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Third-Eye Two Wheeler for Accident Detection with Micro Electro Mechanical System (MEMS) Enabled in Smart Helmet

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Abstract--There are many accidents occurring in the world today. By wearing helmet and driving properly we can control or reduce the impact of these accidents. Thus, arises the need of Smart helmet which will protect the riders as well as help them to drive in a secure way. The Smart helmet consists of a ZigBee device through which the rider can start a bike only if he wears his helmet. It consists of various sensors which helps to detect the level of alcohol consumed by the vehicle rider, vibration sensor which detects the hit percentage when the rider meets with an accident and immediately report it to the nearby ambulance and the rider's family members and friends. There is a capacity sensor with which only two people allowed to travel in the bike as it can detects the weight of the persons. All the sensors are interfaced through PIC board and it uses Internet Of Things through which if the rider travel at over speed, then automatically fine is debited from their account. For tracking the closest nearby ambulance we use KNN (K-Nearest Neighbour) Algorithm.

Keywords: KNN,PIC Board, IOT, ZigBee, Sensors.

I. INTRODUCTION

The Smart helmet is used to reduce the impact of accidents and attempts to protect the riders from accidents.

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Nowadays most of the people attempts to break the rules and laws of road safety by rash driving ,drunken driving, triples riding on a bike, and so on which may lead to accidents

Motorcycles and bikes displays an integral part of personalized transportation in India. However, due to many reasons or unfortunate, there are several accidents that takes place with leads to loss of lives. Every year, about 300,000 youngsters are admitted in the department of emergency because of bike injuries, and to minimum level of at least 10,000 teenagers have injuries which requires a few days for normal recovery after getting admitted in the hospital. Statistics says, motorcycle deaths accounted for 15 % vehicle crash deaths in 2015 and more than double the number of motorcyclist deaths in 1997.

Through an ONEISS survey conducted by the Department of Health, it was found that 90% of the motorcycle riders were killed in accidents were not wearing a helmet at the time of impact. This, along with drunken driving is a major reason of accidents. Thus Smart helmet consists of various sensors connected to the PIC board which can detect and report the activities of the rider. To solve these problems and ensuring safety, the rider should wears the helmet all the time during his/her ride.

The person/rider is wearing the helmet.it can detect using the IR sensors, fitted inside the padding foam. The helmet can detect to find a possible accident, using the on board accelerometer and pressure sensor. If the values detected exceed the prescribed threshold, it is reported as an accident. Emergency contacts, specified by the rider during app setup, are informed about the possible accident, via a system generated email and text message, reverts back containing the address and GPS coordinates when the accident is detected.

The details of the riders were collected from the rider using an application in their mobile. The account details along with other basic information are stored so as if they attempt to drive in a delinquent way then the sensors alert them and if they pursue then warning message is generated.

II. RELATED WORKS

The aim of the smart helmet is to fetch a way for detecting and reporting accidents. Various Sensors including Wi-Fi enabled processor, and cloud computing infrastructures are being used for building this system. This accident detection system sends the accelerometer values to the processor which continuously monitors for the plethora of erratic variations. When an accident occurs, the related and relevant details are sent to

the emergency contacts by using a cloud based services. The location of the vehicle is retrieved from the global positioning system. The system promises a reliable and quick delivery of information making contact with the accident in real time and is appropriately named Connect.

Thus, by making use of the ubiquitous connectivity which is a salient feature for the smart cities, a smart helmet for accident detection is found to be built [2]. A strong framework of cloud computing, seen as a seamless blending of sensors and actuators along with the environment around us, is making this "network of networks for autonomous objects" a reality.

Starting from smart wearable to smart cities, domestic life to industries, the IoT is expanding itself to various different areas. From the view of Gartner Inc., the IoT will include 26 billion units installed by 2020.

Smart security solutions, smart home automation, smart health care, smart wearable etc. are the applications where IOT is used, and by the near future we expect to see its application for a city's transportation system or smart power grids. This paper proposes a brief overview on different trends of the IoT and also discusses in detail about the effects of the IoT on our day-to-day living. It also discusses the need of cloud computing, autonomous control, artificial intelligence in the context of the IoT. Finally, it's concluded with the need in demand of synchronization in the Internet, wireless sensors and actuators and distributed computing for successfully enabling technologies for the IoT[3].In the development of helmet, it may be considered with three main types of hazard such as air quality, helmet removal, and collision (miners are struck by an object). Firstly, the concentration level of the hazardous gases like as CO, SO2, NO2, and particulate matter. The second hazardous event was distinguished as a miner removing the mining helmet off their head. An IR sensor had developed not up to the expectation level but an off-the shelf IR sensor was then used to successfully determine when the helmet is on the miner's head. The third hazardous event is defined as an event where miners are struck by an object against the head with a force exceeding a threshold value of 1000 on the HIC (Head Injury Criteria)[4].Motorcyclist will be alarmed when the speed limit exceeds. A Force Sensing Resistor (FSR) and BLDC Fan are used in the detection of the rider's head and detects the motorcycle's speed respectively. A 315 MHz Radio Frequency Module as wireless link which enables to communicate between transmitter circuit to receiver circuit. Only when the rider buckled the helmet the motorcycle's engine will start. A LED will flash if the motor speed exceeds 100 km/hour [5].

Now a days, the number of two wheelers in India has drastically increased to a great extent. The first and the foremost precaution to avoid death is to protect our head, therefore we go for helmets. This system is a special idea which helps in promoting the usage of helmet in order to make motorcycle driving safer than before [1].In all the above discussed papers we have only detected the accident after it has occurred, but in our proposed model we can detect as well as provide a solution to the occurred problem and more importantly we also provide preventive measure there by to prevent the accidents.

III. PROPOSED SYSTEM

The data gathered from the sensors were stored in a database and if a rider fail to obey the rules at any case then automatically warning message is generated. The best thing about this system is that it doesn't function to work until it's worn by use rand is found as the ZigBee is placed inside the helmet as well as bike which need to be paired. Therefore, it doesn't send any messages if it thrown or falls down in the absence of rider. Also, it's calibrated in such a way that it won't send messages for values due to speed breaker' s or other small knocks in any case.

Another question that arises to our mind is that "Are helmets mandatory to be worn by users to start up with the journey". The answer is absolutely no. We have all our sensors including the MQ3 sensor placed in our vehicle its self. When the sensor crosses the minimum threshold value then it sends a warning message to the user. When the system encounters an accident then it tempts to get the location of the place where the accident has occurred and tries to connect to nearby ambulance using ATS (ambulance tracking system) by KNN algorithm.

A. System Architecture

The system architecture diagram in Fig. 1 represents the major components used in the proposed system.

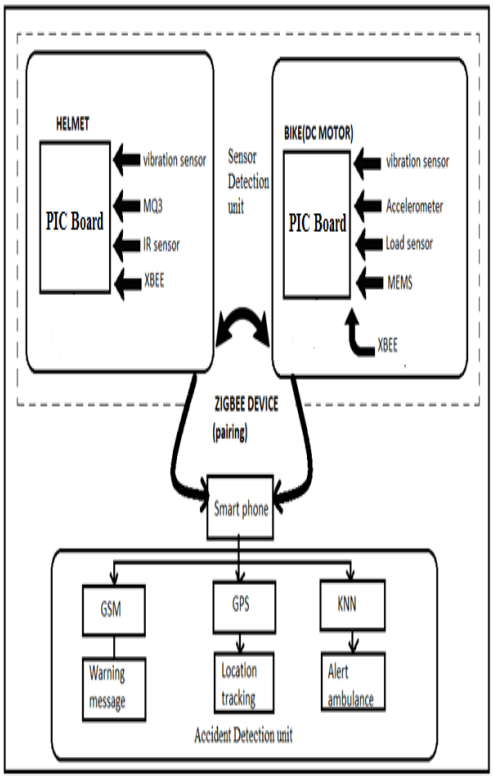


Figure 1.Block diagram

B. Modules:

1) *Android Registration Users:*

The Application Consist of the User registration Process. The Login Page consists of Buttons and Text Field Class in the Android from which the basic details can be fetched from the user and stored.

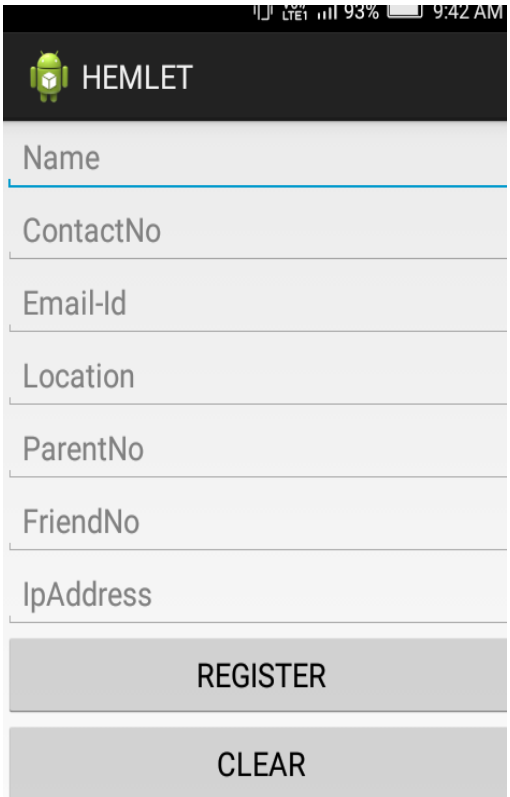


Figure 2.User interface

Fig 2 is the initial step to get into the system where rider should enter their details such name, address, phone number etc.

2) ZigBee Synchronization:

ZigBee device is built for controlling sensor networks on IEEE 802.15.4 standard in wireless personal area networks (WPANs), and it is the product from ZigBee alliance. These kind of ZigBee's WPANs operate at 868 MHz, 902-928MHz and 2.4 GHz frequency. We synchronize all these sensors using ZigBee to establish wireless communications .The large-data rate communication standards require low-latency and low-energy consumptions at lower bandwidths. The available proprietary wireless. ZigBee system structures consist of different kinds of devices such as ZigBee coordinator, Router and End device. Every ZigBee network must consist of at least one coordinator which inturn acts as a root of the network.

3) Sensor Synchronization:

In this module, we implement accident identification using vibration and IR sensor. When user bikes make an accident, vibration sensor will vibrate and if IR sensor is not synchronized with ZigBee. System will wait for 10 seconds if there is no response from user then the system will send notification to the police and ambulance.

Alcohol & Load Monitoring:

During driving mode, we will check whether the driving person is consuming alcohol or not and how many persons are travelling on the bike. To monitor those processes, we use two different devices namely alcohol sensor and load cell. Alcohol sensor will find the alcohol of driving person and load cell will check how many persons were travelling on the bike. If the rider is sensed with alcohol beyond the prescribed threshold value or if load exceeds the allocated value warning is produced and if further ignored bike is made to stop .

4) Location Tracking:

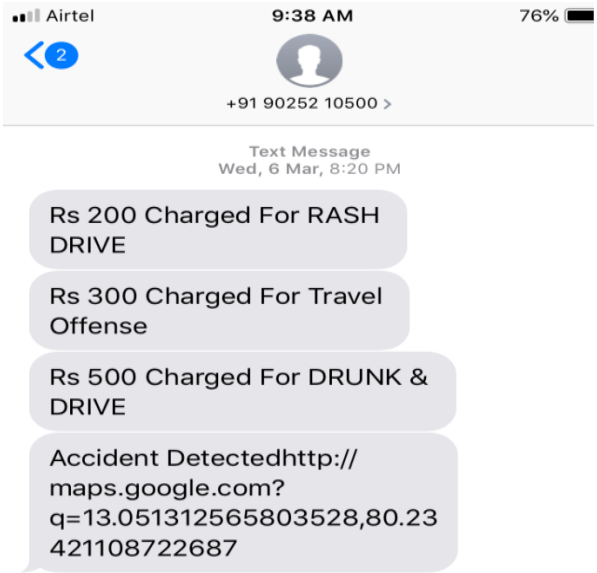


Figure 3.Alert Messages

In the above fig 3. Shows that the messages are sent to family, neighbors and friends.GPS is used to locate the rider and if the accident is detected then the location information is sent to the nearby ambulance using KNN algorithm.

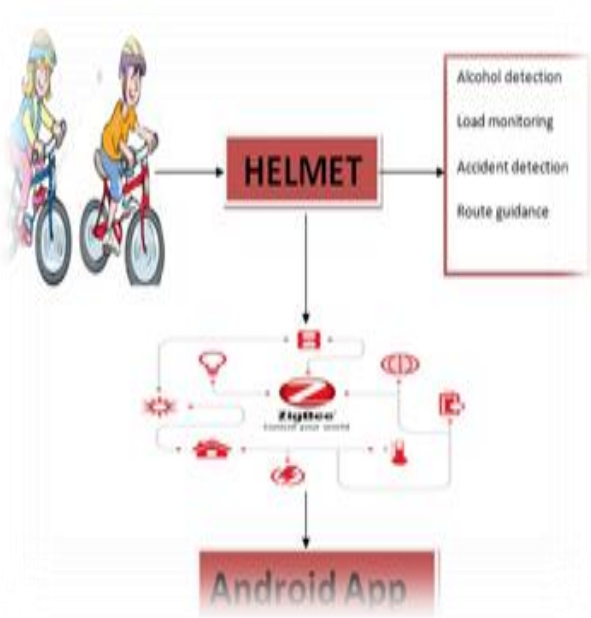


Figure 4.Overview of the system.

In the above figure 4, it depicts the over view of proposed system where the helmet along with the PIC board, the vehicle and the mobile of the user are inter connected with the Zigbee.

C. Sensors and its Purposes:

D. Algorithm Used:

Source of Action	Sensors	Uses
Injury of head	IR sensor	Detects if the person wears helmet or not
Drunken and drive	Alcohol sensor	It detects whether the rider is drunken or not
Rash driving	Speed limit sensor	Senses the speed limit to certain Level
Location Inaccuracy	GPS	It tracks current location where accident has occurred
Riding with excess Load	Capacity sensor	It detects if threshold value exceeds the given limit or not

K nearest neighbour:

When accident is detected then the alert is sent to the nearby ambulance by choosing the nearest one using KNN since it is necessary to attend the emergency situation at the right time. Nearest Ambulance is chosen as follows:

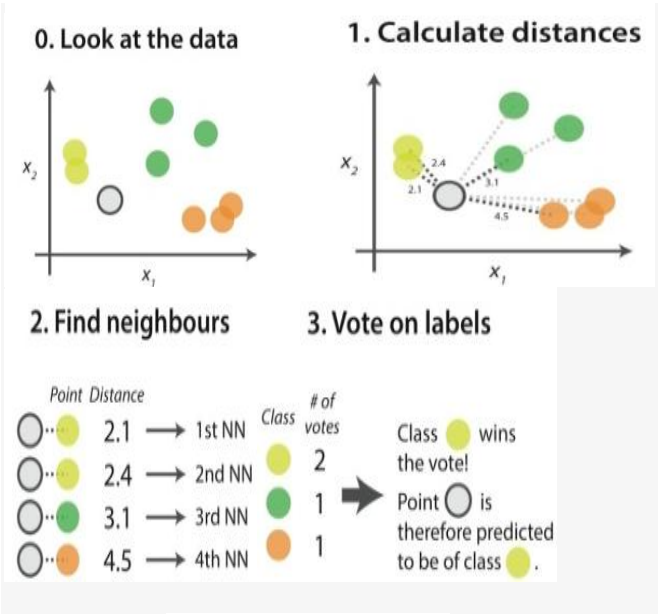


Figure 5.Process of KNN

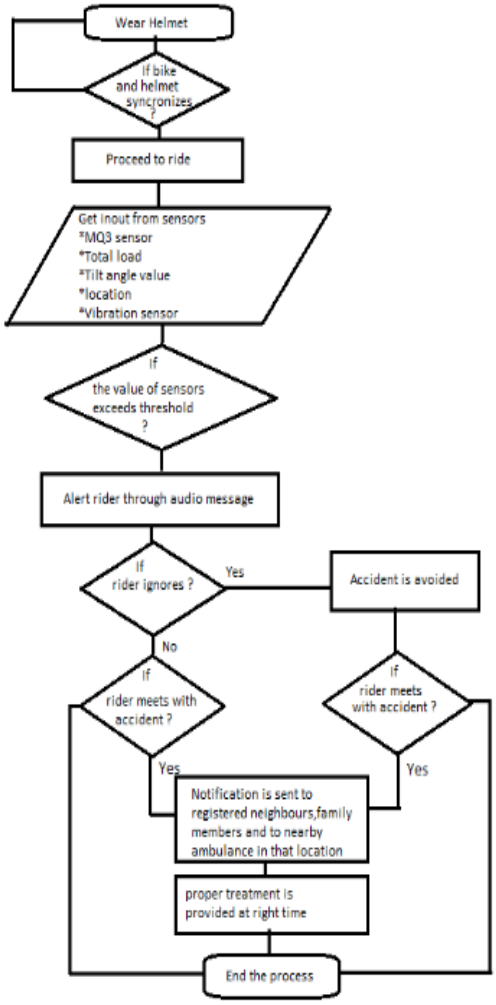
Steps 0: To differentiate the grey point into a class, here we have three potential classes- lime green, green, orange.
Step 1: To calculate and find the distance between the grey point and all other points.
Step 2: To evaluate the nearest neighbours by ranking points by enlarging the distance.The nearest neighbour of the grey point are the ones closest in dataspace.
Step 3: Select the predicted class labels, based on the classes of the k nearest neighbour present.

4) Raspberry Pi

The raspberry pi is a low cost, minimal effort, credit card measured computer that plugs into a PC screen [15]. The Raspberry Pi 3 B+ as shown in Fig. 4 is 1.4 GHz 64-bit quad core processor, onboard Wi-fi, Bluetooth and USB booth capabilities.

The Raspberry Pi Foundation gives Arch Linux ARM and Debian appropriations for download, and advances Python as the fundamental programming language. In the internet gateway device, we use raspberry pi model 3 B+, it includes a quad-core ARM Cortex-A7 CPU is running at 900MHz. It is created utilizing Python Library for Communication of RPI with Xbee ZB.

E. Algorithm Used:



1. User wears the helmet and its gets synchronized with the bike only if IR sensor is properly detected.
2. Now the user proceeds to ride where he analysed with MQ3 sensor, tilt, load and vibration sensors.
3. If the obtained sensors value exceeds the threshold value an alert notification is generated to respective user.
4. When the user meets with an accident notification messages are sent to registered neighbours, Family members and to nearby ambulance in that location.
5. If no ambulance is identified in that location then the coverage area is enlarged to spot the ambulance in that region.
6. Identified causality is provided with proper first aid and treatment
7. There by reducing the loss of Life

Table1 :Test Cases

Test cases	IR sensor	Capacity sensor	Vibration sensor	Alcohol sensor	Ability to Ride
Case1	yes	Yes	Yes	yes	No
Case2	yes	No	No	yes	No
Case3	yes	No	Yes	No	No
Case4	yes	Yes	No	No	No
Case5	yes	No	Yes	yes	No
Case6	yes	Yes	Yes	No	No
Case7	yes	No	No	No	Yes
Case8	No	No	No	No	No
Case9	No	Yes	Yes	yes	No

In the above table1 there are about 9 test cases that says whether the rider can drive safely or not. The rider can drive only if he wore the helmet which is detected by IR sensor .We have other sensors like MEMS, capacity, Vibration, Alcohol sensors. These sensors checks whether the rider is rash driving, or triples riding, met with an accident, or consumed alcohol or not. If in case the IR sensor is detected for the rider and any of the other sensors were also detected then the rider will not be able to ride the vehicle. If none of the other mentioned sensors were detected then the rider won't be able to start the bike as he doesn't wear the helmet.

IV. PERFORMMANCE EVALUATION

In our existing model helmet detection can be recognized only up to 85% but in our proposed model this can be identified up to 92% which is comparatively better .Our proposed system also exhibits Accuracy in a much more a precise way. In general Accuracy refers to more trust worthy way in which the data are out casted. Precision conveys the fact that how the data's are being expressed in reality and what sort of modifications has to be made to change it to our convenience. Then the next factor convenience depicts the way how flexible, malleable the data can be obtained and processed at anywhere and at any time and with respect to any location.

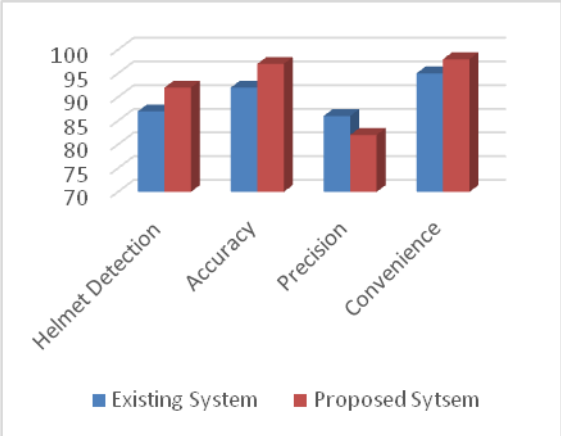


Figure 6.Comparison of Accident detection functionality

V. CONCLUSION

The Smart Helmet contains few vibration sensors at different location of helmet , where the possibility of hitting is high which are internally connected to PIC board connection. Therefore , when the rider crashes, the helmet hits the ground, the sensors senses the vibration and data is extracted by the PIC , GPS data using the GPS module that is interfaced with PIC. When the information captured exceeds minimum stress threshold limit as prescribed value then GSM module automatically senses and sends the message to nearby ambulance and to family members. When an accident is met with the help of GPS location is identified and details are fetched to nearby ambulance in that locality. Finding an ambulance is done by KNN algorithm so that the shortest possible path is identified with respect to the casualty. If the ambulance is not identified in that location area, then the coverage area is exceeded and then the same steps are followed. This process is followed as long as the ambulance is identified with respect to the casualty's location. Thanks for KNN which helps to serve this. This is made convenient especially if the rider travels in remote areas. Thus, technology makes the rider to have a safe and happy journey.

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