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Intelligent Accident Detection and Vehicle Security for Two Wheelers

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Abstract

Quick medical assistance in case of accidents aid in saving the lives. The main aim of this developed system is to alert the nearby hospital about the accident and to provide immediate medical aid. The system has various sensors such as accelerometer, vibration and tilt, to identify the variations in the vehicle. The system makes decision based on the value of the sensors and sends the information through smartphones connected to the Raspberry pi module. The vehicle security system uses a fingerprint recognition for ignition of vehicle engine to ensure the protection of the vehicle from unauthorized access.

Keywords: GSM, GPS, Fingerprint Sensor, Accident detection system.

1. Introduction

Accidents are one of the most serious threats that a person encounters when driving a vehicle, especially when riding a two-wheeler. So, this research proposes a method that detects accidents in distant areas and alerts neighbouring hospitals and the victim's neighbour about the accident, allowing the person to receive first assistance as soon as feasible. In this research, various sensors such as accelerometer, vibration, tilt, GPS, GSM, fingerprint, and RTC module using the Raspberry Pi 4 module are interfaced. The accident is identified by using the vibration and tilt sensors. If the value of the vibration and tilt sensors exceeds the predefined value, the system takes it as an accident , and the GSM module of the system will send an alert message to the victim; if the victim responds back to the message immediately, an accident has not occurred, the emergency protocol will be terminated. If the

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victim does not respond to the message, the system considers it as an accident, and after 60 seconds from the alert message, it obtains the geographical location via the GPS module and transmits the geographical location along with a message stating that an accident has occurred to a nearby hospital as well as the victim's family and neighbor's via the GSM module.

Using this technique, the death rate due to accidents may be reduced by ensuring that the victim has received the first aid as soon as feasible. Since an accelerometer is used, it records the speed of the vehicle. The system itself could act as a small black box and give the reason for the accident taken place and denotes the first accused

Additionally, a security system was developed for the ignition of the vehicle. The ignition mechanism is activated via a fingerprint sensor in this case. The user might save his fingerprint using the fingerprint sensor. When starting the engine, the user ignites it using his or her finger print. If the finger print matches with the already saved one, the relay will turn on and the motor starts, resulting in engine activation. If the finger print does not match with the previously saved finger print, an alert message is sent to the owner. If the owner is unable to start the engine using his fingerprint, to the owner can visit the login page, and reset his password using login credentials. Thus, this solution assures the vehicle's safety along with an alert system that tells local hospitals and the victim's family members about the accident and its exact position.

2. Literature Review

Paper [1] presents the hardware module (Arduino) for accident detection using vibration sensor. if the vibration value exceeds a certain limit, then an alert message was sent to the registered mobile number through an GSM module.

Paper [2] uses cloud technology to detect the accident. If an accident happens in an accident-prone zone it immediately sends a message from the victim's mobile to the nearest hospital. It senses the accidents using GSM, GPS, NODE MCU-ESP8266 modules.

Paper [3] aims to reduce the accident that happens due to carelessness of the particular person. The research uses the following software and modules such as My Rio, GSM and GPS. The entire system was simulated using Lab View and it detects the accident occurrence effectively.

Paper [4] helps to improve the response time and it was achieved using sensors and microcontrollers. Here they use gyro sensors for angle measurements and vibration sensors for sensing vibration. The gyro sensor monitors the angle between 45° to 315° and a vibration sensor detects the collision occurrence if the impact frequency was more than or equal to 90 Hz.

Paper [5] describes about the automatic accident detection system. This system immediately notifies an emergency text message to a contact person. Sudden change in acceleration, rotation and impact force in the vehicle was detected periodically in this system. It uses fuzzy logic for decision making.

Paper [6] consists of Android based application that detects an accidental situation and sends emergency alert message to the nearest police station and health care centre. The application was integrated with an external pressure sensor to extract the outward force of the vehicle body. It measures speed and change of tilt angle with GPS and accelerometer sensors respectively on Android phone. By checking conditions, this application also capable of reducing the rate of false alarm.

Paper [7] describes when an accident occurs Accident Detection (AD) takes place by enabling the Piezoelectric Force Sensor, which alerts the Microcontroller that is connected to GPS and GSM module. GPS finds the vehicle's exact location of accident occurrence and the Micro controller waits for a certain time to get a response from the Victim, based on the response from the Victim. A Smart Reporting System (SRS) will send a message to contact person using the GSM module.

Paper [8] proposed a system utilizes the capability of a GPS receiver to monitor speed of a vehicle and to detect the accident based on monitored speed and it will send the accident location to an Alert Service Centre. The GPS will monitor speed of a vehicle and compare with the previous speed in every second through a Microcontroller Unit. Whenever the speed will be below the specified speed, it will assume that an accident has occurred. The system will further send the accident location acquired from the GPS along with the time and the speed by utilizing the GSM network

Paper [9] developed the system using Raspberry Pi and Microcontroller where an on-board unit in every vehicle was required. The proposed system is capable of detecting the vehicle accident automatically, and performs necessary help to the affected people, and propagates the warning messages to the road side vehicles to avoid the further accident.

3. Methodolgy

The Raspberry Pi 4 module is connected to the various Sensors mentioned below to detect the accident as shown in Fig 1. Using GPS and GSM module, the person's current location can be identified and the emergency protocol is activated. For security reasons, the vehicle ignition was controlled by using fingerprint scanning system.

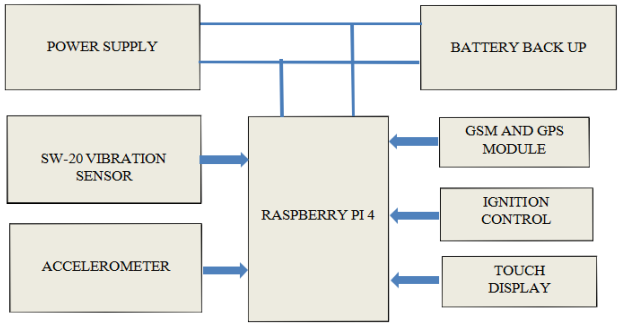

Figure 1. Block Diagram of Intelligent Vehicle Accident Detection and Security System.

3.1 Flow Diagram for Vehicle Security System

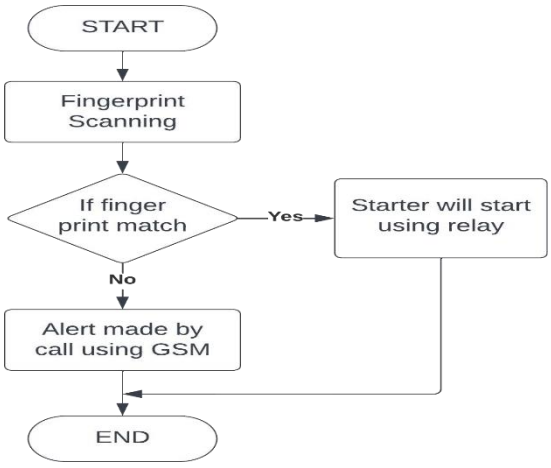

Figure 2. Flowchart of Intelligent Vehicle Security System.

An ignition system is activated using a fingerprint sensor. Initially the user saves his/her fingerprint using the fingerprint sensor. If the finger print matches with the saved one, the relay closes and the motor gets started and thus ignition of engine takes place. But if the finger print does not match with the previously saved finger print it sends an alerts message to the owner. The flow chart for vehicle security is shown in Fig 2.

3.2. Flow Diagram for Vehicle Accident Detection System

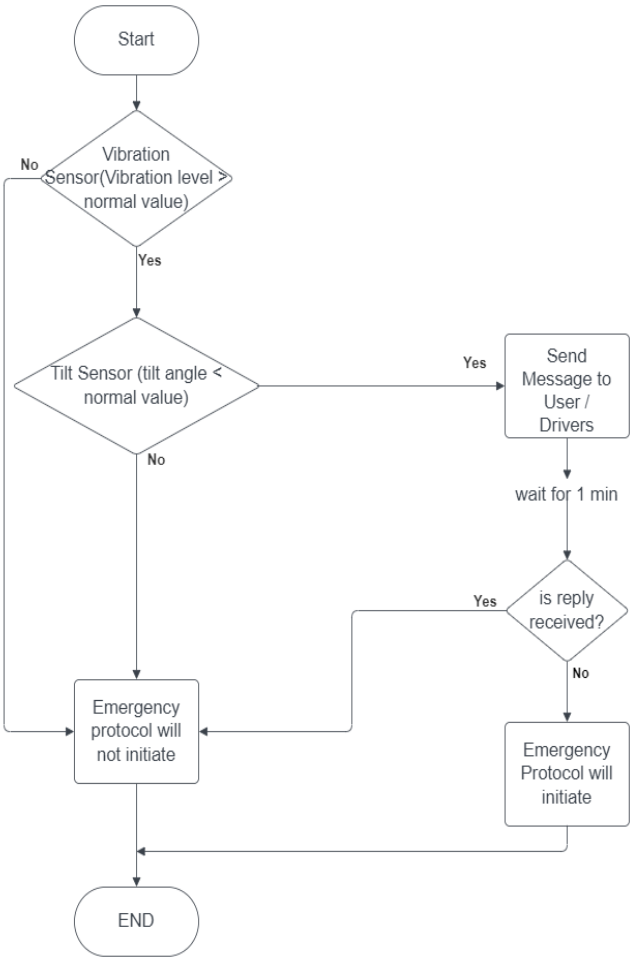

Figure 3. Flowchart of Intelligent Vehicle Accident Detection System

The vibration and tilt sensor will detect the accident. If the value of vibration sensor and tilt sensor exceeds the predefined value, then it gives an information that the accident has occurred and with the help of GSM module, an alert message will be sent to the victim. If the victim responds to the message immediately it means that an accident has not occurred and

the emergency protocol will be terminated. If the victim does not respond to the message after 60 seconds, the system senses that an accident has occurred and alert message will be sent to contact person

The system sends the geographical location through GPS and GSM module with a message stating that an accident has occurred and also it conveys the message to the nearby hospital and to the victim's family members. The flow chart for Intelligent vehicle accident detection system is shown in Fig 3.

3.3. Hardware Components

A. NEO-6M GPS Module

The NEO-6M GPS module is a device that uses satellite signals to determine the location and time of a device.

It is equipped with a Global Navigation Satellite System (GNSS) which receives the signals from multiple satellite systems which includes GPS, GLONASS, and Galileo.

The pin configuration for NEO-6M GPS is shown in Table 1. The module can be used to determine the precise location, speed, altitude of the device and time. It has a built-in antenna and can operate at temperatures ranging from -40°C to +85°C.

Table 1. Pin Configuration for NEO-6M GPS Interfacing

PIN NAME (NEO-6M GPS MODULE)	PIN NAME (TTL TO USB UART CONVERTER)
VCC	VC+
RX	TX
GND	GND

B. Fingerprint Sensor - R307

The R307 is a fingerprint sensor that is used to detect and identify fingerprints. It uses an optical fingerprint scanner to capture and to digitize an image of a fingerprint. The R307 is a compact and lightweight sensor that is easy to install and use. It has a high sensitivity and accuracy. This sensor is also durable and scratch-resistant surface, making it suitable to use in variety of environments.

The pin configuration for R307 Fingerprint Sensor is shown in Table 2.

Table 2. Pin Configuration for R307 Fingerprint Sensor

PIN NAME (R307 SENSOR)	PIN NAME (TTL TO USB UART CONVERTER)
VCC	VC+
RX	TX
TX	RX
GND	GND

C. MPU6050 Accelerometer

The MPU6050 is a micro electro mechanical systems (MEMS), which measures acceleration and angular velocity. It is a compact, low-power sensor that can be used to detect changes in movement and orientation.

The MPU6050 sensor consists of a three-axis accelerometer and a three-axis gyroscope, which are combined on a single integrated circuit.

This allows the sensor to measure acceleration in three dimensions (x, y, z) as well as angular velocity around those axes. The pin configuration for MPU6050 Accelerometer Sensor is shown in Table 3. The MPU6050 is commonly used in applications such as motion tracking, gaming, and virtual reality, as well as in the development of drones, robotics, and other motion- sensitive devices.

Table 3. Pin Configuration for MPU6050 Accelerometer.

PIN NAME (MPU6050 ACCELEROMETER)	PIN NAME (RASPBERRY PI 4)
SDA	GPI 3
SCL	GPI 5
VCC	GPI 5
GND	GPI 34

D. SIM-900a GSM Module

The GSM SIM900A is a wireless module that allows communication with other devices using the Global System for mobile communications network. It is commonly used in applications such as alarm and tracking systems. The pin configuration for GSM SIM900A

is shown in Table 4. The SIM900A module has a built-in SIM card slot, which allows to connect to a GSM network without any external hardware.

Table 4. Pin Configuration for GSM SIM900A.

PIN NAME (GSM SIM-900A)	PIN NAME (RASPBERRY PI 4)
SDA	GPI 3
SCL	GPI 5
GND	GPI 34

E. TFT Resistive Touch Screen Display

A TFT resistive touch screen display is a type of display that combines a TFT (thin-film transistor) LCD screen with a resistive touch screen. The TFT LCD screen is a type of display that uses thin-film transistors to control the flow of current to the pixels, resulting in high-quality images with a wide viewing angle. The pin configuration for TFT Resistive Touch Display is shown in Table 5.

Table 5. Pin Configuration for TFT Resistive Touch Display.

PIN NAME (TFT RESISTIVE TOUCH SCREEN DISPLAY)	PIN NAME (RASPBERRY PI)
HDMI	HDMI 0

4. Result and Discussion

The above-mentioned sensors are interfaced with the Raspberry Pi module in order to detect the accident. Based on the parameters obtained in Raspberry Pi it makes a decision whether the accidents have happened or not. Further the result will be displayed on the touch display. For security concerns the fingerprint is being scanned from the fingerprint sensor and it checks with the already saved fingerprint. If it matches with the saved one, ignition starts. Instead of ignition of motor, a blinking of LED was used. The working model of the developed system is shown in Fig 5.

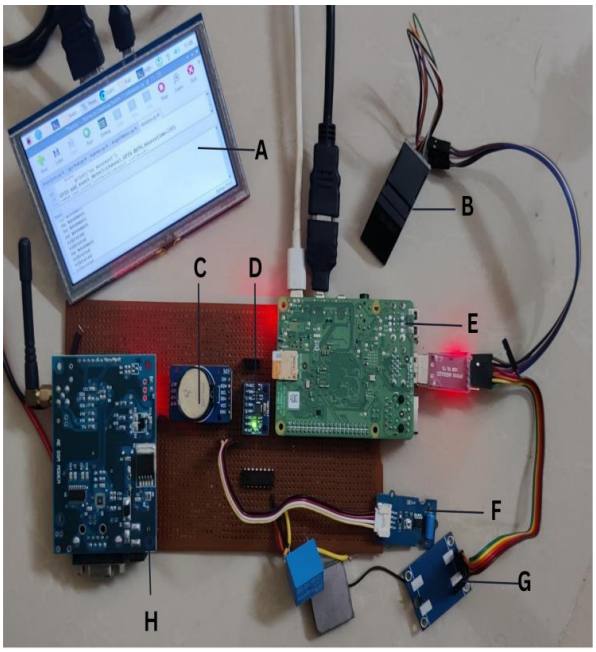

Figure 4. Hardware Model of Intelligent Vehicle Accident Detection and Security System.

The various components present in the hardware model are mentioned as A, B, C, D, E, F, G, H as shown in Fig 4.

A: LCD Display

B: R307 Fingerprint sensor

C: RTC Timer module

D: MPU6050 accelerometer

E: Raspberry pi 4

F: Vibration sensor

G: NEO-6M GPS module

H: SIM-900a GSM module

The output shown on the led screen is, When the fingerprint matches with the saved one, was shown as in Fig 5 as Ignition Started and Fig 6 shows the blinking of LED respectively.

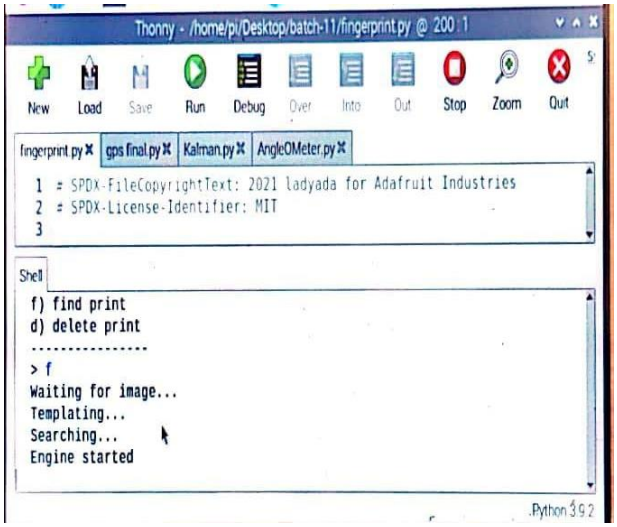

Figure 5. Fingerprint Recognition

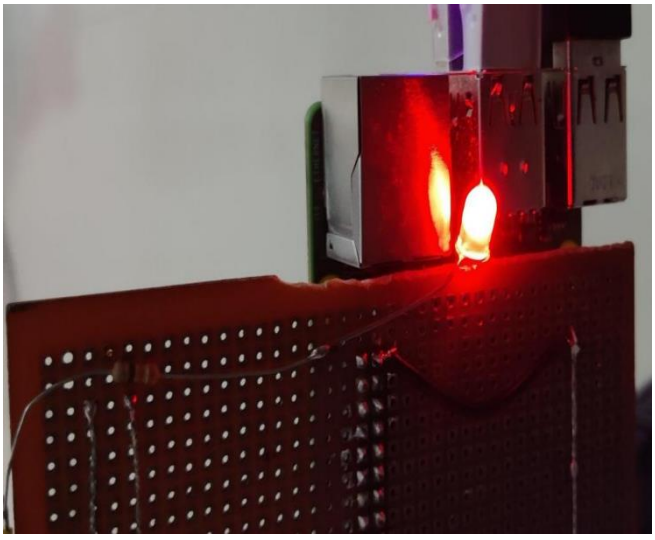

Figure 6. Output for Authorized Fingerprint

Using the tilt sensor, the vehicles tilt angle was being monitored, if the title angle exceeds the predefined value it sends a signal to the module and it takes the decision based on the title angle. The output from the tilt sensor was shown in Fig 7.

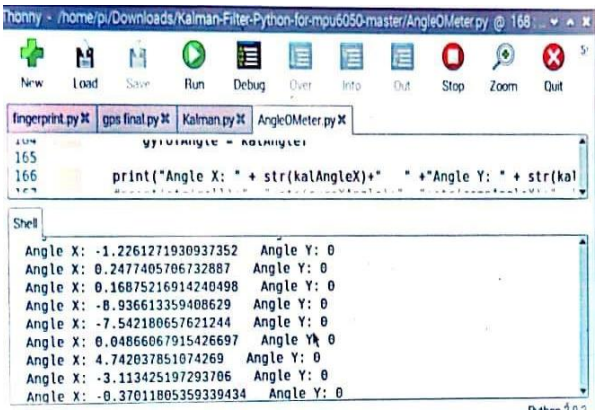

Figure 7. Angle Measurement

On the occurrence of accident, GPS module itself detects the person's current location and sends an appropriate location which further activates the emergency protocol. The GPS location values of the user was displayed in Fig 8.

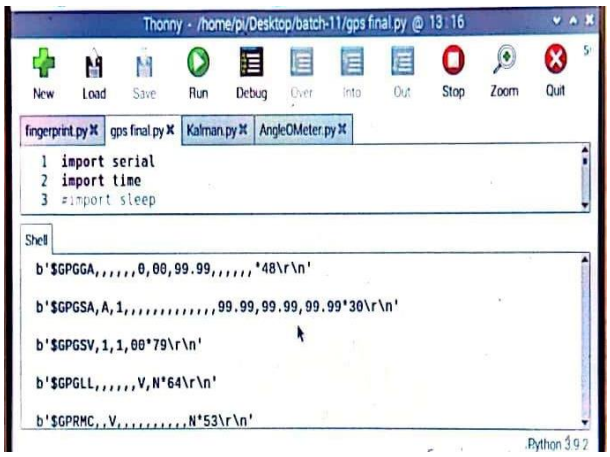

Figure 8. Location Measurement using GPS

5. Conclusion

A two-wheeler accident detection and security system with a flow distinct from an existing system was proposed. The standard system flow determines whether the victim is conscious. However, with the improved flow of accident detection system, it can determine whether the person was stable or not and the person can get the first aid as soon as possible preventing the fatal outcomes. With the improved accident detection system, with an integrated security mechanism helps to determine whether the vehicle was being used by

someone other than owner. Hence by implementing the improved accident detection and security system in two-wheelers reduce the fatality rate due to accidents

References

[1] Dr. C. K. Gomathy, K Rohan, Bandi Mani Kiran Reddy, Dr. V Geetha, Accident Detection and Alert System, Journal of Engineering, Computing & Architehture,2022.

[2] Nazia Parveen, IOT Based Automatic Vehicle Accident Alert System, International Conference on Computing Communication and Automation (ICCCA),2020.

[3] D. Vijay, Ibrahimbagh, Vehicle Accident Alert System Using LABVIEW, International Conference on Emerging Smart Computing and Informatics (ESCI),2021.

[4] Jasspeed Singh, Vengadeshwaran Velu, Umar Nirmal, Vehicle Accident Detection System using Internet of Things (VADS – IoT). IEEE. 2021.

[5] Asad Ali and Mohamad Eid, An Automated System for Accident Detection, IEEE,2015.

[6] Adnan Bin Faiz, Ahmed Imteaj, Mahfuzulhoq Chowdhury, Smart vehicle accident detection and alarming system using a smartphone, International Conference on Computer and Information Engineering (ICCIE),2015.

[7] Kavyashree S Kulkarni, Chaitra Shettar, Abheejit Chowdhury, Narasimha Kulkarni, Pawan Kumar Doddamani, vehicle accident detection, life-saving & smart reporting system, International Conference on Communication and Electronics Systems (ICCES),2021.

[8] Md. Syedul Amin, Jubayer Jalil, M. B. I. Reaz, Accident detection and reporting system using GPS, GPRS and GSM technology, International Conference on Informatics, Electronics & Vision (ICIEV),2012.

[9] Md. Saeef Abdul Hadi, Abhijit Saha, Faysal Ahmad, Mohammad Shahriyar Hasan, Mehebub Hasan Milon, A Smart Accident Detection and Control System in Vehicular Networks, 2018 5th International Conference on Networking, Systems and Security (NSysS).

[10] R. Vijaysanthi, N. Radha, M. J. Shree and V. Sindhujaa, Fingerprint authentication using Raspberry Pi based on IoT, 2017 International Conference on Algorithms, Methodology, Models and Applications in Emerging Technologies (ICAMMAET).

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