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AI-Powered CCTV Accident Alert System

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Abstract: Road accidents are a major cause of fatalities worldwide, often worsened by delayed emergency response. Traditional CCTV systems rely on manual monitoring, leading to human errors and time delays. This project proposes an AI-Powered CCTV Accident Alert System that uses computer vision and deep learning to detect accidents in real time. The system employs YOLO and OpenCV for accurate detection and integrates GPS APIs to identify the exact location of incidents. Once an accident is detected, alerts are automatically sent to nearby hospitals and police stations through cloud-based services. This reduces response time and increases the chances of saving lives. The system is scalable, cost-effective, and can be integrated with existing CCTV infrastructure. It contributes to improved road safety and supports the development of smart city solutions.

Index Terms **- Accident Detection, Computer Vision, Deep Learning, YOLO, CCTV, Emergency Alert System.**

I. INTRODUCTION

Road accidents are one of the leading causes of death and injury across the world, and the lack of timely emergency response significantly increases the severity of these incidents. In many cases, victims do not receive immediate medical attention due to delays in accident detection and reporting. Traditional CCTV surveillance systems depend on manual monitoring, which is inefficient, time-consuming, and prone to human error. As a result, many critical incidents go unnoticed or are reported too late, reducing the chances of saving lives. With rapid advancements in artificial intelligence and computer vision, there is a growing need to develop automated systems that can detect accidents in real time and initiate immediate response actions.

This paper proposes an AI-Powered CCTV Accident Alert System that leverages deep learning and computer vision techniques to automatically identify road accidents from live video feeds. The system uses advanced object detection algorithms such as YOLO along with OpenCV to analyze video streams and detect unusual events indicative of accidents. Once an accident is detected, the system integrates with GPS services to determine the exact location and sends instant alerts to nearby hospitals, emergency services, and police authorities through cloud-based communication channels such as SMS, email, or mobile applications. This automation eliminates the dependency on human intervention and ensures faster response times.

The proposed system is designed to be scalable, cost-effective, and easily deployable using existing CCTV infrastructure, making it highly suitable for smart city environments. By reducing detection and response time, the system has the potential to significantly improve emergency management and increase the survival rate of accident victims. Overall, this approach contributes to enhancing road safety and demonstrates the practical application of artificial intelligence in real-world public safety scenarios.

II. RESEARCH METHODOLOGY

The research methodology for the proposed AI-Powered CCTV Accident Alert System focuses on the design and implementation of an automated solution for real-time accident detection and alert generation. The system is developed using computer vision and deep learning techniques to analyze live video feeds obtained from CCTV cameras. Initially, video data is captured and processed frame by frame using OpenCV, which enables efficient handling and preprocessing of video streams. A pre-trained deep learning model based on the YOLO (You Only Look Once) algorithm is employed to detect objects such as vehicles and identify abnormal patterns that indicate potential accidents. The model is trained and fine-tuned using relevant datasets to improve accuracy and reliability in different traffic conditions.

Once an accident is detected, the system extracts the location information using GPS or predefined camera location mapping. This information is then transmitted to a cloud-based server, where an alert mechanism is triggered. The alert system sends real-time notifications to nearby hospitals, emergency services, and police authorities through various communication channels such as SMS, email, or mobile applications. This ensures rapid response and minimizes delays in providing medical assistance. The

system architecture integrates multiple components including video processing, machine learning models, location tracking, and cloud communication to function as a unified solution.

The implementation is carried out using programming languages such as Python, along with libraries and frameworks like OpenCV and deep learning models for object detection. The performance of the system is evaluated based on parameters such as detection accuracy, response time, and reliability under different environmental conditions. The methodology ensures that the system is scalable, cost-effective, and compatible with existing CCTV infrastructure, making it suitable for deployment in real-world scenarios and smart city environments.

III. RESULTS AND DISCUSSION

The results of the proposed AI-Powered CCTV Accident Alert System demonstrate its effectiveness in detecting road accidents in real time and generating timely alerts. The system was tested using various video samples representing different traffic conditions, lighting environments, and accident scenarios. The YOLO-based object detection model successfully identified vehicles and detected abnormal events such as collisions with a high level of accuracy. The integration of OpenCV enabled efficient frame processing, ensuring smooth and continuous video analysis. The system showed a rapid response time, where alerts were generated immediately after accident detection and successfully transmitted to the intended recipients through cloud-based communication channels.

The performance evaluation indicates that the system significantly reduces the time required to detect and report accidents compared to traditional manual monitoring methods. This reduction in response time can play a crucial role in saving lives by enabling faster emergency assistance. Additionally, the system proved to be reliable under varying environmental conditions, although slight performance variations were observed in low-light or highly congested scenarios. These challenges can be further addressed by improving the training dataset and enhancing model optimization.

Overall, the results validate that the proposed system is efficient, scalable, and practical for real-world implementation. The discussion highlights that automated accident detection not only improves emergency response but also contributes to better traffic management and public safety. The system's ability to integrate with existing CCTV infrastructure makes it a cost-effective solution for smart city applications, reinforcing its potential for large-scale deployment.

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