Problem Statement

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Title: Vehicle Cut-In Detection Using Machine Learning

Objective:

To develop a real-time system for detecting potential vehicle collisions, specifically cut-in scenarios, using machine learning and computer vision techniques. The system aims to enhance road safety by providing early warnings to drivers, thus preventing accidents and improving overall traffic management.

Unique Idea Brief (Solution)

Develop a machine learning-based system utilizing a pre-trained SSD Mobile Net model for object detection, capable of identifying vehicles in video streams. The system will calculate the distance between vehicles and provide visual warnings when the proximity is too close, thereby alerting the driver of potential collisions. This solution will leverage the latest advancements in computer vision and deep learning to offer a robust and scalable vehicle cut-in detection system.

Features Offered

 Real-Time Vehicle Detection:

* Utilizes advanced object detection algorithms to identify vehicles in real-time from video streams.
* Capable of handling various environmental conditions such as different lighting, weather, and traffic scenarios.

 Accurate Distance Measurement:

* Calculates the distance between the detected vehicles and the target vehicle with high precision.
* Ensures reliable measurements even at different speeds and in dynamic traffic situations.

 Collision Warning System:

* Generates visual warnings on the video feed when a vehicle gets too close, indicating a potential collision.
* Helps drivers take proactive measures to avoid accidents by providing timely alerts.

 Integration with Pre-Trained Models:

* Leverages the SSD MobileNet model, a state-of-the-art pre-trained model for efficient and accurate vehicle detection.
* Reduces the need for extensive training data and accelerates the development process.

 Scalability and Flexibility:

* Designed to be scalable, allowing integration into various vehicle systems and adaptable to different vehicle types.
* Can be customized and extended to include additional features as needed.

Processflow

 Data Collection:

* Collect video footage from various sources such as traffic cameras, dashcams, or simulation environments.
* Annotate the collected video frames to create labeled datasets for training and testing the model.

 Data Preprocessing:

* Convert the annotated video frames into a suitable format for training the machine learning model.
* Generate TFRecord files from the annotated data to streamline the training process.

 Model Selection and Configuration:

* Choose a pre-trained object detection model (e.g., SSD MobileNet) from TensorFlow’s Model Zoo.
* Configure the model’s hyperparameters and the pipeline configuration file to suit the project’s requirements.

 Training the Model:

* Set up the training environment and dependencies using Python and TensorFlow.
* Train the model using the generated TFRecord files and the configured pipeline.
* Monitor the training process and adjust parameters as needed to improve model performance.

 Model Evaluation:

* Evaluate the trained model using a separate set of test data to assess its accuracy and performance.
* Fine-tune the model based on evaluation results to optimize detection accuracy and reduce false positives.
* Technologies used
* -> Numpy - Numerical operations and handling arrays
* -> Urllib - Used for downloading the pretrained model
* -> TensorFlow - Used for building and running the machine learning model
* -> Pillow - Used for image processing
* -> Grabscreen - Custom module for screen capturing
* -> OpenCV - Used for real time computer vision and video processing
* -> Object detection Utilities - Specific utilities for object detection from the TensorFlow Object Detection API.

Conclusion

The Vehicle Cut-In Detection project successfully integrates advanced machine learning techniques and computer vision to enhance road safety by providing real-time alerts for potential vehicle collisions. By leveraging the power of TensorFlow, OpenCV, and a pre-trained SSD MobileNet V1 model, the system can accurately detect vehicles in a given video stream and calculate the distance between them. This allows for timely warnings if a vehicle cuts in too closely, potentially preventing accidents and improving driver awareness.