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Smart Accident Detection, Prevention and Reporting using Arduino

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ABSTRACT

Numerous people lose their lives in traffic accidents every day. In India, 4,80,652 traffic accidents resulted in a total of 1,51,113 fatalities in 2019. In terms of road accident deaths, India currently retains the top rank. Excessive speed was the primary cause of fatalities in road accidents. To save the lives of several injured accident victims, this is a serious problem that needs to be remedied. In order to address the ongoing challenges surrounding automobile accidents, various automobile companies have implemented a range of safety systems, including safety airbags, seat belts, camera sensors, and more. Despite these efforts, the root causes of accidents and their resulting effects have proven difficult to mitigate entirely. To tackle this persistent issue effectively, there is an urgent need for a comprehensive system that can automatically detect accidents as they occur. This system would play a crucial role in promptly communicating vital information about the accident and its precise location to both nearby hospitals and concerned relatives without any delays. When a car has an accident, the accelerometer immediately provides data to the Arduino, which then sends the alarm message through the GSM MODULE, including the location that is identified by the GPS MODULE, to recently saved crisis contacts.

Keywords:- Arduino, Gas Sensor, Eye Blink Sensor, Accelerometer, GSM & GPS Module, Buzzer, LED

I. INTRODUCTION

The use of vehicles has significantly increased in the modern world, which has increased traffic volume and, in turn, contributed to an increase in road accidents. Due to a lack of timely preventive and safety facilities, this damages the property and results in human life loss. The proposed embedded system takes the necessary precautions to prevent accidents from happening. As the position was provided to the

emergency services' smart devices with mobile network accessibility coupled with a link to a Google Map, they could quickly locate the area. Approximately 1214 road accidents occurring every day. Major road accidents in India are caused due to the over speeding and violation of traffic rules.

The road accident rates are increasing day by day due to large numbers of vehicle running on the road. In all these Vehicles, the speed control needs to be implemented. Here is the new idea of ours to install an automated speed control system in the vehicles to control the speed mainly in the restricted areas like school, college zones etc. In the event of an accident, the accelerometer picks it up, GPS is used to determine the location, and then a GSM module is used to communicate the information to the police and ambulance service. The message received on a mobile device includes the address of the accident site in the form of a Google Maps link, which will assist emergency services like ambulance services and police stations in quickly reaching the victim and saving lives. Additionally, the information that the sensors have stored can be used later to look into the accident. Since the system is being watched over by a cloud, several criminal behaviors can be traced and observed. In the event of a chase or other emergency, the cloud service can remotely stop or lock the car.

II. LITERATURE SURVEY

Accident Prevention and Alert System using Arduino using IoT technology which was published by Aswin, Sujitha, Archunan, Sandhya Devi R in the IRJET journal in 2021. The paper was proposed towards generation of alerts and alarms using Buzzers and LEDs in case of accidents. Arduino-Home which is available on the Arduino.cc website.

The paper was published by Arduino itself and was intended towards the use of Arduino Uno R3 and circuit design. An Arduino Based Automatic Accident Detection and Location Communication System which was published by Souvik Roy, Akanksha Kumari, Pulakesh Roy, Rajib Banerjee in IEEE Xlpore in 2020. The paper was focused towards implementation of Vehicle Tracking using GSM/GPS/GPRS automatic alerts.

IoT in Connected Cars: Challenges and Chances which was published by B. Lakshmipraba, V.G. Shivakumar in IJEAT in 2019. The findings of the paper are uses of IoT in vehicles and their use cases in various scenarios and challenges.

Research Study on Advanced Driver- Assistance Systems (ADAS) published by J. Anand, A. Manoj Kumar, K. Naresh, G. Janakiraman on IRJETS in 2021. The paper consisted of implementation and working principle of ADAS system.

Cloud Computing Arduino Cloud IoT Integration with REST API published by Nemese Kalubi, Sayeed Sajal in IEEE Xplore in 2022. The paper was intended towards to connect an Arduino to a cloud to share and monitor data.

III.LITERATURE REVIEW

3.1. Existing System

Using Arduino to create a smart accident detection, reporting, and prevention system. Alcohol/gas sensors, eye- blinking sensors, and other sensors are employed since these two factors account for the majority of accidents: drunk driving and driver inattention. Following this, automatic notification of emergency contacts is made in the event of accident detection. car recovery after theft at no additional expense. Delivering emergency assistance more quickly. safety of the vehicles and efficient fleet management. decreased number of traffic collisions. Any car can easily and inexpensively have the system installed. Additionally, ADAS compatibility for autonomous steering and braking is possible. This would be useful for observing, checking, and looking into several illicit actions.

3.2. Proposed System

When a collision occurs, the accelerometer detects it up, GPS is used to determine the location, and then a GSM module is used to communicate the information to the police and ambulance service. The message received on a mobile device includes the address of the accident site in the form of a Google Maps link, which will help rescue agencies, such as ambulance services and police stations, reach the victim swiftly and save lives. The system will carry out preliminary inspections to help prevent accidents, and in the event of an incident, quick reporting is carried out to help prevent loss of life. In addition, our established system will aid in the surveillance and detection of crimes involving vehicles, such as auto theft, excessive speeding, and drug trafficking.

IV.REQUIREMENT SPECIFICATION

4.1. Hardware Requirement Specification

4.1.1. Arduino :-

It is a board-based microcontroller called the Arduino Uno. Six analogue inputs, fourteen digital input and output pins, a reset button, a power jack, an ICSP header, a USB port, and a 16 MHz ceramic resonator are all included. Simply put in a USB cable, an AC-to-DC adapter, or a battery to start using it; it already includes everything required to support the microcontroller.

The open-source Arduino platform is mostly used to develop electronic projects. UNO is the board that is used the most.

FIG : Arduino

4.1.2. GPS Module :-

The global positioning system (GPS) is a satellite-based system that determines and records its position on Earth using both the ground and satellites. GPS receivers receive data signals from GPS satellites and learn their best practices from the satellites.

By calculating the amount of time needed for the sign to travel from the satellite to the beneficiary, this is completed. The GPS beneficiary module provides output in the NMEA string format, which is the industry standard. It provides yield on the Tx pin sequentially at the standard 9600 baud rate. The NMEA string for this GPS recipient contains a number of parameters, such as longitude, range, elevation, time, and so on. Every string starts with a dollar symbol ($) and ends with a carriage return or line feed.

FIG : GPS Module

4.1.3. GSM Module :-

A chip or circuit known as a GSM or GPRS module can be used by a cell phone or cash register to communicate with a GSM or GPRS framework. A GSM modem can be a standalone modem that connects via serial, USB, or Bluetooth, or it can be a cell phone with GSM modem functionality. It requires AT instructions, which are given through sequential correspondence, in order to cooperate with the processor or controller.

FIG : GSM Module

4.1.4. Accelerometer: -

All things considered, an accelerometer is an electromechanical device that calculates quickening powers. These forces might be either static, like the constant force that gravity has on the body, or dynamic, like any vibrations on the accelerometer. Different mechanisms are used by accelerometers. One such method is piezoelectric impact, which uses gem-like tiny structures to generate voltages when accelerative forces strike against them.

FIG : Accelerometer

4.1.5. Alcohol Sensor: -

The alcohol sensor, also known as a MQ3 sensor, detects the presence of ethanol in the environment. When a drunk individual breathes near an alcohol sensor, the sensor detects the ethanol in their breath and offers data based on the amount of alcohol in the breath. More LEDs would illuminate if the alcohol percentage was higher.

FIG : Alcohol Sensor

4.1.6. Eye Blink Sensor: -

This eye-blink sensor employs infrared technology and features an IR transmitter as well as an IR receiver. The eye blink sensor shines infrared light into the eye and measures variations in the reflected light. The results are determined using the infrared light reflected from the eye.

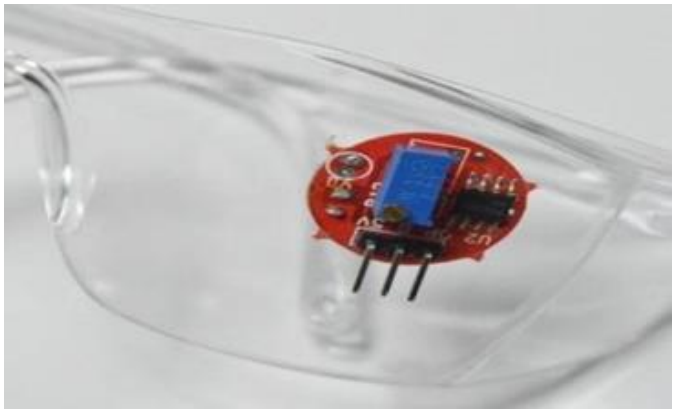

FIG : Eye Blink Sensor

4.1.7. Buzzer and LEDs

A mix of buzzers and LEDs can be employed in accident detection and prevention systems to alert drivers to prospective hazards and risky driving practices. For instance, the Arduino can use the buzzer to sound an alarm and the LEDs to flash a warning signal to inform the driver to take a break or find a designated driver if the eye blink sensor detects that the driver is starting to get sleepy.

The Arduino may also use the buzzer to sound an alarm and the LEDs to flash a warning signal to deter the driver from getting behind the wheel if the alcohol sensor determines that the driver has drank alcohol.

FIG : Buzzer And LEDs

4.2. Software Requirement Specification

4.2.1. Arduino IDE: -

The Arduino Integrated Development Environment (IDE), often known as the Arduino software, has a code editor, a message area, a text console, a toolbar with basic function buttons, and a variety of menus. It links to the Arduino hardware to upload and communicate with programmers.

4.2.2. Android Studio: -

Google created and made available the official integrated development environment (IDE) for producing Android apps, known as Android Studio. Using the tools given by an IDE, programmers may simply design, install, run, and test software, in this case Android apps.

V. METHODOLOGY

The system has the three phases: Pre accident, Post-accident and Reporting. As you can see, the engine will not start if the driver is drunk and an alert will be generated. In case the vehicle is running, the temperature sensor, gyroscope, eyeblink sensor, accelerometer and GPS module will continuously keep a track of the respective parameters. If any of them goes out of limit, the ADAS will be triggered and vehicle will be brought back in control. The data from the vehicle will be sent to the emergency contacts which includes the Police control room and Ambulance Unit by default. The user can add their family or friends in the emergency contacts also. This data can include the vehicle statistics, sensor readings, alerts, and the location coordinates of the vehicle.

A buzzer and red-light LEDs alert the driver, and alcohol, eye blink, and temperature sensors help prevent accidents. First, an alcohol sensor measures the driver's blood alcohol content; if it is less than a certain level, the motor turns on and the automobile is ready to drive. When alcohol is detected, the motor shuts down. Similarly, the eye blink sensor detects fatigue in the driver and informs him or her with a buzzer and red LED lights. The microcontroller is constantly updated with the coordinates of the car's position by the accelerometer in the vehicle unit. If it is found at random, the GPS location tracker follows it and uses GSM to communicate the latitude, longitude, and position on Google Maps to emergency numbers.

Block diagram

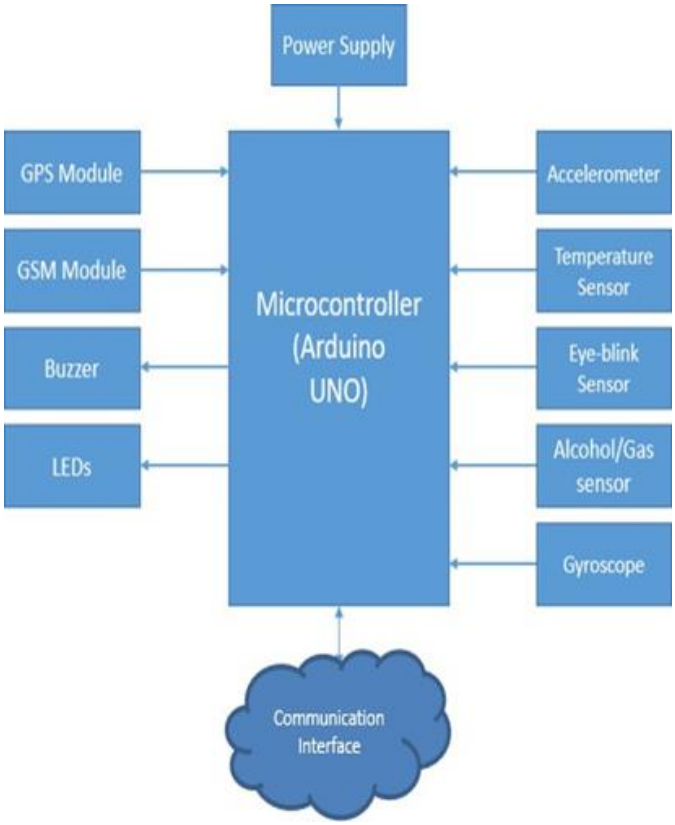

FIG : Block Diagram

VI.IMPLEMENTATION

In Android, an activity is a screen on which the user interacts with the phone. It uses widgets such as buttons, text forms, and images to communicate data. The main activity, which delivers user input to the Arduino and displays received text, is the center of the tutorial. To test device connectivity, both the USB and Bluetooth apps use the same layout. The programmer requires additional permissions, which are listed in the manifest, such as making the phone a USB host.

The system has three phases: Pre-accident, Post-accident, and Reporting. The engine won't start if the driver is drunk, generating an alert. While the vehicle is running, sensors like temperature, gyroscope, eyeblink, accelerometer, and GPS continuously monitor relevant parameters. If any parameter exceeds limits, the ADAS (Advanced Driver Assistance System) triggers to regain control. A cloud service remotely monitors this data, which is also sent to emergency contacts (default: police control room and ambulance unit). Users can add their own family or friends as emergency contacts. The data includes vehicle statistics, sensor readings, alerts, and location coordinates, stored in the cloud for future analysis.

The vehicle unit incorporates preventive measures such as an alcohol sensor, eye blink sensor, and temperature sensor. The alcohol sensor detects alcohol concentration in the driver's breath, preventing vehicle operation if it exceeds a threshold. The eye blink sensor alerts the driver with a buzzer and red LEDs if signs of drowsiness are detected. The temperature sensor continuously monitors the engine's temperature and triggers alerts if it surpasses a predefined threshold. An accelerometer provides vehicle position data, and if irregular movement is detected, a GPS location tracker activates and sends latitude, longitude, and Google Maps position to an emergency number using a GSM SIM module.

System Architecture :

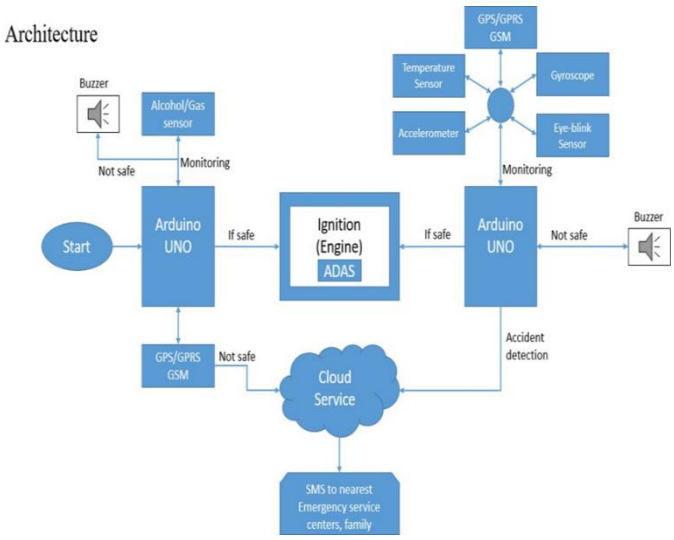

FIG : System Architecture

The architecture consists of 2 phases:
Pre-ignition. Post-ignition.

Pre-ignition:

At this stage, the system will do a check to prevent the accident. The precautions taken here are:

Alcohol sensor checks the alcohol level through breath of the driver. If the alcohol concentration is below the threshold, the engine will start and if the level exceeds the threshold, the engine will not start and an alert will be generated for the driver as well as for the police. If found drunk, the system reports the same to the police with the location of the vehicle.

Post-ignition:

This would do a continuous check during the vehicle is running. The precautions taken here are:

Eye-blink sensor will keep a track of the eye of driver. If found sleepy, the engine will stop and a buzzer will be triggered to wake up the driver.

- Accelerometer: If an accident occurs, the speed of the vehicle will immediately change to zero. The accelerometer reads this and detects it as an accident. The same is reported to emergency services and contacts with the location.
- Temperature sensor: The temperature sensor alerts if the engine is over-heated. In case of

accident and fire, the temperature sensor will alert the fire department also.

- Gyroscope: The gyroscope is used to determine the position of vehicle in 3D space. This will determine if the vehicle is collapsed or turned-over due to accident. It will help emergency services to plan their rescue.

The system is cheap and easy to install on any vehicle. It can also be made compatible with ADAS for automatic steering and braking. This would be helpful to monitor, inspect and investigate many criminal activities as well.

Flow Chart :

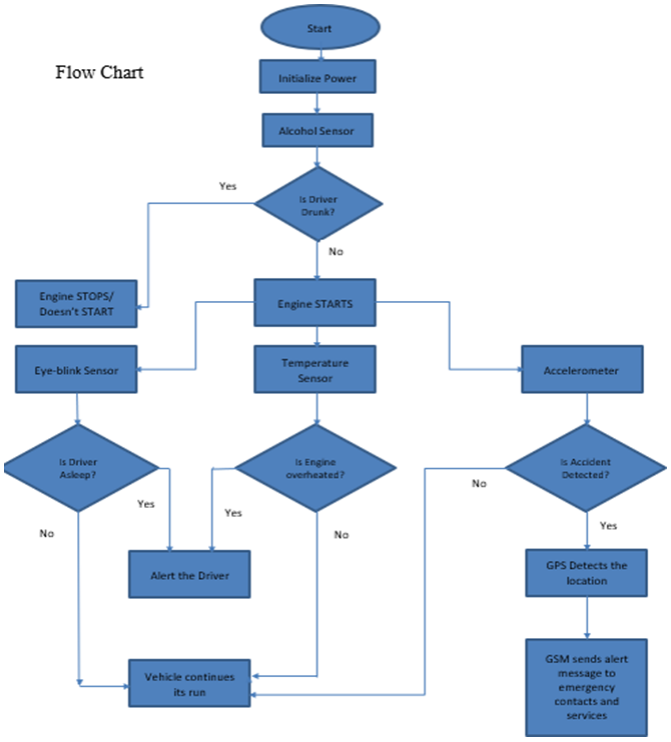

FIG : Flow Chart

VII. RESULTS

Firstly, connect the Eye-blink sensor, Accelerometer and temperature sensors on the breadboard as shown in the figure. Where eye-blink sensor is used to monitor the driver's drowsiness level and alert them when they are becoming too sleepy to continue driving safely. Accelerometer is used to detect the speed and report the position of vehicle and also analyze the movement of vehicle. And temperature sensor is used for the measure the temperature of vehicle for detecting overheating.

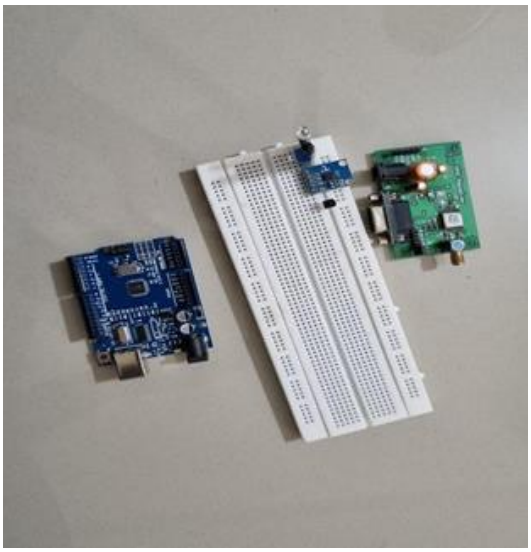

Fig .1

Now, we connect the GPS Module with help of jumper wires. Also Connect the alcohol Sensor. to detect the presence of alcohol in a driver's breath and alert them if they are under the influence of alcohol. A GPS module can be used in an accident detection and prevention system to provide accurate location data for the vehicle. When a person who has consumed alcohol breathes near the sensor, it can accurately identify the ethanol in their breath and generate an output signal that corresponds to the concentration of alcohol.

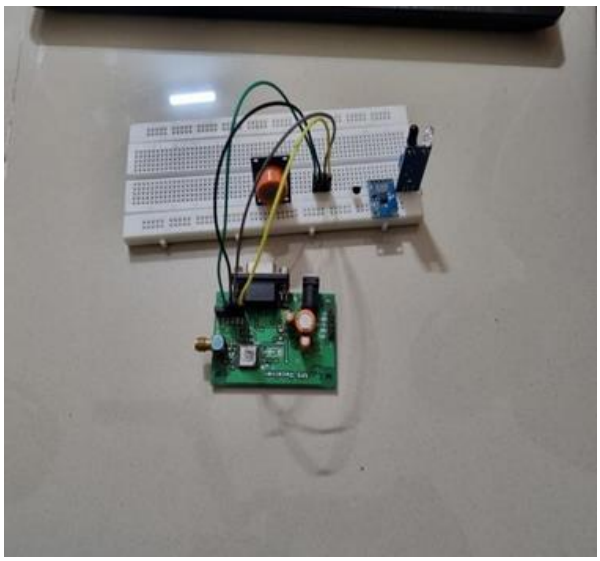

Fig .2

Connected all remaining sensors such as GSM Module, Arduino, LED display and buzzer to the breadboard. Done with all connections required for the implementation. A GSM module can be used in an accident detection and prevention system to provide cellular network connectivity for the system. In an accident detection and prevention system, a combination of buzzer and LEDs can be used to provide visual and audio feedback to the driver about potential hazards and unsafe driving behavior

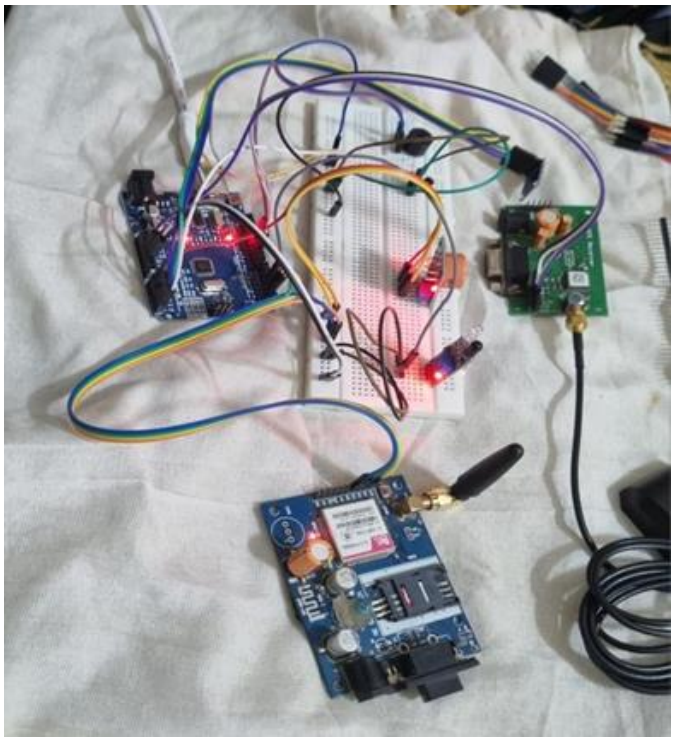

Fig .3

The above diagram illustrates how our system is implemented. The model includes all of the sensors, input devices, warning devices, and reporting system connected to the Arduino UNO R3, which serves as our primary processing unit, via a breadboard. The vehicle's coordinates are discovered using a GPS receiver, and an SMS alert with the coordinates and a link to a Google Map is sent using a GSM module. For the purpose of detecting an accident or an abrupt shift in any axis, the accelerometer ADXL335 is used. Additionally, status messages or coordinates are shown on an optional 16x2 LCD The SIM28ML GPS module was used. In the event of a collision, the car tilts, and the accelerometer alters the values of its axes. Arduino reads these numbers and decides if any of the axes change. If there is a change, Arduino reads the coordinates by extracting the $GPGGA String from the GPS module data (see above for an explanation of how GPS works) and sends an SMS to a predefined number with the accident site coordinates to the police, an ambulance, or a family member. The message also contains a Google Map link to the accident scene, allowing you to easily follow its whereabouts. When we receive the message, we just click the link, which takes us to a Google map where we can see the exact location of the car. The vehicle's speed in knots (1.852 KPH) is also included in the SMS and displayed on the LCD.

An activity is a screen on which the user interacts with the phone. Widgets such as buttons, text fields, photos, and so on are included in activities to aid in the flow of information. This tutorial will only use one activity, the Main Activity, which will accept user input and communicate it to the Arduino. According to this definition, an activity is a screen on which the user interacts with their phone. Widgets that aid in information communication, such as buttons, text boxes, and images, are examples of activities. The only activity utilised in this tutorial is the Main Activity, which will accept user input to transmit to the Arduino and display the text that is received. The layout of both the Bluetooth and USB apps will be the same. It's a simple one, with only the bare minimum of widgets required to test the devices' connectivity. I was seeking libraries that handle all of this automatically because setting up a serial connection in Android is tricky because you have to provide a lot of stuff manually.

It has the three phases: Pre accident, Post-accident and Reporting. As you can see, the engine will not start if the driver is drunk and an alert will be generated. In case the vehicle is running, the temperature sensor, gyroscope, eyeblink sensor, accelerometer and GPS module will continuously

keep a track of the respective parameters. If any of them goes out of limit, the ADAS will be triggered and vehicle will be brought back in control. This all is monitored by a cloud service remotely. The emergency contacts, which by default include the police control center and the ambulance unit, will receive the data from the car. The user can add their family or friends in the emergency contacts also. The vehicle unit incorporates various sensors and preventive measures to enhance safety and prevent accidents. It collects and processes data, including vehicle statistics, sensor readings, alerts, and location coordinates. This data is then stored in the cloud for future research and investigations.

A temperature sensor, an eye blink sensor, and an alcohol sensor are all included in the vehicle unit. The alcohol sensor detects the alcohol concentration in the driver's breath. The motor is allowed to operate, signaling that the car is prepared to be driven if the detected alcohol concentration is below a predetermined level. The motor is shut off, stopping the driver from operating the car if alcohol is found above the threshold.

To address driver drowsiness, the eye blink sensor continuously monitors the driver's eye movements. If signs of drowsiness are detected, such as prolonged eye closure or reduced blink frequency, the system activates an alert mechanism. This includes activating a buzzer and illuminating red-colored LED lights to alert the driver and prevent potential accidents.

The vehicle unit also incorporates a temperature sensor to monitor the engine's temperature continuously. If the temperature exceeds a predetermined threshold, the system triggers alerts to notify the driver about the high engine temperature. This helps in preventing engine damage and potential breakdowns.

The vehicle unit also has an accelerometer that continuously records the position and motion of the vehicle. The detection of sudden or erratic changes in the position of the vehicle suggests potential theft or accidents. In such circumstances, a GPS position tracker is engaged and provides current coordinates for the location of the car. To send the latitude, longitude, and Google Maps position to an emergency contact number for prompt assistance, the system makes use of a GSM SIM module.

It's crucial to remember that the description supplied is simply meant to serve as an illustration and that the implementation and performance of such a system may vary depending on the precise needs and technologies used.

VIII. APPLICATION

An accident detection and prevention system using Arduino can have various applications, including:

1. Free Stolen Vehicle Retrieval: Our system includes a built-in feature for recovering stolen vehicles at no additional cost. If your vehicle is stolen, you can track its location using the GPS module and promptly notify the authorities. This ensures a higher likelihood of recovering your vehicle quickly and minimizing financial loss.
2. Enhanced Emergency Response: By utilizing our vehicle safety system, emergency services can be dispatched faster in case of accidents or emergencies. The system automatically sends alerts to the police control room and ambulance unit, providing them with real-time vehicle data, including location coordinates. This enables swift and targeted response, potentially saving lives and reducing the severity of injuries.
3. Comprehensive Vehicle Security and Efficient Fleet Management: Our system offers robust vehicle security features, ensuring the safety of your vehicles and facilitating smooth fleet management. With sensors such as accelerometers, temperature sensors, and GPS modules, you can monitor various aspects of your vehicles in real time. This helps prevent theft, unauthorized use, and potential

breakdowns, while also enabling effective fleet tracking and optimization.

4. Promoting Road Safety and Accident Prevention: The implementation of our system contributes to a reduction in the number of road accidents. By continuously monitoring parameters such as temperature, gyroscope, eye blink, and accelerometer, potential risks or driver fatigue can be detected early.

This allows for timely alerts and interventions, helping drivers maintain control and avoid hazardous situations, ultimately leading to a safer driving experience for all road users.

IX. CONCLUSION

In the 21st century, the continuous advancement of science and technology has led to a heightened focus on vehicle safety. Drunk driving, drowsy driving, and engine overheating resulting in fires are significant causes of accidents. The implementation of this project aims to mitigate accidents caused by these factors. Automatic, economical, and energy- efficient technology makes for simple installation in automobiles.

By integrating a GSM module and GPS, the system enables the transmission of emergency alerts to specific locations, notifying rescue units promptly. This timely alert mechanism plays a crucial role in saving numerous lives. The system is designed for regular individuals, offering affordability and simplicity of installation across all automobiles. Its versatility allows for application in various scenarios.

The potential of this system extends beyond individual users, as it can be adopted on a larger scale by medical teams and law enforcement authorities. This collaborative approach enhances the efficiency of addressing and managing accident cases. By leveraging the capabilities of this system, these entities can effectively respond to emergencies, ultimately saving more lives.

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