



PROJECT REPORT
PERFORMANCE ANALYSIS CLAHE AND ECA
FOR OBJECT DETECTION IN ADVERSE WEATHER
CONDITIONS USING CMCA-YOLO

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ABSTRACT

Object detection in extreme weather conditions such as heavy rain, fog, and low light is still a major challenge for deep learning-based detection models, including YOLOv5. One of the developments of YOLOv5, namely CMCA-YOLO, has shown improved performance through the integration of Criss-Cross Attention (CCA) and Multi-Spectral Channel Attention (MSCA) modules. However, this model has not specifically addressed the visual quality degradation in images due to weather disturbances. This study proposes two additional approaches to address this issue. First, a preprocessing method using Contrast Limited Adaptive Histogram Equalization (CLAHE) to enhance local contrast in severe weather images. Second, the addition of an Efficient Channel Attention (ECA) module after the CMCA layer in the CMCA-YOLO architecture to strengthen important channels without significantly increasing model complexity. The dataset used includes images in rainy, foggy, and low light conditions, which have been converted to YOLO format and automatically processed using OpenCV. The modified architecture will then be trained and evaluated using mAP@0.5, precision, recall. Evaluations were conducted on several model combination scenarios to identify the most optimal architecture to be applied to an object detection system in extreme environments.

Keyword: Object Detection, CMCA-YOLO, CLAHE, ECA, Extreme Weather