

## ***A Unified Model to Enhance Traffic and Road Sign Detection Under Adverse Weather Conditions***

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This study addresses the significant challenge faced by Advanced Driver Assistance Systems (ADAS) in adverse weather conditions such as rain, fog, and low light, which hinder the systems' ability to detect traffic and road signs. Traffic sign detection and recognition systems rely on computer vision, which is affected under poor visibility scenarios. We propose a unified model that effectively mitigates the impact of multiple weather phenomena. Most existing methods address only one weather condition at a time. However, in real driving scenarios, multiple weather impairments may co-occur, and some methods produce artifacts that significantly reduce traffic sign recognition accuracy. To address these issues, we developed an algorithm that simultaneously removes weather degradation from images, enhancing traffic and road sign detection. Our algorithm focuses on conserving computational resources, providing fast processing crucial for real-time traffic sign detection. The methodology involves a feature extraction of various weather conditions using multiple existing machine-learning algorithms. These algorithms are trained to reduce weather-induced image degradation for specific weather conditions. A unified platform is then developed to integrate these trained algorithms, effectively addressing adverse weather conditions, including rain, fog, and low light, within a single framework. The evaluation of the proposed model against existing enhancement methods shows that it achieves the highest average traffic sign recognition confidence score of 0.91. Additionally, the enhanced images from our model exhibit a significantly greater reduction in BRISQUE scores compared to the input weather-degraded images, indicating a substantial improvement in image quality. These results confirm that the proposed model offers a significant advancement over current models, providing superior image quality and more reliable traffic sign detection and recognition under adverse weather conditions. This unified approach for handling various weather conditions presents considerable advantages over existing single-condition methods, thereby enhancing the overall effectiveness of ADAS in poor visibility scenarios.

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