RUTGERS
WINLAB | Wireless Information Network Laboratory

Autonomous System Infrastructure

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SCAN ME

INTRODUCTION

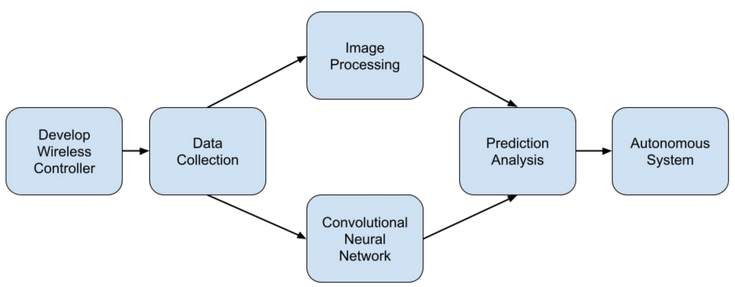
Inventors have been working on self-driving cars since the 1920s, starting with Francis Houdina's radio controlled car in 1925. Since then, major advancements have been made in self-driving, including discovering AI technology and neural networks. Today, many cars contain autonomous features like lane-assist, cruise control, and self-parking. Companies like Google and Tesla continue to work on creating highly advanced autonomous vehicles so that one day cars will not need to have any manual controls, such as steering wheels and gas pedals.

OVERVIEW

Purpose

To develop a server-client infrastructure to allow for remote control of autonomous robots in the WINLAB Orbit smart city environment, modeled after 120th and Amsterdam Ave in NYC.

High Level Design



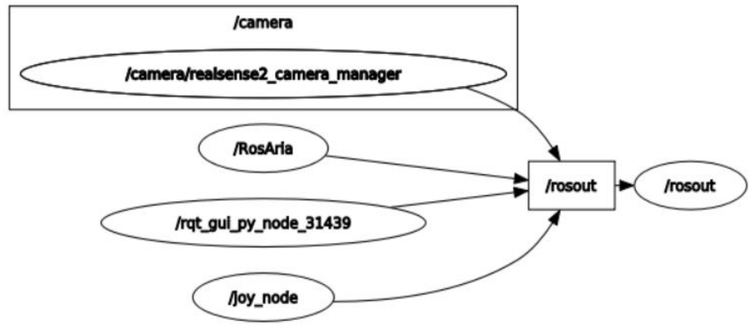
Software and Hardware

- OpenCV (for computer vision libraries)
- Python (programming language)
- PyTorch (maching learning library)
- ROS (for robotics applications)
- Linux (operating system)
- RealSense Camera (for data acquisition)
- Pioneer 3DX Robot (robot model)

METHODOLOGY

Data Acquisition with ROS

- Connected the RosAria node to the Joy node through Roscore so that the joystick controller could be used to drive the robot
- Recorded several ROS bagfiles storing steering and image data for training and testing neural network
- Wrote a script to convert bagfiles into Numpy .npy arrays. This script also mapped images to their corresponding steering commands based on timestamps.
- Created a publisher and subscriber node to connect the neural network's outputted steering data to the RosAria node on the robot



Convolutional Neural Network

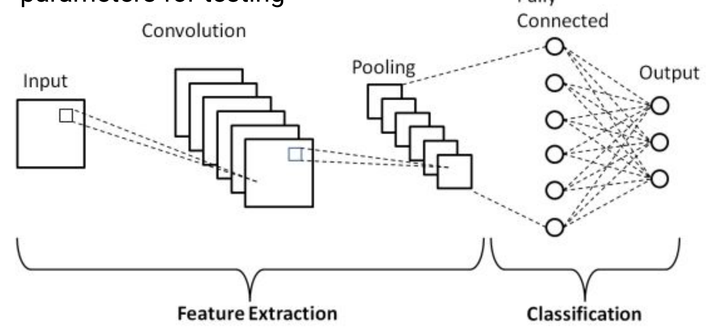
A deep learning algorithm widely used for image/object recognition and classification.

Layers in our CNN model:

1. Input layer (f(x) = x)
2. 3 convolutional layers
3. 3 pooling layers
4. 3 output layers

Training and Testing:

- Scripted a custom dataloader class to load training data into our model as tensors
- Built the training class that used the data from the dataloader class to train the model
- Saved the weights file that contains all the model parameters for testing



CONCLUSIONS & FUTURE WORK

Conclusion

Neural Networks are the basis for deep learning and autonomous control and can be used alongside various operating systems to create self-driving algorithms for robots and smart cars. The CNN algorithm, specifically, can be used to easily correlate and predicit steering and image datasets.

Future Work

- Implement the image collection and the convolutional neural network so that they work in more complex settings, such as areas with traffic lights, stop signs, or pedestrians.
- Implement autonomous driving onto the mini smart car created by hardware design group

References

Glon, Ronan, and Stephen Edelstein. "History of Self-Driving Cars Milestones." *Digital Trends*, Digital Trends, 31 July 2020, https://www.digitaltrends.com/cars/history-of-self-driving-cars-milestones/.

Bojarski, Mariusz, et al. "End-to-End Deep Learning for Self-Driving Cars." *NVIDIA Technical Blog*, 9 Sept. 2021, https://developer.nvidia.com/blog/deep-learning-self-driving-cars/.

ROS & Pytorch documentation sites

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