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Road Accident Detection and Notification System

Mrs. Nalini H C [1], Anurag K R [2], Darshan L Gowda [3], Kishore M P [4], Sanjana B R [5]

[1]*Asst. Professor, Dept. of Information Science & Engineering, Rajeev Institute of Technology, Hassan,*

[2-5]*Information Science & Engineering, Rajeev Institute of Technology, Hassan*

Abstract - The "Road Accident Detection and Notification System" is a comprehensive solution designed to improve road safety and emergency response efficiency. It begins with data collection, where vehicle-related and environmental information is gathered, followed by data processing to analyze patterns and detect potential accidents. Once an incident is identified through event detection algorithms, the system determines its precise location using geolocation techniques. The detected accident is then verified through secondary validation methods to reduce false alarms. After verification, the system sends automated notifications with critical details such as location, severity, and timestamp to emergency services and pre-registered contacts. Finally, it facilitates emergency response coordination by streamlining communication, ensuring timely action, and minimizing the overall impact of road accidents.

Key words: computer vision, video processing.

1.INTRODUCTION

Road accidents remain a significant public safety concern, leading to millions of deaths and injuries worldwide each year. Rapid urbanization, increasing vehicle numbers, and human errors contribute to the rising frequency of accidents, making road safety a global priority. According to the World Health Organization (WHO), road traffic injuries are among the leading causes of death, particularly for individuals aged 5 to 29. The consequences extend beyond human casualties, affecting economic stability, emergency healthcare systems, and overall public safety.

Grade I: The ability to detect accidents efficiently and provide real-time notifications is essential for mitigating risks and improving emergency response times. One of the biggest challenges in accident management is the delay in detection and reporting, as traditional methods rely on bystanders or passersby. In many cases, accidents occur in isolated areas where help may not arrive in time, leading to severe injuries or fatalities. Studies have shown that timely medical intervention within the "golden hour"—the first hour after an accident—can significantly increase survival rates.

Grade II: The implementation of automated accident detection systems leverages artificial intelligence, machine learning, and video analysis to identify accidents in real time. These systems analyze accident patterns, detect unusual vehicle movements, and classify incidents based on severity. Unlike manual reporting, automated systems process large volumes of data with higher accuracy and reliability, eliminating human dependency in the early stages of accident response. Upon detecting an accident, notifications can be sent to emergency services, hospitals, and registered contacts to ensure immediate assistance.

Grade III: Beyond emergency response, accident detection systems contribute to broader road safety improvements and traffic management strategies. By analyzing accident-prone areas, authorities can implement preventive measures such as improved road designs, better signage, and stricter traffic enforcement. These systems also support post-accident investigations by providing crucial data for understanding crash causes and potential solutions.

Grade IV: An additional advantage of such systems is their role in insurance claim processing and legal documentation. Traditional accident reporting often leads to disputes due to a lack of concrete evidence, delays, or conflicting witness statements. An automated system that records and verifies accident details—such as timestamps, location, and severity—can streamline claim settlements and reduce fraudulent cases, ensuring fairness for all parties involved.

As transportation networks expand and road safety challenges grow, the need for advanced accident detection and notification systems becomes increasingly urgent. By integrating automated accident detection with real-time communication and data-driven insights, these systems offer a proactive approach to reducing fatalities and improving emergency response. The implementation of such technology has the potential to revolutionize traffic management, enhance public safety, and save countless lives by minimizing the consequences of road accidents.

2. LITERATURE REVIEW

A literature study is a crucial step in the software development process since it provides insightful information and new insights for improving and streamlining existing techniques. To gather relevant data for the current investigation, a number of research publications have been reviewed. The following section highlights the significant studies in the field of accident detection and notification systems that have influenced the recommended work:

Nassar and Al-Tuwaijari proposed a machine learning-based approach for detecting vehicle accidents using surveillance camera footage. The system employs a hybrid model combining Convolutional Neural Networks (CNN) and Support Vector Machines (SVM) to classify accident occurrences. Two datasets were used for training: one with 4,814 images of size (28x28) and another with 990 images of size (32x32). The proposed model achieved a high accuracy rate, with a training accuracy of 99.74% and testing accuracy above 90%. The system was tested in real-world scenarios, successfully detecting accidents within 30 seconds and sending notifications via email. The authors suggest future improvements, such as integrating deep learning advancements like TensorFlow 2.0 API and utilizing in-vehicle sensor data for accident detection instead of relying solely on surveillance cameras.

A study by Abinesh Kannan S and co-authors presents a system that utilizes a centroid-based Gaussian Mixture Model (GMM) algorithm to analyze surveillance footage for real-time accident detection. By accurately identifying objects using the axis bounding box technique, the system achieves a high detection rate with minimal false alarms across various environmental conditions. Additionally, the integration of the Geopy module enables real-time location tracking, facilitating prompt emergency responses. This approach aims to enhance road safety by reducing response times to traffic accidents.

3. SYSTEM DESIGN

Existing system:

Existing accident detection and notification systems primarily rely on conventional methods such as manual reporting by bystanders, emergency hotline calls, or basic in-vehicle crash detection mechanisms like airbags and impact sensors. These approaches often lead to delayed responses, especially in remote or low-traffic areas where accidents may go unnoticed for extended periods. Some modern vehicles incorporate basic telematics systems that use GPS and onboard diagnostics (OBD) to detect crashes and notify emergency contacts; however, these systems are limited in accuracy and often depend on cellular network availability.

Surveillance-based detection systems using CCTV cameras are also employed in urban areas to monitor traffic incidents. These systems generally rely on human operators or basic motion-detection algorithms, which can lead to inefficiencies and false alarms due to environmental factors like shadows, lighting conditions, and obstructions. While certain mobile applications allow users to report accidents manually, they still require user intervention, making them ineffective in severe crashes where the driver or passenger may be incapacitated.

Proposed system:

The proposed systems aim to enhance road accident detection and notification using advanced technologies and frameworks. They integrate sensors like accelerometers, gyroscopes, and GPS modules to monitor vehicle parameters and detect accidents in real-time, supported by machine learning algorithms and signal processing techniques to minimize false positives. Vision-based systems employing cameras and intelligent video analytics (IVA) are also suggested for real time monitoring of road activities. These systems include GPS tracking for precise location identification and immediate transmission of accident details to emergency services through GSM, satellite communication, or other networks. Notifications can be sent to designated contacts or centralized monitoring centers with details such as the time, location, and severity of the accident. Some models incorporate mobile applications and vehicle-to-vehicle (V2V) communication for localized alerts and better user interaction, addressing challenges like network coverage, environmental constraints, and response delays to improve road safety and emergency response efficiency.

4. METHADOLOGY

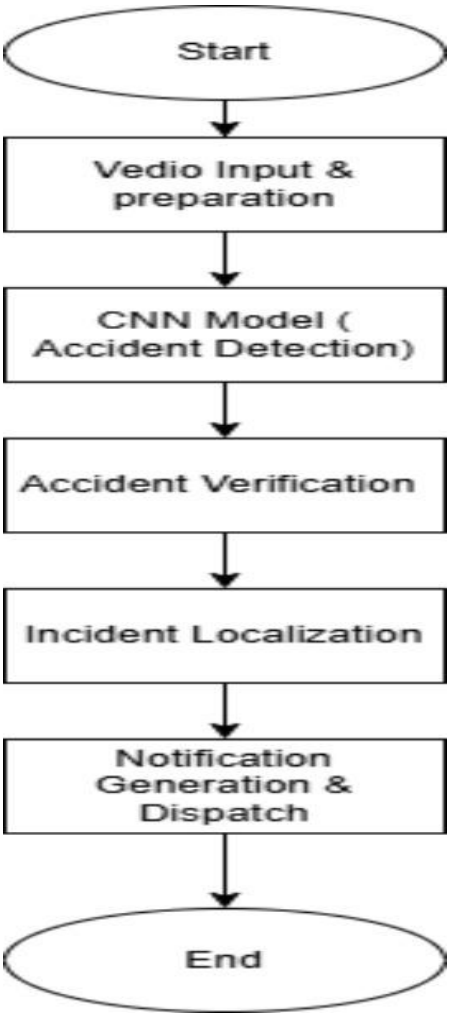

Figure 1: Dataflow Diagram

The proposed accident detection and notification system follows a structured methodology to ensure accurate and identification of road accidents. The process begins with video input and preparation, where footage from surveillance cameras

is pre-processed for clarity and compatibility. Next, a CNN-based accident detection model analyses video frames to identify collisions by detecting abnormal vehicle movements and impact patterns. Once an accident is detected, the system performs accident verification by cross-checking multiple frames to reduce false positives. After confirming an incident, the system proceeds with incident localization, utilizing GPS data or mapping services to determine the exact accident location. Finally, in the notification generation and dispatch stage, an automated alert containing details such as time, location, and severity is sent to emergency services and relevant contacts. This methodology ensures a fast and reliable accident detection system, improving response times and enhancing road safety.

5. CONCLUSIONS

The Accident Detection and Notification System is an efficient solution that uses computer vision (OpenCV) and deep learning (CNNs) to detect accidents. It integrates geolocation services (Google Maps API) to pinpoint the accident's exact location and communicates with emergency responders through Twilio API. Human-in-the-loop verification minimizes false alarms, enhancing reliability. By automating notifications, the system reduces response time and facilitates faster medical assistance, potentially saving lives. The project highlights the role of AI and IoT in improving road safety. Future improvements could include real-time GPS tracking and integration with smart city infrastructure.

6. FUTURE DIRECTIONS

The Accident Detection and Notification System has significant potential for future enhancements to improve accuracy, efficiency. Integration with IoT and smart city infrastructure can further enhance automated monitoring and response by connecting with traffic cameras and urban networks.

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