Mitigating the Impact of Object Overlapping on YOLOv4 Object Detection

Shahrzad Sayyafzadeh, Idongesit Mkpong-Ruffin, Chutima Boonthum-Denecke*
Florida A&M University, Department of Computer and Information Sciences,
*Hampton University, Department of Computer Science

Abstract

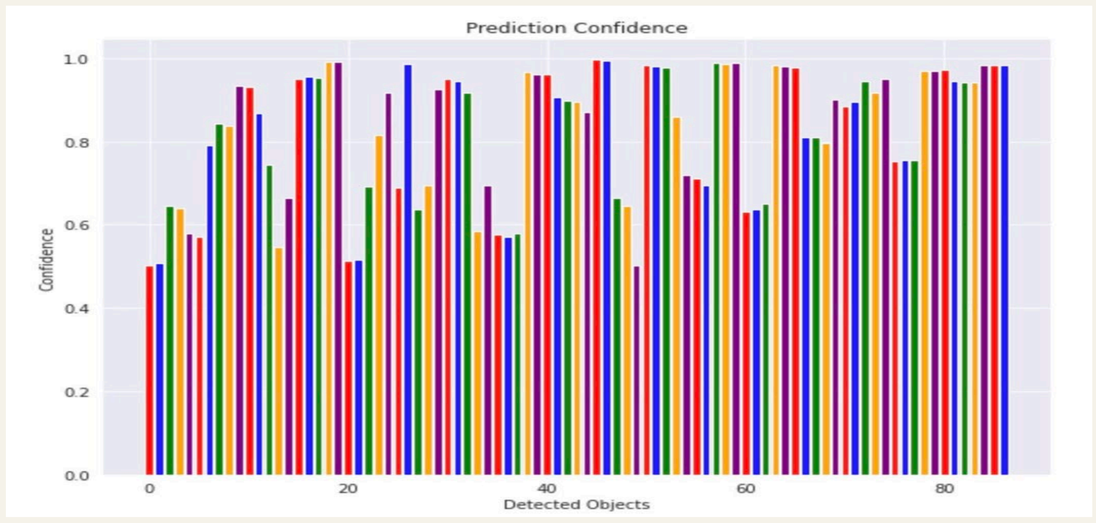
Object detection algorithms like You Only Look Once (YOLOv4) can face challenges when multiple objects overlap within the same grid cell. In this scenario, accurately detecting and classifying each object becomes difficult. Data augmentation techniques can address this issue and improve the accuracy of YOLOv4. More diverse training data can be created by artificially generating images with non-overlapping objects through random shifting, rotating, resizing, color jittering, and flipping. This improves the robustness of the model and helps it better handle real-world images with diverse object configurations. Data augmentation and post-processing can help address overlapping objects in YOLOv4, improving accuracy and performance in object detection tasks. The network was trained to recognize 80 object classes and achieved a 99% prediction rate and 54% confidence rate.

Comparison of Object Detection Results with and without Non-Maximum Suppression (NMS)"

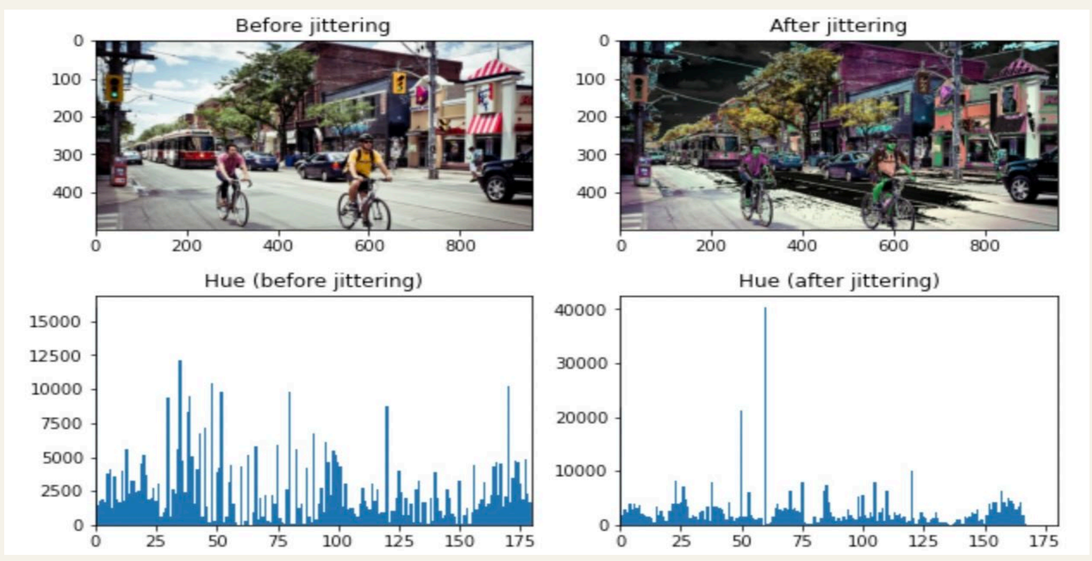
Method

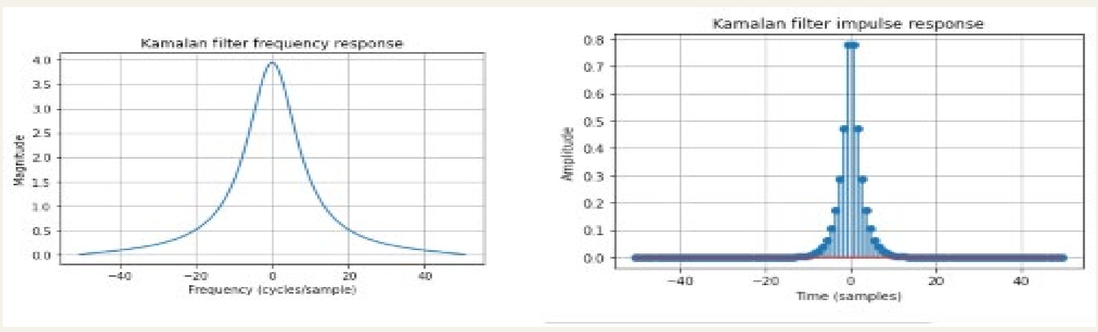
I. Use of Darknet, a neural network framework for object detection in computer vision.
II. Determination of prediction confidence rate; a key metric to evaluate the performance of darknet and other models.
III. Analyze histogram of detected objects with their corresponding prediction confidence rates, to gain insights into the performance of the object detection model.
IV. Implementation of the Kalman filter, color jittering, for a YOLOv4 object detection model to evaluate the noise of object overlapping.

Results



Insights from a Histogram of Detected Objects and Confidence Rates in Object Detection Models





Evaluating Object Detection and Tracking in YOLOv4 Model through Kalman Filter Frequency and Impulse Response Analysis

Conclusion

I. The histogram shows that most detected objects fall into the higher confidence rate bins, indicating that the model has correctly identified these objects with a high degree of confidence.
II. Accurately detecting and classifying overlapping objects can be addressed by utilizing data augmentation techniques such as random shifting, rotating, resizing, color jittering, and flipping, which improve the model's accuracy.
III. generating more diverse training data with non-overlapping objects enhances the model's robustness and ability to handle various object configurations in real-world images. By combining data augmentation and post-processing techniques such, as Kalman filter, color jittering, the accuracy and performance of YOLOv4 in object detection tasks can be significantly improved.

Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. 2016. You only look once: Unified real-time object detection. *Proceedings of the IEEE conference on computer vision and pattern recognition,* pp. 779-788, 2016.
Ruan, J. & Wang, Z. 2018. An Improved Algorithm for Dense Object Detection Based on YOLO. *Advances in Intelligent Systems and Computing* book series (AISC, vol 905). *The 8th International Conference on Computer Engineering and Networks (CENet2018),* pp 592–599.
Sarda, A., Dixit, S. & Bhan, A. 2021. Object Detection for Autonomous Driving using YOLO [You Only Look Once] algorithm. *The 2021 Third International Conference on Intelligent Communication Technologies and Virtual Mobile Networks (ICICV) Proceeding.*