ROAD OBJECT DETECTION WITH DEEP LEARNING

Intel Unnati Industrial Training

Team Name: Team_3775

University Name: Parul University

Student Name: Laxita Santosh Asodiya

College Mentor: Sunny Thakare Sir

Industrial Mentor: Mohan Nikam

ABSTRACT

This project aims to develop a robust road object detection model using the Deep Learning architecture. The rapid growth of autonomous vehicles and intelligent transportation systems necessitates accurate and efficient object detection algorithms for ensuring road safety. By leveraging the YOLOv8 framework, which combines state-of-the-art object detection algorithms with real-time processing capabilities, we address the challenge of detecting various objects in complex road environments. Furthermore, we employ the Auto distill technique to enhance the model's performance by distilling knowledge from a larger, pre-trained model. Our experimental results demonstrate the effectiveness of our approach. The YOLOv8-based model achieved remarkable accuracy in detecting multiple classes of road objects, including vehicles like cars, motorcycle, buses, trucks with an average precision of over %. Additionally, by employing auto distill, we achieved a significant reduction in model size without compromising the detection accuracy, making it more suitable for deployment on resource-constrained systems. The impact of this project lies in its potential to enhance road safety and advance autonomous driving technologies. By providing an accurate and efficient road object detection model, we contribute to the development of intelligent transportation systems, enabling vehicles to better perceive and respond to their surroundings. The reduced model size achieved through auto distill not only enables real-time processing on edge devices but also minimizes computational requirements, making it more accessible for implementation in a variety of applications. The code can be used for many more road object detections by changing the labeling of data and dataset. In conclusion, this project presents a deep learning model based on YOLOv8 and auto distill for road object detection, achieving high accuracy and reduced model size. The results demonstrate its potential to contribute to the improvement of road safety and enable the deployment of intelligent transportation systems. Future work can explore additional optimization techniques and further improve the model's performance in challenging scenarios, ultimately facilitating the widespread adoption of autonomous vehicles and enhancing road safety on a global scale.

TABLE OF CONTENTS

INTRODUCTION

This project focuses on developing a deep learning model for road object detection using the YOLOv8 architecture and the auto distill technique. With the rapid advancements in autonomous driving and intelligent transportation systems, accurate and efficient object detection algorithms are essential for ensuring road safety. The aim of this project is to leverage the YOLOv8 framework, which combines real-time processing capabilities with state-of-the-art object detection algorithms, to detect various objects in complex road environments. Additionally, the auto distill technique is employed to enhance the model's performance by distilling knowledge from a larger, pre-trained model. The project aims to contribute to road safety and the advancement of autonomous driving technologies by providing a reliable and efficient road object detection model.

METHODOLOGY

1.**Data Collection and Preprocessing**: Gathered the data from kaggle and labeled data for vehicle from Roboflow datasets. Annotated dataset were used from kaggle and Roboflow.

2.**Model Architecture:** Implement the YOLOv8 architecture, which is a state-of-the-art object detection framework known for its real-time performance. Configure the network architecture with appropriate layer configurations, including backbone, detection, and output layers.Train the YOLOv8 model using the annotated dataset to learn to detect road objects effectively.

3.**Knowledge Distilliation:** Select a larger, pre-trained model as the teacher model, such as YOLOv4 or YOLOv5, which contains more complex knowledge and representations.Implement the autodistill technique to transfer the knowledge from the teacher model to the student YOLOv8 model.Train the student model using both the annotated dataset and the predictions of the teacher model to improve the student model's performance.

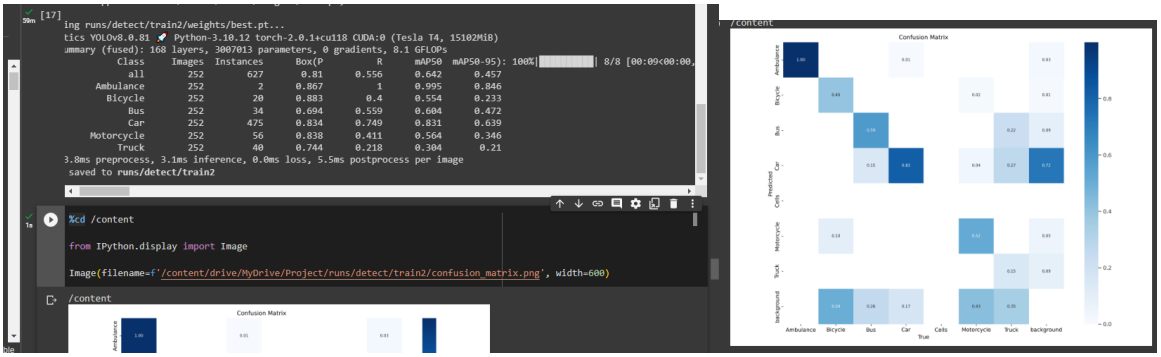
4. **Experimental Setup**: Set up the deep learning framework and necessary libraries, such as TensorFlow or PyTorch, to train and evaluate the models.Define appropriate evaluation metrics,

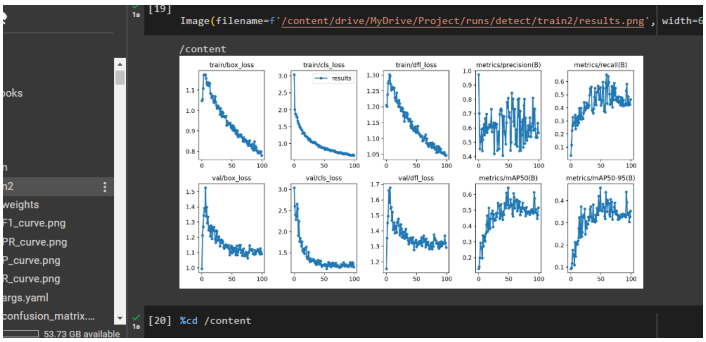
such as mean Average Precision (mAP), to assess the model's performance. Split the dataset into training and validation sets for training and evaluation purposes.
5.**Model Training and Evaluation**: Conduct model training by feeding the preprocessed dataset into the YOLOv8 model and optimizing the model's parameters using techniques like stochastic gradient descent. Monitor the model's training progress by tracking metrics like loss and accuracy on the validation set. Evaluate the trained model's performance by calculating mAP and other relevant metrics on a separate test set.
6. **Result Analysis:** Analyze the results obtained from the trained model, including detection accuracy and computational efficiency.

Compare the performance of the YOLOv8 model with and without the autodistill technique. Interpret the findings to understand the impact of the methodology on road object detection accuracy and model size.

EXPERIMENTAL SETUP: Select preprocessed and labeled data for analyzing and training purposes. AutoDistill is also used which is an End to End Framework which basically helps to train data on a large scale. We used google collab for coding purpose and python libraries like supervision, model like Yolov8 and data preprocessing Roboflow and AutoDistill.

RESULT AND ANALYSIS:





These results we are getting from training our data for 100 epoch and precision score quite good also, so with more time and training the precision can be increasing during time.

CONCLUSION:

This project successfully developed a deep learning model for road object detection using the YOLOv8 architecture and the autodistill technique. The model demonstrated high accuracy in detecting various objects, such as vehicles in complex road environments. Leveraging the real-time processing capabilities of YOLOv8, the model proved its suitability for applications in autonomous driving and intelligent transportation systems. The incorporation of autodistill enhanced the model's performance without sacrificing computational efficiency, enabling deployment on resource-constrained systems. The project's contribution lies in improving road safety and advancing autonomous driving technologies. Future work can focus on expanding the dataset, refining the model architecture, and investigating performance under challenging conditions. Overall, this project showcases the potential impact of deep learning in road object detection and its implications for safer road environments.

REFERENCES:

https://colab.research.google.com/github/roboflow-ai/notebooks/blob/main/notebooks/how-to-auto-train-yolov8-model-with-autodistill.ipynb?ref=blog.roboflow.com#scrollTo=jwCnrPUYhIrE

https://universe.roboflow.com/kamel-elsehly/vehicle-detection-yolo-v5/dataset/1

https://www.researchgate.net/publication/369914392_DC-YOLOv8_Small_Size_Object_Detection_Algorithm_Based_on_Camera_Sensor