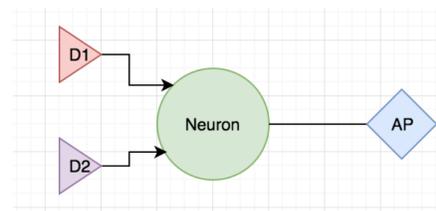


Introduction

- Self Driving Cars are a relatively old idea, present in science fiction for decades. However, it has recently become a very hot topic for companies such as Google, Uber, and even Apple to experiment with.
- These cars are designed to drive without any human intervention required — this means that the car must be able to sense its environment, using cameras or lasers to map it out, and make decisions based on the inputs of the possible paths and safe options.
- The goal of this research is to implement a neural network in self driving cars to make decisions regarding path.
- The currently proposed option involves using a CPU and machine learning to decide what path the self-driving car should take.
- This method would involve a lot of energy consumption. However, using a neural network to choose the path of the car uses a lot less energy and makes the system far more stable and robust.

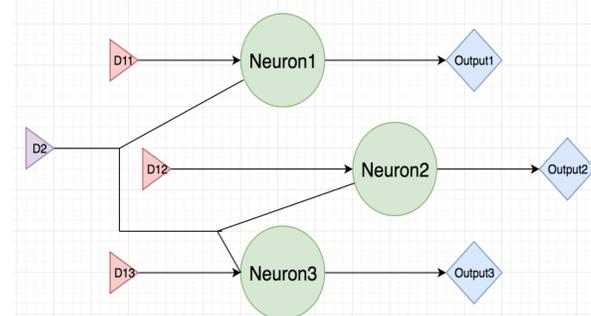
Description

- Using machine learning to decide the path of the car requires a lot of power and resources
- We can use a neural network in conjunction with a CPU and machine learning in order to keep the system robust while decreasing energy consumption, thus making it easier to manufacture and more stable.
- A digital neural network is an application-specific integrated circuit, or an ASIC. Because it is designed to perform a specific task, it is extremely energy efficient.
- The output of each neuron is compatible with that of other neurons, so the system of the car can make decisions in all fields by combining outputs from various sources.



Neuron Diagram

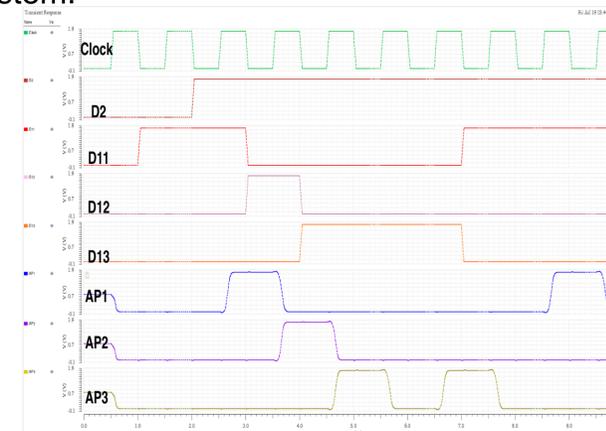
- The neural network functions at a higher rate of success when confronted with a high number of inputs, because it only registers the input as true or false.



Neural Network Diagram

Results

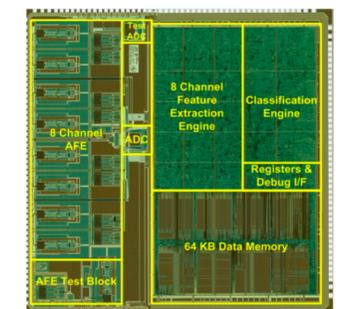
- Each input of the neural network represents a different condition. A spike in a specific input represents that input becoming true.
- For example, D11, D12, and D13 could represent the presence of 3 different lanes, whereas D2 could represent the possible presence of pedestrians nearby.
- Based on the true/false nature of each of these inputs, the output for each neuron is calculated. The total output of the neural network is based off the outputs of each neuron, along with any potential outputs from other neurons in the system.



Outputs of a neural network in response to various inputs

Objective & Impact of Professor's Research

- Professor Dina El-Damak leads the Emerging Technologies and Ultra-Low Power Systems group, which means her research involves optimizing new technologies to perform with maximum energy efficiency.
- The potential to implement self-driving cars around the globe is held back by the energy consumption it would require.
- By reducing the energy consumption for self driving cars as well as many other technologies, we can make the world more advanced while retaining goals such as energy efficiency and environment protection.



<https://www.deldamak.com/research.html>

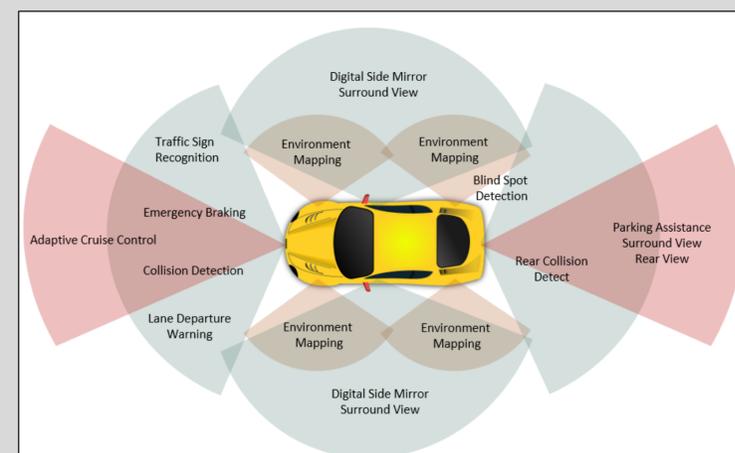
Ultra Low Power Analog to Digital Converter

Skills Learned

- I learned how to efficiently read scholarly literature, by splitting it up into the introduction, method, results, and discussion. I learned how to create an annotated bibliography and research a topic efficiently using credible sources.
- I learned how to model a neural network from the ground up, using Cadence to create digital circuits. I also learned how to simulate inputs for this network and study the outputs.
- I learned valuable skills such as time management and setting goals for myself.

Acknowledgements

I would like to thank Professor El-Damak and Hongyu Fu for their guidance in this project, as well as Dr. Katie Mills and Dr. Megan Harrold for their involvement in the SHINE program. I would also like to thank the SHINE team, including the professors who spoke at all the cohort meetings and held workshops, as well as my parents for supporting me.



https://qulsar.com/Applications/Vehicular_Sync/Autonomous_vehicles.html

Sensory map of a self-driving car using