

ABSTRACT

Drowsy driving defined as driving in a state of fatigue, microsleep, or extreme exhaustion is a major contributor to fatal road accidents worldwide: accounting for 21% in the United States, approximately 1,300 incidents annually in the United Kingdom, and up to 7% of fatal truck accidents in Japan. In Indonesia, the National Transportation Safety Committee (KNKT) reports that fatigue or drowsiness is a contributing factor in up to 80% of toll road accidents, particularly during early morning and midday hours. Although trucks and buses are involved in fewer accidents compared to motorcycles, the resulting fatalities and financial losses are significantly greater.

This study developed an IoT-based drowsiness detection system using the ESP32-CAM module integrated with a MobileNetV2 CNN image classification model to detect eye closure as an indicator of drowsiness. The system is equipped with a buzzer for audible alerts and is capable of sending real-time notifications to both Telegram and a web dashboard when three consecutive eye-closure events are detected. The original (float32) model achieved high classification accuracy of up to 93%. After quantization to the lighter INT8 format for embedded deployment, the model retained an accuracy of approximately 88% when tested on a computer with a test dataset. However, real-world performance on the ESP32-CAM device showed varying accuracy depending on the detection scenario: 43% for open-to-closed eye transitions, 40% for continuously open eyes, and 80% for continuously closed eyes. These drops in performance were primarily due to hardware limitations in processing power and memory.

Despite this, the system successfully functioned in real time to detect and respond to signs of drowsiness. With a total estimated hardware cost of only Rp 274,500, the system meets its design goal of being an affordable yet functional solution for drowsiness detection in truck and bus drivers.

Keywords: Accuracy, CNN, Drowsy driving, IoT, Microsleep; Real-time, Telegram, Web Dashboard.