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IoT based Speed Monitoring System based on Location of the Vehicle

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Abstract*: Nowadays there is an increasing amount of road accidents happening around the world. The amount of road accidents is especially high in metropolitan cities. The main reason for road accidents is almost always due to the negligence on part of the driver. Maximum number of Road Accidents occur due to over-speeding and drunk driving. This system helps detect over-speeding vehicles by directly implementing the particular hardware inside the vehicle itself and depending on the GPS position of the car and regional speed limits alert the authorities based on the violation. This technique helps us to reduce costs which need to be incurred to install speed cameras at roads at regular intervals. The system will detect the speed of the car, and in case of a violation the license plate number along with the registration details and the photo of the driver will be directly sent to the concerned authorities. This system aims to decrease the amount of accidents that happen across the globe and help conserve human lives. Road accident still remain one of the highest contributors to the loss of human life. For experimental results, we used raspberry pi and the GPS antenna for detection of over speed and alert the authorities on violation.

***Keywords*: GPS, GSM, Haversine, IOT.**

I. INTRODUCTION

Recent Survey and Statistics show that more than 1.35 million people die every year due to road accidents and crashes. The Agenda for Sustainable development for 2030 has set the goal of reducing the number of deaths by a factor of 2 cause by road accidents by 2020.Road Crashes apart from taking a huge number of human lives also are a huge impact on a countries development and economy. Crashes amount to a loss of approximately 3% of a countries GDP.

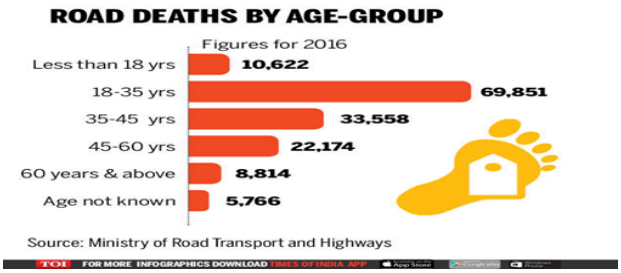

Fig 1. Road deaths by Age group.

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More than half of the accidents that take place nowadays include pedestrians and motorcyclists. 93% of the accidents in the world are occurring in developing countries although these countries only amount to 60% of total vehicle population in the world. Here, the fig given below show the reasons of accident which killed the people in an accident.

Most road traffic accidents include people in the age group of 5 to 29 years.This is mostly due to the less developed traffic control systems and laws that are existing in countries today.

Fig 2 Reasons of death in accident.

II. LITERATURE REVIEW

The current system that is in place main makes use of speed guns which are held by traffic police officers to monitor over speeding vehicles. But this system is inefficient in a lot of ways. Firstly it is very difficult and time consuming to detect each and every vehicle that's violating the traffic rules , especially in a country like India which has a very high population and on top of that it requires a lot of manpower to just make use of the system.

Secondly even after detecting a traffic violation traffic police needs to chase after the driver and book them a challan. This becomes extremely difficult during night times and poor weather conditions.

There are so many techniques used for detecting and measuring the speed of the vehicle. The use of Ultrasound sensors, RFID technology are one of the techniques which are used by many countries to find the overspeeding of the vehicle. Some of the techniques which are used or currenty in use are given below:

[1] In the Novel Technique to Detect Over speeding Vehicles RFID technology was used which included the use of RFID tags installed on each vehicle which would help identify the details regarding the vehicle. Then RF detectors need to be placed at the roads where traffic needs to be monitored. The drawback to this system is that it can only work in locations where the appropriate hardware is available.

[2] The use of Ultra sound sensors can also be utilized to detect speed of the vehicle by automatically detecting the vehicles in range and making use of the time it takes for the waves to hit the vehicle and the time that it takes for the waves to return back to the sensor using the Doppler Effect phenomenon to calculate the speed of the vehicle. The drawback is the necessity of the presence of ultrasonic sensors at regular intervals of space and the range of detection of this technology.

[3] Image detection techniques used to detect the speed of the vehicles also exist. The system first detects the vehicles that come into its field of view and capture its images then noise reduction techniques are applied to increase the clarity of the image. Then the speed of the vehicle is calculated. The problems with such system is the highly complex algorithms that need to be applied and the processing power that comes with it. It is also very difficult to tell apart moving objects with respect to still objects just by making use of an image.

[4] This system make use of a video clip to calculate the speed of the vehicle which first uses denoising algorithms to detect the vehicles and calculate the speed and the drawback is the still more processing power that is required to run those algorithms on a constant influx of video data.

III. PROPOSED METHODOLOGY

The architecture block diagram of the model is shown below in fig3. It makes use of an Rasberry pi 3 which is a very cheap computer that runs Linux operating system.

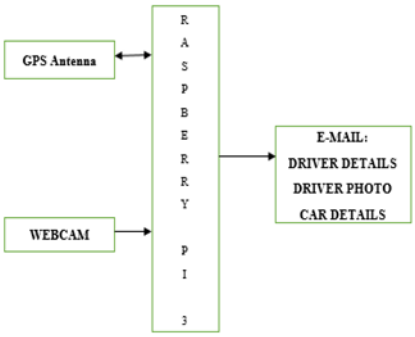

Fig 3. Architecture block diagram.

It is connected to two main sensors the GPS and the GSM sensor. They are also attached with respective GSM and GPS antennae which are used to detect the current position of the vehicles. If the vehicle is found to be present in any of the defined regions then the speed of the vehicle is compared to the speed which is defined for that particular area and then the driver is prompted of his violation and is communicated to using the GSM which contains a SIM to receive SMS messages.

Fig 4. Raspberry pi 3used in the model.

IV. IMPLEMENTATION

The First we need to configure the GPS functionality of the module which allows us to get the GPS coordinates of the vehicle. After Configuring and properly getting the location for the vehicle we go for implementing the Geo-Fencing.

GPS module sends the data related to tracking position in real time, and it sends so many data in NMEA format. The given below fig 6 show the NMEA format. The latitude and the longitude part we goona extract from the NMEA format as this is what we all need to find the speed.

Fig 5. Region defined.

The software module will implement a function to convert latitude and longitude supplied by the antennae into distance in terms of kilo meters(km) or meters(m).

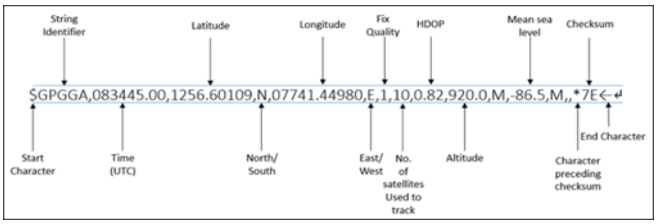

Fig 6. NMEA format.

The function used here is Havershine formula.

$$haversine(\theta) = sin^2\left(\frac{\theta}{2}\right)$$

$$\left(\frac{d}{r}\right) = haversine(\Phi_2 - \Phi_1) + cos(\Phi_1)cos(\Phi_2)haversine(\lambda_2 - \lambda_1)$$

$$d = 2rsin^{-1}\left(\sqrt{sin^2\left(\frac{\Phi_2-\Phi_1}{2}\right) + cos(\Phi_1)cos(\Phi_2)sin^2\left(\frac{\lambda_2-\lambda_1}{2}\right)}\right)$$

The speed of the vehicle is calculated by using the distance formula that is,

Speed= distance/time

Here, the time is the fixed. We taking the time fixed which periodically at a fixed interval of time will calculates the speed.

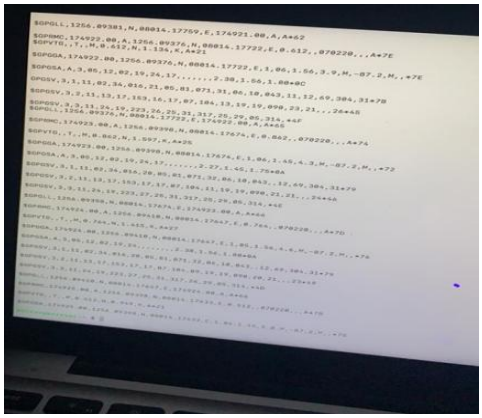

Fig 7. The NMEA format output received from GPS module.

Initially, we divide geographical areas into polygonal shapes which helps us to specify the speed limit of the vehicle that needs to be followed for that particular area. The GPS coordinates for that particular polygonal area is preloaded and the speed constraints are also specified. Using the GPS coordinates for the area and the vehicle we can use Point in Polygon algorithm to check if the vehicle exists in any of the predefined areas and in case of a speed violation we can alert the authorities using SMS or any other alternative communication method. In case of speed violation, license plate number along with the registration details and the photo of the driver will be directly sent to the concerned authorities.

Table 1. Symbols with meaning

Symbol	-	Meaning
Φ1	-	Latitude 1
Φ2	-	Latitude 2
λ1	-	Longitude 1
Λ2	-	Longitude 2
Θ	-	Havershine
R	-	the radius of Earth(6371 Km)
D	-	The distance between two points

Fig 8. Image of the model.

V. RESULTS

This model is designed to solve the problem which was faced in old techniques. GPS module sends the data related to tracking position in real time, and it sends so many data in NMEA format. The fig 7 is the received NMEA format output received from GPS module. Than through the extracted Latitude and Longitude, the speed we got will be compare to the region defined speed and according to its conditions it will notify the traffic police authority. The fig 9 is the example of the email received by the traffic police authority.

VI. CONCLUSION

This system will deter drivers from crossing the speed limit even on highways. If the speed limit is crossed than the authorities can be instantly informed. The advantage of this system is round the clock monitoring and wide range, very reliable and relatively inexpensive. The drawback is that this system needs good signal quality and it is sometimes an issue in case of rural areas.

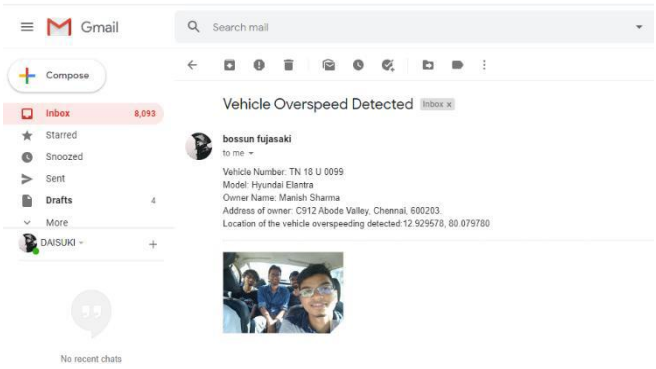

Fig 9. Email Received by traffic police authority.

A useful modification of this system would be the use of cloud storage to detect and store GPS co-ordinates would be very useful for industries such as courier delivery vehicles or vehicles that transport expensive and highly sensitive material.

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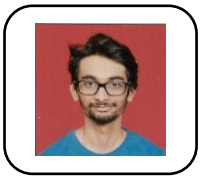
Vikas Yadav is currently pursuing his Bachelor's degree in Computer Science and Engineering from SRM IST. His interests include Machine Learning, Data Science and Artificial Intelligence. He is dedicated to research further into the field of analytics, while simultaneously honing his technical and mathematical skillset.



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