VEHICLE INFORMATION STORAGE CONTAINER WITH VIDEO RECOVERING

A PROJECT REPORT

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Under the guidance of

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in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMPUTER ENGINEERING

of

FACULTY OF ENGINEERING AND TECHNOLOGY

S.R.M. Nagar, Kattankulathur, Chengalpattu District - 603203

MAY 2023

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Under Section 3 of UGC Act, 1956)

BONAFIDE CERTIFICATE

Certified that this project report titled "**VEHICLE INFORMATION STORAGE CONTAINER WITH VIDEO RECOVERING**" is the bonafide work of "**LALITH KISHORE S [Reg No: RA1911043010014]**" who carried out the project work under my supervision along with his batchmates "**YOKESH G [Reg No: RA1911043010008] and MANOJ KUMAR D [Reg No: RA1911043010032]"**. Certified further, that to the best of my knowledge the work reported herein does not form any other project report on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

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Signature of the Internal Examiner	Signature of the External Examiner

DECLARATION

We hereby declare that the Major Project entitled **"VEHICLE INFORMATION STORAGE CONTAINER WITH VIDEO RECOVERING"** to be submitted for the Degree of Bachelor of Technology is our original work as a team and the dissertation has not formed the basis of any degree, diploma, associate-ship or fellowship of similar other titles. It has not been submitted to any other University or institution for the award of any degree or diploma.

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ABSTRACT

Automobiles and advancing technologies have created a new level of data services in vehicles. The accident of the vehicle means an unexpected event that may cause damage to the body of the vehicle or of a body. The main goal of this Black Box project is to use a method to store vehicle accident data (in case an accident occurs), in which image data is taken by an ESP 32 camera while driving and the data is stored in real-time. In this suggested prototype, in order to connect the sensors and communication devices, Arduino uno microcontroller is used. The GPS work is to retrieve info on the whereabouts of the area. The texts about the accident information are sent to the respective person's caretakers by GSM. The model helps in real time monitoring of the vehicles at any given point of time from any place. The information can also be monitored online with the help of the IOT module present in the system. It is used for rescue and investigational purposes.

ACKNOWLEDGEMENT

We hereby our sincere gratitude to the **Management of SRM Institute of Science and Technology** for their encouragement bestowed upon us to complete this project.

We take this opportunity to thank Vice Chancellor **Dr. C. Muthamizhchelvan** for providing us with an excellent infrastructure for developing this project.

We express our sincere gratitude to our Dean – CET **Dr. T V Gopal** for providing us with an excellent infrastructure for developing this project.

We are greatly indebted to our Head of Department, **Dr. Shanthi Prince,** Professor for motivation and guidance throughout the course of the project work.

We express our profound gratitude to our guide **Dr. S. Yuvaraj,** Assistant Professor who has been a constant source of encouragement and support for guiding us through the course of the project work.

Our heartfelt thanks to our Project Coordinator **Dr. J. K. Kasthuri Bha,** Assistant Professor for the support and advice she has given us through our project reviews.

We express our gratitude to the **Faculty and Lab Technicians** of Department of Electronics and Communication for their ready and continuous support in technical assistance given.

Lastly, we extend our thanks and appreciation to our **family members** for their patience and understanding, without whose co-operation this report would not have materialized.

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ABBREVIATIONS

1 **AI –** Artificial Intelligence
2 **AT –** Advanced Technology
3 **Cam –** Camera
4 **DC –** Direct Current
5 **EEPROM –** Electrically Erasable Programmable Read-only Memory
6 **G –** Gas
7 **GPIO –** General Purpose Input/Output
8 **GPS –** Global Positioning System
9 **GSM –** Global System for Mobile Communication
10 **I2C** – **I**nter-Integrated Circuit
11 **IDE** – Integrated development environment
12 **IOT** – Internet of Things
13 **KB** – Kilobyte
14 **LCD –** Liquid Crystal Display
15 **LED** – Light Emitting Diode
16 **LPG –** Liquefied petroleum gas
17 **M2M** – Machine to Machine
18 **PWM** – Pulse Width Modulation
19 **SBB** – Smart Black Box
20 **SD –** Secure Digital
21 **SMS** – Short Message Service
22 **SPI** – Serial Peripheral Interface
23 **SRAM** – Static Random Access Memory
24 **T –** Temperature
25 **USB –** Universal Serial Bus
26 **WHO –** World Health Organization
27 **Wi-Fi** – Wireless Fidelity

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In the year 2022, WHO which is also known as the world health organization published data that showed that more than about 1.3 million casualties occur every season because of road tragedies[1]. The accident of a vehicle can be described as an unexpected scenario that may lead to physical damage to the person and the vehicle. Usually, a black box is a system or a device that is used in flights or aircraft for the sole purpose of collecting accident information in case it occurs for investigation purposes.

Everybody's driving fast and recklessly in this day and age. Accidents are on the rise in these scenarios. Every day there are more and more new vehicles on the road. This will lead to an increase in the number of accidents. There won't be a day on which there is no death caused due to a road accident. In order to reduce these accidents, a number of rules have been put in place, but they have not been able to stop them.

In Europe and America, the Highway Safety Association is planning to install certain devices in vehicles to provide passengers with a certain level of safety[2]. In this regard, General Motors has initiated a number of research and development activities. They are equipped with a number of protection devices, such as airbags, Antilock Braking Systems, and many more. But there is a need to be able to identify the actual cause of an accident in order to carry out research or development.

The accident can be caused by another person's mistake or a malfunction of the vehicle, such as gas leakage or fire damage. Major studies have indicated that over 90% of road accidents occur due to human error. A few car accidents which occur due to the error of the driver are:

- **Over-Speeding**:

Driving an automobile by the driver above the allowed road speed can be described as over speeding. Unfortunately, this act is practiced by almost most of the automobile drivers present in the country. In fact, it is a major killing act that accounts for about 70% of the persons killed.

- **Rash Driving**:

Reckless usage of the vehicle is one of the major attributes of road mishaps. Rash driving can be explained by a number of actions such as Performing sharp cuts, signal jumping, moving in the wrong lanes, etc.

- **Distracted Driving**:

These days almost everybody has a bunch of electronic devices at their disposal, this is one of the major reasons behind distracted driving. Using devices or looking somewhere else while driving the vehicle causes the person's focus to completely be taken away from the road which can lead to major mishaps.

- **Drunk Driving:**

Operation of the motor vehicle by a person while they are under the influence of any kind of alcohol can be described as drunk driving. It makes the driver drowsy and even causes them to have impaired vision. It is one of the major reasons for road accidents especially during the night.

Even though most road accidents occur due to human mistakes. The possibility of it occurring due to vehicle malfunction should not be ruled out. Gas leakage in vehicles can occur due to mistakes in fuel lines, broken tank caps, etc. These leakage accidents can cause major mishaps as they may even lead to fire or even explosions.

Sometimes the vehicle malfunction even goes to the extent of the vehicle catching fire on its own. An automobile is a huge and very detailed machine with a large number of electrical components. In most cases, A vehicle might catch fire when a collision occurs, electrical failure or even a tire burst.

1.2 PROBLEM STATEMENT AND OBJECTIVE

The main objective of this project is to store the data taken by the camera when a person is driving and to use the crash sensor, Temperature sensor, and gas sensor to get the three major road accident information when an accident occurs the system should be capable of sending crucial accident data such as an accident alert message with the location of the accident with its coordinates to the registered mobile number using location services and message services modules.

A model has to be developed so that it is capable of acquiring data for multiple circumstances at the time of a vehicle accident. This model has the ability to send accident information to the authorities or the respective person's caretakers.

There is a need for black box technology to be implemented on-road vehicles. In general, the black box can be described as a system that is used in airplanes or flights for the sole purpose of obtaining accident information if an accident has occurred for investigational purposes. It is also known as a Flight Data Recorder. It records all the activities that an aircraft performs when it is functioning. The black box makes use of a specific algorithm that records all the data of the flight. This data is only accessible to the authorities.

The system in this project will plan to implement the same black box technology in road vehicles for the sole purpose of rescue and investigational purposes. The purpose of this project is to provide effective solutions for the real-time monitoring of vehicles for investigational purposes.

Technically, A general black box system only performs the function of data logging. In road accidents, it is equally important for quick transfer of accident data and accident location for rescuing purposes as a road accident may lead to fatal injuries and sometimes it may even lead to a loss of life. Therefore, one of the main objectives of the proposed black box system is to produce a live vehicle tracking system to help with the immediate deployment of rescue personnel if an accident occurs.

1.3 SYSTEM

In this system, there is an implementation of the black box concept on street vehicles. It is a very efficient system that is used to collect crucial information like the vehicle's temperature, and if Presence of gaseous substances, and sends alerts in case an accident occurs. This proposed system consists of three sensors each of them used for checking different parameters. It also contains a GPS and a GSM unit. The GPS device is integrated for gathering current data when an incident takes place and the GSM is kept for sending emergency SMS in the situation. For photo capturing an esp32 camerais used. To store the data and the photos recovered an SD card module is used as a storage container in this proposed system. The main objective is to develop a system that can store the data collected by the sensors and the camera and retrieve road accident information and transmit image data and accident data with the help of cloud technology.

The main functionalities of the smart black box system is displayed below:

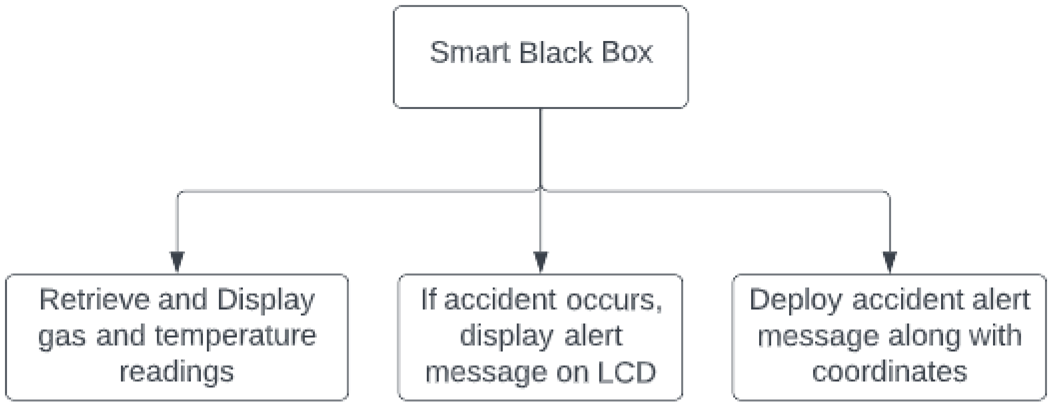

Fig. 1.1 SBB Functionalities

Overall, the proposed black box system is an easy and extremely effective way of collecting important accident-related information and is helpful in sharing this data when an accident occurs with the coordinates or the live location where it has occurred.

CHAPTER 2

LITERATURE SURVEY

This section will go through the previous research work on several aspects such as different implementations of vehicle black box, Different designs and Different outputs etc. A number of different research from trustworthy databases were gathered, read, and compared for creating a model that will be more effective and resourceful than the ones observed.

Yu Yao, and Ella Atkins [3] "The smart black box: A value-driven automotive event data recorder", designed an SBB to amplify less frequency band info saving with the value-driven big bandwidth data recording. The demonstrated SBB determines operations by static compression optimization over metrics for a data value, data size, and continuity. The data gathered by the device should be leveraged to deliver value to various stakeholders based on their unique needs, according to the authors' proposed value-driven approach for the smart black box. Law enforcement organizations can use the data to investigate accidents and establish liability, while insurance companies can use it to precisely assess the level of risk involved in insuring a certain motorist.

Nazia Parveen, Ashif Ali, and Aleem Ali [4] "IOT Based Automatic Vehicle Accident Alert System", made progress on events through the Gyroscope as it assists in figuring out the surroundings and if the retrieved value of a, b, and c parameters are more than the expected readings, an SMS alert is followed with immediate effect. The device's sensors are mounted within the car and can measure a number of things, including impact force, acceleration, and deceleration. The microcontroller that receives the data from the sensors processes and uses algorithms for its functioning.

Navin Kumar M, Pravin Kumar S, Premkumar R, and Navaneethakrishnan L [5] “Smart Characterization of vehicle impact and accident reporting system”, studied and designed a prototype that employs a microcontroller and four vibration sensors to detect an impact and figure out if the incident was an accident. When an accident occurs, this approach categorizes it as a sandwich, rollover, T-bone impact, rear-end collision, or head-on collision. In order to store and analyze the data from the system and enable remote monitoring and analysis, the scientists also suggested using cloud computing. The system's data may be used to rebuild and analyze accidents, giving useful information for enhancing traffic safety.

Gowshika, Madhu Mitha, Jayashree, s. Mutharas [6] “Vehicle Accident Detection System By Using GSM and GPS”, used a GPS, GSM, and accelerometer-based automobile accidentalert system powered by Arduino. This technology uses an accelerometer which is usedfor figuring out if any changes are noted down in the axis of the vehicle. The GSM is inherited for sending an emergency message to the rescue personnel. The system can runon only the GPS and GSM networks and is made to function in locations without accessto the internet. In order to analyze data from the GPS and GSM modules and determine whether an accident has happened, the authors also suggested using a microcontroller.

T Kalyani, S Monika, B Naresh, and Mahendra Vucha [7] “Accident Detection and Alert System”, focused on creating an accident detection system that focuses on accidents that happen due to careless behavior of the individual who is operating the car. This paper establishes an accident alerting system that sends an alert to the person who is driving the car. once the mishap has taken place an alert message will be dispatched to the registered mobile number. Overall, Kalyani the proposed accident detection and alarm model is a creative strategy for enhancing emergency response times. Real-time feedback that the system can give to drivers has the potential to enhance traffic safety and avert collisions.

CHAPTER 3

SYSTEM ANALYSIS

3.1 THEORY

This system tries to develop an SBB architecture to utilize appropriate data collection using a variety of sensors such as the MQ-2 gas sensor, Vibration sensor, LM35 temperature sensor, and ESP32 camera given finite local storage. The idea of the SBB is to implement efficient storage of data and provide necessary important information regarding the accident. The proposed model has used a wide variety of sensors and modules.

The system has used an Arduino Uno microcontroller for interacting with the other modules in the system. Arduino Uno is powered up using the power supply. The Arduino software (IDE) is used for programming purposes. The boot loader is used to upload the code onto the ARDUINO.

The Liquid crystal display is there to show the values of the person interacting. It is present in this setup as a Sixteen Cross Two display. It has the capability to contain 16 characters per sentence limit with 2 sentence lines accommodated in it.

The three sensors indulged in this design are the vibration sensor, Temperature sensor, and Gas sensor. The vibration sensor sends an alert once a high vibration has been felt. The temperature sensor displays the centigrade reading in the motored vehicle and the gas sensor shows data about the presence of gas or not in the surrounding.

There are other modules that are being used such as the GSM module, SD card module, and GPS. These modules are used for storage and communication purposes. When an accident occurs, the role of the GPS is to figure out the coordinates where it has occurred. Once that process is done, the role of the GSM is to deploy the alert message with the coordinates. All along, the SD card module keeps on storing all the data gathered by the sensors and other modules in the black box.

3.2 MODEL IMPLEMENTATION

The goal of the SBB is to store and log data continuously when a person is driving using three sensors and to store and retrieve major road accident information. This model helps in real-time monitoring of the vehicles and provides us with effective solutions when an investigation occurs. The flow chart below shows us how the monitoring is done:

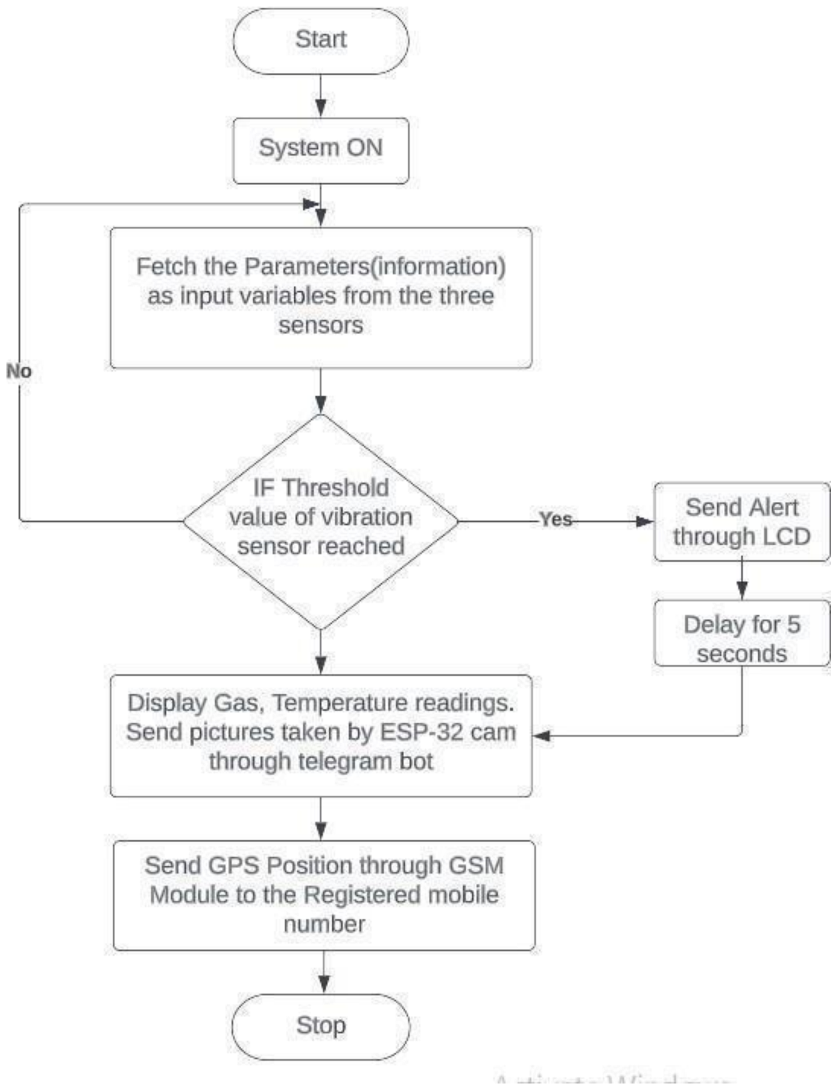

Figure. 3.1 Model Implement

3.3 METHODOLOGY

The methodology of this system involves a total of three steps performed. They are:

- **ACCIDENT DETECTION**: -

Three sensors are used to detect the accident. The temperature sensor is the LM35 Sensor. The gas and the crash sensor are MQ 2 and SW 18010P respectively. GPS data will determine the exact location of the accident. Whenever there's some irregularity in the sensor. Some sort of data is received by the Microcontroller.

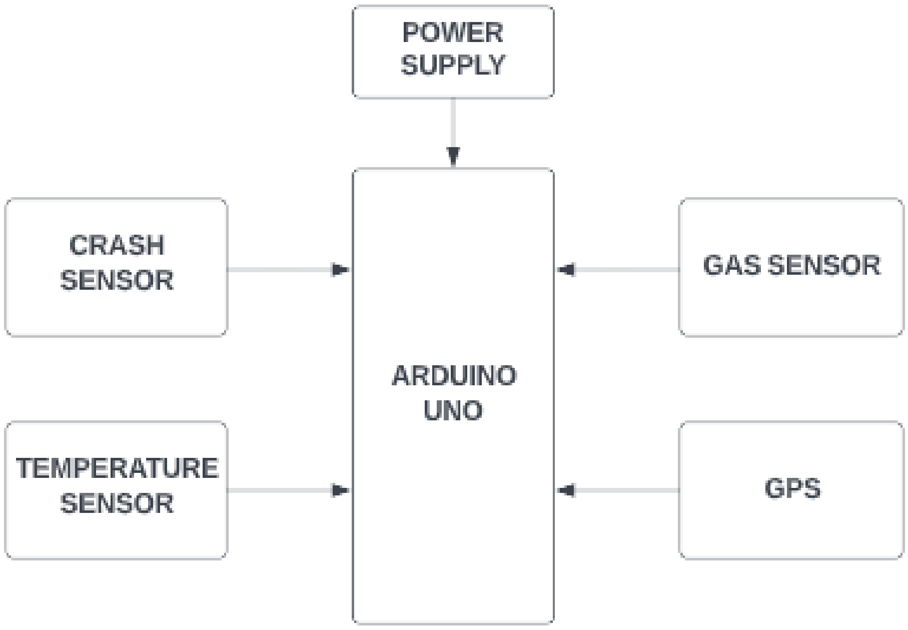

Fig. 3.2 Modules in the SBB used for detection of accident

As shown in the illustration above, the Arduino UNO microcontroller is responsible for interfacing with the systems. It is powered up by an external power supply. The temperature sensor used in this model detects the temperature in its surroundings in Celsius. The gas sensor used in this system is highly sensitive towards sno2, hence helping in detecting flammable gases.

- **STORAGE MODULES AND DATA RECEIVER MODULES**: -

The storage of all of the data from the sensor, ESP32cam, and GPS is made possible via the SD card module. If an accident occurs with the help of these modules, The data will be shared. With this knowledge, the research process is made simpler and more successful with proper values. The ESP32cam takes pictures at regular intervals. It can serve the purpose of a dashboard camera. The GPS obtains data regarding the current position of the vehicle. Both of these modules are connected to the microcontroller. These are the modules that help with investigational purposes if an accident occurs.

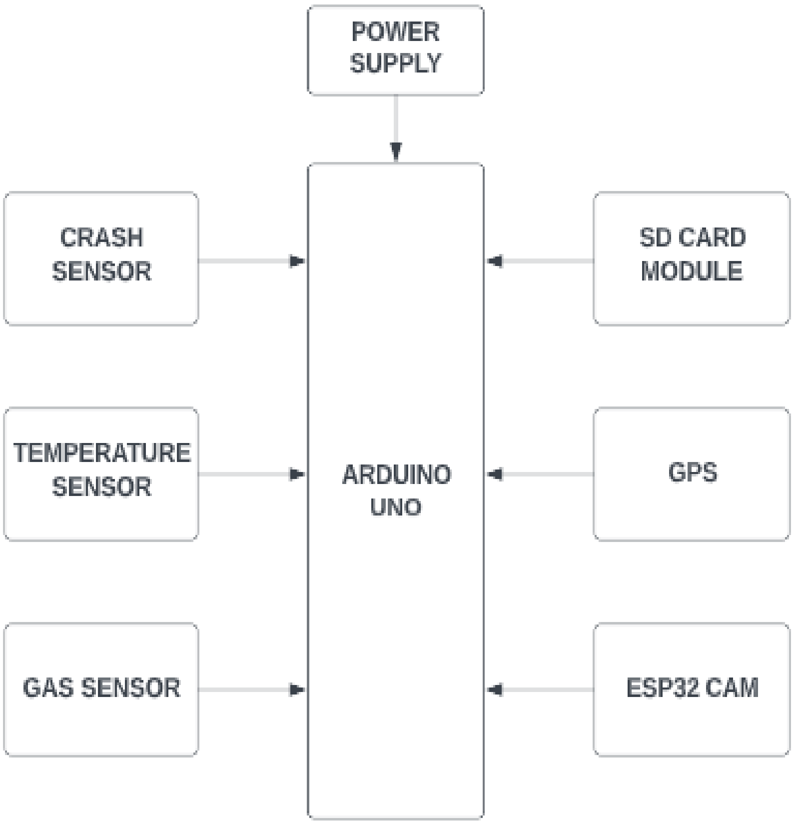

Fig.3.3 Modules in SBB that are used as storage and receiver modules

- **TRANSMISSION MODULES: -**

After, Collection of the data from the sensors and the ESP32cam the information is uploaded using the IoT module, and the information is sent using the GSM module. In case the black box gets damaged all the information is gathered through the IOT. The information regarding the car’s temperature and other crucial data can be viewed by others as the data gets published online using the IOT module. This helps the user to track the condition of the vehicle at any given time and any given place. These are the modules that help with the rescue operation if an accident occurs.

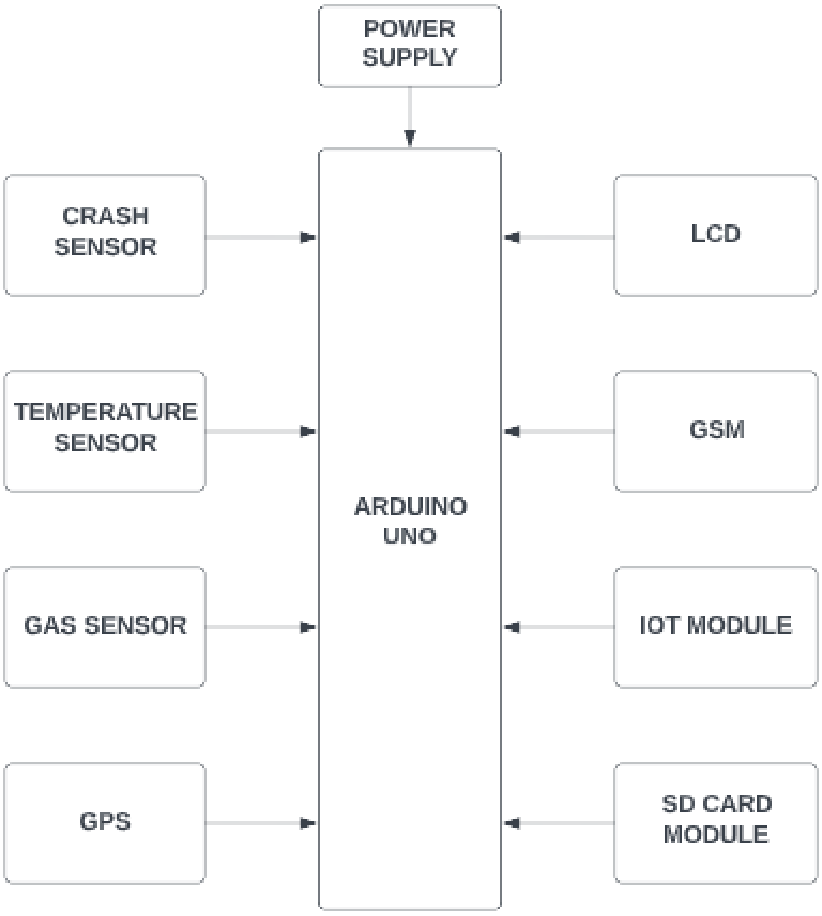

Fig.3.4 Modules in SBB that are used as transmission modules

CHAPTER 4

SYSTEM DESIGN

4.1 PROPOSED ARCHITECTURE

The architecture consists of a power supply, Arduino UNO, Crash Sensor (SW 18010-P), Temperature Sensor (LM35), Gas Sensor (MQ-2), GPS Module, GSM Module, I2C Liquid Crystal Display, SD Card Module, an ESP32 Camera.

The search for answers is made easier and more effective with the assistance of the data provided via these modules.

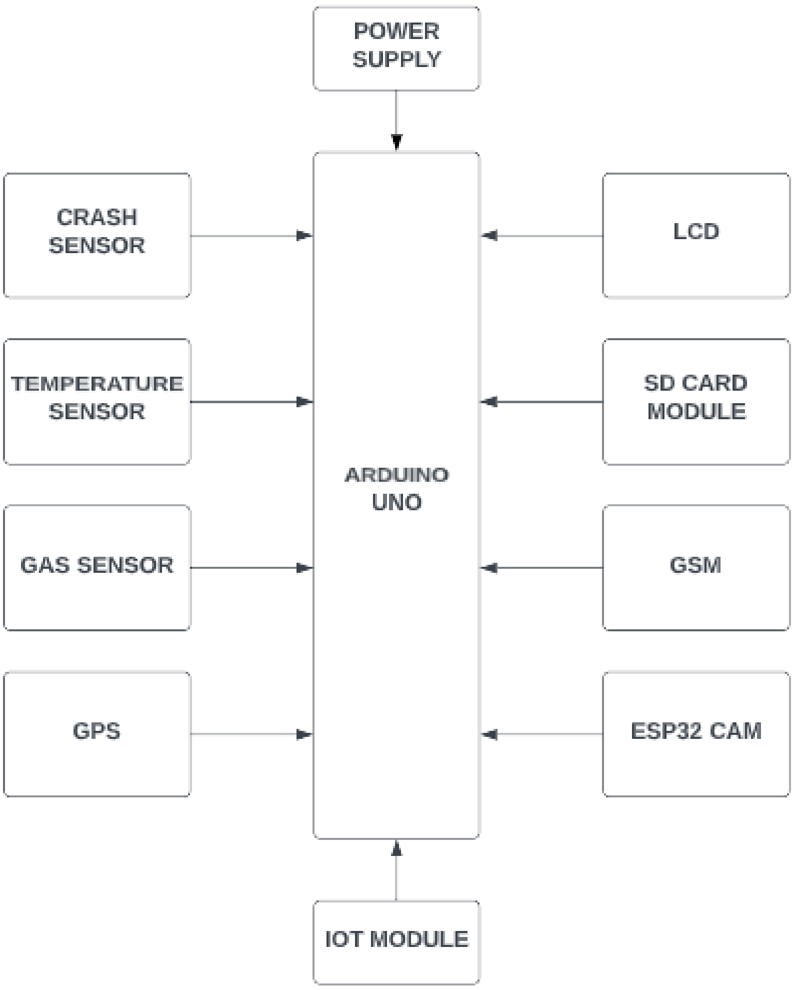

Fig.4.1 Complete SBB Architecture

The proposed method is demonstrated by the architecture above. The ARDUINO UNO is employed in this system to interact with the device's modules and communicate with the sensors. The LCD's purpose is to display the retrieved readings to the user. The microcontroller is connected to the temperature sensor, vibration sensor, and secure digital card. The cloud-based data is modified using the IOT device ESP8266. Through the utilization of the GPS device, details can be acquired about the location specifics of the automobile. GSM functions for transferring alerts to operators and other rescue personnel. The black box module captures the readings around the accident, saves them, and then returns the values. Every time an accident takes place, we can pinpoint the exact cause. The ESP32cam is used for collecting the live stream data.

This proposed black box model has the advantage of being able to connect to other users through the IOT and GSM module. People often come for rescue very late after the occurrence of an accident, which can sometimes result in fatal outcomes. whereas this design transmits an alert message to the registered mobile number as soon as a strong vibration is sensed, and it also updates the ADAFRUIT.IO website to reflect that an accident has occurred. This website also shows the user additional important vehicle data like temperature, the presence of a gas, etc. The ESP8266 is a Wi-Fi module, that allows Wi-Fi capabilities within many different systems, It is the Wi-Fi module utilized in this system. The GSM module is the module that is being used for sending accident-related information via text to other users. The name of this particular GSM module in this system is the GSM Modem-RS232.

However, we must first gain access to the accident site in order to send the information related to the accident. The GPS, or Global Positioning System, has been utilized to do this. Users can receive 3-Dimensional positioning and continuous real-time navigation through the GPS system across the world at any time. In other words, the system makes use of satellites to keep providing directions. In most instances, GPS satellites ideally orbit around the world twice every day. The orbital parameters of each of these 24 satellites allow these devices to decode and gather the present location. Each of these 24 satellites emits or sends a distinct kind of signal. The projected satellite ranges act as a description of the user's region. It is loosely adapted from the ‘trilateration’ math principle.

An ESP32 CAM serves as a tool for picture recording. It is a microcontroller that includes a microSD card socket in combination with a video camera. This camera was picked because, of its capacity to carry out sophisticated operations like picture tracking and recognition, it is perfect for IOT devices that ask for a camera. The two Megapixel sensor of the ESP32-CAM transmits images at a rate of 15 to 60 frames per second. The pictures of the vehicle are automatically transmitted to the user at frequent intervals because it permits WiFi image upload. The ESP32- CAM can be interacted with through a Telegram bot. If the user has access to the internet on their smartphone, they can utilize their Telegram account to request a new photo from any location. When a message or photo is sent to the ESP32-cam automation, the board on which it is built quickly takes a photograph and delivers it to the user.

For the system to function well and deliver the desired result, a power supply has also been employed to create a constant output-regulated power supply.

The Arduino software IDE is the software tool that was utilized for assembling this model. It is the common IDE that is used for connecting and uploading lines of code to the Arduino hardware.

The smart and effective use of sensors, advancements in the communication protocol, and remote monitoring techniques like telegram bots, cloud storage, accident message warning, etc. that can offer practical solutions for real-time monitoring in road vehicles for investigative purposes are the advantages of the proposed smart black box system architecture over the existing models.

4.2 HARDWARE DESCRIPTION

4.2.1 ARDUINO UNO

It is a free and open-sourced electronics framework with simple hardware and software. By using an Arduino board, it is possible to start a motor, turn on an LED, accept inputs such as light from a sensor, turn on a button, or even send a message. The board can be made to do a task by giving its microcontroller a set of instructions. A microcontroller that is based on the ATmega328Pis the Arduino Uno board. The Specifications are: -

- 5V is the operating voltage.
- Contains 14 Digital Input/Output pins.
- Supports USB connectivity and contains a power jack.
- Clock speed is 16 MHz

Fig.4.2 Arduino Board[8]

Advantages

- Low Cost.
- Supports Cross-Platform.
- Open source and extensible software.
- Easy programming environment.

Programming

It can be programmed with the help of the Arduino Software (IDE). The microcontroller's ATmega328 chip has a boot loader built into it that enables users to upload new code to it. The memory of the ATmega328 is 32 KB. Additionally, it includes 1 KB of EEPROM and 2 KB of SRAM.

4.2.2 LIQUID CRYSTAL DISPLAY

It can be described as a common electronic demonstrating technology that can be utilized in a variety of applications. The most common module is the 16x2 LCD display. It contains 2 lines that can display 16 characters in each line. Its specifications are: -

- Consists of Command and Data registers.
- Each character is shown in a 5x7 pixel matrix.

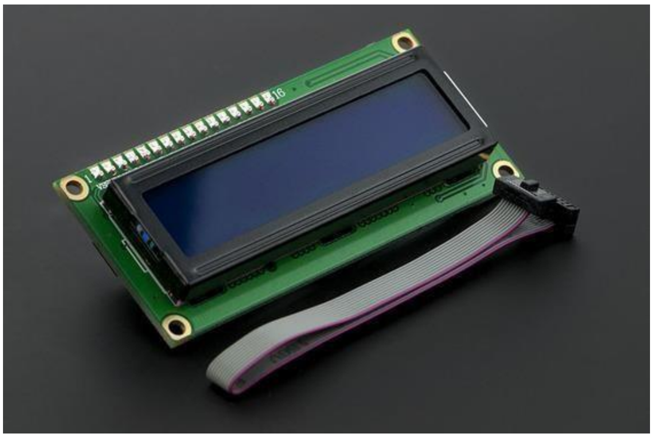

Fig. 4.3 I2C LCD Display[9]

Advantages

- Simple wiring.
- Easy to use.
- Low power consumption.
- Reduced code complexity.

4.2.3 VIBRATION SENSOR

It is a non-directional ultrasensitive sensor. The output’s high and integrated circuit board is active when the module’s stable. When a vibration or a movement has been felt, there will be a quick breakdown, resulting in low output. Furthermore, the sensitivity can be adjusted in accordance with the requirement. The vibration switch turns on in the presence of vibration and turns off in the absence of one. There are many types of vibration sensors available like Velocity sensors, Gyroscope sensors, Strain gauge sensors, etc. The specifications of SW 18010-p are: -

- Non-directional sensor.
- Sensor is present in an airtight seal.
- Response time is 2ms.
- Output is in digital switch form (0 and 1).
- Consists of an Onboard LED that indicates results.
- Potentiometer can be used for adjusting sensitivity.

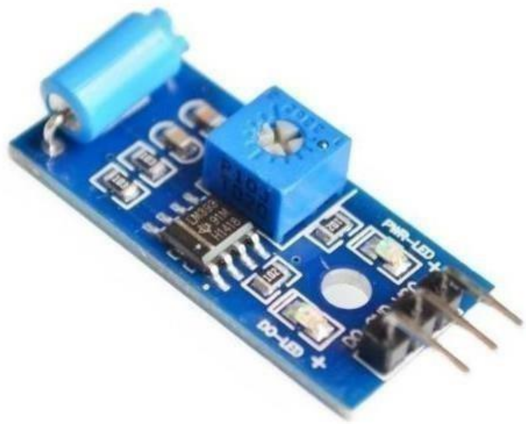

Fig.4.4 Vibration Sensor[10]

Advantages

- no directional vibration sensor.
- Good operating lifespan.
- Can be triggered at any angle.
- Consists of a fixed bolt hole which makes installation easier.

4.2.4 TEMPERATURE SENSOR

The temperature sensor is used to acquire the temperature in its surroundings. It is used to measure the temperature from 0 to 100 degrees Celsius with an accuracy of ±1°C. The sensor features an 8-bit microprocessor and a dedicated NTC for serial data output of temperature and humidity information. It is used in various applications. It can measure the temperature and the humidity present in the surroundings. The sensor has the capability to be easily interfaced with many microcontrollers such as the Arduino UNO, Raspberry Pi, etc. It consists of a thermistor which is used for sensing temperature. The thermistor causes a reduction in the resistance value when the temperature increases. The maximum level of current that is consumed while measuring is 2.5 mA. Its specifications are: -

- Precision is ±1°C.
- Outputs serial data
- Power supply is 3.5V to 5.5V.

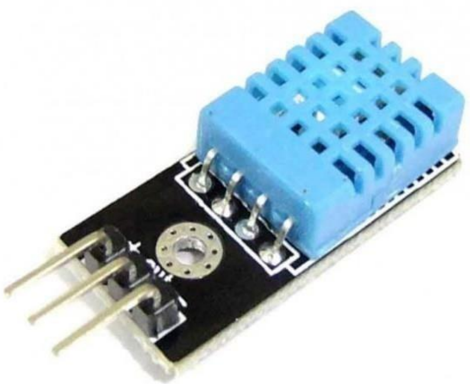

Fig.4.5 Temperature Sensor[11]

Advantages

- Easy to use.
- Low cost.
- Reduced complexity.

4.2.5 GAS SENSOR

The Gas sensor used in this box is a sensor known as MQ-2. Its detecting material is SnO_2. It can be described as a Metal Oxide Semiconductor sensor (MOS). The conductivity present in it increases as the target flammable gas concentration increases. The device can be accustomed to detecting other combustible gases including methane and has great sensitivity to LPG, Propane, Hydrogen, Carbon Monoxide, Methane, Smoke, and Alcohol. An electrochemical sensor on the MQ2 modifies its resistance in response to various gas levels. A voltage divider circuit is created by connecting the sensor in series with a variable resistor, and a variable resistor serves to modify the sensitivity. Its specifications are: -

- Concentration level is 300-10000ppm (Combustible gas).
- Supply voltage is 5v.
- Power supply is 4.5 to 5v DC.
- Consists of power and status LEDs.

Fig.4.6 Gas Sensor[12]

Advantages

- Has high sensitivity towards propane, LPG and smoke.
- Low cost and long lasting.
- Simple driver circuit.
- Compact design.
- Easily mountable.

4.2.6 SD CARD MODULE

Dual I/O voltage SD Card Reader Module, commonly known as a Micro SD Adaptor. It offers a simple method that adds and removes readings present in a regular Secure Digital card. The Micro SD Card Reading Module operates on a 5V or 3.3V power supply that is interoperable with the Arduino UNO or the Mega and includes an SPI connection that is compliant with any memory card. Utilization involving the recording of data, multimedia, sound, and visuals will all benefit from this component. With the help of programming, Reading, and writing of the data is made possible through Arduino. Its specifications are: -

- Input supply voltage is 4.5 to 5.5 v.
- Features an SPI interface.
- Consists of a 3.3V regulator circuit.
- SPI interface is the standard communication interface.

Fig.4.7 SD Card Module[13]

Advantages

- Easy and efficient way to load and unload data.
- Low cost.
- Easily mountable.
- Card insertion and removal is easy.

4.2.7 ESP8266 WIFI MODULE

Espressif Systems invented the microcontroller known as the ESP8266. The ESP8266 is a standalone Wi-Fi networking system that acts as a bridge between other microcontrollers and a Wi-Fi module. It can also run standalone software. This module features numerous pin-outs and a built-in USB port. Through its GPIOs, this module may be coupled with sensors and other application-specific devices with a minimum of upfront development and runtime loading thanks to its robust onboard processing and storage capabilities. Its specifications are: -

- It comprises a 2.4 GHz wireless connectivity unit that additionally to networks, allows WPA and WPA2 and Wired Equivalent Privacy identification.
- Power supply: 3.3 Volts.
- Type of modulation: PWM.
- Consists of 17 GPIO pins.
- Contains 4MB Flash Memory.

Fig.4.8 ESP8266 WIFI Module[14]

Advantages

- Compact size.
- Low cost.
- Low power consumption.

4.2.8 GSM COMPONENT

The GSM/GPRS Modem-RS232's GPRS/GSM two bands Engine SIM900, which runs between 900 megahertz to 1800 megahertz, is employed. connection to a microcontroller with an RS232 chip (MAX232) and a PC is capable to use the modem's RS232 interface. Using the AT command, the baud rate can be adjusted from 9600 to 115200. Consists of a built-in Transmission control protocol/Internet protocol stack that is accessed for access to the network using the General Packet Radio Service. That makes it suitable for M2M interface applications involving SMS, voice, and data transfer. Numerous unregulated sources of power can be connected attributable to the integrated regulation power supply. This gateway is utilized to generate audio calls, Transmit/Retrieve messages, answer incoming calls, and access the net using simple AT commands. Its specifications are: -

- Baud rate is configurable.
- Input Voltage is 12V DC.
- RS232 interface is used for direct communication with the computer.

Fig.4.9 GSM Component[15]

Advantages

- Low cost.
- Data transfer rate is configurable.
- Easy to use.

4.2.9 GPS DEVICE

Global Positioning System or in short, the GPS, can be described as a guidance system based on satellite devices, that comprise at least 24 satellites. GPS operates under any circumstances, around every hour of the day, and does not require any setup or cost of subscription. Throughout the world, GPS reliably offers 3-D real-time positioning, navigation, example, and clock. The GPS satellites orbit the earth twice each day in a fixed orbit. GPS receivers can decode each satellite's unique signal and orbital data to establish the specific position of the satellite communication This is how tracking devices work to pinpoint an individual's coordinates using data and trilateration. Its specifications are: -

- Position update rate: 5Hz.
- Baud rate configurable from 4800 to 115200.
- Range of power supply: 3 V to 5 V.
- Consists of an LED signal indicator.
- Contains EEPROM for saving the data when power is off.

Fig.4.10 GPS Device[16]

Advantages

- High speed.
- Cost effective.
- High accuracy.
- Configurable Baud rate.

4.2.10 ESP32 CAM

The ESP32 Camera is a perfectly working controller with a micro-SD card port and a built-in video lens. The particular lens was picked due to its capability to carry out sophisticated operations like picture tracking and recognition, it is perfect for IOT devices that call for a camera. The two Megapixel sensor of the ESP32-CAM transmits images at a rate of 15 to 60 frames per second. Its specifications are: -

- WiFi image upload is supported.
- Built-in Flash LED.
- Clock speed: up to 160Mhz.
- Consists of Bluetooth 4.2 with BLE.
- 2 Megapixels sensor.
- Image transfer rate: 15-60 fps.

Fig.4.11 ESP32 CAM[17]

Advantages

- Compact and easy to use.
- Low cost.
- High image transmission rate.
- Multiple sleep modes.

CHAPTER 5

RESULTS

In this chapter, the results displayed by the SBB are shown with images.

- After wiring all the modules and attaching all the sensors, Arduino UNO, power supply, GPS, GSM, SD card, and ESP8266 WiFi modules. The proposed SBB will be ready to function and provide the desired outcomes. Below is a representation of the proposed smart black box's hardware:

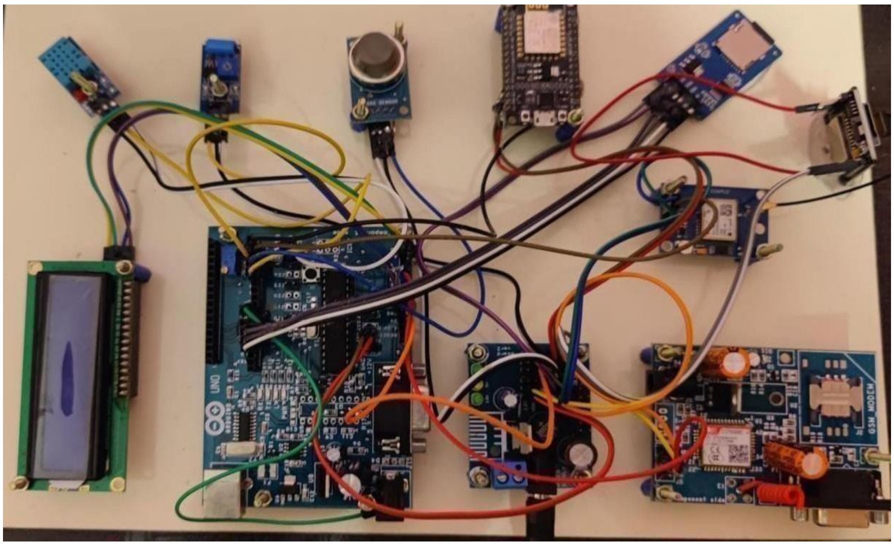

Fig.5.1 SBB with all connections completed

- The above picture is the visual representation of the proposed system in its OFF state. It consists of all the modules that are present in the architecture. i.e., I2C LCD Display, Arduino UNO, Temperature sensor, Vibration sensor, Gas sensor, ESP8266 IOT module, SD card module, GPS module, GSM module, ESP32 Camera, and Power supply. As we can see, the Arduino Uno is wired and connected to all the sensors and modules present in the smart black box design. It is the main component that is responsible for interfacing with all the other components.

- The proposed system in its ON state is shown below:

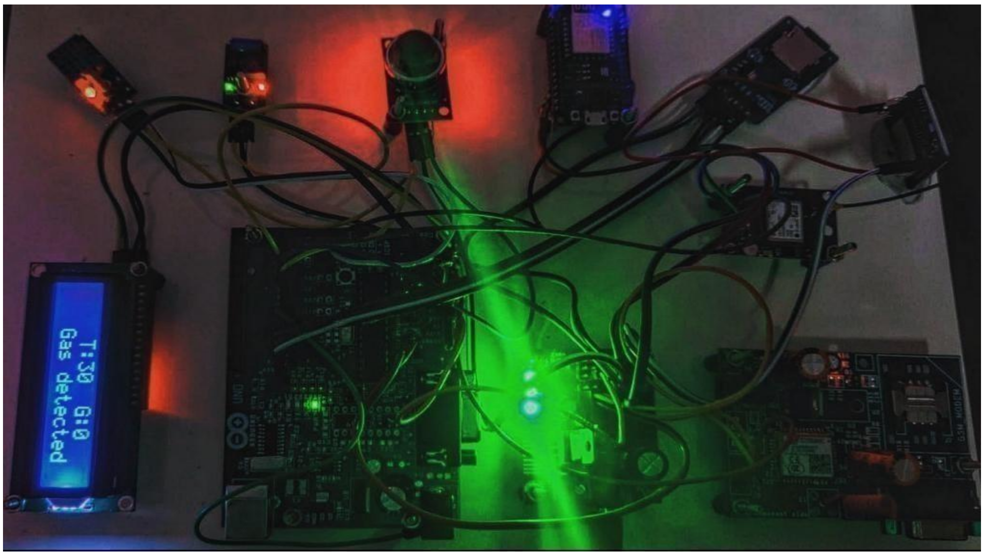

Fig.5.2 SBB when switched on

- It is evident from the image above that the module has been turned on with the aid of a power supply. When the module is turned on, the LCD shows text that is pertinent to the data connected by the three sensors. The ESP32-CAM is placed on the right end of the system and it is responsible for taking pictures and sending them to the user.

- The information displayed on the LCD is displayed below:

Fig.5.3 LCD displaying the information

- It is clear from the image above that information is being displayed on the LCD following data collection from the system's three sensors. Temperature is represented by the letter "T," which shows the temperature value in centigrade. The letter "G" stands for gas, and if any gaseous compounds are found within the car, the gas sensors will identify them and show a 0 and the words "Gas detected." The LCD will show 1 if there isn't any gas present in the car, indicating that there isn't any gas there. There won't be any further text shown on the LCD in this circumstance. If a user is logged into adafruit.io, they can view the same information that is shown on the LCD online.

- When the crash sensor detects a vibration that is greater than the threshold level, an accident is thought to have occurred. Below is a representation of the accident-related LCD display:

Fig.5.4 Alert message displayed on the LCD

- It is possible to deduce from the image above that the LCD is showing information to the effect that the accident happened as soon as it received information from the crash sensor. The user-registered cell numbers are also notified of the accident's happening as soon as it does, along with the event's real-time location. The webpage that shows all the car data has been updated with the news of the accident. Investigations into the accident's cause may be aided by the images transmitted from the ESP32-CAM.

- With the help of an SD card that is included in the SD card module, the accident data is also preserved. Cloud storage is used in this method to restore data even if the incident causes physical harm to the Black Box. On the website io.adafruit.com, you can view the data that is kept in the cloud. To view the data, the user must log in and go to the dashboard, which is on the menu. Below is a list of the data on the dashboard:

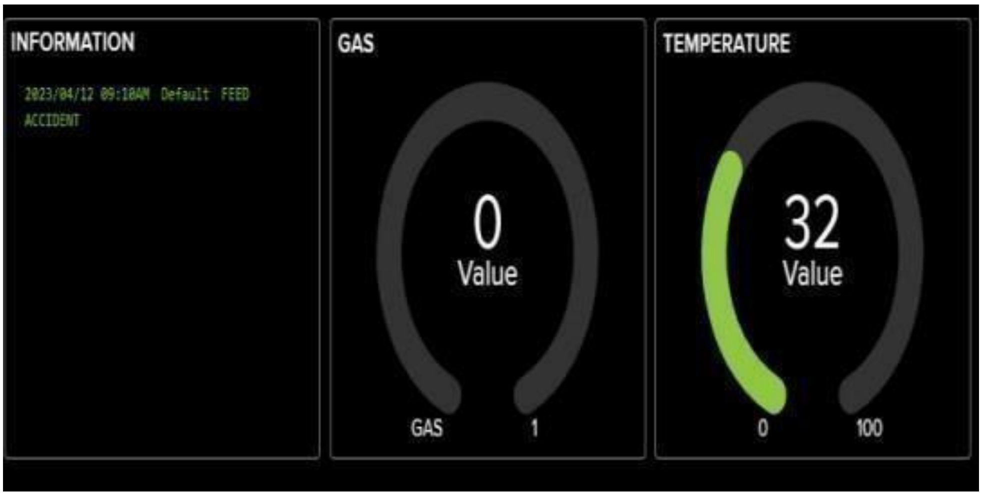

Fig.5.5 Cloud storage of data implemented

- The GPS determines the location, and the GSM communicates the data through SMS to the specified cell phone. The SMS contains the word "ACCIDENT..." as a warning message. The GPS module's data on the incident's location is also provided below the notification.

- The output displayed on the LCD display depends on the values recorded by all three sensors. The table below shows us all the possible outputs:

CRASH SENSOR OUTPUT	GAS SENSOR OUTPUT	TEMPERATURE SENSOR READINGS	LCD DISPLAY
LOW	1	30	T:30, G:1, No Gas detected
LOW	0	27	T:27, G:0 Gas detected
HIGH	0	28	ACCIDENT
HIGH	1	32	ACCIDENT

TABLE 5.1 LCD Display for different sensor readings

CHAPTER 6

CONCLUSION

A Smart Black Box was proposed with intelligent characteristics and a system that gathers information regarding an accident. Additional functionalities were added to the black box which is not present in the ordinary car black box such as IOT functionality to store data using the cloud, the Usage of a telegram bot for receiving pictures at any given time, Temperature, gas readings, etc. The working and connections of the modules were also demonstrated.

The module was tested in different scenarios and it produced an accurate output. As soon as the strong vibration was felt by the module, The alert was immediately displayed on the LCD module, and after a short delay, the message with the coordinates was dispatched to the registered mobile number. The Esp32-cam continuously sent pictures taken via telegram at regular intervals.

Day-to-Day users that travel by road can benefit from this system. It can aid in successfully securing them if any kind of mishap occurs and it can also help them in constantly monitoring the vehicle at any given time.

Overall, the proposed vehicle monitoring system or smart black box is a huge step forward in safety measurements in road vehicles. More implementations and more sophisticated sensor usage can be used to improve the monitoring of road vehicles for individuals all around the world.

CHAPTER 7

FUTURE ENHANCEMENT

- In the future we can use camera and image processing techniques to get more information about the accidents.
- We can implement AI in this model to automatically detect the causes of the accident
- More advanced sensors can be used for getting more accurate outputs and better monitoring technologies.

REFERENCES

[1] Sharma, N., Bairwa, M., Gowtham ghosh, B., Gupta, S.D. and Mangal, D.K., 2018. A bibliometric analysis of the published road traffic injuries research in India, post-1990. Health research policy and systems, 16(1), pp.1-11.

[2] Hsiao, H., Chang, J. and Simeonov, P., 2018. Preventing emergency vehicle crashes: status and challenges of human factors issues. Human factors, 60(7), pp.1048-1072.

[3] Y. Yao and E. Atkins, “The smart black box: A value-driven automotive event data recorder,” in Proc. IEEE 21th Int. Conf. Intell. Transp. Syst. (ITSC), Nov. 2018, pp. 973–978.

[4] Nazia Parveen, Ashif Ali, Aleem Ali, “IOT Based Automatic Vehicle Accident Alert System”, 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), October 2020.

[5] M. Navin Kumar, S. Pravin Kumar, R Premkumar, L Navaneethakrishnan, “Smart characterization of vehicle impact and accident reporting system”, 7 th International Conference on advanced computing and communication systems (ICACCS), vol. 1, no. 187, March 2021.

[6] Gowshika. B, Madhu Mitha. G, Jayashree. S, S. Mutharasu, “Vehicle Accident Detection System By Using GSM and GPS”, International Research Journal of Engineering and Technology (IRJET), vol. 6, no. 1, Jan 2019.

[7] T Kalyani, S Monika, B Naresh, Mahendra Vucha,” Accident Detection and Alert System”, International Journal of Innovative Technology and Exploring Engineering (IJITEE), Vol. 8, March 2019.

[8] Shwetashree Vijay, Pilla Nitish Kumar, Sam Raju, Vivekanandan S, 2019, Smart Waste Management System using ARDUINO, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 08, Issue 11 (November 2019)

[9] Oyebola, B.O., Oluremi, O.A. and Odueso, T.V., 2018. Development of a Heartbeat and Temperature Measuring System for Remote Health Nursing for the Aged in Developing Country. Science Journal of Circuits, Systems and Signal Processing, 7(1), pp.34-42.

[10] Meng, Qiuhan, and Songye Zhu. 2020. "Developing IoT Sensing System for Construction-Induced Vibration Monitoring and Impact Assessment" Sensors 20, no. 21: 6120

[11] Sayali Umbarkar, Shreeya Pol, Mansi Jadhav, Professor Harshad S. Patil, and -. (2021) 'Build a smart, automated IOT plant irrigation system with Raspberry pi and Pub Nub', International Journal Of Advance Research And Innovative Ideas In Education, 7(3), pp. 625-632IJARIIE

[12] T. Arpitha, D. Kiran, V. S. N. S. Gupta and P. Duraiswamy, "FPGA-GSM based gas leakage detection system," 2016 IEEE Annual India Conference (INDICON), Bangalore, India, 2016, pp. 14, doi: 10.1109/INDICON.2016.7838952.

[13] Shah, V., Sheth, V., Sharma, N. and Munshi, A., 2020. Black Box For Automobiles.

[14] Sangolkar,R., Bhombe, R.M. and Welankiwar, A.S., 2020. Fault Identification and Remote Operation of Receiving Substation and Auxiliary Substation Using Iot.

[15] Hussain, A.F., Ajaz, F., Ahmed, N., Stephen, H., Li, Y., Mujib, A.M., Arshad, J. and Das, P.K., 2021, March. Zigbee and GSM Based Security System for Business Places. In 2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) (pp. 264-267).

[16] Handscombe, Jonathon & Yu, Hong Qing. (2019). Low-Cost and Data Anonymised City Traffic Flow Data Collection to Support Intelligent Traffic System. Sensors. 19. 347. 10.3390/s19020347.

[17] Salikhov, R.B., Abdrakhmanov, V.K. and Safargalin, I.N., 2021, November. Internet of things (IoT) security alarms on ESP32-CAM. In Journal of Physics: Conference Series (Vol. 2096, No. 1, p. 012109).

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Vehicle Information Storage Container with Video Recovering

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***Abstract* — Automobiles and advancing technologies have created a new level of data services in vehicles. The accident of the vehicle means an unexpected event that may cause damage to the body of the vehicle or of a passenger. The main goal of this Black Box project is to use a method to store vehicle accident data (in case an accident occurs), in which image data is taken by an ESP 32 camera while driving and the data is stored in real-time. In this suggested prototype, in order to connect the sensors and communication devices, Arduino uno microcontroller is used. The GPS work is to retrieve info on the whereabouts of the area. The texts regarding the accident information are sent to the respective person's caretakers by GSM.**

Keywords— Automobiles, Black box, Arduino Uno, Sensors, GPS device, GSM, ESP 32 camera

I. INTRODUCTION

In the year 2022, WHO which is also known as the world health organization published data that showed that more than about 1.3 million casualties occur every season because of road tragedies. The accident of a vehicle can be described as an unexpected scenario that may lead to physical damage to the person and the vehicle. Usually, a black box is a system or a device that is used in flights or aircraft for the sole purpose of collecting accident information in case it occurs for investigation purposes. In our system, we are implementing the same black box concept on street vehicles. It is a very efficient system that is used to collect important data such as the temperature of the vehicle, and the Presence of gaseous substances, and sends alerts in case an accident occurs. This proposed system consists of three sensors each of them used for checking different parameters. It also contains a GPS and a GSM module. The GPS device is integrated for gathering current data when an incident takes place and the GSM is kept for sending emergency SMS in the situation. For photo capturing an esp32 camera is used. To store the data and the photos recovered an SD card module is used as a storage container in this proposed system.

Overall, the proposed black box system is an easy and extremely effective way of collecting important accident-related information and is helpful in sharing this data when an accident occurs with the coordinates or the live location where it has occurred.

II. LITERATURE REVIEW

Yu Yao, and Ella Atkins, made an SBB to amplify less-frequency band info saving with the value-driven big-bandwidth data recording. The proposed SBB makes decisions by optimizing compression over a static combination of data value, data size, and continuity metrics.

Nazia Parveen, Ashif Ali, and Aleem Ali made progress on events through the Gyroscope as it assists in figuring out the surroundings and if the retrieved value of a, b, and c parameters are more than the expected readings, an SMS alert is followed with immediate effect. Using this technique, the area where the impact occurred can be figured out with ease and an additional GPS was used to achieve info on the event.

Navin Kumar M, Pravin Kumar S, Premkumar R, and Navaneethakrishnan L [3] studied and designed a prototype that uses four vibration sensors and a microcontroller to detect the impact and identify if it is an accident or a minor collision. When an accident occurs, this system determines whether the accident is a rear-end collision, head-on collision, rollover, T-bone impact, or a sandwich.

Gowshika, Madhu Mitha, Jayashree, s. Mutharas [4] used an Arduino-based vehicle accident alert system using GPS, GSM, and an accelerometer. In this system, the Accelerometer detects the sudden change in the axes of the vehicle and the GSM module sends the alert message on your mobile phone with the location of the accident.

T Kalyani, S Monika, B Naresh, and Mahendra Vucha [5] focused on creating an accident detection system that focuses on accidents that happen due to careless behavior of the individual who is operating the car. This paper establishes an accident alerting system that sends an alert to the person who is driving the car. once the mishap has taken place an alert message will be dispatched to the registered mobile number.

III. THEORY

This paper provides an SBB architecture to utilize appropriate data collection using a variety of sensors such as the MQ-2 gas sensor, Vibration sensor, LM35 temperature sensor,and ESP-32 camera given finite local storage. The idea of the SBB is to implement efficient storage of data and provide necessary important information regarding the accident. The proposed model has used a wide variety of sensors and modules.

The system has used an Arduino Uno microcontroller for interacting with the other modules in the system. Arduino Uno is powered up using the power supply. The Arduino software (IDE) is used for programming purposes. The boot loader is used to upload the code onto the ARDUINO.

The Liquid crystal display is there to show the values of the person interacting. It is present in this setup as a Sixteen cross Two display. It has the capability to contain 16 chars per sentence limit with 2 sentence lines accommodated in it.

The three sensors indulged in this design are the vibration sensor, Temperature sensor, and Gas sensor. The vibration sensor sends an alert once a high vibration has been left. The temp sensor displays the centigrade reading in the motored vehicle and the gas sensor shows data about the presence of gas or not in the surrounding.

There are other modules that are being used such as the GSM module, SD card module, and GPS. These modules are used for storage and communication purposes.

Cloud storage is also implemented in the system as a storage backup for data.

IV. METHODOLOGY AND ARCHITECTURE

A. METHODOLOGY

The steps involved in implementing the Project:

i. DETECT THE ACCIDENT: -

Detection of the accident is done using three sensors. Namely, the temperature sensor which here is LM35 Sensor. The gas sensor which here is MQ-2 and the crash sensor which here is SW-18010P. The precise location of the accident is determined using GPS. Whenever there is an abnormality in the sensor. The Microcontroller receives some kind of data.

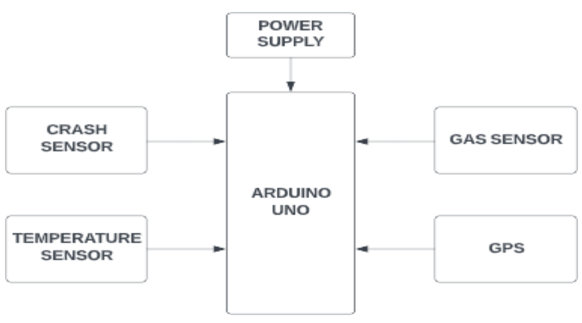


Fig. 1. Detecting modules architecture diagram

ii. STORAGE AND RECEIVER MODULES:

With the help of the SD card module, the Storage of collective information from the sensor, ESP32cam, andGPS is accomplished. If an accident occurs with the use of these modules, the data will be shared. With this information, the investigation becomes easier and is effective with accurate values.

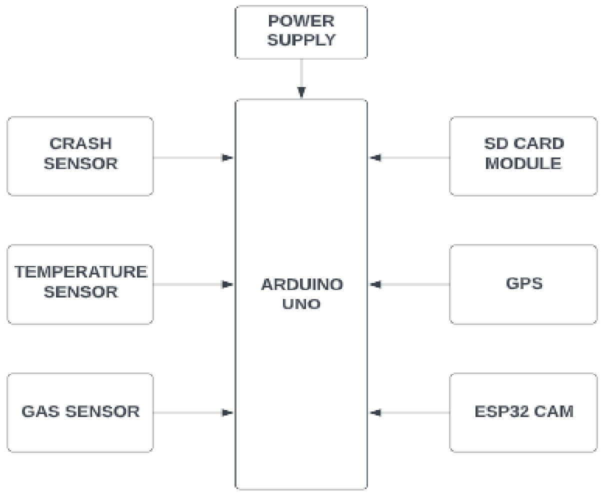


Fig. 2. Storage and receiver modules architecture diagram

iii. TRANSMITTING MODULES:

After, Collection of the data from the sensor and the ESP32 cam the information is uploaded using the IoT module, and the information is sent using the GSM module. In case the black box gets damaged all the information is gathered through the IOT. The information regarding the car's temperature and other crucial data can be viewed by others as the data gets published online using the IOT module.

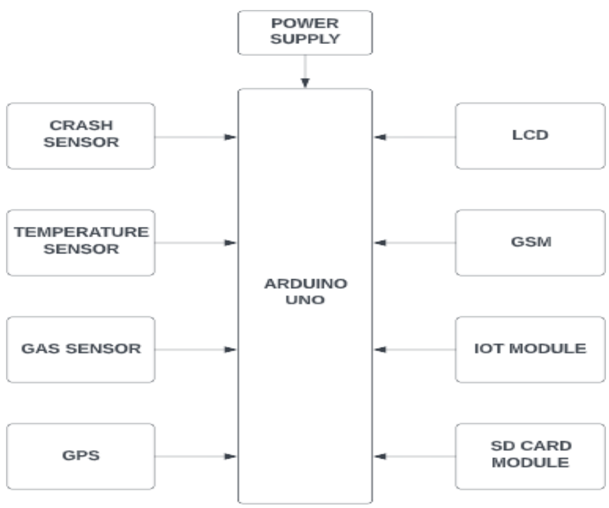


Fig. 3. Transmitting modules architecture diagram

B. ARCHITECTURE

The architecture consists of a power supply, Arduino UNO, Crash Sensor (SW 18010-P), Temperature Sensor (LM35), Gas Sensor (MQ-2), GPS Module, GSM Module, I2C Liquid Crystal Display, SD Card Module, an ESP32 Camera.

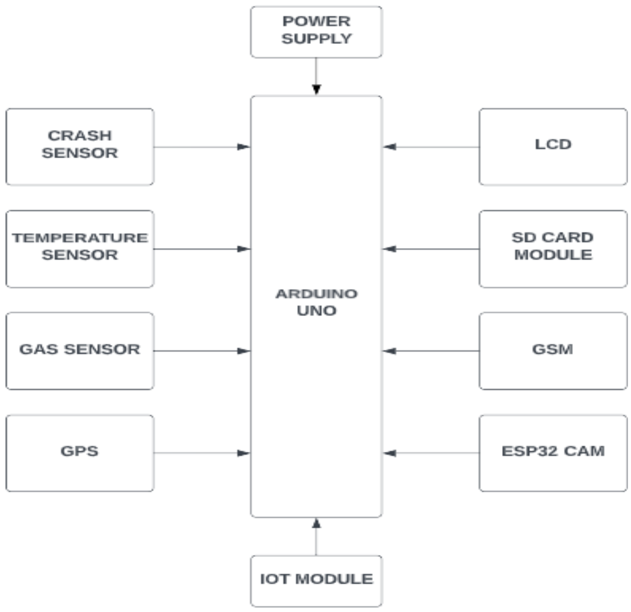


Fig. 4. Smart Black Box design

The above architecture illustrates the proposed method. In this system, ARDUINO UNO is implemented in order to connect with the sensors, and interface with the device modules. The purpose of the LCD is to recover readings and display them to the user. The vibration sensor, Temp sensor, and secure digital card are associated with the microcontroller. The ESP8266 IOT device is employed to modify the cloud-based information. Knowledge concerning the whereabouts of the automobile is gained through the use of the GPS device. Alerts get delivered to the operator and other rescue personnel by using GSM. In the vicinity of the accident, the black box module collects the readings and stores them, and then gives retrieved values. Whenever an accident occurs, we can find the perfect reason for the accident. The ESP32cam is used to collect the live stream at the local host for that accident.

The advantage of this proposed black box model is its ability to connect to other users using the IOT and GSM module. When an accident occurs often people are late for rescue and this sometimes even leads to fatal incidents. But in thisdesign, as soon as a heavy vibration is felt, A warning message is sent to the person’s caretaker and the informationthat an accident has occurred is updated on the ADAFRUIT.IO website. This website also displays other crucial vehicle information like temperature, the presence ofa gas, etc. to the user.

The data is updated using the module (iot). It is characterized as a linkage of hardware devices or other stuff integrated through electronics, tech tools, sensors, etc. to collect and exchange information. The Wi-Fi module which is used in this system is the ESP8266 Wi-Fi module which provides the ability to power Wi-Fi proficiencies within many other systems.

The GSM module is the module that is being used for sending accident-related information via text to other users. The name of this particular GSM module in this system is the GSM Modem-RS232. This module is manufactured with a dual-band GSM engine (SIM900) and it can work in between 900/1800 MHz frequencies. The modem of this module comes with an RS232 interface, which allows the connection of the microcontroller with the RS232 chip.

But for sending the accident-related information we will first need access to the location where the accident occurred. This is done with the help of a Global Positioning System or GPS. The GPS system is used to provide continuous real-time navigation to users with 3-Dimensional positioning worldwide at any given time. In other words, it leverages satellites to continue providing guidance. GPS satellites usually orbit around the world two times a day precisely. Each one of these 24 satellites transmits or sends a unique type of signal with orbital parameters that permit these gadgets to decrypt and gather the current spot. The position of the user is characterized by the estimates of the range of the satellites. It is loosely adapted from the ‘trilateration’ math principle.

picture recording’s done with help of an ESP32 CAM. It is a microcontroller that consists of a video camera and it also has a microSD card socket. This camera was chosen because it is ideal for IOT devices that require a camera because of its ability to perform advanced functions like picture tracking and recognition. ESP32-CAM consists of a two Megapixel sensor with an image transmitting rate of 15 to 60 fps. Because it supports WiFi image upload, The images of the vehicle are automatically sent to the user on a regular basis. A telegram bot has been created to interact with the ESP32-CAM. The user can request a new photo using their telegram account from anywhere as long as they have access to the internet on their smartphone. When the message /photo has been forwarded to the ESP32-cam automation, its board receives a message and clicks one picture immediately, then sends it to the user.

The software IDE which has been used for developing this model is the Arduino software IDE. It is the common IDE that is used for connecting and uploading lines of code to the Arduino hardware. It consists of a text editor which can be used for writing the code and lots of menus which can be used for the implementation of various types of functions. After the compilation of the code, the upload option is used to load the code onto the Arduino board.

Furthermore, a power supply has been used in the system to produce a constant output-regulated power supply for the system to work efficiently and produce the required outcome.

The advantages of the proposed smart black box system architecture over the existing models are the smart and efficient usage of sensors, advancement in the communication protocol, and remote monitoring methods such as telegram bot, Cloud storage, Accident message warning, etc. that can provide effective solutions for real-time monitoring in road vehicles for investigation purposes.

V. RESULTS

After connecting all the sensors, Arduino UNO, Power supply, GPS, GSM module, SD card module, ESP8266 Wi-Fi module and wiring all the modules. The hardware representation of the proposed smart black box is represented below:

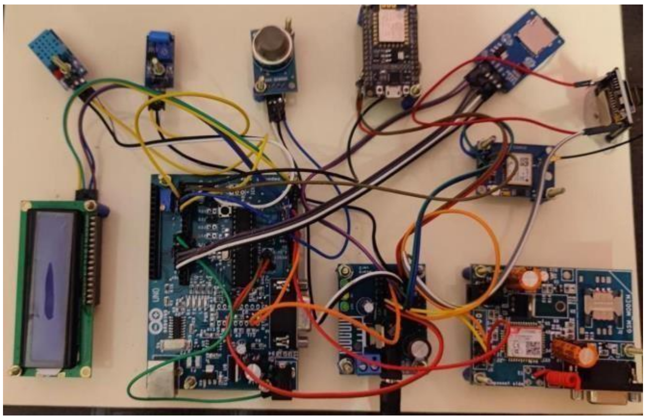


Fig. 5. Smart Black Box in Off-State

The above picture is the SBB system in its off-state. The model in its on state is shown below:

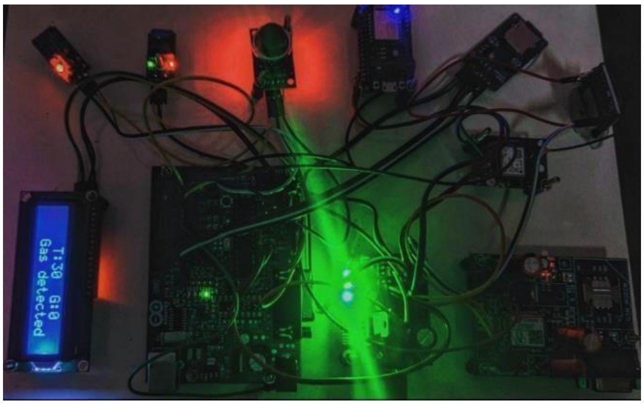


Fig. 6. Smart Black Box in On-State

In the above picture, it is clearly visible that the module has been switched on with the help of a power supply. When the module is switched on the LCD displays text relevant to the data that is connected by the three sensors. The three sensors namely, the gas sensor, the temperature sensor, and the crash sensors are placed right above the LCD and are working effectively. The ESP32-CAM is placed on the right end of the system and it is responsible for taking pictures and sending them to the user.

The information displayed on the LCD is shown below:

Fig. 7. LCD Display

In the above picture, it is visible that the LCD is displaying information after gathering data from the three sensors that are present in the system. 'T' represents temperature and it displays the centigrade reading of the temperature. 'G' represents gas and if the gas sensors recognize any presence of gaseous substancesin the vehicle it displays 0 and displays the text, "Gas detected".In case there is no gaseous substance present in the vehicle thenthe LCD displays 1 which means that there is no gas present. Inthis scenario, there will be no additional text displayed on the LCD. The same information that is displayed on the LCD can be viewed on the internet if the user is logged in to the adafruit.io website.

When The crash sensor feels a vibration above the threshold level then it is considered to be an accident. The LCD display in case of an accident is represented below:

Fig. 8. LCD Display if accident detected

In the above picture, it can be interpreted that the LCD is displaying information that the accident occurred immediately after getting information from the crash sensor. The information that the accident has occurred is also sent to the mobile numbers registered by the user immediately after it has occurred with the live location of the event. The information that the accident has occurred is also updated on the website displaying all the vehicle data. The pictures sent from the ESP32-CAM can be used for investigational purposes regarding the cause of the accident.

The output displayed on the LCD display depends on the values recorded by all three sensors. The table below shows us all the possible outputs:

TABLE 1. Sensor readings and LCD Display

CRASH SENSOR OUTPUT	GAS SENSOR OUTPUT	TEMPERATURE SENSOR READINGS	LCD DISPLAY
LOW	1	30	T:30, G:1, No Gas detected
LOW	0	27	T:27, G:0 Gas detected
HIGH	0	28	ACCIDENT
HIGH	1	32	ACCIDENT

The accident data is also saved with the help of an SD card which is present in the SD card module. Even if the Black Box gets physical damage due to the incident, Cloud storage is being implemented in this system for data recovery.

The data stored in the cloud can be viewed at the io.adafruit.com website. The user has to log in and go to the dashboard which is in the menu to view the data. The information shown on the dashboard is shown below:

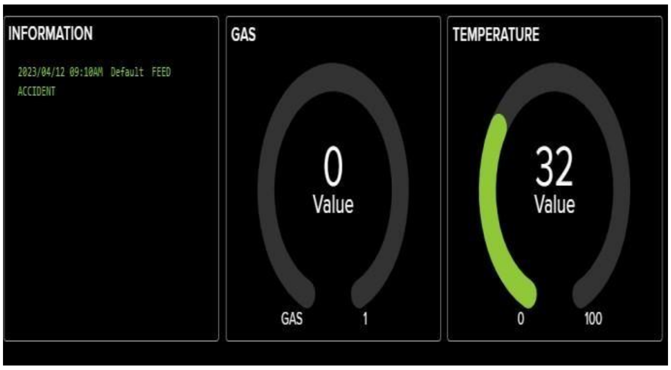


Fig. 9. Data stored in the cloud

In the above picture, The SBB does not detect any gas in its surroundings. Therefore, the value is 0. The temperature sensor reading is 32 degrees Celsius and it is shown on the dashboard.

The GPS gets the location and the GSM sends the information to the registered mobile number via SMS. The SMS is shown below:

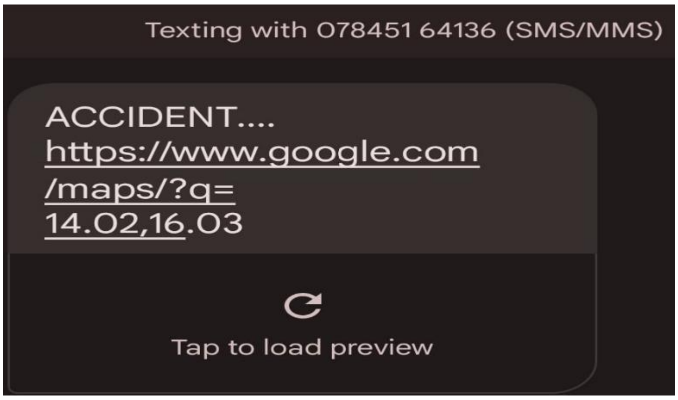


Fig. 10. SMS message sent to the RMN

The SMS message consists of a warning message which says "ACCIDENT…." And below the message is the location of the incident which is gathered by the GPS module.

For seeing the working of the SBB below is a link shared which shows the video output of the system:

https://drive.google.com/file/d/1Mxnw6VSbFuNo4vi0HQN-RYLSwN2wjZWc/view?usp=sharing

VI. CONCLUSION

In this paper, A Smart Black Box was proposed with intelligent characteristics and a system that gathers information regarding an accident. Additional functionalities were added to the black box which is not present in the ordinary car black box such as IOT functionality to store data using the cloud, the Usage of a telegram bot for receiving pictures at any given time, Temperature, gas readings, and many more. The working and implementation details of the proposed system were also demonstrated.

VII. REFERENCES

[1] A. Narayanan, I. Dwivedi, and B. Dariush, "Dynamic traffic scene classification with space-time coherence," 2019, arXiv:1905.12708.

[2] Y. Yao and E. Atkins, "The smart black box: A value-driven automotive event data recorder," in Proc. IEEE 21th Int. Conf. Intell. Transp. Syst. (ITSC), Nov. 2018, pp. 973–978.

[3] N. Li, D. W. Oyler, M. Zhang, Y. Yildiz, I. Kolmanovsky, and A. R. Girard, "Game theoretic modeling of driver and vehicle interactions for verification and validation of autonomous vehicle control systems," IEEE Trans. Control Syst. Technol., vol. 26, no. 5, pp. 1782–1797, Sep. 2018.

[4] N. Cheng et al., "Big data driven vehicular networks," IEEE Netw., vol. 32, no. 6, pp. 160–167, Nov. 2018.

[5] G. Su, N. Li, Y. Yildiz, A. Girard, and I. Kolmanovsky, "A traffic simulation model with interactive drivers and high-fidelity car dynamics," IFAC-PapersOnLine, vol. 51, no. 34, pp. 384–389, 2019.

[6] F.-H. Chan, Y.-T. Chen, Y. Xiang, and M. Sun, "Anticipating accidents in dashcam videos," in Proc. Asian Conf. Comput. Vis. Taipei, Taiwan: Springer, 2016, pp. 136–

[7] D. Zhao et al., "Accelerated evaluation of automated vehicles safety in lane-change scenarios based on importance sampling techniques," IEEE Trans. Intell. Transp. Syst., vol. 18, no. 3, pp. 595–607, Mar. 2017.

[8] M. Navin Kumar, S. Pravin Kumar, R Premkumar, L Navaneethakrishnan, "Smart characterization of vehicle impact and accident reporting system", 7th International Conference on advanced computing and communication systems (ICACCS), vol. 1, no. 187, March 2021.

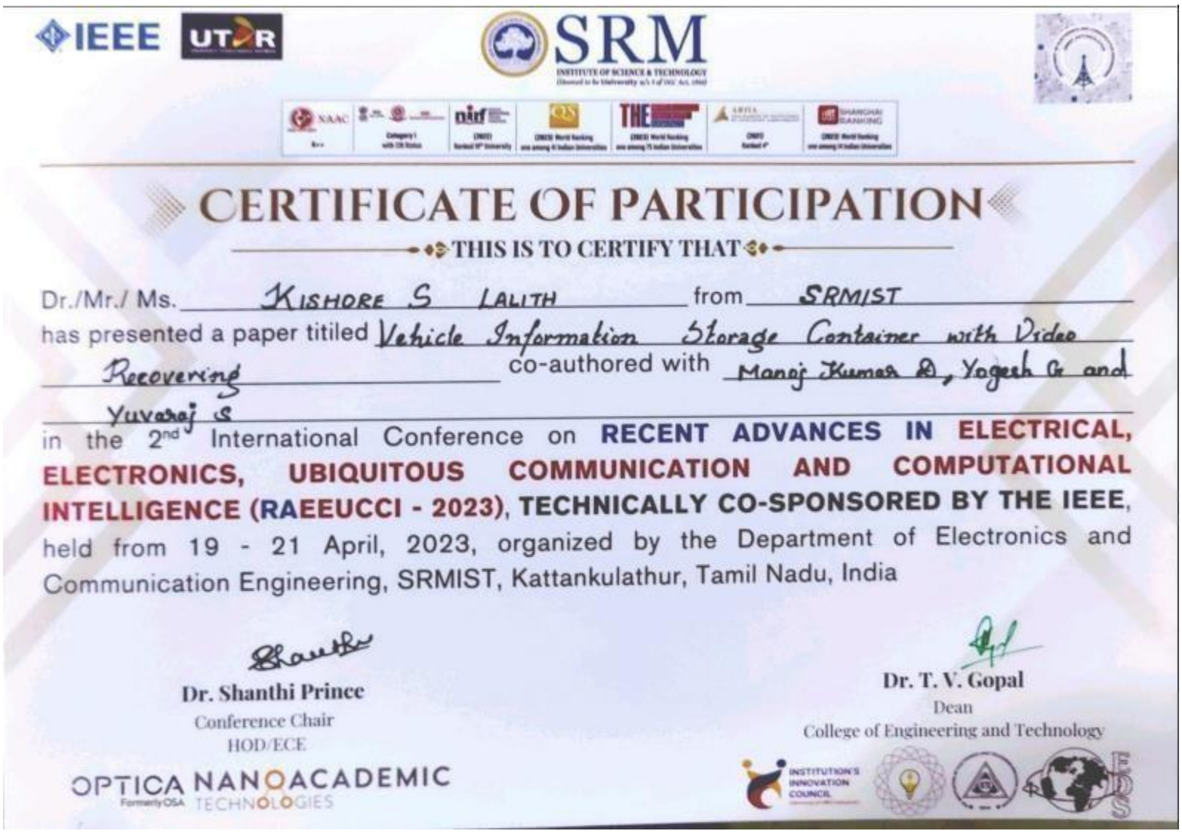
[9] S Dhanya, P.E. Ameenudeen, Aiswarya Vasudev, Saumya Joy, "Automated Accident Alert", 2018 International Conference on Emerging Trends and Innovations in Engineering and Technological Research (ICETIETR), July 2018.

[10] Nazia Parveen, Ashif Ali, Aleem Ali, "IOT Based Automatic Vehicle Accident Alert System", 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), October 2020.

CONFERENCE PUBLICATION STATUS

Yokesh G, Lalith Kishore S, and Manoj Kumar D, "Vehicle Information Storage Container with Video Recovering" presented at the Recent Advances In Electrical, Electronics, Ubiquitous Communication and Computational Intelligence (RAEEUCCI – 2023), April 2023.

Certificate: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