WebSocket-Based Smart Surveillance Camera for Real-Time Detection of Occupational Health and Safety PPE Non-Compliance in Industrial Areas

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Abstract

In industrial settings, ensuring adherence to Occupational Health and Safety (OHS) Personal Protective Equipment (PPE) regulations continues to be a crucial challenge. The creation of a WebSocket-based smart

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Abstract

In industrial settings, ensuring adherence to Occupational Health and Safety (OHS) Personal Protective Equipment (PPE) regulations continues to be a crucial challenge. The creation of a WebSocket-based smart surveillance camera system for the real-time identification and reduction of PPE infractions is discussed in the paper. The proposed system includes an ESP32-S3 microcontroller accompanied by an OV5640 camera module, acting as an edge-processing embedded platform. The Edge Impulse machine learning framework was used to train image classification and detection models, enabling efficient low-latency inference directly on the device. A websocket enabled web server streams video frames in real time for constant monitoring, with instant display using regular browsers without wasting bandwidth. Experimental results demonstrate that even with limited computational resources, the system is able to perform on-device inference with very high responsiveness and good detection accuracy. This technology provides a scalable and affordable way to enhance OHS compliance monitoring in industry, reduce reliance on manual supervision, and encourage proactive risk mitigation methodologies.

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