BUILDING A SELF-DRIVING CAR WITH REAL-TIME OBJECT DETECTION AND COLLISION AVOIDANCE CAPABILITIES

Nathan Griffin, Computer Engineering / Joseph Kutteh, Computer Engineering / Advisor: Dr. Peilong Li

ETOWN ELIZABETHTOWN COLLEGE

OPPORTUNITY

The field of artificial intelligence is rapidly advancing, with exciting developments such self-driving cars from companies like Tesla, GM, and Ford. Enlightened by the similar concepts, this project aims to build an autonomous car on a smaller scale. Cameras, ultrasonic sensors, and infrared sensors were used to make an autonomous car that can follow a track, avoids obstacles, and reads traffic signs.

DESIGN SPECIFICATIONS

The car has a variety of features that can be seen in Figure 5. The IR sensors at the front of the car are used to track a line. The track can be seen in Figure 1. The ultrasonic sensors are located on each side of the car are used to detect objects that are on the track. They are controlled by an Arduino Nano that sends the data to the Nvidia Jetson Nano via UART. The camera on the front of the car is used to read traffic signs. Camera data is processed in real-time using YOLOv8, a deep neural network object detection algorithm [3]. The Nvidia Jetson Nano is the brain behind the operation, computing the data from each sensor and controlling the car.

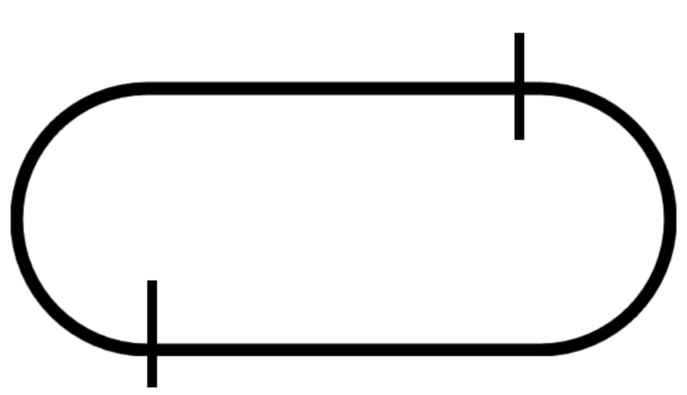

Figure 1: Track
Example of track used to test the car

TECHNICAL DESIGN

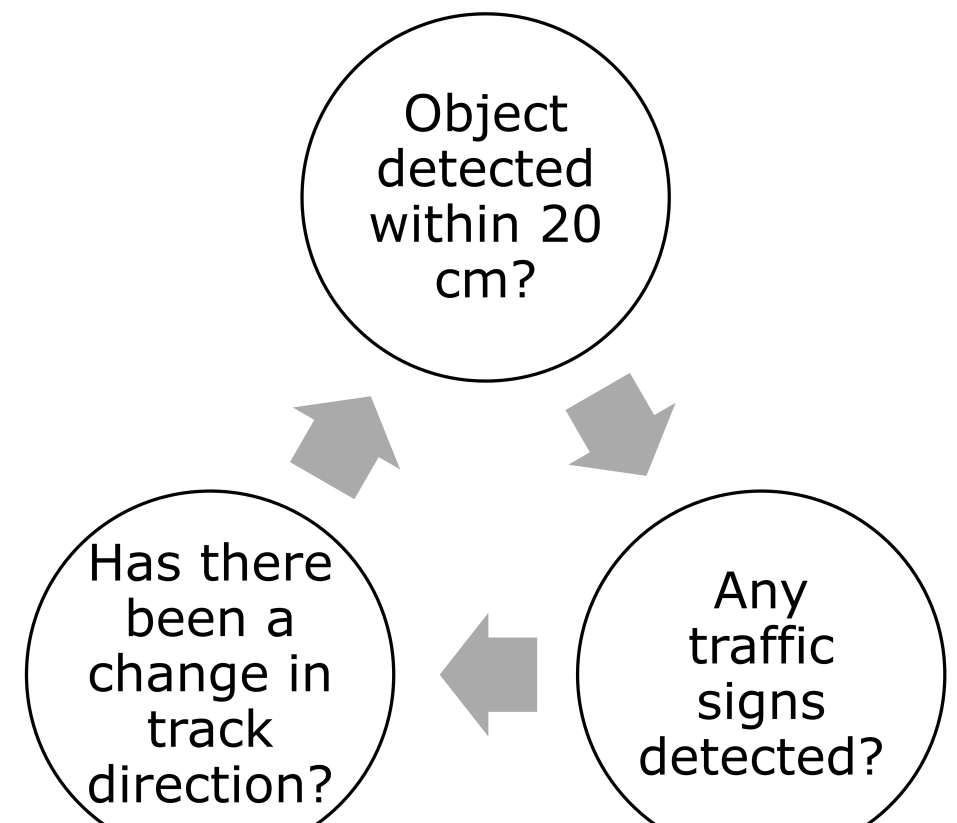

Figure 2: Flowchart
The order in which the code processes and computes data received from sensors

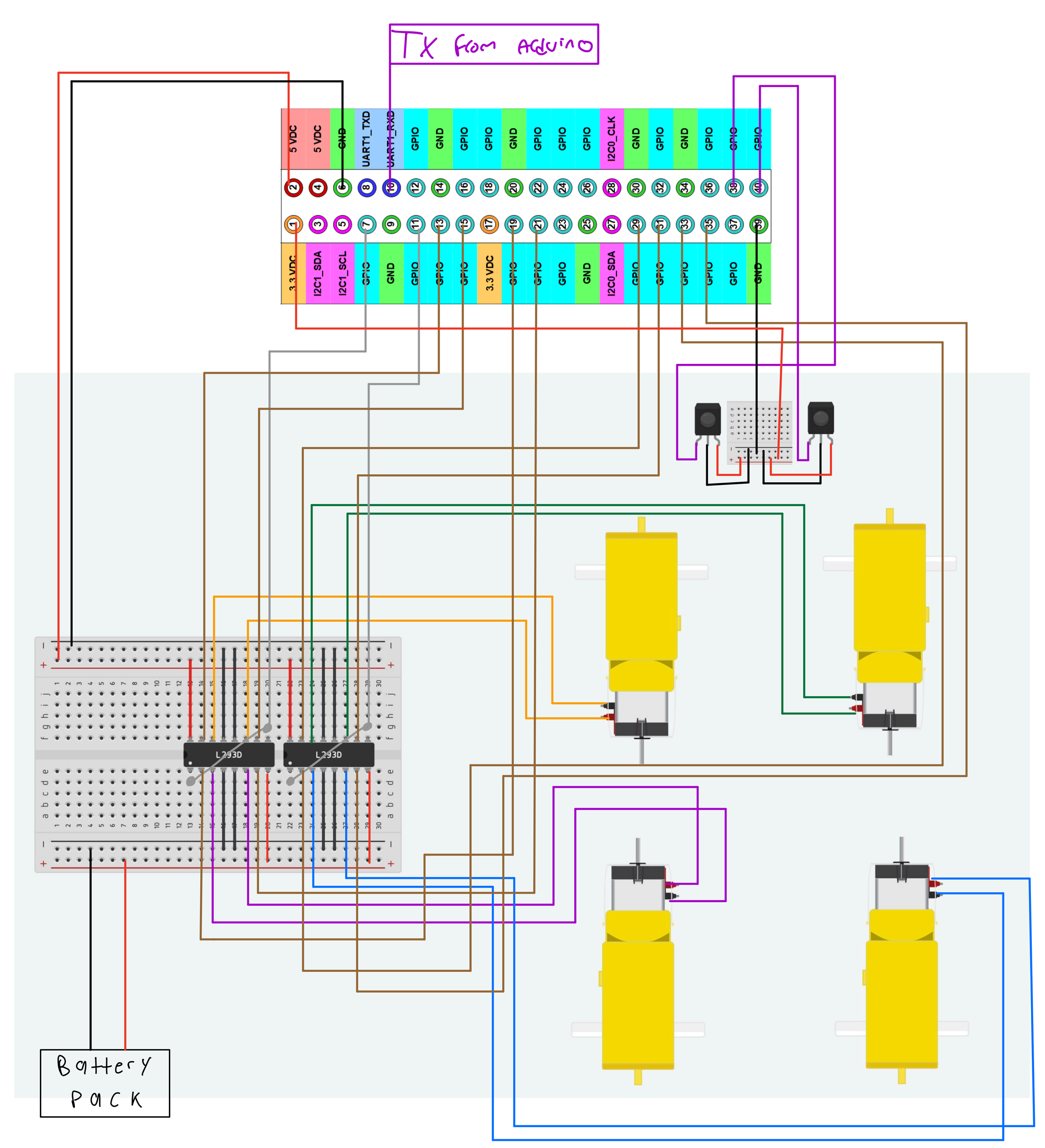

Figure 3: Motor Circuit
The motors are controlled by two L293D motor controllers [2].

PROTOTYPE/DEVICE/PROCESS

Figure 4: YOLOv8 output

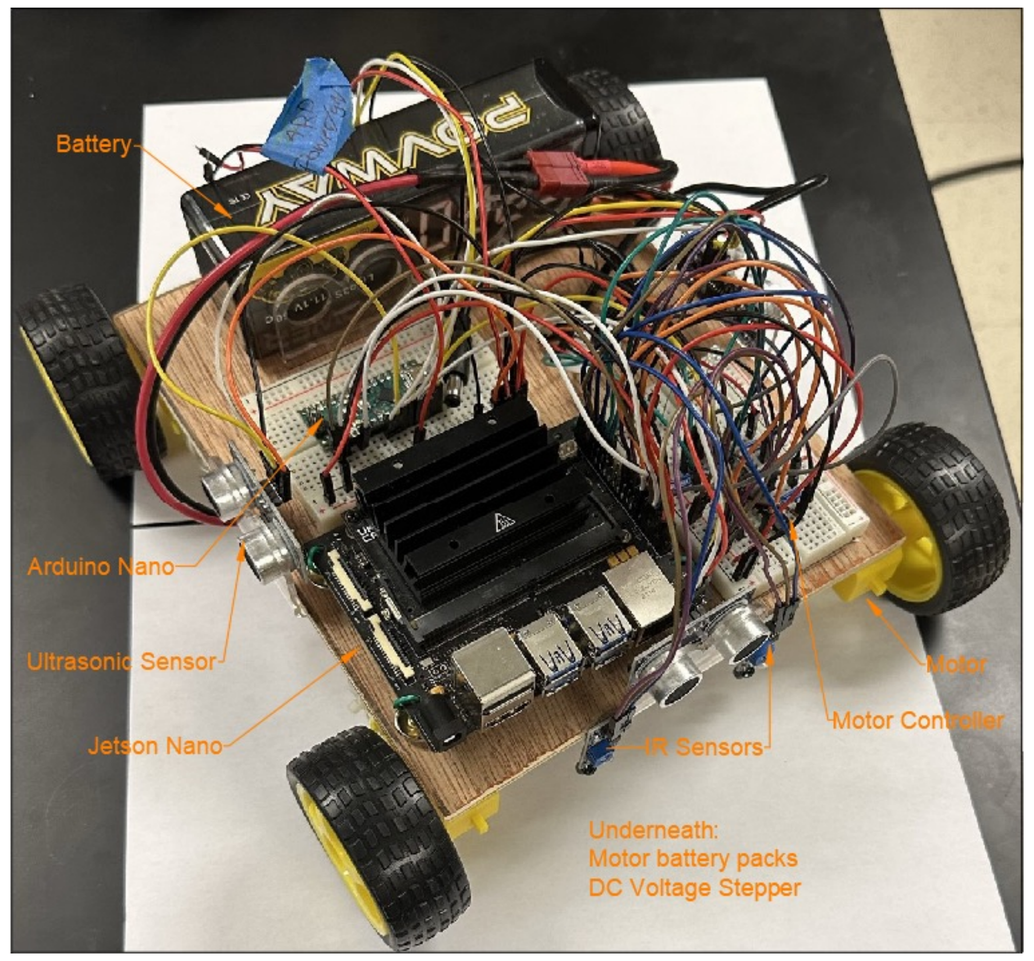

Figure 5: Car

TESTING

We tested YOLOv8 using a large data model which included many unnecessary objects. This led to slow run times. To solve this issue, we created our own custom dataset and trained a new model to use with YOLOv8. Refer to Figure 4 to see the output of the object detection algorithm.

We went through various track designs; different turn angles and line widths were tested.

We choose to build our own power system that used an RC car battery and a DC-DC converter to supply roughly 20 watts of power to the Nvidia Jetson Nano. Also, we provided around 11 volts of power to the 4 DC motors on a separate battery pack.

UART was used as the communication protocol between the Arduino Nano and Nvidia Jetson Nano due to simplicity.

IMPACT

Autonomous cars enhance the safety of the driver and other cars on the road. They allow people with physical disabilities the opportunity to drive.

REFERENCES AND ACKNOWLEDGEMENTS

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[2] "SLRS008D –September 1986–revised January 2016 L293X quadruple half-H ..." [Online]. Available:https://www.ti.com/lit/ds/symlink/l293.pd
[3] "Ultralytics/ultralytics: New - yolov8 🚀 in PyTorch > ONNX > CoreML > TFLite," GitHub. [Online]. Available: https://github.com/ultralytics/ultralytics.

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