SELF-DRIVING SIMULATION WITH COMPUTER VISION AND CARLA

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CARLA SIMULATOR

- An open-source simulator for autonomous driving
- Developed to support training and validation of the autonomous driving system.
- Provides different environmental conditions such as light, fog and etc…

WEATHER CONDITIONS

VEHICLE IN CARLA

Camera

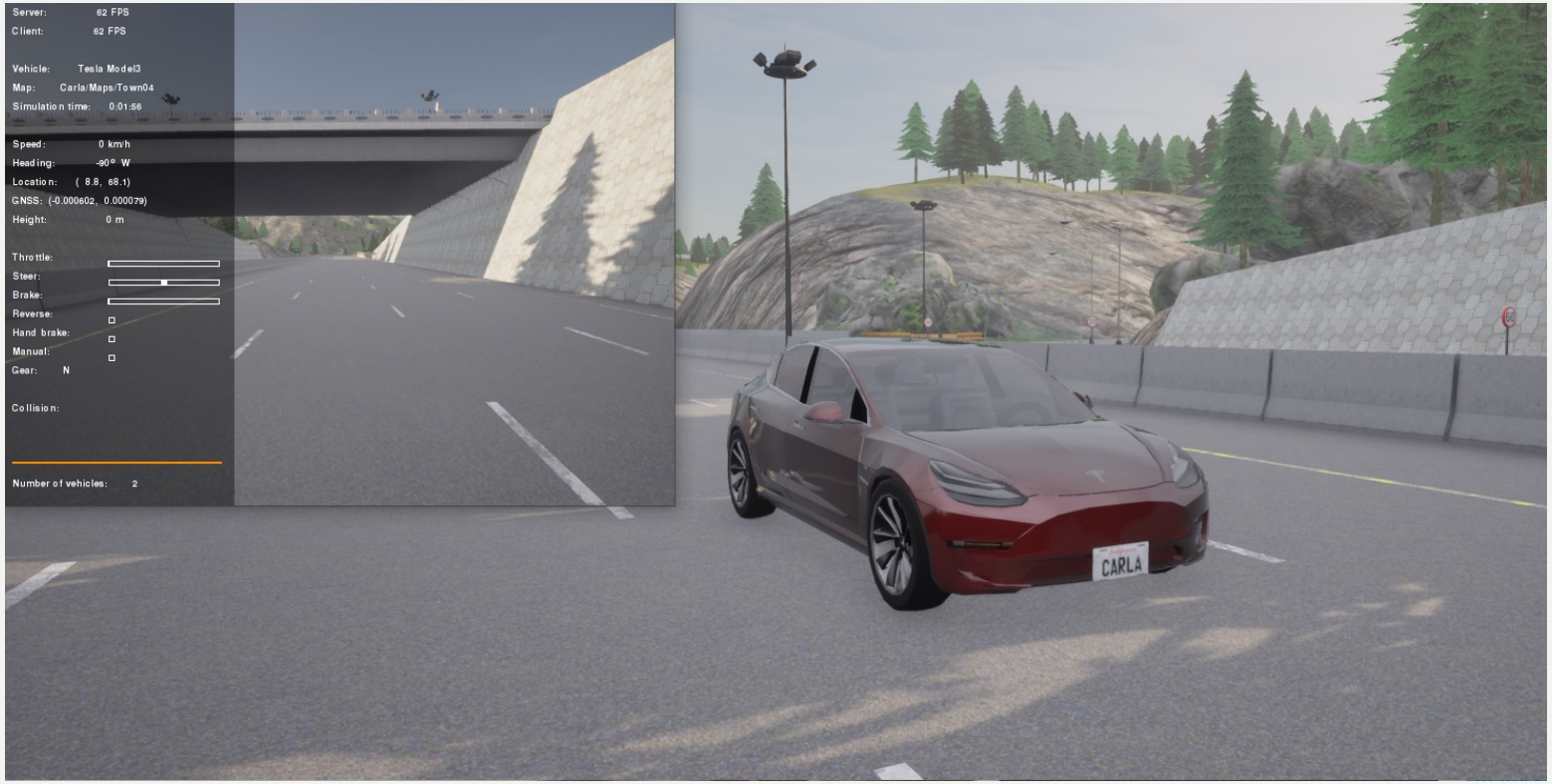
- Free of position
- Multiple cameras can be activated

Control

- Throttle
- Steer
- Brake

Sensors

- Collisions (lanes, and objects)
- Ground truth (traffic signs and lights)



PERSPECTIVE

DASHCAM PERSPECTIVE

METHODS FOR SELF-DRIVING VEHICLES IN THE MARKET

TESLA FOCUSES ON COMPUTER VISION-BASED AI

MERCEDES-BENZ AND HONDA ARE EQUIPPED WITH SCALA LIDAR

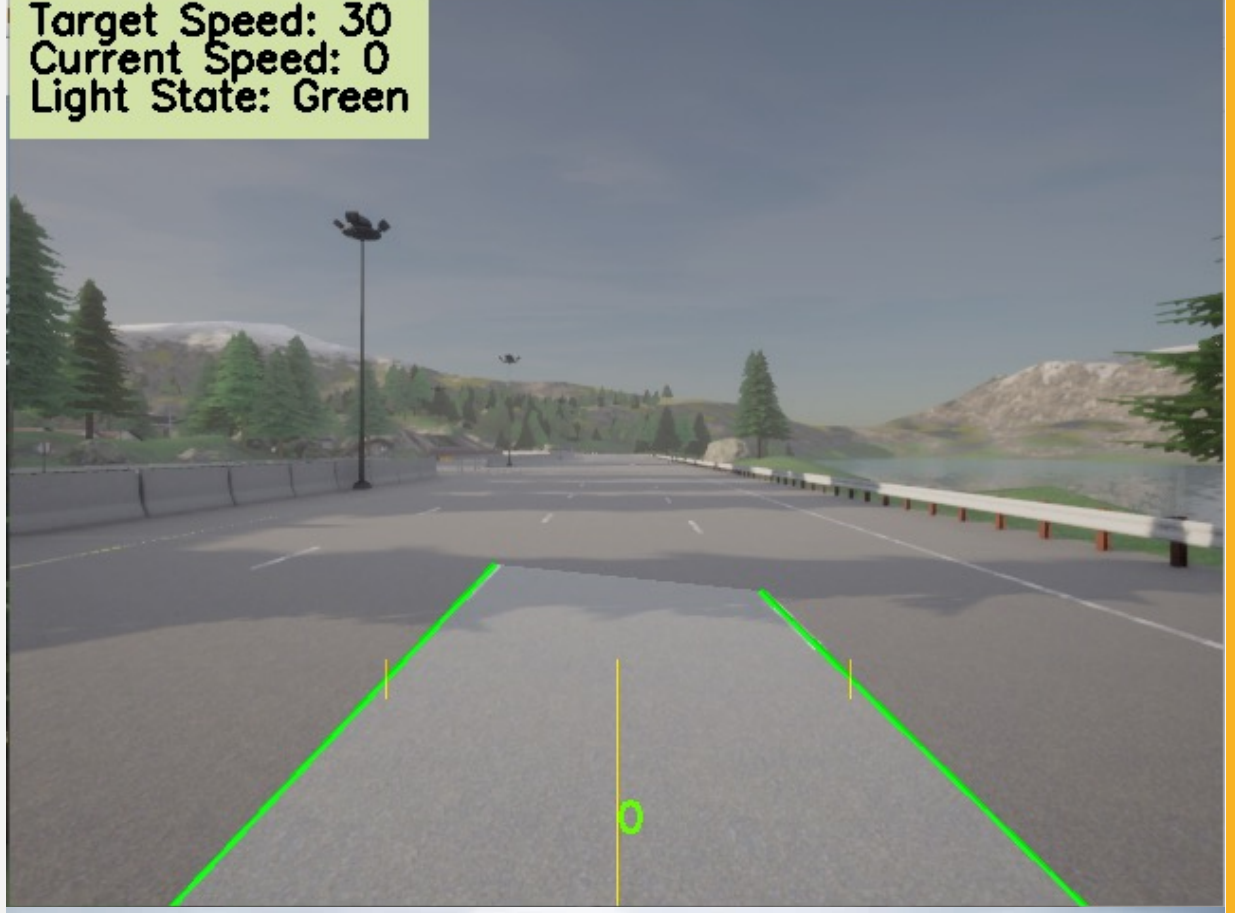
GOAL OF THIS RESEARCH

Achieve autonomous driving through Carla simulation and computer vision

- Object detection & classification using YOLO v5
- Vehicle Control
- Routing

LANE DETECTION

- Detect the lane using Hough line detection.
- Compare the center point of the vehicle to the center point of the lane detected then steer as needed



YOLO V5

YOU ONLY LOOK ONCE

- Ultralytic's open-source AI-based computer vision model
- It is capable of achieving state-of-the-art results for object detection tasks
- Implemented via Open-cv Python

YOLO TRAIN DATASETS

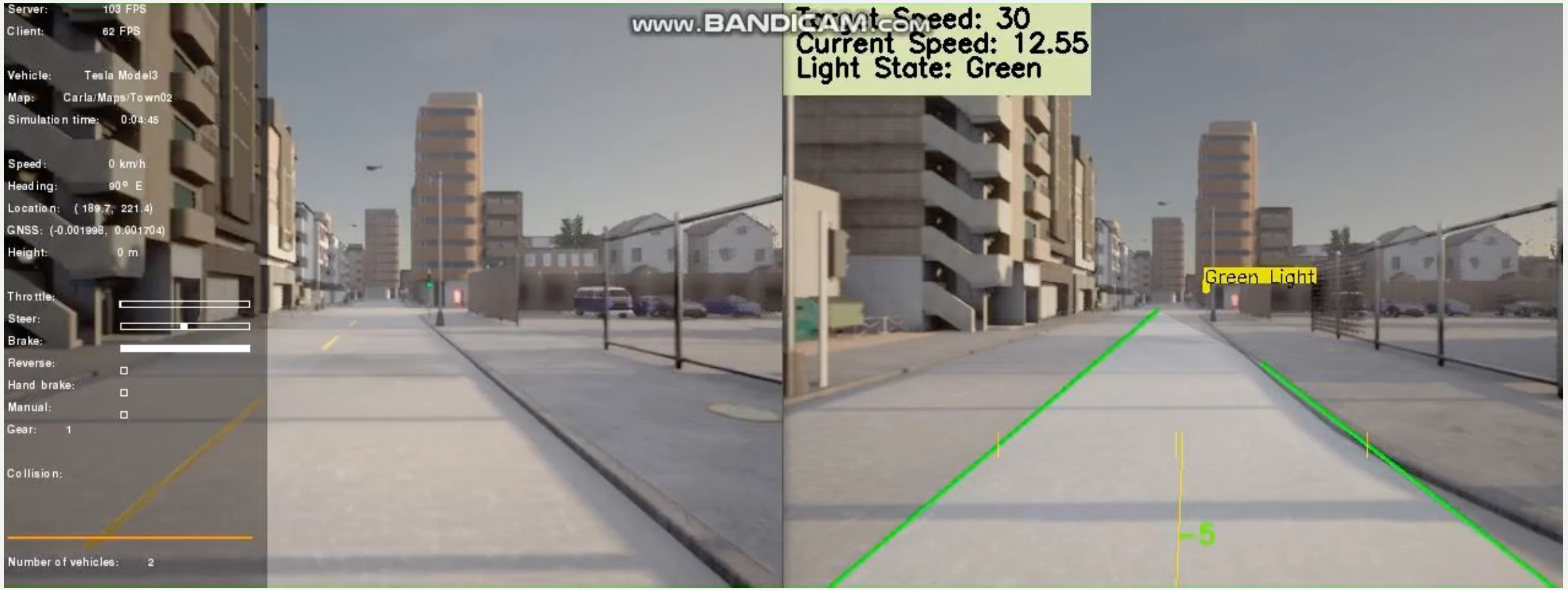
1.6K TRAINING IMAGES

YOLO V5S, 32 BATCHES, 120 EPOCHS

9 CLASSES

- Red light
- Yellow light
- Green light
- 30 Speed sign
- 60 Speed sign
- 90 Speed sign
- Human
- Bicycle
- Vehicle

INDICATORS AND DETECTION

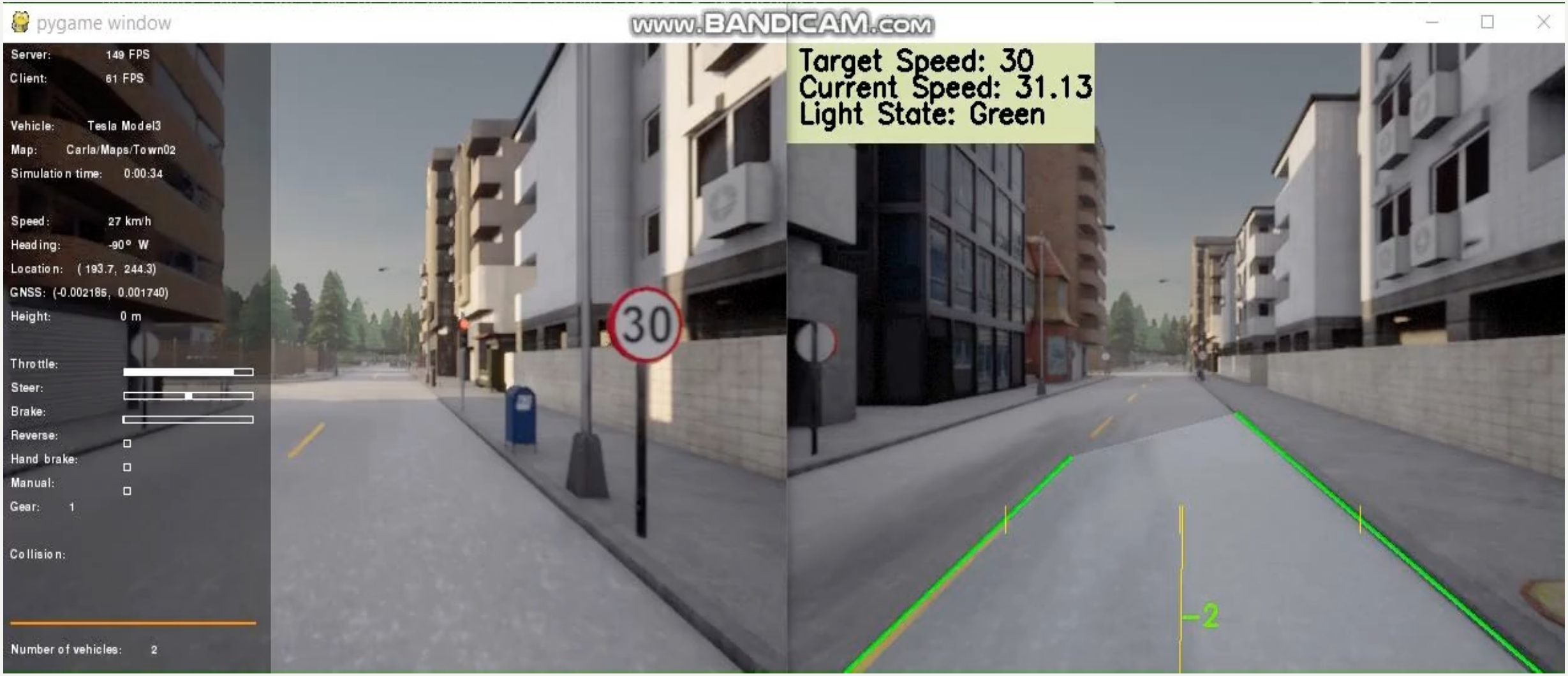


TRAFFIC LIGHT

SLOWING DOWN ONCE RED IS DETECTED

TRAFFIC LIGHT II

ACCELERATING ONCE GREEN IS DETECTED

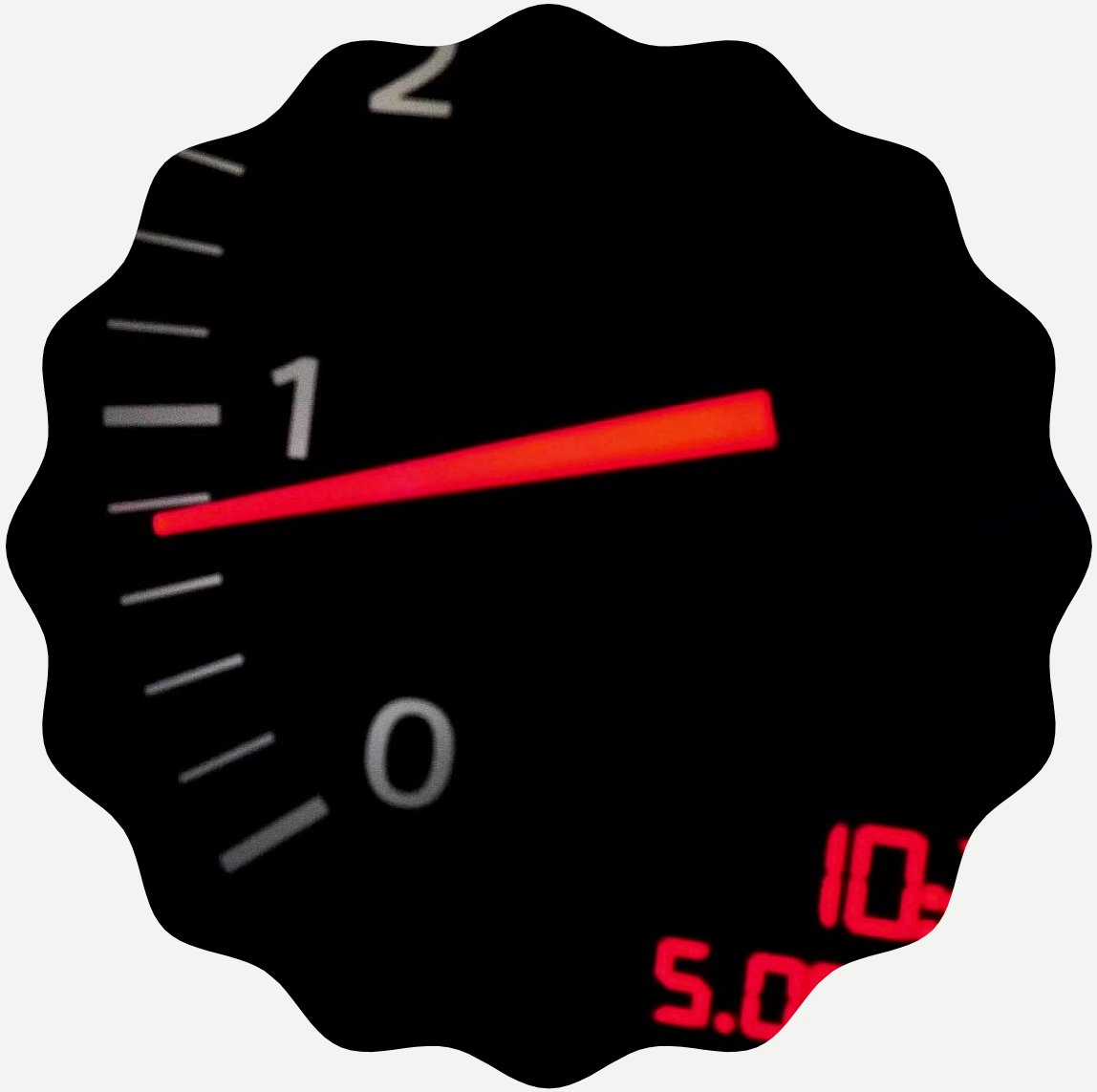


SPEED SIGN DETECTION

CHANGES TARGET SPEED ONCE DETECTED

VEHICLE CONTROL

- Closed-loop control
  - Simulation of real-time operation
- Based on lane detection and object detection, issue vehicle control signals
- Adjust its speed according to the speed limit
- The controller tries to match the center point of the dashcam and the center point of the lane
- Provide sharper steer if the distance of the two center points is greater over a threshold
- The vehicle matches the target speed and provide needed throttle



VEHICLE CONTROL

MAKE ADJUSTMENT TO ITS THROTTLE

RESULT

Accuracy was tested

- Under four conditions (light and fog implemented)
- Each with 158 images
- From destination A to B in Town 02

Clear Sunset

- 132 / 158 (83.5%)

Clear Evening

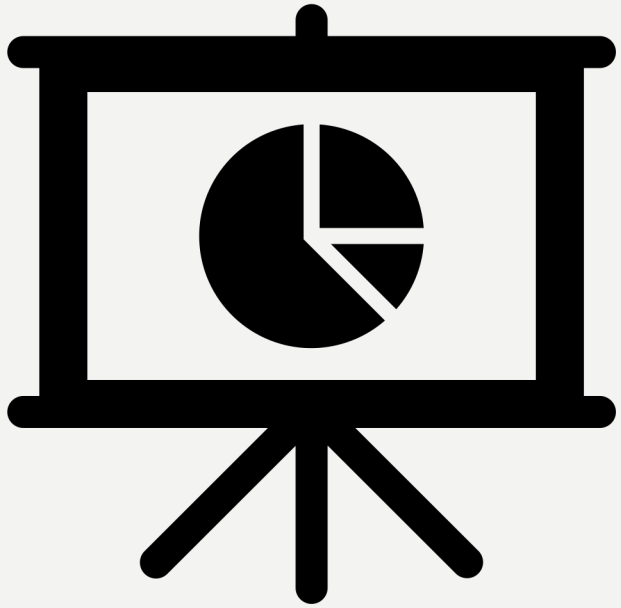
- 130 / 158 (82.2%)

Foggy Sunset

- 128 / 158 (81%)

Foggy Evening

- 124 / 158 (78.5%)



FUTURE WORK

1. Making decision when multiple objects are detected
2. Routing system for interactions with no lanes
3. Evaluate how well comfort, travel time, and safety
4. Implement multiple cameras to create a 3D Map of my surroundings

SOURCES

https://carla.readthedocs.io/en/latest/

https://carla.readthedocs.io/en/stable/carla_settings/

https://github.com/ultralytics/yolov5

https://universe.roboflow.com/alec-hantson-student-howest-be/carla-izloa

http://scipy-lectures.org/packages/scikit-image/

QUESTIONS