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Can Linked Vehicle Monitoring Validation System

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Abstract: ***Nowadays evasion from due payment of automobile loan, vehicle insurance is an ordinary affair. This paper deals with the design & development of an advanced vehicle locking system in the real time environment based on the loan / Insurance details. The proposed system consists of an PIC16F877A and PIC18F458 controller and GSM module that is embedded in the vehicle with an interfacing to Engine Control Module(ECM) through Control Area Network (CAN) Bus which is in turn, communicated to the ECM. The ECM will allow to start the vehicle only after receiving the fair signals from the PIC controller. If the user attempts to remove the PIC controller unit, the fair signal won't get received by the ECM and thereby the engine will not ignite. In this proposed work, Real Time Clock (RTC) and EEPROM data will automatically lock the vehicle on the every 30th day of the month. The engine can be unlocked only by the banker / insurer by sending the due clearance confirmation message. It makes the way for the prompt payment of the dues by the customer. Inculcating hardware implementation, ensuring vehicle security, user friendliness are some of the valuable features enlisted in this project. PROTEUS software is used for simulation and MP LAB for compilation.***

Keywords: Control Area Network (CAN), Real Time Clock (RTC), EEPROM, PIC 16F877A, PIC 18F458, GSM.

1. Introduction

Indian automobile market has claimed global attention, being the second largest two wheeler market, fourth largest commercial vehicle market and eleventh largest passenger car market in the world, and poised to become the third largest automobile market next only to the United States and China. Research says 75% of vehicles purchased in the last decade were financed through loans. The automobile finance offered by banks and financial institutions at affordable rates of interest has paved the way for the growth of the automobile sector in India. Various schemes and features are available to consumers which can accommodate their every need, thus luring them into a financing option.

Normally all the vehicle owners want to pay their regular loan/ insurance for their care. But many of the consumers doesn't pay their loan/insurance properly, they are preparing duplicate copy of insurance and in case of vehicle loan, few of them are cheating the bank or any private office by submitting duplicate nativity certificate. Nowadays the Bankers & Insurers give the intimation to the customer at every month to pay their loan due amount through SMS to their registered mobile number. If the customer doesn't pay their due amount more than one month, immediately they will take the action to cease their vehicle. But it is very difficult to find their address because few of them are not submitting their proper nativity certificate and few of them will dismantle the vehicle after few due date gets over. So evasion from due payment of automobile loan, vehicle insurance is an ordinary affair. Currently there is no valid system to track the defaulters, which affects the government exchequer hardly and also affects the prosperity of the individuals. Hence there is an urgent need to fill this vacuum by modernizing the existing technology in automobile industries. As a matter of initiation, an innovative PIC based control system exclusively for car has been designed and implemented in this paper.

Today modern cars already contain a multiplicity of controllers that are increasingly networked together by various bus communication systems with very different properties. Automotive communication networks have access to several crucial components of the vehicle, like breaks, airbags, and the engine control. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. This paper deals with the design and development of a CAN (Controller Area Network) linked automatic vehicle locking system for an automobile, which is being used to follow the proper loan due / Insurance of a vehicle. It makes the way for the prompt payment of the dues by the customer.

2. Proposed System

The proposed system attempts to make life more interesting by reducing unnecessary waste of man-power by employing microcontrollers. The developed system here analyzed, makes use of a CAN based Global System for Mobile communication (GSM) technology. An interfacing GSM module is connected to the PIC16F877A controller which is in turn, linked to the main controller PIC18F458. In this proposed work, Real Time Clock (RTC) and EEPROM data will automatically lock the vehicle on the every 30th day of the month. Once the date exceeds 20th day, the LED in the vehicle glows continuously till 30th of the month. When the RTC reflects the date 30, the PIC16F877A Controller sends the data '0'to the EEPROM using Inter-Integrated Circuit (I2C). The message stored in the EEPROM will be read by the PIC18F458 controller whenever the car is turned on.

If the stored data reflects '0', the car is locked immediately through Control Area Network (CAN) Bus. The above mentioned system is designed and installed in the vehicle. If the user paid the loan / Insurance due amount on time, the information is being used by the loan/Insurance officer for further processing. The message '$1'which will be sent by the banker / insurer to the PIC16F877A controller, that reads the SMS and is stored in the EEPROM. Whenever the car is turned on, the main controller PIC18F458 reads the SMS ($1) from the EEPROM that will be communicated to the

Engine Control Unit (ECU) through Control Area Network (CAN) Bus, which leads to unlock the car immediately.

The main concept in this design is introducing the mobile communication into a CAN bus system. Fig .1 shows the block diagram of the proposed system. Our research based on PIC16F877A & PIC18F458 microcontroller due to its low cost and the PIC is a famous, known, easy to programmed and build with another devices directly such as LCD, it's a reliable controller even its accessories is available such as its programmer, compiler (Micro C), and simulator such as PROTUS.

The proposed system has following features & advantages:

Features of new invention:
1) Compact Size of the board.
2) In built theft avoidance system.
3) Removal of PIC controller unit leads to zero ignitions.
4) Automatic vehicle loan and insurance dues collection.
5) Jammer usage won't affect the control unit because of Real Time Clock (RTC).

The main novelty and contributions of this paper include the following.

3. Real Time Clock

The DS1307 real time clock (RTC) IC is an 8 pin device using an I2C interface. The DS1307 is a low-power clock/calendar with 56 bytes of battery backup SRAM. The main advantage of RTC is that they have an arrangement of battery backup which keeps the clock/calendar running even if there is power failure.

4. GSM Module

GSM (Global System for Mobile communication) modem is used to establish communication between a computer and a GSM system. The function of the modem in this paper is to send a text message using SMS. It is convenient to use because it runs on AT (Attention) command set and RS232 interface.

5. PIC Controllers

5.1 PIC 16F877A

Microcontrollers are used in this project because of its high speed performance, low-cost and programming flexibility. Furthermore, PIC16F877A microcontroller has a built in universal synchronous asynchronous receiver transmitter (USART) hardware that allows direct communication with personal computer. PIC16F877A belongs to a class of 8-bit microcontrollers of reduced instruction set computing (RISC) architecture. All single-cycle instructions except for program branches, which are two-cycle. Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle. Up to 8K x 14 words of Flash Program Memory, Up to 368 x 8 bytes of Data memory (RAM), Up to 256 x 8 bytes of Electronically Erasable Programmable Read Only Memory (EEPROM) Data Memory. There is also very little 'data' storage, again a few dozen bytes, and this is in EEPROM which is slow and clumsy to change. EEPROM is used to hold values to be remembered when the power is turned off. To allow us to modify programs during the debugging stage and to optimize the control code we need an EEPROM.

5.2 PIC18F458

These devices are available in 28-pin, 40-pin and 44-pin packages. PIC 18F458 is a High-Performance Enhanced Flash Microcontrollers with CAN. It belongs to a class of 8-bit microcontrollers of reduced instruction set computing (RISC) architecture. Operating speed: DC – 40 MHz clock input DC – 200 ns instruction cycle. PIC18F458 devices 8 A/D channels and also implement 5 I/O ports.

5.3 Inter-Integrated Circuit (I2c)

The Inter-Integrated Circuit (I2C) module is a serial interface useful for communicating with other peripheral or microcontroller devices. These peripheral devices may be serial EEPROMs, display drivers, analog-to-digital converters, etc. The I2C module contains independent I2C master logic and I2C slave logic, each generating interrupts based on their events. In multi-master systems, the software is simply partitioned into a master controller and a slave controller.

When communicating, one device is the "master" which initiates transfer on the bus and generates the clock signals to permit that transfer, while the other device(s) acts as the "slave" responding to the transfer. The clock line, SCLx, is output from the master and input to the slave, although occasionally the slave drives the SCLx line. The data line, SDAx, may be output and input from both the master and slave.

5.4 Controller Area Network (CAN)

A modern automobile may have as many as 70 electronic control units (ECU) for various subsystems. Typically the biggest processor is the engine control unit (also engine control module/ECM or Power train Control Module/PCM in automobiles); others are used for transmission, airbags, antilock braking/ABS, cruise control, electric power steering/EPS, audio systems, power windows, doors, mirror adjustment, battery and recharging systems for hybrid/electric cars, etc. Some of these form independent subsystems, but communications among others are essential. A subsystem may need to control actuators or receive feedback from sensors. The Controller Area Network (CAN) standard was devised to fill this need. CAN is a multi-master broadcast serial bus standard for connecting ECUs.

The CAN Bus is an automotive bus developed by Robert Bosch, which has quickly gained acceptance into the automotive and aerospace industries. CAN is a serial bus protocol to connect individual systems and sensors as an alternative to conventional multi-wire looms. It allows automotive components to communicate on a single or dual-wire networked data bus up to 1Mbps. Development of the

CAN bus started originally in 1983 and was officially released in 1986 at the Society of Automotive Engineers (SAE) congress in Detroit, Michigan. The first CAN controller chips, produced by Intel and Philips, came on the market in 1987. Bosch published the CAN 2.0 specification in 1991.

In 2006, over 70% of all automobiles sold in North America will utilize CAN Bus technology. Beginning in 2008, the Society of Automotive Engineers (SAE) requires 100% of the vehicles sold in the USA to use the CAN Bus communication protocol while the European Union has similar laws. Several new aftermarket devices have been introduced into the market that utilize the CAN Bus protocol but until now, there have been no new devices that assist the aging after-market remote starter and alarm system technology. Now there is an aftermarket module that offers remote starter and alarm connectivity to the CAN Bus communication protocol.

CAN is based on the "broadcast communication mechanism", which is based on a *message-oriented transmission protocol.* The Controller Area Network (CAN) is used in a broad range of embedded as well as automation control systems. The use of a CAN Bus in Automobiles makes it possible to network electronic devices such as control units or intelligent sensors, provides the following advantages for the Vehicles as an overall system:

1) Data exchange between control units take place on a uniform platform. This platform is called a protocol. The CAN Bus acts as a so-called data highway.
2) Systems involving several control units, e.g. ESP, can be implemented efficiently.
3) System expansions are easier to implement in the form of optional extras.
4) The CAN Bus is an open system which permits adaptation to various transmission media such as copper or optical fibre cables.
5) Control units are diagnosed via the K-wire. Inside the car, diagnosis already takes place via the CAN Bus in some cases (for example the airbag and the door control unit).
6) In this context, this is called a "virtual K-wire". In future cars, there will be no K-wire.
7) A cross-system diagnosis is possible across several control units.

The developed system makes use of an embedded system and GSM technology. The proposed system, installed in the vehicle can be easily controlled from the loan/Insurance office by sending a message from their mobile / internet to the vehicle engine by interfacing with CAN bus and GSM modem**.**

6. Controller Authentication

Authentication of all senders is needed to ensure that only valid controllers are able to communicate within automotive vehicle systems. All unauthorized messages may then processed separately or just immediately discarded. Therefore, every controller needs a certificate to authenticate itself against the gateway as a valid sender. Once, the vehicle is loan / Insurance due date has been exceeded, the information is being used by the loan/Insurance officer for further processing. The information is passed onto the PIC controller which is in the form of the SMS by including the symbol $, the controller unit reads the SMS which is given by the GSM and it is stored in the EEPROM.

7. Ignition Control of the Vehicle

The ignition system of an internal-combustion engine is an important part of the overall engine system that provides for the timely burning of the fuel mixture within the engine. All conventional petrol (gasoline) engines require an ignition system. The ignition system is usually switched on/off through a lock switch, operated with a key or code patch. The ignition system works in perfect concert with the rest of the engine of a vehicle. In this proposed work, the ignition control of the vehicle is based on the information stored in EEPROM.

Once, the vehicle is loan / Insurance due date has been exceeded, based on the output of the real time clock the PIC16F877A controller sends a data _0' to the PIC16F877A controller, and it is stored in the EEPROM. The message stored in the EEPROM will be read by the PIC18F458 controller whenever the car is turned on, and then the car is locked immediately. If the user paid the loan / Insurance due amount on time, the information is being used by the loan/Insurance officer for further processing.

The message _$1'which will be sent by the banker /insurer to the PIC16F877A controller, that reads the SMS and is stored in the EEPROM. Whenever the car is turned on, the main controller PIC18F458 reads the SMS ($1) from the EEPROM that will be communicated to the Engine Control Unit (ECU) through Control Area Network (CAN) Bus, which leads to unlock the car immediately.

8. Software Simulation

PROTEUS software is used for simulation and MP LAB for compilation. In this proposed work, Real Time Clock (RTC) and EEPROM data will automatically lock the vehicle on the every 30th day of the month. Once the date exceeds 20th day, the LED in the vehicle glows continuously till 30th of the month (Fig.2).

LED ON

Fig.2: Alert Intimation to the user Fig.3 Programming for Microcontroller. When the RTC reflects the date 30, the PIC16F877A Controller sends the data '0' to the EEPROM using Inter-Integrated Circuit (I2C). The message stored in the EEPROM will be read by the PIC18F458 controller whenever the car is turned on. If the stored data reflects '0', the car is locked immediately through Control Area Network (CAN) Bus. The above mentioned system is designed and installed in the vehicle.

Fig.3 shows the programming details of the microcontrollers. When the RTC shows the date 30, the PIC16F877A

Controller sends the data '0' to the EEPROM using Inter-Integrated Circuit (I2C) & PIC18F458 Controller will check the EEPROM whenever the vehicle gets started. If the EEPROM data is 0, the vehicle will not ignite. If it is 1, the vehicle will ignite the engine. (Fig.4 & 5).

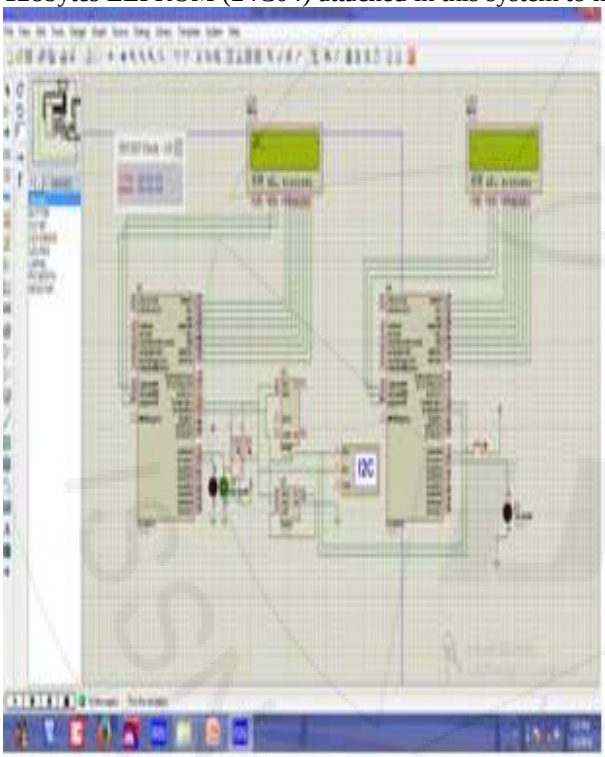
If the EEPROM Data is 0, the LED connected in the PIC18F458 controller will be in OFF condition.

If the EEPROM Data is 1, the LED connected in the PIC18F458 controller will be in ON condition.

9. Hardware Implementation

In this part, PIC16F877A controller is used to observe the Real Time Clock (RTC), receive the SMS from the loan / Insurance office and to store the data to the EEPROM through I2C serial interface communication protocol. Though the controllers have an inbuilt EEPROM memory, external 128bytes EEPROM (24C04) attached in this system to hasten the process. Based on the EEPROM data, the PIC18F458 controller will lock / unlock the vehicle through Control Area Network (CAN) Bus. On 20th day of every month, LED will blink inside the vehicle and 30th day the vehicle will be locked automatically with the help of RTC (DS1307). Hence the RTC plays an important role in this project work.

If the user paid the loan / Insurance due amount on time, the information is being used by the loan/Insurance officer for further processing. The message _$1'which will be sent by the banker / insurer to the PIC16F877A controller, that reads the SMS and is stored in the EEPROM. Whenever the car is turned on, the main controller PIC18F458 reads the SMS ($1) from the EEPROM that will be communicated to the Engine Control Unit (ECU) through Control Area Network (CAN) Bus, which leads to unlock the car immediately. So the GSM module also plays a vital role in this project. GSM Module (SIM300) is used for this work. Fig.4 shows the hardware implementation of this project.



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