Smart System for Vehicle Security and Management

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Abstract

Vehicle tracking systems were first developed for the fleet management to monitor the vehicle's location. But with the increase of number of vehicles, the safety of vehicles are becomes more complex and insecure, so there is more demand of safety and security of the vehicle rather than only monitoring its location. Now the more intelligent systems are deployed with increasing popularity, which will also provide some additional benefits to the vehicle users. To fulfill these requirements, the smart system needs to be developed.

In this paper, we propose a smart system which will be based on Microcontroller, GPS, GSM and RFID technology, for the monitoring, controlling and security of the vehicle. This smart system will helps to the vehicle owner or/and operational manager of transport business to operate their vehicles with maximum security and efficiency by gaining the real time insights from the remote vehicle.

Keywords: GPS-GSM-RFID, control systems, safety and security, vehicle management.

1. Introduction

VEHICLE Tracking System is now one of the most popular technological changes in all over the world that is going to make our personal and business life lot easier. As the term suggests, it enables one to track or monitor the location of vehicle in instant time. Primarily, the system functions with the help of different technologies like the Global Positioning System (GPS), traditional cellular network such as Global System for Mobile Communications (GSM) and other radio frequency medium. But GPS is more effective and accurate in this field. As far as vehicle tracking in India is concerned, its uses and market are expected to increase within a couple of years [1]. Vehicle tracking system in India is mainly used in transport industry that keeps a real-time track of all vehicles in the fleet. The tracking system consists of GPS device that brings together GPS and GSM technology using tracking software. The attached GPS unit in the vehicle sends periodic updates of its location to the route station through the server of the cellular network that can be displayed on a digital map. The location details are later transferred to users via SMS, e-mail or other form of data transfers [3].

The Need:

Safety and security of a vehicle is of prime most importance for its owner and they are always on the lookout for a better and foolproof mechanism for theft prevention [2]. However, 'preventing' is just one aspect of security. In the unfortunate event of vehicle theft, having the knowledge of vehicle's whereabouts increases its retrieval chances by multifold. Even otherwise, equipping your vehicle with a smart system is a good idea as you are always in the know about all the happenings related with your automobile.

2. Principle of Proposed System

In this smart system we can manage the vehicle from remote place for it's continuous monitoring, control and security purpose. We used the RFID technology for detection of unauthorized access of the vehicle, GPS for it's location finding and GSM technology for the communication between vehicle and control centre. This will provide a full spectrum of the business intelligence capabilities including data integration, data mining, reporting, analysis, etc.

By using this system, we can find out the efficiency of vehicle as well as driver with adding more safety of vehicles. This is a remotely operated system, without disturbing / informing to any other.

This smart system can be divided in three parts,
1) Vehicle Tracking system
2) Control Centre
3) Communication

3. Requirements for Proposed System

Followings are major requirements to develop this smart system,
1) Remote Monitoring for
   o Individual Vehicle's location
   o Identification of each vehicle with time-stamp
   o Identification of each vehicle's driver
   o Vehicle status like fuel level, light, Door, Ignition.
2) Remote Control for
   o Individual Vehicle's Ignition On / OFF
   o Individual vehicle's Door Open / Close
   o Each Vehicle's Fuel ON / CUT-OFF
   o Each Vehicle's Light ON / OFF
3) Detection of unauthorized access of the vehicle for theft control.
4) Fuel management like usage, available, mileage purpose.
5) In places where GSM coverage is not there, system should store the updates and forward it when it returns to GSM coverage area.
6) Should allow automatic switching between SMS and GPRS, when vehicle moves to a location where there is poor GSM coverage or GPRS is not present.
7) Centralized Database management and analysis at control Centre.

4. Architecture

The conceptual architecture of proposed smart system for vehicle tracking, control and security purpose is shown in Fig.1.

Fig. 1 Basic Architecture

In this smart system the vehicle tracking unit will be placed inside the vehicle, which will continuously / on periodic basis communicate with the control centre, which will be either Computer system through GPRS based GSM modem or mobile system for SMS.

The three parts / sections of this smart system can be elaborated as below,
- Part I- Vehicle Tracking System Unit for vehicle status monitoring, control and Security purpose
- Part II- Control Centre for remote operation via mobile or computer system.
- Part III- communication for data transfer to/from either SMS or computer via GPRS using GSM network.

Each section is having different purpose and all the information of part I is sent to part II and / or vice versa for the end user / system through the part III.

These sections are explained in details as follows,

A. Vehicle tracking system Unit

In this vehicle tracking system unit, we have used different technologies like,
- GPS technology for getting the location, speed and direction of the vehicle [5].
- RFID technology is used to identify the authorized / unauthorized personal access of the vehicle [2][4].
- GSM technology for communication between vehicle unit and control centre [5].

Microcontroller is a main heart of this unit which is used to collect all the information from different devices which are connected to it, after collecting all these data microcontroller does the processing on it as per the defined logic and send it to control centre for user information or action. This system works without human intervention, so it is an independent and automatic system. To avoid the theft damage / stopping of this vehicle unit, it is installed inside the vehicle such that no one can access it until they follow the standard process.

B. Control Centre

Control Centre can have following options for their operations.
- Mobile station
- Personal Computer station
- Web Server

B.1 Mobile Station
In mobile station operation user can send the control command to the vehicle for the control request and accordingly the vehicle will do its operation like door lock / unlock, fuel on / off, ignition on / off, light on / off, etc. It

also sends the current information of the vehicle to the user whenever it is required or in emergency case of theft.

B.2 Server / PC Station

Control Centre has GSM / GPRS modem attached to it that receives SMS from vehicle tracking system and sends those messages to the server / PC through serial port. The Control Centre saves this information into database. By using this system user can monitor the current as well historical information of the vehicles [1].

B.3 Web Server

Tracking server has a GSM / GPRS modem attached to it that receives data from vehicle units through GPRS and sends those data to the server through serial port. Tracking server saves this information into database.

Tracking server maintains all information received from all the vehicle units installed in different vehicles into a central database. This database is accessible from internet to authorized users through a web interface. Authorized users can track and control their vehicle and view all previous information stored in database [1].

To display this information to end users, the front end software is required that can display all information to the end user. End user is the user of system who has installed the vehicle unit in his vehicle and also the administrator of the system who is managing Vehicle Tracking System. There may be a number of vehicles installed with vehicle units therefore server must be able to manage and distinguish information sent by all vehicle units. For this purpose information must be available to server about all vehicles that are installed with vehicle units. Whenever vehicle unit is installed, information about that vehicle is stored in the database. Web interface must also support this functionality. Since web interface will be accessible over the internet therefore access must be restricted to authorized users only.

C. Communication for data transfer

When all required information is extracted and processed, it needs to be transmitted to a remote control centre which will be able to display this information to the end user. For real time tracking, control and safety of vehicle, reliable data transmission to remote control centre is very important. Wireless network is required to transmit vehicle information to remote control centre. Existing GSM network is selected to transmit vehicle information to remote control centre because of broad coverage of GSM network. It is also cost effective rather than to deploy own network for transmission of vehicle information. For data transmission over GSM network GSM modem is required. GSM modem can send and receive data SMS text messages and GPRS data over GSM network [3].

5. Hardware Implementation

5.1 Vehicle Tracking System

It is responsible for capturing and transferring all the information which we had discussed earlier between Vehicle and control Centre [1][2]. The details of this unit are shown in below fig. 2.
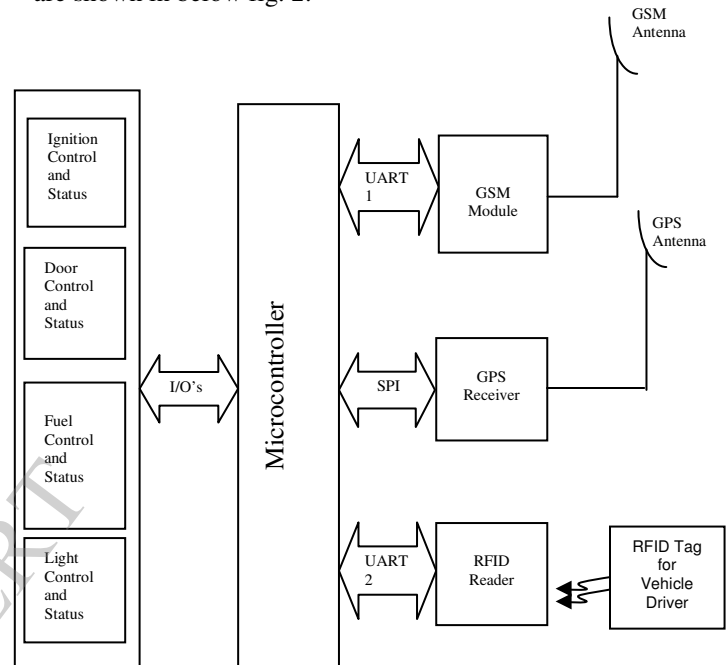

Fig. 2 Vehicle tracking system

5.2 Control Centre

As discussed earlier, we can have different options for the control centre design as per the end user requirements like only mobile unit can be used for the control centre operations second Personal Computer and GSM modem (SMS) can act as a control centre and third Personal computer and GSM Modem (GPRS activated) also used for web access for the control centre operations [3].
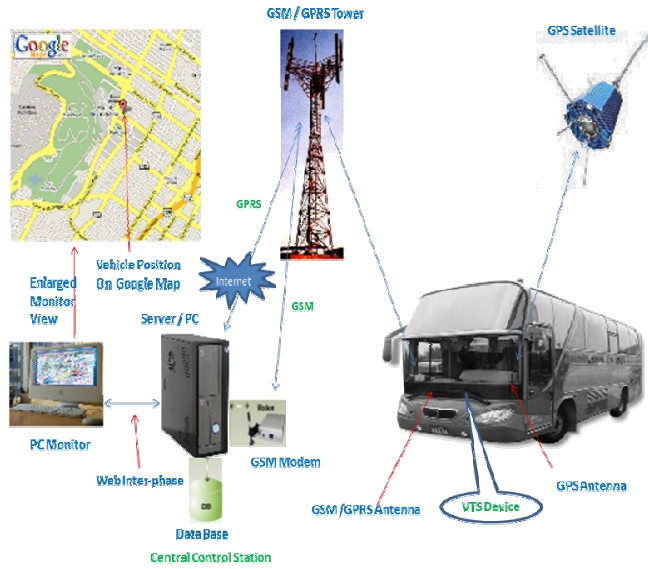
5.3 Total Working System

Fig. 3 Total system

In this total system we have shown all the functional devices with their connections for the successful working of this system.

6. Software Implementation

Microcontroller is acting as Central Processing Unit for Vehicle tracking unit. All operations of the smart vehicle unit are to be controlled by the microcontroller. Microcontroller needs instructions to operate the whole system. These instructions are provided to microcontroller by writing the software into microcontroller's flash memory [1]. It reads the software instruction by instruction and performs the action as required by instruction. Complete software is broken down into small modules as shown in below Figure. 4
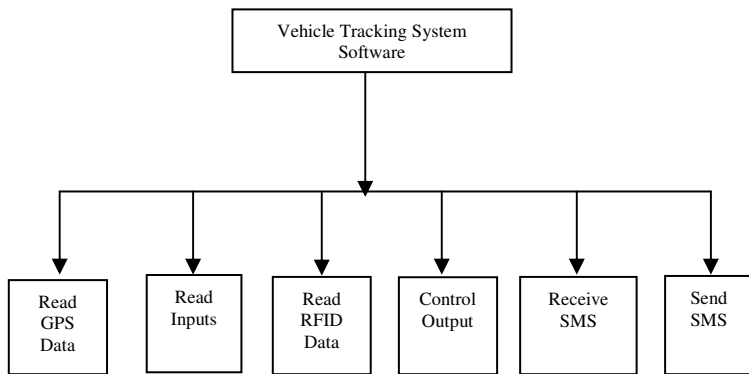

Fig. 4 Software modules
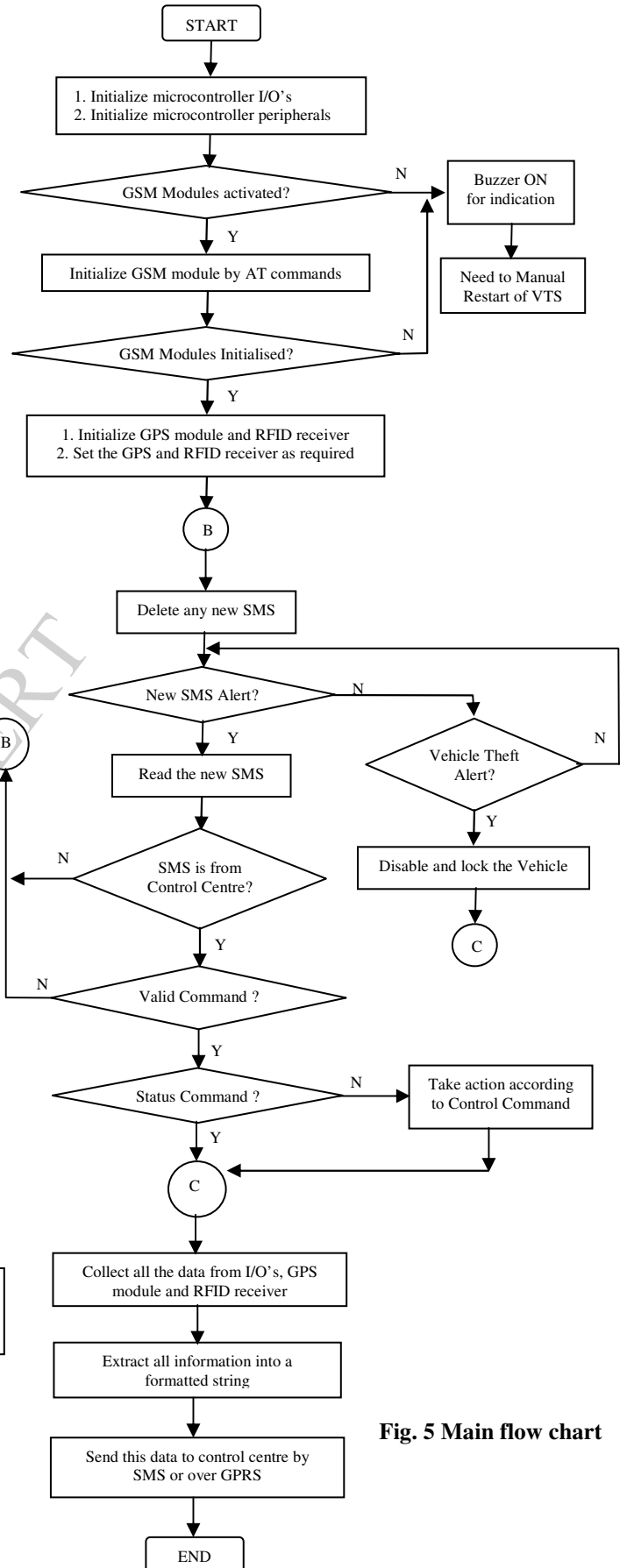
BASIC OPERATION FLOW CHART

Fig. 5 Main flow chart

7. Conclusion

Based on the above illustrative discussions, it is evident that the proposed Microcontroller, GPS, GSM and RFID based smart system for the remote vehicle monitor, control, security and fuel management purpose, has a Business Intelligence (BI) capabilities [2]. Furthermore, reporting and analysis allows users to easily access, format, and distribute the information to related department like police, fire, vehicle owners, etc.
Hence, this smart system for vehicle monitoring, controlling and security will helps to the vehicle owner or operational Manager of transport business to operate their vehicles with maximum security and efficiency by gaining the real time insights from remote vehicle to make the optimal and timely decisions.

8. References

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