Research Paper Engineering

Car Monitoring Smart System

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ABSTRACT

Owning a car is no more seen as a luxury, it is now considered as a daily necessity for present day generation. Though the present day cars have well equipped technology instilled in them, there is still scope for improvement in the present day cars to make them more robust to the environment. In this paper, we would like introduce a smart system for car monitoring which when added to the car's automation, shall strengthen the user-car relationship and also provide access remotely, apart from making the car more robust to the environment, through a smartphone. This smart system is a combination of algorithms which have been prototyped and have the following features in it:

- Central locking of the car remotely, beyond RF range used in present day cars.
- Retrieval of GPS co-ordinates on request (Continuous Tracking, prevents theft)
- Fuel theft and fuel level indication on request.
- Rash driving notification.

KEYWORDS Embedded system, Microcontroller,Smartphone, GSM, accelerometer.

INTRODUCTION

In present day lifestyle, it has become impossible to live without technology Be it home automation, smartphones usage, internet banking and so on. We prefer making use of technology in our day to day activities as it makes our life simpler and hassle free. Our main objective of this project is to make use of the technological advancements and instill them within a car, hence making accessibility to a vehicle more convenient. As is it rightly said, maintaining a car is more crucial than just owning a car. We have designed a smart system, whose inclusion in the present day car's technology will help the car user have a better understanding of his/her car. The system is based on a 16 bit microcontroller unit, which communicates to the user on his smartphone via GSM technology. This system has been assigned a prefix of being 'Smart' mainly because of the algorithm programmed in it, wherein the microcontroller unit has the ability to judge rash driving and also takes the responsibility of intimating it to the user through an SMS.

The usage of GSM technology in this embedded system, not only makes the system wireless but also provides the manufactures a wide scope for improvisation in the long run. This system comes with a custom built application, with a user friendly interface, thus making it easier for the user to interact with the microcontroller. As mentioned earlier, this system makes central locking of a car possible beyond normal RF range. All that the user has to do is to tap the 'Unlock' or 'Lock' key on his smartphone, in order to unlock or lock his car respectively. Apart from this, the global position system, helps retrieve the coordinates of the car, thus helping the user have a precise location of the car. This not only helps us track our car and share its details with our dear ones, but also is the helpline that we can approach during a theft. The system also includes an algorithm programmed in it, where fuel theft is immediately notified to the user on his phone through an SMS, thus alarming the user about his immediate attention. This feature proves to be very useful, when we have parked our vehicle in an area out of sight, like basement parking and so on. Also, the present day technology used in cars does not have the feature to indicate any fuel leakage, as mostly the driver isn't aware of any leakage due to the presence of the fuel tank in the rear end in majority of the cases. An on-request fuel level indicator helps us keep track of the amount of petrol left in our car, thus making it easier to plan our day.

This system comes with a microcontroller unit, which is interfaced with the Electronic control unit of the car system and makes use of the CAN protocol used mainly in present day cars. A GPS module and a GSM module interfaced to the microcontroller unit helps us retrieve all the required coordinate details and to send it through GSM communication to the user. The GSM module acts as a two way device, thus helping us to both receive commands from the user as well as provide information to the user based on the scenario. In order to retrieve the fuel level readings, the microcontroller is interfaced with the fuel level sensor in the car, which is calibrated according to various cars. The change in resistance value in the fuel sensor helps us in fuel theft scenarios and shall be intimated to the user accordingly.

Concepts

1) Car Monitoring System: It is a combination of technologies embedded on to a chip, which includes interfacing of a number of sensors and a software interface to make it user friendly. Present day automations, make it a point to invest ample amount of technology in the car system. Some of the present day car monitoring systems include rear view cameras, automatic shooting of the air bags, anti-braking system, alarming of vehicle misconduct and so on. The technology nowadays is so advanced that few cars in the developed nations have automatic car parking feature installed in them too. Technology is improving daily at a very fast rate and it is beneficial for the mankind when made use of in the right things, and car monitoring systems are one amongst them. Provides ease and makes the cars more robust to an environment in the absence of the owner of the vehicle, hence making it very useful and necessary to implement them in every car. The heart of every embedded car system is a microcontroller unit which makes it easy to interface various sensors to it, thus helping in the process of making a smart system for the monitoring of cars.

2) GSM: It is a type of wireless communication used for data

transfer between two devices for a very large distance. The frequency of operation is in the range of 850-1900 MHz which falls in the unlicensed Industrial, scientific and medical (ISM) Band. It is a circuit switched transport, where the data would be sent initially in the form of packets, which is broadly known as GPRS. GSM was intended to be a secure wireless system, as it has been considering the user authentication using a pre-shared key and challenge-response, and over-the-air encryption. It uses the frequency hopping technique at a nominal rate of 1600 hops/sec using a full duplex signal. The key features of GSM communication are low cost, low power consumption and lesser interference. The pre-requisite for data exchange is to only know the receiver's subscriber identity module details which authenticate the connection. Information can be exchanged only after entering the number of the receiver. A unique characteristic of GSN wireless technology is the ability to simultaneously handle data and voice transmissions. It provides users with a variety of innovative solutions such as automation systems and transfer of quick information between people.

Accelerometer: It is a device which measures proper acceleration experienced by an object, wherein proper acceleration refers to a free-fall or inertial acceleration by an observer who is momentarily at rest with respect to the object being measured. They are used to sense orientation, coordinate acceleration and vibration, either in single or multiple-axis. An accelerometer behaves as a damped mass on a spring. When the accelerometer experiences acceleration, the mass is displaced to the point that the spring is able to accelerate the mass at the same rate as the casing. The displacement is then measured to give the acceleration. It has a multitude of applications in various fields such as engineering, medicine, transport and navigation.

DESIGN

Product Design: This car monitoring smart system often termed as an embedded system is a combination of both hardware and software with many algorithms coded to it. This smart system is connected to the engine control unit of vehicles and thus making it easier for us to monitoring the condition of our car and also procure necessary information remotely. The electronic components used in this device are as follows:

Accelerometer (mma7361): It is used to calculate the rash driving point in the car system. They are attached to the accelerator and the brake pedals of the car thus, helps to track movements in the y plane. It is the main component used in the device, based on whose values the calibration is done for checking over speeding and too many sudden brakes that have been applied within a very short period of time. The accelerometer's stable state involves the condition where the y values retrieved from the accelerometer are both zero, which is also the reset condition for the accelerometer. Stable state is the initial position when it is idle and before the start of engine.

GSM Module: It is used to establish wireless communication between the car monitoring smart system and the user's smartphone. GSM is the preferred medium for wireless communication while exchanging data continuously over a large distance (using high-wavelength within the range of 2.4 to 2.485 MHz). In this device, as the data is being retrieved by the sensors, the renesas chip sends the data with the help of the GSM module to its destination smartphone. Data is being sent on request from the user as well as from the system when there is a necessity to be informed to the user.

Renesas Microcontroller Unit: In the renesas series the microcontroller opted was R5F1000LE. The presence of this single chip microcontroller created by Renesas is a 16-bit REN RISC-based microcontroller combined 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit converter. The device operates between 1.8-5.5 volts. In this device, all the sensors are interfaced to the micrcontroller and the GSM module is the medium of communication between the car system and the user's smartphone. Hence the data received by the sensors is given to the Renesas chip, which in turn sends it over GSM to the user's smartphone.

Li-Ion Rechargeable Button Cells (Power Source): Rechargeable Li-Ion cells of capacity 3.6V are being used, in order to power up the Renesas Microcontroller. The car system will have continuous power supply inflow from the battery present in the car.

WORKING

The main idea of this smart system aims to cater a robust environment for the vehicle and to provide remote access to the user, beyond the existing RF range. There are four components to this car system, which are remote locking beyond rf range, requesting of GPS coordinates, fuel theft alarm and a notification for a rash point driving which will be sent to the owner of the vehicle. Firstly, the feature to either unlock or lock a car without the presence of a key, is executed based on a SMS which is going to be sent from the user's phone. The application in the smartphone is built in such a way that when the option 'Unlock' is pressed on the phone, an SMS is sent to the car system. The SMS with the code word 'CUK', is received at the car system end and it will be verified from the user's number. Once the verification has been done, the door is then unlocked. Likewise when the option 'Lock' is pressed on the phone, an SMS with the code word 'CLK' is sent to the car system. On the arrival of the message, the message is further verified and the sender's number is checked. Once the above mentioned criteria are satisfied, then the door is locked. There is calibration done exclusively for every car according to the car's body dimensions. The next feature in the smart system is to provide the global positioning values of the car. It helps the owner of the car locate his car at any point of time, thus helping him prevent theft of his vehicle. On the application in the smartphone an option called ' GPS' is instilled on it, where an SMS with the keyword 'GP' is sent to the car system. On receiving the SMS, the keyword which is received is verified at the car system end and the sender's mobile number is check again. Only after both the above mentioned criteria is satisfied at the car system's end, the GPS module which is installed in the car will give both the latitude and the longitude of the car. The global positions are sent back through an SMS to the owner's smartphone, which he can open it in google maps. This comes of great use when the owner is worried about his dear ones and also in case of a car theft, as it helps in tracking the position of his car at all points of time. The next feature in the car monitoring system is to be alarmed about any fuel theft or fuel leakage. Nowadays, there is no mechanism to exactly keep a check on fuel theft or fuel leakage. This system comes up with a smart algorithm which help to identify either a fuel leakage or a fuel theft, based on the reduce in the fuel level in a particular interval of time. The position of the fuel sensor needs calibration for every vehicle as the size of fuel tank for every vehicle varies. Apart from the indication of fuel theft and fuel leakage, the system also has the feature of procuring the exact fuel left in the car or the last level of fuel in the car before the ignition was switched off. This helps to plan our day well in advance and to avoid last minute hassle in running out of fuel. For the first two scenarios when there is either a fuel leakage or fuel theft, an SMS is sent automatically to the owner's smartphone, thus informing that his presence is very much required at the location of the car. This has further scope of locking the fuel tank outlet, thus stopping the outflow of fuel. In the latter case when the user wants to know the fuel level in the car, he has an option called 'Fuel Level' on the application, which sends an SMS to the car system requesting for the fuel left in the car. A code word called 'FL' is sent to the car system from the user's smartphone. On receiving the SMS, the car system checks the code word and also verifies the user's mobile number. Once both the criteria are satisfied, then the fuel left in the car is intimidated back to the user through an SMS. The final feature in the car system is to notify the user in case of driving. This helps to keep a check on the trip analysis of the car which could have been driven by

someone else. The criteria chosen for checking of rash driving point is over speeding, applying of sudden brakes and also applying of both accelerator and brake pedals at the same time for a long duration. The above mentioned criteria are continuously check with help of accelerometers that are attached to both the accelerator as well as the brake pedals in the car. The variation in the Y axis,, with respect to time, helps us calculate the rash driving point. The driver of the vehicle is given a threshold up to which driving mistakes are acceptable. Once the threshold has been crossed, then the owner of the vehicle gets an intimation from the car system indicating him that the rash driving point has been reached and it needs to be looked in to. The presence of the last feature helps to have a trip analysis of anyone who used the car. This helps to drive consciously and thus prevents unnecessary road accidents. The entire system revolves around the presence of a microcontroller unit that exists in the car system. The various components that are included in this system over all are two accelerometers, a GPS module, a GSM module and a fuel sensor. The GSM module is initialized at the start of the system, which is followed by the start of the of GPS, wherein it receives the location of the car and saves it in the cache memory. In case there is any change in the location, then it will immediately replace it and send it over to the user. This car system is attached to the engine control unit present in every car and thus helps to receive information of all the components that are associated with the vehicle. The system is an add on to the existing vehicles which help us make the accessibility to the vehicle more convenient and also robust to the environment.

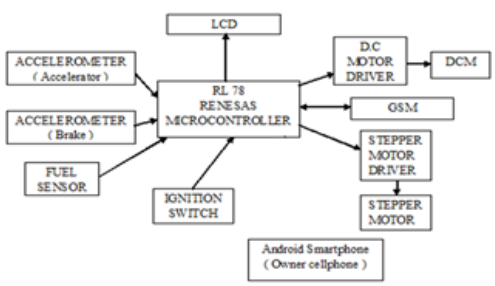

Fig 3.BLOCK DIAGRAM

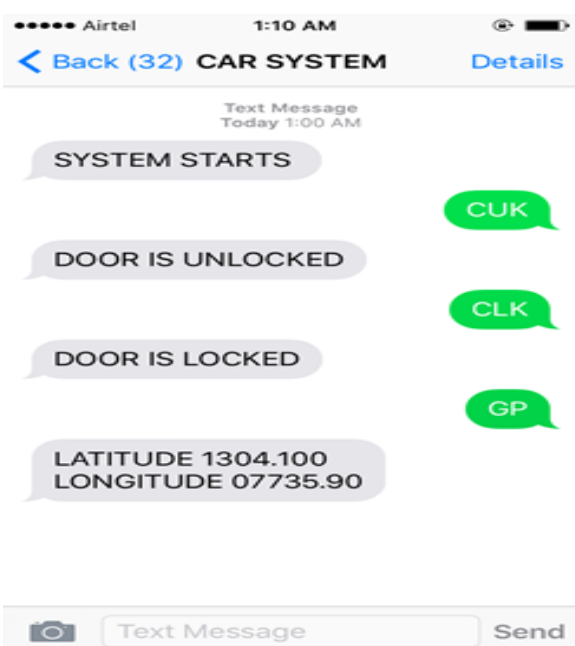

Fig 4 .SMARTPHONE

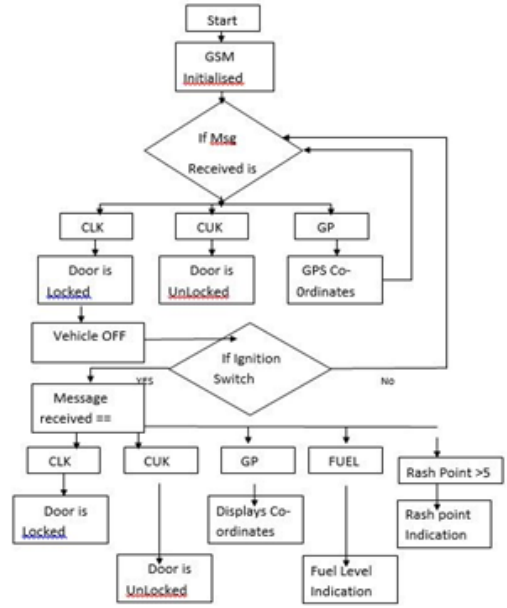

Fig 5 .FLOW CHART

Conclusion and further improvements

From the prototype that has been made, the car monitoring smart system turns out to be an economical and useful addition to the existing cars and also the cars that will come out in the future. The main advantage of this system is the usage of GSM technology, which makes it possible to access the car remotely. The presence of various modules like the GPS module and the GSM module, brings about maximum benefits to this prototype. The prototype has further improvements that can be seen in the near future, which may include the presence of a touch sensor that will notify the user when an unknown person touches the car, also there can be a scope for improvement in the intimation that can be sent to the driver during rash driving. This could be a small message displaying on a portable LCD screen. Also, in case of excess speeding, the accelerator pedal can be made hard, thus not allowing acceleration beyond a particular point. Overall, this smart system's presence in the car helps to make the car more robust to the environment and helps the user have full control of his car inspite of his absence at the location

VI. References

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