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Preventing Road Accidents using IoT

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Abstract— Road accidents are one of the biggest concerns leading to loss of life. Road accident injuries are predictable and preventable, but it is important to understand the ways in which road safety interventions and technology can be used to prevent or may be completely wash out this curse. One of the major factors for this is over speeding. This paper talks about how introducing IoT devices in automobiles and accident prone areas helps reduce the risk of accidents. Our proposal works by sensing the automobiles in accident prone areas based on its current location, checking for its speed and notifying the driver about what needs to be done. In cases of accidents, notifications are sent to the automobiles nearby informing them about it, while distress signals are sent to the nearest police station and hospital for immediate help. The idea would also be useful in many other applications such as alerting the concerned in the event of an accident, thus helping in immediate response from emergency services.

Keywords— Safety, Accident, IoT, Cloud, Location, Speed

I. INTRODUCTION

Internet of Things represents a general concept for the ability of network devices to sense and collect data from the world around us, and then share that data across the Internet where it can be processed and utilized for various purposes. IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications. The interconnection of these embedded devices (including smart objects), is expected to provide in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to areas such as smart cities.

Devices collect useful data with the help of various existing technologies and then support the flow of data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens, or refrigerators/freezers that use Wi-Fi for remote monitoring.

The expansion of Internet-connected automation into a plethora of new application areas, IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems.

This Paper presents how to prevent accidents using IoT devices. This is achieved by using IoT sensors in accident prone areas that sense and collect information from the surroundings, uploads it to the cloud and data is processed later. The sensor placed on the road identifies a car that is over speeding, identifies the location of the car and communicates to the IoT device of that car, thus warning the driver. In case of an accident, the device notifies the concerned authorities for immediate help.

This paper is organized as follows, Section I contains the introduction of our proposed model, Section II contains the previous related works in the field, Section III contains the description of the various devices used in building our proposed model, Section IV contains the methodology and working of our model, Section V discusses the various factors leading to rise in accidents and numbers related to them, Finally, Section VI is the Conclusion and points on Future Scope of our model.

II. RELATED WORK

Our work is related to prior work in detection of over speeding and consequent alerts to the driver.

- **Utilizing the Emergence of Android Smartphones for Public Welfare**: The author has developed an application that senses the accident using the accelerometer sensors in the Smartphone. Once the accident is sensed, the application automatically generates the geographical information by GPS and sends location information using a voice message which

was recorded earlier to 108 ambulance emergency response service which runs in India. The most important requirement of this application is that the smartphone should not be kept near the person who is driving the vehicle; it must be kept inside the vehicle and the testing of the accelerometer is performed by moving the mobile left or right or free fall motion. The major issue with system is the smartphone inside the vehicle can fall accidently with a real accident and thus, the chances of false positive will be increased [2].

- **Intelligent obstacle and over speeding sensor**: This paper deals with an intelligent approach to the obstacle detection in motor cycles using ultrasonic sensors to avoid dashing. While driving the motorcycle, the speedometer starts to deflect and the information is given to comparator which checks for speed range. On reaching 65kmph, the over speeding sensor is activated. The driver is alerted by the above sensors to avoid dashing with nearby obstacles and once the speed is reduced to 25kmph, these sensors get deactivated. The sensor detects the obstacles in all the directions and gives warning to the driver through a colour change and audio alarm. By using Ultrasonic Sensor the problem of overlapped beam pattern is overcome which is the major problem with other sensors [6].
- **WreckWatch**: This paper consists of a developed smartphone based accident detection and notification system. In this system, a prototype smartphone based client/server application was developed and called WreckWatch that implements a mechanism to provide accident detection and notification by using the embedded smartphone sensors and communication interfaces. The main issue related with WreckWatch system is the deactivation of the system when the speed is below speed threshold since the detection process of WreckWatch begins to recording the accelerometer information and looking for potential accidents only if the speed of the vehicle (as well as the smartphone) is greater than speed threshold and thus, this filtering will shut off the detection process in case of low speed condition and cannot detect the accident in low speed [8].

III. LITERATURE SURVEY

A number of approaches to provide security and safety through monitoring the vehicle's real time precise positioning and information using different technologies have been proposed.

IoT sensor (accelerometer): An accelerometer is a device that measures acceleration, i.e. rate of change of velocity of a body in its own instantaneous rest frame. Accelerometers have found multiple applications in fields such as automobile, fitness, science, etc. The main application of an accelerometer is instantaneous speed detection of that vehicle. This speed is displayed either by an analog or a digital meter. They are used to detect and monitor vibration in rotating machinery. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. They are used in drones for flight stabilization. These sensors form an integral part even in spacecrafts monitoring while on a space expedition.

GSM Module: A Global System for Mobile communications (GSM) module is a specialized type of module which accepts a SIM card and operates over a subscription to a mobile operator. It is the most popular wireless standard for mobile phones in the world. The main application of this GSM module is to allow transmission of Short Message Service (SMS) in text mode and PDU mode. The GSM module has various fields of applications such as wireless distance communication, etc. Also, GSM helps in tracing the whereabouts of miscreants and thereby helps in preventing unwanted and malicious activities.

GPS Module: Exact location on the Earth can be identified by the position of the location on a particular latitude and longitude. These imaginary lines are mapped and a constellation of satellites around the orbit of the Earth transmit the position accordingly. The Global Positioning System (GPS) is a space-based radio navigation system that provides reliable positioning, navigation, and timing services to users on a continuous worldwide basis and is freely available to all. The GPS receiver receives the signal containing the precise location information of the object at that time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world. GPS has proved to be big boon for most of the industries and even individuals, especially to the transport industry.

Crash Sensors: Crash sensors are triggered in the event of a crash. Depending on your car's make and model, it generally has from one to three crash sensors, which are usually in the very front of the car in the area people often call the "crush zone." In case of a crash, the car suddenly decelerates due to an impact; this zone registers the action first. These sensors then deploy the airbags as quickly as possible. Crash sensors measure variables such as wheel speed, brake pressure, occupant condition, and increase in pressure to determine if the car is indeed experiencing a crash. Some vehicles may have additional crash sensors near the doors that activate side-curtain airbags in case of a side collision.

IV. METHODOLOGY AND WORKING

There are 3 major scenarios which help describe the working of our proposed method.

Case 1: Once the speed above a certain limit is attained by a moving vehicle, the speed sensor starts to detect the car. This information is transferred to the IoT device it is connected to. IoT sensor communicates with the cloud to retrieve information about all the vehicles in that location with the

help of GPS, finds the overspeeding vehicle and sends alert to the IoT device attached to that vehicle and speed of the vehicle is reduced to a desired value.

Case 2: This is a scenario where multiple vehicles are speeding on the road. The speed sensor detects these overspeeding vehicles, the information is transferred to the IoT device it is connected to. IoT sensor communicates with the cloud to retrieve information about all the vehicles in that location with the help of GPS, finds the overspeeding vehicles and instead of individual communication, it broadcasts the alert message to those IoT devices placed in those vehicle and thus speed is reduced in those vehicles.

Case 3: IoT sensors is also embedded with crash sensor that detects motion, changes in forces and impact also with GSM and GPS modules. When there is a serious collision the sensor dispatches an Emergency alert to a pre-defined contact, nearby police station and ambulance by notifying the particular incident GPS coordinates and thus minimizes emergency response time.

The initial installation of the sensor in a vehicle requires the following information to be stored in the cloud: Sensor ID, Vehicle number, Vehicle type, Vehicle model, Owner's name, Owner's contact number, 5 emergency contacts with their numbers. Once the sensor has been installed and the corresponding data is pushed to the cloud, the sensor can monitor the location of the vehicle as well as its speed. A GPS tracking device will be connected to the sensor to retrieve the location data at any point in time. The sensor will also be connected to the speedometer to access the information on the speed of the vehicle.

Along with the sensors deployed in the vehicles, we will also have sensors installed in the accident prone areas. The information stored in this sensor is as follows:

- Sensor ID
- Location of installation
- Maximum speed limit

The above information which is pushed to the cloud during installation will be used by every vehicle which crosses the installation area.

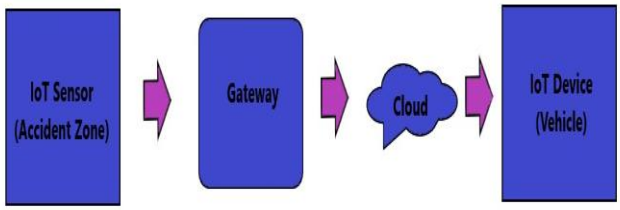

Figure 1. Workflow of the proposed model

Once all the above devices are installed, we can focus on the actual working of our accident prevention mechanism. When a vehicle approaches an accident prone area, the sensor installed in the vehicle will query the location of the vehicle and the sensor of the area to determine the approximate difference in location. If the difference is within the range of 1 kilometers, the vehicle sensor contacts the area sensor for the information on maximum speed limit. This queried information is checked against the current speed data obtained from the accelerometer of the vehicle. Both these values are compared and if the speed is above the speed limit, the vehicle is asked to slow down. This signal is sent based on the type of vehicle and the type of sensor installed in the device. If an accident does occur, the sensor installed in the device can receive the information from crash sensors of the vehicle. In such a case, the current location of the vehicle is used to find police station and hospitals nearby, and sending them SMS notification via GSM modules installed in device, with the information provided by the device during installation. This information will include the following:

- Current location of the device
- Vehicle number
- Vehicle model
- Owner's name
- Owner's contact number
- Emergency contacts with their numbers

In order to send signals to hospitals and police stations nearby, we will maintain a database with the following information:

- Hospital name/Police station
- Contact information
- Location

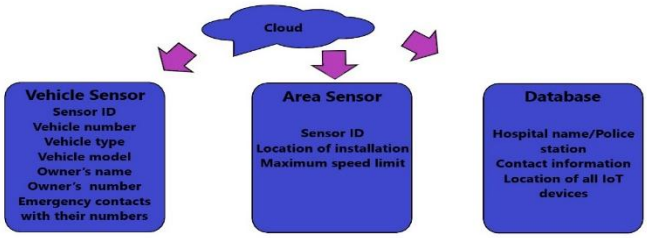

Figure 2. Various Information stored in server database

V. RESULTS AND DISCUSSIONS

Road accidents are the biggest killers in India. As per Transport Research Wing (TRW), The total number of road accidents increased by 2.5 per cent from 4,89,400 in 2014 to 5,01,423 in 2015. The total number of persons killed in road accidents increased by 4.6 per cent from 1,39,671 in 2014 to 1,46,133 in 2015. Road accident injuries have also increased by 1.4 per cent from 4,93,474 in 2014 to 5,00,279 in 2015. The analysis of road accident data 2015 reveals that about 1,374 accidents and 400 deaths take place every day on Indian roads which further translates into 57 accidents and loss of 17 lives on an average every hour in our country. About 54.1 per cent of all persons killed in road accidents are in the 15 - 34

years age group during the year 2015 which means most of our youth (who are the contributing group for the progress of our country) lose their lives on roads.

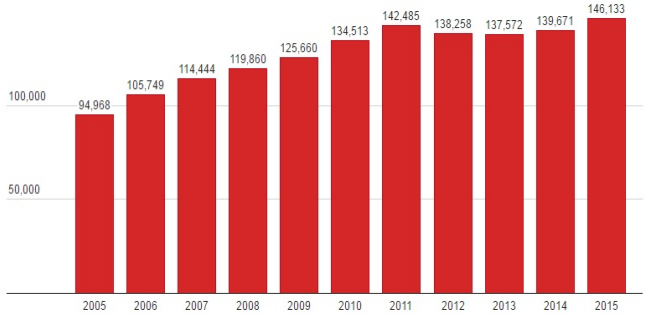

Figure 3. Statstcial Representation of Road Accidents in India

The causes for India's exceptionally high number of casualties in road crashes include bad road user behavior, defective road design and engineering, weak enforcement of traffic rules and the lack of rapid trauma care. Elaborating on road user behavior would throw light on three major areas:

- Distracted Driving
- Speeding
- Drunk Driving

Speeding is one of the top reasons for road accidents. Our project concentrates on this area and hoped to bring down the number of road accidents. In the last five years Chandigarh has seen 2,340 road accidents that snatched over 740 lives in the City Beautiful, famous for its wide roads. As per National Road Safety Commission, about 50% road accidents in Ghana are caused by over speeding. A lot more can be added on to this list .Thus, making it evident that "over speeding" is the major reason for accidents. Hence, we have considered this issue and proposed our ideas to control it and thus reduce death rates.

VI. CONCLUSION AND FUTURE SCOPE

Our proposed model is a big step towards driverless vehicles which can bring about safer commute system in our cities. It aims to prevent the accidents even before they occur, hence they prevent significant loss to human life as well as vehicular damages. The usage of IoT sensors and cloud technology makes this whole detection and prevention process very cost-effective and also carries it out in a very efficient manner. The proposed technology can work effectively both during the day and night as it involves very little human interference and reducing the human errors involved in accidents drastically. It assists emergency services and quick response teams to take immediate action.

One of the limitations in our model is the requirement an active internet connection for the effective functioning of the model, which might not be feasible in some terrains. Another limitation is the case of slow responses from the emergency services which are still under the control of humans, which in turn render the model less effective.

With constant updation and modification, the model can be easily implemented on a large scale, thereby making the dream of accident-free roads a reality. IoT is still at a very tender stage, hence there could be a lot more in store with its future technologies making the same model much more efficient than the current one. This idea can be extended to vehicles like bikes, mopeds and lorries where in notifying the driver regarding the danger and automating the brakes can be implemented in an efficient way.

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Authors Profile

Mr. R. Saiprasanth pursued Bachelor of Engineering in Computer Science from RNS Institute of Technology under Visvesvaraya Institute of Technology, India in 2018. He has previously presented technical paper titled "RAGE - Radar Based Gesture Technology in Intelligent Home Automation", in 29th CSI Students Convention, Karnataka in September 2015. He is a Full Stack Developer and has successfully completed numerous technical internships under the same domain ; Eventers- 12 months ,Turbizo-4 months, Gnani.ai-1 month. "IoT based Smart Campus" was an idea proposed and realised by Mr.Saiprasanth. His area of interests include Web Development , Iot and Android.

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Ms.Spoorthi.S pursued Bachelor of Engineering in Computer Science from RNS Institute of Technology under Visvesvaraya Institute of Technology, India in 2018. She has previously presented technical paper titled "Automated Irrigation Technology For Mixed Cropping." She has also done a project named"IoT based Smart Campus". She has worked as an intern in several organizations and completed the work assigned succesfully. Her area of interest lies in Web Develeopment and Coding.

Ms Sweta Kumari pursued Bachelor of Engineering in Computer Science and Engineering from RNS Institute of Technology, Bangalore affiliated to Visvesvaraya Technological University, Belgaum in 2018. She has been the member of IEEE since 2014 and she has been the IEEE Computer Society Chairman for RNSIT Student Branch in 2017 and Women in Engineering(WIE) Chairman in 2016. She has interned for 4 months in Indian Institute of Science, Bangalore. Her areas of focus include Deep Neural Network models and Web Development..

