Anti-Theft Vehicle Tracking with Automatic Police Notifying using Haversine Formula

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ABSTRACT

Security, especially theft security of vehicle in common parking places has become a matter of concern. An efficient automotive security system is implemented for anti-theft using an embedded system integrated with Global Positioning System (GPS) and Global System for Mobile Communication (GSM). This proposed work is an attempt to design and develop a smart anti-theft system that uses GPS and GSM system to prevent theft and to determine the exact location of the vehicle. In case of an accident this system automatically sends the message for help to one's relatives. The preventive measures like engine ignition cutoff, fuel supply cutoff, electric shock system is also available. The owner can lock or unlock his/her vehicle with the help of SMS. This complete system is designed taking into consideration the low range vehicles to provide them extreme security.

Tracking framework or system is getting to be progressively vital in expansive urban areas and it is more secured than different frameworks. The proposed work is cost-effective, reliable and has the function of preventing theft and providing accurate tracking system. A smart anti-theft system is one of the essential systems that homogenize both GPS and GSM systems. It is fundamental because of the huge numbers of uses of both GSM and GPS frameworks and the wide use of them by a great many individuals all through the world.

Keywords: *GPS, GSM, Arduino, Haversine Formula.*

1. INTRODUCTION

The anti-theft vehicle tracking system is a kind of developing a tool which protects your much essential needed thing in a person perspective to keep his/her vehicle. In this growing era of technology, we the humans are much intended to come up with new systems which enhance the future generation into a global system. The Global Positioning System (GPS) plays an important role in developing this tracking feature. It is so because of the enabling feature of locating an exact position of any kind of activity around the world, round the clock. GPS is a satellite-based navigation system which lets you depict the location of the vehicle. It makes you detect the exact position and helps in identifying a particular thing. This satellite-based navigation system communicates with the mobile application that is installed within the device. The device gets a notification regarding the position of the vehicle which makes easy to locate anywhere in the respective place. GSM (Global System for Mobile Communication) is a mobile-based technology which retrieves the location of the vehicle and sends a notification for the owners mobile. Both the GPS and GSM works

based on Arduino system, which is actually a microcontroller. It is necessary that every vehicle (four-wheeler) should be having a tracking system installed in the vehicle which protect from being stolen.

2. RELATED WORK

Many idea and research are done on this vehicle tracking system.

[1]Kunal Maurya, Mandeep Singh, Neelu Jain demonstrated a GPS and GSM based continuous monitoring system.

[2] Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad, Rania M. Jodeh created a system that monitors the vehicle speed, location and also gives an alert when the speed of the vehicle exceeds the limit.

[3] Devyani Bajaj, Neelesh Gupta used a GPS, GSM, RFID to track the vehicle in real time and display the transmitted data on a server.

[4] Huang Guan1, Wang Xingang, Wu Wenqi, Zhou Han, Wu Yuanyuan presented a system which detected vehicle, lane, and road.

[5] Wajeeha Najeeb, Khurram Khurshid compared the Difference based Tracking and block based tracking.

[6] Shruthi.K, Ramaprasad.P, Ruschil Ray, Manjunath A. Naik, Shubham Pansari made a system that could take a picture of the unauthorized driver and informed the police.

[7] Pankaj Verma, J.S Bhatia made a wamp server to display the transmitted data of the vehicle.

[8] Several works are done to lock the engine and door.

3. EXISTING SYSTEM AND DRAWBACKS

a. Existing System

- GPS is the most widely used technology ever used since ages.
- GSM comes with a mobile communication system to give notification.
- Tracks the vehicle in real time and display the transmitted data on a server.
- Lock the engine and door of the vehicle.
- Created a system that monitors the vehicle speed, location and gives an alert when speed limit exceeds.

b. Drawbacks

- Picture authorization was unsuccessful.
- Several works were done to lock the engine but most of them were an attempt to failure.
- Data errors and server failure was the most faced problem to some extent.

4. PROPOSED SYSTEM AND IMPLEMENTATION

GPS technology: The Global Positioning System (GPS) is a technical marvel made possible by a group of satellites in Earth's orbit. It transmits precise signal, allowing GPS receivers to calculate and display accurate location, speed, and time information to the user. GPS depicts the location of the vehicle and possess information to the respective owner regarding the vehicle details and makes a hand in easy to locate it exactly anywhere across the globe.

GSM technology: Global System for Mobile communications is an open, digital cellular technology used for transmitting mobile voice and data services. It is a mobile telephony system which was first used in Europe and still existing, also across the other parts of the world. It digitalizes and streams the data from other sources and connects multiple devices altogether. GSM, together with other technologies, is part of the evolution of wireless mobile telecommunications that includes high-speed circuit switched data, enhanced data GSM environment, and Universal Mobile.

Arduino: Arduino is an open-source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world.

Haversine formula: Haversine formula determines the geographic relation between the great-circle distances
Between two points on a sphere given their longitudes and latitudes. Important in navigation, it is a special case of a more general formula in spherical trigonometry, the law of haversines that relates the sides and angles of spherical triangles. Haversine maintains an equilibrium between accuracy and computational efficiency that performs over the entire earth.The equation of haversine formula is as follows:

$$hav\left(\frac{d}{r}\right) = hav(\varphi_2 - \varphi_1) + \cos(\varphi_1)\cos(\varphi_2)\,hav(\lambda_2 - \lambda_1)$$

Where hav means haversine function.

$$hav(\theta) = \sin^2\left(\frac{\theta}{2}\right) = \frac{1 - \cos\theta}{2}$$

d = the space between the two co-ordinates

r = the radius of the sphere

θ = angle between coordinates

ij1, ij2 = latitude of co-ordinate 1 and latitude of co-ordinate 2, in radians

Z_1, Z_2 = longitude of co-ordinate 1 and longitude of co-ordinate 2, in radians

Haversine Formula:

It is mainly used to calculate the distance between two points on a sphere given their longitudes and latitudes. Mostly probably, Haversine plays an important role in determining the navigation system of a particular thing. Using the formula, it is easy to get the exact location of the vehicle as the coordinates do predict the system with the help of longitudes and latitudes. The Haversine Formula is more accurate than the law of cosines formula because of problems associated with small distances.

Our proposed model can perform to track the vehicle in shortest possible time; also can lock the vehicle if an emergency. In Fig-4, the functional block diagram of tracking is shown.
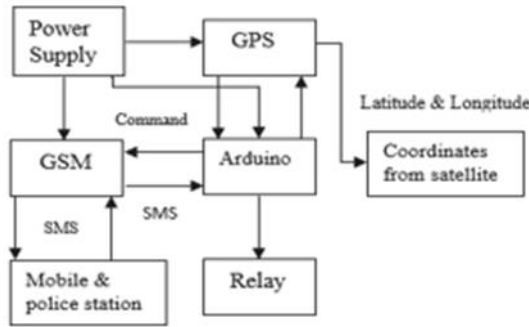

Fig.1. A functional block diagram of vehicle tracking and regaining system

The owner can send a message via GSM to the device in any real time to track the vehicle. The device will respond by sending the location of the vehicle using the GPS. By obtaining the location, the owner can decide whether the vehicle is lost or not. The owner of the vehicle will have a device (mobile) and will able to receive notification and can able to take a respective action. When the owner receives a message about the stealing of vehicle, he/she can take appropriate action by switching off the engine by using the device through their location itself. Switching off the engine will restrict the movement of the vehicle and does not let the thief to get stolen.

A database is designed which contains the location of the police station and their relevant mobile number as an array. Arduino has a memory, which can store the database. A larger database needs an external memory drive.

Based on this data, the algorithm finds the nearest police station of the lost vehicle by using Haversine formula. Haversine formula is used to find the minimum distance between two locations. After finding the nearest police station, a message is sent to it so that the police can take appropriate steps to catch them.

In the case of emergency, the owner commands to lock the door through message using the certain keyword. If the keyword is matched, Arduino will generate a fixed voltage. This fixed voltage initiates the relay, which closes the door later. Therefore, this project is focused on obtaining the vehicle as soon as possible.
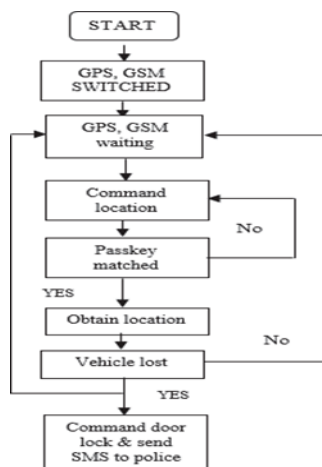
Fig. 2. Flow chart of anti-theft tracking and regaining operation

5. HARDWARE IMPLEMENTATION
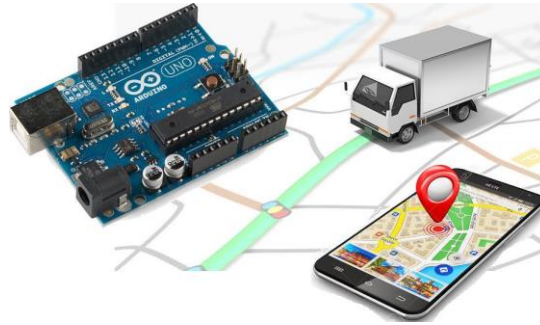
Fig.3. Hardware description of the proposed model

The hardware implementation of vehicle tracking system describes main interconnections between the vehicle, mobile phone and the working system of Arduino along with GSM and GPS. The tracking system of a particular vehicle is divided into two parts that are, working unit and owners unit. Working unit consists of GSM, GPS, and Arduino. The 5v adapter powers the GSM. GSM can also be powered by the rechargeable battery. An important notice while using GSM is to keep charging the mobile phone as it works on mobile device only. An adapter is used to get a continuous power source. The GPS is connected to the Arduino 5v pin. It is easier to power the GPS from the Arduino. Arduino is connected to the rechargeable battery. If the hardware connections are inserted properly, the working of entire tracking system seems to be easy and conditional. Whenever the vehicle gets stolen or being stolen, the user/owner gets a notification to the mobile to which the entire device is connected. Working unit sends and receives messages to the device once the system gets completed.

6. RESULTS

- The owner can open the android application and clicks on " vehicle position". Software then fetches position from the message and display the coordinates on map as follows.

- Figure shows the present location of the Car on Google Map

Fig.4.

Haversine algorithm calculates the position of the vehicle through GPS using Haversine formula to get the coordinates associated with longitudes and latitudes. The system describes the exact position of the vehicle according to the obtained coordinates with the help of Haversine formula and helps in finding the vehicle or to inform the nearest police station about the stolen vehicle.

Fig.5. Description of notification received from Arduino system

As soon as the owner/user of the vehicle gets a message about illegal unlocking of the vehicle, the owner/user can return a passkey saying to lock the vehicle so the thief could not steal the vehicle. This protects the vehicle from getting stolen. The owner can even cut off the start exhaustion engine system where the thief cannot start the vehicle. The above picture shows the same lock feature enabled in the system.

7. FUTURE WORK

Considering the present developed idea of the anti-theft vehicle tracking system, another insight can be developed regarding the same situation. Taking the real-time database practically, we can set up a camera which detects the face ID of the person who tries to steal the vehicle. This will make the police the catch the particular person more easily and accurately. The camera can be installed along with Arduino set up a system in such a way that no person could able to identify its presence. Alert message transmits to all surrounding stations can be possible by simply modifying the code. After detecting the route and direction of the snatched vehicle, the special alert message can be sent to upcoming police stations. The camera will help in capturing the hijacker's face, which will be activated by owner command. Additionally, a small buzzer can also be installed with Arduino so that whenever a person tries to unlock the door, it immediately alerts the user/owner with its highly audible sound and alert the user/owner to take appropriate steps in order to protect the vehicle.

8. CONCLUSION

Nowadays, Vehicle theft is increasing at an alarming rate. In this paper, a system is developed to make a solution to regain the car after notifying law enforcing authorities. In this system, the user can track the vehicle using messaging. When the vehicle is theft, user or owner can command to lock the vehicle door along with engine killing arrangements and send the co-ordinates of the lost vehicle to the nearest police station. Then the police will respective steps in order to locate the vehicle and catch the person who stole it. Installing this feature in every vehicle will protect everyone's valuable thing and also decrease the statistics of vehicle theft process in every place.

9. REFERENCES

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