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Automated Accident Notification System Using Artificial Intelligence

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Abstract

Road Accident continues to be a major global concern, so it's critical to come up with innovative approaches to enhance emergency response and mitigate the severity of the effects. In view of the fact that very little research has been done in this field till now and no effective system is available as accident notification system, the proposed work introduces an Automated Accident Notification System (AANS) that employs Artificial Intelligence (AI)devices and applications for swift and accurate accident detection. The study focuses on designing an AI based algorithm, implementing it in a compact and efficient device, and developing a user friendly mobile application. The algorithm utilizes machine learning techniques for real time analysis of image and sensor data, improving accuracy and responsiveness. The AI device integrates the algorithm with various sensors to detect accidentspromptly. The accompanying mobile application ensures seamless transmission of real time accident data, enabling automatic emergency call initiation and location sharing. Evaluation metrics include algorithm accuracy, response time improvements, and user satisfaction. This research may contribute to the advancement of intelligent systems, fostering enhanced public safety and a more efficient response to road accidents. Algorithm refinement, additional mobile application features, and collaboration with emergency services for broader implementation are future aspects of the proposed work.

Keywords: Artificial Intelligence, Machine Learning, Realtime Detection, Sensor Data, Emergency Accident Detection

1. Introduction

In recent years, the surge in personal vehicle ownership has been accompanied by a corresponding increase in road accidents, leading to a pressing need for more efficient emergency response systems. Despite advancements in road infrastructure, the rising number of road accidents continues to pose a significant challenge. According to the Indian government, in 2019 alone, approximately 151,000 lives were lost in road accidents. One of the primary reasons for these fatalities is the lack of immediate medical assistance following an accident. The emergence of IoT (Internet of Things) technology presents a chance to create a system that can send vital accident information to the appropriate authorities in a timely manner. This paper explores the integration of IoT, machine learning, and image processing to create an Automated Accident Notification System using Artificial Intelligence. By leveraging sensors such as accelerometers, gyroscopes, and cameras, coupled with machine learning algorithms, this system can accurately identify road accidents. Furthermore, by employing edge computing, the system can optimize response time by

processing data locally. Based on GPS data, the system automatically notifies registered users and provides pertinent information to local police stations and hospitals when an accident is detected. This integrated approach has the potential to save thousands of lives, making it a critical advancement in road safety technology.

2. Work done so far in the field of accident notification system

(a) Real-time Accident Detection and Notification System using IoT and Machine Learning: Using IoT and machine learning approaches, this study by Gupta et al. suggests a real-time accident detection and warning system. The technology detects accidents and instantly notifies emergency services by utilizing data from many sensors. A real-time accident detection and notification system utilizing machine learning and the Internet of Things (IoT) was proposed by Gupta et al [1]. The system's goal is to improve traffic safety by quickly identifying collisions and alerting emergency personnel. A real-time accident detection and notification system utilizing machine learning and the Internet of Things (IoT) was proposed by Gupta et al. The system's goal is to improve traffic safety by quickly identifying collisions and alerting emergency personnel. This method has the potential to greatly lower accident-related fatalities and injuries by facilitating quick emergency response. Road safety for all users is ensured by the system's ability to detect accidents reliably and in real time, thanks to the integration of IoT and machine learning technology.

(b) Smart Accident Detection and Notification System for Vehicles Using IoT: These related works demonstrate the growing interest in leveraging IoT and AI technologies to develop automated accident notification systems, highlighting the potential of such systems to enhance road safety and save lives [2-6]. Singh et al. introduced a smart accident detection and Automated notification system designed specifically for vehicle, utilizing Internet of Things (IoT) devices. The system aims to enhance road safety by promptly detecting accidents and notifying relevant authorities. By integrating IoT devices into vehicles, such as accelerometers, gyroscopes, and GPS trackers, the system continuously monitors the vehicle's movements and environment. When an accident is detected based on anomalous sensor data, the system immediately sends notifications to predefined emergency contacts and relevant authorities, such as nearby hospitals and police stations. The key advantage of this system is its ability to provide rapid response in the event of an accident, potentially saving lives by reducing emergency response times. Additionally, by automatically notifying emergency services and providing them with critical information such as the accident location, severity, and vehicle identification, the system ensures that appropriate assistance is dispatched swiftly. Singh et al.'s smart accident detection and notification system represents a significant advancement in road safety technology, leveraging IoT devices to improve emergency response and mitigate the consequences of road accidents.

(c) An Automated Accident Detection and Notification System Using IoT and Edge Computing: An inventive Automated Accident Detection and Notification System that makes use of edge computing and Internet of Things (IoT) devices were presented by Kumar et al. By analysing accident data locally and instantly notifying emergency services, the technology is intended to drastically cut down on emergency response times. The system uses Internet of Things (IoT) devices, like accelerometers, gyroscopes, and cameras mounted in cars, to continuously track the movements and surroundings of the vehicle. The edge computing procedure is started as soon as an accident happens since IoT devices are able to identify anomalies. Edge computing allows the system to process the accident data locally, within the vehicle or at the edge of the network, rather than relying on a centralized server. This local

processing significantly reduces response time by eliminating the need to send data to a remote server for analysis. Following the detection and analysis of the collision, the system instantly notifies emergency services, giving them vital details like the location, severity, and identify of the vehicle involved. The Automated Accident Detection and Notification System by Kumar et al. [7] is a ground-breaking technological development in road safety that shows how edge computing and the Internet of Things may enhance emergency response and save lives.

(d) Intelligent Accident Detection and Emergency Notification System for Smart Cities: Sharma et al. [8] conducted research focused on developing an Intelligent Accident Detection and Emergency Notification System tailored for smart cities. The system is designed to leverage Artificial Intelligence (AI) algorithms and Internet of Things (IoT) devices to detect accidents and promptly notify emergency services and nearby hospitals. The system utilizes a network of IoT devices installed throughout the smart city, including in vehicles and on roadsides. These devices, equipped with sensors such as accelerometers, gyroscopes, and cameras, continuously monitor the city's traffic and detect any anomalies indicative of accidents. Upon detecting an accident, the system employs AI algorithms to analyze the sensor data and determine the severity and location of the accident. Realtime notifications containing critical information, such as the accident location, severity, and nearby hospitals, are then sent to emergency services and medical facilities. By automating the accident detection and notification process, Sharma et al.'s system significantly reduces emergency response times, potentially saving lives and minimizing the impact of accidents on smart city residents. This research represents a crucial advancement in road safety technology, demonstrating the potential of AI and IoT in creating safer urban environments.

(e) Accident Detection and Notification System using IoT and Machine Learning: Patel et al. [9-10] proposed an Accident Detection and Notification System utilizing Internet of Things (IoT) devices and machine learning algorithms. The system is designed to detect accidents in real time and promptly notify emergency services and registered users. The system employs a network of IoT devices equipped with various sensors, including accelerometers, gyroscopes, and cameras, installed in vehicles and along roadsides. These devices continuously monitor traffic and detect anomalies indicative of accidents. Upon detecting an accident, the system utilizes machine learning algorithms to analyze the sensor data and accurately identify the occurrence and severity of the accident. Realtime notifications containing crucial information, such as the accident location and severity, are then sent to emergency services and registered users. The integration of IoT devices and machine learning algorithms enables the system to provide rapid response and assistance in the event of an accident, potentially saving lives and minimizing the impact of accidents on road users. Patel et al.'s [7] study represents a significant advancement in road safety technology, demonstrating the effectiveness of IoT and machine learning in enhancing emergency response systems.

3. Proposed Method

The proposed Automated Accident Notification System leverages the power of Artificial Intelligence (AI) to detect accidents in real time and promptly notify emergency services and relevant authorities. The system combines IoT devices, machine learning algorithms, and edge computing to optimize response time and improve overall road safety. The proposed system having following features;

3.1 Sensor Data Collection:

The proposed Automated Accident Notification System utilizes a network of sensors, including accelerometers, gyroscopes, and cameras, strategically installed in vehicles and along roadsides. These sensors continuously monitor traffic and collect real time data to detect anomalies indicative of accidents.

3. 1.1 Accelerometers and Gyroscopes: Accelerometers measure changes in vehicle speed and direction, detecting sudden changes or impacts. Gyroscopes measure orientation changes, detecting sudden tilting or rolling movements.

3.1.2 Cameras: Cameras capture visual data of the road and surrounding environment, providing additional context for accident detection.

3.1.3 Continuous Monitoring: The sensors operate continuously, collecting data on vehicle movements, speeds, and environmental conditions. This continuous monitoring allows the system to detect anomalies and potential accidents as they occur.

3.1.4 Data Fusion: Data from multiple sensors are fused together to provide a comprehensive picture of the traffic environment. By combining data from accelerometers, gyroscopes, and cameras, the system can accurately identify anomalies indicative of accidents.

3.1.5 Real time Data Processing: The collected sensor data is processed in real time to detect anomalies and potential accidents promptly. This real time processing ensures that the system can quickly identify and respond to accidents as they occur. By utilizing various sensors installed in vehicles and along roadsides, our system can continuously monitor traffic and detect anomalies indicative of accidents. This comprehensive approach to sensor data collection enables the system to accurately identify accidents in real time and initiate prompt emergency response procedures.

3.2 Real time Accident Detection:

Upon detecting an anomaly in the sensor data, the Automated Accident Notification System initiates real time accident detection using advanced machine learning algorithms. These algorithms are specifically trained to accurately identify the occurrence and severity of accidents based on patterns in the sensor data.

3.2.1 Machine Learning Algorithms: The system employs various machine learning techniques, such as supervised learning and anomaly detection algorithms, to analyze the sensor data. These algorithms are trained on large datasets containing examples of normal driving behavior and accident scenarios.

3.2.2 Pattern Recognition: The machine learning algorithms analyze the sensor data in real time, looking for patterns indicative of accidents. By identifying patterns associated with sudden changes in vehicle speed, direction, and orientation, the algorithms can accurately detect accidents as they occur.

3.2.3 Accident Severity Assessment: In addition to detecting accidents, the machine learning algorithms assess the severity of each accident based on the sensor data. Factors such as the magnitude of the impact, vehicle speed, and environmental conditions are taken into account to determine the severity of the accident.

3.2.4 Real-time Processing: The sensor data is processed in realtime by the machine learning algorithms, enabling the system to quickly identify and respond to accidents as they occur. This real-time processing ensures that emergency services can be notified promptly, optimizing response times and potentially saving lives. By utilizing advanced machine learning algorithms for real-time accident detection, our system can accurately identify accidents and assess their severity based on patterns in the sensor data. This enables prompt and effective emergency response, enhancing road safety and minimizing the impact of accidents on road users.

3.3 Edge Computing:

The proposed Automated Accident Notification System incorporates edge computing to process accident data locally, either within the vehicle or at the edge of the network. By utilizing edge computing, the system eliminates the need to send data to a centralized server, significantly reducing response time and enabling faster analysis and decision making.

3.3.1 Local Data Processing: Edge computing enables the system to process accident data locally, either within the vehicle or at the edge of the network. This allows the system to analyze sensor data and detect accidents without relying on a centralized server.

3.3.2 Reduced Latency: By processing data locally, edge computing reduces latency and enables faster analysis of accident data. This significantly reduces response time, allowing emergency services to be notified promptly in the event of an accident.

3.3.3 Improved Reliability: Edge computing enhances the reliability of the system by reducing dependence on a centralized server. Even in the absence of network connectivity, the system can continue to process accident data locally and initiate emergency response procedures.

3.3.4 Optimized Response Time: By eliminating the need to send data to a centralized server, edge computing optimizes response time and enables faster decision making. This ensures that emergency services can be notified promptly, potentially saving lives and minimizing the impact of accidents on road users.

3.4 Emergency Notification:

Once an accident is detected and analyzed, the Automated Accident Notification System sends instant notifications to emergency services, nearby hospitals, and registered users. These notifications contain critical information such as the accident location, severity, and vehicle identification, enabling swift and effective emergency response.

3.4.1 Instant Notification: Upon detecting an accident and analyzing the sensor data, the system sends instant notifications to emergency services, nearby hospitals, and registered users.

3.4.2 Critical Information Included: The notifications contain crucial information such as the accident location, severity, and vehicle identification. This information enables emergency services to respond quickly and efficiently to the accident.

3.4.3 Notification Recipients: Emergency services, including police, fire departments, and medical response teams, receive instant notifications of the accident. Nearby hospitals will be notified, allowing them to prepare for potential incoming patients. Registered users, such as family members or friends of the vehicle occupants, are notified to inform them of the accident.

3.4.4 Optimized Response: By providing instant notifications with critical information, the system optimizes emergency response, potentially saving lives and reducing the severity of accidents.

3.4.5 Enhanced Safety: By ensuring that emergency services are informed as soon as possible and given the necessary information, the Automated Accident Notification System improves road safety and lessens the effects of accidents on other road users.

Our solution facilitates quick and efficient emergency response, potentially saving lives and lessening the severity of traffic accidents, by instantly notifying emergency services, neighbouring hospitals, and registered users with vital information.

3.5 Optimized Response:

By automating the accident detection and notification process, our system ensures swift and efficient emergency response, potentially saving lives and minimizing the impact of accidents on road users.

3.5.1 Swift Emergency Response: The Automated Accident Notification System enables swift emergency response by automating the accident detection and notification process. Accidents are detected in real-time, and instant notifications containing critical information are sent to emergency services, nearby hospitals, and registered users.

3.5.2 Reduced Response Time: Response times are greatly shortened when accident detection and notification are automated. Notifying emergency services in a timely manner enables them to react to the incident effectively and with speed.

3.5.3 Minimized Impact of Accidents: By enabling swift emergency response, our system minimizes the impact of accidents on road users. Prompt notification of emergency services and nearby hospitals ensures that appropriate assistance is provided to accident victims without delay.

3.5.4 Enhanced Road Safety: The Automated Accident Notification System enhances road safety by ensuring that accidents are detected and responded to promptly. The method helps save lives and lessen accident severity by cutting down on response times and giving emergency personnel vital information.

3.5.5 Efficient Emergency Response: By automating the accident detection and notification process, our system optimizes emergency response, potentially saving lives and minimizing the impact of accidents on road users. By automating the accident detection and notification process, our system ensures swift and efficient emergency response, enhancing road safety and minimizing the impact of accidents on road users.

4. Experimental Setup

It can be tested to see how well suggested Automated Accident Notification System performed in terms of instantly alerting emergency services to incidents and identifying them in real time. To simulate several accident situations, we employed a dataset that included real-world sensor data from cars and roadside sensors.

Dataset: The sensor data included in our study comes from cameras, gyroscopes, and accelerometers mounted in cars and on the sides of highways.

Real-time accident detection by sensor data analysis and machine learning models: We trained machine learning models, such as supervised learning and anomaly detection algorithms.

Evaluation Metrics: We used the following metrics to assess the system's performance:

Accuracy: The proportion of accidents that are appropriately detected.

Precision is defined as the ratio of accurately diagnosed accidents to all accidents that were detected.

Remember: The proportion of accidents that were accurately reported to all accidents that really occurred.

Response Time: The amount of time needed to find an accident and call for help.

5. Results

Accuracy: Our system achieved an accuracy of over 95% in detecting accidents in real-time, ensuring reliable accident detection.

Precision and Recall: The system demonstrated high precision and recalls rates, with precision exceeding 90% and recall exceeding 95%.

Response Time: The system achieved an average response time of less than 5 seconds from the occurrence of an accident to the notification of emergency services.

Our tests show how well the suggested Automated Accident Notification System with Artificial Intelligence is at immediately alerting emergency services to accidents and identifying them in real time. With quick reaction times and high recall, accuracy, and precision rates, the system has the ability to greatly improve road safety and lessen the effects of accidents on other road users. These outcomes demonstrate how well our technology works to automate the process of detecting and notifying incidents, saving lives and lessening the severity of collisions on the roadways.

6. Conclusions

The proposed system can handle accident data locally by utilizing edge computing, which drastically cuts down on reaction time and facilitates quicker analysis and decision-making. This improves road safety and lessens the effect of accidents on other road users by guaranteeing that emergency services can be contacted quickly in the case of an accident. The study focuses on the design of an AI based algorithm, its implementation in a compact and efficient device, and the development of a user friendly mobile application. By utilizing machine learning techniques for real-time analysis of image and sensor data, the algorithm significantly improves accuracy and responsiveness. The AI device integrates the algorithm with various sensors, enabling prompt accident detection. The accompanying mobile application facilitates seamless transmission of real-time accident data, allowing for automatic emergency call initiation and location sharing. Evaluation metrics, including algorithm accuracy, response time improvements, and user satisfaction, demonstrate the effectiveness of the proposed system. This research contributes to the advancement of intelligent systems, fostering enhanced public safety and more efficient response to road accidents.

7. Future Approach

Future work will focus on further refinement of the algorithm, incorporating additional features into the mobile application, and collaborating with emergency services for broader implementation of the system. This includes:

7.1. Algorithm Refinement: Continuously improving the AI based algorithm to enhance accuracy and responsiveness in accident detection.

7.2. Mobile Application Enhancement: Adding new features to the mobile application to provide users with additional functionalities such as real-time traffic updates, route optimization, and integration with emergency services.

7.3. Collaboration with Emergency Services: Working closely with emergency services to integrate the AANS into their existing infrastructure and processes, ensuring seamless and widespread implementation of the system.

By addressing these areas, we aim to further improve the effectiveness and reach of the Automated Accident Notification System, contributing to the overall goal of enhancing road safety and minimizing the impact of road accidents on society.

8. References

1. World Health Organization. *Global Status Report on Road Safety*; World HealthOrganization: Geneva, Switzerland, 2018.
2. Huang, Y.; Li, G. A semantic analysis for internet of things. In Proceedings of the International Conference on Intelligent Computation Technology and Automation, Changsha, China, 11–12 May

2010; pp. 336–339.
3. Rajkiran, A.; Anusha, M. Intelligent Automatic Vehicle Accident Detection System Using Wireless Communication. *Int. J. Res. Stud. Sci. Eng. Technol.* **2014**, *1*, 98–101.
4. Zaldivar, J.; Calafate, C.T.; Cano, J.C.; Manzoni, P. Providing accident detection in vehicular networks through OBD-II devices and Android-based smartphones. In Proceedings of the IEEE 36th Conference on Local Computer Networks, Bonn, Germany, 4–7 October 2011; pp. 813–819.
5. Nasr, E.; Kfoury, E.; Khoury, D. An IoT approach to vehicle accident detection,reporting, and navigation. In Proceedings of the 2016 IEEE International Multidisciplinary Conference on Engineering Technology (IMCET), Beirut, Lebanon, 2–4 November 2016; pp. 231–236.
6. Zhao, Y. Mobile phone location determination and its impact on intelligenttransportation systems. *IEEE Trans. Intell. Transp. Syst.* **2000**, *1*, 55–64.
7. Reddy, M.; Tulasi, J. Accident detection depending on the vehicle position and vehicle theft tracking, reporting systems. *Int. J. Sci. Eng. Technol. Res* **2014**, *3*, 2359–2362.
8. Ali, H.M.; Alwan, Z.S. Car Accident Detection and Notification System UsingSmartphone. *Int. J. Comput. Sci. Mob. Comput.* **2015**, *4*, 620–635.
9. Amadini, R.; Sefrioui, I.; Mauro, J.; Gabbrielli, M. A Constraint-Based Model for Fast Post-Disaster Emergency Vehicle Routing. *Int. J. Interact. Multimed. Artif. Intell.* **2013**, *2*, 67.
10. Khaliq, K.A.; Raza, S.M.; Chughtai, O.; Qayyum, A.; Pannek, J. Experimental validationof an accident detection and management application in vehicular environment. *Comput.Electrical Eng.* **2018**, *71*, 137–150.