Cloud-Connect Report

Overview

We propose a dual-model approach for environment perception, combining a computer vision model for road sign detection with a Haar cascade classifier for pedestrian detection. The road sign detection module will extract the target speed, which will be communicated to the Functional Mock-up Unit (FMU). The FMU will then use this information to determine the appropriate control actions for the ego vehicle.

System components

Computer vision model Yolo 5

In this project, we utilized the YOLOv5 (You Only Look Once version 5) model as our machine learning engine for road sign detection. YOLOv5 was selected due to its balance between speed and accuracy, making it well-suited for real-time object detection tasks in autonomous driving scenarios. The model was trained on a dataset of road signs to accurately identify and classify various sign types encountered in typical driving environments. Its lightweight architecture enabled efficient integration into our perception pipeline, ensuring quick inference times without compromising detection reliability.

The model has 7M parameters and has less than 0.15s prediction time on CPU.

Haar Cascades

For human face detection, we employed the Haar cascade classifier, a machine learning-based approach commonly used for real-time object detection. Haar cascades operate by scanning the input image at multiple scales and positions using a series of simple rectangular features, which are evaluated quickly using integral images. We used a pre-trained Haar cascade model specifically designed for frontal face detection. This method was chosen for its efficiency and low computational overhead, making it ideal for real-time applications where fast and reliable face detection is required, such as in driver monitoring or pedestrian identification systems.

OCR

As an added safety measure, Optical Character Recognition (OCR) is employed to perform a secondary scan of the image, specifically targeting the detection of text such as “STOP” and speed limit indicators. This serves as a verification step to enhance the reliability of

road sign recognition. OCR is also used to extract the numerical speed limit values from signs that have already been detected by the primary model. To optimize performance and reduce computational load, OCR operates on significantly smaller bounding boxes focused on the detected sign regions.

Azure Database

The system also logs events to a database hosted on Azure, recording the timestamp, event type, and associated sensor data. This stored information can be used later for analysis, helping to evaluate system performance, identify patterns, and support future improvements.