An IOT Based Smart System for Accident Prevention and Detection

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***Abstract*— Nowadays, the number of accidents has increased rapidly. About 17 accidents take place every hour. Bike accidents constitute a major chunk of all accidents; this is because two-wheelers do not have as many safety parameters which are included in four-wheelers. Reasons causing it can be due to not wearing a helmet, feeling drowsy while driving, alcohol consumption, two vehicles coming into closer proximity without both drivers' notice, breaking of traffic signals, driving without a valid or no driving license, careless driving, unintended triggering of the acceleration pedal, etc. The main objective of this paper is to propose a system which can effectively help in preventing any kind of mishaps and if such conditions occur then how it detects and informs the concerned authorities and people, so that the situation can be taken care of immediately. This system detects accidents by vibration sensors, accelerometers. For detection, we use GPS and GSM module which locates the site of the accident and correspondingly informs the person's near ones and nearby hospitals through a text message. Only sending a text message to nearby hospitals won't be enough because it cannot avoid secondary accidents and hence, this system caters this requirement too. The system provides an idiosyncratic prevention and detection system that dispenses the ultimate panacea for drivers which ensures safety and prevents loss of life by taking appropriate measures in right time. It also checks whether the driver is drowsy or in an unstable state which can lead to pedal mix-up and in some cases unintended acceleration or turning of the steering wheel to the wrong direction which can lead to crashing of the vehicle with other vehicles or concrete road barrier. This system also provides a mechanism by which it identifies whether the person that will be riding the bike has a valid driving license or a driving license at all by already embedded RFID on driving license. The RFID reader on the bike will have will have at most 10 registered users, so that the family members or his/her friends can also ride the bike. Hence, this mechanism also handles theft related issues.**

***Keywords*— Vibration Sensors, RFID,GPS Module, GSM Module, Vehicle to vehicle communication, Ultrasonic sensor, accelerometer, Eye Blink monitoring system (EBM), Alcohol sensor, mobile edge computing(MEC).**

I. INTRODUCTION

The increased usage of vehicles has led to increased chaos on the roads. This increased chaos has led to increased number of accidents. According to the Global status report of WHO having information from about 180 countries, shows that worldwide the total number of deaths occurring in road accidents has attained to 1.25 million per year, with the highest road traffic fatality rates in low-income countries[9]. This artefact talks about various devices and various technologies which help in preventing accidents and detecting them immediately to avoid any causality on-site. The main intention is to ensure safety and security of the driver in road accidents.

According to NCAER in 2016, the middle-class population in India is 267 million [10]. Such huge population does not have enough resources to buy a four-wheeler; hence they tend to buy two-wheeler as they are affordable. Four-wheelers have many parameters which looks after the safety of the driver such as seat belts, Airbags, etc. While in case of bikes, safety measures are to be added from external source like helmets.

Accidents involving ineligible drivers are huge in number. These incompetent people, to a larger extent, comprised of teenagers with age between 15-18yrs. Teens go through their adolescence period where they are pumped up with emotions hence this leads to rash and reckless driving. They try to show off by doing stunts on the bike which leads to disastrous results. This system also monitors and deals with such circumstances also. The number of people breaking the law has also increased over the past 5 years. The figures talking about the same is shown in Figure 1. The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure, which will help us in integrating various components of the system coherently. This method has several advantages like high performance, user friendly even an incompetent can use it.

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Law breakers	Two wheelers	Four wheelers
Signal jumping	2,20,859	1,46,945
Drunken Driving	36,727	17,237

Figure 1: Statics of law breakers[2]

II. Goals and objectives:

- To learn and understand the working principle of sensors and technologies which will help implementing this project.
- Various sensors such as alcohol sensor, pressure sensor, vibration sensor, accelerometer, etc. will be used in this project hence understanding each one of them is very critical from the development point of view of the system.

- To design a device which will increase the safety of the driver
- After understanding the requirements and specification of all the modules we will finally start designing the system.

- To validate the driver by viewing his driving license
- This is done by using RFID which will be on the driving license and the RFID reader on the bike's front panel.

- To check whether he/she has consumed alcohol or not-Alcohol sensor will detect whether the person gas consumed alcohol or not.

- To monitor distances between automobiles and use V2V communication in order to reduce noise pollution-by Wirelessly communicating with neighboring vehicles to avoid crashes rather than using horns.

III. Motivation

According to a report of NDTV, over 1, 37,000 people were killed in road accidents in 2013 alone, that is more than the number of people killed in all our wars put together. [9]

The prime motives behind this idea are:

- Increasing number of road accidents which is estimated to be over 2 million. [10]
- People violating traffic laws like drunk driving, not wearing helmets and illegal production of driving license or in some cases driving of bike without any license.
- Lack of treatment of injured people in proper time.
- Night Driving in some cases causes Drowsy Driving.

IV. Literature Survey

Indranil Nikose and Tushar Raut [1] discuss a system which detects whether the person has consumed alcohol or not and whether he/she is wearing a helmet or not. This system also detects accidents by setting a timer of 10 min. The system uses alcohol sensor and RF transmitter and receiver for preventing accidents, if the output of both the sensors is true then only the bike will start. If any mishap occurs then, it triggers the timer and id the driver is not able to drive the bike again in 10 min then a text message is sent to his relatives and the ambulance.

The smart helmet which is proposed in [2] consists of a RF transmitter and RF receiver. The transmitter is connected to the helmet and the receiver is placed on the ignition switch of the bike. Unless and until the driver does not wear the helmet the bike will not get start which ultimately helps in preventing any fatal injuries if something happens. If the driver removes the helmet while driving the bike will automatically stop. Manjesh N and Prof.Sudarshan Raj [3] elaborate over a smart helmet which is capable to detect accidents using a pressure sensor and a vibration sensor and locate the site of the accident using GPS module and communicate that message to the registered numbers on the person's phone using the GSM module.

An insightful view in [4] deliberates about a system which helps drivers who have to often travel during the night time. Drivers tend to get drowsy or sleep which sometimes leads to contretemps. It uses Eye Blinking System (EBM) and accelerometer to check whether the driver is feeling sleepy or not if so an alarm is set off. EBM system works with the help of IR sensors which monitors the blinking patterns of the driver ,because the light gets more reflected when we close our eyes than when we keep our eyes open. The accelerometer checks whether the tilt angle is a bit beyond the threshold value.

V2V communication is used in [5] which helps in communication of all kinds of vehicles with each other. One vehicle will transmit message wirelessly to another vehicle which reduces noise pollution and also notifies both the drivers what distance are they maintaining between them which is done by ultrasonic sensors. Unintended acceleration and pedal mix-up is also one of reasons causing fatal accidents. The solution provided for the same in [6] takes care of such circumstances. It checks whether the driver is drowsy or not; done by image processing. The system keeps track of the acceleration patterns of the person, if the person involuntarily triggers the acceleration pedal instead of the brake pedal the system design is capable of turning that acceleration into deceleration gradually.

The system discussed in paper [7] describes a system which maintains a client-server architecture where the driver's phone plays the role of client and the nearby hospitals, regional transport office (RTO), nearby vehicles, etc. When a collision happens the client mobile takes the picture of the real-time situation of the accident site and sends to the server, validates the seriousness of the mishap, checks whether necessary measures are taken or not, etc.

V. Mathematical Model of proposed system.

S= {s, e, X, MSG,Fme, Sc, Fl, SF}

Let,

s = Initial state where the bike has not started yet.

e = End state where either the system successfully does it's work and the driver has safely reached his/her destination or the system detects that accident has occurred and the message has been transmitted to predefined numbers.

X= {AS, RFIDin, US, RFS, Alcohol, VS, PS, thres}

Where,

Alcohol is the output coming from alcohol sensor.

RFIDin is the input coming from RFID reader on the bike.

AS is the output from the acceleration sensor which acts as input to this system.

US is the output coming of ultrasonic sensor.

RFS is the signal from the RF receiver about whether the person has worn a helmet or not.

VS is the output of vibration sensor.

PS is the output of pressure sensor.

Thres is the threshold value.

MSG = {Rmsg, Tmsg,Buzzer}

Where,

Let Rmsg be the message received from another vehicle.

Let Tmsg be the message transmitted to other vehicle.

Fme = {EMG,PIX,SPEN}

Where,

EMG=function which sends text messages at the time of emergency situations.

PIX=function which sends live status of the accident to the concerned people using the camera.

SPEN=function which stops the bike or not allows the bike to start if initially in s.

Where,

Sc = denotes that the user has successfully reached his/her destination without any mishap happening.

Fl = denotes a failure case which says the system did not detect any anomaly.

SF = denotes that accident has occurred and the situation is detected quickly and informed to the concerned people as soon as possible.

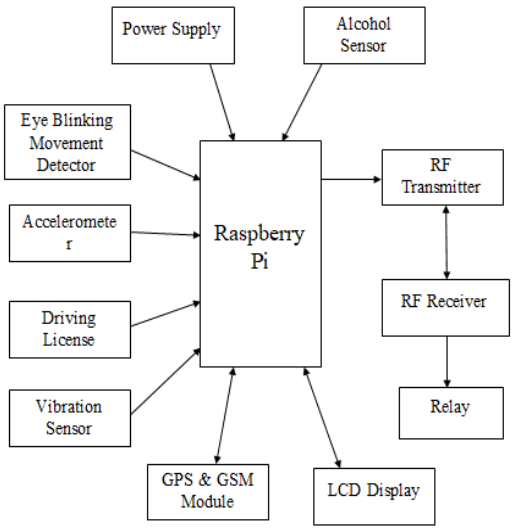

Figure 2: Block diagram describing how various modules interface with each other.

VI. Working of Proposed System

The system provides an idiosyncratic prevention and detection system that dispenses the ultimate panacea for drivers which ensures safety and prevents loss of life by taking appropriate measures in right time. This system integrates all the components in the existing systems and adds new functionalities.

The system first checks whether the person that is going to ride the actually has a driving license or not. If the person has a driving license is present then the next step to check whether the driving license is valid or not. The RFID reader embedded on the bike will have at most 10 registered users that are permitted to use the bike. So, this helps in ensuring that the bike will not get stolen and that the person riding the bike is not under age or inexperienced. Then when the user starts to ride the bike the camera fit on the front of the bike will monitor whether the traffic signal displayed is red or not, if so then the automatic braking system will gradually reduce the speed of the bike. It will automatically cause deceleration.

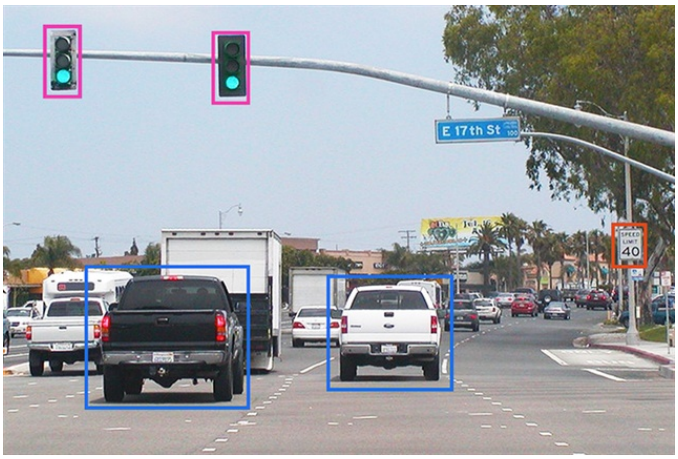

Figure 3: Traffic light detection.

The ultrasonic sensor used continuously keeps track of the distance maintained between any two vehicles. If greater than threshold, immediately warn both drivers using V2V communication. This helps in reducing noise pollution and only concerned people will be alerted without disturbing the others.

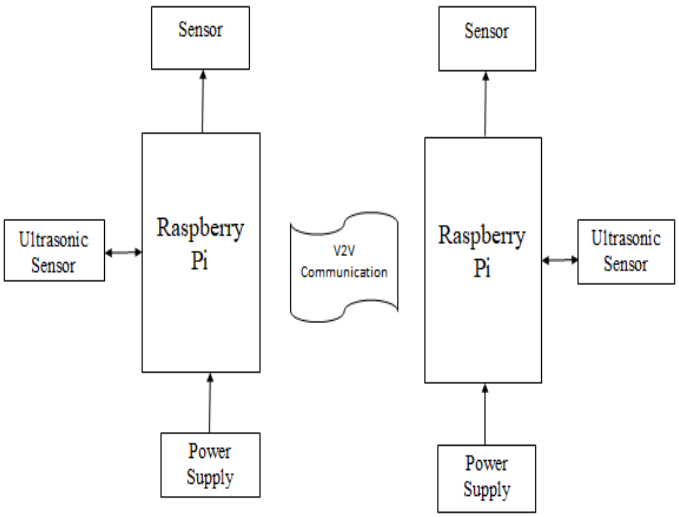

Figure 4: Block diagram of V2V communication between vehicles using Raspberry Pi.

When the accident occurs it uses MEC for avoiding secondary traffic accident and sending message to nearby hospitals for help. Rather than informing the hospital every time it is efficient to message the neighboring vehicles for even faster response because in such situations time acts as a critical parameter.

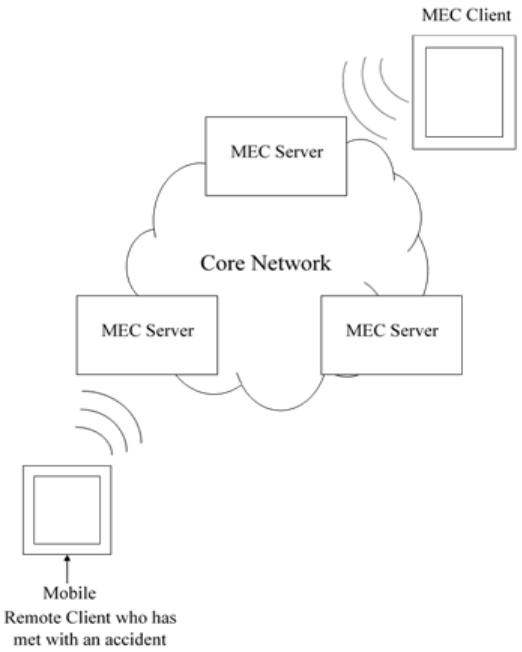

Figure 5: MEC client server interaction.

Figure 6: EBM system and accelerometer used in [4].

VII. ALGORITHM

1. Check whether the bike's engine has started or not.

```
If s==true then
        continue;
else
        Fl++;
```

2. Check whether the driving license of the person is valid or not. If that is not the case then do not start the engine.

```
If RFIDin == valid_driving_license then
        continue;
else
        call SPEN();
```

3. Test whether the input from RF transmitter turns out positive, which indicates that the user has worn a helmet and has not consumed alcohol.

```
If (Alcohol && RFS)==true
        remove_relay();
```

4. Then parellely check for following conditions:

a) If the driver is drowsy, then the state is detected and the alarm or the buzzer is triggered.

b) If the traffic signal is red, the bike should reduce its speed gradually by triggering the braking system.

c) If the ultrasonic sensor detects that two vehicles are critically close to each other, it sends messages to that vehicle wirelessly through a well-established server.

```
result=monitor(Rmsg,Tmsg);
if result<threshold then
        set Buzzer=true;
```

d) Check if the vehicle has met with an accident.

```
while(true)
        if(check(PS,VB))
                then accident=true;
If condition! =true
        e=true;
        display_LCD ("Success");
```

5. If condition 4.d holds true then, capture the live situation from the MEC client and send it to the server.

```
call PIX();
```

6. The server then sends a message regarding the location and the situation of the accident which is tracked down using GPS module and the message is sent with the help of GSM module respectively.

```
call EMG(PIX(), ef, GSM);
```

VIII. Flowchart of Proposed System:

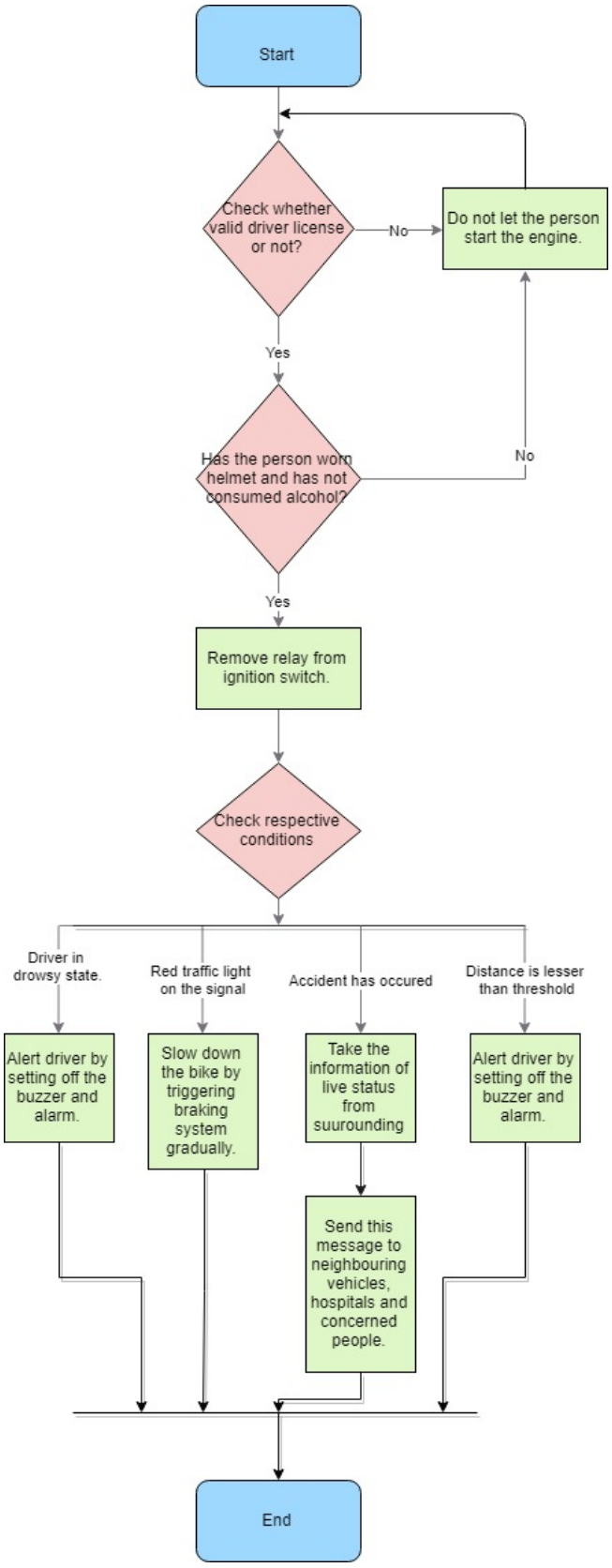

Figure 7:Control Flow of propsed system.

IX. Conclusion and results

The Smart accident prevention and detection is proposed using technologies such as V2V communication, Raspberry Pi, various sensors, MEC architecture, etc. It is an efficient one for solving the problem of accidents.

From the above conducted examination and analysis, we can conclude that this system mainly comprising of RFIDs, Sensors, etc. have an upper hand over the traditional systems.
The system prevents accidents by monitoring various conditions such as red light detection, validating driving license, detection of drunken driving case and many more. Using this method we can track and ensure that our loved ones are safe. This also solves the problem of maintaining the traffic properly for the sake of their and others safety. It is efficient in terms of both the parameters as well as performance.

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