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Intelligent Vehicle Black Box System Using IoT

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Abstract. Humans are currently involved in numerous transportation-related accidents on the roads. Numerous accidents and fatalities caused by human error are the result of the rising number of vehicles on Indian roads and a lack of enforcement of traffic laws. They also suffer loss of life and valuable property as a result of those accidents. As a result, accidents involving driver inattention to traffic laws and driver fatigue follow. The field of computer vision is actively researching real-time eye detection and tracking. Face alignment can benefit from eye localization and tracking. The duration of eye closure and percentage of eye closure (PEC) can be used to measure driver fatigue. It is based on a hardware system that uses a camera to capture images of the driver in real time and software to monitor the driver's eye in order to prevent accidents. In the event of an accident, GSM and GPS are utilised to track the location of the automobile, and the local hospital and police are alerted. Thanks to IoT technology, this position may always be found in the cloud platform service. The 24/7 Governance is notified to call for emergency assistance by using the push and panic button.

1 Introduction

The Internet of Things (IoT) is a new kind of communication. IoT devices use a variety of wireless communication protocols to connect to the internet. Machine to machine service is provided to these devices. Devices like home automation, smart grids, and others are designed to function in real time thanks to the advancing IoT technology. The potential business is required for the technology's advancement and growth in order to develop the massive platform. Accidents account for millions of deaths each day, according to the WHO [1]. To find a solution to the problem in numerous nations, where a vehicle Black Box is being used to find one. Despite numerous campaigns, the problem continues to worsen on a daily basis, including drunk driving, speeding, and sleep deprivation. The visual data will be provided by this article, and the cloud will keep track of it with the aid of a low-power microcontroller. This is necessary because of the constant work that has been done in recent years. The first and second rules of this article are to current data to end users in a straightforward manner and to envision data by sensing sensors. The automotive technology is primarily levelled by the automation industry through low power and high range [2].

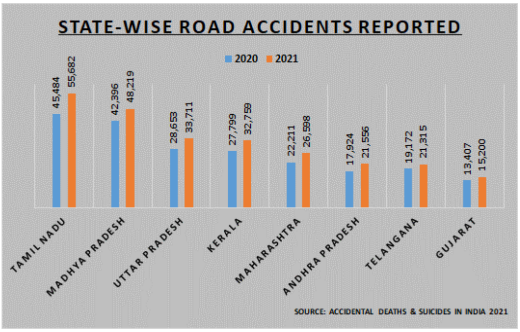

Fig. 1. Accident data analysis occurs in 2020-21

The black box in the car constantly refreshes the data that collects collision and location tracking information when it is in active mode. Therefore, the automobile collisions can be easily identified, making it possible for governments

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or hospitals to assist the victims. Indian Express reports that there were at least 4,80,652 accidents and 1,50,785 deaths in India in 2016. The figure suggests that 1,317 road accidents resulted in at least 413 deaths per day. In addition, the data reveal that 55 accidents per hour during the specified time period resulted in at least 17 fatalities in road accidents. The Fig.1 below provides the accident data analysis for 2017.

2 Literature survey

Millions of people die annually in traffic accidents, according to statistics from the World Health Organization (WHO). According to statistics, driver carelessness and fatigue account for the majority of fatal accidents. Nowadays, urban traffic congestion is getting worse, so some systems like GSM can be used to create a communication unit between vehicles. Using latitude and longitude to indicate vehicles' proximity, this system aims to monitor vehicles in the surrounding areas. With the assistance of a message indication, the drivers are notified when these vehicles are extremely close within this restricted proximity range. Inaccuracies in speed, distance, and response time calculations, among other issues, are the system's primary drawbacks [3]. According to Y. Ji and S. Wang, it is difficult to identify fatigued driving in complicated surroundings. In this study, for further exploration of driver tiredness states, a tired driving detection system based on multi-index fusion and a state recognition network is proposed. The face correction based on the key points of the eyes, determining the state of the eyes by intercepting a binocular image, and determining the state of the mouth by intercepting a mouth image based on the left and right corner points are some of the face detection and facial key point detection techniques used in this study. This makes it possible to detect the driver's head tilt, deflection, and other movements more precisely [4]. A state recognition network for the eye and a state recognition network for the mouth are employed in binocular vision to recognise the condition of the mouth. The two characteristics of the mouth state and the eye state of driver exhaustion are then combined in order to better explore the problem. The method has a detection accuracy of 98.42 percent on a dataset of public eyes, and a detection accuracy of 97.93 percent on a dataset of open mouths. In compared to other algorithms already in use, the suggested approach offers the benefits of high accuracy and straightforward implementation [5].

Abnormal driving behavior, according to J. Hu, L. Xu, and X., may be a major risk to the public and the motorist. We suggest examining typical driving behaviour in this study to spot aberrant driving. A specialised driver model is developed to act as the virtual driver and regulate speed using the locally developed neural network and actual Vehicle Test Data [6]. The driving behaviour is normalised by using the virtual driver to perform the speed-following job required by a typical driving cycle test, such as the FTP. The typical abnormal driving behaviors of being fatigued or drunk, being reckless, and using a phone while driving are all characterized and simulated. Based on the abnormality index is developed and used to quantify the abnormality [7]. To confirm the proposed scheme's efficacy, numerical experiments are carried out for increasing the rate at which the injured or partially obscured sign is recognized [8]. The PCA method has a very high rate of accuracy. a recognition self-organizing map (SOM) with a 99 percent hit rate that applied SOM to each level of RSs. For the purpose of recognizing red traffic signs, our method makes use of SVM with a bagged kernel and RGB subdivision and form matching detection to cut down on processing time.

The detection algorithm uses grayscale images to make it more resistant to changes in illumination. This situation prompts the investigation of additional security measures to prevent vehicle thefts. To prevent vehicle theft, we have decided to implement our project in vehicle safety and security areas. The user can keep track of their vehicle, its routes, and when it arrives using the Vehicle Tracking System [9]. There is yet another issue. Numerous individuals have chosen to travel in their own vehicle as a result of recent automobile industry advancements. Vehicle ownership has increased as a result of this. However, finding a place to park all of these automobiles in major metropolitan areas is a tedious and challenging task. Towing and other issues arise as a result of improper parking, for which there is currently no solution.

As a result, the parking issue and subsequent towing issue are also addressed in the project. To address all of the aforementioned issues, the project includes features like keyless door unlocking, keyless ignition control via keypad, and seatbelt use. The project can also locate a stolen or towed vehicle and address intruder issues from the vehicle's window. The vehicle's security should be improved by these features [10]. The Black Box Optimization, a more effective and accurate grouping variant of the differential grouping algorithm, can be proposed as a solution to this issue. By estimating the magnitude of round-off errors, the DG2 algorithm is used to determine a trustworthy threshold value. However, it is only used to determine how the two vehicles interact with one another. The test with high-voltage circuit breakers' short-line fault interruption is utilized by a brand-new black-box arc model [11-12]. During the interruption process, the voltage and current waveforms are often modelled using black-box arc models. The parameters of this arc model are generated in this study using an optimization approach over a specified time period in order to minimize the difference between the simulated and measured arc voltages. These arc characteristics are utilised in a condensed circuit to mimic short-line failures. Quantitative ratings are given to the model's accuracy in waveform fitting and interruption prediction. As a result, accidents that take place in a quiet area are not always possible. The following cases have been added to our proposed system in order to avoid these issues [13-14].

3 Proposed system

The suggested solution includes a functioning model of a black box system that may be integrated into a car. The solution also entails boosting security by guarding against harm to the black box data. The BLXDAQ (BlackboX Data Acquisition) module stores data on a vehicle's movement parameter, primarily for the purposes of accident analysis and safety measures. The sensors that are incorporated into the engine and system of the vehicle are connected to these modules. The vehicle's location in the cloud is updated using the IOT module. It indicates the vehicles' precise latitude and longitude in Fig.2.

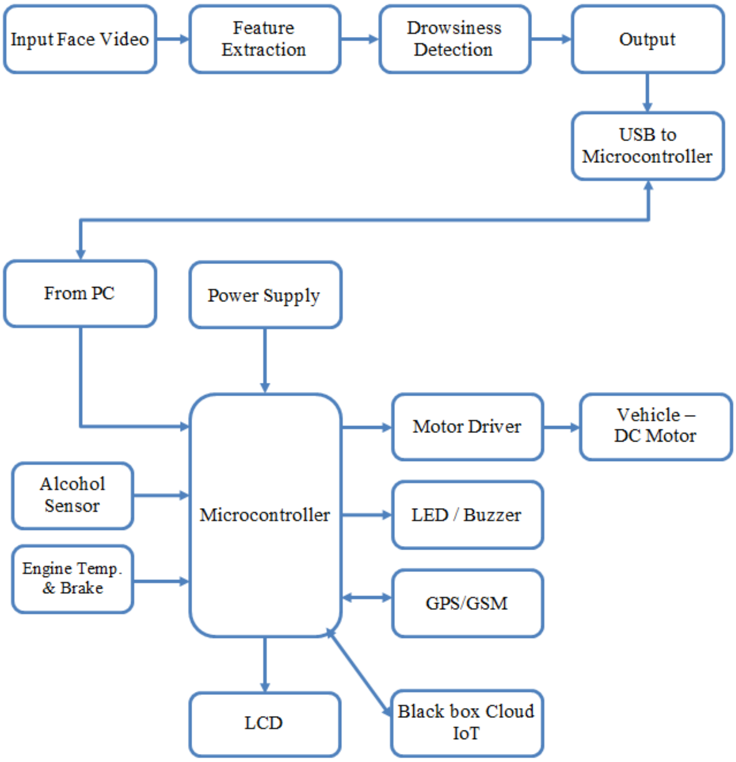

Fig. 2. Proposed diagram of Black-Box system

Due to the increasing movement of heavy vehicles, driving at night has become a challenging situation marked by numerous accidents and concerns for both transportation authorities and the general public. After a few days of continuous driving, the drivers' reduced reflexes reduce their ability to drive, resulting in accidents. The drivers are required to drive with little rest. Tiredness is found to be the cause of most accidents where people fall asleep. A combination of symptoms like poor performance and a subjective sense of drowsiness is known as fatigue. There is still no widely accepted definition for the term "fatigue" despite the extensive research that has been carried out. There are various types of fatigue, including the ones outlined below, which are viewed from the perspective of the individual organs' functionality: 1) physical fatigue in a specific area (such as a skeletal or ocular muscle); 2) general physical exhaustion as a result of extensive manual labor; 3) sleepiness (fatigue of the central nervous system); 4) mental exhaustion (inability to do anything). We can use linear discriminate analysis to notice faces and track the states of the eyes with greater precision in the proposed system. The carter's eyes will be closed as a corrective measure in the event of abnormal behavior, and an alarm will sound. After correctly locating the driver's head and eyes in the camera image, the system moves on to the analysis phase. For the purpose of detecting drowsiness, various Image Processing techniques are used to preprocess this image. Finally, provide a voice, SMS, and email alert admin with face recognition alert system. Additionally, an embedded system is used to slow the vehicle down to keep the driver from getting into an accident.

3.1 Microcontroller

The development processes determine a significant portion of the final system's functionality, therefore effort is made to ensure that the best techniques, resources, and tools are employed. IDE will be used to develop the system. There will also be usage of embedded C programming. With the purpose of enhancing performance, several system components will be migrated to Android.

3.2 PSU Board

This board is linked to the relay chip, which is then linked to the system for the vehicle model. The microcontroller, DC motor, and sensors' power needs are mostly met by this board.

3.3 Buzzer

This driver, which is powered by the microcontroller board, supplies electricity to the buzzer. To supply power to the buzzer, the enable pins of this driver must be high.

3.4 Camera

To capture continuous photographs of the traffic signs and signals in the actual world, a camera is employed. We can transmit the PC the photos obtained from the camera so it can operate the automobile based on those images.

3.5 Python software

Python is a high-level, all-purpose programming language that is often used for making projects of various kinds, including those for business and academic endeavours. Many versions of its programme are available, including IDLE, Python 2, and Python 3. Moreover, there are additional versions of Python IDLE for python programming accessible within these two categories.

3.6 Open CV

Open-Source Computer Vision is what it stands for. Its programming function library is mostly for real-time computer visions. It is mostly used for image processing, where it is employed for tasks such as face recognition, object detection, picture recognition, traces, and other related ones. It offers more than 2500 optimise algorithms for a variety of conventional algorithms and cutting-edge computer vision methods.

4 Intelligent vehicle black box system

4.1 Working principle

The majority of real-time apps failed due to insufficient power usage. The controller of this Intelligent Vehicle Black Box employing IoT utilizes less electricity and prefers real-time applications. Several sensors, such as accelerometers, ultrasonic sensors, and breathalyzers, are used to ensure the driver's safety. When a motorist exceeds his or her alcohol consumption limitations, the owner or the vehicle authority's designated contact is instantly alerted. By utilizing the technology, the driver will be vigilant and will refrain from such activities. When a collision is near, the ultrasonic sensor warns the driver by keeping track of the distance between the surrounding automobiles.

After a collision, the accelerometer measures the tilt values and simultaneously transmits the message and position through GSM and GPS. The panic button is used to contact emergency contacts, whereas the push button is intended to request aid from the government. Sensor readings and position are sent to the cloud for tracking reasons.

4.2 Hardware Design

The hardware is now integrated into automobiles as IoT technology develops. These vehicles' sensors gather information and send it to the microcontroller. As soon as the accident happens or the driver drinks, the emergency contacts will be notified. Vehicles consume a lot of energy, hence ESP32 is utilised to keep the programme running for a longer duration.

4.3 Designing Operational Flow

The operational flow design is shown in Fig.3. The many states in which the system transitions while the intended action is being performed are described by the following steps:

- Step-1: The alcohol sensor, ultrasonic sensor, and accelerometer start initializing after receiving power from the system.
- Step-2: GPS is always used to transmit the location to the cloud.
- Step 3: The ultrasonic sensors located in the front and rear of the car alert the driver through a buzzer if they assess that the space between the other vehicles in the area is narrowing.
- Step 4: Now, if these sensors exceed the limit, proceed to Step 4. If not, proceed to Step 3.
- Step 5: The message and the location are sent right away if the accelerometer detects a collision.
- Step 6: After the controller receives this message, it performs three tasks simultaneously. The message and the location will be delivered to the supplied cell phone number using a GSM module. The Cloud stores this location.

The system is put into a moving car once all the parts are connected correctly. The vibration sensor detects the acceleration caused by the collision in the event of an accident, and its ADC output pins are directly connected to Arduino ADC pin A0. The system is successfully initialized, the sensor is calibrated, and the samples of the sensor data vehicle are displayed on the LCD after the program has been successfully compiled and uploaded on the Arduino IDE. After receiving a GPS signal, the vehicle's current position's latitude and longitude, as well as its speed, are shown. When the accelerometer is shook unnaturally, such as in the case of an accident with a quick shift in axis, the latitude and longitude are also communicated through Google maps. Moreover, an SMS is delivered to the phone number in the code. The message is received at the specified location and mobile phone number.

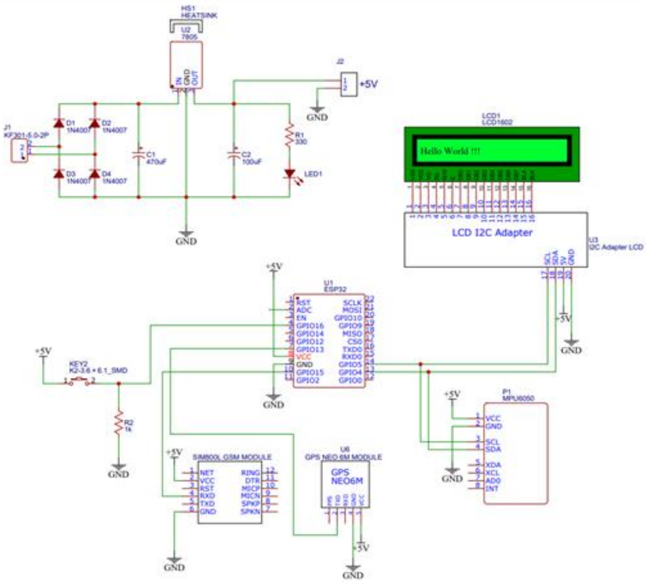

Fig. 3 Proposed Circuit Diagram

5 Conclusion and future scope

To solve global concerns, the Internet of Things (IoT) technology of today is quickly developing. The alerting of the driver in collision situations is the primary focus of this paper, and the location can be easily tracked by utilizing Cloud Computing Services. We offered a low-power microcontroller that could act as the device's main controller during automation in the hardware implementation as our contribution. We are certain that with major assistance from embedded systems, the Internet of Things, and cloud computing, the Intelligent Vehicle Black Box leveraging IoT will be dependable and power efficient in real-time applications. In the future, power consumption can be greatly decreased by GPS and GSM modules, which can be readily added into hardware, have a rechargeable battery, and can operate the device for a longer amount of time. The suggested system's objective is to offer details regarding the accident's location. Receiving help and aid for the accident victim is made simpler. This system's GPS module is utilised to find the car. To deliver accident information, GSM is employed. The suggested systems deliver results that are adequate.

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