NXP AIM Challenge

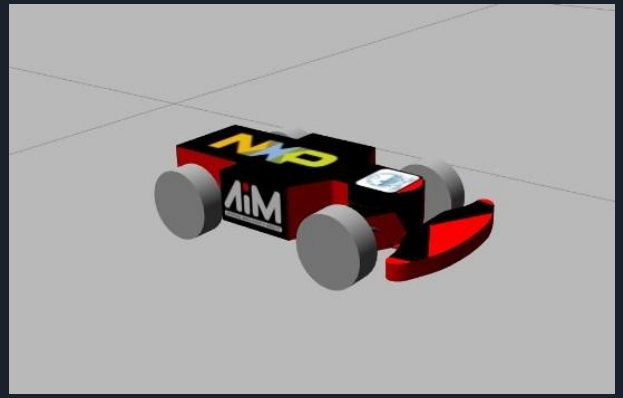
Vellore Institute of Technology
Team LEGO

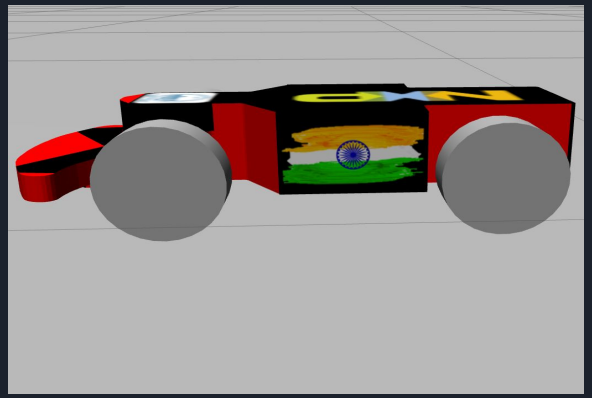
Shobhit Tulshain - Electrical and Electronics (6th Sem)
Worked on AI and Deep Learning part of the project.

Keval D Rana - Electrical and Electronics (6th Sem)
Worked on ROS and integration.

Arnav Kalia - Mechanical (6th Sem)
Worked on Design of the car.

Car Model





System HW, Interface and Sensor Details

Sensor used:

- Pixy Camera
- We adjusted the camera orientation to get a better view of the road and its obstacles/ signs.

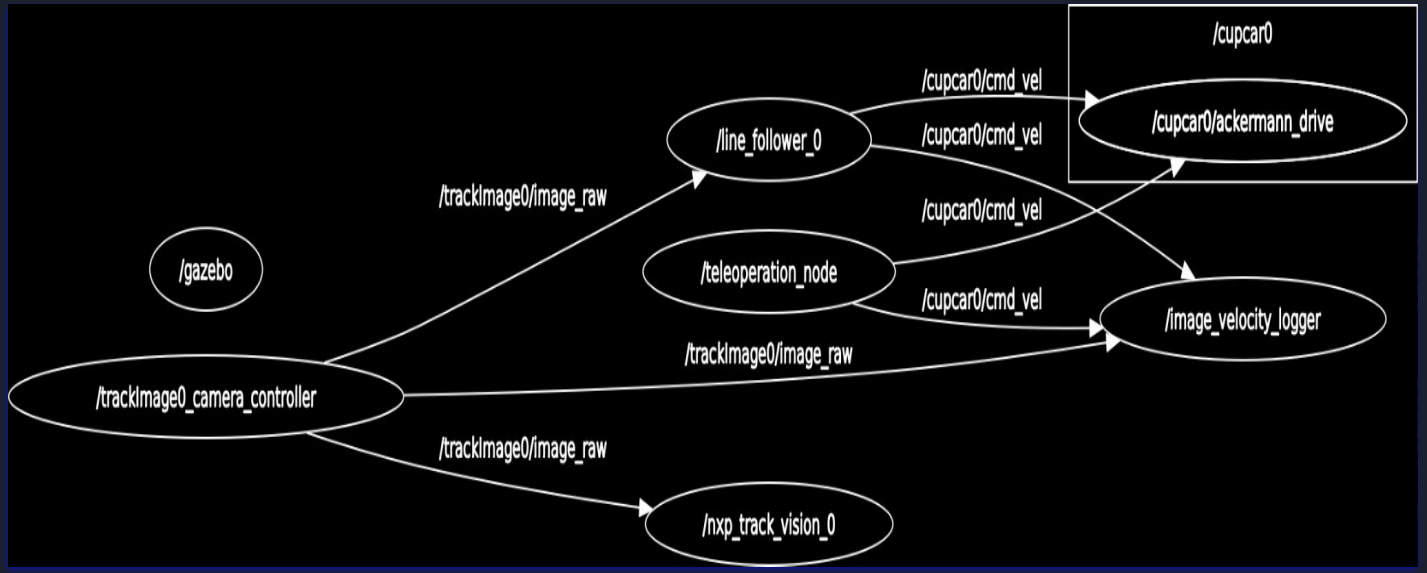
Interface:

- ROS topics for communicating between the different nodes(Publisher/ Subscriber model).

System Hardware:

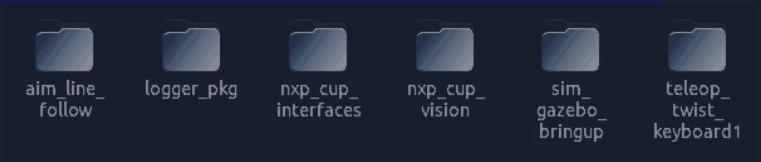
- We opted for a CNN based model that learns from dash images, steer & linear speeds.
- This requires a power processor -more so in an actual real world scenario, where the data collection is more prone to noises and variations.
- The high level commands which is the acceleration and the steering values are obtained directly from the deep learning model that we have built.

SW Architecture and Block Diagram



2 Nodes created for collecting dataset:

- Image-velocity logger
- Teleoperation



AI / ML Implementation

Two aspects of AI/ML implementations:

1. Behavioural Cloning

   This is a Convolutional Neural Network (CNN) approach where the target model in our case the car, imitates the driving actions of the actual human. The dataset is generated based on how the user would drive which is then fed into the model and it outputs the high level commands which is the throttle and the steering values with very high level of accuracy. The major advantage is that it has the ability to improve itself over time and can replicate the driving actions of anyone..

1. Traffic sign detection

   This is also a CNN based approach where the traffic signs are located and then classified based on which the actions are performed simultaneously.

Coding

The coding structure and procedure that we have followed is very modular and computationally very efficient to reduce the load on the host system. It is also designed in such a way that it can run on varying system specifications and will not be affected by any system FPS with proper debugging and time constraints.

There are two deep learning models used in this project as stated in the previous slides. Both these models make use of deep convolutional neural network architecture having a number of layers to extract meaning out of the images. ROS has been used to integrate the software and hardware aspect of the project.

The behavioural cloning method used in our project takes this project to another level of efficiency and eliminates the need of the traditional environment mapping techniques like the 3D point cloud mapping and through this method we have tried to come up with an data-driven end-to-end driving solution.

Our Journey

The entire duration of the competition was an amazing experience working on a quality project that deals with a problem statement which a number of organizations in the world are dealing. A number of brainstorming sessions among the team members, various debugging and testing, failures and again modifying the project to come up with a working model is really an achievement for us and with a positive mindset, we are happy to make it till the end of this competition

Conclusion: To finish on a good note

We learnt:
- ROS2 framework: was in the bucket list for quite some time.
- Using blender and new file types for 3D models.
- Developing Deep learning based solutions for real time simulations.

We thank:
- the NXP-AIM management for the thorough design of the competition, and the initiative to bridge the industry-academia gap.
- each other for putting with each other :)

We plan to keep building up on the project to make something useful out of it with relevance to the real world.