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Self-Driving Toy Car Using Deep Learning

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Abstract

Our research focuses on building a student affordable platform for scale model self-driving cars. The goal of this project is to explore current developments of Open Source hardware and software to build a low-cost platform consisting of the car chassis/framework, sensors, and software for the autopilot. Our research will allow other students with low budget to enter into the world of Deep Learning, self-driving cars, and autonomous cars racing competitions.

Introduction

Self-driving car technology is one of the hottest areas of research and business. In the last few years, we have seen an enormous evolution in this area with autonomous cars from Uber, Tesla, Waymo. Artificial Intelligence, in particular Machine Learning and Deep Learning, has contributed to developing the latest generation of algorithms for the essential elements in the self-driving pipeline *Localization*, *Perception*, *Prediction*, *Planning*, and *Control*. Moreover, in recent years, an evolving sport of racing autonomous, electrically powered vehicles has emerged. These type of racing competitions such as **Roborace** are exciting and lucrative attractions that also worked as platforms for research and development for tech companies.
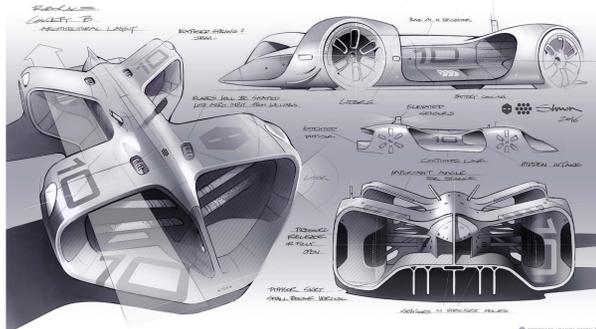
Background

Roborace's expensive high tech vehicles are out of reach for an average student. The alternatives are Amazon Deepracer & Donkeycar; a 1/18th and 1/10th scale model autonomous racing cars. These platforms provide developers with the opportunity to explore advanced AI techniques used on real self-driving cars. However, the cost of the hardware goes from $300 to $400. Our goal is to make cheaper and novice friendly version to make the process more streamlined for new users of donkeycar.

Materials & Method

To build the self driving car we used the following:

Hardware:
- Raspberry Pi 3B+ / NVIDIA Jetson Nano
- Raspberry Pi Camera V.2
- PCA 9685 Servo
- 3D printed hat & chassis
- 4 channel ESP
- NiMh 7.4V battery
- DC 5V battery

Software:
- Donkey Pi
- Donkey auto pilot.
- Tensorflow and Keras to train

Results

- Our model is capable of taking commands through local host.
- After the first run, the successful autopilot rate is 68%- 96%.
- While in autopilot mode, it can capture video at 30 frames per second @720p.

Conclusions

Our hardware and motor modifications already cut the cost to half of an actual donkey car. We are exploring JetBot as well, which is made by NVIDIA. Our goal is to make an understandable & simple version of self driving CityTech Race Car with a lower cost.

Future Work

- Voice control will be added
- Advanced hardware modification to achieve at least 40 mph speed.
- 3D printed body & upgraded chassis to maintain light weight.
- New simple software for training AutoPilot.
- CityTech Race Car and CityTech Race League

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References

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- https://en.wikipedia.org/wiki/Autonomous_racing
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- http://f1tenth.org/build.html
- https://aws.amazon.com/deepracer/

Donkey

Control Mode | Max Throttle | Throttle Mode
Joystick | Gamepad | Device Tilt | Select Max Throttle ▼ | User ▼

Angle & Throttle

Mode & Pilot
Select Mode ▼
Start Recording (r)

Click/touch to use joystic.