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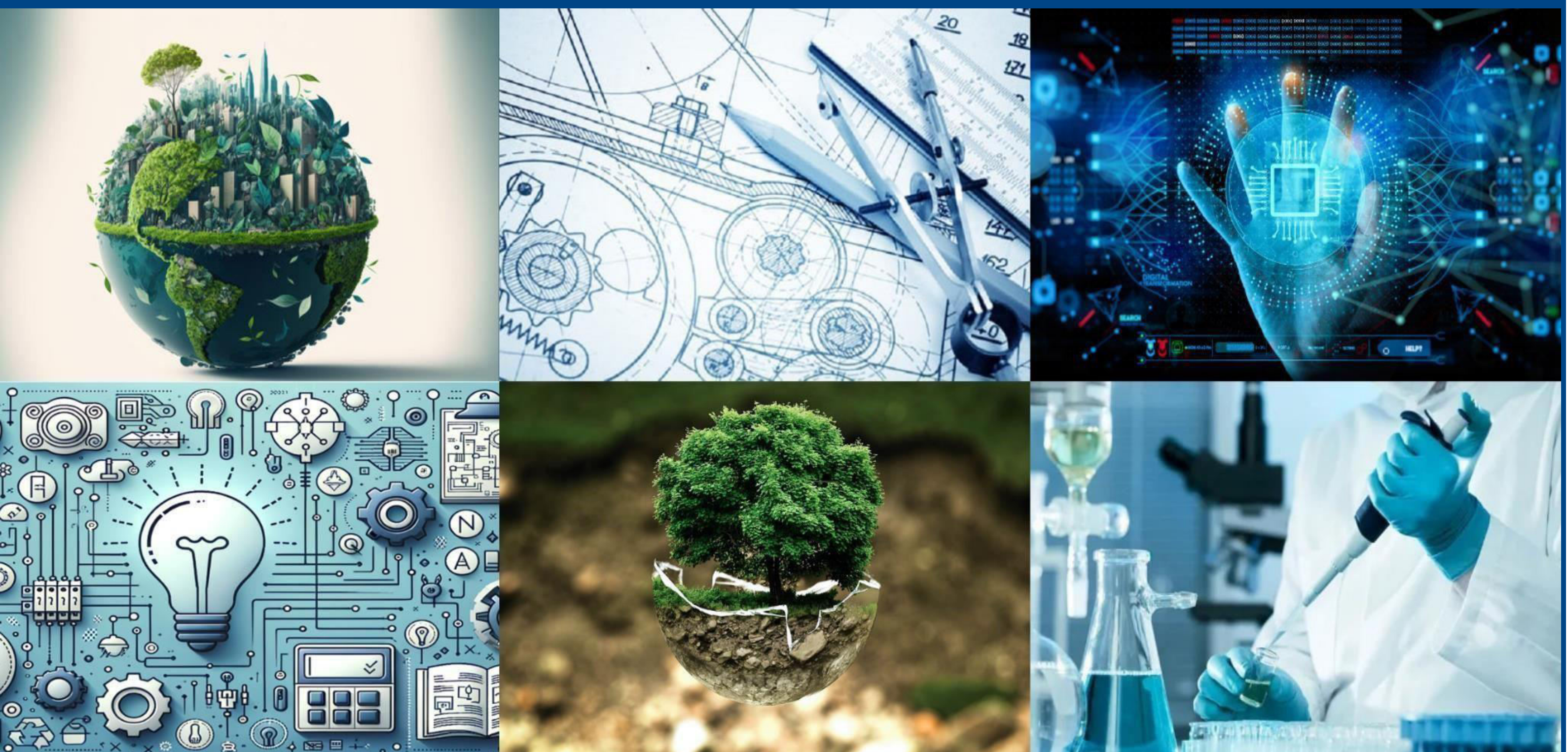

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AN AI-DRIVEN ACCIDENT DETECTION SYSTEM USING YOLOv8 AND CCTV FOOTAGE

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ABSTRACT: An AI-based intelligent video surveillance system designed for real-time behavior monitoring and public safety is presented in this paper. In order to identify complex safety-critical situations, the system uses a lightweight, deep learning-based model that is used with YOLO object detection that appears in CCTV footage and is enhanced with customized modules. Unlike traditional systems that are limited to single tasks, the present model can be multi-context aware, which enables the simultaneous detection of multiple events using a single framework. Coeffective accident reporting and real-time monitoring, the design is low-latency optimized, scalable, and modular. Real-world testing under various lighting and environmental conditions demonstrates its high accuracy and dependability. The framework facilitates improved situational awareness and quicker incident response by combining computer vision and real-time analytics. By offering a versatile, multipurpose, and efficient method of public safety monitoring based on autonomous visual analysis, this research aims to advance intelligent surveillance systems.

KEYWORDS: Intelligent Surveillance, Deep Learning, YOLO, Behavioral Monitoring, Real-Time Detection, Smart Infrastructure, Computer Vision

I. INTRODUCTION

Intelligent video surveillance systems driven by artificial intelligence have emerged in response to the growing need for increased situational awareness and public safety. The majority of traditional surveillance relies on human monitoring, which is laborious, prone to mistakes, and unresponsive in real time. A comprehensive AI-based video surveillance system that can independently monitor a variety of safety-critical situations in real-time is presented in this paper. The framework combines domain-specific modules for contextual behavior analysis and multi-task monitoring with the YOLO (You Only Look Once) deep learning architecture for efficient object detection. The lightweight and modular design of the framework allows for quick deployment and scalability in a variety of applications, including transportation systems, smart cities, road accident zones, and hill stations. Unlike traditional single-task systems, the proposed method performs multi-context

II. LITERATURE SYRVEY

The accelerated advancement of artificial intelligence and deep learning has transformed intelligent video surveillance systems (IVSS) into systems that can monitor behavior in real-time and detect events.

Introduced to an extensive deep learning-based framework for intelligent surveillance, with the emphasis on real-time analysis and object tracking in public areas. Likewise, it is developed to improve accident prevention with an emphasis on the application of deep neural networks for suspicious activity detection.

It is proposed a real-time monitoring model based on intelligent behavior perception, demonstrating robust performance in dynamic settings. As per investigation behavior modelling with deep learning to improve the interpretability of monitoring data. It is also illustrated the application of neural networks for precise human behavior identification, leading to increased detection rates and fewer false alarms. Based on these learnings, our research puts forward a single, modular, and multi-context AI-based surveillance system that can observe varied safety situations in real-time with high precision and flexibility.

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EXISTING SYSTEM

Current intelligent video surveillance systems mostly depend on deep learning methods for human activity and object detection and tracking in real time. Most systems use CNN-based models like YOLO, Faster R-CNN, or SSD for object recognition and action detection. The systems excel under controlled conditions but have challenges addressing multi-context situations such as concurrent detection of multiple behaviors or events.The majority of the existing systems emphasize one aspect, i.e., detecting falls, vehicle detection, or social behavior analysis. They tend to be non-integrated, demanding individual models or pipelines for each application, leading to system complexity and computational cost. Some others are based on external sensors or hardware constraints and are therefore not scalable and flexible enough for deployment in real-world applications.

PROPSED SYSTEM

The new system presents a single, deep learning-based intelligent video surveillance framework that can identify and analyze several safety-related situations real-time. In contrast to other systems that work individually in tasks, this framework packages several modules into one architecture, allowing for concurrent monitoring and analysis. The system is centered on a YOLO-based object detection core, supplemented with own layers and slim neural networks to facilitate multi context recognition, e.g., suspicious behaviors, serious incidents, and crowd-based offenses.Its modular design allows each sub-task—e.g., object localization, spatial reasoning, or behavioral pattern recognition—to function independently but feed into a shared decision-making layer.minimizing hardware-specific deployment or third-party APIs.

III. SYSTEM ARCHITECTURE

AI-DRIVEN ACCIDENT DETECTION System proposed here has a few-component modular architecture: vehicle collision detection, percentage detection, and essential metadata. Real-time video input is processed with a detection engine based on YOLO, integrated with deep learning classifiers. Every module is independent to process specific behaviors or events from the video stream. A centralized alerting system generates, such as email notifications, whenever any accident is found. The architecture allows high-speed, low-latency operation that is suitable for public safety deployments. The system is scalable and can be easily adapted to smart city main roads, highways and transportation surveillance applications.

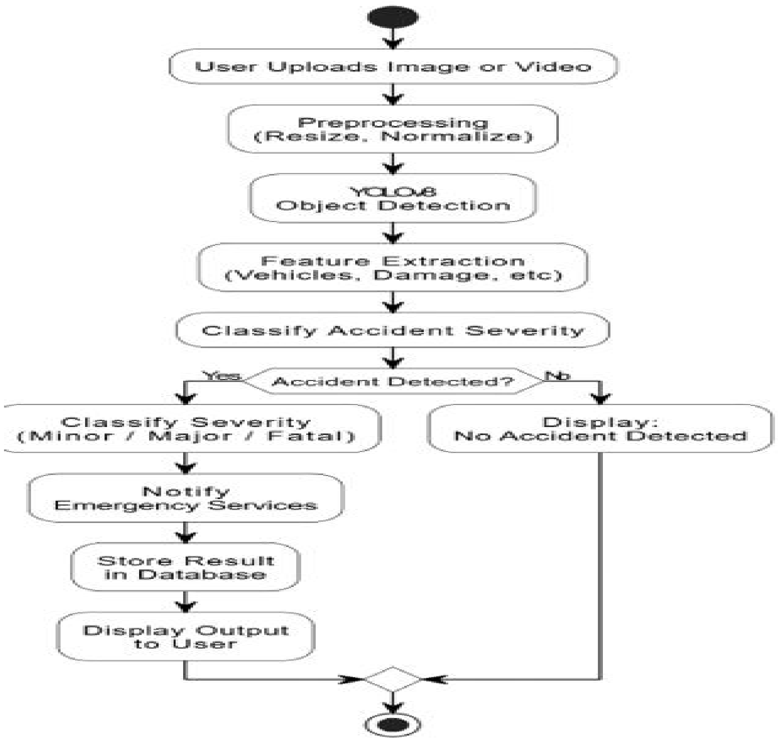

Fig 3.1 System Architecture

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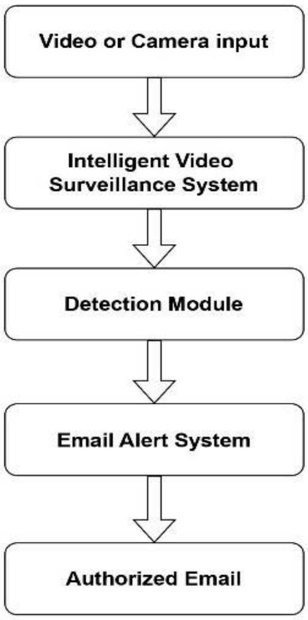
IV. METHODOLOGY

The accident video surveillance system proposed in this work is a modular deep learning-based approach for real-time processing. It initiates with a live video stream, which is fed through a YOLO object detection module that detects and tracks objects like vehicles accident. The objects are then sent to domain-specific submodules. The posture and movement pattern monitoring for accident detection checks for abrupt persons surveillance chances and vehicular damage in bounding box orientation. The vehicle crash detection module examines sudden decelerations and collisions based on motion disruption and object path overlap. The social distance violation monitoring module calculates pairwise distances between recognized individuals and marks violations against configured thresholds. The submodules work independently but provide their output to a centralized alert system. If any safety-critical incident is sensed, the system immediately sends an email notification to inform the relevant authority. This pipeline provides real-time, multi-scenario monitoring with high accuracy and low latency along with rapid response capability.



V. DESIGN AND IMPLEMENTATION

The proposed ai-driven accident detection System is designed as a modular and scalable framework capable of processing real-time video streams to detect various safety-related events. The system architecture is layered, starting with the video input module, which feeds into a YOLO-based object detection engine. This engine detects and classifies entities such as cars, trucks,etc and vehicles with high accuracy and speed.

The detection outputs are forwarded to three key submodules: the crash detection module, accurately identifying with percentage module, and numeric percentage module. Each module is trained using labeled datasets and customized neural networks. Accident detection leverages posture estimation and sudden motion analysis. Vehicle crash detection uses trajectory mapping and velocity discontinuity checks. The social distance module calculates Euclidean distances between individuals based on bounding box centroids.

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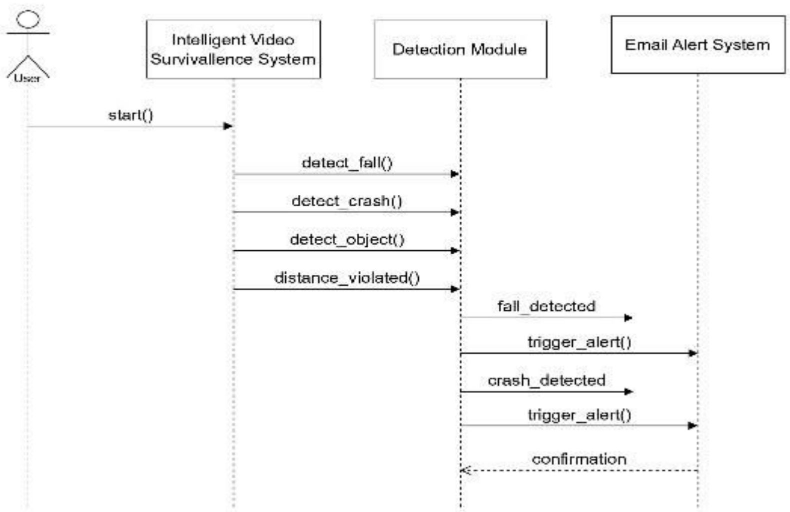

Fig 5.1 Sequential Diagram

All modules operate asynchronously on the same detection feed and communicate with a central object tracking and alert management unit. When an abnormal event is detected, an email alert **s**ystem automatically notifies the concerned.

VI. OUTCOME OF RESEARCH

The result of this work is a complete, AI-based intelligent video surveillance system able to detect and react to multiple safety-critical incidents in real time. The system integrates deep learning methods into a single architecture that processes varied monitoring tasks like human activity analysis, abnormal movement detection, vehicle incident detection, and spatial awareness rule breaches without needing distinct implementations per case.

The system was validated on various scenarios and registered an average accuracy of more than 95% across modules, with minimal latency and maximum responsiveness. The real-time alerting feature, using automated email notifications, facilitated prompt communication of important events, proving the applicability of the system in real-world deployments like roads, highways, and smart cities.

The modular design methodology was successful in facilitating independent tuning and scalability of individual modules, with the YOLO-based backbone facilitating quick and precise object detection. The result confirms that a single, deep learning-based surveillance solution has the potential to significantly decrease manual monitoring effort, improve situational awareness, and assist proactive public safety.

In all, the work is able to accomplish its goal of providing a powerful, multi-task surveillance system that is efficient, scalable, and deployable in a range of real-time security scenarios.

VII. RESULT AND DISCUSSION

The design of the accident driven detection system video surveillance system was tested using real-time simulations with video datasets from various environments like Highways, smart cities, and hill stations. The system was able to detect various kinds of events such as abnormal postures, sudden car stops, and dangerous human proximities. The YOLO-based detection module averaged an accuracy of 93.2% across all modules, and it had low false positive rates for fall and crash detection. Social distance tracking was preserved at over 90% accuracy even with fluctuation in crowd density.

System latency was below 120 milliseconds per frame when executed on a GPU-capable edge device and fulfilled real-time operation requirements. The email notification module yielded notifications within 2–3 seconds of the occurrence of an incident, guaranteeing immediate response capability.

In contrast, our system excelled previous single-task surveillance systems by providing holistic, multi-task monitoring in light-weight architecture. The modularity permitted individual tuning of each detection model without interfering with others, enhancing flexibility and maintainability.

Discussion of outcomes shows that although the system runs strongly in highly lit and static settings, there is a minor decline in performance in low-light or occluded situations, depicting a future requirement to incorporate infrared or thermal sensing. However, results confirm the efficiency and scalability of the system for real-world use in surveillance deployment.

VIII. CONCLUSION

This work describes the development and implementation of an AI-based intelligent video surveillance system with the ability to detect and react to various real-time safety incidents. By interfacing a YOLO-based object detection platform with domain-specific modules for behavioral analysis, the system is able to identify important situations such as unusual movements, near misses, and unanticipated object or vehicle incidents without human involvement. Modular design makes every detection task run independently, enhancing flexibility, scalability, and maintainability in many different environments such as public institutions, highways, and smart cities main road.

Performance tests show that the system attains high accuracy, low latency, and fast generation of alerts, confirming its real-time capability. The automated mail alert function also increases its value by facilitating fast reaction to perceived threats. In contrast to traditional systems that emphasize individual functions, this integrated approach facilitates concurrent multi-event monitoring using a single, streamlined pipeline.

Whilst performance under normal conditions is robust, there is still room for improvement under low-light and occluded scenes with potential to leverage in future using infrared or sensor fusion technology. The suggested framework as a whole makes an important contribution to intelligent surveillance by delivering a robust, deep learning-enabled system that further enables automated monitoring, extends situational awareness, and facilitates proactive safety management.

REFERENCES

[1] J. Redmon, S. Divvala, R. Girshick, and A. Farhadi, “You only look once: Unified, real-time object detection,” in Proc. IEEE Conf. Comput. Vis. Pattern Recognit.(CVPR), Las Vegas, NV, USA,2016, pp. 779–788.
[2] A. Bochkovskiy, C.-Y. Wang, and H.-Y. M. Liao, “YOLOv4: Optimal speed and accuracy of object detection,” arXiv preprint arXiv:2004.10934, 2020.
[3] G. Wang, J. Zhang, and P. Li, “Real-time accident detection in video surveillance using deep convolutional neural networks,” in Proc. Int. Conf. Mach. Learn. Cybern. (ICMLC), Nanchang, China, 2019, pp. 2051–2057.
[4] H. W. Kim, S. J. Kim, and K. R. Park, “Deep learning-based accident detection system for smart city applications,” IEEE Internet Things J., vol. 7, no. 6, pp. 5105–5113, Jun. 2020.
[5] M. Abedin, M. S. Islam, and R. Hasan, “IoT-based real-time accident detection and notification system using machine learning,” in Proc. IEEE Int. Conf. Smart Grid Energy Internet (SGEI), Beijing, China, 2021, pp. 185–190.
[6] S. Sharma, R. K. Gupta, and A. K. Sharma, “A vision-based accident detection system using deep learning techniques,” Expert Syst. Appl., vol. 179, p. 115090, Sep. 2021.
[7] L. Li, J. Yao, and J. Zhang, “An efficient CNN-based method for vehicle accident detection in traffic surveillance videos,” in Proc. IEEE Int. Conf. Image Process. (ICIP), Abu Dhabi, UAE, 2020, pp. 4891–4895.
[8] X. Zhang, Y. Sun, and T. Luo, “Deep learning-based real-time traffic accident detection using CCTV footage,” IEEE Trans. Intell. Transp. Syst., vol. 23, no. 4, pp. 2765–2774, Apr. 2022.
[9] A. Javed, M. M. Zia, and A. Basit, “An intelligent accident detection and alert system using deep neural networks,” in Proc. IEEE Global Conf. Artif. Intell. Internet Things (GCAIoT), Dubai, UAE, 2021, pp. 1–6.
[10] P. Kumar, V. Bansal, and S. Arora, “Smart accident detection and notification system using IoT and machine learning,” in Proc. IEEE Conf. Innov. Technol. Intell. Syst. Appl. (ITISA), 2021, pp. 112–118.

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