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ACCIDENT DETECTION SYSTEM USING INTELLIGENT SURVEILLANCE

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ABSTRACT

Accident detection in urban environments is crucial for enhancing public safety and reducing emergency response times. This research proposes an innovative system leveraging intelligent surveillance techniques to detect and respond to accidents promptly. The proposed system incorporates advanced computer vision algorithms and to analyze real-time video feeds from surveillance cameras. The framework begins with the acquisition of video data from strategically placed cameras in urban areas. Yolo version model is employed to detect accidents in the video frames. Subsequently, the system employs motion analysis and anomaly detection algorithms to identify unusual patterns or events that may indicate a potential accident. To enhance accuracy and reduce false positives, the system incorporates contextual information, such as road conditions, weather, and traffic flow. Machine learning algorithms are trained on historical data to better understand normal patterns and differentiate them from anomalous situations. Additionally, the system adapts in real-time to changes in the environment, ensuring robust performance under varying conditions. Upon the detection of a potential accident, the system triggers immediate alerts to emergency services, providing them with the precise location and nature of the incident. The integration of geospatial information enables emergency responders to reach the scene rapidly, improving the overall response time. The proposed intelligent surveillance system holds the potential to significantly improve safety by automating accident detection and response. The fusion of computer vision and real-time data analysis establishes a proactive approach to accident prevention, ultimately contributing to the creation of safer and more resilient smart cities. Future work will focus on scalability, real-world deployment, and continuous improvement through feedback loops from emergency response systems.

Keywords: Computer Vision, Machine Learning Algorithms, Anomaly Detection, Intelligent Surveillance.

I. INTRODUCTION

Accident detection using intelligent surveillance is a cutting-edge solution that leverages advanced technologies to enhance safety and response mechanisms. This product employs sophisticated surveillance cameras equipped with computer vision algorithms to continuously monitor real-time traffic or public spaces. The system is trained to recognize patterns indicative of accidents, such as sudden collisions or erratic movements.

Once an anomaly is detected, the system triggers immediate alerts, enabling swift response from emergency services. Additionally, the product may incorporate machine learning models to improve accuracy over time by refining its ability to differentiate between normal activities and actual accidents. From a product perspective, this technology offers a proactive approach to public safety, minimizing response times and potentially saving lives.

The proposed intelligent surveillance system holds the potential to significantly improve urban safety by automating accident detection and response. The fusion of computer vision and real-time data analysis establishes a proactive approach to accident prevention, ultimately contributing to the creation of safer and more resilient smart cities. Future work will focus on scalability, real-world deployment, and continuous improvement through feedback loops from emergency response systems.

An accident detection surveillance system on roads serves several important purposes. Firstly, it enhances road safety by providing real-time monitoring of traffic conditions and promptly detecting any incidents or accidents that may occur. This allows for quicker response times from emergency services, potentially saving lives and minimizing the severity of injuries.

Additionally, these systems contribute to traffic management and optimization. By identifying and responding to accidents promptly, authorities can implement diversion strategies to reroute traffic and prevent further congestion. This helps in maintaining smooth traffic flow and reduces the likelihood of secondary accidents.

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Moreover, accident detection surveillance systems can aid in investigating the causes of accidents. The collected data and footage can be valuable in analyzing the factors leading to accidents, which can then be used to implement measures to prevent similar incidents in the future. Overall, the system plays a crucial role in enhancing road safety, minimizing traffic disruptions, and improving overall transportation efficiency.

II. LITERATURE SURVEY

A lot of work has been done in this field some of which is by Daxin Tian, Chuang Zhang, Xuting Duan. They proposed an automatic car accident detection method based on Cooperative Vehicle Infrastructure Systems (CVIS) and machine vision. Firstly, a novel image dataset CAD-CVIS is established to improve accuracy of accident detection based on intelligent roadside devices in CVIS. Especially, CAD-CVIS is consisted of various kinds of accident types, weather conditions and accident location, which can improve self-adaptability of accident detection methods among different traffic situations. Secondly, they developed a deep neural network model YOLO-CA based on CAD-CVIS and deep learning algorithms to detect accident. In the model, they utilized Multi-Scale Feature Fusion (MSFF) and loss function with dynamic weights to enhance performance of detecting small objects. Finally, their experiment study evaluates performance of YOLO-CA for detecting car accidents, and the results show that our proposed method can detect car accident in 0.0461 seconds (21.6FPS) with 90.02% average precision (AP).

A Vehicle Accident Emergency Alert system is proposed for immediate attention which could save life. As soon an accident occurs the vibration sensor or the accelerometer present in the system, transmits the signals to Arduino controller. Latitudes and longitudes data are collected from the GPS system, passed using the GSM module to the emergency Centre, and sends a text message to all the people listed in the emergency List. Getting the exact location would help the ambulance to reach the spot with shortest route and time. The proposed alert system could be implemented with less cost and incorporated in all vehicles in near future so that the rate of life-loss could be minimized.

The dangerous driving can be detected using accelerometer in car alarm application. It is used as crash or roll over detector vehicle during accident or after accident. An accelerometer receives the signal which is used to recognize the severe accident. In this paper, when vehicle met with an accident or roll over the vibration sensor will detect the signal and sends it to ATMEGA 8A controller. GSM send alert message to police control room or rescue team from microcontroller. Now police can trace the location to the GPS after receiving the information.

Similarly, an SW420 sensor can be used as a crash or rollover detector of the vehicle during and after a crash. The vibration sensor is utilized in order to check the vibration rates of the car.

B Sumathi, S Janani Priyadarshini, G. Jayavarshini, L Sundari proposed a system that aims to alert the nearby medical center about the accident to provide immediate medical aid. The attached accelerometer in the vehicle senses the tilt of the vehicle and a heartbeat sensor on the user's body senses the abnormality of the heartbeat to understand the seriousness of the accident. Thus, the systems will make the decision and sends the information to the smartphone, connected to the accelerometer through GSM and GPS modules. The Android application in the mobile phone will send text messages to the nearest medical center and friends. Application also shares the exact location of the accident and it can save time.

Deeksha Gour and Amit Kanskar's paper focuses on an optimized-Yolo algorithm which is capable of detecting accidents in real time, also can run on central processing unit-based devices such as laptops or mobile phones. Laptops and mobile phones are not generally equipped with large graphical processing units. The model is trained on custom dataset achieving a mean average precision(map) of 33.31%. Optimized-yolo is designed for creating smaller and faster detection models apart from its original Yolo V3.

III. METHODOLOGY

CV Zone: Computer Vision Zone is a one top computer vision platform that provides premium resources for learning computer vision techniques. It makes it easy to run Image processing and AI functions. At the core it uses OpenCV and Mediapipe libraries.

Ultralitics: It is an intuitive AI platform for creating, training, and deploying machine learning models with a no-code interface and deep learning framework support. It simplifies the process and empowers users with an end-to-end solution for deployment to cloud, edge, or browser. They are dedicated to create the best artificial

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intelligence models in the world. Open source works here on GitHub offer cutting-edge solutions for a wide range of AI tasks, including detection, segmentation, classification, tracking and pose estimation.

OpenCV-Python: OpenCV-Python is a substantial library of Python bindings designed to solve computer vision problems. It is a great tool for image processing and performing computer vision tasks. It can be used to perform tasks like face detection, objection tracking, landmark detection, and much more. OpenCV was built for maximum efficiency and performance of computing-intensive vision tasks. Therefore, it has a strong focus on real-time applications of AI vision. The open-source software is written in optimized C and can take advantage of multicore processors (multi-threading).

YOLOv8: The key feature of YOLO is its single-stage detection approach, which is designed to detect objects in real time and with high accuracy. Unlike two-stage detection models, such as R-CNN, that first propose regions of interest and then classify these regions, YOLO processes the entire image in a single pass, making it faster and more efficient. YOLOv8 has better accuracy than previous YOLO models. The latest YOLOv8 implementation comes with a lot of new features for example user-friendly CLI and GitHub repo.

RESTful API: Also referred to as a RESTful web service or REST API is based on representational state transfer (REST), which is an architectural style and approach to communications often used in web services development. REST technology is generally preferred over other similar technologies. This tends to be the case because REST uses less bandwidth, making it more suitable for efficient internet usage. RESTful APIs can also be built with programming languages such as JavaScript or Python.

IV. SYSTEM DESIGN AND WORKFLOW DIAGRAMS

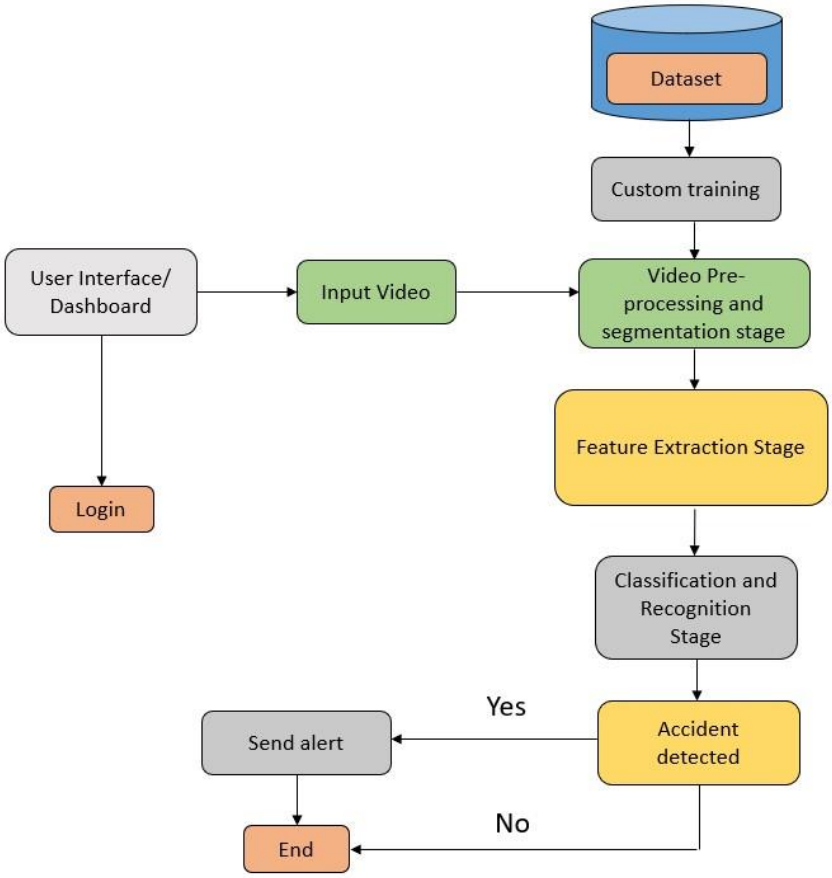

Figure 1: System Overview Diagram

System Overview Diagram represents high level overview of the system. It shows how the different module of system interacts together.

User Interface: This is user interface that is operated by the admin. It is the where the admin will be notified about the accident that has taken place, in the form of an alert message.

Processing: This part is responsible for processing video through the surveillance cameras. With the help of

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YOLOv8, processes such as image processing and object detection make it possible to identify accidents.

Data: This includes the dataset where accidents videos are stored. This dataset is used for training and testing the model. The data is fetched while processing to take respective action once an accident is detected.

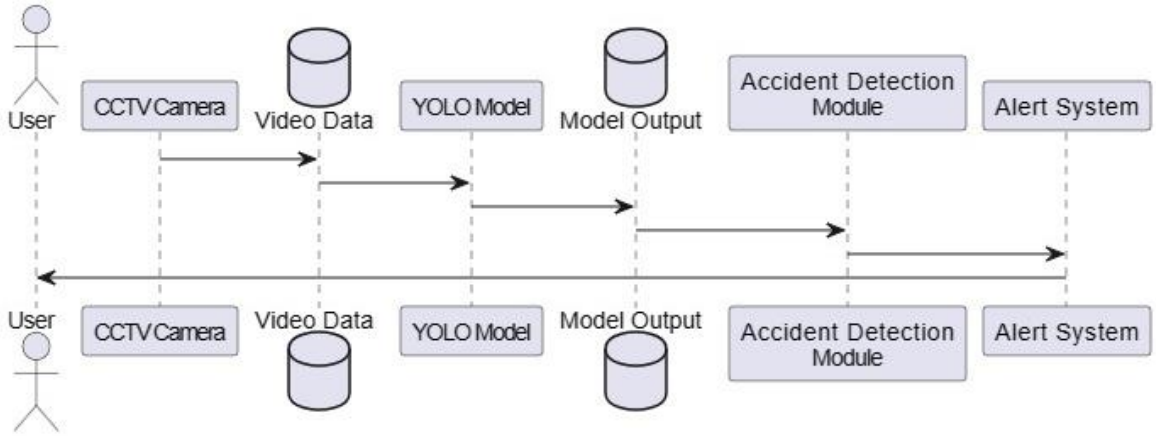

Figure 2: Accident Detection System Architecture

V. CONCLUSION

Thus, in conclusion the immediate triggering of alerts to emergency services upon accident detection is a critical feature that can significantly reduce response times. The system provides precise information about the location and nature of the incident, enabling emergency responders to reach the scene swiftly and effectively. This real-time communication is crucial for minimizing the impact of accidents and saving lives.

While the proposed road car accident detection system shows great promise, there are challenges and considerations for future development. Scalability, real-world deployment, and continuous improvement through feedback from emergency response systems are essential aspects that require further attention.

Additionally, ensuring the system's compatibility with existing infrastructure will be important for successful implementation in smart cities.

In summary, the intelligent surveillance system for road accident detection represents a proactive and technologically advanced approach to enhance urban safety. As technology continues to evolve, the ongoing refinement and deployment of such systems have the potential to contribute significantly to the creation of safer and more resilient urban environments.

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