Autonomous Subsystems

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Annual Report

Heads

Viswonathan Manoranjan
Sneha Rao Ganta

Overview

The autonomous subsystem team is currently focused on building solutions and algorithms to implement an autonomous mini-vehicle by the end of next year. Starting off with simple projects, we have moved on to complex solutions that are instrumental in building our first-ever EV. The team consists of 4 members currently, as the current requirements are being fulfilled adequately. After the inductions, we jumped to a 2-month learning program where the inductees familiarised themselves with machine learning concepts and computer vision. They carried out mini-projects to implement their learnings, following which they were assigned to larger-scale projects.

Completed Projects

I. *Monocular Depth Estimation*

Project Duration - 3 months

Project Details

The problem of determining the depth value (distance relative to the camera) of each pixel given a single (monocular) RGB image is known as monocular depth estimation. This challenging endeavour is a necessary step in establishing scene knowledge for applications like 3D scene reconstruction, autonomous driving, and augmented reality. Modern approaches often fall into two categories: building a sophisticated network with enough power to regress the depth map directly or separating the input into bins or windows to reduce computational complexity. We use the initial method and build a sophisticated model that uses the KITTI dataset for training.
We develop and implement models for Spatio-temporal monocular depth estimation in real-time using CLSTMs, GANs, 3DCNNs, data generators, and encoder-decoder networks.

II. *Lane Tracking Algorithm*

Project Duration - 1 month

Project Details

While self-driving cars use a variety of technologies (deep learning, cloud computing, and robotics, to name a few) that are powered by data from a variety of sensors, one of the comparatively more straightforward tasks is for the car to recognise lane lines on the road to stay inside its lane while driving. This project uses Python and Computer Vision techniques to construct a lane line identification algorithm based on Probabilistic Hough Transform for lanes detection and Kalman filter for tracking implemented with Python and OpenCV on photos and videos.

III. *Motion Planning A* Algorithm*

Project Duration - 3 months

Project Details

Motion planning, often known as the navigation problem or the piano mover's issue, is a computational problem that seeks a sequence of valid configurations that transports an object from source to destination. Computational geometry, computer animation, robotics, and computer games all utilise the phrase.
Consider guiding a mobile robot inside a structure to a distant waypoint. It must complete this mission while avoiding walls and avoiding falling downstairs. A motion planning algorithm would take these tasks as input and generate the speed and turning commands that would be issued to the robot's wheels. Motion planning methods may be used for robots with more joints, more complex jobs, different limitations, and uncertainty (e.g. imperfect environment or robot).
We used the hybrid A* search algorithm and implemented the following paper by Stanford to find the minimum cost solution.

Projects in progress

I. *Motion Prediction Algorithm*

Predicting the behaviour of traffic agents around an autonomous vehicle (AV) is one of the vital unsolved challenges in reaching full self-driving autonomy. We are currently researching and implementing different motion prediction algorithms on the LEVEL 5 OPEN DATA Prediction Dataset.

Future Plans

The plans, for now, are aligned towards developing all the necessary algorithms required to manoeuvre a miniature autonomous vehicle. We also aim to induct a few more sophomore students to work on simultaneous projects and contribute towards reaching the goal sooner. We also plan on implementing the algorithms on Carla and using deep reinforcement techniques to develop algorithms.