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Embedded Automobile Engine Locking System, Using GSM 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. The instrument is installed in the engine of the vehicle. An interfacing GSM modem is also connected to the microcontroller to send the message to the owner's mobile.

The main objective of this instrument is to protect the vehicle from any unauthorized access, through entering a protected password and intimate the status of the same vehicle to the authorize person (owner) using Global System for Mobile (GSM) communication technology. This system deals with the concept of network security. The main concept in this design is introducing the mobile communications into the embedded system. The entire designed unit is on a single board.

Keywords - Pass Word, GSM Modem, AT Commands, Interfacing, I²C, RS232 and UART protocols.

I. INTRODUCTION

In these days, automobile thefts are increasing at an alarming rate all over the world. So to escape from these thieves most of the vehicle owners have started using the theft control systems. The commercially available anti-theft vehicular systems are very expensive. Here, we make an attempt to develop an instrument based on 8051 microcontroller and operated using GSM technology. The instrument is a simple and low cost vehicle theft control embedded system.

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. Over billion people use GSM service across the world. The utility of the 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 both signaling and speech clarity, as its channels is digitized. It means that the GSM system is now considered as a third generation (3G) mobile communication system.

II. COMPONENTS, INTERFACINGS AND PROTOCOLS:

1. AT89S52 Microcontroller
2. DC Power supply unit

3. 4x3 Matrix keypad
4. 16x2 Liquid crystal display (LCD)
5. 12V Relay and DC Fan
6. GSM Modem
7. GSM Mobile
8. MAX232 line driver
9. 24C02 E²PROM
10. L293D motor driver & DC motor
11. Buzzer
12. DB9 connector

2.1 Microcontroller Unit:

The AT89S52 is a low-power, high-performance complementary metal-oxide semiconductor (CMOS) 8-bit microcontroller with 8K bytes of flash programmable and erasable read only memory (FPEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry standard 80C51 and 80C52 instruction set and pin out. The on-chip flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit central processing unit (CPU) with flash on a monolithic chip, the Atmel AT89S52 is a powerful microcontroller, which provides a highly flexible and

cost effective solution to many embedded control applications.

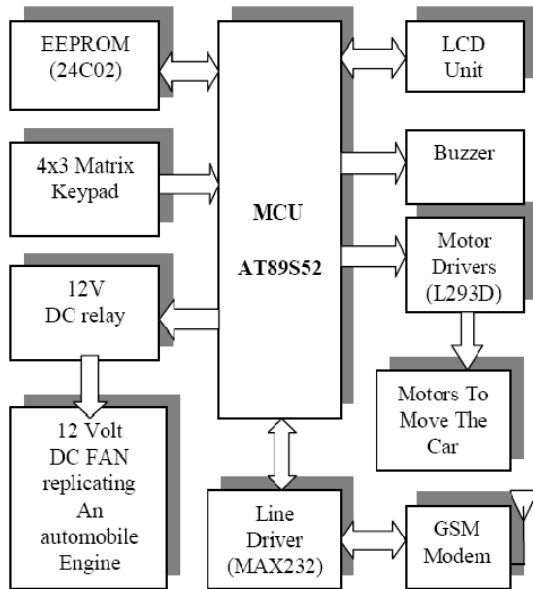


Fig. 01 : Block Diagram

Features of the microcontroller:

1. It is a 8-bit microcontroller with 921.6 KHz. of machine cycle
2. It has got a external crystal oscillator with 11.0592 MHz frequency
3. 8K bytes of flash ROM and 256 bytes of RAM
4. 4 bidirectional I/O ports with 8 pins each
5. Three 16-bit timer/counters with 4 modes of operation.
6. A six-vector two-level interrupt architecture
7. A full duplex serial port(UART) with 28.8KHz frequency
8. 8-bit data bus and 16 bit address bus

2.2 DC Power Supply Unit:

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

1. 230V/12V step down Transformer.
2. Bridge Rectifier with 4 x 1N4007 diodes.
3. 470µF/35V Capacitor as a Filter.
4. 7805 Voltage Regulator IC.

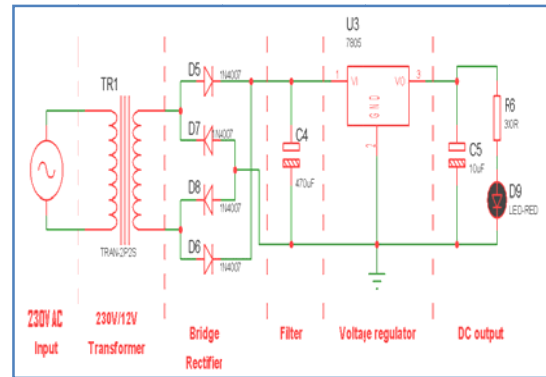


Fig. 02 : Circuit Diagram of Power Supply

This transformer steps down the incoming line voltage depending on the needs of the power supply. This alternating voltage is then fed to the rectifier. The rectifier is a diode circuit that converts the ac to pulsating dc. This pulsating dc is then applied to the filter circuit. The filter is a circuit that reduces the variations of the dc voltage. 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 power supply output. It also provides a further smoothing of the dc voltage. We are using an IC 7805 as voltage regulator to get a 5V output voltage.

2.3 4X3 Matrix Keypad:

Keypads and LCDs are the most widely used input/output devices. In this section, we first discuss keypad fundamentals, along with key press and key detection mechanisms, and then it is shown how a keypad is interfaced to an 8051 µC. Keypads are organized in a matrix of rows and columns. The CPU accesses both rows and columns through ports. When a key is pressed, the row and column are connected; otherwise there is no connection between them.

Scanning and identifying the key pressed:

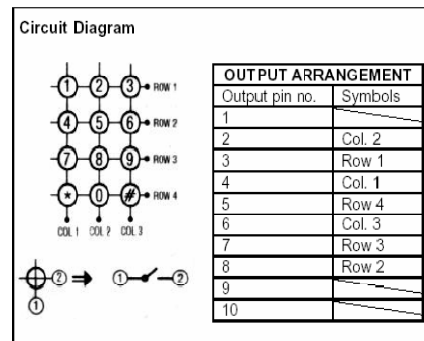


Fig. 03 : Schematic diagram of Keypad

In the above figure a 4X3 matrix keypad is connected between two ports. 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 1s for all columns since they are all connected to high voltage (Vcc). If all the rows are grounded and a key is pressed, one of the columns will have 0 since the key which is pressed provides the path to ground. It is the function of the microcontroller to scan the keyboard continuously to detect and identify the key which has been pressed.

2.4 Liquid Crystal Display (LCD) unit:

A 16x2 character Line LCD module is a parallel port module. An 8051 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 an 8051 μ C is an LCD display. 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.



Fig. 04 : Schematic diagram of LCD

The three control lines are referred to as EN, RS, and RW. The EN line is called "Enable." This control line is used to tell the LCD that you are sending it data. The enable pin used by the LCD latches the information presented to its data pins. When data is supplied to data pins, high to low pulse must be applied to this "EN" pin in order to latch the data present at the data pins. This pulse must be a minimum of 450 ns wide.

The RS line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data, which should be displayed on the screen. The RW line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Some commands are given below for reference.

Table 01: LCD Command Codes

Code (Hex)	Command to LCD Instruction Register
1	Clear Display of the screen
38	2 line, 5X7 Matrix
80	Force cursor to begin from 1 st line
C0	Force cursor to begin from 2 nd line

2.5 12V Relay and DC Fan:

The relay is an electromagnetic switch. 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 ignition of the automobile. A DC Fan is connected with the relay replicating the automobile engine to verify the operation of the system.

2.6 GSM Modem:

The GSM/GPRS Modem comes with a serial interface through which the modem can be controlled using AT command interface. Here a SIMCOM made (SIM300) modem interfaced with the microcontroller operates in 900 MHz frequency.

The protocol used by GSM modems for setup and control is based on the AT-Command set. 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-Command set needs to be implemented. The following section describes the AT-Command set.

Table 02: AT Command Sets

Command	Description
AT	Check if serial interface and GSM modem is working.
ATE0	Turn echo off, less traffic on serial line.
AT+CNMI	Display of new incoming SMS.
AT+CPMS	Selection of SMS memory.
AT+CMGF	SMS string format, how they are compressed.
AT+CMGR	Read new message from a given memory location.
AT+CMGS	Send message to a given recipient.
AT+CMGD	Delete message

2.7 GSM Mobile:

In our project we used a GSM mobile to receive the SMS sent by the instrument regarding the engine-on status. The mobile number must be programmed with the source code. 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.

2.8 MAX232 line driver:

A MAX232 chip is required to convert RS232 voltage levels to TTL levels, and vice versa. 8051 has one transmitter (Tx) and a receiver (Rx) for transferring and receiving serial data from the port 3 (P3.0 and P3.1). They require a line driver to make them RS232 compatible. A line driver converts the RS232's signals to TTL voltage levels that will be acceptable to 8051's Tx and Rx pins.

2.9 AT24C02 EEPROM:

The AT24C02 is a 256 byte/ 2K-bit EEPROM, which is used to retain the password even after power failure. The device is organized as a single block of 256 x 8-bit memory with a two-wired serial interface. The 24C02 supports a bi-directional two-wired bus and data transmission [I²C] protocol. The bus has to be controlled by a master device (μC) which generates the serial clock (SCL), controls the bus access, and generates the START and STOP conditions, while the 24C02SC works as slave.

2.10 L293D motor driver IC & DC motor:

The purpose of using 4 no. of 12V DC motors is to drive the hardware kit just like an automobile. Since, MCU can interpret the logic 1 as 5v & 0 as 0v, so L293D motor driver IC is used to convert 5v logic to 12v logic to drive the motor efficiently with full RPM. Here used one IC to drive 2 motors. Accordingly there are used two ICs for our prototype model.

2.11 Buzzer

A buzzer is an audio signaling device, which may be mechanical, electro-mechanical or electronic. Typical use of buzzers / beepers includes alarms and timers etc.

III. ASSEMBLY OF THE SYSTEM:

All electronic components are assembled on a single Vero-board. After mounting and soldering of the components and sockets as shown in the photograph, the other peripherals like keypad, LCD, Buzzer, microcontroller with other ICs are mounted/ inserted.

For power supply unit a 230V AC followed by a step down transformer and a full wave bridge rectifier circuit is used as shown in the circuit diagram. Alternatively a 12V DC supply from a 12V battery is used for circuit operation.

Now, output power supply is given 5v to MCU & 12v to Relay. Relay connected to pin-0 of port-0 of the MCU. Keypad connected from pin 0 to 3 row wise and from pin 4 to 6 of port-1 column wise. GSM modem connected to pin 0&1 of port-3. Again LCD is connected to the pin 0 to 7 of port -2 and pin 2 to pin 4 of port -0 as shown in the circuit diagram. A 12V dc Fan is

connected with the relay replicating the automobile engine. That means when the relay is activated the fan will move. Otherwise it will be idle. The L293D IC-1 is interfaced with port 0-5&6 and port 3-3 & 4, where as L293D IC-2 is connected to port 0-1 & 7 and port 3-2 & port 1-7 as shown in the circuit diagram.

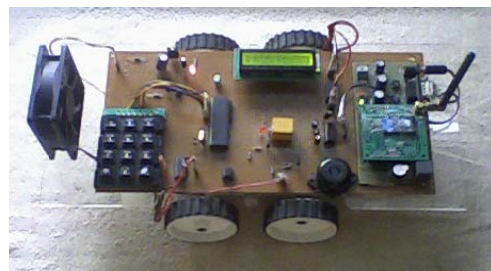


Fig. 05: The Complete Circuit Board

IV. INTERFACINGS AND PROTOCOLS USED:

In this project there are six interfacings used like 4x3 Matrix Keyboard, 16x2 LCD, GSM Modem, Motor Driver IC L293D, 12v Relay, 12v Buzzer etc. In addition, three protocols are being used like RS232, I²C, UART to functional the instrument successfully.

Circuit Diagram:

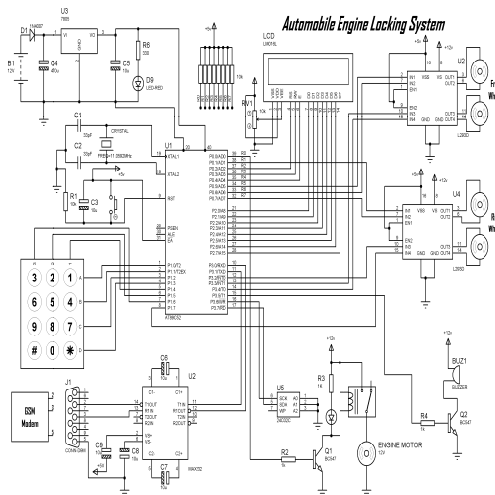


Fig. 06: Circuit Diagram

V. WORKING OF THE MODULE:

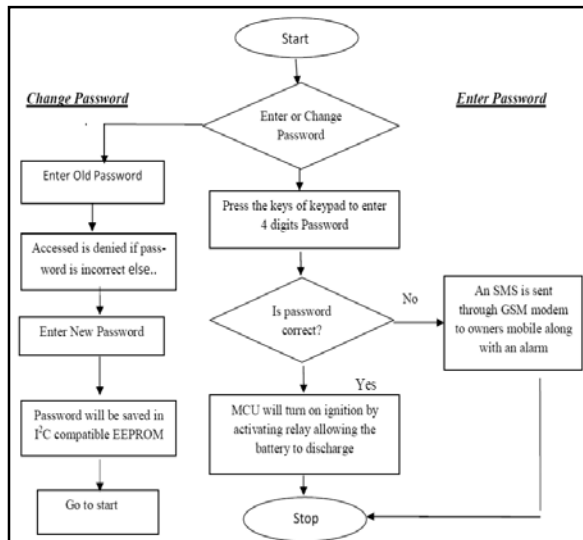
The embedded system installed in the engine of the vehicle along with the GSM modem. By entering a correct password (like: *abcd) the instrument allows to activate the 12V relay and then ignition of the engine will start. Hence start the vehicle. If anyone tries to enter the password randomly, then after three trials, the MCU will block the entry of further password. Then, the buzzer will be turned on to create a noise to panic the

culprit, followed by sending a message “**Alert: Car Is Under Threat**” through GSM modem to the owner’s mobile for further action for prevention of his vehicle.

According to the prototype model after entering correct password the Fan will move and at the same time, according to the instruction it will run forward for 10 sec and backward for 10 sec like an automobile.

Password can be changed by the following proper procedure. First enter #, then enter the old password, then new password. Now test, whether the new password is working or not. As per algorithm given below the new password will retain even after power failure. So it will work as usual.

The source code is written in embedded C language. To develop the source code the flow chart of the project is shown in the figure below.



VI. CONCLUSION:

This is a unique method of designing and assembling a low-cost, compact theft control system for an automobile. This instrument is an ultimate threat to vehicle thieves. By installing this instrument in the automobile engine it is very difficult to access by an unknown person, since it is based on GSM Technology. In future, there is no doubt, that all of the vehicles will be embedded with this unique kit. In addition to the above features we can also add extra features like thumb/face recognition to ascertain more security of the vehicle.

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