ACCIDENT DETECTION AND ALERT SYSTEM

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ABSTRACT

The time between the occurrence of accident and the emergency medical facility provided to the accident location is the important factor in the survival rates after the accident. By reducing the time between the accident and medical facility provided to the scene decreases mortality rates so that more lives can be saved. One approach to eliminate that delay is to use Accident Detection & Alerting System Using Raspberry Pi. This gives alert if the accident occurred and immediately notify to the emergency responders. To identify the Accident happen to Vehicle we use MEMS sensor and vibration Sensors. A GPS Module is used to get the location and also a GSM SIM is used for alerting a by SMS notification to respective persons or Emergency Services Alert message includes location of the accident Longitudes and Latitudes, Map location Link, direction of accident of the vehicle and driver heart beat pulse rate. To state the engine status we use D.C Motor. A Buzzer is used for alarming purpose to get notified to surrounding people near to accident. LCD 16X2 display used for the operation status to indicate. Flame Sensor is used whether the car got in fire accident or not , if it senses fire then a SMS notification will send to owner and as well as to respective persons. The Pulse sensor is used to check the heart beat rate of driver. if incase the pulse is low the car engine will automatically off

Keywords: Raspberry pi Pico, GPS, GSM , Pulse Sensor, MEMS sensor,16x2 LCD Display, Vibration ,Flame Sensor

I. INTRODUCTION

1.1 INTRODUCTION

Each day in the newspapers or in news the mankind read about thousands of people dying in road casualties not because of improper medical facilities or non-availability of efficient medications but just because the families of the people did not get timely informed. Isn't it sad? Those just because of delayed communication, a number of people are dying every day in the world. To overcome this delayed communication a number of accident detection, notification and vehicle tracking systems have been developed in the recent years. Some of the systems proved to be of great use but still lack somewhere. This system aims to review some of these designed and proposed systems for Accident detection, notification and vehicle tracking. These systems if practically interfaced and implemented in vehicles can help saving lives and that too by informing the families of the people or preferred persons…

In the recent years various vehicle tracking, accident detection and notification systems have been developed, these all systems are based on different technologies, makes use different controllers and sensors to control the functioning of the system and sense the value of the parameter on which the functioning is based upon, or uses different communication protocols to establish the communication. Over the years the technology has advanced and so have these systems. The strong demand for vehicles has resulted in greater traffic congestion and road accidents. Demand primary road accidents occur due to driver recklessness in cities, but accidents often occur outside of cities owing to intoxicated driving. Not only can driving while inebriated result in fatalities, but so does driving while not wearing a seat belt. As a result, the public's life is in grave danger. The reason for this is that our country lacks the greatest emergency facilities. This study introduces an automated alarm system that provides the most detailed information about the accident.

1.2 OBJECTIVE OF THE PROJECT

The main aim of the project is to design and develop a system to monitor the vehicle status, quickly and accurately detect when an accident has occurred and alert the appropriate authorities or emergency services as quickly as possible. This can help to minimize the response time of emergency services and increase the chances of saving lives and reducing the severity of injuries sustained in the accident.

1.3 EXISTING SYSTEM

The MEMS sensor and Piezo electric sensors will always read the values and send to the raspberry pi meanwhile GPS will start tracking the location all the time. MEMS sensor gives the analog readings but in raspberry pi we won't have inbuilt analog to digital convertor so we use the ADC- mcp3208 for conversion, we specify the thresholds values for MEMS sensor if we get beyond that values then the raspberry pi will send the command to webcam, GSM and start taking the GPS values. Now send this GPS location to GSM modem and then the start sending the alert message with that location to the specified mobile number. (3) In the meanwhile, webcam start taking video up to specified duration and capture the image of the victim then send the

both video and image to raspberry pi then the raspberry pi send this video and image to the mail id given by us, then start working like initially. The same process for the Piezo sensor also when it on.

1.4 ROLE OF IoT

IoT plays a crucial role in the development of an accident detection and alert system. IoT technology can be used to connect a wide range of sensors and devices, including cameras, accelerometers, and GPS devices, and enable them to communicate with each other and transmit data to a central processing system. By using IoT technology, an accident detection and alert system can collect real-time data from a wide range of sources and use this data to quickly and accurately detect when an accident has occurred. For example, IoT sensors can detect sudden changes in speed, impact force, and the direction of a vehicle or pedestrian, which can indicate an accident, has occurred.

IoT can also be used to provide location-based services, which can help emergency services to locate the accident quickly and respond faster. This can be especially useful in areas where accidents are more likely to occur, such as highways or busy urban intersections. In addition, IoT can enable the system to send alerts and notifications to relevant authorities and emergency services, including the police, fire department, and ambulance services. This can help to ensure that emergency services are notified quickly and can respond rapidly, which can be critical in saving lives and reducing the severity of injuries. Overall, the use of IoT technology in an accident detection and alert system can improve the accuracy, speed, and efficiency of the system, which can help to reduce the number of fatalities and injuries caused by accidents on the road.

1.5 SYSTEM BLOCK DIAGRAM:

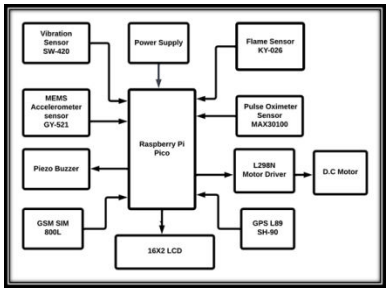

Fig.1 Block Diagram of Accident Detection and alert System

Here is a block diagram of the project with basic input and output functions of each block. Complete set project measurements that are required, are mentioned in above figure .It illustrate the basic operation that takes place in project and also the hardware (components) are also mentioned in each block with ,that input and output supply pipe line.

II.RASPBERRY PI PICO

Raspberry Pi Pico is a microcontroller board based on the Raspberry Pi RP2040 microcontroller chip. It is designed as a low-cost, high-performance microcontroller board with flexible digital interfaces. In the field of MCUs, Raspberry Pi Pico has become one of the most popular topics recently. To help beginners get started with Raspberry Pi Pico quickly, we are releasing the Starter Guide of Raspberry Pi Pico Based on Micro Python. Through four chapters and a total of 16 lessons of study, this course can help you get started with Raspberry Pi Pico easily. With its help, you can learn Micro Python from scratch, and build some interesting projects. You don't need to have knowledge of Micro Python programming or electronics to begin. The course will take you through learning this knowledge step by step, and quickly put it into practice in each project. No one expected that Raspberry Pi, the most popular single-board computer maker in the world, would suddenly release a microcontroller of its own. What's more surprising is that Raspberry Pi Pico does not base its design on the common ESP32 or SAMD21, but instead a brand new microcontroller chip: the RP2040 microcontroller.

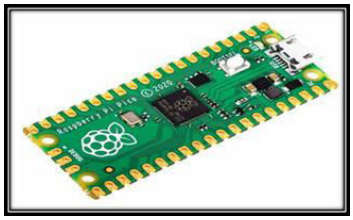

Fig.2.Raspberry Pi Pico

The RP2040 microcontroller is a microcontroller chip independently designed by Raspberry Pi, and is powered by a dual-core ARM Cortex-M0+ processor that runs up to 133Mhz.With a large on-chip memory, symmetric dual-core processor complex, deterministic bus fabric, and rich peripheral set augmented with our unique Programmable I/O (PIO) subsystem, RP2040 provides professional users with unrivalled power and flexibility. With detailed documentation, a polished Micro Python port, and a UF2 boot loader in ROM, it has the lowest possible barrier to entry for beginner and hobbyist users. RP2040 is manufactured on a modern 40nm process node, delivering high performance, low dynamic power consumption, and low leakage, with a variety of low-power modes to support extended-duration operation on battery power. Raspberry Pi Pico pairs RP2040 with 2MB of Flash memory, and a power supply chip supporting input voltages from 1.8-5.5V. It provides 26 GPIO pins, three of which can function as analogue inputs, on 0.1”-pitch through-hole pads with castellated edges. Raspberry Pi Pico is available

as an individual unit or in 480-unit reels for automated assembly.

But, The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to Node-MCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike Node-MCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well.

2.2 VIBRATION SENSOR

This module features a vibration sensor, an adjustable trim pot, and a comparator chip to give an adjustable digital output based on the amount of vibration. The multi turn trim pot can be adjusted to increase and decrease the sensitivity. Additionally, there are two onboard indicators to announce the power and trigger/output status. The working voltage of the module is between 3.3V to 5V DC.

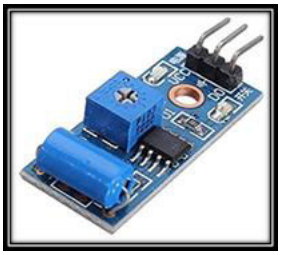

Fig. 3.Vibration Sensor SW-420

The vibration sensor module provides logic-level outputs based on the vibrations and the external impulses applied to it. That means, when there's no vibration its output remains in logic-low (L) state. But during vibration detection the output state changes to the logic-high (H) level for a while. I successfully captured the output transition with the help of a 5VDC power supply and an oscilloscope.

INTRODUCTION TO GSM 800L MODULE

The SIM800L is a GSM module from Sim com that gives any microcontroller GSM functionality, meaning it can connect to the mobile network to receive calls and send and receive text messages, and also connect to the internet using GPRS, TCP, or IP. Another advantage is that the board makes use of existing mobile frequencies, which means it can be used anywhere in the world. The SIM800L GSM/GPRS module is a miniature GSM modem that can be used in a variety of IoT projects. You can use this module to do almost anything a normal cell phone can do, such as sending SMS messages, making phone calls, connecting to the Internet via GPRS, and much more.

To top it all off, the module supports quad-band GSM/GPRS networks, which means it will work almost anywhere in the world.

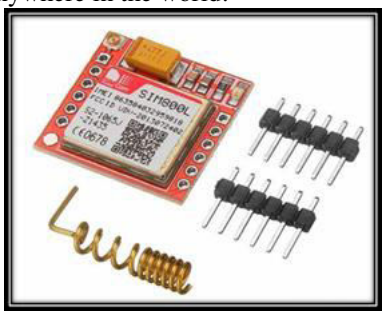

Fig. 4 GSM SIM 800L

III.ACCELEROMETER SENSORS (ADXL335)

The ADXL335 is a small, low-power, 3-axis accelerometer module designed by Analog Devices. It is commonly used in a variety of applications such as tilt sensing, motion sensing, and vibration measurement.

The ADXL335 can measure acceleration in the X, Y, and Z axes with a range of +/- 3g. It has a built-in voltage regulator and signal conditioning circuitry that allows it to output an analog voltage proportional to the measured acceleration. The module can be powered with a voltage between 1.8V to 3.6V.The ADXL335 communicates with a microcontroller or other electronics using analog voltage signals. The output voltage can be measured and converted to a digital value using an analog-to-digital converter (ADC) or processed directly with a microcontroller.

One advantage of the ADXL335 is its low power consumption, which makes it suitable for battery-powered applications. It also has a small form factor and is relatively inexpensive, making it a popular choice for DIY projects and prototyping.

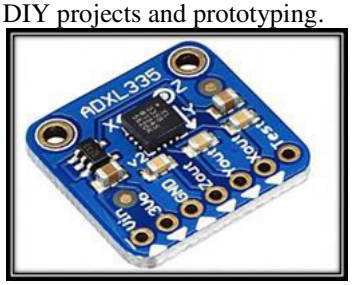

Fig. 5 Accelerometer ADXL335

3.1 PULSE OXIMETER OPERATION

The MAX30102, or any optical pulse oximeter and heart-rate sensor for that matter, consists of a pair of high-intensity LEDs (RED and IR, both of different wavelengths) and a photo detector. The wavelengths of these LEDs are 660nm and 880nm, respectively.

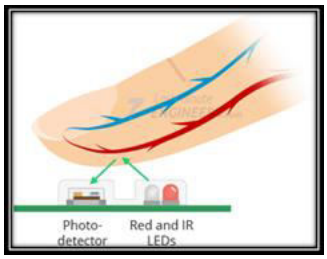

Fig.6 Pin Diagram of MAX30102

3.2 INTRODUCTION TO PIEZO BUZZER

A Piezo buzzer is a type of electronic buzzer that uses a piezoelectric element to generate sound. Piezoelectric materials generate electricity when they are subjected to mechanical stress, such as when they are bent or compressed. Conversely, when an electric current is applied to a piezoelectric material, it will expand or contract, creating mechanical stress that causes it to vibrate. A Piezo buzzer consists of a piezoelectric element, a resonant cavity, and a driver circuit. When an electrical signal is applied to the piezoelectric element, it vibrates at its resonant frequency, causing the resonant cavity to vibrate as well. This vibration generates sound waves, which can be heard as an audible tone or beep.

Piezo buzzers are widely used in a variety of applications where a loud, clear tone is required, such as alarms, timers, and notification devices. They are typically small and lightweight, making them ideal for use in portable devices and applications where space is limited. Piezo buzzers are also very efficient, consuming very little power and generating minimal heat. Piezo buzzers are available in a range of sizes and frequencies, and they can be driven by a wide range of voltages and currents. They are often designed to operate at specific frequencies and can be tuned to produce different tones or sounds by changing the size and shape of the resonant cavity. Some Piezo buzzers also include built-in driver circuits that simplify their use in electronic circuits.

Fig .7. Piezo Buzzer

3.3 INTRODUCTION GPS L89 SH-90 MODULE

L89 is a high performance GNSS module supporting multi-constellation GNSS and dual GNSS bands. It can acquire and track GPS, Indian Regional Navigation Satellite System (IRNSS), GLONASS, BeiDou, Galileo and QZSS signals. With 2 embedded antennas, the module can work at L1 and L5 bands simultaneously. Compared with the GNSS module working at L1 band only, L89 can generally increase the number of visible satellites, reduce TTFF and enhance positioning accuracy, especially when driving in rough urban environments. L89 achieves exceptional performance both in acquisition and tracking, and fully meets the industrial standard. With embedded LNA, dual antennas and antenna switch function, it is an ideal product for automotive, consumer and industry tracking applications.

Fig 8. GPS L89 SH-90

3.4 INTRODUCTION TO FLAME SENSOR KY-026

The KY-026 flame IR sensor is packed with a photo diode that is sensitive to the spectral range of light that is created by an open flame. The flame sensor detects wavelengths ranging from 760nm to 1100nm in the infrared spectrum. After detecting a flame, the digital out (DO) line will become HIGH. The analog out (AO) will provide a direct measurement of the reading.

It is not recommend that this device contacts a flame, as the plastic is likely to melt, or combust. Flame sensor should be kept at a reasonable distance from the source flame.

` This is the Flame Sensor Module which is also known as the Infrared IR Fire Sensor Detector. This Flame Sensor is extremely sensitive to IR wavelengths between 760-1100nm light. This flame sensor is ideal for short-range fire detection and can be used to monitor projects or as a safety precaution to cut devices OFF / ON or to turn ON buzzers or Send SMS. It can be used in hundreds of projects. I have found that this Flame Sensor is mostly accurate up to about 3 feet. I think this much range is enough.

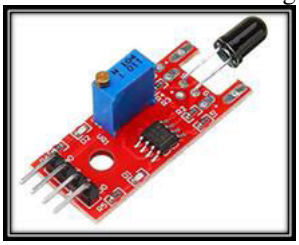

Fig.9. Flame sensor KY-026

IV. LIQUID CRYSTAL DISPLAY

Nowadays, we always use the devices which are made up of LCDs such as CD players, DVD players, digital watches, computers, etc. These are commonly used in the screen industries to replace the utilization of CRTs. Cathode Ray Tubes use huge power when

compared with LCDs, and CRTs heavier as well as bigger. These devices are thinner as well power consumption is extremely less. LCD 16×2 working principal is, it blocks the light rather Tempt an dissipate. This article discusses an overview of LCD 16X2, pin configuration and it's working. LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smart phones, televisions, computer monitors and instrument panels.

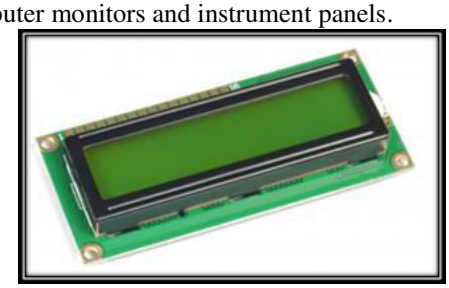

Fig.10 16X2 Liquid Crystal Display

4.1 D.C MOTOR

A DC motor or direct current motor is an electrical machine that transforms electrical energy into mechanical energy by creating a magnetic field that is powered by direct current. When a DC motor is powered, a magnetic field is created in its stator. The field attracts and repels magnets on the rotor; this causes the rotor to rotate. To keep the rotor continually rotating, the commentator that is attached to brushes connected to the power source supply current to the motors wire windings. One of the reasons DC motors are preferred over other types of motors is their ability to precision control their speed, which is a necessity for industrial machinery. DC motors are able to immediately start, stop, and reverse—an essential factor for controlling the operation of production equipment.

Fig.11 D.C Motor

4.2 D.C MOTOR DRIVER (L289N)

The L289N driver is a type of integrated circuit (IC) commonly used in robotics and other motor control applications. It is a dual H-bridge motor driver, which means it can control the speed and direction of two DC motors independently. The L289N driver operates on a voltage range from 4.5 to 46 volts and can deliver a continuous output current of up to 1 ampere per channel (2 amperes peak). It is a popular choice among hobbyists and engineers for building robots, RC cars, and other motor-controlled projects because it is inexpensive, easy to use, and widely available.

To use the L289N driver, you typically connect it to a microcontroller or other control circuit that sends signals to the driver to control the motor speed and direction. The L289N driver has two enable inputs (one for each channel) that allow you to turn the motor on and off and two direction control inputs (again, one for each channel) that determine the motor's direction of rotation.

The L298N Motor Driver Module is a high power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control.

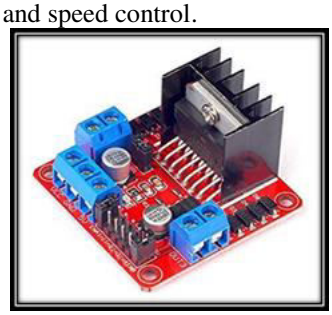

Fig.12 D.C Motor Driver L289N

V.SYSTEM CONFIGURATION & IMPLEMENTATION

5.1 SCHEMATIC DIAGRAM

Here is the interconnection configuration of the system. The Sensors, Power supply and Loads, are the above figure shows where to connect and how to connect. It is just the connections how are made on to the Board (Raspberry Pi Pico), but reality is that this varies by vehicle sizes and there zones. This all setup is fixed to under the vehicle.

So that the circuit connection can't visible and also occupies unwanted space of the vehicle.

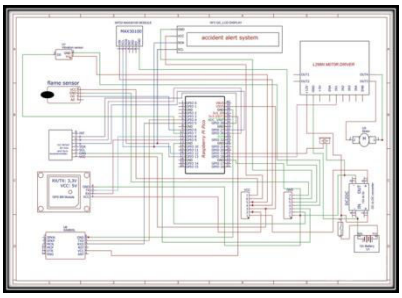

Fig. 13 Schematic Diagram of Accident Detection and Alert System

5.2 FLOWCHART:

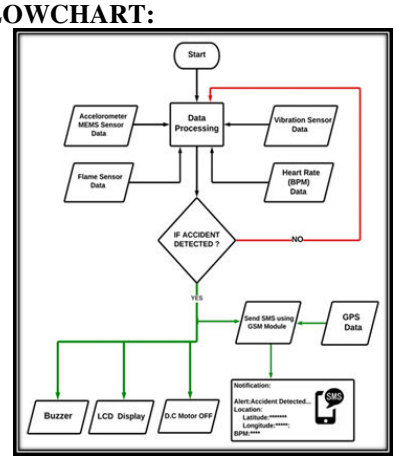

Fig.14 Flowchart

5.3 WORKFLOW

1. It starts from collecting data from Accelerometer MEMS sensor, Vibration Sensor, flame sensor and Pulse oximeter sensor, the data is transfer to Raspberry Pi Pico .Meanwhile the data processing task also happens in Raspberry Pi Pico, that conversion or any calculations needed to take place.
2. All the Data transferred to Raspberry Pi Pico, then it checks sensor value according to programming conditions .If satisfies then true block executes or else block.
3. There are the conditions in program to what should do if the accident happens or any abnormal status is identified.
4. If the values of MEMS Sensor or Vibration sensor are crossed to the threshold values in program conditions, then is identifies the vehicle is NOT in SAFE Position.
5. When a system is NOT in SAFE Position, then a buzzer makes a Alarm, D.C Motor will turn OFF and status will display NOT SAFE..!
6. Also it takes the Latitude and longitude positions from GPS and BPM and Flame Sensor values, from all these information will be send GSM to send SMS to user.
7. So, that all the information of an Accident will be send to programmed Mobile Number.
8. If the values are NORMAL then loop repeats again.
9. When an accident happens then the last Heart rate is stored in Raspberry pi Pico for further usage.
10. If in any case the fire is generated in car , even that case leads to Accident (NOT SAFE).In that position also it will send the information of accident Notification to user.
11. As SMS notification Contains:
    - Latitude and Longitude Positions
    - Last Heart Beat Rate
    - Type of Accident
12. Overall, if any sensor values cross the threshold values of given program conditions the then it will be in NOT SAFE and send SMS notification.

VI.RESULTS, ADVANTAGES, DISADVANTAGES & APPLICATIONS

6.1 RESULTS

PHYSICAL FORM OF CIRCUIT

6.1.1 CASE -1

First case is only about how an ACCIDENT DETECT'S:

In this major component of Accelerometer MEMS sensor and Pulse Oximeter are used.

If Accident Detected then Actions to be performed are:

- Turn OFF D.C Motor
- NOT SAFE..! Status display
- Buzzer Sound

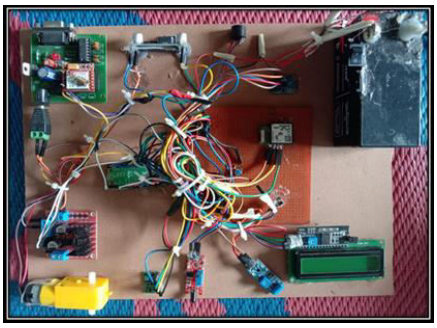

Fig. 15 Withut Power Supply

6.1.2 CASE-2

Second case is only about how ACCIDENT Information is passed to user:

In this major component of GSM SIM 800L and GPS Module are used.

If Accident Detected then following action to be performed with case-1:

- Take the GPS Locations and BPM value
- Send SMS to Mobile number with GPS location, BPM value and Type of accident

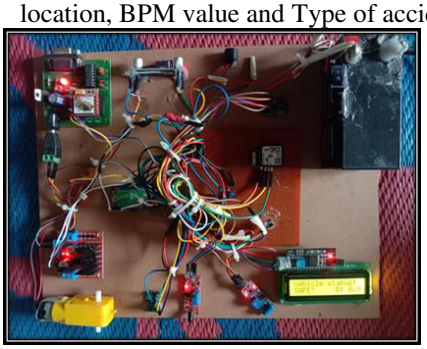

Fig.16 With Power Supply

6.1.3 SMS NOTIFICATIONS

If the device identifies the accident then the following type of SMS Notification will be send.

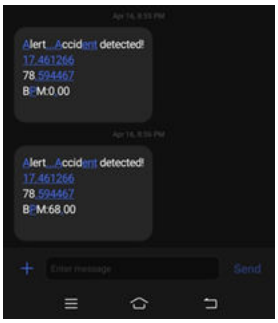

Fig. 17 SMS Notification for accident identified

Fig. 18. SMS Notification for accident identified with Flame Sensor

6.2 ADVANTAGES

1. 24/7 Vehicle tracking With Location.
2. Immediate response when an accident happens.
3. Emerngecy Medical services Provided fastly.
4. We get notification whereever the accedentt may happen.
5. We get Location of accident where it happen.
6. The person who is drivering , we get his Heart Pulse Rate.
7. We get information when ever a fire is produced in car.

6.3 DISADVANTAGES

1. All the time it need an GSM with proper signal connection.
2. A continuous power supply is required.
3. In false sensing values leads problem to unnecessay notification.

6.4 APPLICATIONS

1. To Identifies the vechicle accedent.
2. To continously monitoring vehicle status.
3. It is useful for the busy schedule persons.
4. It can be also used in general stores.

VII.CONCLUSION & FUTURESCOPE

7.1 CONCLUSION

In conclusion, accident detection and alert systems are a valuable technology for preventing accidents and improving response time in the event of an accident. These systems can provide rapid response, accurate location information, and automated alerting to emergency services, 24/7 monitoring, and cost-effective accident prevention. By improving safety for drivers, passengers, and pedestrians, these systems have the potential to save lives and reduce the overall costs associated with accidents. The use of accident detection and alert systems is an important step toward achieving a safer and more efficient transportation system, and their continued development and implementation should be a priority for all stakeholders involved in road safety.

7.2 FUTURESCOPE

The future scope of accident detection and alert systems is promising, and there are several areas where further development and implementation could lead to significant improvements in road safety. Some of these areas include:

1. Integration with Autonomous Vehicles: As autonomous vehicles become more common, accident detection and alert systems can be integrated into their design to provide enhanced safety features and reduce the risk of accidents.
2. Integration with Traffic Management Systems: By integrating accident detection and alert systems with traffic management systems, emergency services can be alerted quickly and efficiently, and traffic can be rerouted to avoid accident-prone areas.
3. Advanced Sensor Technologies: Advanced sensor technologies such as LiDAR, radar, and machine vision can be used to detect accidents more accurately and provide real-time information to emergency responders.
4. Big Data Analytics: Big data analytics can be used to analyze accident data and identify patterns and trends, which can help in the development of more effective accident prevention strategies.
5. Cloud Computing: Cloud computing can be used to store and process large amounts of data from accident detection and alert systems, which can improve the accuracy and efficiency of these systems.
6. Wearable Technologies: Wearable technologies such as smart watches and health trackers can be used to detect and alert emergency services in the event of an accident involving a pedestrian or cyclist.

Overall, the future of accident detection and alert systems is bright, and the continued development and implementation of these systems can lead to significant improvements in road safety and accident prevention.

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