IOT Based Smart & Secure Vehicle Monitoring System

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Abstract

In In the present day world, vehicle security becomes one among the highest most concerns for a private . Now a days, the existing alarm systems of vehicles could be easily overridden since required tools are equally easily available. Security in travel is primary concern for everyone. This Project describes a design of effective information system that can monitor and secure an vehicle / car condition in traveling. The aim of using IoT for tracking and monitoring is thanks to the good advantages that provide when working with its components. In this paper, we propose a vehicle tracking system by using Raspberry Pi connected to various sensors and GSM modem.

The proposed system which may be an android/iOS based "app" or application, offers endless monitoring of the vehicle for any suspicious movement where the vehicle are going to be fitted with a smart device having inbuilt G.P.S., a SIM card with internet facility, SMS/Notification sending interface and support for the Accelerometer application programming interface (A.P.I) along with an application that can capture the vibrations of an external surface. This system, using the concepts of "machine to machine communication" and "Internet of Things" will intimate the owner of the vehicle location just in case of the movement whenever detected. One of the main advantages of the proposed system is that it can differentiate between the "theft" and therefore the "tow" allowing users to require appropriate action.

Key Words – *Vehicle Monitoring System, Internet of Things (IOT), Vehicle Security System, Machine-to-Machine Communication, Vehicle Theft*

I. INTRODUCTION

Today we live in the time where the security of one's assets are of the top priority concerns for one, their vehicles being one of these. Every individual feels the necessity of monitoring their vehicle parked in unknown vicinity. The vehicle may or might not be fitted with an alarm and therefore the alarm may or might not trigger. The proposed system will monitor the vehicle continuously whenever it's in motion. The vehicle will be fit with a smart device with a Global Positioning System (G.P.S.), internetwork and Global System for Mobiles (G.S.M.) and different sensors like temperature sensor, speed sensor, ultrasonic sensor, etc.

Internet of Things (IoT) is nothing but the devices (things) communicating with each other by using the internet. IoT may be a trend-setting innovation during which all the info from sensors

is stored in the cloud/database where it can be easily accessed from the cloud. Sensors and actuators for gathering the data and sending across the internet are also included in this advancement. We use cloud/database not only to store data but also for data analysis, gathering, visualization. Most of the thefts occur because of not maintaining a proper distance between them this is also a serious problem that to be considered, to overcome these issues we had planned a vehicle observing and controlling framework, in that we have utilized distinctive sensors and gathered data from every sensor and data is analyzed and we had utilized a GPS module to track the data and here the microcontroller we have used is Raspberry Pi.

II. LITERATURE SURVEY

Vehicle Security System By Using GSM Technology by K.Priyanga S.Sangeetha C.Thilagavathi R.Vinodhini Vaishanavi.K

This framework portrays the plan and development of a propelled auto security framework utilizing GSM technology. It uses the GSM portable communication to transmit a caution flag and control the direction. The control and communication between the client and therefore the framework are accomplished through a brief message administrations (SMS) convention are accessible within the telephone . In the event that the auto entryway is unlawfully opened or the auto is vibrated, an alert flag will be initiated and it send SMS message to the proprietor's cell phone quickly.

Microcontroller-based Vehicle Security System with Tracking Capability using GSM and GPS Technologies by Orven F. Mendoza

Microcontroller based Vehicle Security System with Tracking Capability utilizing GSM and GPS Technologies, is a framework that can be utilized to expand vehicle security, as it can track area of missing vehicle, and enable specialists to possess dependable proof that the vehicle is stolen. The task utilizes the Global System for Mobile (GSM) and the Global Positioning System (GPS) technology, which incorporates the utilization of GPS collector module, GSM module, and microcontroller as its essential segments. It also uses a vibration sensor which is use to sense vehicle movement and a buzzer that sends an alarm when sensors are triggered.

IoT security: Review, blockchain solutions, and open challenges Minhaj Ahmad Khan a, *, Khaled Salah b

IoT may be a promising disruptive technology with incredible growth, impact and potential. A review of emerging topics associated with Internet of Things (IoT) security and Blockchain is presented. A mapping of the main security issues for IoT to possible solutions is tabulated. Blockchain technology and its robust solutions for challenging and important IoT security problems are reviewed.

III. METHODOLOGY AND WORKING

A. Temperature Sensor:

DHT11 Sensor is used to check the engine temperature .DHT11 sensor consists of three pins, power supply of dht11 is 3.3v, GNDpin is connected to GND pin of NodeMCU, Digital pin of dht11 sensor is connected to Digital pin of NodeMCU

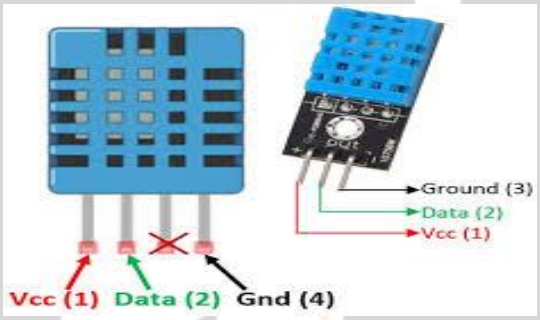

Fig. Temperature Sensor (DHT11 Sensor)

B. Raspberry pi 3 Model B

The simplest use for a Raspberry Pi is as a personal computer . Along with the Pi itself, the microSD card, and power supply, you'll need a HDMI cable and a suitable display.. The processor at the heart of the Raspberry Pi system is a Broadcom BCM2837 system-on-chip (SoC) multimedia processor. This means that the vast majority of the system's components, including its central and graphics processing units along with the audio and communications hardware, are built on to that single component hidden beneath the 256 MB chip at the centre of the board.

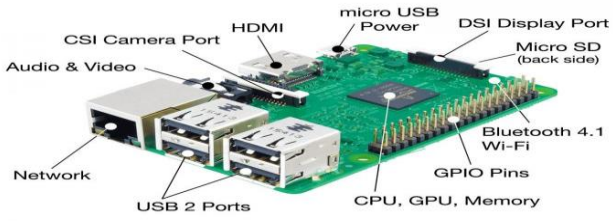

Fig. Raspberry pi 3 Model B

C. GSM(Global System for Mobile Communucation)

GSM resembles the mobile phones where few of the mobile features are not available for the GSM. Similar to mobile phones it can connect to network operator where we can communicate through the sms.The frequency band of the gsm generally varies over 900MHz or 1800MHz. It also has LEDs where it can glow upo giving the power supply of 12v to the gsm sensor.Blue light which indicates the network signal it glows for every 3 seconds .overall the sole purpose of gsm is for communication.

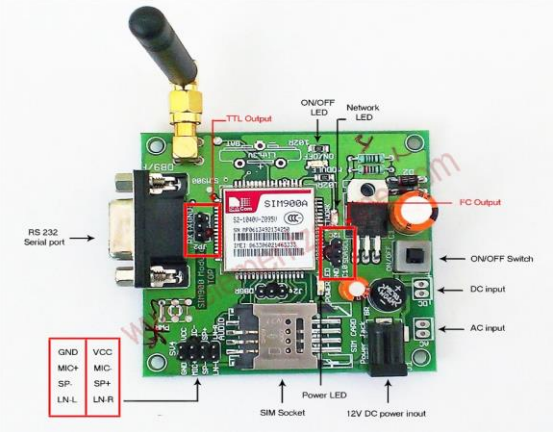

Fig. GSM Sensor

D. GPS(Global Positioning System):

GPS is navigation System which provides the location and timing services .Initially these were used for defense academy and later on came into usage for everyone. Main advantage of gps is to trace the situation of anything which has these gps device. It operates based on four or more satellites to get the location.In the project these are used for tracking the location of the vehicle.

Fig. GPS Sensor

E. Ultrasonic Sensor :

The transmitter emits a 8 bursts of an directional 40KHz ultrasonic wave when triggered and when timer get started. Ultrasonic pulses travel outward until they encounter an object, the thing causes the wave to be reflected back towards the unit. The ultrasonic receiver would detect the reflected wave and stop timer. And according to the timer, fuel level or pressure can be calibrated.

Fig. Ultrasonic sensors

F. Real time Monitoring

The data is gathered using the sensors integrated in the automobile and this data is sent to the Raspberry pi 3.A Wi-Fi dongle is used to provide internet service to the Raspberry pi 3 which acts as a gateway and this sensor data is uploaded to the cloud database or data visualization platform. This data is retrieved by the mobile application which provides the live feed.

Moreover the user can also set an alert system to indicate him/her whenever the driver exceeds a certain speed limit or the pressure in the car tyre is low or when the driver gets deviated from the actual route.

G. Emergency Alert System

Whenever an accident occurs the vibration and the impact is sensed. If the impact is greater than or equal to the average calculated impact (Threshold) that causes threat to the human life then an alert is sent to the required users stating the accident location and the status of the car during the accident. A smart algorithm based on threshold coordination is implemented.

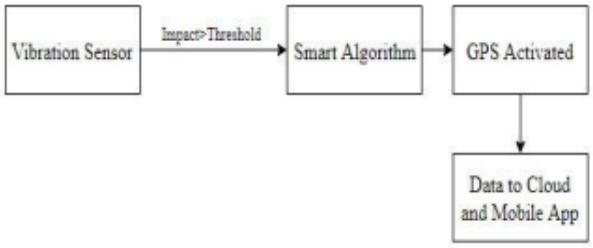

Fig. Emergency alert system

H. Mobile Application

The mobile application has a sophisticated user interface. The user uses this application to monitor their vehicle and various restrictions can be set such as the user can be alerted whenever the vehicle exceeds a certain speed limit (Based on country). This ensures the safety of the passengers as well as safety of vehicles. The main feature of this application is that it provides real time data about the vehicle and data visualization and comparison can be made. The Figure shows the sample application. The live health of the vehicle parameters can be monitored using this low cost efficient setup

Fig: Mobile application sample

IV. DATA COLLECTION AND PROPOSED ALGORITHM

Here the data is obtained from some inbuilt sensors present in the car.

ENGINE TEMPERATURE	Ranges between 150 and 270
TYRE PRESSURE	Ranges between 25 and 35
ENGINE OIL LEVEL	Ranges between 30 and 50

Table . Optimum data range

The above table represents the important data needed for the estimation of the safety of a vehicle. Here this data obtained from the vehicle is logged and used for analysis.

Number of data instances: 600

Number of Attributes: 4

ENGINE TEMPERATURE	HIGH[>220], NORMAL
TYRE PRESSURE	LOW[<30],NORMAL
OIL LEVEL	HIGH[>45], NORMAL
SAFETY[CLASS]	0[NO], 1[YES]

Table . Attribute values

Data analysis is carried out using KNN and Naive Bayes algorithm.

A. KNN Algorithm

K-nearest neighbor algorithm stores all available cases and classifies new cases supported similarity measures. Here binary classification can be applied to classify the data and predict whether the condition of the vehicle is safe or not. Here training data is taken and fed to the KNN model and this contains both safe and unsafe data where safe is considered as 1 and unsafe is considered as 0. Here Fig. represents the plot of engine temperature vs. tyre pressure. Here the data which represents temperature and pressure within the threshold is represented as '+' and rest as '-'.

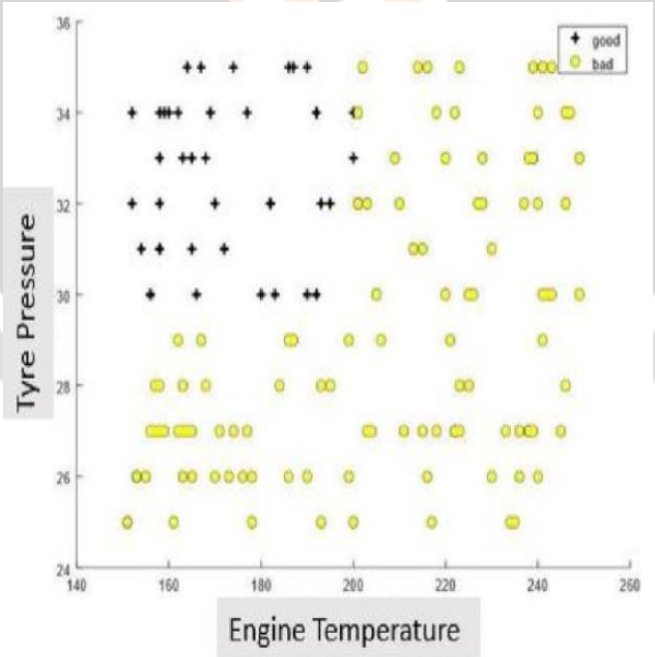

Fig. Plot of data

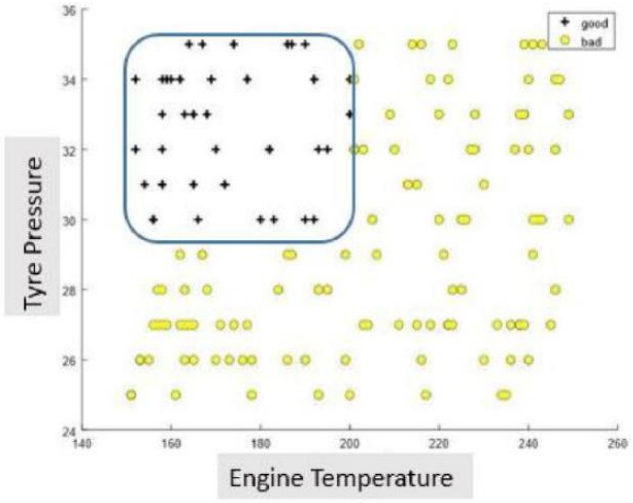

Fig. Decision boundary of model

Here Fig represents the plot after recognizing the decision boundary. Now for a new data it will be able to predict whether it belongs to the safe region or unsafe region and classify it accordingly.
By the majority of vote obtained from its neighbors a case is classified. This is done by calculating the minimum distance between them. The Euclidean distance can be calculated as:

D= ((x1-y1)2 - (x2- y2)2) ½

B. Naive Bayes

Bayesian classifiers are statistical classifiers and are used to predict the class membership probabilities such that it can estimate whether a given tuple belongs to a certain class. Bayesian classifier is based on the Bayes theorem. Here X is considered as "evidence" and H be some hypothesis such that the data tuple X belongs to a specified class C.
Here we use Bayesian classification to predict the class label of a tuple. The training data contains the engine temperature, oil level, tyre pressure. The class label attribute, safety, has two distinct values namely yes, no(0,1).Let Ci correspond to two classes 1 and 2 where C1 corresponds to class safe and C2 corresponds to class unsafe .The tuple we wish to classify is

X = (engine temperature=normal, tyre pressure = normal, oil level=normal)

We need to maximize
P=(X/Ci) P(Ci) , For i=1,2 (2)
P (Ci) is the prior probability for each class.
P (Safety=yes) = 136/600=0.226
P (Safety=no) = 464/600=0.77 The following conditional probabilities is then estimated:
P (engine temp=normal/safety=yes)
P (engine temp=normal/safety=no)
P (tyre pressure=normal/safety=yes)
P (tyre pressure=normal/safety=no)
P (oil level=normal/safety=yes)
P (oil level=normal/safety=no)

Using these probabilities, we can obtain

P(X/safety=yes)=P (engine temp=normal/safety=yes)*P (tyrepressure=normal/safety=yes)*P(oil level=normal/safety=yes)

Similarly, P(X/safety=no) can be calculated.
To find the class Ci, that maximizes P(X/Ci) P(Ci),we calculate

P(X/Safety=yes)* P (Safety=yes) = 0.226
P(X/Safety=no)* P (Safety=no) =0.090 As,

P(X/Safety=yes)*P(Safety=yes)> P(X/Safety=no)*P(Safety=no)

Therefore the naive Bayesian classifier predicts Safety=Yes for tuple X.

V. DESIGN

We proposed a monitoring and secure vehicle system based on GPS as one of IoT applications for tracking,monitoing and security systems. The proposed system ensures an efficient energy for real time
Trackingand monitoring . This system consists of three main parts the tracking and monitoring unit, Cloud/Database and android application . The tracking and monitoring unit resides inside the vehicle and sends the required information to the cloud/Database like the temperature , location,speed and fuel level of the vehicle by identifying latitude and longitude of the vehicle then the location is visualize on the map to provide a real time tracking.

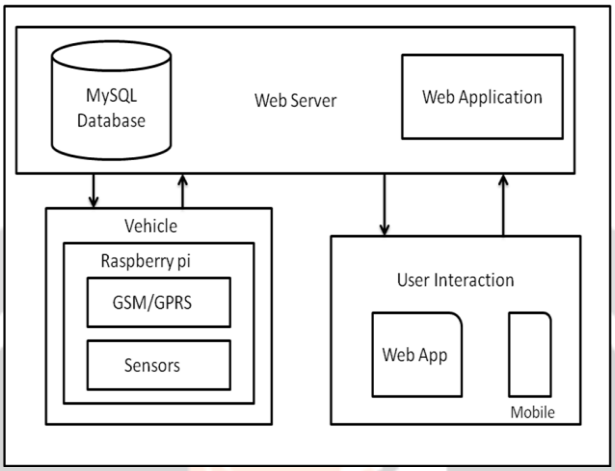

Fig. Block Diagram

Using the reading from this application, the scenario for the movement will decided. Once the scenario is decided, a notification will be sent to the mobile device(s) which will already be linked to the system application. Along with the notification, the owner are going to be ready to track the vehicle movement real time using the G.P.S. and the Maps application which are the foremost widely used technologies for vehicle tracking also as capturing current position of the vehicle and therefore the refore the maps allowing owner to alert the authorities in time with substantial information about location in hand in case of theft. There are various application development software programs available today that allow us to make an android/iOS based “app” (application) to realize the specified functionality. One such software is the “Android Studio”. We have various classes and interfaces readily available to make the specified system application.

VI. RESULT AND DISCUSSION

As the data can be obtained in real time this system can be implemented in order to monitor the automobile and ensure the safety of the people. The data collected from the vehicle can be used to evaluate the condition of the vehicle using machine learning algorithms such as KNN algorithm and Naive Bayes algorithm and alerts can be sent in case a particular threshold limit is exceeded. The rental taxis and cars can be monitored by the company using the mobile application and the driver behavior can also be determined as the data regarding the vehicle speed, location can be viewed using the mobile application in real time and in case of any doubtful events the owner can be immediately alerted. Emission rate of the cars can be monitored as various sensors monitoring the emission rate can be integrated with the raspberry pi thereby saving the environment from CO2 emission and eventually global warming. Alerting people in times of emergency or accidents in a real time environment where pushed notifications can be received on an unlikely incident such as accident. This data obtained from the vehicle can also be used for various other analysis and for further improvement of the vehicle. The following results are obtained from data analysis:

KNN	ACCURACY=93%
	Can be used to predict the class of tuple For X= [engine temp=normal, tyre pressure=normal, oil

NAIVE BAYES	level=normal] we estimate P(X/Ci) P(Ci) for safety=yes as 0.226 and for safety=no as 0.090 and therefore the classifier predicts safety=yes.

Table. Result sample

VII. LIMITATIONS OF THE SYSTEM AND THEIR POSSIBLE SOLUTIONS

1. Device safety/Removal of the monitoring device:
The smart device will be fit in such a way that some intermediate level of expertise and sophisticated tools will be required to physically remove it. For instance, near or inside the vehicle engine.

2. Device battery life:
The inbuilt battery of the device may have lesser life within the proposed system as G.P.S. and internet connectivity consume tons of battery and can be required continuously. Hence we will remove the inbuilt battery and therefore the device will run on the vehicle battery itself. Voltage can be regulated using plug pins.

3. Network connectivity issue:
There could also be a case where the device loses the network connectivity. In such a case the user will have the last known position of the vehicle. Furthermore, if the device recaptures the network, the system can start working again by picking up the current location.

4. The Ultimate failure: Device hardware failure
This is the "worst case" scenario from which the recovery are going to be next to impossible. The best solution for this is often to stop this scenario by regularly doing the upkeep of the device.

VIII. SOME OF THE DRAWBACKS OF THE SYSTEM

1. App crashes:
Sometimes the system application may crash and therefore the system then can not be in use.

2. System installment in two-wheeler:
As bike engine is outside the device are going to be viewable or easily visible so we'd like to seek out an ideal place to put in the system.

3. Portable mobile Jammer:
If the thief uses a transportable jammer which will lock the service provider connectivity. In this scenario the system will no longer be functioning. This is a one of the biggest drawbacks of the system.

IX. FUTURE ENHANCEMENTS

The current proposed system may contribute in "theft detection", but we will enhance the system by upgrading it in such how that just in case of the theft, the vehicle engine are going to be locked by a sign sent by the smart device to the microcontroller within the system.

X. CONCLUSIONS

Vehicles are one of the most valuable assets of a person, hence their security becomes one of the top priorities.
Using the proposed system, we'll be ready to monitor the suspicious movement of vehicles which can end in the detection of the vehicle theft. We will also be able to know if the vehicle has been towed and where to go to pick it up in case it has been towed. The system is probably going to falter just in case of the app crash, hardware failure or network connectivity issue etc. Majority of these can be avoided by regularly maintaining the device.

XI. ACKNOWLEDGMENT

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