ABSTRACT

The Catenary System, especially the Trolley Wire in electric trains, is susceptible to wear and temperature fluctuations, which impact operational efficiency and safety. To replace inefficient manual inspections, this research offers an image processing-based solution. We utilized a thermal Flir One Gen 3 kamera and a Z Cam E2 kamera to collect trolley wire data, then analyzed it using Convolutional Neural Network (CNN) algorithms to detect arcing (electrical sparks) and wear. Test results indicate that the thermal *Flir One Gen 3 kamera achieves an average accuracy of 99.80% in temperature measurement. Our trained CNN model successfully detected the proposed arcing by combining three transfer learning models: VGG16, ResNet50, and VGG16-Alt, with experimental results showing that the ensemble model achieved an accuracy of 94.83%. Furthermore, for trolley wire wear analysis, two CNN architectures were compared: EfficientNetB0 with specific optimization for trolley wire contour detection achieved an accuracy of 87.2%, and ensemble ResNet50 reached 87.48% through 5-Fold Cross-Validation.*

Keywords: *wear, temperature, catenary system, electric train, image processing, Convolutional Neural Network (CNN).*