Traffic Accident Severity Detection Using Deep Learning Approach

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Abstract- *Road accidents are a major cause of fatalities worldwide, with delayed emergency response being a critical factor in the loss of lives. Traditional accident detection methods rely on manual reporting, witness intervention, or emergency calls, often leading to significant delays in providing medical assistance and managing traffic congestion. Additionally, existing traffic management systems lack the capability to automatically detect accidents in real time and optimize emergency response routes, further exacerbating the issue. As a result, there is an urgent need for an intelligent system that can detect accidents instantly, assess their severity, and ensure a swift emergency response. This project proposes a Smart Traffic Accident Detection and Automated Emergency Response System using deep learning-based object detection techniques. The system employs the YOLO (You Only Look Once) algorithm, a state-of-the-art object detection model, to analyse real-time traffic camera footage and identify accidents with high accuracy. Once an accident is detected, the system evaluates vehicle damage to determine crash severity and automatically sends alerts, including accident location and vehicle information, to emergency responders, hospitals, and traffic control centers. By automating accident detection and response, this system significantly reduces the delay in medical assistance, improving survival rates and enhancing traffic management efficiency. By integrating artificial intelligence, computer vision, and real-time monitoring, the proposed system contributes to road safety and supports smart city initiatives. The automated nature of the system ensures faster decision-making, minimizes human intervention, and enhances overall emergency response effectiveness. Future enhancements could include GPS-based route optimization, vehicle-to-infrastructure (V2I) communication, and AI-driven predictive analytics to further improve accident prevention and road safety.*

Keywords- Accident Detection,YOLO Algorithm, Severity of Accident, enhance traffic Management.

I. INTRODUCTION

Traffic accidents represent a major global issue that results in injuries, deaths, and lost economic productivity. The World Health Organization (WHO) reports that globally, 1.3 million people are killed annually due to road traffic crashes, while many more suffer severe injuries. One of the major causes of high fatality rates is the delay in detecting accidents and/or emergency response and the critical loss of time for getting medical assistance. In addition, accidents that cause traffic congestion can worsen the situation for others on the roadway by secondary accidents and increasing the risk for other roadway users. Quick accident detection and emergency response is vital for minimizing accidents, limiting injuries and fatalities, and improving the efficiency of traffic management.

Real-time and accurate accident detection requires cutting-edge technology in artificial intelligence (AI), computer vision, and Internet of Things (IoT) devices. Conventional accident detection capabilities, including manual monitoring, a witness report, an emergency call (e.g., 911), etc. mean that delays are unavoidable due to misreported locations, hesitation on part of human beings, or simply, not reporting the accident. Delays in medical attention and prolonged obstruction from traffic congestion all take place.

In order to address these drawbacks, an accident detection system must include automated real-time monitoring and intelligent dispatch mechanisms that guarantee timely intervention by authorities and emergency medical agenciespersonnel. With the use of advanced object detection possibilities with Artificial Intelligence (AI), surveillance cameras, and smart sensors, governments can determine if accidents have occurred, determine accident severity, and assist traffic personnel and emergency responders in getting to an accident more quickly. This helps safety on the road, it also improves traffic flow and helps manage traffic activities and congestion thus reducing secondary accidents.

The use of deep learning detection methods such as YOLO (You Only Look Once) can provide a better option to improve both the speed and accuracy of detecting accidents. Automated alerts can allow emergency dispatchers and traffic management staff information about an accident quickly so then they can make better decisions.

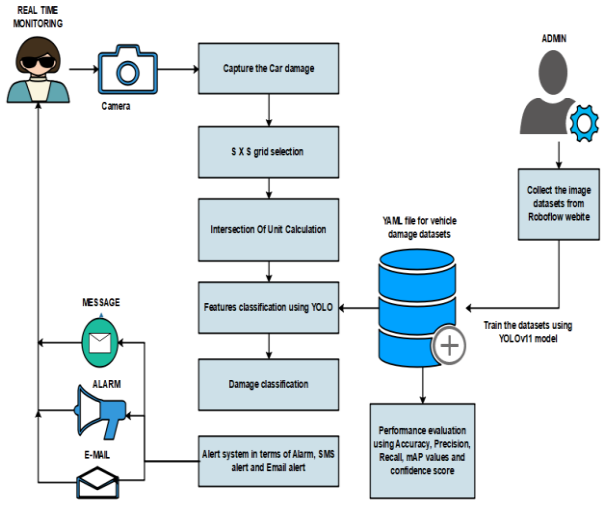
II. EXISTINGSYSTEM

At present, the methods through which accident detection and emergency response are carried out are typically manual, relying on emergency calls (for example, 911), witness reports, or traffic surveillance by authorities. Typically, these types of reporting via physical surveillance create a delay in accident detection/response since they involve human interaction that could be limited or absent completely. Many bystanders or witnesses to an accident are timid or fearful to report these incidents due to panic, fear of reporting, or other factors.Along similar lines, when accidents occur in remote locations or hours-- these accidents become unnoticed for long periods. Consequently, time lost in accident detection slows the emergency medical response increasing the risks of death and serious injuries. Further, traditional traffic monitoring systems involve using passive surveillance cameras, and operators must review the footage to find accidents often leading to much delay is that type of monitoring. The other significant drawback to the current type of systems for accident monitoring is the failure to incorporate an automated accident severity/grading system and automated emergency route management.When accidents are reported, emergency responders usually have difficulties ascertaining the nature of the crash, and therefore they encounter difficulties in determining which cases are severe enough to warrant a more prioritized response with available resources and human time. AI-driven assessment of the severity of possible emergency response involvement would involve determining the magnitude of force involved in the crash by evaluating the manner in which vehicles were displaced, possible vehicle damage sustained, and occupant displacement during the crash. Furthermore, real-time, GPS-enabled route optimization can help ensure that an ambulance or emergency personnel is deployed quickly to an accident site, while also providing responsive alternatives if traffic conditions change. Smart city frameworks can be leveraged to coordinate known in place traffic signals to ensure emergency vehicles have a clear path once notified of the accident site (and with a traffic routing for non-emergency vehicles along the way). The mechanisms and veracity of adopting an AI-enabled crash detection and response system will change the landscape of traffic safety by reducing response times, improving response allocation, and most importantly saving lives. As urbanization completely transforms land-use patterns from one generation to the next, and road networks continue to grow and complicate understanding safe travel and traffic patterns, the rational action is to leverage intelligent, automated solutions. The operating systems available assisted with Artificial Intelligence that can potentially change traffic safety and response efficiency considerably, and effectively help bring the overwhelming consequences of traffic accidents down. collaborative filtering, resume parsing, and Natural Language Processing (NLP) for exact job matching.

ENHANCED ACCIDENT SEVERITY DETECTION IN REAL TIME

Existing methods to detect accidents rely completely on manual reporting and need to abandon these elements that cause delays in emergency response and traffic management. Consequently, this results in higher fatalities and longer delays. There is a need for an intelligent, real-time system for accident detection, severity assessment and automated emergency notifications. To respond to the deficiencies of the existing accident detection protocols, this project proposes a Smart Traffic Accident Detection And Automated Emergency Response System (STAERS). STAERS uses deep learning-based object detection to identify traffic accidents. In particular, STAERS employs YOLO (You Only Look Once), which is the state-of-the-ar deep learning algorithm and can utilize footage directly from surveillance camera feeds to detect road traffic accidents in real-time. Upon the identification of an accident, the system also uses deep learning to assess the damage from the accident by evaluating the degree of damage sustained by the various vehicles involved in the accident. Based on the severity of the accident/impact, the system will automatically create alerts (remotely) and send relevant information (e.g., the location of the accident, the severity of the accident) alerts to emergency responders, hospitals, and traffic management centres. Therefore, this solution will ultimately eliminate the need for manual reporting, increase the speed by which we detect accidents, and activate emergency response, with very real and quantified benefits in the form of saved lives, and reduced road harm.

III. SYSTEM ARCHITECTURE



Description

1. Real-Time Monitoring:

- A camera captures footage of car damage in real-time.
- The footage is processed usingS × S grid selection to segment the frame.
- Intersection of Unit Calculationhelps localize the damage region within the frame.

2. Feature Classification Using YOLO:

- The segmented video frames are processed using the YOLO algorithm to classify damage features.
- This step identifies and localizes vehicle damages efficiently.

3. Damage Classification:

- Classified features are further analyzed to determine the extent and type of damage.

4. Alert System:

- Based on the classification results, the system sends alerts via SMS, alarm, or email.

5. Data Collection & Model Training:

- An admin collects training datasets (e.g., from Robo-flow).
- The data is labeled in YAML formatand used to train the YOLOv1 model.

6. Performance Evaluation:

- The trained model is evaluated using various metrics like Accuracy, Precision, Recall, mAP, and Confidence Score to ensure its reliability and efficiency in detecting accidents.

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