Embedded Automobile Engine Locking System Using GSM & GPS Technology

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ABSTRACT
This paper deals with the design &development of an embedded system, which is being used to prevent / control the theft of a vehicle. The developed instrument is an embedded system based on GSM technology. Here, we have made an attempt to develop an instrument based on Atmega8 microcontroller and operated using GSM technology. The device is a simple and low cost vehicle theft control embedded system. The entire system is installed in the engine along with GSM Modem. When the owner of the automobile finds that the automobile is missing, a SMS can be send by his/her mobile which is authenticated by device to stop & lock the engine of the automobile. The information is passed onto the central processing system which is in the form of the SMS, the microcontroller unit reads the SMS and sends it to the Global Positioning System (GPS) module using the triangulation method. GPS module feeds the exact location in the form of latitude and longitude to the user’s mobile. By reading the signals received by the mobile, one can control the ignition of the engine; say to lock it or to stop the engine.

The main concept in this design is introducing mobile communications into the embedded system. The entire designed unit is on a single board.

Keywords--- AT Commands, AVR, Interfacings, GSM, GPS.

I. INTRODUCTION

Now a days, automobile thefts are increasing all over the world. So to escape from these thieves it is very important to use theft control systems. The commercially available anti-theft vehicular systems are very expensive. Here, we make an attempt to develop an instrument based on Atmega8 microcontroller and operated using GSM technology. The instrument is a simple and low cost vehicle theft control embedded system.

The development of satellite communication technology is easy to identify the vehicle locations. Vehicle tracking systems have brought this technology to the day-to-day life of the common person. Today GPS used in cars, ambulances, fleets and police vehicles are common sights on the roads of developed countries. All the existing technology support tracking the vehicle place. The Global System for Mobile communications (GSM) is the most popular and accepted standard for mobile phones in the world established in 1982 and it operates in 900 MHz frequency. The GPS/GSM Based System is one of the most important systems, which integrate both GSM and GPS technologies.

It is necessary due to the many of applications of both GSM and GPS systems and the wide usage of them by millions of people throughout the world.

II. COMPONENTS

1. Atmega8A Microcontroller
2. DC Power Supply Unit
3. 16x2 Liquid Crystal Display (LCD)
4. 12V Relay & DC Fan
5. GSM Modem
6. GSM Mobile
7. ULN 2003A Line Driver IC
8. Crystal Oscillator
9. Buzzer

I. Microcontroller Unit
The ATmega8 is a low-power CMOS (Complimentary Metal Oxide Semiconductor) 8-bit microcontroller based on the AVR (Advanced Virtual RISC) architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1 MIPS per MHz, allowing the system design to optimize power consumption versus processing speed. As given in [1] the ATmega8 microcontroller provides the following features:

- 8Kbytes of In-System Programmable Flash with Read While Write capabilities.
- 512 bytes of EEPROM
- 1K byte of SRAM.
- 23 general purpose I/O lines.
- 32 general purpose working registers.
- Three flexible Timer/Counters with compare modes.
- Internal and external interrupts, a serial programmable USART.
- A byte oriented Two-wire Serial Interface.
- A 6-channel ADC (eight channels in TQFP and MLF packages) with 10-bit accuracy.
- A programmable Watchdog Timer with Internal Oscillator, an SPI serial port.
- A five software selectable power saving modes.

The device is manufactured using Atmel’s high density non-volatile memory technology. The Flash Program memory can be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip boot program running on the AVR core. It is programmed as given in [2].

2. Power Supply

The DC power supply unit is divided into 4 elements as below:

1. 12V SMPS.
2. 470µF/35V Capacitor as a Filter.
3. 7805 Voltage Regulator IC.

The input AC supply of 230V is converted to 12V DC by SMPS. This DC supply is given to the GSM modem & the filter circuit. The filter is a circuit that reduces the variations of the pulsating DC. Here the capacitor is used as a filter. The filtered DC is then fed to a voltage regulator stage. The voltage regulator is used to maintain a constant voltage at the output. It also provides further smoothing of the DC voltage. We are using an IC 7805 as a voltage regulator to get 5V in output.

3. Liquid Crystal Display (LCD) Unit

A program must interact with the outside world using input and output devices that communicate directly with a human being. One of the most common devices attached to a controller is an LCD display. Some of the most common LCDs connected to the microcontrollers are 16x1, 16x2 and 20x2 displays. This means 16 characters per line by 1 line, 16 characters per line by 2 lines and 20 characters per line by 2 lines respectively. We are using 16x2 LCD display here. A 16x2 character line LCD module is a parallel port module. LCD requires 3 control lines as well as 8 I/O lines for the data bus. So this LCD will require a total of 11 data lines.

![Figure 2: Schematic diagram of LCD](image)
<table>
<thead>
<tr>
<th>Code(Hex)</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C</td>
<td>ClearDisplayofthescreen</td>
</tr>
<tr>
<td>38</td>
<td>C0</td>
<td>Forcecursortobeginfrom2nd Line</td>
</tr>
<tr>
<td>80</td>
<td>C0</td>
<td>Forcecursortobeginfrom1st Line</td>
</tr>
</tbody>
</table>

### 4. DC Relay

The relay is an electromagnetic switch actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life and proven high reliability. When relay is activated, then it closes the loop of ignition, hence start the engine. When relay is de-activated, it opens the loop of ignition, hence stop the engine. A DC fan is connected to the relay replicating the automobile engine to verify the operation of the system. The relay has a high enough rating for the load that we are driving.

### 5. GSM Modem

The GSM modem is a specialized type of modem which accepts a SIM card operates on a subscriber’s mobile number over a network, just like a cellular phone. It is a cell phone without display. The GSM modem specific commands are adapted to the services offered by a GSM modem such as: text messaging, calling a given phone number, deleting memory locations, etc. Since the main objective for this application is to show how to send and receive text messages, only a subset of the AT-commands set needs to be implemented. "AT command set for GSM Mobile Equipment" describes the main AT commands to communicate via a serial interface with the GSM sub-system of the phone as in [3]. In [4], the hardware and software of the GPS and GSM network were developed.

### 6. GSM Mobile

We have used a GSM mobile to send the SMS sent by the unit regarding the engine status & receive the SMS regarding the location & engine status. The mobile number must be authenticated first by the unit. So that the control unit can send the SMS and in the same time the authorized person received the same SMS to take care of his vehicle.

### 7. ULN 2003A IC

ULN is a high voltage, high current darlington array each containing seven open collector darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA as given in [5]. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout. These versatile devices are useful for driving a wide range of loads including solenoids, relays, DC motors, LED displays filament lamps, thermal print-heads and high power buffers. Here we have used it to drive DC fan which is replicating the engine. ULN2003A is supplied in 16 pin plastic DIP packages with a copper lead frame to reduce thermal resistance.

### 8. Buzzer

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. Buzzers are electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.
III. ASSEMBLY OF THE SYSTEM

The assembly of the embedded system designed from is described below:

All the components are assembled on a single one sided PCB (Printed Circuit Board) with GSM modem connected to it. The power supply is given to the GSM modem by a 12V 1A DC adapter from 220V AC supply.

The supply of GSM modem is taken & given to the capacitor filter & 7805 voltage regulator which regulates the voltage to 5V DC. This 5V DC supply is given to the components on the board. A LED is connected after 7805 voltage regulator which shows supply status. It glows when supply is ON. A resistor is connected in parallel with the LED as current limiting resistor. A variable resistor is connected with the LCD for setting its contrast.

The ULN2003 IC is connected to T73 DC Relay. ULN2003 IC drives the DC fan connected at the output of the relay when the relay is closed. Rotating DC fan shows that engine is ON.

A buzzer is also connected which creates sound showing that modem & unit is working properly.

In this project, 5 interfacings are used i.e. LCD, ULN2003A IC, Buzzer, GSM Modem & Relay.
IV. WORKING OF THE SYSTEM

The entire system is installed near the engine along with the GSM modem.

First the owner’s GSM mobile number is authenticated by sending a secret password which is saved in microcontroller’s EEPROM. When the password sent to the GSM modem matches with the saved password, a SMS reply is given by the modem to the GSM mobile stating that the mobile number has been authenticated.

Now when the owner wants to check the status & location of his vehicle, he has to send a command as SMS to GSM modem which is saved in the microcontroller unit.

The GSM modem on receiving command transmits a signal to microcontroller unit which takes the location data from the inbuilt GPS & sends it to owner’s mobile along with engine status – on or off.

In case of theft of vehicle owner can stop the engine of the vehicle by sending required command as SMS from his GSM mobile to GSM modem.

The GSM modem on receiving SMS sends a signal to microcontroller unit & microcontroller then takes action
by driver IC making relay open circuited. Thus, the engine stops gradually. Now the owner can recover his vehicle from that location.

Figure 6: Snapshot of the system

V. CONCLUSION

This method of controlling vehicle theft is a low cost & compact theft control system. It is a threat to vehicle thieves and it cannot be accessed by an unknown persons since it is based on GSM technology. This system is designed to improve vehicle security and accessibility.

VI. FUTURE SCOPE

This embedded system will be used in all automobile vehicles in next generations due to its features & low cost. In this system more features can be added by using various types of sensors as described:

We can use it in cases of emergency help after an accident by adding a sensor which senses the accident by opening of air bag & sudden large shock. The GSM modem can be used to communicate with nearest police station & hospital.

We can add an alcohol sensor which gives signals to device when the driver is drunk & a SMS is sent to owner specifying this. The owner then can control the vehicle as in [6].

We can add a sensor to sense door window glass breaking which sends SMS to owner by same procedure as above.

Face detection camera sensing can also be integrated with this unit as in [7].

This project could be made more convenient and secure with the use of satellite modems instead of cell phones as tracking device as the system may fail when there is no network coverage.

A Central Door locking System can also be integrated with this unit to ensure more safety.

REFERENCES