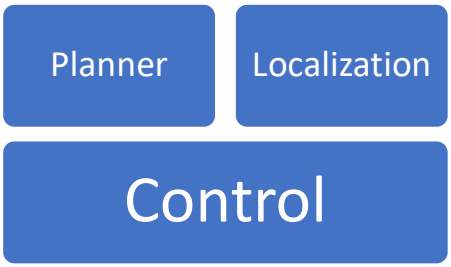
CS4278 Project Report

The approach can be broken down into the Planner, Localization and Control modules.



The Planner takes in the map image, converts it into a readable map, to search for the best action using A* search. This action is retrieved using its current tile and the goal, and at the same time the next tile can also be determined.

The Localization module uses the observed image to determine the pose of the robot. It processes the visual input, determines the position with respect to the lane.

The Control module makes use of the localized pose of the robot, together with the planner, to determine the next action to be taken.

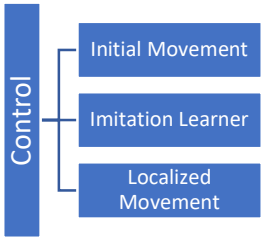
Processing Visual Input

The image processing module for localization carries out the following operations:

2 color filters (white and yellow) and cropping were used to remove non-relevant off-road objects that may lead to false positives and a gaussian blur is used to remove any noise on the image.

The 2d line segments in the image plane are converted to 2D coordinates in the 3D plane without elevation using homography. This allows the calculation of the position and orientation with respect to the lane. The angular displacement from any lane is equivalent to angular displacement of duckiebot and the distance from a lane can be used to calculate its lateral displacement from the center of the right lane.

Controls Vehicle



The Controller can be broken down to several sub-modules, including initial movement, imitation learner, and localized movement modules. The straight road Imitation Learner consists of an Imitation Learner neural network trained on driving on straight roads, and is used whenever the vehicle is going

straight. The original code for the imitation learner using iil-dagger is given in the original project repo, and adapted for our use.

The localized movement module makes use of the localized orientation and position of the vehicle from the Localization module and with the next tile from the Planner module. It can calculate the optimal orientation, compare it with the current orientation, and produce an action to adjust itself.

The initial movement module simply rotates until the Localization module informs that it is parallel to the lane. It then follows the lane until a tile change, whereby either the imitation learner or localized movement module will take over.

Essentially, if the Imitation Learner takes control when the road is straight and the next tile is not a junction, otherwise it will rely on the localized movement module.

Global Navigate

A* Search is used to globally navigate the maps. The Planner module can be broken down into 2 sub-modules, which the MapGrid and the Search. MapGrid takes in the map image, and converts it into a readable map for the search algorithm to go through. A state for the algorithm is a tile with one of the four orientations. The output of the Search will then be the optimal action to take given the state. The Search is implemented as an online algorithm.

As mentioned above, the Controller makes use of the Planner and Localization, to determine where the robot should head towards. The information from the planner allows the calculation of the next tile, and thus combining this with localized pose, it can be determined which way the vehicle should go.