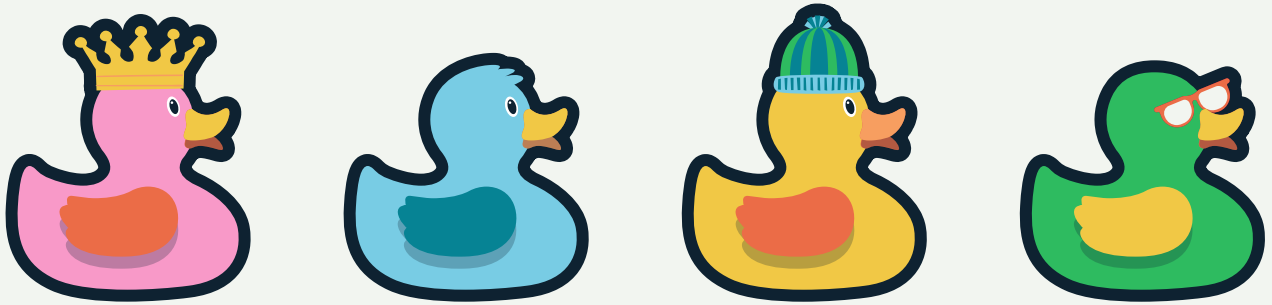

DuckieBot Follower

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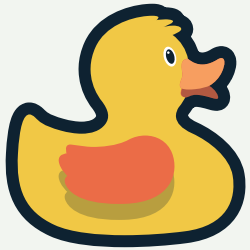
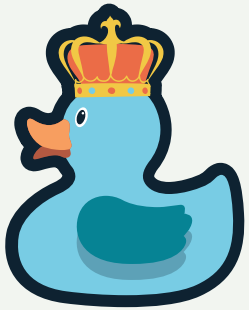
Project description



Lane Following

Use standard CV algorithms to move along the road lane



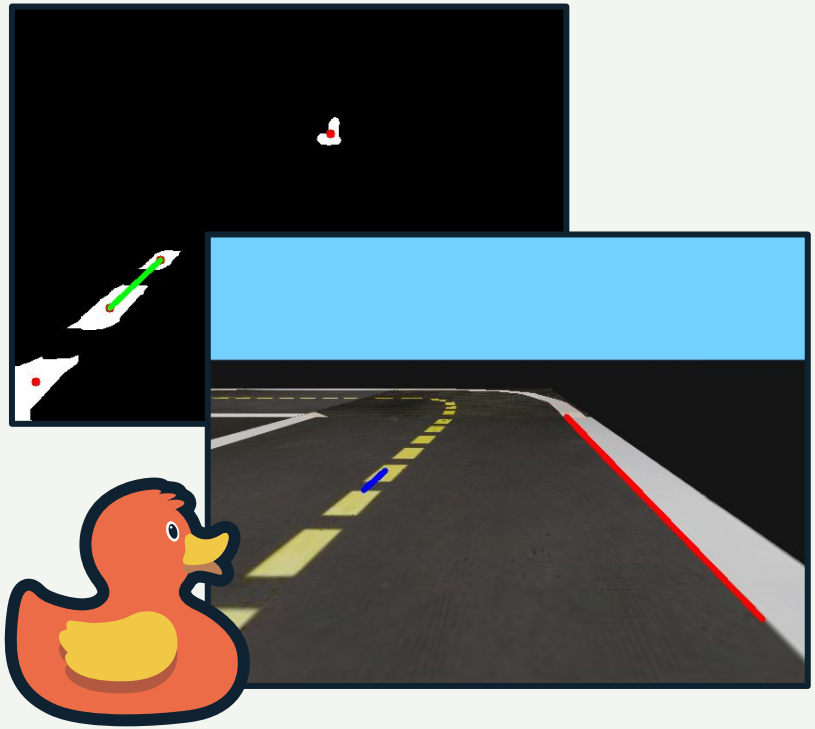
ArUco

Use ArUco markers to find the guidebot's distance and orientation

Object Detection

Train and use a object detection DNN model to retrieve the guidebot's pose

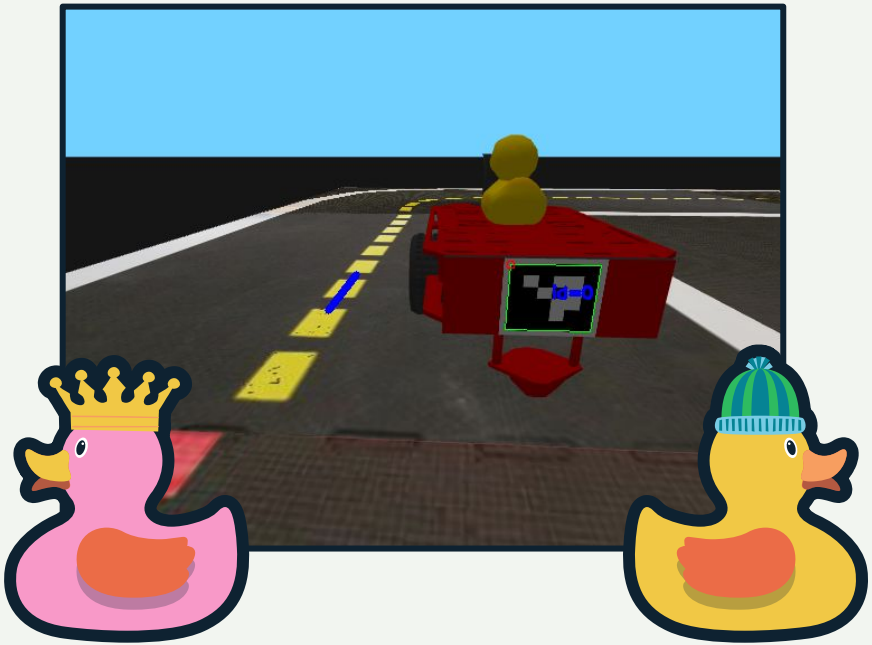
Lane following



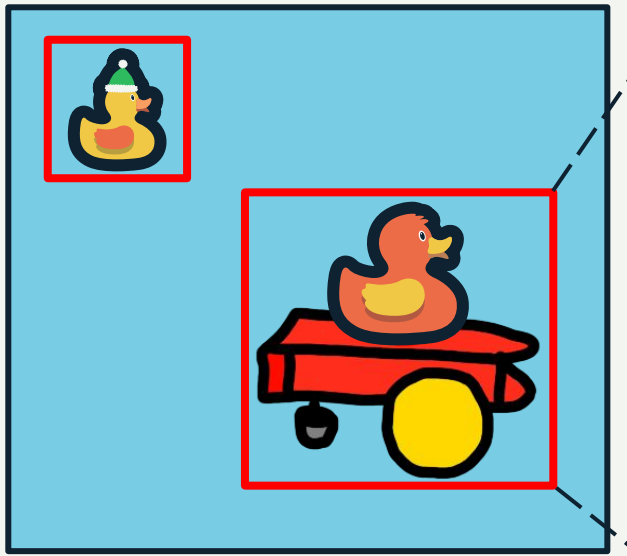
- Tracks the yellow, white and red lane markings.
- Uses OpenCV algorithms for line detection: color masks, erosion/dilation, *Hough* transform.
- Computes a yellow line interpolation.
- Determines the line angles and adjusts speed accordingly.
- Uses event driven movement and simple loops for intersection paths.

ArUco Marker Detection

- OpenCV ArUco module.
- 4×4 marker.
- Corner detection used to retrieve:
  - Rotation (rvecs).
  - Translation (tvecs).
- Vectors used to estimate guide's pose:
  - Distance.
  - Relative Angle.



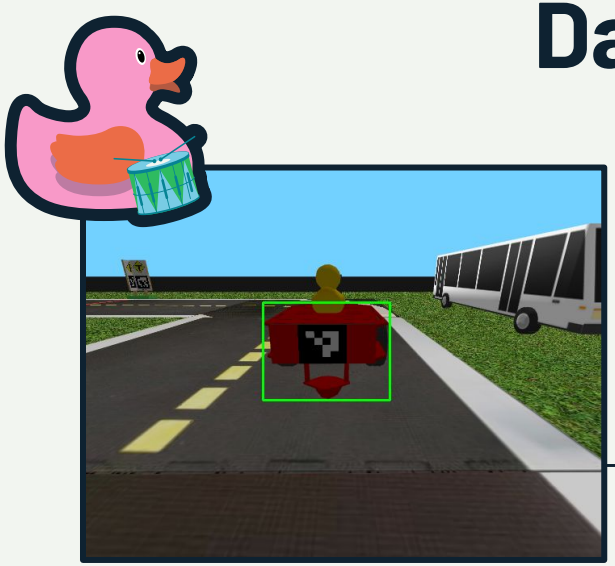
Object Detection



Each prediction contains 17 output values:

- Objectness (1)
- Bounding Box Regression (4, xywh)
- Class Classification (2, Duckiebot or Duckie)
- Distance Ordinal Regression (5, VC/C/M/F/VF)
- Rotation Ordinal Regression (5, VL/L/M/R/VR)

Dataset Collection



Label:

Class:	1
BB:	220 164 157 121
Rel. Position:	0.3533 0.0 -0.0133
Rel Orient.:	-0.00552

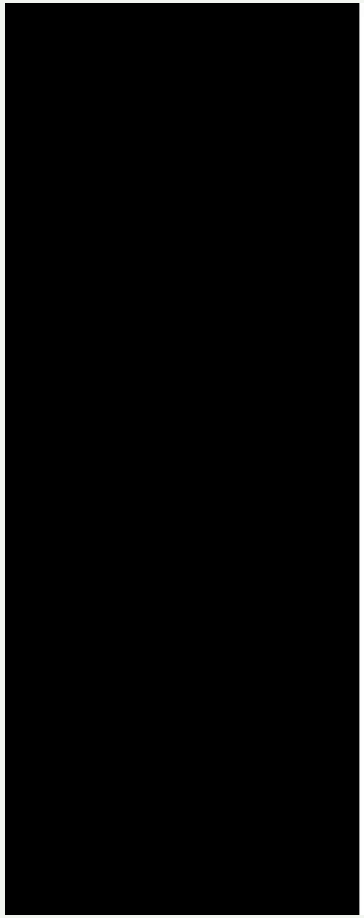
Methodology — Capture screenshots throughout various simulations.

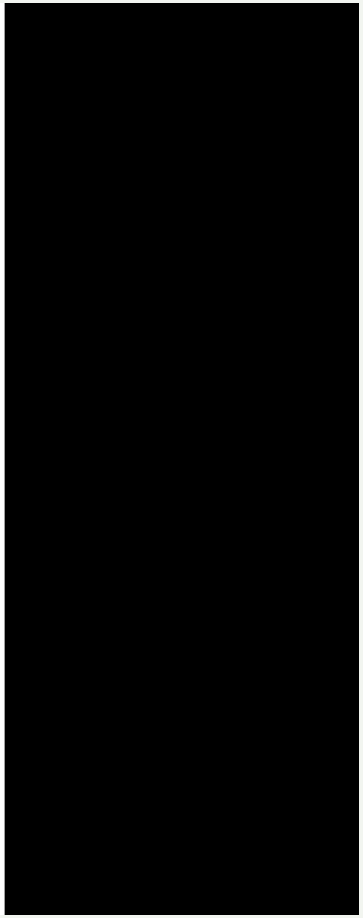
Labels — Class, Bounding Box, Relative Position, Relative Orientation

Bounding Box — CV is used to get an approximation of the BB

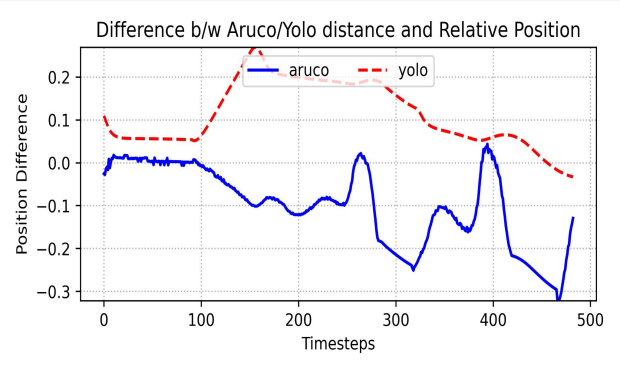
Diversity — 965 samples across 6 distinct maps.

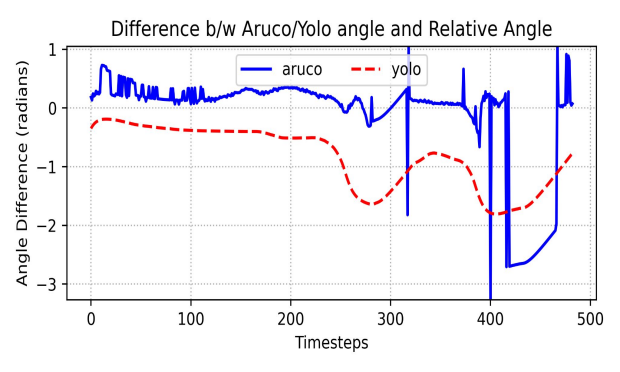
Video





Results





- The lane following implementation is a limitation, tending towards becoming unstable due to accumulating errors over longer runs.
- ArUco detection offers better results upon starting the simulation, but decays over time.
- The camera view has limited visibility in sharp turns, which hinders the ability to detect the guide robot.

Conclusions and Future Work

Lane Following

Implement a RL or PID-based controller for movement

Dataset

Gather new screenshots from the simulation

Object Detection

Use other approaches to train the models

Thank you!