

A Deep Learning: Convolution Neural Network Trained Autonomous Car using Cheap Hardware Costing Less than 100 US Dollars

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Motivation

After finishing Deep Learning course at Harvard Extension School in May 2019, I would like to challenge my skills or the knowledge I gained from the course so I decided to build this Robotic car.

Objective

The objective of this challenge is to: Build a Convolution Neural Network model from scratch which identifies the lane direction (forward, left and right) and deploy the model onto Raspberry PI board which drives the Robotic car.

Hardware & Technology

Hardware The following hardware was used for this challenge which costs less than 100\$.

Hardware	Price (USD)
Raspberry PI 3B+	35
PI Camera Module	14
PI Camera Mount	15
4 AA Batteries	6
Robotic Car (2 Wheels drive)	15
Jumper Cables, Ties, Misc. etc.	10
Cardboard for Lane Markings	1 height

Software The following software libraries are used to image processing and to build the CNN model:

Technology
Python
Keras
Tensorflow 1.12
Pillow
PIL Image Processing
Open CV2 for Image Processing
Matplot Lib for Visualization

Data To generate the data needed to train the CNN model, the robot car was driven using keyboard between the road lanes (shown on right hand side). For each direction (forward/left/right), 300+ images (a total of 1000+) were taken. These 1000+ images were hand labelled for 3 output classes: forward, left and right. The images are pre-processed to remove the hue/saturation/RGB colour components. The black white images of size 75x75 pixels are fed to the CNN model for training and to predict the car driving direction.

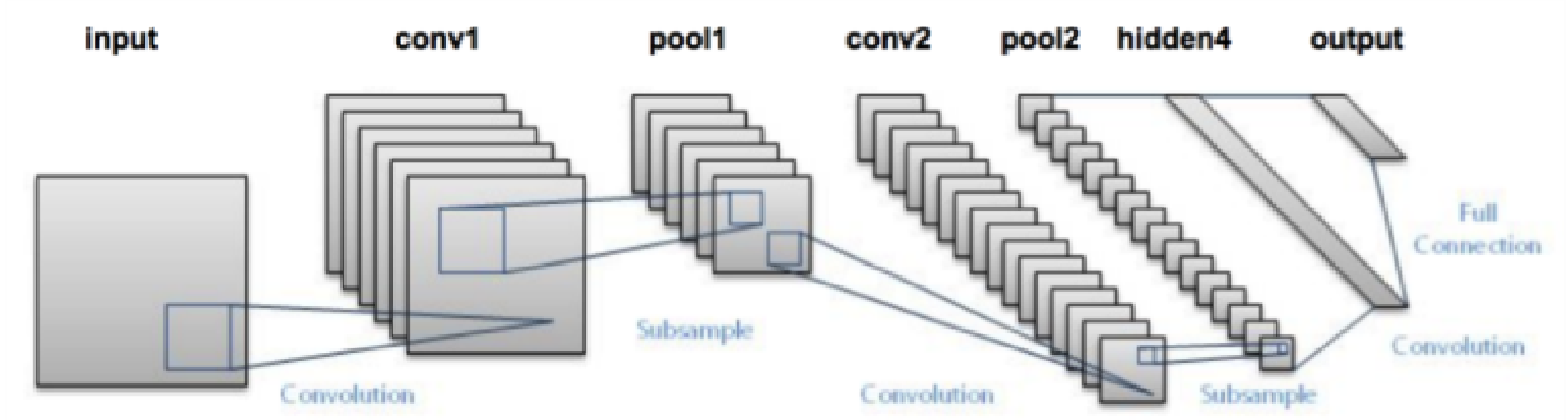
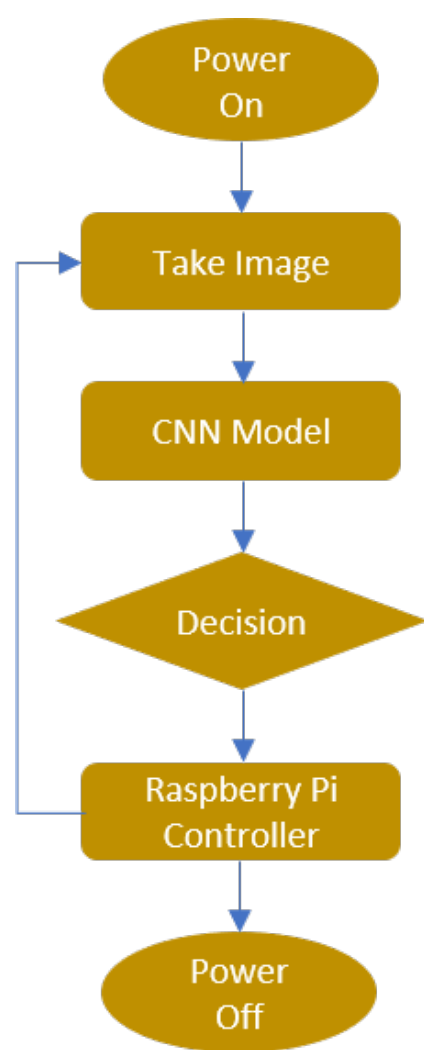


Figure 1:Convolution Neural Network Architecture

Approach

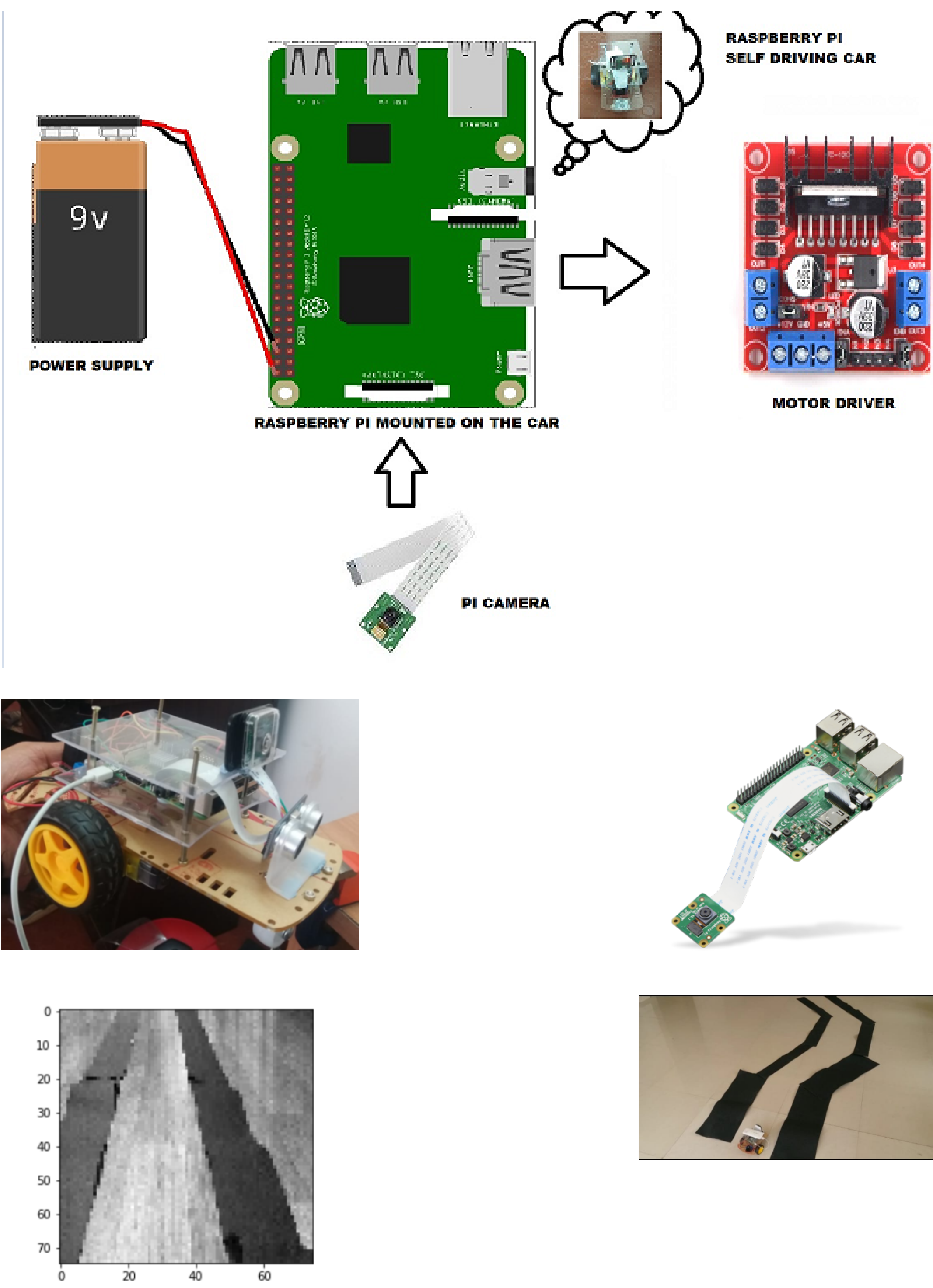
The end to end integration architecture of the Robot car, CNN model is shown below.



Results Conclusion

The CNN model was successfully trained using just 1000+ images which was predicting the direction with accuracy of 98%. The trained CNN model was deployed on to the 35\$ Raspberry PI which takes the direction command from CNN model and control the direction of robots motor drive. A link to the short video demonstration is provided below in the contacts section.

Next Steps - I would like to extend the CNN model so that it can predict the traffic signs: Green, Amber and Red and also presence of toy sized humans.



Contacts & Links

For implementation details, source code and other useful information, please visit to my GitHub link below. A short video of the Linguistic Search Engine is also available on YouTube (link below).

- fam281@g.harvard.edu
- Github:<https://github.com/mohammed-fakruddin/DeepLearningAutonomousCarNavigation>
- YouTube Video: <https://youtu.be/E3X2OTYIC0A>