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IOT BASED AUTOMATIC VEHICLE ACCIDENT DETECTION AND RESCUE SYSTEM

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Abstract:
Road accidents are a critical hassle, resulting in a massive lack of lifestyles because of delays in emergency reaction. To deal with this hassle, we endorse an IoT-primarily based vehicle detection and recovery gadget that detects injuries in actual time and provides a rapid reaction. The gadget integrates diverse sensors, inclusive of a vibration sensor, a MEMS sensor, an ultrasonic sensor, and a temperature sensor, for vehicle fitness tracking and collision detection. When an coincidence takes place, the Arduino microcontroller methods the information from the sensors and triggers. A buzzer is activated to signify the accident, and the GPS module statistics the precise location, that is then sent to emergency services and family individuals via an internet connection. In addition, motor drives and DC automobiles can be used to simulate automobile operation for trying out functions. The machine is battery-powered and shows real-time statistics on an LCD display. This low-price and efficient solution appreciably reduces response times and increases the chances of saving lives in essential situations.

Keywords: Embedded C, NodeMCU, Alcohol sensor, Vibration sensor.

INTRODUCTION

The variety of avenue accidents in Malaysia is growing at an alarming price. In 2018, the Malaysian Ministry of Transport (MOT) recorded 548,598 avenue accidents, resulting in 6,284 deaths. Whether a victim is alive or useless is decided via the response time of the Emergency Response Service (ERD), which depends on how fast the ERD gets information about the incident. The importance of quick reaction time inside the occasion of an accident is important for twist of fate sufferers. Detailed evaluation indicates that a one-minute discount inside the response time to a twist of fate will increase the risk of saving a person by using up to 6%. In general, the response time to an accident is related to the region and severity of the accident, in addition to the congestion across the accident web site. With less site visitors, the response time of the ERD to the accident notification inside the occasion of an accident will increase, on occasion up to 24 hours GSM communications are employed as a technique for manipulating and managing loads. Go from everywhere in the international by means of sending a message. It has its very own determinism. So here it's far used to reveal and control DC motor, stepper motor, temperature sensor and strong nation relay by way of sending message thru GSM modem. Hence there may be no want to waste time on manual coping with and transportation. Therefore, it's far considered as a totally powerful conversation through mobile communication, useful in industrial manipulate systems, vehicles and every other remotely managed gadgets. It is greater comparatively cheap and fee effective; consequently GSM is desired for this control technique. ZigBee - ZigBee Global Positioning System is used for tracking and navigation in cars.

RELATED WORK

An essential phase in the process of developing software is evaluating the literature. Prior to expanding the device, it is crucial to consider time factors, cost savings, and commercial enterprise robustness. Finding the operating systems and languages needed to expand the device comes next, after those requirements are satisfied. When a programmer starts building a device, they need several kinds of outside assistance. Advanced programmers, books, and websites can all provide this assistance.

We expand the suggested tool by taking into account the aforementioned issues prior to system creation. Examining and assessing all requests for improvement is a major task for the mission development branch. The most crucial stage in the software program improvement approach for every difficulty is the literature evaluation. Time considerations, aid requirements, human resources, economics, and organizational skills should be identified and examined prior to developing equipment and related designs. Finding the software program specifications for your particular PC, the operating system needed for your assignment, and the software programs needed for the switch are the next steps after these variables have been considered and thoroughly investigated. Steps such as developing equipment and related characteristics.

Lu Wei, Lei Gao, Jian Yang, and Jinhong Li created a novel reinforcement learning technique for traffic light control in 2023. To better comprehend traffic demand, their method takes into account both moving and halted cars. They enhanced traffic flow and decreased delays and queues in simulations by employing a deep reinforcement learning-based approach [1]. Using deep learning, Yacong GAO, Chenjing Zhou, Jian Rong, Yi Wang, and Siyang Liu created a technique in 2022 to forecast short-term traffic speeds. To increase accuracy, they employed historical and projected traffic flow data, and they discovered that the LSTM model performed best. This approach facilitates more efficient route planning for cars and traffic management [2].

In 2021, Bijan Moaveni and Fatemeh Khosrosereshki presented a traffic model for crossing metro lines that concentrated on the effects of transfer stations. Their nonlinear discrete event model takes technological delays into consideration and illustrates how these disruptions spread and impact system stability. The model's ability to effectively manage delays and accurately depict metro traffic behaviour was confirmed when it was tested using actual data from Tehran's metro [3]. To enhance traffic management, Yash M. Dalal, Soumyalatha Naveen, and Ashwin Kumar UM presented a technique in 2023 that combines image detection with Gaussian blur. By precisely identifying cars and examining traffic patterns, this method aids urban planners in minimizing gridlock and improving traffic flow [4].

Xiaoping Ma, Sibo Lu, Honglan Huang, and Yanpiao Chen created a traffic management plan in 2023 that integrated intersection monitoring, prediction, and control. To enhance traffic flow, they clustered intersections and adjusted signal timing using clever algorithms. Simulations demonstrated that it outperformed other approaches in terms of efficiency and delay reduction [5]. Jiaming Wang, Long Xu, Zhonghe He, and Li Wang created a model in 2022 to examine urban traffic flow while taking into account various means of transportation, such as buses and autos. They developed a three-dimensional model to examine how buses and cars interact and impact traffic capacity using data from Beijing's road network. Their methodology is helpful for managing traffic control in places with varying travel needs and aids in understanding how traffic changes over time [6].

Edouard Ivanjko, Željko Majstorović, Mladen Miletić, and Filip Vrbanić collaborated on defining key traffic situations for urban mobility in 2021. They analyzed traffic data from Slovenian motorways using machine learning techniques. By developing pertinent scenarios for machine learning models, their findings will aid in the improvement of traffic management systems [7]. Victor Cherniy, Olena Sharovara, Ihor Vasyliev, Sergiy Bezshapkin, and Olena Verenych conducted research on road traffic management in Kyiv, Ukraine, in 2020.

They enhanced traffic planning and decision-making by utilizing contemporary technology such as GIS and spatial databases. Through their efforts, the city was able to improve its traffic control system [8].
A smart traffic control system that modifies signal timings according to traffic flow was created in 2024 by Devika S. G., Govind A., and Lekshmi D. It also uses the YOLO v8 algorithm and siren detection to prioritize emergency vehicles, such as ambulances. This technique enhances safety and lessens traffic [9]. In order to examine traffic with regular and connected automobiles, Zuping Cao, Lili Lu, Chen Chen, and Xu Chen developed a model in 2023. According to their findings, traffic flow improves with more linked cars on the road, cutting down on wait times and travel times. Queue lengths were cut by 64.6% and travel times were shortened by 48.3% when all vehicles were connected [10].

EXISTING SYSTEM

When a car is involved in an accident, the location's GPS coordinates and the car's number are instantly sent to the hospitals in the area, guaranteeing that those in need receive assistance in a timely manner. The owner receives a text message informing them of the car's condition when it is attempted to crank. If the car's engine fails during a lengthy drive. Time is saved by capturing and transmitting the GPS coordinates and error signals from the vehicle's dash board to the nearby service facility. Here, the GPS is utilized to track the precise location of the vehicle, and the GSM is used to transmit the text message. The GPS module, GSM, and microcontroller (PIC 16F877A) communicate with each other via the serial communication interface UART. The following are some uses for the RS232 communication standard. Properties of electrical signals, including voltage levels, signalling rates, timing and slew rates, short-circuit behaviour, and voltage withstand levels.

Disadvantages

- Not audible in buildings
- Unable to pinpoint precise accident scenes during incidents there is virtually little communication speed.
- We are unable to find the car.

PROPOSED SYSTEM

By automatically identifying collisions and guaranteeing prompt emergency response, the suggested Internet of Things-based autonomous vehicle accident detection and rescue system aims to improve road safety. An accelerometer sensor is integrated into the system to track vehicle motion and identify abrupt hits, which could be a sign of an accident. When an accident is detected, a GPS module records the precise location, and a GSM module immediately notifies the victim's guardian and emergency services of the location. A buzzer or alarm system is also triggered to alert those in the vicinity for prompt aid. A microcontroller provides smooth operation, controls component communication, and processes sensor data. By drastically cutting down on emergency response time, this automated method improves accident victims' chances of surviving. The technology offers a dependable and effective way to enhance road safety and rescue operations by utilizing IoT and real-time tracking.

Advantages

- Since the car can only be started if the owner acknowledges it, high security is achieved.
- If a car breaks down, we do not have to look for a service shop.
- The accident victims can receive prompt medical assistance.
- During accidents, the precise coordinate can be determined.
- In addition to preventing drunk driving, we may keep an eye on the driver's heart rate.

SYSTEM ARCHITECTURE

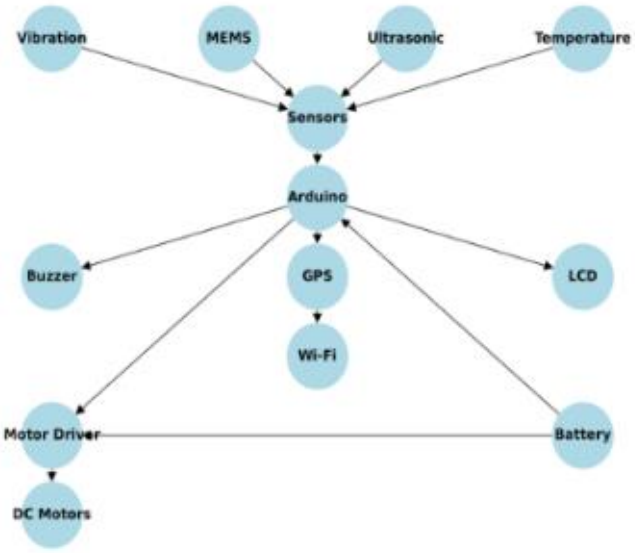


Fig 1: System Architecture

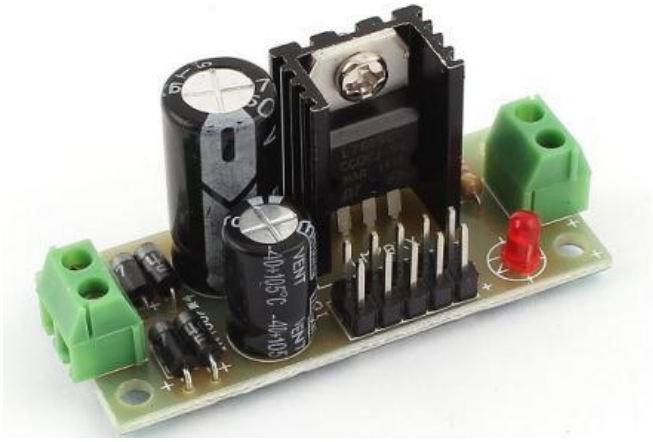
Hardware Components explanation

- Power supply
- MEMS sensor
- Vibration sensor
- Ultra sonic sensor
- Arduino UNO
- Buzzer

Rectifier

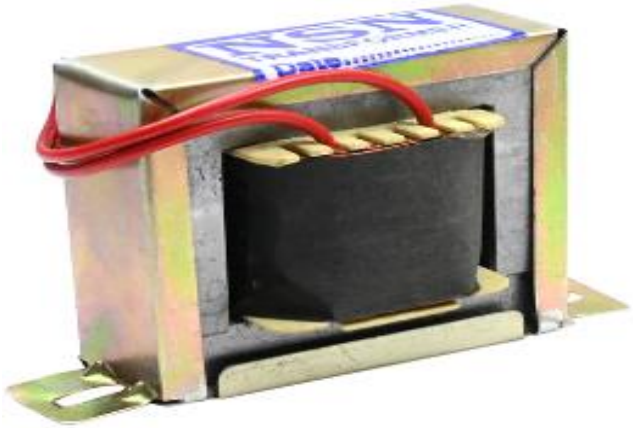
A rectifier is an electrical device that uses one or more P-N junction diodes to change alternating electricity into direct current. A diode only allows current to flow in one direction, just like a one-way valve. This method is known as "rectification." A rectifier that transforms the entire alternating current cycle into pulsing DC is known as a full wave rectifier. Full wave rectifiers use the entire input AC cycle, as opposed to half wave rectifiers, which only use the half wave. There are two primary types of rectifiers: regulated and unregulated. Rectifiers with a variable voltage are known as controlled rectifiers. MOSFETs, IGBTs, or SCRs can be used to convert an uncontrolled rectifier into a controlled rectifier. Compared to unmanageable ones, these are better.

Regulator



A controller is a device or equipment that automatically controls things like the temperature of a room or a person's body temperature. An automated voltage regulator keeps the generator's output steady. With the use of additional electrical additives, voltage regulators (VRs) maintain a strong supply's voltage within manageable bounds. Although some can convert electricity from AC to AC or DC to DC, voltage regulators are mostly employed to convert DC to DC. Regardless of load conditions or feedback voltage changes, a voltage regulator generates a constant current depth voltage. Direct and variable voltage regulators are the two types available. The output of a regulated strength deliver has voltage regulators. The regulator ensures that the output voltage is consistently within the electricity deliver rating, thus the quantity of current pulled via the tool is independent.

Transformer



A step-down transformer lowers the voltage that enters the site by boosting electrical current. It accomplishes this by switching between the crucial lower voltage in the optional windings and the high approaching voltage in the important twisting. An electrical device known as a step-down transformer lowers the voltage of an AC power source. It consists of an iron centre, an optional winding, and a necessary winding.

ARDUINO UNO

One common Arduino board is the Arduino UNO. In this case, UNO stands for "one" in Italian. To refer to the initial release of Arduino software, it was called UNO. Additionally, it was Arduino's first USB board to

be released. It is widely utilized in many projects and is regarded as a powerful board. Arduino UNO was created by Arduino.cc. Atmega328P microcontrollers are the foundation of Arduino UNO. Unlike other boards, such the Arduino Mega board, etc., it is simple to use. The board is made up of circuits, shields, and input/output (I/O) pins that are both digital and analog..

Fig 2. Arduino uno

IOT (Internet of Things)

IoT stands for Internet of Things, which means that getting access to and the use of the devices and home equipment you use every day on line.

Our IoT guide covers all IoT topics consisting of get entry to, functions, pros and cons, surroundings, framework of desire, architecture and domains, biometrics, CCTV cameras and security systems. Opening doors, gadget.

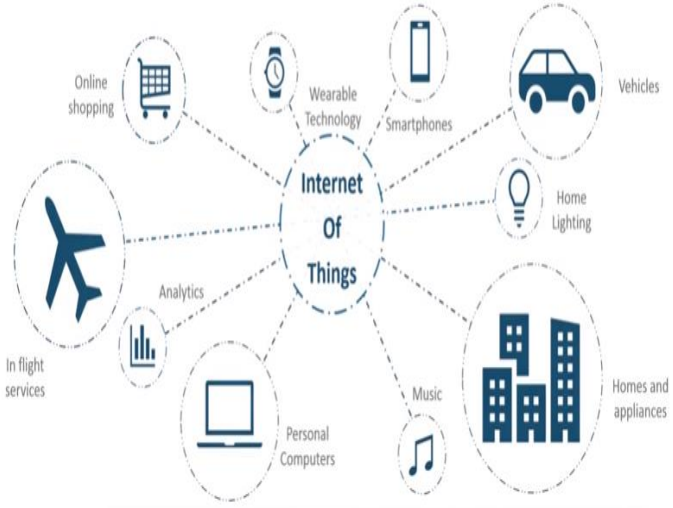


Fig 3. IOT Internet of Things

MEMS Sensor:

MEMS Sensor (Micro-Electro-Mechanical Systems Sensor) The MEMS sensor detects tilt, movement, and sudden orientation changes in the vehicle. In case of a severe accident, such as a rollover, this sensor confirms the severity of the crash. By working alongside the vibration sensor, it helps reduce false accident detections.

Fig 5. MEMS Sensor.

Buzzer

There are many procedures to the connection between someone and art work. A preferred manner to degree volume is to apply a buzzer. Therefore, in layout method, some clever technologies are frequently related to configurations.

Fig 8. Buzzer

GPS Module:

When an accident is detected, the GPS module determines the precise location of the car. IoT connectivity is used to transmit the location coordinates to family members and emergency agencies. This function is crucial for expediting rescue efforts and delivering prompt medical aid.

Vibration Sensor

For screening and analytical purposes, a vibration sensor also known as a vibration detector—measures the vibration levels in machinery. Industrial vibration sensors are used by maintenance crews to monitor conditions and determine the frequency and intensity of vibration signals. In addition to general vibration levels that show whether your asset is stretched, vibration sensors can give more detailed readings.

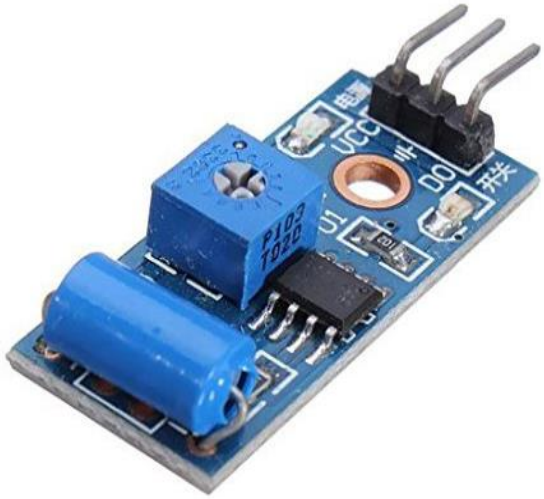


Fig: Vibration sensor

Ultrasonic sensors

UAVs employ stereo vision and ultrasonic sensors to determine how far away they are from the ground. A flight control system can then use ultrasonic sensors to keep the vehicle at a certain altitude. Ultrasonic pulses are sent towards the ground by an ultrasonic sensor, which then receives the reflection of the pulses when they bounce off the ground. As time passes between the transmitted and reflected waves, the sensor determines the distance to the ground.

Fig: Ultrasonic sensors

USED SOFTWARE

Programming Language: Embedded C

Embedded C is a microcontroller-based totally programming language that uses hardware I/O addressing, fixed-factor mathematics, and different functions that distinguish it from C. Embedded systems are specialised systems designed to carry out specific features or duties. An embedded device consists of both hardware and software, with the software often called firmware integrated into the computer hardware. Embedded C is used to program a extensive variety of microcontrollers and microprocessors. Embedded C requires fewer resources than better-stage languages which include assembly programming language.

ARDUINO IDE AND ITS PROGRAMMING

Similar to your computer, Arduino is a tool for creating computer systems that can sense and control the physical world. It is an open-source platform for physical computing that is mostly built on a simple microcontroller board and a programming environment for creating board software. With the ability to receive inputs from various switches or sensors and operate various lighting fixtures, automobiles, and other body outputs, Arduino can be used to construct interactive objects. Arduino projects have the ability to operate independently or in conjunction with computer programs.

Result and Discussion

This project uses sensors and Internet of Things technology to improve road safety and emergency response. When an accident occurs, a vibration sensor detects it and alerts the system. It detects symptoms of fatigue by tracking eye blinks and determining whether the driver is inebriated. If any of these issues are discovered, the system alerts law enforcement or rescue personnel to the location of the car. If the collision is minor and the driver is unharmed, they can switch off the alert to conserve emergency resources.

CONCLUSION

An important step toward reducing collisions and improving road safety is the incorporation of the Internet of Things (IoT) into car safety systems. IoT offers proactive measures like identifying possible hazards, warning drivers, and even automatically controlling car functions to prevent collisions by utilizing real-time data from several sensors, GPS, and communication technologies. In addition to lowering the chance of accidents, this strategy makes sure that important information is quickly shared with emergency services in the case of an occurrence. It is anticipated that when IoT technology develops further, its use in car safety will go even further, providing more complete solutions for preventing collisions and ultimately saving lives on the road.

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