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GSM Based Two Wheeler Theft Detection System using Digital Lock

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Abstract:
Vehicle security system has been a topic of great interest over the years due to the increasing vehicle theft cases reported all over the world. Most of the advanced vehicle security systems best suit the four wheelers. As of the security system for two wheelers is concerned, the systems available in market are of no match to the well equipped thieves. When under attack, these systems can only immobilize the engine and sound a loud alarm. It is a serious limitation. In this paper we propose a reliable and robust design of Two Wheeler Vehicle Security System (TWVSS) with features enhancing the security of the vehicle and ensuring the safety of the rider. In our proposed security system various new features are included in addition to the engine immobilizer and alarm. Few of the important features supported by our system are alerting owner by SMS about the theft attempt, allowing user to control the system remotely by SMS, Remote Keyless System, relay operated locking system (engine lock, fuel lock). Redundancy is maintained to make the system reliable even in the worst case scenario, but due to cost constraints a tradeoff between cost and redundancy was necessary. Our system is designed to be compatible with almost all the brands of vehicle.

Keywords*:* GSM technology, Relay, SMS, Remote keyless system, Redundancy, Compatibility.

I. INTRODUCTION

According to the report published by National Crime Records Bureau (NCRB), in the year 2011 alone 122,367 two wheeler vehicles were stolen in India. Out of which only 32,826 vehicles were recovered [1]. Typically, two-wheelers are stolen right off streets or apartment parking lots. By the time the police are alerted (which could be a few hours since the theft), the vehicles are made underground leaving almost no traces. Later the vehicles are either dismantled or sold in neighboring states/districts at throw-away prices, leaving the owner and police helpless in bringing the thief to book. The story remains same for rest of the world. The only possible way out of this problem is implementation of security system in the vehicle. The security system should be capable of performing reasonably well even in unfavorable conditions to meet the desired level of security [2], [3].

The price of the security system should be reasonably low or else the automobile manufacturers cannot implement such a system, as it will increase the overall cost of the vehicle by a big margin. If the design of the security system is such that it is compatible with most of the brands and classes of vehicles then it helps reducing the NRE cost. The overall power consumption should be less as the source of supply for the security system is the 12V battery of the vehicle.

Keeping these requirements and constraints in mind we propose this new design of Two Wheeler Vehicle Security System (TWVSS). The remainder of this paper is organized as follows. Section 2 gives the insight of the work carried out in this field. Section 3 gives the description of the proposed TWVSS. Section 4 describes the design of hardware module. Section 5 describes the design of software module. Section 6 shows the result of the tests conducted. Section 7 lists some of the future enhancements that could be carried out. Lastly, Section 8 concludes the paper.

II. RELATED WORK

Indeed, we are not the first to observe the flaws and limitations of the present day vehicle security systems. Several researchers have described potential vulnerabilities in automotive security systems. The traditional security systems as priced low, but they merely act as an alarm system and are no match to the well equipped thief. Many security systems have been proposed over the years, but almost all the recent advanced security systems are designed especially for cars. Several researchers have even used image processing technology to capture the face of driver and compare it with the picture of authorized drivers to detect the intrusion . Whereas some proposed systems include finger print detection system along with face detection. These security systems are complex, costly and cannot be implemented on two wheelers. Two wheeler vehicles offer very less space to install the security module and hence even area is one of the major constraints. The demand is to design a system that performs necessary function, simple to operate, reasonably priced and small enough to be placed under the seat of the vehicle.

III. DESCRIPTION OF PROPOSED TWO WHEELER VEHICLE SECURITY SYSTEM

An overview of the complete system is described in this section before detailing the specifications and the necessity for each module in the system. The general view of operation of the proposed security system is shown in fig. 1. The conventional handle locking system is replaced by a handle lock operated by relay and controlled by the Remote Keyless System (RKS) [20]. RKS has a transmitter and a receiver module. The receiver module is installed on the vehicle and the owner of the vehicle has the remote (transmitter module). The RKS remote could be used to lock/unlock the locking system (engine lock, fuel lock), switch ON/OFF the engine . Fuel lock replaces the knob at the nozzle of fuel tank.The

vehicle owner's cell phone with the registered Subscriber Identity Module (SIM) number acts as the master key of the security system. It is given higher priority over RKS and hence it can override the instructions from RKS. A Short Message Service (SMS) is sent to the registered SIM via the Global System for Mobile communication (GSM) module whenever the vehicle is unlocked using the RKS remote. Owner can in turn send a SMS to initiate the locking sequence, if he/she feels an unauthorized person has unlocked the vehicle [13]. Two sensitivity levels are chosen so as to nullify the chance of false alerting [20]. The owner is alerted by an SMS , if there is any physical tampering with the vehicle or if the vehicle has been moved from the place where it was parked (>15m). The owner can, anytime, request the security system of the vehicle for its status by sending an SMS. The status message sent in response to request includes the lock status, location coordinates .

IV.HARDWARE MODULE

4.1. SYSTEM SPECIFICATION AND BLOCK SCHEMATIC

- **System specification :**
  - AVR micr0c0ntroller ATMega 16
  - GSM modem
  - RF Transmitter & Receiver
  - 1 Relay for fuel
  - 1 Relay foe engine
  - 5V & 12V DC Power Supply
  - RFID reader module

- **Block diagram:**

Hardware design begins with selection of proper equipment required to do the various jobs. Selection is mainly on the basis of current and voltage ratings, IC packages, clock rate and cost. Power supply is designed for the various components according to their ratings RKS module is designed to operate at a frequency of 433 MHz with a half duplex communication link. The Remote consists of a 433 MHz transmitter, encoder, power supply and a simple loop antenna. The receiver module consists of 433 MHz receiver, decoder, power supply and a simple loop antenna. As shown in fig. 2, the receiver module is interfaced with the MCU. As shown in fig. 3, the remote consists of two buttons, each associated with different operation. The chosen pair of encoder and decoder should have same number of addresses and data format. We used 4 bit hot code to represent each button. The 12 bit parallel data is encoded to serial data for transmission through RF transmitter. These 12 bits are divided into 8 address bits and 4 hot code bits. This 8 bit address data is unique to every pair of receiver and transmitter module as stated earlier. The received serial data is decoded to parallel data. The 8 bit address data is compared with the local address data three times continuously. If these two address bits matches, the 4 bit hot code is made available to the MCU. For our design (under standard conditions), we obtained maximum communication range of approx.100m, justifying the use of low cost simple loop antenna.

Figure.1. Keyless Remote System

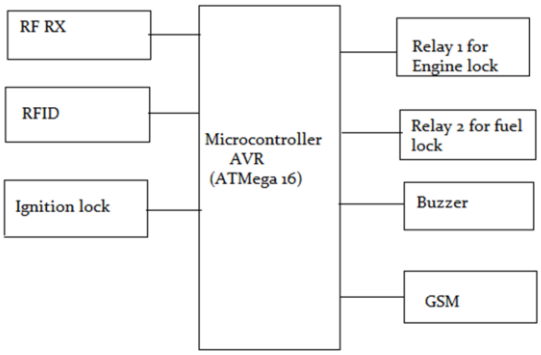


Figure.2. Block diagram

4.2. Locking system

The engine, fuel and locking systems are operated by relays. To avoid the fuel theft, a lock is placed at the nozzle of the fuel tank. This lock acts as a valve. Once the vehicle is locked, fuel lock blocks the nozzle, disrupting the fuel flow in the tube. As there is no fuel flowing into the engine, it cannot be started, thus serving two purposes. Another lock is placed at the rear side of the vehicle, to jam the sprocket of wheel. Once the sprocket is jammed, the wheel cannot rotate. This ensures redundancy in the proposed security system. Owner can control the locking system from his/her mobile phone (sending a SMS) or RKS remote.

4.3. Display Unit

The LCD is used as a display unit in the system to display the results. A 16x2 display and 4 data pins are being used. The operating voltage of LCD is 5V. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

4.4. GSM Module

The GSM module is required to establish a communication link between the owner of the vehicle and the security system [8], [17]. We used SIM300 GSM module in our system. AT commands were used to control this module. SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz. SIM300 also provides General Packet Radio Service (GPRS). The current consumption is as low as 2.5mA in SLEEP mode. SIM memory is used to store messages. The SIM300 module communicates with the MCU using asynchronous serial communication with a baud rate of 9600. The owner of the vehicle can send SMS to lock down the bike. Owner can also disable the remote keyless system if the remote is stolen. These features becomes very useful if incase duplicate or stolen remote is used to unlock the vehicle. Thus the cell phone of the owner with the registered SIM acts as the master key, which can override the instructions from the remote.

4.5.Power supply design

An ideal regulated power supply is an electronic circuit designed to provide a predetermined voltage Vo, which is independent of load current, temperature and also of any variations is line voltage. The power supply consists of:-

- Step-down transformer
- Bridge Rectifier
- Filter
- IC Regulator

Power supply is a vital part of all electronic systems. This circuit is required to drive the various components on the board. It is normal voltage regulator built with ubiquitous Transformer-Bridge Rectifier-Filter-Regulator assembly. We required a 5v supply for digital IC's. A step down transformer in the block diagram decreases the value of primary mains voltage at 50 Hz and applies a pure sign wave with 0 average values to a rectifier circuit. The circuit converts such wave forms to a pulsating DC wave forms having a non-zero average or DC value. Such a ripple containing DC waveform is applied to a filter which reduces the ripple factor and improves the DC contents in the waveform. If the output waveform across filter is directly connected to a load, without the regulator block, the load is said to be connected to an unregulated power supply.

V.SOFTWARE FLOW

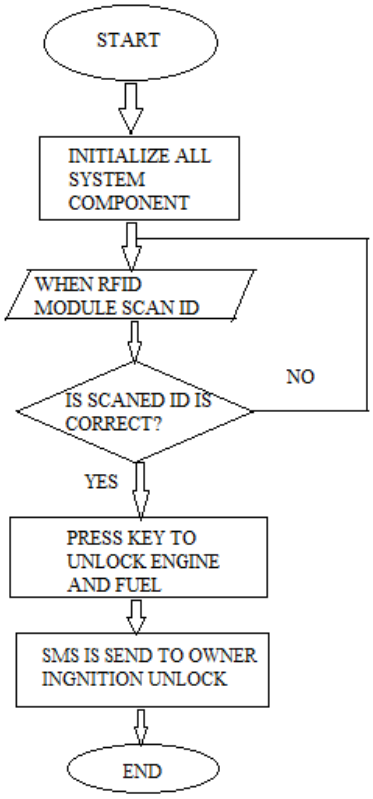


Figure.3. flowchart

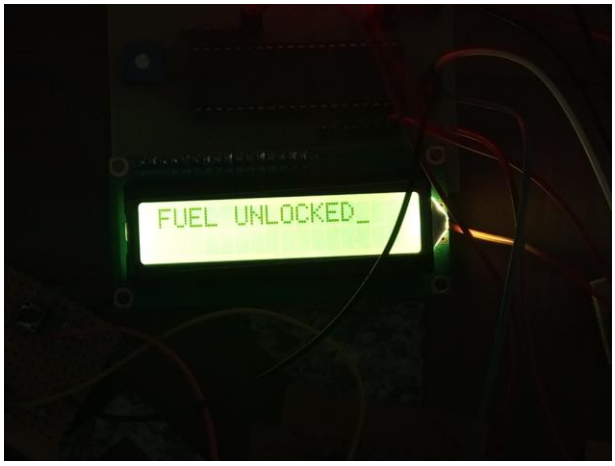
V. TEST SETUP AND TESTING PROCEDURE

Once the PCB along with the peripheral devices, it is necessary to verify that, the design is correct & the prototype is built to the design drawing. This verification of the design is done by writing several small programs, beginning with the most basic program & building on the demonstrated success of each. It is important to test and troubleshoot the hardware in the following steps:

- Physically check all the connections.
- Check whether power supply wires are firmly connected to all boards.
- Check for any dry solders.
- Check if IC's are physically in place.
- Check whether all components are correctly mounted.
- Check whether VCC and ground are shorted.
- The PCB has a single main VCC and ground track on it.
- Check IC's VCC and ground:
- Once the above step is performed check individual IC's to see that correct pins are connected to VCC and Ground. This can be achieved by checking the voltage levels on multi-meter at each VCC and Ground pins of all IC's.

VI. RESULTS

- Initially vehicle is in unlocked state (Lock = 0), lock button on RKS remote is pressed, the locking sequence is performed (Lock = 1).
- When we show a card, RFID module scan this ID number. If this number is detected correctly then signal is send to the microcontroller.
- User can press a key for unlock the ignition and fuel to start a bike.
- First we press a button to unlock fuel lock and after that we press second button to unlock ignition lock, system shows that fuel and ignition is unlocked and user can start a bike.
- At the same time sms is send to owner's mobile for security purpose.



VII. FUTURE ENHANCEMENTS

a. Hopping code algorithm could be used in Remote Keyless System (RKS) for added security.

b. Presently only SMS feature is available, we can include the Call feature for ease of operation. Like for example giving miscall would lockdown the vehicle.

c. SIM 300 even supports GPRS coding schemes hence data network could be used to send alerts and receive control messages.

d. Microphone could be interfaced to the GSM module so that during theft activity voice call could be established with the owner enabling him/her to be able to listen and record the conversation of people around the vehicle.

e. In future GPS technology can be used to trace the locatin of vehicle.

VIII. CONCLUSIONS

Our proposed Two Wheeler Vehicle Security System is the advanced, reliable and robust version of security mechanism for two wheeler vehicles. The proposed security system also gives space, in terms of hardware and software, to add up custom applications to make the product even more user-friendly. Proposed TWVSS can be installed on two wheeler vehicle of any class or company, thereby creating a huge market for the product. Stress was laid in designing a cost efficient system so that it could also be even bought by the owners of the low end bikes. Small size of the module allows it to be placed under the seat of the vehicle, there by needing no physical changes to be done to the vehicle. We believe the frequency of the two wheeler vehicle thefts that are encountered these days could be highly suppressed by installing our proposed security system.

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X. BIOGRAPHIES

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