Deep Learning Autonomous Car based on Artificial Intelligence

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Abstract: Implementation of end-to-end convolutional neural networks in Autonomous Vehicle (modified prototype car) is the prime purpose of this project. This car model is designed to experiment different algorithm and deep learning technique upon it. Primarily, this car is operative autonomously using PID & Distance Finder Algorithm for steering control and obstacle avoidance, and hector SLAM for localization and mapping. Project aim is to make this car more robust regarding the matter of steering control by combining the previous algorithm for control with deep learning techniques. End-to-end convolutional neural network as deep learning technique will be used in this driverless car for higher accuracy. Convolutional neural networks (CNNs) can map the raw pixels from a front-facing camera to the steering commands for a self-driving car. End-to-end approach means that with minimum training data from humans, the system will learn to steer, with or without lane markings, on both local roads and highways. Before real time training, a similar simulation environment is also made to evaluate the network's performance in that simulator. Another deep learning approach which is also going to implemented, is combination of CNN and DQN in which case Camera Image date and LiDAR system date both are collected from autonomous vehicle.

1. Background and Purpose

After DARPA grand challenge, self-driving car become center of concern in research field as well as giant companies like Tesla, Google, etc. Everyone is trying to invent and implement modified techniques for driverless car. A universal modified prototype car to implement various deep learning method, will boost up the learning interest, save huge amount of times and ease the implementation process. This prototype car is designed in that way so that different Deep learning method can be easily tested on it.

2. Concept and Idea

Images from recording are fed into a CNN that then computes a proposed steering command. The proposed command is compared to the desired command for that image, and the weights of the CNN are adjusted to bring the CNN output closer to the desired output. The weight adjustment is accomplished using back propagation as implemented in the machine learning package. Once trained, the network is able to generate steering commands from the video images of a single center camera. Considering the scenario, camera is installed in prototype car maintaining the angles.

Similarly, LiDAR is installed considering other methods like DQN. Also previous algorithm for obstacle avoidance and SLAM use the huge LiDAR system data as input. In Fig.1, combination of CNN and DQN is shown.

3. Design and Functions

Pico-station router supports the communication between the car and user to manually train, get feedback on users mapping environment and find agent state. Camera and LiDAR is used as sensors input. Inertial Measurement Unit (IMU) Razor-9DOF sensor is used for angle initialization. Camera, LiDAR, Teensy MCU, Pico-station and RAZOR IMU is

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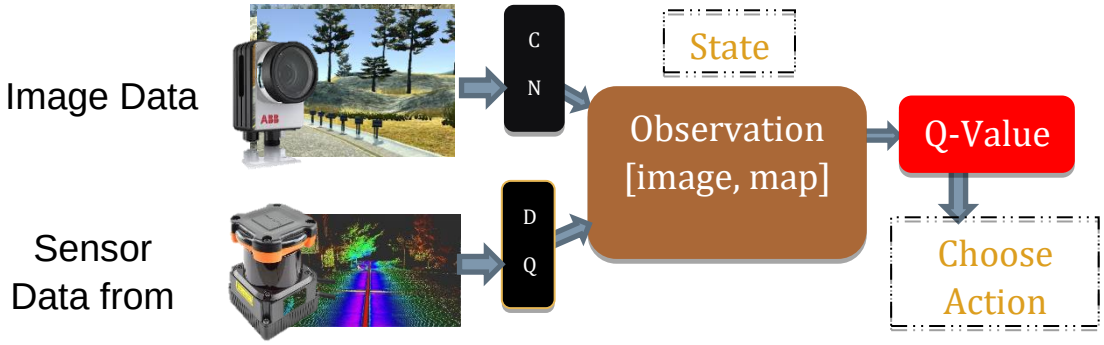

Fig.1 Training Neural Network Model.

connected with embedded GPU NVidia TK1 via USB hub and powered by energizer battery pack. The only two PWM output is provided by NVidia TK1 is to servo and motor controller which are powered by External LiPo Battery. GoPro is used to monitor the agent state while experiments. In a nutshell, this autonomous car is a compact hardware package where various self-driving car control algorithms can easily be executed to test.

4. Problems and Future Work

The real time data collection is hard to get due to the size of vehicle since it needed to be trained manually. In future, larger version real car can be used instead of this prototype version. Future purpose will be to implement Deep Reinforcement Learning techniques like Dueling DQN, Double-DQN, etc. in the autonomous car.

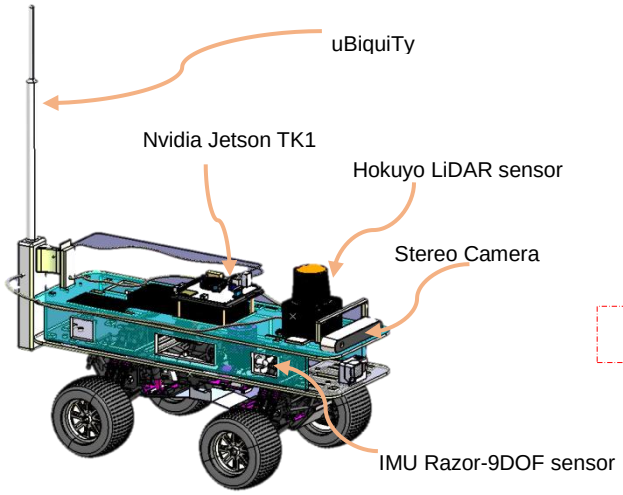

Fig.2.1 Cad Design.

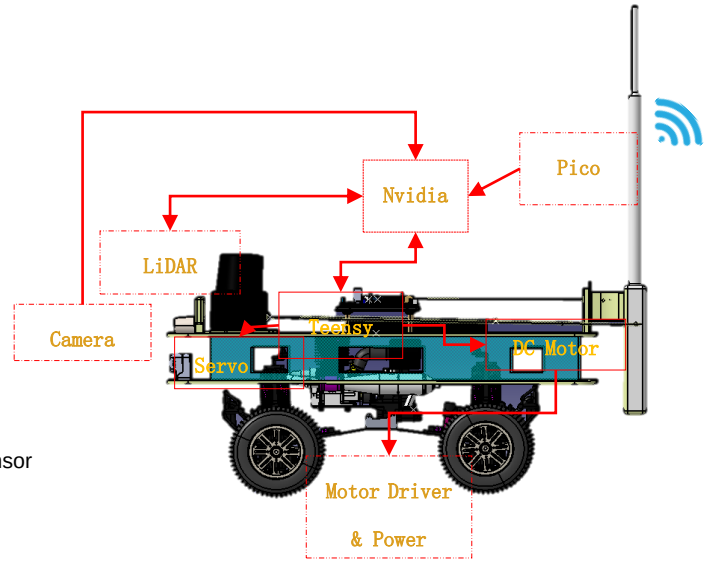

Fig.2.2 Function.