



Hydro Guard: Strengthening Public Safety Through Advanced Detection And Notification

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Abstract: Ensuring public safety has become a major concern with growing urbanization. Traditional manual monitoring of surveillance cameras is inefficient and prone to human error, leading to delayed responses in critical situations. This paper presents an AI-based system for the real-time detection of violence and weapons from video streams. The proposed system utilizes YOLOv8 for accurate weapon detection and a Transformer model to analyze temporal patterns for violence detection. By integrating feature fusion, the system reduces false alarms and automatically generates alerts for immediate security response. This solution offers a scalable and efficient approach to automated public surveillance.

Index Terms: Public Safety, AI-Based Surveillance, YOLOv8, Transformer Model, Weapon Detection, Violence Detection, Deep Learning, Real-Time Monitoring.

I. INTRODUCTION

With the rapid growth of urban environments, the deployment of surveillance cameras has become widespread. However, the effectiveness of these systems is often limited by the need for continuous human attention, which is resource-intensive and prone to fatigue. Manual analysis often fails to capture sudden violent events or the presence of weapons in real-time, resulting in high risks to public safety.

To address these limitations, we propose an intelligent surveillance framework that automates threat detection. The system is designed to provide minimal human intervention while maintaining high efficiency in detecting complex spatial and temporal patterns of violence.

II. RELATED WORK

Existing research in public safety has explored various methodologies, from sociological pathways to automated computer vision:

Pathway Approach: Jensen et al. (2020) analyzed behavioral patterns in radicalization, providing insights into pre-violence indicators but lacking real-time video automation.

- **Comparative Analysis:** Thijs et al. (2024) used statistical analysis to differentiate between violent and non-violent suspects, though the methods were not applicable to computer vision tasks.
- **Traditional Machine Learning:** Serrano Gracia et al. (2015) implemented "Fast Fight Detection" using motion analysis, which achieved faster detection but struggled with environmental complexity and weapon identification.

In contrast, our proposed system integrates state-of-the-art deep learning architectures (YOLOv8 and Transformers) to simultaneously detect weapons and violent actions.

TABLE I — Summary of Related Work on River and Water Cleaning Robots

III. SYSTEM ARCHITECTURE AND METHODOLOGY

A. System Overview

The architecture is divided into specialized modules for frame processing and threat classification.

B. Hardware and Software Specifications

The system is built on an Intel Core i3/i5 processor with a minimum of 8 GB RAM. The software stack includes:

- **Language:** Python 3.x.
- **Frameworks:** Django for backend and VS Code for development.
- **Models:** YOLOv8 (Weapon Detection) and Transformer (Violence Detection).

TABLE II — Hardware Components and Specifications

**C. System Working**

Video Input: Captures live feeds from CCTV or datasets.

Preprocessing: Resizing, normalization, and noise reduction.

Weapon Detection: YOLOv8 identifies items like guns or knives in individual frames.

Violence Detection: The Transformer model analyzes a sequence of frames to identify fighting or hitting.

Feature Fusion: Combines scores from both models to make a final decision.

Alert Generation: Triggers visual/audio alarms and notifies authorities.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The integration of spatial (YOLOv8) and temporal (Transformer) learning significantly improves overall detection efficiency.

- **Weapon Detection:** YOLOv8 provides fast and accurate detection in varied video frames.
- **Violence Detection:** The Transformer model effectively identifies behavioral patterns across sequences.
- **Reliability:** The use of feature fusion helps in reducing false alarms commonly found in traditional motion-detection systems

TABLE IV — Comparative Analysis of Hydro Guard vs. Existing Systems

V. CONCLUSION AND FUTURE WORK

The proposed AI-based system enhances public safety by providing automated, real-time threat detection with reduced human effort. It is a scalable solution suitable for high-security environments like airports, banks, and smart cities.

Future Work:

- Integration with IoT systems for enhanced alert mechanisms.
- Training with larger datasets to further refine accuracy.
- Development of models for predictive behavior analysis to prevent crimes before they occur

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