Vehicle Security System using Embedded and GSM Technology

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Abstract

This paper deals with design and development of the theft control system for an automobile, which is being used to prevent or control the theft. The developed system makes use of an embedded system based on GSM technology. The designed and developed is installed in the vehicle. An interfacing mobile is also connected to the microcontroller which is in turn, connected to the engine. We need to give the password before starting it. Once an unauthorized person tries to run the vehicle by giving a wrong password an alert message is sent to the owner of the vehicle that the vehicle is being stolen. This information is passed on to the central processing system whereby sitting at a remote place, a particular number is dialed by them to the interfacing mobile that is with the hardware kit which is installed in the vehicle. By reading the signals received by the mobile, one can control the ignition of the engine, say to stop the engine immediately. Again it will come to the normal condition only after entering a secured password. The owner of the vehicle and the central processing system will know this secured password. The main concept in this design is introducing the mobile communication into the embedded system. The designed unit is very simple and low cost. The entire designed unit is on a single chip. When the vehicle is stolen, the owner of the vehicle may inform to the central processing system, then they will stop the vehicle, by just giving a ring to the secret number and with the help of SIM tracking knows the location of the vehicle and informs to the local police or stops it from further movement.

Keyword- GSM, Embedded, Security

I. INTRODUCTION

In recent years, vehicle thefts are increasing at an alarming rate around the world. People have started to use the theft control systems installed in their vehicles. The commercially available anti-theft vehicular systems are very expensive. Here, we make a modest attempt to design and develop a simple, low cost vehicle theft control scheme using an inbuilt microcontroller. This scheme involves a microcontroller and a mobile for the communication purposes.

Tracking of the stolen vehicle can be done through the internet interface. Once the position of the stolen vehicle is found out using the GPS, a location request is sent back to the central processing system, which takes care of the event to be performed using remote control systems.

Control functions of the tracking system allow us to perform many functions such as to stop or start the vehicle, automatic position reporting based on time or distance, over speed detection and reporting, etc.

This paper is organized in the following sequence. A small literature survey on the theft control system was given in the previous paragraphs. This is followed by the preview of the GSM mobile communication concepts, Microcontroller along with its peripherals, overview of the design and SIM tracking.

II. PRESENT ANTI-THEFT DEVICES

All vehicle theft prevention equipment's help to deter criminals. Many anti-theft devices are also effective in protecting your vehicle from burglaries & vandalism. Following are some of the anti-theft devices that are used now-a-days.

- Kill switch
- Tire\wheel locks
- Alarms
- Electronic keys
- Electronic tracking devices

The above mentioned anti-theft devices are not 100% save so to overcome this GSM based systems which are more reliable can be used.

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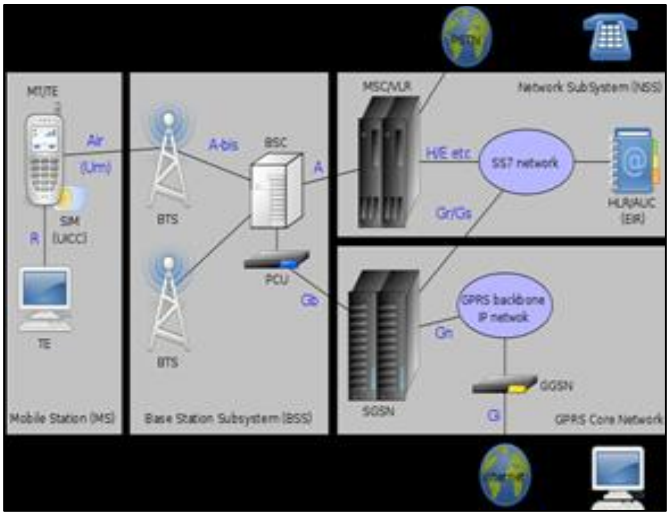
III. GSM (GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS)

The Global System for Mobile Communications (GSM) is the most popular standard for mobile phones in the world. Over billion people use GSM standard makes international roaming very common between mobile phone operators, enabling subscribers to use their phones in many parts of the world. GSM differs significantly from its predecessors in that both signaling and speech channels are digital, which means that it is considered a second generation (2G) mobile phone system. This fact has also meant that data communication was built into the system from very early on.

The structure of the GSM network is explained in the following paragraphs. The network behind the GSM system seen by the customer is very large and complicated in order to provide all of the services which are required and is divided into number of sections, viz

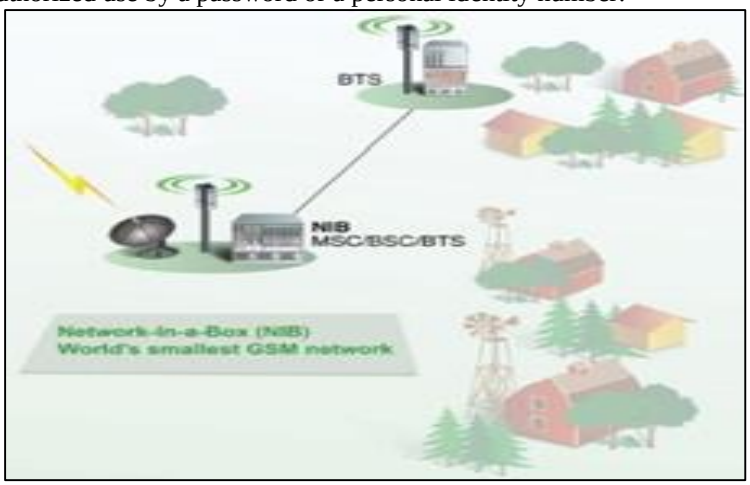
- The base station sub-system (the base station and their controllers)
- The network and switching sub-system (the part of the network most similar to the fixed network)
- The GPRS core network (the optional part which allows packet based internet connection)

All of the elements in the above system combine to produce many GSM services such as voice calls and SMS. One of the key features of the GSM is the Subscriber Identity Module (SIM) commonly known as SIM card. The SIM is a detachable smart card containing the user's subscription information and phonebook. This allows the user to retain his information after switching ON the handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM.



The mobile station (MS) consists of the mobile equipment and the smart card called the SIM. The SIM provides personal mobility, so that the user can have access to subscribed services irrespective of a specific terminal. By inserting the SIM card into another GSM terminal, the user is able to receive the calls at the terminals, make calls from that terminal and receive other subscribed services.

The mobile equipment is uniquely identified by the International Mobile Equipment Identity (IMEI). The SIM card contains International Mobile Subscriber Identity (IMSI) and is used to identify the subscriber to the system, secret key for authentication and other information. The IMEI and IMSI are independent, thereby allowing personal mobility. The SIM card may be protected against unauthorized use by a password or a personal identity number.



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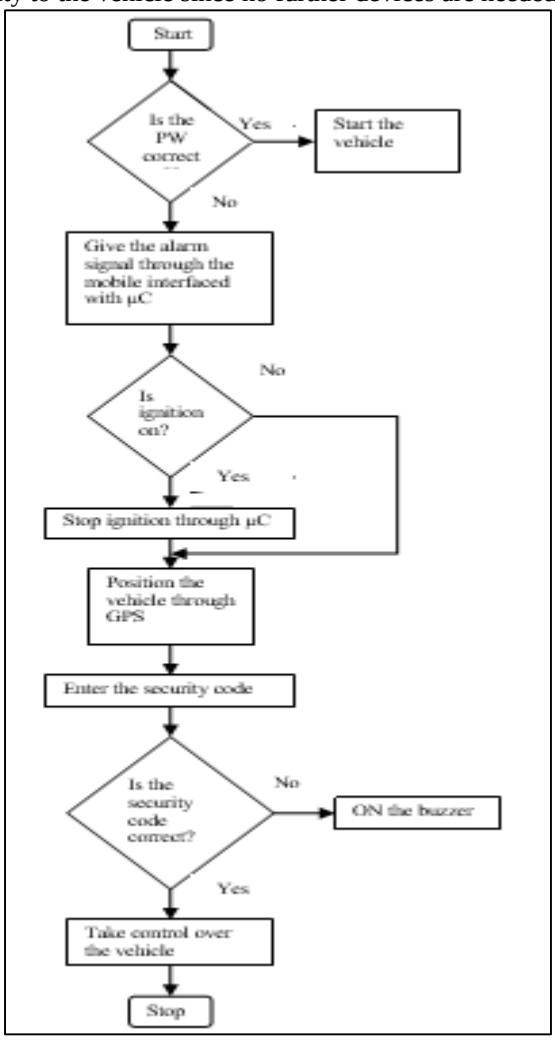
The base stations sub-system is composed of two parts viz,. The Base Transceiver Station (BTS) and the Base Station Controller (BSC). These communicate across the standardized ABIS interface, allowing (as in the rest of the system) operation between components made by different suppliers. The BTS houses the radio transceivers and define a cell and handles the radio-link protocols with the mobile stations. In a large urban area there will potentially be a large number of BTS's deployed, thus, the requirements for BTS are ruggedness, reliability, portability and minimum cost.

The BSC manages the radio resources for one or more BTS's. It handles radio-channel setup, frequency hopping and handovers. The BSC is the connection between the MS and the Mobile Switching Service. The Central component of the network sub-system is the Mobile Services Switching Centre (MSC). It acts like a normal switching node of the PSTN or ISDN and additionally provides all the functionalities needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities which together form the network sub-system. The MSC provides the connection to the fixed networks

IV. ADVANTAGES OF USING GSM BASED SYSTEM

This system has the following advantages-

1) This system is covered by a powerful network of GSM which enables security of vehicle to the owner.
2) This can be operated in any part of the globe.
3) The possibility of hacking the system is next to zero due to its constructional program.
4) This operates even if power source (battery) is removed from the vehicle
5) This provides the end of the security to the vehicle since no further devices are needed.



V. COMPONENTS OF THE EMBEDDED SYSTEM BLOCKS

The block diagram of the design is shown in the figure and it has

- A GSM mobile

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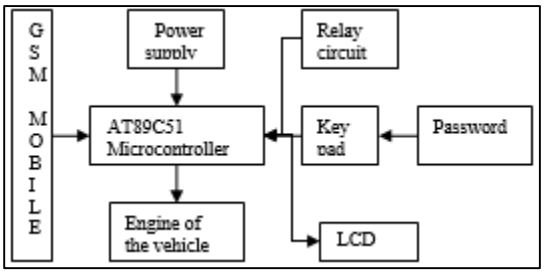
- Microcontroller
- Relay
- Keypad
- LCD
- Power supply

These blocks will interact with each other.

VI. OVERVIEW OF THE DESIGN



A. Microcontroller

Microcontroller is the heart of the designed unit, which handles all the signals. All other interfacing blocks are interfaced to it. By accepting the high pulse from the mobile's ringer circuit it sends command to the relay connected to Port P1.7, which cuts the connection. The AT89C51 is a low-power; high performance CMOS 8-bit microcontroller with 4Kilo bytes of flash programmable and erasable read only memory (PEROM). [1]

The device is manufactured using Atmel's high density non-volatile memory technology and is compatible with the industry standard MCS-51 instruction set and pin out. The on-chip flash allows the program memory to be reprogrammed in system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications.

B. Power Supply

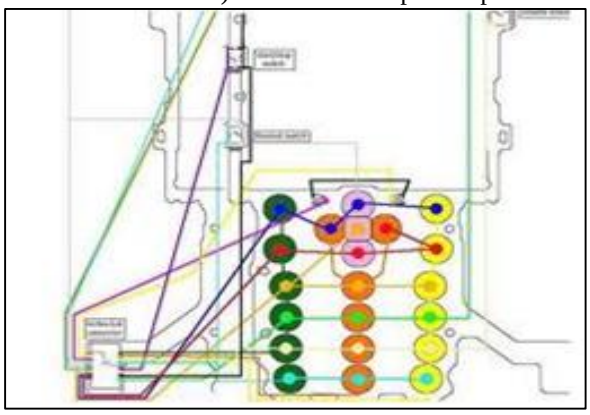
The power supply consists of AC voltage transformer, diode rectifier, and ripple filter and voltage regulator. The transformer is an AC device. It has two coil windings, the primary and the secondary, around a common magnetic core. The current flowing in the primary winding generates a time varying electromagnetic field, which in turn induces an output voltage and output voltage. The higher voltage side has a thinner wire with more turns while the lower voltage side has thicker wire and fewer turns.

C. Relay

The relay we are using in this work is a 230V/2A relay and its an electromechanical relay. The excitation voltage that is required is +12VDC. It is driven using the relay driver IC ULN2003/ VLN 2003A. The device is connected to the electromechanical relay. When the relay is excited by applying the 12V DC voltage the relay gets activated and the process turns ON the device and when the excited voltage is stopped the relay gets deactivated and in the process turns OFF the devices. In magnetic relay, insulated copper wire coil is used to magnetize and attract the plunger. The plunger is normally connected to N/C terminal. A spring is connected to attract the plunger upper side. When output received by the relay, the plunger is attracted and the bulb glows

D. Keypad

Keypad used here for inputting the data is of the form (4X3) matrix board, which is used to connect to the microcontroller (from P3.0 to P3.3 row wise and from P1.3 to P1.5 column wise). It is used to input the password for validation purposes.



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The rows are connected to an output port and the columns are connected to an input port. If no key has been pressed, reading the input port will yield 1's for all columns since they are all connected to high (Vcc). If all the rows are grounded and a key is pressed, one of the columns will have 0 since the key pressed provides the path to ground. It is the function of the microcontroller to scan the keyboard continuously to detect and identify the key pressed.

VII. GSM MOBILE

Mobile used in our network is NOKIA3315 from which a pair of wire comes from its ringer circuit to micro-controller's port P1.6 and to the GND. When a ring is made, a high pulse is provided to the microcontroller. The mobile's ringer circuit output, where the ringer is connected normally is given to the microcontrollers port P1.6. When the ring is given from mobile, output will become high which is read by microcontroller and stops the vehicle via the relay.

VIII. LCD

Here the LCD is connected Port2 (P2.0 to P2.7) of the microcontroller. It is used to display messages (either error or accepted). Variable resistor connected to Pin3 of LCD, is used to control the brightness of LCD. A liquid crystal display is a low cost, low power device capable of displaying text and images. LCD's are systems often do not have video monitors like those that come standard with desktop systems.

LCD can be found in numerous devices like watches, fax and copiers and calculators. The LCD (L1682) used here is the Seiko instruments standard temperature make. A variable or fixed resistor must be used on any LCD module as it appears in the above schematic. Seiko instruments intelligent dot matrix liquid display modules have on-board controller and LSI drivers, which display alpha numerics and a wide variety of other symbols in either (5X7) dot matrix. The internal operation in the controller chip is determined by the signals sent from the MPU.

IX. DESIGN OF THE EMBEDDED BLOCK

A keypad is connected with the microcontroller which is used to enter the password. A GSM mobile is interfaced with the microcontroller which sends an alarm signal to the owner when an invalid password is entered. A relay circuit is also included in the design which is used to control the ignition by starting or stopping the engine. When the owner receives the alarm message, he sends a message to the microcontroller to take the control of engine through relay circuit.

X. SIM TRACKING THROUGH GPS

The designed unit employs a system that uses information available to the cell phone operators as a matter of course to determine location of any mobile phones within the GSM network. The system uses timing advance methodology to determine the relative position of the phone from a cell site. When combined with an accurate map of the cell tower location, a good position of the mobile phone can be calculated. This is done without any action of the mobile phone user and does not send any information to the phone to know that it is being tracked.

A location serves is installed at the mobile phone operator's site (at the location of the vehicle) connected to the internal server, which, in turn serves as the gateway and connects to the mobile phone locator server via the internet. Because the issue of personal privacy, today the service is only being offered to commercial entities, not to general consumers. However, as the

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technology can also be used when dealing with consumer and public safety, it is likely that consumers will be offered a mobile phone for useful purposes, say in the control of thefts in vehicles.

Commercialization of the service today requires that the person being tracked signs a consent form. The tracking PC is then loaded with the software and map. When in operation the PC must be connected to the Internet. The request is then sent to the tracking serve, which then passes the request to the server at the mobile operator. After the request is serviced, the data is then sent to the tracking server, which then passes the request to the server at the mobile operator. After the request is services, the data is then sent back to the PC for the display of the location. Accuracy of mobile phone tracking varies with the size of the cell site coverage and varies from 200 meters to several kilometers. Still, the location of the phone can be very useful depending on the application.

XI. CONCLUSION

A novel method of designing a low-cost, compact theft control system for a vehicle was designed and demonstrated in this paper. This work is an ultimate threat for vehicle thieves. Nowadays, the vehicles are least secured when it is stolen by thieves. By this work, which is presented in this paper, it is very easy to track the vehicle at a higher degree of accuracy, since it is based on GSM technology, which is very developed now. So it is very much easy to get back the vehicle. The crux of the work is that the whole process is done at the least possible cost and it is almost accomodable to the practical application. In future, there is no doubt that all of the vehicles will be embedded with this unique kit. Microcontroller codes were written in assembly language to control the theft of the vehicle.

XII. FUTURE ACTIVITIES

This system can be used to track a vehicle. This can be used as an alternative to GPS system. This can also be used to check for mileage by presetting the journey start status. This can be used to set remainders and alert systems for all devices inside a vehicle. This can be done by just using necessary hardware along with the mobile.

It can hence be stated that by using such technologies high priced vehicles can be safeguarded from many anti-social elements. All the more usage of mobile phones to safeguard vehicles becomes a simpler and an effective process to control thefts.

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