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# Automated Accident Detection and Rescue System

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**ABSTRACT:**
Road accidents are a burning social problem, which may lead to serious injuries and fatalities because of late emergency services. The current paper outlines an IoT-based Automatic Vehicle Accident Detection and Rescue System aimed at detecting the accidents immediately and warning the relevant authorities on the issue. In the system combination of sensors, such as vibration, MEMS (accelerator), ultrasonic, and temperature sensors are used to constantly check the conditions of the vehicle and identify abnormal situations, which most likely indicate a collision. When detected, Arduino microcontroller calculates sensor information and activates an alert protection. The GPS module calculates the geographical positioning of the location of the accident taking its exact geographical position and then transmits it through GSM/IoT communication to the emergency services and pre-registered contacts. There is instant local indication of a buzzer, and system status and alerts are represented on an LCD. To validate experimentally, motor drivers and DC motors are added in order to model vehicle movement. The system is connected with a stable battery power source, which guarantees efficiency in case of serious circumstances. This is a solution that is not expensive, can be scaled and is simple to deploy hence fit to be popular. The proposed system leads to higher chances of survival and better road safety as it makes the process of medical intervention fast and reduces the response time.

**KEYWORDS:** Accident Detection, Internet of Things (IoT), Arduino, GPS Module, GSM Communication, Vibration Sensor, MEMS Sensor, Ultrasonic Sensor, Emergency Alert System.

**INTRODUCTION:**
Due to urbanization, the increase in the number of vehicles, road security has become a worldwide crisis. Accidents are common because of drunken driving, fire caused by electricity or fuel problems and inadequate level of obstacle awareness. Although there has been the development of automotive technology, majority of safety systems are in reactionary mode, as opposed to preventative systems [1]. The issue of drunk driving is one of the main causes of accidents. Studies reveal that preventive systems such as automatic alcohol detector devices have the potential of extremely lowering the incidences of accidents [2], [3]. The conventional breathalysers, though, had to be operated manually, and could not be used to monitor the drivers once they were on the road. Fire in vehicles is rather rare, but it develops very fast and has devastating consequences. Flame and temperature sensors offer early signals but they are often only able to raise local alarms but not automated vehicle control or providing emergency notifications, which restricts the effectiveness of responding to it [4]. Equally, the infrared sensors are

much better in detecting obstacles when visibility is low, but they are normally designed as a standalone solution and rarely as an integrated solution [5]. The Internet of Things (IoT) is changing the level of safety on the vehicles, providing links between sensors, communication devices, and cloud services into an intelligent system capable of monitoring the situation and making real-time decisions [6], [7]. Thing Speak is a platform that allows remote visualization of data and proactive safety control [8]. The paper has introduced an IoT-based vehicle safety system of an ESP8266 NODEMCU with alcohol, fire, and infrared sensor, GPS and GSM modules. The system constantly checks hazards and blocks the vehicle under unsafe conditions, notifies in terms of location, and transmits data to the cloud in order to monitor it remotely.

**LITERATURE SURVEY:**

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]. Yacong GAO, Chenjing Zhou, Jian Rong, Yi Wang and Siyang Liu developed a method in 2022 to predict the short-time traffic speed by using deep learning. They used historical and predicted data of traffic flow to enhance accuracy and they found that LSTM model worked best. This strategy will help in planning of routes of cars more efficiently and the control of traffic [2]. In 2021, Bijan Moaveni and Fatemeh Khosroweshki introduced a crossing line of metro traffic model that focused on the influence of the transfer stations. Their nonlinear discrete event model puts into consideration technological delays and shows how such disruptions propagate and affect system stability. The efficiency of the model in handling delays and a good representation of metro traffic behaviour was evident when the model was solved with real data of Tehran metro [3]. In a 2023 study, Yash M. Dalal, Soumyalatha Naveen and Ashwin Kumar UM introduced a methodology, which integrates image detection and Gaussian blur to improve the traffic management. This approach will help urban planners reduce gridlock by greatly efficient classification of cars and investigating the use of traffic patterns [4]. In 2023, Xiaoping Ma, Sibo Lu, Honglan Huang, and Yanpiao Chen developed an intersection monitoring, prediction, and control plan that is based on a traffic management plan. To improve traffic flow they combined intersections and timed the signals with intelligent algorithms. It was found to be more efficient and less delaying than other methods based on simulations [5]. In 2022, Jiaming Wang, Long Xu, Zhonghe He, and Li Wang developed a model that analyzes the movement of the urban traffic, considering not only the types of the means of transportation but also buses and autos. They have created a three-dimensional model to analyze the interaction and the influence of bus and cars upon the traffic capacity by using the data of the road network in Beijing. Their approach proves useful in the management of traffic control in areas that have different travel requirements and helps in determining how the traffic can change over time [6]. Zeljko Majstorovic, Edouard Ivanjko, and Mladen Miletic and Filip Vrbanic worked on the definition of the key traffic conditions to ensure urban mobility in 2021. They examined the content of the traffic in Slovenian motorways through machine learning. Their findings will be useful in enhancing the traffic management system by creating relevant scenarios of machine learning models [7]. In 2020, Victor Cherniy, Olena Sharovara, Ihor Vasyliev, Sergiy Bezshapkin, and Olena Verenych carried out a study on the premises of road traffic management in Kyiv, Ukraine. They have improved traffic planning and decision making using the modern technology like GIS, and spatial database. They managed to upgrade the city in terms of traffic control [8]. This plan involved the development of a smart traffic control system that adjusts signal time based on the traffic movement, which was invented in 2024 by Devika S. G., Govind A., and Lekshmi D. It also applies to YOLO v8 algorithm and siren detection to give priority to emergency vehicles, including 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:**

The existing safety systems employed in vehicles (driving) are designed to address an issue individually i.e. drunk driving, fire or obstacles instead of being integrated as a whole system. Detection of alcohol is usually done using breath-analysers or ignition locks and this requires the driver to be involved directly which means they are not closely monitored at all, the driver is already on the road and can easily bypass them [1], [2]. Fire detection systems tend to rely on the flames, smoke, or heat sensors, which trigger the alarms in car. They are good at identifying the issues at an early stage, but the majority of them do not actually put control of the vehicle. or draft other safety measures, and restricts their assistance to a certain degree in perilous cases [3]. Obstacle-detecting systems aid drivers to remain conscious of the environment, so they have a local warning, particularly when proceeding at a slow pace or in a low visibility environment (infrared, ultrasonic, or proximity sensors). However, these systems deal with only a single job and fail to interact with alcohol or flames components [4]. More recent IoT-based vehicle monitoring incorporates sensors, wireless communications, and the cloud platform in real-time information accessibility [5], [6]. Despite these advancements there are numerous existing systems that are either too costly, too complex, and/or issue alerts on everything uniformly, overloading communication channels. The only thing missing is a consumer-friendly, universal vehicle safety system that can constantly keep a check on the vehicle, make sure the car can automatically control when needed, send smart alerts when needed only, and simply place all the data in the cloud base which is what this proposed system is out to perform.

**PROPOSED METHODOLOGY:**

The suggested system is aimed at the actual time identification of vehicles accidents and instant contact with emergency services based on IoT technology. It incorporates various sensors including vibration sensor, MEMS sensor (accelerator) sensor, ultrasonic sensor, temperature sensor etc. to regularly check the state of the vehicle and its direction. These sensors assist in detecting irregular scenarios such as sudden impact, collision or the odd tilt, which are the signs of an accident. It will have an Arduino microcontroller that works as the main control component, where all sensor information is obtained. When the perceived values are above preset values, the system will recognize it to be an accident event. This is followed by activation of a buzzer to give an alert locally and the GPS module records the latitude and longitude of the accident scene. This is then sent to the GSM module to pre-destined callers like the emergency services and family members through SMS or IoT systems. Real time system status and alert messages are displayed using an LCD display. The battery provides power to the system, such that even when power is off, the system will not go down. To be used in testing and demonstration, there are a motor driver and DC motors which mimic the movement of vehicles. Generally, the suggested system will provide fast detection of accidents and extensive information sharing, making the response time to the emergencies much less, and the likelihood to save lives much higher.

**BLOCK DIAGRAM:**

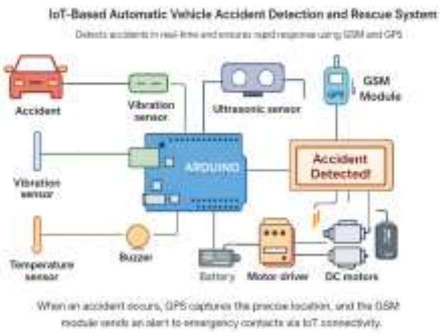


**FIG1: BLOCK DIAGRAM**

**HARDWARE WORKFLOW:**
**ARDUINO MICROCONTROLLER**

**FIG 2: ARDUINO UNO**

The key processing component of the system is the Arduino. It gathers information of all the sensors that are interlinked like vibration, MEMS, ultrasonic sensors, and temperature sensors. When applied to the incoming signals, it analyses the signals against some predefined threshold values to detect abnormal conditions such as sudden impact or tilt. After detecting an accident, the Arduino triggers notifications and lights the buzzer, retrieves the location data of the GPS module, and transmits the information via the

GSM module. It is easy to program, and it is inexpensive coupled with flexibility as it would be adapted to real-time embedded projects.

**VIBRATION SENSOR**

**FIG 3: VIBRATION SENSOR**

The sensor of vibration is used to recognize abrupt shocks or blows that are usually experienced when an accident happens. When the amount of vibration reaches some certain level, it produces a signal. This aids in detecting collision incidents at an early stage. The sensor is easy, sensitive, and efficient in sensing sudden physical disturbances, and hence, it is a requisite part of accident detection systems.

**MEMS SENSOR**

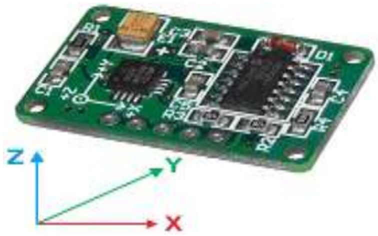


**FIG 4: MEMS SENSOR**

The MEMS accelerator, as well, is a measure of the acceleration and tilt of the car in various directions. It is able to sense a sudden motion change like sudden interview of speed or rollover or strange orientation. The system will be able to distinguish between normal movement and accident conditions by taking a continuous monitoring of these parameters, enhancing the detection.

**ULTRASONIC SENSOR**


**FIG 5: ULTRASONIC SENSOR**

Through the ultrasonic sensor, it is possible to measure the distance between the vehicle and obstacles. It operates on the principle of generating ultrasonic waves and time taken by the echo to reflect. This assists to determine possible collisions or unexpected changes in the proximity, facilitating the accident detection process.

**TEMPERATURE SENSOR**

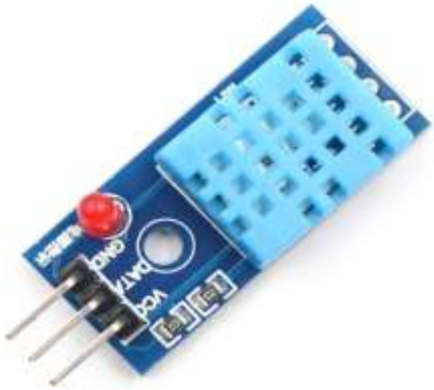


**FIG 6: TEMPERATURE SENSOR**

The thermometer measures the intensity of heat in the area of the vehicle. The temperature gets very high in case of a failure especially because of fire or because of overheating of the engine. This sensor can assist in the identification of such situations and further confirmation of a serious situation.

**GPS MODULE**

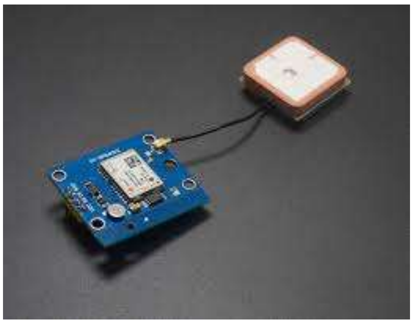

**FIG 7: GPS MODULE**

The GPS module is charged with the role of identifying the precise geographical location of the vehicle. In case of an accident being detected, it records the latitude and longitude positions. This data is quite essential so that the rescue crews could quickly find the accident place and support the victims in a timely manner.

**GSM MODULE**

**FIG 8: GSM MODULE**

The GSM module supports wireless call via transmission of SMS notifications to destined contacts. It sends the message about the accident, as well as the details about location acquired in the GPS module. This will make sure that emergency services are notified and family members to get notified.

**BUZZER**


**FIG 9: BUZZER**

One is the sound of the buzzers that offer a warning signal of the accident. It assists in providing an alert to people nearby of the event and acknowledges that the system is activated. It is simple and a useful alert system.

**LCD DISPLAY**

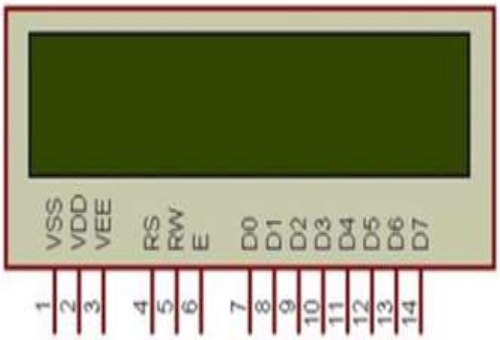


**FIG 10: LCD DISPLAY**

The LCD screen allows viewing real-time information about the system including sensor readings, system health and alerts. It assists users to get familiar with the operating condition of the system and submit visual feedbacks when it is on.

**MOTOR DRIVER**

**FIG 11: MOTOR DRIVER**

To test and simulate the DC motors, the motor driver is used. It serves as a controller between the motors and Arduino; they can be controlled in terms of speed and direction. This assists in showing the flow of vehicles under controlled conditions.

**DC MOTORS**

**FIG 12: D.C MOTOR**

The prototype is simulated by employing the use of DC motors to mimic the action of a vehicle. They assist in testing the system with the aid of the moving conditions, including vibrations or abrupt halts detection.

**BATTERY**

**FIG 13: BATTERY**

It is supplied by a battery to make the system work continuously even in case of power failure. Power stability is essential to the proper readings of sensors and communication in the case of an emergency.

**RESULT AND DISCUSSIONS:**

The developed IoT-based Automatic Vehicle Accident Detection and Rescue System was tested under different simulated conditions to evaluate its performance and reliability. The system successfully detected accident scenarios such as sudden impact, abnormal tilt, and rapid deceleration using the combination of vibration and MEMS sensors. The inclusion of multiple sensors reduced false triggering and improved detection accuracy compared to single-sensor systems. During testing, once an accident condition was identified, the Arduino microcontroller responded immediately by activating the buzzer and initiating the alert process. The GPS module accurately captured the location coordinates with minimal delay, and the GSM module successfully transmitted alert messages to predefined contacts. The average response time from detection to message delivery was observed to be within a few seconds, which is critical in emergency situations. The LCD display provided clear real-time updates, making it easier to monitor system behaviour. The temperature sensor also responded effectively in scenarios involving heat rise, adding another layer of safety. The motor driver and DC motors helped simulate vehicle movement, validating the system’s performance under dynamic conditions. However, minor limitations were observed, such as dependence on GSM network availability and slight delays in GPS signal acquisition in obstructed environments. Overall, the system demonstrated reliable performance, cost efficiency, and practical applicability, making it a promising solution for enhancing road safety and reducing accident response time.

**CONCLUSION:**

The proposed IoT-based Automatic Vehicle Accident Detection and Rescue System effectively detects accidents and ensures timely communication with emergency services. By integrating multiple sensors with GPS and GSM technologies, the system provides reliable real-time monitoring and quick response, which can significantly reduce fatalities caused by delayed medical assistance. The prototype demonstrates a cost-effective and practical approach suitable for real-world implementation in vehicles. In future, the system can be enhanced by integrating advanced technologies such as machine learning for more accurate accident prediction and reduced false alarms. The use of mobile applications and cloud platforms can improve data tracking and user interaction. Additionally, incorporating camera modules and direct integration with emergency networks can further strengthen the system's efficiency and reliability.

**REFERENCES:**

1. L. Wei, L. Gao, J. Yang and J. Li, "A Reinforcement Learning Traffic Signal Control Method Based on Traffic Intensity Analysis," 2023 42nd Chinese Control Conference (CCC), Tianjin, China, 2023, pp. 6719-6724, doi: 10.23919/CCC58697.2023.10240019.
2. Y. Gao, C. Zhou, J. Rong, Y. Wang and S. Liu, "Short-Term Traffic Speed Forecasting Using a Deep Learning Method Based on Multitemporal Traffic Flow Volume," in IEEE Access, vol. 10, pp. 82384-82395, 2022, doi: 10.1109/ACCESS.2022.3195353.
3. F. Khosrosereshki and B. Moaveni, "Traffic Modeling and Validation for Intersecting Metro Lines by Considering the Effect of Transfer Stations," in IEEE Access, vol. 10, pp. 1946-1955, 2022, doi: 10.1109/ACCESS.2021.3139470.
4. X. Ma, S. Lu, H. Huang and Y. Chen, "A Comprehensive Regional Traffic Coordination Control Strategy Integrated the Short-Term Traffic Flow Identification and Prediction," in IEEE Intelligent Transportation Systems Magazine, vol. 15, no. 4, pp. 137-149, July-Aug. 2023, doi: 10.1109/MITS.2023.3253134.
5. Y. M. Dalal, S. Naveen and A. K. UM, "Unveiling Traffic Patterns for Effective Traffic Management System," 2023 International Conference on Network, Multimedia and Information Technology (NMITCON), Bengaluru, India, 2023, pp. 1-6, doi: 10.1109/NMITCON58196.2023.10276327.
6. J. Wang, L. Xu, Z. He and L. Wang, "Macroscopic Traffic Flow Modeling and Empirical Analysis of Multiple Modes of Travel in Urban Road Network," 2022 4th International Academic Exchange Conference on Science and Technology Innovation (IAECST), Guangzhou, China, 2022, pp. 513-517, doi: 10.1109/IAECST57965.2022.10061880.
7. F. Vrbanić, M. Miletić, E. Ivanjko and Ž. Majstorović, "Creating Representative Urban Motorway Traffic Scenarios: Initial Observations," 2021 International Symposium ELMAR, Zadar, Croatia, 2021, pp. 183-188, doi: 10.1109/ELMAR52657.2021.9550867
8. V. Cherniy, S. Bezshapkin, O. Sharovara, I. Vasyliev and O. Verenych, "Modern Approach to the Road Traffic Management in Cities of Ukraine: Case Study of Kyiv Municipal Company "Road Traffic Management Center"," 2020 IEEE European Technology and Engineering Management Summit (E-TEMS), Dortmund, Germany, 2020, pp. 1-6, doi: 10.1109/E-TEMS46250.2020.9111757.

9. D. S. G, G. A and L. D, "Next-Generation Traffic Control: Adaptive Timer and Emergency Vehicle Priority in Intelligent Traffic Management," 2024 International Conference on E-mobility, Power Control and Smart Systems (ICEMPS), Thiruvananthapuram, India, 2024, pp. 1-6, doi: 10.1109/ICEMPS60684.2024.10559373.
10. Z. Cao, L. Lu, C. Chen and X. Chen, "Modeling and Simulating Urban Traffic Flow Mixed with Regular and Connected Vehicles," in IEEE Access, vol. 9, pp. 10392-10399, 2021, doi: 10.1109/ACCESS.2021.3050199.