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Design and Implementation of Intelligent Speed Breaker System for Vehicles using IOT

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***Abstract*—Bad visibility conditions which occur due to fog in winters or night time driving are the major causes of road accidents in India. The main reason for such accidents is the unintentional ignorance of speed breakers which may be due to the driver not being able to detect them or may be due to over speeding of vehicles. This paper brings an idea of an intelligent speed breaker system that helps in detecting speed breakers well in time so that such accidents can be avoided. This system makes use of a RF module that warns the person who is driving about the existence of a speed breaker in proximity, with this it also helps in automatically reducing the vehicle's speed if no action is taken by the driver in time. With the help of Internet of Things (IoT), GPS Location (latitude & longitude) of speed breaker can be sent to cloud using GPS and stored on cloud to use it for future to avoid mishaps.**

***Index Terms*— RF module, GPS, Proximity, IoT, latitude, longitude.**

I. INTRODUCTION

Due to poor visibility conditions during winters and during night time, it becomes strenuous for a driver to notice speed breakers. This increases the chances of accidents which may cause serious injuries to the driver as well as the passengers and will also cause destruction to the vehicle. Thus, we develop a system which will assist the driver to become conscious of the existence of a speed-breaker in proximity and alter or change the speed of the vehicle in order to avoid the occurrence of an accident [3].
This prototype can be derived by using a RF module that consists of a Transmitter and a Receiver. The RF Transmitter which transmits RF signals is fixed to the speed breaker and which is received by the RF Receiver which is connected to the vehicle [4]. The RF Receiver receives signals from RF Transmitter and alerts the driver about the existence of a speed breaker in proximity through audio and text messages. The RF Receiver sends signal to the motor through Arduino IDE to automatically decrease the vehicle's speed. Using Internet of Things, the location details (latitude & longitude) of the speed breaker is stored on the cloud with the use of GPS module that can be used in future to prevent mishaps.

II. LITERATURE REVIEW

- Over speeding and improper visibility conditions have made people lose not only their life but also the other people on the roads. According to a survey done by The Times of India, speed breakers account for around 30 crashes and 9 deaths every day [8], [10].
- As per the analysis done by the Road Transport & Highways Ministry in 2018, approximately 7672 deaths occurred as a result of accidents caused due to unawareness of speed breakers. This figure is not less and it is increasing every year [7].

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- According to a survey conducted recently, it has been noticed that the main cause of accidents is that the vehicles are thrown off balance, especially while travelling on new route and in night. Also, though the Google maps provide data about ongoing repairs on a road but there does not exist any concept of providing any data about the location of speed breakers [9]-[10].
- Thus this provides us an opportunity to develop a system that may alert the driver about the existence of speed breakers in proximity and automatically slow down the vehicle speed.

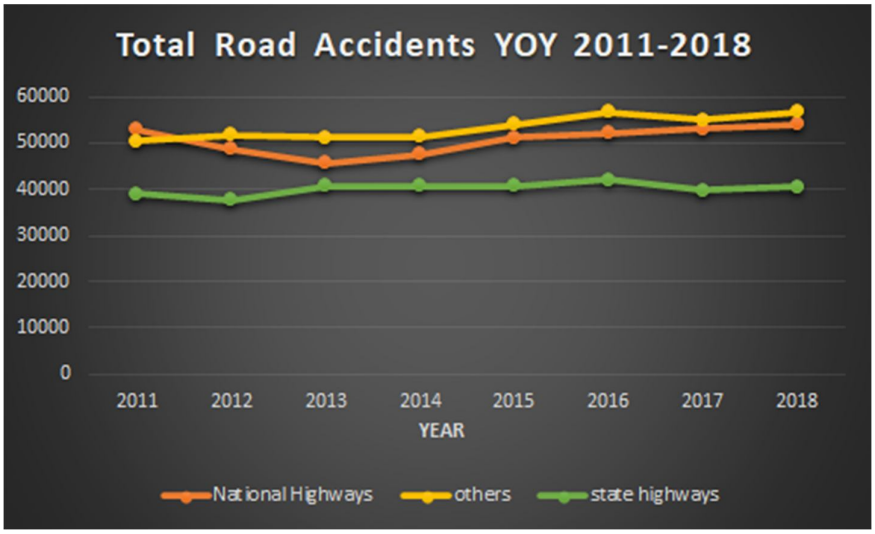

Fig. 1.Road Accidents per lakh population of India

Figure 1 shows the statistics of road accidents that happened over last year (2011-2018) in India, it has clearly been shown that accidents in cities or in the states are more than national highways and state highways. One possible reason could be no proper planning of road network in the city and over speeding of vehicles, and when there is a speed breaker ahead of them they are not able to reduce the speed in time and that causes mishaps.
The current model on speed breaker detection makes use of a mobile based application to give an alert to the driver about the existence of a speed breaker in the proximity. The SWAS (Speed breaker early Warning system) is a current model on smart speed breaker alert system that gives an alert to the driver about the existence of a speed-breaker ahead with the exact location of it and is sent to the cloud platform in order to avoid accidents in future.[13]
Another model of speed breaker detection system that sends an alert to the person who is driving the vehicle, by using light or sound signals i.e. using sirens or LED lights. The major disadvantage of these systems is the functionality, it is observed that while driving, most drivers do not check their smartphones which is also advised not to use phones while driving.The duration of operation of the battery of a smartphone is less [4]. In the case of battery discharge, the smart phone may switch off putting the driver at the risk of having an accident in poor visibility conditions. Another limitation is the readiness and affordability of smartphones to everyone. Next, the sirens add to the existing noise pollution. In case of hearing impaired individuals driving the vehicle, there would be no use of a siren.

III. METHODOLOGY

The basic idea of the project represents a speeding vehicle approaching a speed breaker in proximity. The RF Transmitter which is connected to the speed breaker, transmits RF signals within a specified radius and the RF Receiver is connected to the vehicle. On entering inside the given radius of signal transmission of RF Transmitter, a wireless communication occurs between the transmitter and receiver and the driver receives an alert about the existence of a speed breaker in proximity through audio and text messages and the vehicle slows down either by the action of the driver or through Arduino IDE that sends signal to the motor to automatically reduce the vehicle's speed. Using Internet of Things, the location details (latitude & longitude) of the speed breaker is sent to cloud with the help of GPS module and stored in order to use it in future to prevent accidents.

A. Detection of the Speed Breaker

The first step is the detection of any nearby speed breaker. This is achieved with the help of RF module. The different types of RF modules are: [1]

1. Transmitter : The transmitter emits radio frequency signals that are propagated by modulated waves.
2. Receiver : The receiver detects processes the signals emitted by the transmitter by demodulating the radio frequency wave.
3. Transceiver : A transceiver consists of both a transmitter as well as a receiver. It is a more expensive and complex system and operates on half duplex cycles.
4. System on a Chip(SoC) module : Though similar to the transceiver, the SoC module is used for packetizing the signals sent/received.

A RF module consists of a transmitter-receiver pair, a circuit board, an antenna and a serial interface for communication. The data to be sent is in the form of a radio wave which is modulated to carry the information. The receiver demodulates the wave and operates on the data received.

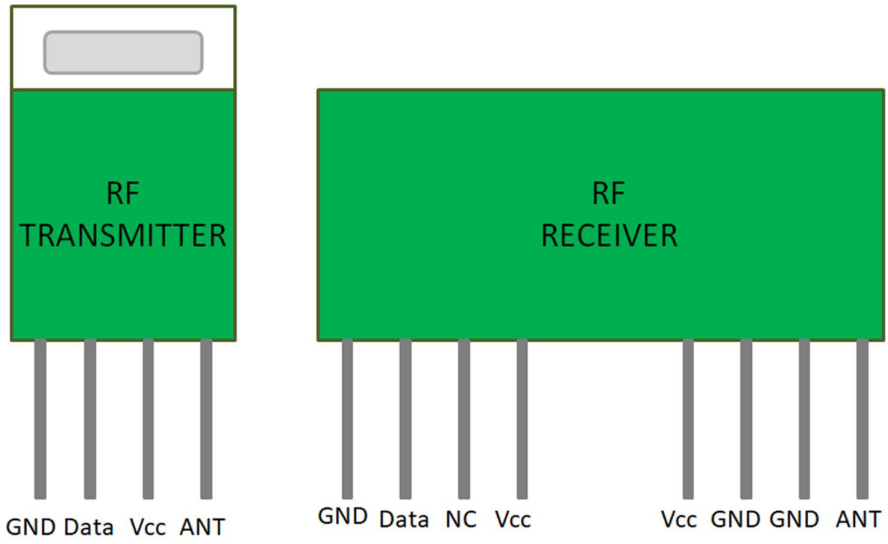

Fig. 2 Pin diagram of RF Module [1]

This system consists of a RF Transmitter connected to the speed breaker which continuously transmits signal within a particular radius and a RF "Receive attached to the vehicle." Whenever a vehicle enters into the given radius of signal strength, the RF receiver connected "to the vehicle will detect signals from the RF transmitter" and the driver will get an alert regarding the existence of a speed breaker in proximity. Arduino IDE is employed for having wireless communication between the RF transmitter and the RF receiver. For programming the detection of speed breaker, decreasing the vehicle's speed automatically and saving the speed breaker's location to cloud for future reference, embedded C is used [5].

B. Reducing the vehicle's speed

After detecting the speed breaker, the next step is to reduce the speed of the vehicle to ensure that if in case the driver does not notice the alert of presence of speed breaker, there is no collision of the vehicle with the speed breaker. This achieved through Arduino.

Arduino is programmed in Arduino IDE. Arduino is an open source platform based on easy-to-use hardware and software (Arduino IDE) .The Arduino IDE is used to type and execute the code on the hardware of the machine. It is basically used to read analog or digital input signals from different sensors and turn it into an output. The output can be turning on/off the LEDs, ringing a siren, activating the motor etc. With the help of a USB cable, the code is loaded onto the board [5].

When the RF receiver will receive a signal from the RF transmitter, a signal will be sent to the motor through Arduino that will instruct the motor to reduce the vehicle's speed. The program being run on the Arduino IDE will signal the motor to reduce the vehicle's speed unless the RF receiver stops receiving signals from the RF

transmitter. Thus, even if the driver does not notice the presence of a speed breaker, there will be no collision as the vehicle will be moving at a lower speed in the proximity of a speedbreaker.

C. Storing data to cloud using IOT

After detecting the speed breaker and automatically reducing the speed of the vehicle , the next step is to is send the exact location of the speed breaker via internet and storing it on cloud storage. There are many cloud service providers that offer free services upto a certain data limit. Some of them are Google Cloud Platform, Amazon Web Services, Microsoft Azure, IBM Cloud etc. Cloud Service Providers or CSPs allow people to store data either for free (upto a certain data limit) or with a small user fee. People can access network services. They need not worry about the storage infrastructure. They can also access their data from any system and from any geographical location. Thus cloud storage is an efficient, cheap and easy to use facility. This idea can be implemented by using the concept of Internet of Things (IOT) . IOT allows the user to connect various devices over the internet to communicate with each other. The storage of data can enable us to analyse and identify the accident prone areas. The data can be stored in cloud with the help of GPS. Thus, the storage of data in the cloud will prevent any such accidents in future and probably help to solve the issues faced by automobile drivers.

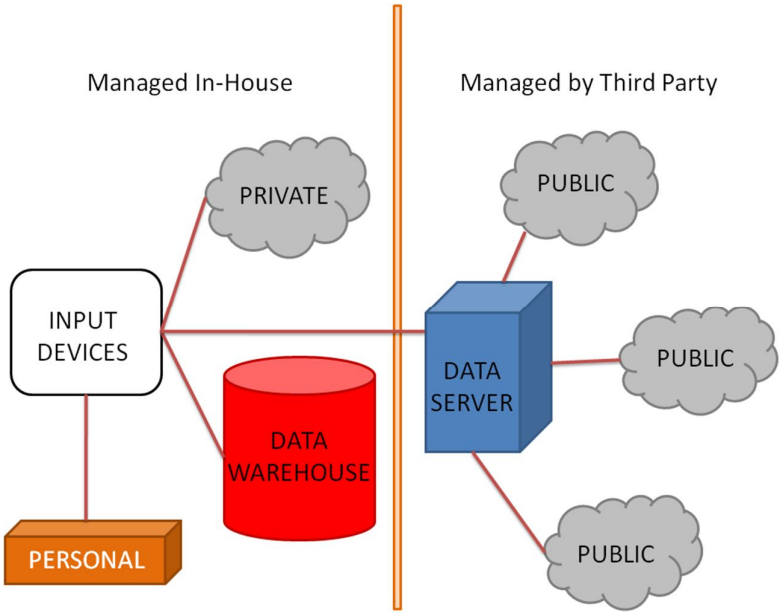

Fig. 3. Data Storage on cloud

One such tool which used in this model is ThingSpeak - an open Internet of Things platform which allows users to send data and store it to the cloud. It can be used across various platforms without any hardware or software issues. It is mainly used by small organizations and self-employed people to store and retrieve data from the cloud using the http protocol. It also offers location tracking applications. The basic planning model we have proposed will have a GPS module which will record the exact location of the speed breaker by recording the latitude and longitude of the location. This information is then sent to the cloud storage via ThingSpeak. This also allows the user to analyse data using MATLAB. Thus, the data collected from the speed breakers can, in future, be used for prevention of accidents.

IV. Results and Discussions

The system was made to undergo certain tests and tasks to check whether the prototype works with out any errors and faults, and then final system test to rectify the errors if any. Conducting tests at the end of the project completion is important, to confirm whether the prototype is working fine and smoothly as planned. The sooner an issue is isolated, the sooner it can be fixed.

To begin with testing, we started with Interfacing of hardware module with Arduino, for better understanding and knowing its operations before we compile it as an entire hardware setup.

After we did the interfacing of every module, we begin with the entire hardware setup consisting of Arduino, RF module, Motor Driver, GSM and GPS module connected to a 5A power supply and linked to the same Wi-fi network. After we did the hardware setup, the RF transmitter on the speed breaker will transmit the signal upto a certain range, when a vehicle enters in that range the RF receiver on the vehicle will catch that signal and an alert will be sent to the drivers phone, in case the driver doesn't lowers the speed or misses the alert, an alert will sent to the Arduino for speed reduction of vehicle, the motor driver will reduce the vehicle speed in that case.
Once the speed beaker is detected the location will be stored on the cloud (ThingSpeak) [11].

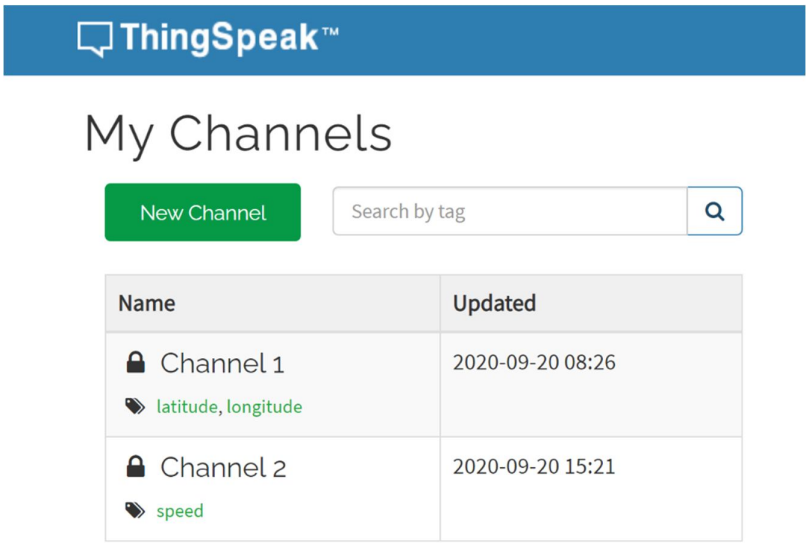

Fig. 4.ThingSpeak Cloud platform [2]

Fig 4 shows the ThingSpeak [2] cloud platform, where we created channel 1 and channel 2, in order to visualize the data that will be uploaded here either in the form of a csv file for multiple locations or we can import single data in the channel, the data will be stored on this cloud service. The data stored will be used for future reference and will help other drivers/ people to get access to this so that they'll know about the speed breakers in their locality.
The purpose of this cloud service is to avoid the usage of RF transmitter/receiver frequently on a particular location or on speed breakers. Once the speed breaker of a particular location is detected the data will be imported to the ThingSpeak cloud using GPS module that is connected to the Arduino.

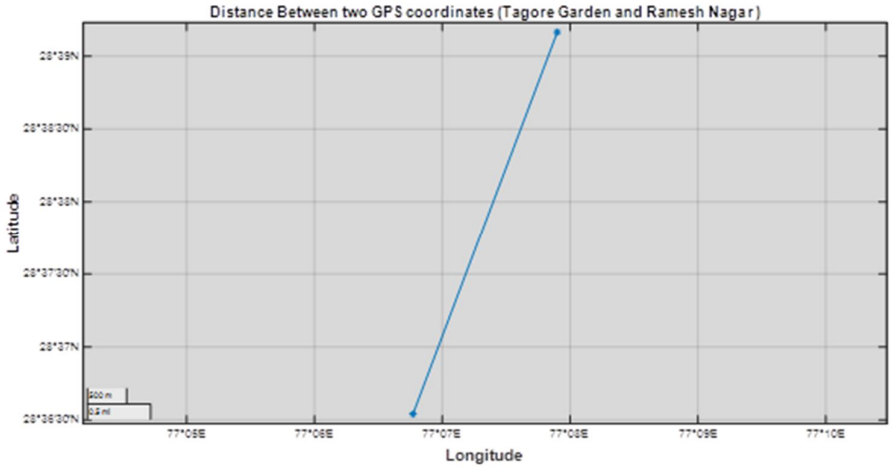

Fig. 5. MATLAB Visualization

Fig 5 shows distance between the two coordinates which we uploaded on ThingSpeak platform and analyzed the data with the use MATLAB visualisation, two coordinates show the location of speed breakers in the city. The above figure is a plot for a particular area, we can similarly plot and analyse the data of various locations using a .csv file. The csv file will be uploaded on ThingSpeak and we can visualize the data using MATLAB for multiple locations.

V. CONCLUSION

Studies say that the Indian road network, spanning over 5 million kilometers, carried almost 90 percent of the country's passenger traffic. With the rapid increase in no. of cars and over-crowded Indian roads, road safety is a major concern for the country's citizens. The main reason for road accidents is badly designed speed breakers, drowsiness, over speeding, foggy weather etc. Our proposed system provides the efficient way to deal with this problem with promptness and minimizing the increase no. of road accidents in the country.

The system is designed in such a manner that an alert will be sent to the drivers in advance when their vehicle is approaching a speed breaker. This has two types of alert system one which is given on the connected phone no. of the driver and other alert is reducing the speed of vehicle after crossing a certain range of the RF module [12]. The speed reduction of the vehicle takes place when the driver misses the first alert i.e. text or audio warning message. It was shown that after detecting the speed breaker in the city, the data was imported on ThingSpeak using a GPS module used for future reference and other drivers who can access this.

FUTURE SCOPE

As discussed in this paper about road networks in India, road accidents are increasing year by year due improper planning and execution and most importantly carelessness of vehicle drivers. With the evolution of smart city projects in India launched in 2015 ideally aim at developing the entire urban eco-system. Our proposed prototype is a part of this project that can be beneficial for future use. Smart city basically integrates information and communication technology, and communicating with other devices over the internet which makes use of Internet of Things (IoT).

The scope of this technology is very bright and is a life-saving tool. In future, every vehicle and speed breaker will have such a type of system that will decrease the number of road accidents. Many technologies are being worked on to provide a better facility for speed breaker detection to avoid accident rates due to ignorance of speed breakers. Development is being made on different types of speed breaker detection systems involving different data acquisition techniques like 3D reconstruction-based detection, vibration-based detection and computer vision-based detection.

Moreover, sensors based on ultrasonic technique are also being worked on that will be very effective while driving in hilly areas especially at night. In future we can make use of machine learning and artificial intelligence for detection of speed breakers instead of using RF module which increases the overall cost of this project, making use of machine learning algorithms we'll train our model to recognize certain patterns of speed breakers in the city which will make our prototype more efficient and smarter to use [13].

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