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Rohan Sahay
Department of Electronics and Communication Engineering, BIT Mesra, Jharkhand, India

Anoopraj Verma
Department of Electronics and Communication Engineering, BIT Mesra, Jharkhand, India

Megha Dadel
Department of Electronics and Communication Engineering, BIT Mesra, Jharkhand, India

Corresponding Author:
Rohan Sahay
Department of Electronics and Communication Engineering, BIT Mesra, Jharkhand, India

Accident detection and reporting system for 2-wheel vehicles

Rohan Sahay, Anoopraj Verma and Megha Dadel

Abstractz
The rise of vehicles has increased the rate of road accidents which are playing one of the major roles in causing life loss. Moreover, poor emergency facilities enhance the risk of severity caused by an accident. The severity can be brought down by providing medical facilities at right time. The proposed work is based on a system that integrates ADXL345, ATMega328, and ESP32. When two-wheeled vehicles meet with an accident, a system that is installed on vehicles will detect the accident by Adxl345 which is detecting its orientation coordinate. ADXL345 will be sending coordinates to ATMega328 which in response sends a signal to ESP32 (if the accident condition is satisfied) to trigger an alert mail to the user's contacts mail ids. In case of false detection of the accident or case of technical glitch, the user can terminate the alert mail by pressing a button provided in the vehicle, in such a situation. The objective of this system is to provide adequate help within a definite time frame and reduce severity of the condition by sending alert mail.

Keywords: ADXL345, IFTTT, ATMega328, ESP32, API, accelerometer

Introduction
The exponential rise of the vehicular system has a huge impact on globalization and the economy in the modern world. But it also causes calamity because, as the globe's population grows, the number of vehicles grows at a far faster rate, increasing rush and increasing the chance of crashes that result in death all across the world [1, 2].
Various researchers have found that the maximum road accident causality is increasing as a result of emergency services' delayed response. Once the accident occurred, the alert mail was sent through ESP32 & IFTTT. This helps in knowing when his accident occurred and giving immediate first aid at the earliest. Another option is to use a GPS receiver to monitor a vehicle's speed, detect an accident based on the monitored speed, and report the position and time of the accident to the Alert Service center through the GSM network using GPS data processed by a microcontroller [3]. The accident can be detected with help of ADXL345. The orientation coordinate of 2-wheeled vehicles is measured. The ADXL345 is a low-cost device that typically has an accelerometer and gyroscope on all three axes, which can offer enough information on orientation coordinates [4]. If anyhow, a technical glitch condition arises, then a press button is provided by which the user can terminate sending of Alert mail [5].
There are numerous accident detection devices available today. Seldom these technologies are high priced and focus on four-wheelers only. A low-cost solution aimed at two-wheelers is largely absent although accidents are mostly faced by two-wheelers. The usual technique for detecting the accident employs the Global Positioning System (GPS) to determine the accident spot, and then sends a message via a microcontroller [6, 7].
This research presents a technique for identifying the occurrence of an accident using the two-orientation wheeler's coordinate.

Related Work
In [1], Fatma *et al*. suggested a completely automated accident detection and reporting system based on GPS and GSM. It finds the accident site precisely, calculates the distance, chooses the closest Work done by Mamu *et al*. [2] is also available on the deceleration of a low-cost Micro Electro Mechanical Systems (MEMS) which is based on the Inertial Measurement Unit's accelerometers (IMU). Jubayer *et al*. published a study in which they employed a GPS receiver to check a vehicle's speed, detect accidents depending on the checked velocity, then communicate the accident location to an Alert Service centre [3].

Roberto Lot *et al*. in [4] suggested a unique approach for real-time roll angle determination in two-wheeled vehicles utilizing low-cost sensors. The suggested method employs a non-linear Kalman filter, and its performance is evaluated using both simulated and real data obtained on an instrumented test vehicle. In [5] Syedul *et al*. offer an accident detection and localization system based on determining deceleration and combining data from accelerometers and GPS. Goud *et al*. proposed a system inwhich a vibration sensor detects a signal or if a car rolls over, and a Micro electro mechanical system (MEMS) sensor detects the signal and transmits it to an ARM controller. After obtaining the information, the police can immediately trace the location using the GPS MODEM [6]. Darwin *et al*. proposed a method that sends out an alert before a dangerous scenario arises and promptly communicates the location of the mishap. Once an accident occurs, the alarm will be sent if the motorist is unable to drive and his or her location is tracked using GPS (Global Positioning System) [7]. In [8], Saket *et al*. provide an intelligent system for finding and reporting two-wheeler accidents. A microcontroller-based low-cost Accident Detection Unit (ADU) with a GPS positioning system and a GSM modem sense and transmits accidental events to a centralized server as part of the framework.

In [9] Srushti *et al*. proposed an Intelligent Accident Prevention method. The goal of the plan is to reduce the amount of time it takes to locate the accident and to provide emergency services. So that an ambulance may arrive on time and save a life. When a vehicle is involved in an accident, the Micro electro mechanical system (MEMS) sensor detects the signal, which is then processed by Arduino, according to Jayati *et al*. The Arduino uses the GSM Module to transmit an alarm message to a police control room or a rescue team, which contains the location. After receiving the information, the authorities can immediately trace the location using the GPS Module [10].

When a vehicle is involved in an accident, a sensor on the car detects it immediately and sends a message to the microcontroller, according to Nimisha *et al*. The microcontroller then uses a GSM modem to send the alert message to a police control center or a rescue team, which includes the location through GPS. The location of the accident will also be sent to the victim's relatives via an alert message. If no one is injured, the driver can turn off the alert message using a switch in the vehicle [11]. Aboli *et al*. presented a system in which an accelerometer sensor can be utilized in automotive security systems to detect vehicle vibrations and GPS to provide vehicle position, allowing unsafe driving to be detected. When an accident occurs, the accelerometer detects the signal and sends it to the AVR controller, the microcontroller activates the airbag, and a message with the accident location is sent through GSM to preprogrammed numbers such as ambulance, police station, etc. [12]

Proposed Work

A sensor is providing Coordinates to the microcontroller (ATMega328) on which the microcontroller decides whether it is an accident or not, based on the conditions provided to the microcontroller for the accident. The process is explained below in form of block diagram.

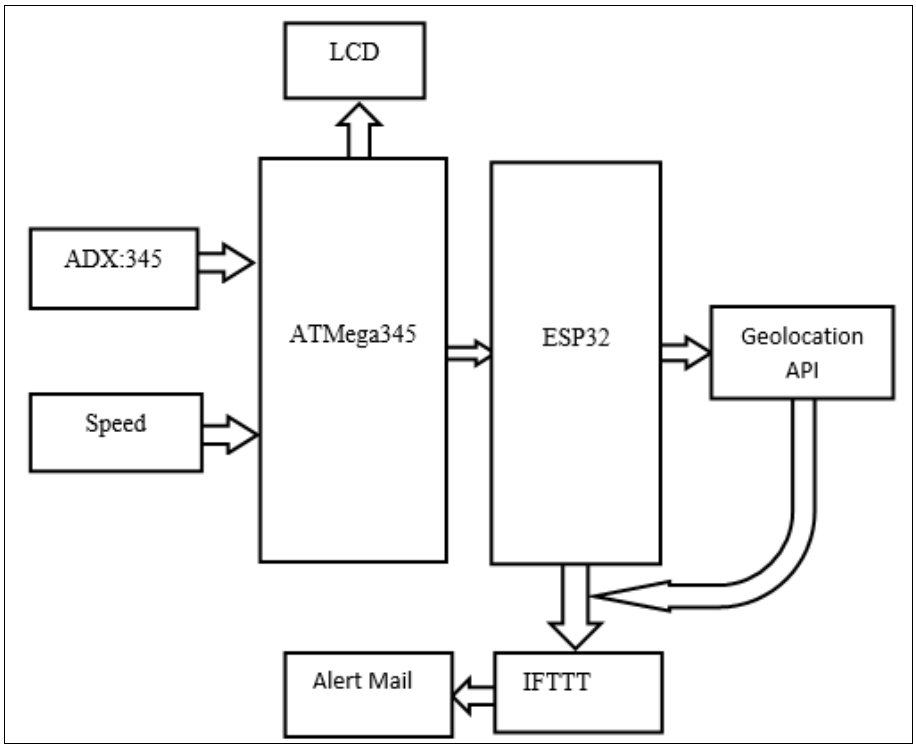

Fig 1: Block Diagram of Accident detection and reporting system

Here, the ADXL345 accelerometer sensor is used for providing coordinates to ATMega328.Whenever an accident condition is detected by ADXL345, then the microcontroller checks the condition of speed. If speed satisfies the condition of the accident, then the microcontroller (ATMega328) forwards this signal to the Wi-Fi module (ESP32 in this project). When ESP32 receives the signal of "accident detected by AtMega328" then an alert LED is triggered indicating that "Technical glitch counter" has started. If for any unwanted reason or bug, a technical glitch

condition occurs then the user can press the button, thus stopping the ALERT Mail from sending. If no technical glitch has occurred, then after waiting for 60 seconds, ESP32 triggers the IFTTT server by sending a request JSON string.IFTTT gets triggered by ESP32 using the HTTP POST method, thusgenerating and sending an ALERT Mail to the user's contact mail (whichhas been registered in IFTTT). Here LCD is used for displaying the coordinates received from ADXL345.For getting the location of the accident, Geolocation API is used. For using Geolocation API, ESP32 takes all the nearby internet signals and then extracts all signal details. Details: Mac address [Wi-Fi BSSID], Signal Strengths=0. After getting all details, a JSON string is formed according to the format provided by API, and then the request is sent using the HTTPS POST method.

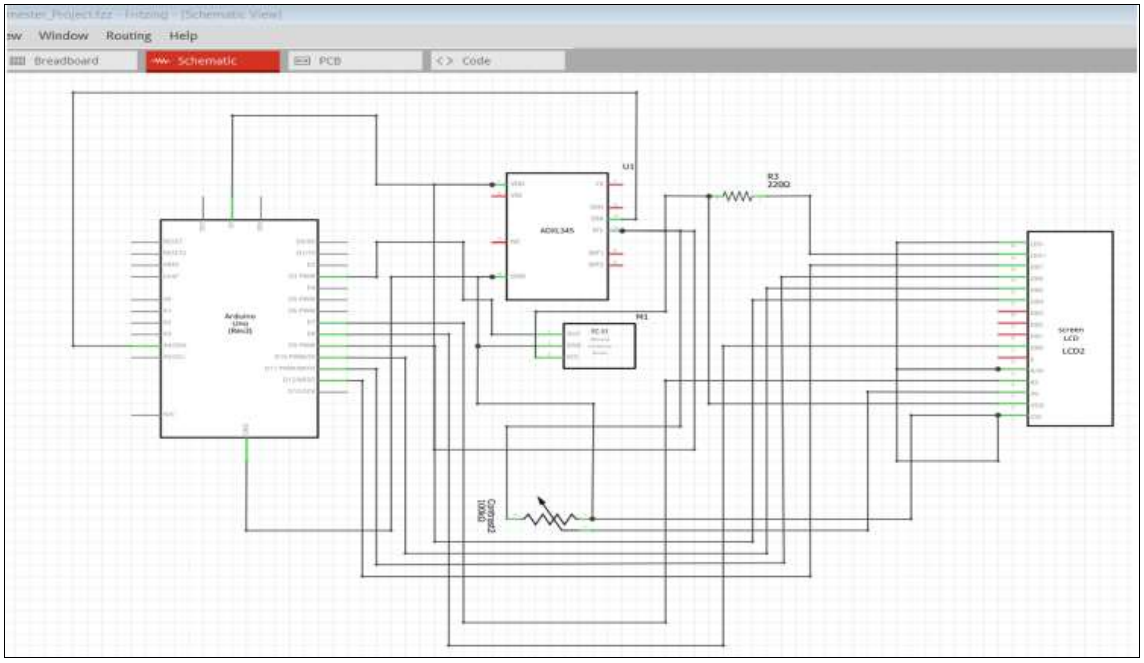

Fig 2: Schematic Diagram

A. ADXL345

A MEMS, analog type sensor which is a 3-axis accelerometer is used to detect accident. It can sense both static and dynamic acceleration, where we are using static acceleration for accident detection. It requires I2C interface and a power supply of 3 to 6V.

B. IFTTT

IFTTT stands for "If This Then That". It is private commercial company, mainly used in automation and IoT projects. It is using http post method to communicate with the device. It uses JSON for sending alert email. In this project, Gmail services of IFTTT is used.

C. JSON

JSON i.e., "JavaScript Object Notation" a lightweight, text-based language used for the interchange of data over the web. It is an extension of JavaScript scripting language and has a fil extension of "JSON" and is human readable data interchange. SON is independent of the language in which it is used.

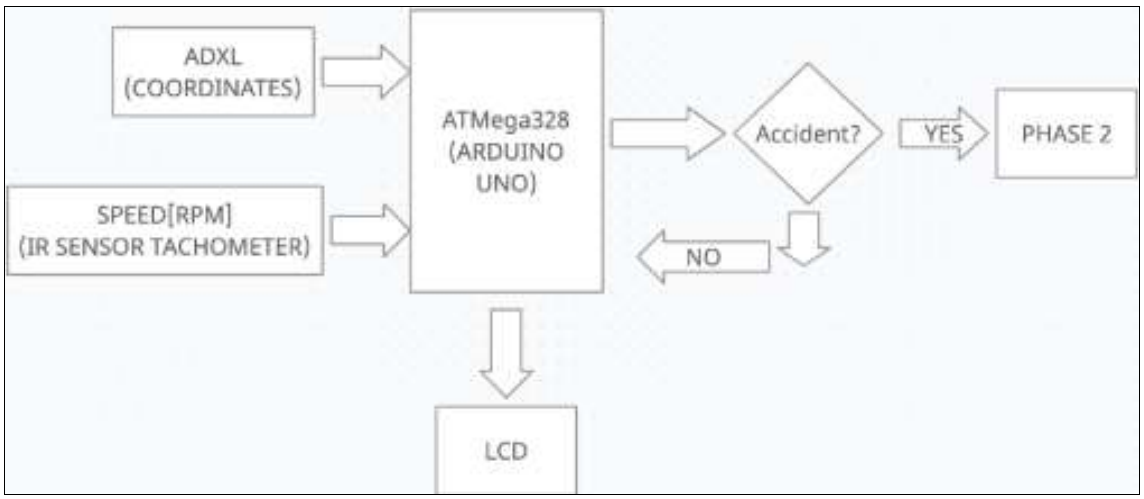

Fig 3: Flowchart

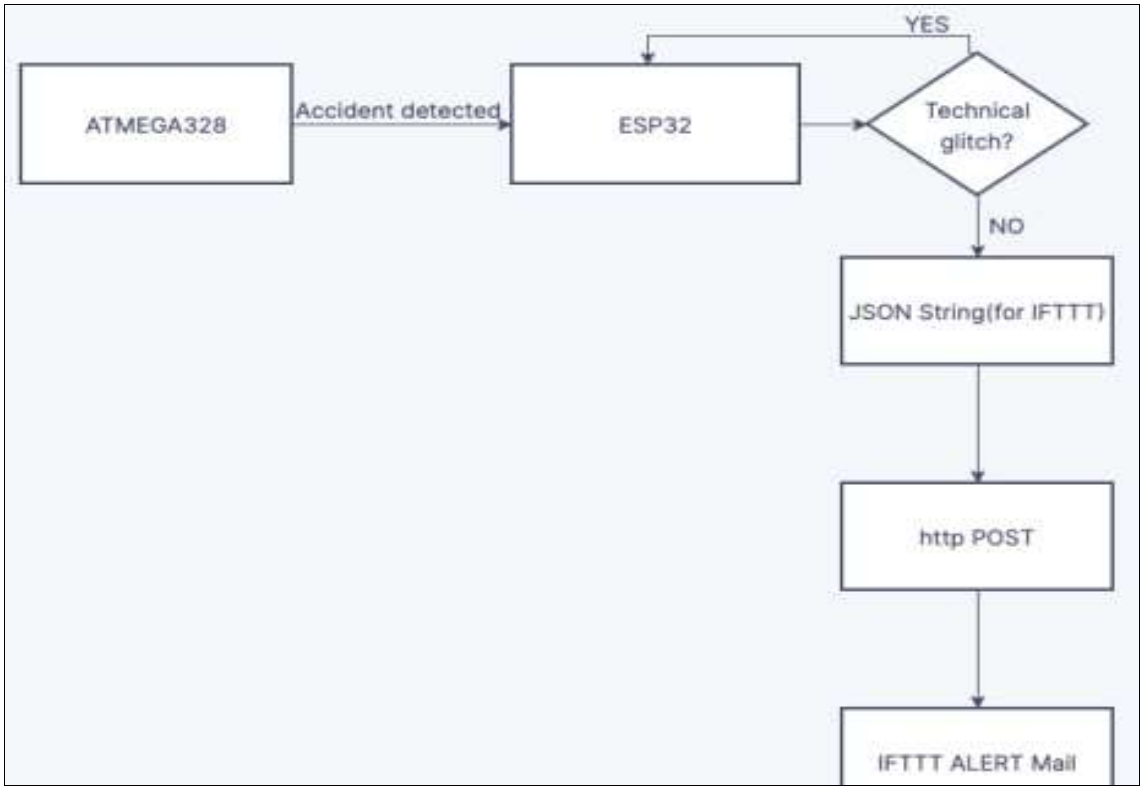

Fig 4: Workflow

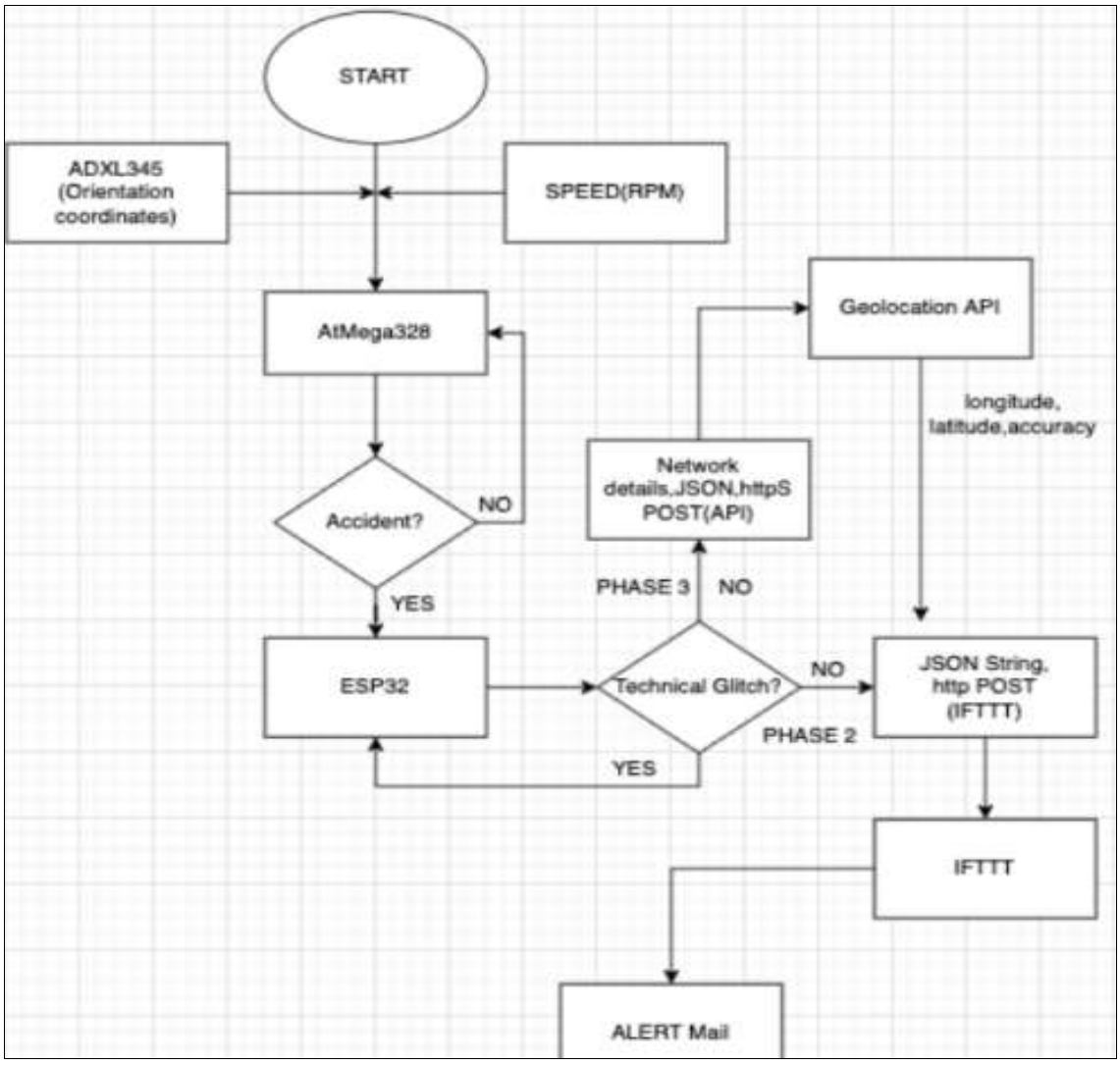

Fig 5: System Workflow

HTTP Status Code	Response Message	Additional Info (This is not part of the Response)
200	Success	This is when all is good.
400	Insufficient Input. Please provide Customer ID, UserName and Password	This is when any one of customerId, userName and password are empty or null.
400	Customer ID doesn't exist	This is when CustomerId doesn't exists in the database
400	User not found	This is when UserName doesn't exists in the database
400	Invalid password	This is when Password doesn't match
401	User account is locked	This is when all input is good but User account is locked

Fig 6: Response Table

Screenshots

The following section contains the screenshots of the hardware setup, output, and the alert mail. Fig 2 shows the hardware components that include Microprocessor ATMega328, ADXL345, LCD and IR sensor. Fig 3 shows graphically how accident is detected. Fig 4 shows the message that received from the detector.

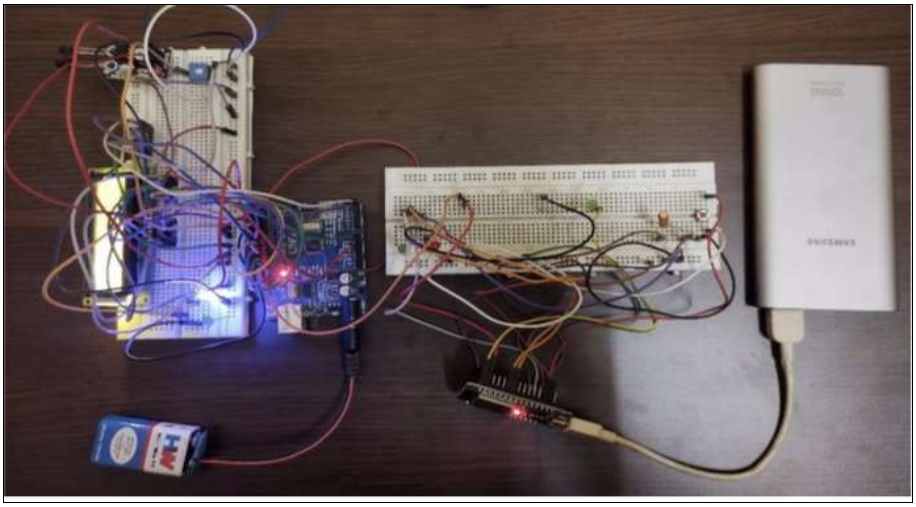

Fig 7: Accident Detector

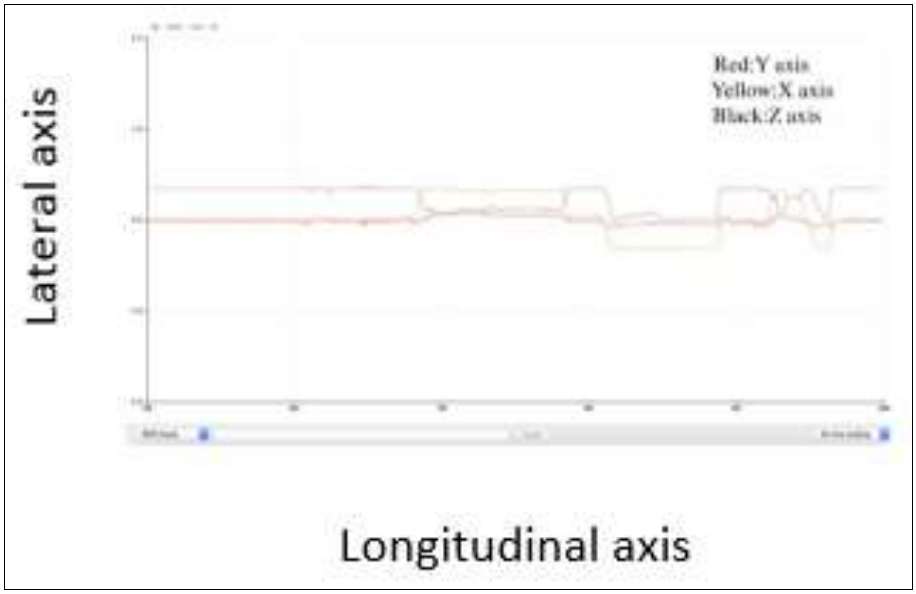

Fig 8: Accident graph

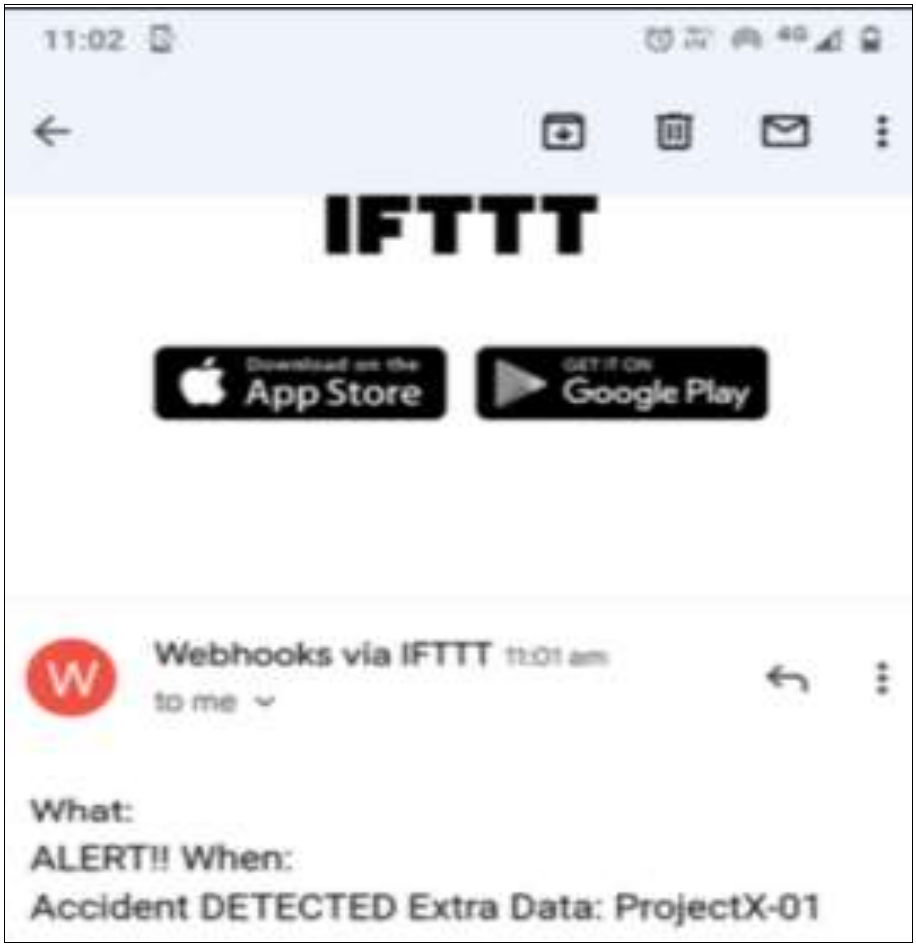

Fig 9: Alert Mail

Conclusion

In proposed work the system is developed which is capable of detecting accidents in any two-wheel vehicle and reporting immediately to the user's contacts through email, thus help in providing adequate help at an inappropriate time interval.

Accelerometer ADXL345 with Arduino Uno as ADXL345 uses I2C communication protocol allowing it to get interfaced with Arduino Uno easily.The coordinates from ADXL345 and another input speed i.e., RPM of the vehicleis provided to the ATMega328(Arduino Uno). Depending on these two conditions ATMega328 decides whether a situation is an accident condition or not. If the accident is detected a trigger signal is sent to ESP32 to activate. After being activated, ESP32 checks for the technical glitch. The user is provided with a technical glitch button so that he/she can press the button and terminates the Alert Mail from sending. If the technical glitch button is not pressed, then the device detects it as an accident and triggers IFTTT by using the HTTP POST method, and a JSON string is also sent for Alert Mail.

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