IMPLEMENTATION OF AN INTEGRATED VEHICLE SECURITY AND TRACKING SYSTEM: A REVIEW OF TECHNICAL LITERATURE

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ABSTRACT

One of the major problems confronted by our present society, particularly for security intervention, is the security of our vehicles. It is a great concern, especially in metropolitan cities where the issues of car theft or car snatching become very rampant. This research work, intends to modify the work of (Naji et al., 2020) and implement a universal vehicle security and tracking system in which vehicles are tracked and controlled using cellular networks. The system will be equipped with exceptional vehicle Passive Infra-Red (PIR) motion detector which detects and keep special account of the vehicle movement. In addition to this, a surveillance camera module that will keep track of the video clip or image of the theft is to be installed. A thumb print device is attached to the steering, which has a high degree of complexity of biometric modalities that has high accuracy during authentication. The microcontroller is an aTmega328p mounted on an Arduino Uno module and programmed with AT interface commands to effectively communicate between the software and the hardware. The system enables the easy tracking of car by adopting wireless technology. To achieve this, development of a cost effective microcontroller vehicle security and tracking system and demobilize system will be modified and implemented. The result of the research will be validated with the work of (Naji et al., 2020) using robustness and reliability as performance metrics.

Keywords: *Vehicle surveillance system; tracking system; fingerprint system; microcontroller; messaging; GSM.*

INTRODUCTION

The most usable advances in this moving world is internet of things (IoT). IoT portrays implanted gadgets which are interlinked with the web. It involves gadgets like sensors, actuators, and engines (Mounika and Chepuru, 2019). Vehicle security means providing security to the vehicle against any possible thefts. The security system of vehicle has become a major concern for many decades to the manufacturing companies and vehicles owners, where as in most cases a stolen vehicle may not be traced by the owner and tend to leave the owner with the wonder of how it has been stolen despite the security system installed by the manufacturer (Kumar, 2017). The main idea of this research work is to modify and implement the Global Positioning System (GPS), Passive Infra-Red (PIR) sensor, thumb print module, a camera system and Atmega328 microcontroller that can effectively control and communication with the vehicle when it is stolen. The use of cellular network is the cheapest, much easier and best way to link between a vehicle and its proprietor, by which kind of security of the system can be established through creating messages for each vehicles proprietor as preferred (Naji. *et al.,* 2020). Tracking systems creates many wonders in the security of the vehicle, the hardware is fitted on to the vehicle in such a manner that it is not visible to anyone who is inside or outside of the vehicle. Thus it is used as a covert unit which continuously or by any interrupt to the system, sends the location data to the monitoring unit. When the vehicle is stolen, the location data from tracking system can be used to find the location and can be informed to police for further action. Some vehicle tracking system can even detect unauthorized movements of the vehicle and then alert the owner. This gives an edge over other pieces of technology for the same purpose (Vijay *et al., 2015*).

REVIEW OF SIMILAR WORKS

Alli *et al.,* (2015), proposed a GSM technology coupled with some digital control techniques to carry out the necessary function of its system. The work was divided into two subsystems: the remote access link and the vehicle subsystems. The system can be controlled from anywhere in the world once there is GSM coverage. Previous works have been done involving tracking of vehicle location via the internet. The use of the internet was only restricted to places where there could be internet access facilities. The design employed the use of a GSM/GPRS modem (Modulator and Demodulator) module to gain access to the vehicle systems. However, the work was only explored to track down the exact location of a vehicle but not to demobilize the vehicle from a distant place.

Kamble *et al.*, (2016), Proposed a vehicle tracking system that used a SIM908 GSM/GPRS/GPS module which has similar features to the SIM808 module proposed in this work, except that the SIM908 also has Bluetooth functionality. They used an ATmega32 microcontroller which was an 8-bit high performance microcontroller from the same Atmel's Mega Advanced Virtual RISC (AVR) family as the ATmega328P proposed to be used in this research work. The paper enumerated the features of the devices and technology referenced in the work. A lot of tools and process were used in the production of the PCB and there was not much on the codes, tests or results of the project. One cannot replicate the project with just the information in the paper.

Gugapriya, (2016), developed an anti-theft vehicle tracking and disabling system which they tagged Anti-Theft Vehicle Locking System using Controller Area Network (CAN). The device used a SIM900A GSM module for SMS communication with the module, GPS receiver MT3333 module for location-based services, and MAX232 microcontroller that acts as both driver and receiver to the CAN bus. They also used a flow sensor as fuel sensing device, and a fuel valve for cutting off fuel supply to the engine. In all, about six (6) boards and the fuel sensing and cut off devices were used. These made the project expensive, cumbersome and difficult to troubleshoot in the event of a fault.

Alshamisi and Kepuska, (2017), proposed the design and implementation of a real time GPS tracker system using Arduino. The system used Arduino MEGA 2560 and Adafruit FONA 808 Shield. The MEGA 2560 was designed for more complex projects like 3D printers and robotics. This work was intended to be made simple enough for artisans with basic computing and electronics knowledge to construct. For such persons, the Arduino Uno board, which was an entry level board, was the most appropriate. There was also no evidence that the work was implemented.

Joshi *et al.*, (2017), designed a device tracking system using two technologies, GPS and ZigBee to achieve the same result as proposed to be achieve in this project. It took advantage of the radio properties of ZigBee to provide location information in areas where there was no GPS coverage like in large buildings, underground buildings, or thick foliage. For the GPS part, they made use of Arduino Uno board with ATmega328 board and GPS-GSM SIM808 module, same as in this project, but they also used a 16x2 Liquid Crystal Display (LCD) and ZigBee. These segments together made the project a bit more complex and expensive. On the contrary, the ZigBee made it possible to locate a device within 200 meters in areas where there was no GPS coverage, but such areas are few and vehicles are mostly in the open with clear view of the sky, such level of accuracy is mostly not needed for vehicle tracking.

Liawatimena and Linggarjati, (2017), developed a web-based vehicle tracking system for fleet management and early accident notification. It utilized an embedded system with GPS, a 3-axis accelerometer, and GSM features. The GPS shield used a Mediatek MT3339 GPS receiver. Particle cloud provides the tools required to access the embedded device on the web. The device was periodically queried for the x, y, z axis and coordinates of the vehicle, and the result analyzed and logged. Also, one needed to log in to the website to retrieve information on the vehicle, which required internet connectivity and a computer or Smartphone that might not be readily available. This project only requires SMS capability in phones, internet connection is not required. It also has the capability of disabling a vehicle on demand. The project served its intended purpose but did not have features to disable the vehicle when stolen.

Tien and Phung, (2017), designed a system based on the global mobile communications system (GSM) and global positioning system GPS. The system was designed to track and control vehicles in open environments and outdoor areas as a practical model for monitoring and tracking applications. The system consists of accelerator sensor-KXSC72050 of Koinix to get a moving direction of the vehicle and a sensor compass YAS529 from Yamaha. The system receives the vehicle's location through the data received from the GPS receiver. This data is sent directly to the main center by using the services of short Message Services (SMS) or General Package Radio Service (GPRS). The main center contains advanced equipment and auxiliary tools that supported GSM techniques-WMP100 of the Wavecom. Lastly, the located position of the vehicle will be represented on Google map. This system consists of accelerator sensor-KXSC72050, and a sensor compass YAS529 from Yamaha which are very expensive, and lacks the ability of notifying the owner before the vehicle could be stolen.

Mashood, (2017), designed a remote tracking device to track a vehicle's location, remotely switch ON and OFF the vehicle's ignition system and remotely lock and unlock the doors of the vehicle. An SMS message is sent to the tracking system and the system responds to the users request by performing appropriate actions. Short text messages are assigned to each of these features. A webpage is specifically designed to view the vehicle's location on Google maps. By using relay based control concept introduced in this paper, number of control features such as turning heater on/off, radio on/off etc. can be implemented in the same fashion. The author focuses more on the tracking aspect not considering other security possibility of the vehicle.

Ganapathy *et al.*, (2018), developed a vehicle security system that utilized the usual GSM and GPS technologies, but also incorporated finger print identification. It used Arduino MEGA 2560 and Arduino Nano microcontrollers, SIM900A GSM module, and Fingerprint Sensor R-305. Although the fingerprint feature added an extra layer of access control, its presence gave away the existence of the security system thus eliminating the element of surprise and leading to the possible tracing and disabling of the whole security system. In this research work the authors focused more on the fingerprint capabilities of the system and did not dwell much on the tracking features.

Jose, (2018), developed a tracking system incorporated with wireless sensors in the network to monitor the parameters of the vehicle. ZigBee is used to transfer the data from the sensors to other components. The work of Dimil Jose, is in no doubt less reliable due to the distance covered by the ZigBee. ZigBee covers a distance of almost 200 meters in transmission of data, whereas in this work, satellite advancement is used as a means of data transfer in tracking of vehicle location and other parameters such as speed and exact location.

Al-Fedaghi, (2018), developed a remote tracking device to track a vehicle's location, remotely and an SMS message is sent to the tracking system and the system responds to the users request by performing appropriate actions. Short text messages are assigned to each of these features. Such as temperature, speed, and distance covered. The author focuses more on the temperature, speed and distanced covered not considering the security of the vehicle.

Rana, (2018), designed a vehicle security system that consist of a setup mixed with software and hardware using android application and Raspberry Pi Board B+ model. The system is based on remote keyless entry (RKE) system where by a key fob transmitter and receiver are used at high frequency of 315MHz in U.S and 433.92MHz in Europe. The author only considers the viability of some specific region like U.S and Japan and the entire Europe. Contrast to the work, this research work can be viable in any region around the world.

Chepuru, (2019), developed a system which is designed to trace the vehicle when it is lost using GPS and GSM technology. GPS receiver and GSM module uses Arduino UNO controller to forward the commands. This system is fixed inside a vehicle. GPS module will transfer the location values to the controller. Controller will receive it and sends that information to the automobile user using GSM modem. the owner can take appropriate action using GSM mobile App. To provide security to the system, which is placed inside the car, RFID technology is used. The system uses IoT technology to store and visualize the sensors data. The author only capitalizes on the tracking aspect without considering or employing the advancement of more sensors that could notify the owner of the vehicle during the theft.

Bukola, (2020), developed a system that monitors and communicates with the device owner. The development was of an antitheft vehicle security system using Global Positioning System (GPS), Biometrics and mobile communication protocol that will monitor, protect and secure vehicles. Data transfer between the user and the proposed system are achieved through a short message services (SMS) protocol available in the cellular phone. The proposed system was interfaced with an immobilizer which uses Biometric (i.e. Fingerprint) authentication to turn on the engine and to intimate the vehicle owner of any unauthorized entry. To start the ignition of the four-wheeler one should enter the authorized fingerprint. However, the author gave much priority only to heavy duty engines.

Naji *et al.*, (2020), developed a system using the Global Positioning System (GPS), the Global System for Mobile communications (GSM) and a microcontroller that can control the vehicle when it is stolen. GSM is directly connected to the microcontroller (which is an Arduino processor). The Short Message Service (SMS) is processed in the microcontroller unit and forward it to the GPS unit to give the exact location in the form of latitude and longitude on the owner's mobile phone. Some of the features of the system are: the ability to lock and unlock vehicle doors, find its position, turning on the lights, turn flashing lights. Turning on lights and turning flashing light is way out of security and anti-theft system and the author concentrated only on finding the position of the vehicles when the vehicle is already stolen.

APPLICATIONS

Vehicle security and tracking system can be found in a wide variety of applications and may be classified as follows:

Field Service Management

Companies can track their various field service personnel for repair and maintenance and can send the closest field engineer to the client’s place leading to speedy and timely complaint resolution and achieving consumer satisfaction.

Field Sales

Mobile field salesmen can easily reach their customers and target clients in unknown areas by getting proper directions and thereby reducing their time spent in locating them and achieving higher productivity.

Trailer Tracking and Surveillance

Logistics and Cargo companies use Vehicle tracking system to keep a track of the trailer carrying the load / cargo.

Cold Storage Monitoring

Temperature Sensing is very important in case of transportation and distribution of refrigerated and perishable goods. With the help of GPS Tracking System, one can come to know if the temperature of the cold storage is less or more than the prescribed level.

Oil and Gas Industry

GPS Vehicle Tracking System helps the oil distributors by monitoring the oil tanker’s movements in the given location so that exact time of oil distribution to the customer’s oil station can be monitored. Drivers have also the facility to send alert to the fleet managers in case of any emergency / accidents / mishaps etc. This leads to improved asset utilization, customer satisfaction, vehicle and driver safety and safer work environment.

Ambulance Tracking and Emergency Medical Services Fleet

Through GPS vehicle tracking system, ambulances and EMS Fleet can be monitored and sent quickly to the critical patients, thus providing timely medical facility and saving lives.

GPS Wildlife Tracking

Wildlife researchers and animal conservation agencies can track the movement of animals and their migratory patterns. The systems can be attached to their collars, harness or put directly on their bodies.

CONCLUSION

It is evident from the reviewed literature that it can be concluded that thieves are now becoming more and more well equipped with technology capable of defeating car manufacturers and anti-theft systems. Motorists are now resorting to older traditional techniques like mechanical steering locks to deter thieves from stealing their vehicles. The main benefit of vehicle tracking systems is the security purposes by monitoring the vehicle's location which can be used as a protection approach for vehicles that are stolen by sending its position coordinates to the police center as an alert for the stolen, the ability to sense the presence of theft when going on inside the vehicle and image capturing ability to capture the theft. Consequently, research has so far focused on developing robust and sensitive devices to mitigate these problem.

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