Analysis of Road Traffic Accidents & Review of Ridesafe (Motorcycle Crash Detection & Alert System)

Afzal Hannan, Bhavit Yadav, Chirag Yadav

Abstract— This research paper deals with motorcycle road accidents and show how certain simple technologies such as a mobile application and a small hardware setup can improve and enhance overall response time over critical situations such as a crash or an accident through communication which leads to prompt medical treatment for the injured. Presents study of Ridesafe, an Android Mobile Application that provides a platform for motorcycle riders to inform their contacts about the crash so that there is information of the potential accident scenario even after the crash took place. This highlights that an automated crash emergency information mobile application is better than the traditional way of information communication of crash. The conclusion is validated by data.

Index Terms—crash detection & alert system, first aid, mobile android application, road traffic accidents(RTA).

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1 INTRODUCTION

This paper is intended to search for all the available information which might help to validate the fact that a road accidents deaths are preventable if given prompt medical attention to the wounded or injured. Deaths caused by road accidents are due to increase in number of vehicles, disobeying of traffic rules and risky attitude while driving. This information has been gathered from newspaper articles. Websites, journals, databases and some government websites for an overview of recent years. [4]

The number of vehicles are increasing day by day and so are accidents, resulting in large numbers of deaths due to them. Two wheeler vehicles are among the most affected. Most of such accidents causes deaths due to lack of immediate medical help can be observed on urban roads, rural roads and highways.

A system that detects an accident and alerts the knowns can help in faster medical aid, thus comes the idea of a motorcycle crash detection and alert system that detects potential accidents and sends a message to given saved contacts about it. The system will check for an accident with the help of a hardware setup and via a mobile application will send the location using a google maps link of the area of the accident to three contacts via SMS.

The proposed system provides a low cost solution to two vehicle wheeler riders to avoid delay in communications in case of a potential accident.

To lower fatality rate number an improved motorcycle crash detection and alert system is presented. The system consists a gyroscope and an Android based mobile device along with a Bluetooth module HC06 for connectivity purposes of the hardware and mobile application.

The previous work regarding vehicle safety instrument was a complete hardware model which could be fixed in the vehicle without the use of any smartphone. It contained a SIM card module share location and had an integrated accelerometer to measure the speed of the vehicle, whereas our model uses a Bluetooth device to share data and uses the accelerometer present in our modern day smartphones. Our vehicle safety instrument is derived from this model and has the following advantages over its predecessor:

• Reduced assembly time: An additional accelerometer and SIM module increases the assembly time. Thus our model takes less assembly time.

• Accessibility: A mobile phone is mundanely available thus increasing accessibility.

• Features: A smartphone also has a better computing power, storage and other sensors thus adding onto more features such as creating an accident database, checking location with nearby accidents, noting down accident prone areas, etc. All such features can be added easily with an Android application.

• Cost: Cost is significantly reduced as we don't use a different SIM Card (and a telecom plan) and accelerometer. The SIM Card and accelerometer are both present in a modern day smartphone. We use a Bluetooth device to connect the smartphone with our model.

• Chances of failure: SIM card module is hard to manage as it is a very small component and might lose in an accident, thus failing the model. However, usually a smartphone is very well taken care of.

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- *Afzal Hannan is currently pursuing B.Tech degree program in Computer Engineering at Delhi technological University, Delhi, PH-+91 8447192604. E-mail: Afzal.hannan@gmail.com*
- *Bhavit Yadav is currently pursuing B.Tech degree program in Computer Engineering at Delhi technological University, Delhi, PH-+91 8588039271. E-mail: bhavit.yadav@gmail.com*
- *Chirag Yadav is currently pursuing B.Tech degree program in Computer Engineering in Delhi technological University, Delhi, PH-+91 7838021768. E-mail: cyadav015@gmail.com*

2 ROAD TRAFFIC ACCIDENTS (RTA)

This section examines the recent road traffic accidents scenario of our country in an overview by comparing fatality rates & injuries with respect to year 2016-2017.
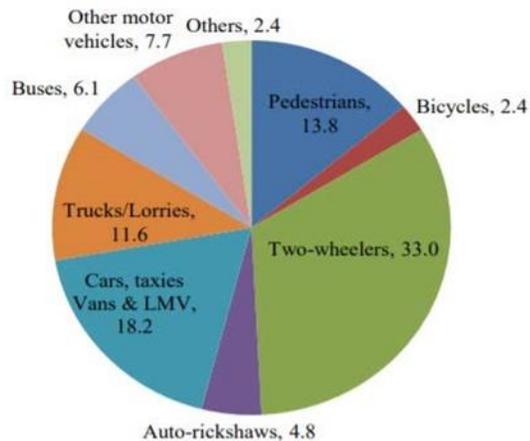
Figure 1: Share of different vehicles in road accidents (year 2017 and 2016)

Road traffic accident (RTA) is a nationwide concern and also one of the vital avoidable public health tie-up and is increasing which can be linked to increase in the number of vehicles (especially 2-wheelers) and enlarging lifestyle development and risky mindset. A total of 4,64,910 road accidents have been reported by States and Union Territories (UTs) in the year 2017, which took 1,47,913 lives and caused injuries to 4,70,975 persons. Among vehicle categories involved in road accidents, two-wheelers accounted for the highest share (33.9%) in total accidents and according to 'Global status report on road safety 2013' it is on the eighth place and expected to be at the fifth place by 2030 if trends continue at the same pace (1, 7). In developing countries mortality due to RTA is projected to rise by fatalities (29.8%) in 83% provided stringent measures are not taken. 2017.

The fatality rate due to RTA in South Asia was 10.2/100,000 persons in the year 2000 which is predicted to rise to 18.9/100,000 persons by the year 2020 (predicted to change by:

Table 1: Depicts deaths by various vehicles for years 2017 and 2016

Road-user category	Persons killed 2016	Persons killed 2017
Pedestrian	15,746 (10.5)	20,457 (13.8)
Bicycles	2,585 (1.7)	3,559 (2.4)
Two-wheelers*	52,500 (34.8)	48,746 (33.0)
Auto-Rickshaws	7,150 (4.7)	7,167 (4.8)
Cars, Taxis, Vans & LMVs	26,923 (17.9)	26,869 (18.2)
Trucks/Lorries	16,876 (11.2)	17,158 (11.6)
Buses	9,969 (6.6)	9,069 (6.1)
Other Motor Vehicles (including e-rickshaw)	15,988 (10.6)	11,410 (7.7)
Others (Animals drawn vehicle, cycle rickshaws, hand carts, & other persons)	3,048 (2.0)	3,479 (2.4)
Total	**1,50,785**	**1,47,913**

*Two-wheelers include motor cycles, scooters, mopeds and scooty.

144 %) lower and upper middle class account for 91% of the global mortality due to RTA although these countries have only about 50% of the world's vehicles [8].

Given below are some of the adverse effects:

1.   Economic: RTAs cost US $518 billion globally. In developing nations a loss of about $100 billion/year occurs because of accidents. As a result of RTAs, the affected families have to put up with the cost of extended medical care, bear the loss of wage earner take additional care of the disabled which ultimately leads them to poverty because the expenses are borne exclusively by the family of the disabled .In India itself the gross domestic product lost due to RTAs was 1-3% in the year 200809 . RTAs also contributes to the massive burden on the health sector (e.g. pre hospital and acute care as well as rehabilitation). Lack of road safety leads to spending of 20 billion/year in India which corresponds to food requirements of half of the countries malnourished children [2]

2.   Physical health: Around 30-50 million people are injured or disabled in an accident. More than three fifth of brain injuries was caused by RTAs. Head and neck injuries leads to major spinal and brain damage.

3.   RTAs also effect on the psychological and social well-being aspect of a person along with his/her family.

3 PROMPT MEDICAL HELP IN RTA

The world health organization states that 50% of deaths in accidents can be prevented by prompt medical care if given with 30-60 minutes of the accident. First aid is the initial care given to the injured before a proper medical treatment begins. The first aid can be the difference between life and death if a person receives it before a medical help and also helps the wounded to recover faster.

Critical four minutes: When a person meets with an accident, after the impact when the air supply is blocked there is loss of oxygen that can cause death. Therefore the first four minutes becomes crucial.

The 'golden hour': The person has a greater chance of survival if first aid is given within an hour of an injury.

The first aid in emergency situations involves techniques that enhance the preparedness and trigger immediate response to health emergencies. Evidence proves that first aid are the life saving measures when given to person immediately enhances the chance of survival an even reduced consequences of injuries.

If information like location and time of such accidents or injuries can be communicated to the right contact at the right time and prompt medical help is provided it might help change the fatality rate of such accidents in our country.

4 REVIEW OF RIDESAFE

RideSafe is a system consists of an android mobile application as well as a small hardware setup. To overcome fatality rate number an improved bike accident detection and alert system is presented. The system consists of two modules namely an accelerometer cum gyroscope and GPS (Global Positioning System) cum GSM (Global system for Mobile) module of the

mobile device are used along with a Bluetooth module.

The main target is to make accident detection and alert detection for two wheeler vehicles as they are most vulnerable to accidents. The system detects the crash and sends the location of the driver in the form of a small message along with a link of location. There is no delay in communication and the medical help can reach the person faster even if the person is unable to communicate the information. Notification of such occurrence place and important role in analysis of the situation and better response time. The time of occurrence of the accident and the time of arrival of the medical health is an indicator to most of the survival cases. [5]

In the proposed system, biomechanics of the bike such as lean angle and data of various sensors such as accelerometer and gyroscope from the hardware and mobile device sensor (accelerometer) are integrated and studied to identify potential accident scenario. The same model can be applied to cycling, skiing and running etc. Features:

4.1   Architecture of the System

The proposed system consists of a crash detection hardware setup and an android mobile application on a smartphone. Sensors will constantly monitor the two wheeler vehicles orientation and as soon as bikes posture changes abnormally it sends an alert message to the synced contacts via SMS and location using GPRS of the mobile device.[1]

4.2   Accident Detection System

The MPU-650 sensor is a calibrated gyroscope cum accelerometer that is connected to the arduino uno. Further arduino is connected to a bluetooth module (HC06). As the vehicle falls or there is a potential crash the readings of the sensors would change abruptly the arduino signals bluetooth to communicate to the android application to send the alert SMS with location. [1]

4.3   Bluetooth Connection with Smartphone

The android mobile application and the hardware have independent bluetooth modules. Hardware has HC06 module and mobile application uses the bluetooth of the inbuilt mobile device. The information flow between the hardware setup and the mobile device take place by a bluetooth as it is efficient for small range connectivity. 4) Mobile Android Application

An Android application is used to communicate with the Bluetooth device and this Android application will send messages with the GPS location of the accident to the three synced contacts. Android Studio is used to develop the Android application. Android Studio for Android is an open-source web application provided by Google.

Purpose:

Accelerometer and gyroscope sensor are used to determine whether an accident had occurred. The communications between the modules are done by using Bluetooth. The smart phone with the android app will send a message to the friends and family of the victim through message. Crash detection and alert systems are highly relevant in these days and this project aims at developing a low cost solution for the same for

the benefit of the society.

5   FABRICATION OF COMPONENTS

5.1 Arduino and MPU-6050

- The MPU6050 supports only I2C Communication and hence, it must be connected only to the I2C Pins of the Arduino. The I2C pins of Arduino are multiplexed with the analog input pins A4 and A5 i.e. A4 is SDA and A5 is SCL.
- Coming to the MPU6050, we have used a normal breakout board that provided eight pins. The above image shows the schematic representation of the MPU6050 Breakout board.
- In this, we will be using the SCL, SDA and the INT pins to connect with Arduino.
- Hence, the SCL Pin of the Arduino (A5) is connected to the SCL Pin of the MPU6050. Similarly, the SDA Pin of the Arduino (A4) is connected to the SDA Pin of the MPU6050 board.
- Additionally, we will be using the Interrupt feature of the MPU6050 to indicate (or interrupt) Arduino when the 1024 Byte FIFO buffer is full. So, connect the INT pin of the MPU6050 to the external interrupt 0 (INT0) pin of Arduino UNO i.e. Pin 2.
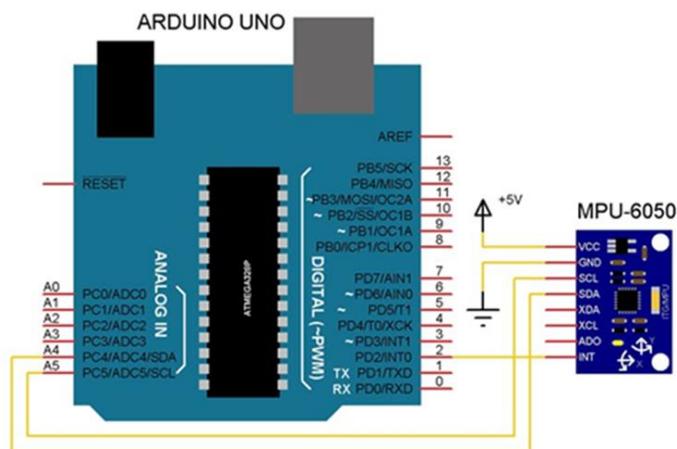- In I2C Communication, the MPU-6050 always acts as a slave.[3]

Figure 2: Connection between Arduino and MPU 6050

5.2 Arduino and HC-05 Bluetooth Module

- HC-05 is a serial port module which makes it very easy to use. If you see the pin configuration of HC-05, there are total 6 but we only need 4 middle ones for our set-up. o Connect VCC with 3.3V of Arduino, please do not connect it with 5V as that can cook the module
- Connect GND with any GND of Arduino
- Connect Rx pin with Tx of Arduino

• Connect Tx pin with Rx of Arduino

Now power-up the Uno using USB cable, a red light LED on HC-05 will start blinking, means we are ready to go forward.
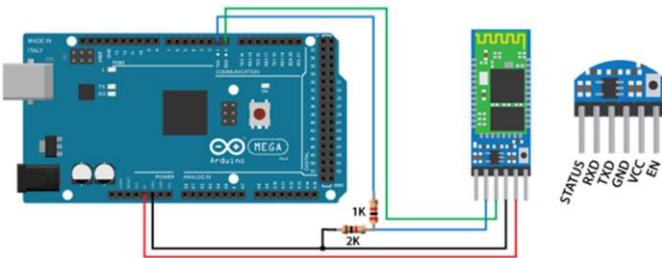

Figure 3: Connection between Arduino and HC-05 Module

5.3 How the hardware is working?

MPU-6050 Orientation Tracking – 3D Visualization
Next, in order to make the 3D visualization example we just need accept this data the Arduino is sending through the serial port in the Processing development environment. We read the incoming data from the
Arduino and put it into the appropriate Roll, Pitch and Yaw variables. In the main draw loop, we use these values to rotate the 3D object; in this case that's a simple box with a particular color and text on it. See figure to understand the Yaw, Pitch and Roll.
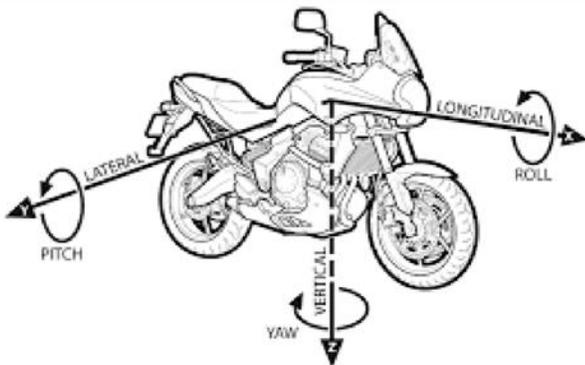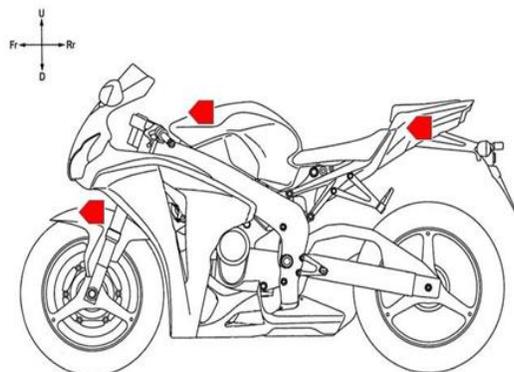

Figure 4: Yaw, Pitch and Roll variable

Figure 5: Bike along with sensors

The only down side is that the Yaw will drift over time because we cannot use the complementary filter for it. For improving this we need to use an additional sensor. That's usually a magnetometer which can be used as a long-term correction for the gyroscope Yaw drift. However, the MPU-6050 actually has a feature that's called Digital Motion Processor which is used for onboard calculations of the data and it's capable of eliminating the Yaw drift. below shows how sensor can be placed to get the accurate data about the orientation of the bike.

5.4 Android Application

The name of the android App is "RideSafe". The android app is a medium to read the values collected from the sensor and make a decision to send out the help message to trusted contact The Text message contains the location of the user where accident took place in the form of link which opens the Google Map.
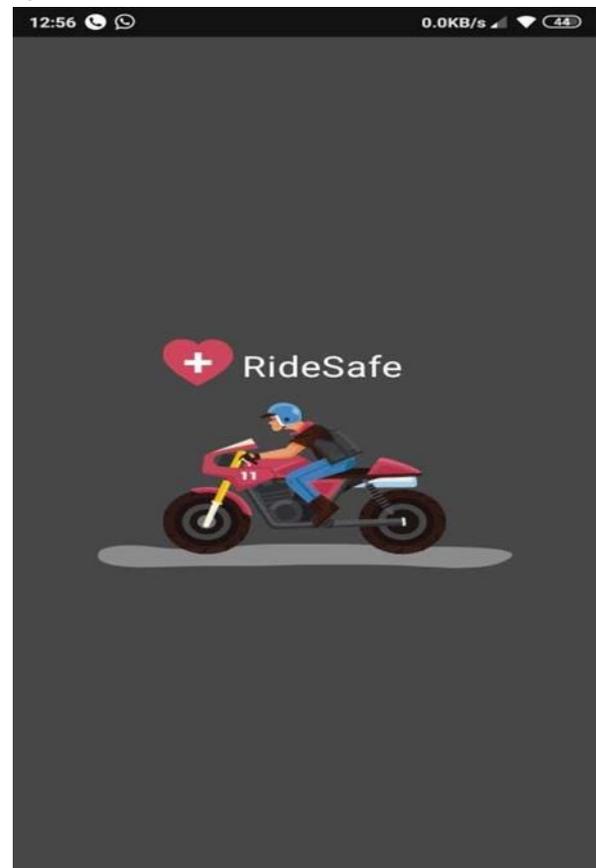

Figure 6: Screenshot of the Android Application

6 CONCLUSION

This paper clearly depicts that fatality rate has increased globally as well as in India. Most of which are two wheeler Vehicles. Result of this analysis and review is intended to provide an insight on road traffic accidents and give an overview of recent year's scenario and how a motorcycle crash detection and alert device can benefit the person. The result of the analysis clearly shows a relationship between fatality rate and prompt medical help and how it can help reduce death numbers of accident and is validated with data. Ridesafe, Motorcycle Crash detection and Alert system performs it functionality. In addition, further works on test cases for various scenarios and improvement on accident data recording system is required and its integration with current motorcycle crash detection and alert system is recommended.

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