Title: Car Red Light Running Detection using YOLOv5s

Introduction In this project, we aim to develop a car target detection model based on the YOLOv5s architecture to improve the accuracy of car red light running detection in traffic environments. The model will identify vehicles violating traffic rules, potentially preventing accidents and improving overall traffic safety. The evaluation indicators for this project are mAP (Mean Average Precision) and F1-score, which is the harmonic average of precision and recall rates.

Dataset To train the model, we will use a dataset containing labeled images and videos of cars in various traffic environments, including those running red lights. The dataset should include a diverse range of scenarios, such as different lighting conditions, weather, and vehicle behavior, to ensure the model's robustness.

Model Architecture and Key Algorithms We will use the YOLOv5s (You Only Look Once, version 5 small) architecture as the base for our car target detection model. YOLOv5s is a real-time object detection model that is known for its speed and accuracy.

Key algorithms and components of the YOLOv5s architecture include:

a. CSPNet: Cross Stage Partial Network is the backbone of YOLOv5, which helps improve gradient flow and model performance by connecting partial feature maps from consecutive stages.

b. SPP: Spatial Pyramid Pooling module captures multi-scale features by applying different pooling scales to the feature map, which enhances the model's ability to detect objects at various scales.

c. PANet: Path Aggregation Network helps in aggregating the feature maps from different layers of the model, improving information flow and detection performance.

d. Leaky ReLU: The activation function used in the model to introduce non-linearity, which helps the model to learn complex patterns in the data.

Training and Evaluation We will split our dataset into training, validation, and testing sets to train and evaluate the model. After training the model, we will assess its performance using mAP and F1-score. We will fine-tune the model by adjusting hyperparameters, augmenting the dataset, and employing techniques such as transfer learning to achieve higher accuracy in detecting cars running red lights.

Conclusion This document presents an overview of our approach to develop a car target detection model based on the YOLOv5s architecture to accurately identify vehicles running red lights in traffic environments. By evaluating the model using mAP and F1-score, we aim to optimize its performance, leading to improved traffic safety and a reduction in accidents involving vehicles violating traffic rules.