**Abstract**

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The Smart Crowd Flow Analyzer is an advanced computer vision-based system designed to monitor, track, and analyze human movement patterns in crowded public spaces. With the growing frequency of large gatherings in urban areas—such as festivals, sports events, concerts, and public rallies—ensuring the safety and smooth movement of people has become a critical challenge. Traditional manual monitoring methods are often slow, prone to human error, and lack the ability to respond quickly to sudden changes in crowd behavior. This project addresses these issues by introducing an automated system that can observe and analyze crowd dynamics in real time.

The system utilizes surveillance video feeds from CCTV cameras as input. Deep learning-based object detection models, such as MobileNet-SSD or YOLO, are used to accurately detect individuals within each video frame. Detected individuals are then tracked across frames using centroid-based tracking algorithms, which assign unique IDs to each person and monitor their movement trajectories. By continuously calculating movement density, velocity, and direction, the system identifies critical zones of congestion or unusual crowd behavior. This enables the generation of alerts when unsafe conditions are detected, allowing authorities or event organizers to take timely preventive measures.

Furthermore, the system stores movement data over time, which can be used for post-event analysis and planning future crowd management strategies. Its real-time nature and scalability make it suitable for smart city infrastructure, airports, train stations, shopping malls, and large public events. By combining computer vision, deep learning, and data analytics, the Smart Crowd Flow Analyzer offers an effective and automated approach to enhance public safety and optimize crowd management operations, reducing the risk of accidents and ensuring a safer experience for the public.