TASK-3 REPORT

1. Introduction:

This project aims to develop a machine learning model capable of predicting car colors, counting cars, and determining the number of males and females present at a traffic signal. The model will include a specific rule to swap red and blue car colors. This project leverages computer vision techniques and deep learning to analyze traffic scenes.

2. Background:

Traffic monitoring is crucial for urban planning and ensuring road safety. Accurate detection and classification of vehicles and pedestrians at traffic signals can help manage traffic flow and reduce congestion. This project expands on conventional traffic monitoring by adding gender detection for pedestrians and an intentional color-swapping feature for red and blue cars.

3. Learning Objectives:

- To understand the principles of computer vision and deep learning.
- To develop and train a convolutional neural network (CNN) for object detection and classification.
- To handle custom rules within a machine learning pipeline.
- To evaluate and improve model performance on diverse datasets.

4. Activities and Tasks:

1. **Data Collection**: Gathered image datasets containing traffic scenes from coco dataset, annotated with car colors, counts, and pedestrian genders.
2. **Data Preprocessing**: Annotate images of cars, Label car colors and count of genders.
3. **Model Development:**

- Car Detection and Color Prediction: Developed a CNN to detect and classify car colors, swapping red and blue labels.
- Car Counting: Implemented object detection techniques to count the number of cars.
- Pedestrian Detection and Gender Prediction: Developed a separate CNN to detect pedestrians and classify their genders.

4. **Training and Validation**: Train the model using annotated datasets and validate its performance on a separate validation set.

5. **Custom Rule Implementation**: Ensure the model swaps the predictions for red and blue cars.

6. **Evaluation**: Assess the model's accuracy, precision, recall, and F1-score for each task.

7. **Feedback and Iteration**: Gather feedback from initial results and refine the model to improve performance.

5. Skills and Competencies:

- Machine Learning: Understanding of neural networks, especially CNNs.
- Computer Vision: Proficiency in image processing and object detection techniques.
- Python Programming: Ability to use libraries such as TensorFlow, Keras, OpenCV, and Scikit-learn.
- Data Annotation: Skills in preparing and annotating datasets for supervised learning.
- Model Evaluation: Knowledge of metrics and techniques for assessing model performance.

6. Feedback and Evidence:

- Feedback: Gathered from peer reviews and performance metrics. Iterative testing and refinement based on feedback.
- Evidence: Performance reports, confusion matrices, and visual examples of model predictions demonstrating its effectiveness and areas for improvement**.**

7. Challenges and Solutions:

- Challenge: Obtaining a diverse and well-annotated dataset
- Solution: Used coco datasets, data augmentation techniques, and manual annotation to ensure dataset quality and diversity.
- Challenge: Accurate gender detection in varied lighting and occlusion conditions.
- Solution: Enhanced model robustness through extensive training with diverse data and implement advanced image preprocessing techniques.
- Challenge: Swapping red and blue car colors without affecting other predictions.
- Solution: Implemented post-processing logic within the model's prediction pipeline to swap colors after initial prediction.

8. Outcomes and Impact:

- Outcomes: A robust model capable of detecting and counting cars, swapping red and blue car colors, and identifying the gender of pedestrians at traffic signals.
- Impact: Improved traffic monitoring and management, enhanced road safety, and potential applications in smart city infrastructure.

9. Conclusion: This project successfully developed a machine learning model to predict car colors, count cars, and determine pedestrian genders at traffic signals. The model incorporates a specific rule to swap red and blue car colors, showcasing its versatility and adaptability. The project highlights the importance of robust data preprocessing, model training, and iterative refinement in developing effective computer vision applications.