theft. From research conducted, it was found that majority of the existing car security systems uses only alarm and doesn't send message to the car owner let alone immobilizes the car [1]. This vehicle anti-theft control system consists of an electronic device installed in the vehicle so that it can be tracked by the owner or security once the vehicle is stolen. The tracking is done to know the actual location of the vehicle by displaying the longitude and latitude of the vehicle's location. This information is displayed on the owner's phone. The vehicle control system can also be used to monitor the behavior of drivers, like employers and employees or parent and teen driver. When used as a security system an anti-theft control system may serve as either an additional or a replacement for a traditional alarm system. Presently in the leading market of automobile anti-theft production is CMOS chip production combined with GPS positioning system [2]. The main concept behind the work is receiving sent Short Message Services (SMS) and processing it further as required to perform the desired operation. Location tracking using GPS is of two types; passive and the active types. Passive system monitors, locate and store data on journey basis either when the doors are opened and close or when the vehicle ignition is ON. The information is viewed when required from a computer system or output device that can display the information. The active system is also known as real-time, it sends information to a mobile phone or computer as the event is happening such that when an intruder try to start a vehicle, the vehicle ignition is energized and SMS alert is sent instantly to the owner of the vehicle with details of latitude and longitude of the vehicle's location. The active system is usually better for commercial use and for vehicle tracking and immobilizing vehicle under the control of intruder.

2. LITERAURE REVIEW

Various writers have presented works on GPS/GSM technology. A hybrid GPS-GSM localization of vehicle that incorporate GSM/GPS to track vehicle using Google map was developed by AL-Khedher, the module has a GPS mounted on the moving vehicle to recognize its position and to exchange the information as SMS to a beneficiary station [3]. Ibrahim et al describe a hostile security frame work that uses a secured frame work outline with Dual Tone Multi Frequency DTMF and a GSM to screen and shield automobile [4]. Rashed et al described a GPS based tracking system that keeps track of the location of a vehicle and the speed based on mobile phone text messaging. The system is able to provide real time text alert for speed and location. The present location can be locked and the system will alert the owner if the vehicle has been moved from the present locked location. Every one hour the GSM mobile informs the owner of the current location of the vehicle stating the longitude, latitude and speed. Upon actuation, it naturally grounds the automobile by detecting the ignition scratch supply from the auto-battery [5]. The utilization of

ARM microcontroller, GSM and GPS module together with an accelerator and temperature sensor is carried out by Joshi and Mahajan. Jian-ming et al they describe vehicles anti-robbery framework utilizing GSM/GPS module. The framework utilizes fast blend sort single-chip C8051f120 and stolen vehicle is discovered by the utilization of vibration sensor.

3. MATERIAL AND METHOD

The design of anti-theft control system for vehicle using GSM/GPS technology is composed of the DC power supply section, voltage regulator, GSM (SIM900B), GPS(SIRF3), microcontroller (PIC16f877A), System unit (relay driver), LCD, level converter (MAX232) and Transistor I.C(ULN2004).

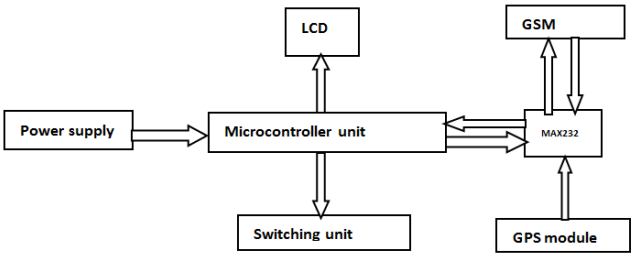

Figure 3.1 Block Diagram of the System.

The 12 volts battery provide the source of excitation to the entire circuit, a voltage regulator unit is connected to regulate the voltage to 5v for efficient operation of the entire component of the design work. The microcontroller unit contains programs that communicate with the GSM/GPS module via Max232 converter.The GPS module generates the location and position of the vehicle at any time giving its latitude and longitude while the GSM module is for communication between the admin and the device. The switching unit is responsible for stopping the vehicle when the command is given. To locate a vehicle, the user sends SMS to the vehicle's tracking system when the user's message gets to the number at the modem the system sends a return reply (SMS) automatically to the user's mobile phone indicating the position of the vehicle in latitude and longitude. The user then responds appropriately with regards to the message received from the modem. Simply putting it, the system is designed in such a way that when the Ignition of the car is put ON, the system becomes energized hence initializing both the Microcontroller and the GSM/GPS module onto which the microcontroller picks the signal to acquire the vehicle's location information from the GPS module via MAX 232 and transmit it to GSM module through MAX232. The vehicle's geographical co-ordinates latitude and longitude are recorded in the memory. A smart phone application has been created to display the vehicle location on Google maps using the recorded latitude and longitude values. The GSM module immediately sends a message to the owner's phone number wherever he/she may be as far as it is within the reach of network. When vehicle is stolen the owner decides on the action to take knowing the AT commands. The microcontroller has already being programmed waiting for a command from the issuer. Hence the vehicle owner sends command to the microcontroller to immobilize the vehicle in case of theft. The system architecture is made up of the following parts;

3.1 PIC16F877A MICROCONTROLLER

Microcontroller is an embedded system with input and output ports, memory and processor. It is a programmable device that accepts digital data as input process the data according to the instruction in its memory and gives output. The choice of PIC16F877A was considered in this work because of its low power, high performance speed, inbuilt features and EEPROM technology. The EEPROM technology makes it possible to write and erase the program as many times as possible. It is a 40 pin microcontroller, 35 of the pins are for input and output.It consists of two 8 bit and one 16 bit timer. The UART (universal asynchronous transmitter and receiver) block in the device makes it possible to receive and transmit data over a serial line with little load on central processing unit.

The general specification of microcontroller is stated as follows:

- Data memory = 368byte

- Flash program memory = 8Kbit
- EEPROM data memory =256 byte
- 3 independent Timers /counters
- 35 instruction set
- Frequency 0-20 MHz
- 35 input and output pin.

The PIC16F877A diagram is shown below.

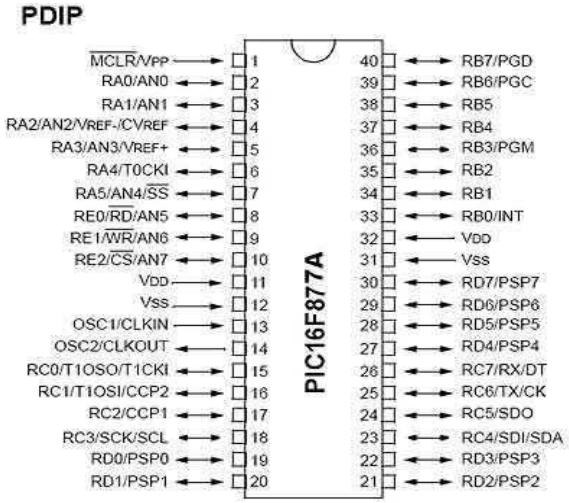

Figure 3.2 PIN diagram of Microcontroller PIC16F877A

3.2 CLOCK GENERATOR

A clock generator is a type of circuit that produces timing signal for use in synchronizing circuit operations. It produces continuous, synchronized electrical signal for timing purposes in the microcontroller. It ensures that all other components work harmoniously. Clock generators are generally made of a quartz or ceramic piezo-electric circuit board that includes an oscillator and amplifier

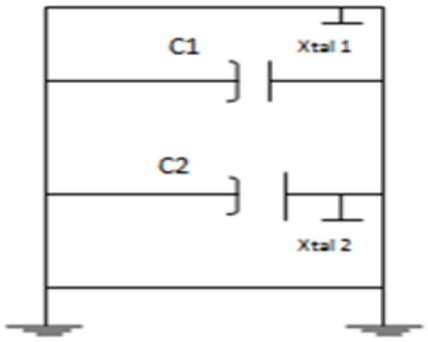

Figure 3.3 Diagram of Clock Generator

The C1 and C2 provide stability and restarting of the oscillator during power down mode of the processor by holding its active long enough.

The range of C1 and C2 is from 10pF - 40pF in this case the value for C1 and C2 are

C1=C2=15pF

Where;

XTAL1-Input to the inverting oscillator amplifier and input to the internal operating clock of the processor

XTAL2 - Output from the inverting oscillator amplifiers

3.4 CRYSTAL OSCILLATOR

The crystal oscillator was picked based on the frequency capability of the controller. The oscillator frequency range is from 0-20MHz this design used an 8MHz frequency oscillator.

3.5 GSM MODEM (SIM900B)

The GSM modem is a special type of modem that uses SIM card, operates on a subscriber's mobile number over a network, just like a cellular phone. It can be described as cell phone without display. In this paper the GSM modem used is SIM900B. The SIM900B delivers GSM/GPRS 850/900/1800/1900MHz voice performance, SMS, Data and fax in a low power consumption and form factor.

GENERAL FEATURES OF GSM SIM900B

Quad-Band 850/900/1800/1900 MHz

- GPRS multi-slot class 10
- GPRS mobile station class B
- SAIC (Single Antenna Interference Cancellation) support

3.6 GPS MODULE (SIRF3 CHIP)

Data such as location coordinates; speed and time are received by the GSM module and transmitted to microcontroller through MAX232. The GSM module used is SiRF3 chip interprets signals from GSP satellites to determine location and position of GPS receiver.The SiRF3 is a range of high sensitivity GPS microcontroller chips.

Features of SiRF3 are:

- 20-Channel Receiver, which can process the signals of all visible GPS and WAAS satellites simultaneously.
- Receiver sensitivity of -159dBm while tracking
- SBAS(Satellite based augmentation system) support
- Power consumption of 62mW during continuous operation.
- Assisted GPS can reduce Time to first fix (TTFF) to less than one second.

3.7 ULN2004

This is a high voltage, high current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each unit has clamp diodes for switching inductive loads. This is shown in the circuit below.

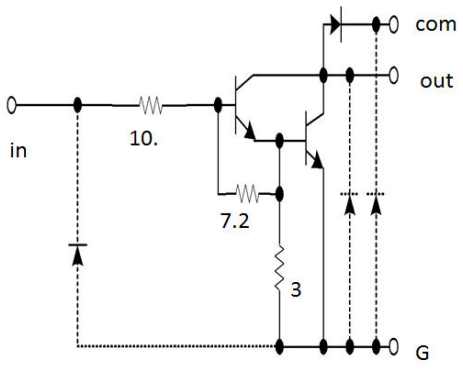

Figure 3. 4Diagram of ULN2004

It canbe used in logic buffer, line drivers, lamp drivers, LCD display drivers etc

FEATURES OF ULN2004

- Output clamp diodes for switching inductive loads
- Inputs compatible with various types of logic
- Output current (single output): 500mA
- High sustaining voltage output: 50V (MIN.)

3.8 LEVEL CONVERTER (MAX232)

The MAX232 is an integrated circuit that converts signals from a TIA-232 (RS-232) serial port to signals suitable for use in TTL-compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide TIA-232 voltage level outputs (about ±7.5 volts) from a single 5-volt supply by on-chip charge pumps and external capacitors.When a MAX232 IC receives a TTL level to convert, it changes a TTL logic 0 to between +3 and +15 V, and changes TTL logic 1 to between −3 and −15 V, and vice versa for converting from TIA-232 to TTL.

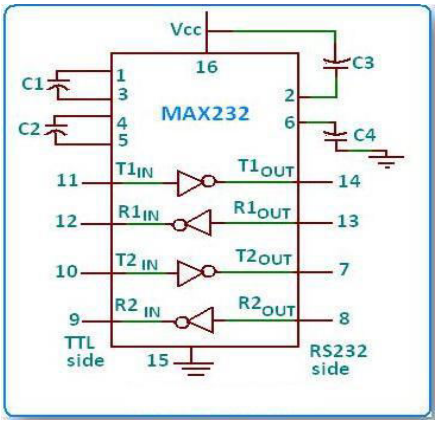

Figure 3. 5 Diagram of MAX232

Features of MAX232 are:

- Two drivers and two receivers
- ±30V input levels

- Low supply current 8mA typical
- Operated from a single 5v power supply DC with 1.0uf charge pump capacitor

3.7 FLOWCHART SHOWING THE ANTI-THEFT CONTROL SYSTEM

The anti-theft control system can be explained using the flow chart shown below;

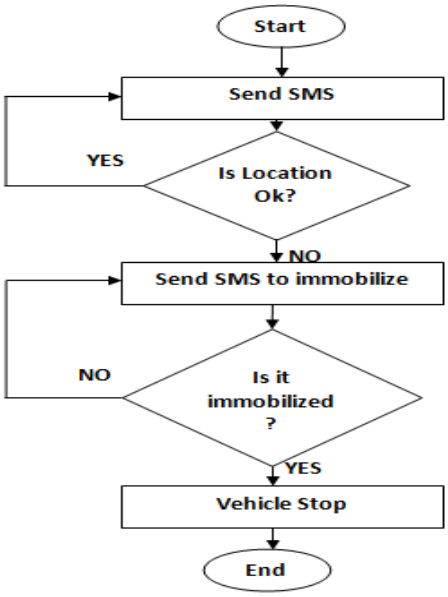

Figure 3.6 System flowchat

3.8 SIMULATION USING PROTEUS SOFTWARE

The functionality of the system was tested by first simulating it. Proteus was used as the simulation software it is a very powerful tool for electronic circuit simulation. During the course of the design and simulation in PROTEUS major corrections were made to the circuit. Also expected outcome (result) was obtained with the PROTEUS software.

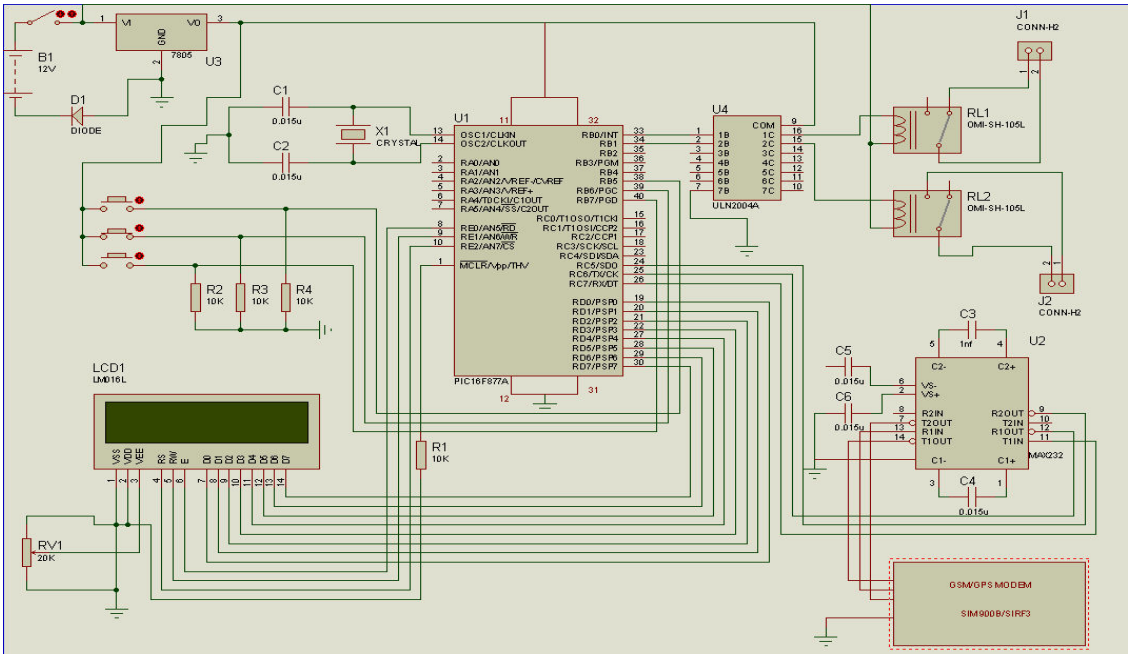

Figure 3.7 System Design Using Proteus

4. RESULT AND DISCUSSION

The proposed system was tested with mobile phones from different locations. The phones were used to send SMS and receive field back from the GPS module. Errors were detected and proper troubleshooting was carried out and errors found were successfully corrected after which final testing was done and the performance was satisfactory.

When the system key is turned on, the LCD displays messages as “INITIALIZINNG – BUSY- READY”. After that, a “REGISTER “command is typed by the user/administrator wishing to access the security area and enable interface with the SIM. If the Module is interfaced with the Microcontroller, then a message containing the acceptance of the SIM along with his details is sent to the authorized owner.

The sequence of operation carried out is shown in table 4.1.

Table 4.1: SMS communication between the system and authorizer

OPERATION	OUTPUT
ON	LCD display message as • Initializing • Busy • Ready
Message sent by System	SMS details • Registration Status (Admin ok indicating the number is registered) • Immobilized/Stop ok • Mobilized/Resume ok
Message from the Owner	SMS details • REGISTER (send Adminpasswordphonenumber) • Mobilized/Resumepassword • Immobilized/stoppassword

The result presented in table 4.1 shows that;

- After initializing, the vehicle owner/adminsendadmin+password+phonenumber to the microcontroller and is registered to enable both the microcontroller and the phone number registered to communicate. If the phone number is not registered there wouldn't be any communication between the phone and microcontroller, hence the admin wouldn’t be able to track the vehicle via his mobile phone.
- The owner of the vehicle is able to send commands for mobilization, immobilization from his/her phone using the command stop+password to immobilize and resume+password to mobilize the vehicle.
- When a registered admin want to know the position of the vehicle or device, he /she can simply place call on the device and the responds of the module in the line is busy, it hang up the call and respond in real time, the longitude and latitude including the speed, time, date and status of the door.
- When SOS (save our soul) button is pressed it will sent help me! With latitude /longitude

to all the admin number registered on the module for every 3 minutes, to stop this, the admin have to send **help me!,**backto the microcontroller /module to stop sending.

5. CONCLUSION

This work has presented a vehicle anti-theft control system using GPS/GSM technology. The system includes a combined module of GSM/GPS technology which can track vehicle from any location. The system is very cheap since the technology is easily accessible; the system is secured as the security standard is maintained by network providers and is effective, mostly in areas with network availability, the system is usual friendly since the vehicle can be immobilized by just an SMS. GSM/GPS technology is an effective security check technology with optimum cost to avoid vehicle theft. The system is therefore the best for vehicle anti-theft monitoring and tracking system when compared with the conventional method, because it gives fast response time and control of vehicle from any location.

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