Anti-theft Security System Using GSM, GPS, RFID Technology Based on ARM 7

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Abstract

An embedded system based on the Global Positioning System, the GPS, and Radio frequency identification technology is developed to prevent automobile from theft. This consists of GSM, GPS, RFID & two sensors. When any one wants to open the door of vehicle, it will ask for correct RFID identification & accelerometer sensor is used to measure any breaking of window & movement of car ,if any unauthorized access is there ,a message will be sent to the owner's mobile. This is followed by the system present in the car asking the user to enter correct password . If the user fails to enter the correct password in three trials ,a text message is sent to the owner's mobile with vehicle location using GPS. Further the connection to fuel injector of the car is deactivated so that unauthorized person cannot start the vehicle anyhow.

Keywords-GSM, GPS, RFID reader, Keil, Accelerometer sensor, Proximity sensor

1. Introduction

Commercially available anti theft devices are very expensive & not affordable. Now a day's car theft cases are higher. So there is a need of an excellent protection of vehicle with the reliable anti-theft device. Car central locking system gives the best guarantee. A car with central locking security system helps the user to lock and unlock. Again this system could not prove to provide complete security of the vehicle in case of theft. So a more developed system makes use of an embedded system based on GSM, GPS, and RFID technology. The designed & developed system can install in the vehicle. GSM is the most popular accepted standard for mobile phones in the world. This device uses the ARM 7 microcontroller which will interface to other peripheral devices like GSM, GPS, RFID reader, accelerometer sensor etc. The accelerometer sensor will interface to microcontroller which is used to sense the Vibrations. When vehicle is parked the accelerometer will sense the vibrations or movement of the car. When vibration goes above particular limit the Short Message Service will be send to the owner's mobile.

The vehicle is provided with the RFID reader. The vehicle is developed by using two Direct current motor which would be connected to the microcontroller using Motor Driver integrated circuit for increasing the current. The Door assembly is developed using DC motor which would be controlled using the relay. When the theft is there, the door will lock automatically. When an unauthorized person wants to open the door of car then he/she is unable to open without RFID tag. There may be possibility that the person may break the window of car, accelerometer will sense the vibrations and send the message to owner's mobile. After entering in car user try to start, but unable because when key is inserted, proximity sensor detects obstacle & one message will be displayed on liquid-crystal display for entering correct password. User will be given three trials, after third trial ,message will be send to owner's mobile with location of car & alarm will on for knowing surrounding person what's going on there [3]. This section gives the introductory part; Second section gives overview of systems designed previously, the proposed system. The third section gives the system overview including hardware and software specification. Fourth section includes the conclusion and future scope.

2. Related Work

Many researchers have proposed many anti-theft systems. This system is an integration of more modern technologies [1, 4]. System included in [2] uses a GSM which serves as a mediator between outside world and system, its output is in form of frequency, there is need of Dual-tone multi-frequency decoder for converting frequencies into voltage levels of zeros and ones. Microcontroller used in [1] is a 8-bit which serves a less than other 16-bit, 32-bit microcontrollers. The proposed system in this paper is designed to give complete security to automobile. The system consists of ARM 7 microcontroller which is LPC 2148 by Philips Company .The block diagram is as shown in fig.1. It uses two sensors i.e. proximity sensor and accelerometer sensor. ARM7-LPC2148 microcontroller is

based on a 32-bit ARM7 TDMI-S CPU with real-time emulation, embedded trace support.

This combines microcontroller with high speed flash memory ranging from 32 KB to 512 KB. DC power supply unit is obtained by using 4 components [1] such as step down transformer, rectifier, filter circuit and voltage regulator IC.230V/12V step down transformer is used in this, which steps down the incoming line voltage. The output of transformer is given to the rectifier, which is a diode circuit (bridge rectifier). Rectifier transforms AC to pulsating DC. This DC is given to filter circuit which minimizes variations of the DC voltage. Filter is nothing but a 470 uF/35V capacitor. The filtered output is given to the voltage regulator (here 7805 voltage regulator IC is used) to maintain a constant voltage. IC 7805 is used for getting 5V output voltage. This power supply unit provides smoothing of DC voltage as well. The voltage required for peripheral devices of microcontroller is 5V.

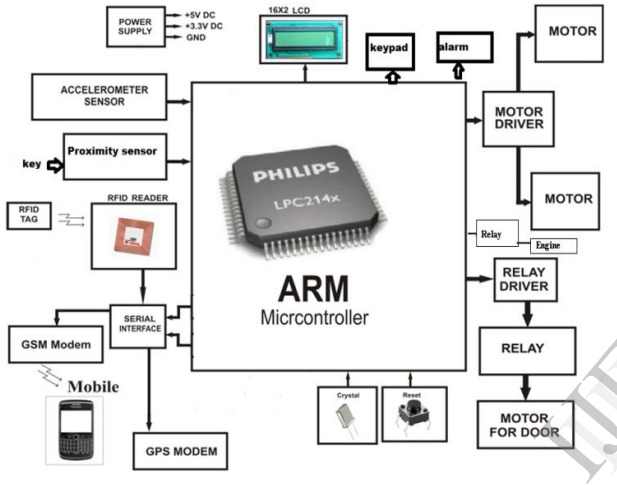

Fig.1. Block diagram

3. System overview

The system consists of two main parts .The first part contains door control and second part contains security which is provided to stop the ignition of vehicle, message conveying ability to owner for unauthorized access with correct vehicle location using GPS and GSM which uses serial communication.

4 Hardware specifications

4.1. Microcontroller

Microcontroller used here is ARM7-LPC2148 microcontroller. It has a 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. The 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 is ideal for applications where miniaturization is a key requirement, such as access control. Serial communication interfaces ranging from a USB 2.0 full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 KB up to 40 KB are also available. It is very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing large buffer size. Several 32-bit timers, single or dual 10-bit analog-to-digital converter (s), 10-bit digital-to-analog converter, Pulse-width modulation channels and 45 fast General-purpose input/output lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers suitable for industrial control and medical systems.

4.2. GSM

GSM is the most popular technology in the world. The name GSM first comes from a group called Group Special Mobile (GSM), which was formed in 1982 by the European Conference of Post and Telecommunications Administrations (CEPT) to develop a pan-European cellular system. That would replace the many existing incompatible cellular systems. When GSM service started in 1991, the abbreviation "GSM" was renamed to Global System for Mobile Communications. GSM uses Frequency Division Multiplexing and Time Division Multiplexing. FDMA divides the frequency ranges for GSM, which are 890-915, 935-960. Module used here is S2-1040W-Z0936 (SIM 900A). The GSM network can be divided into three parts

i. Mobile Station
ii. Base Station
iii. Network Subsystem

The mobile station consists of mobile equipment and a Subscriber Identity Module. The most common mobile equipment is the mobile phone. By inserting the SIM card into phone, the user is able to receive calls at that phone, make calls from that phone, or receive other services. The mobile equipment uniquely identifies the International Mobile Equipment Identity. The Base Station Subsystem consists of the Base Transceiver Station and the Base Station Controller.

4.3. GPS

The Global Positioning System is global navigation satellite system which uses a constellation of between 24 and 32, medium Earth Orbit satellites that transmit precise microwave signals that helps GPS receivers to determine their location, speed, direction, and time. GPS has become a widely used aid to navigation worldwide, and a useful tool for map-making, land surveying, commerce, scientific uses, tracking and surveillance. Also, the precise time reference is used in many applications including the scientific study of earthquakes and as a time synchronization source .A GPS receiver measures its position by carefully timing the signals sent by the constellation of GPS satellites high above the Earth. Each satellite continually transmits messages containing the time, a precise orbit for the satellite sending the message, and the general system health and rough orbits of all GPS satellites. In fig.2. we will see the GPS modem.

Fig. 2. GPS modem

4.4 RFID

RFID is a generic term for technologies that use radio waves to automatically identify people or objects. There are many methods of identification, the most used is to store a unique serial number that identifies a person or object on a microchip that is attached to an antenna. The combined antenna and microchip are called an "RFID transponder" or "RFID tag" and work in combination with an "RFID reader" (sometimes called an "RFID interrogator"). This system consists of a reader and one or more tags. The reader's antenna is used to transmit radio frequency. Depending on the type of tag, the energy is "harvested" by the tag's antenna and used to power up the internal circuitry of the tag. The tag will then modulate the electromagnetic waves generated by the reader to transmit its data back to the reader. The reader receives the modulated waves. After receiving reader, modulated waves converts those into digital data. There are two common types of tag technologies. "Passive tags" are tags that do not contain their own power source. When radio waves from the reader reach the chip's antenna, the energy is converted by the antenna into electricity that can power up the microchip in the tag (parasitic power). The tag is then able to send back information stored on the tag by reflecting the electromagnetic waves. Active tags have their own power source and transmitter. The power source, (i.e. generally a battery), is used to run the microchip's circuitry and to broadcast a signal to a reader. Passive tags do not have their own transmitter, must reflect their signal to the reader, the reading distance is much shorter than with active tags. However, active tags are larger and more expensive. The Sunrom RFID Card Reader is developed specifically for passive tags. Frequency refers to the size of the radio waves used to communicate between the RFID system components (reader and tags). RFID tags and readers must be tuned to the same frequency in order to communicate effectively. The read range of a tag depends on many factors: the frequency of RFID system operation, the power of the reader, environmental conditions, physical size of the tags antenna and interference .Taking into consideration a number of engineering trade-offs (i.e. antenna size reading distance v. power v. manufacturing cost), the Sunrom RFID card reader's antenna was designed with a RFID operation at a tag read distance of around 7 cm.

Fig. 3. RFID reader

4.5. LCD

LCD used here is 16 by 2. Following fig.4 shows the microcontroller and LCD interface.

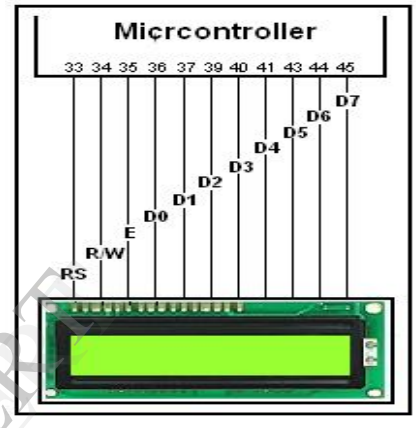

Fig. 4. LCD

LCD Pin Description:

LCD pin configuration is as follows

V_{CC}, V_{SS}, V_{EE}

V_{CC} & V_{SS} provides +5V & ground respectively, V_{EE} is used for adjusting LCD contrast.

Register Select

If RS = 0, the instruction command code register is selected, allowing the user to send a command such as clear display, cursor at home, etc. If RS = 1, data to be displayed on LCD.

R/W (Read/Write)

If R/W = 1, Read operation. If R/W = 0, Write operation. The LCD, to latch information presented to its data pins uses the enable pin. When data is supplied to data pins, a high to low pulse must be applied to this pin in order to latch data present at the data pins. The pulse must be a minimum of 450ns wide. D_0-D_7 is used to send information to the LCD or read the contents of the LCD's internal registers. To display letters and numbers, ASCII codes are sent for the letters A-Z, a-z and numbers 0-9 to these pins while making RS=1. There are also instruction command codes that can be sent to the LCD to

clear the display or force the cursor to the home position or blink the cursor. We also use RS = 0 to check the busy flag bit. When D7 = 1, the LCD is busy in taking care of the internal operation, will not accept any new information. When D7 = 0, the LCD is ready to receive new data.

4.6. Accelerometer (ADXL 335)

The ADXL335 is a small, low power, 3-axis accelerometer. This measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications and dynamic acceleration, shock, or vibration. The user can select the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the XOUT, YOUT, and ZOUT pins. Bandwidths can be selected to suit the application. The range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis are given. ADXL335 is available in market in a small, low profile, 4 mm × 4 mm × 1.45 mm, 16-lead, plastic lead frame chip.

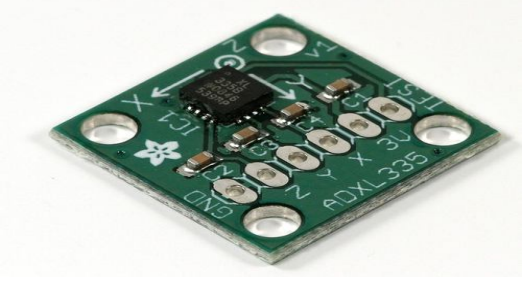

Fig. 5. Accelerometer sensor

4.7 Inductive proximity sensor

Fig.6 shows components of inductive proximity sensors. Operate under the electrical principle of inductance. Inductance is the characteristics where a fluctuating current, has a magnetic component, induces an electromotive force (emf) in a target object [3]. To amplify a device's inductance effect, a manufacturer twists wire into a tight coil, passes a current through it.

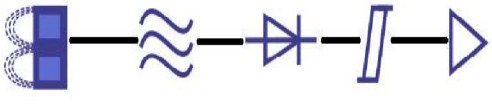

Fig. 6. Components of inductive proximity sensor

An inductive proximity sensor [3] has five sub-parts: a) sensor b) oscillator c) detection circuit d) flip -flop and e) output circuit. The inductance of the loop changes according to the material inside it , presence of metal i.e. key increases the current .This change can be detected by sensing circuitry.Fig.7 shows typical inductive proximity sensor.

Fig. 7. A typical inductive proximity sensor

4.8. Relay

The relay is electromechanical. The voltage required is +12V DC. It can be obtained using the relay driver IC. When the relay is excited by applying the 12V DC, the relay gets activated, turns ON the device and when the excited voltage is stopped, the relay gets deactivated and turns OFF the device.

4.9. Keypad

Keypad is commonly used input/output device. Rows are connected to an output port; columns are connected to an input port [1]. Microcontroller scans the keypad to detect the key pressed. When the key is pressed, rows and columns are connected. There is no connection between them when no key is pressed.

5. Software specification

Keil was founded in 1986 to market add-on products for the development tools. It is provided by many of the silicon vendors. The Keil generates code for any device that is compatible with the 8051, 251, C16x/ST10, or ARM microcontrollers. The exception to this would be a device that has removed or changed the instruction set. However, that device would no longer be a compatible part. When we start a project using the Keil uVision integrated development environment, we must select a chip from database. Keil constantly updates the database. To ensure that we always have the latest database, we may download the recent updates from the Keil Website. The programming can be done by using 'embedded C.

6. Conclusion

Antitheft security system can be installed in automobile easily. Because of this security system, it is too hard to an unknown person to access. Here an attempt is made to make a low-cost and excellent vehicle anti-theft control system which uses very low power supply, not only this but also some extra features like face recognition, alcohol sensor can be added to give more security. Future scope is that the system should be more compact(i.e. Can be embedded on single chip) and more secure.

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