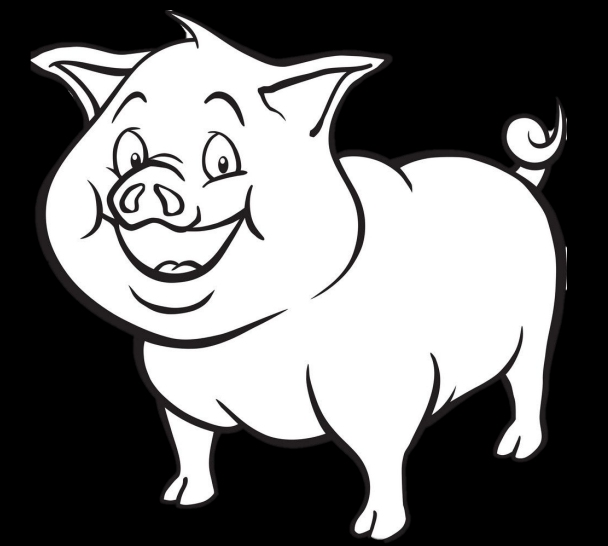




Engineering

“Robo Pig”

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Project Concept

Our clients are children of elementary school age. The problem that we are addressing is the need for increased physical activity in children of this age group, which will be accomplished by creating an interactive toy car that avoids obstacles and the child.

Functional Requirements

- Effectively detects ground objects up to a certain distance
- Effectively avoids/maneuvers around detected objects
- Runs at a speed where a child can walk/run after it
- Must be durable and resist drops

Quantitative Requirements

- Project cannot exceed \$375
- Project must be completed within 12 weeks
- Needs to run at least 1 hour on full charge

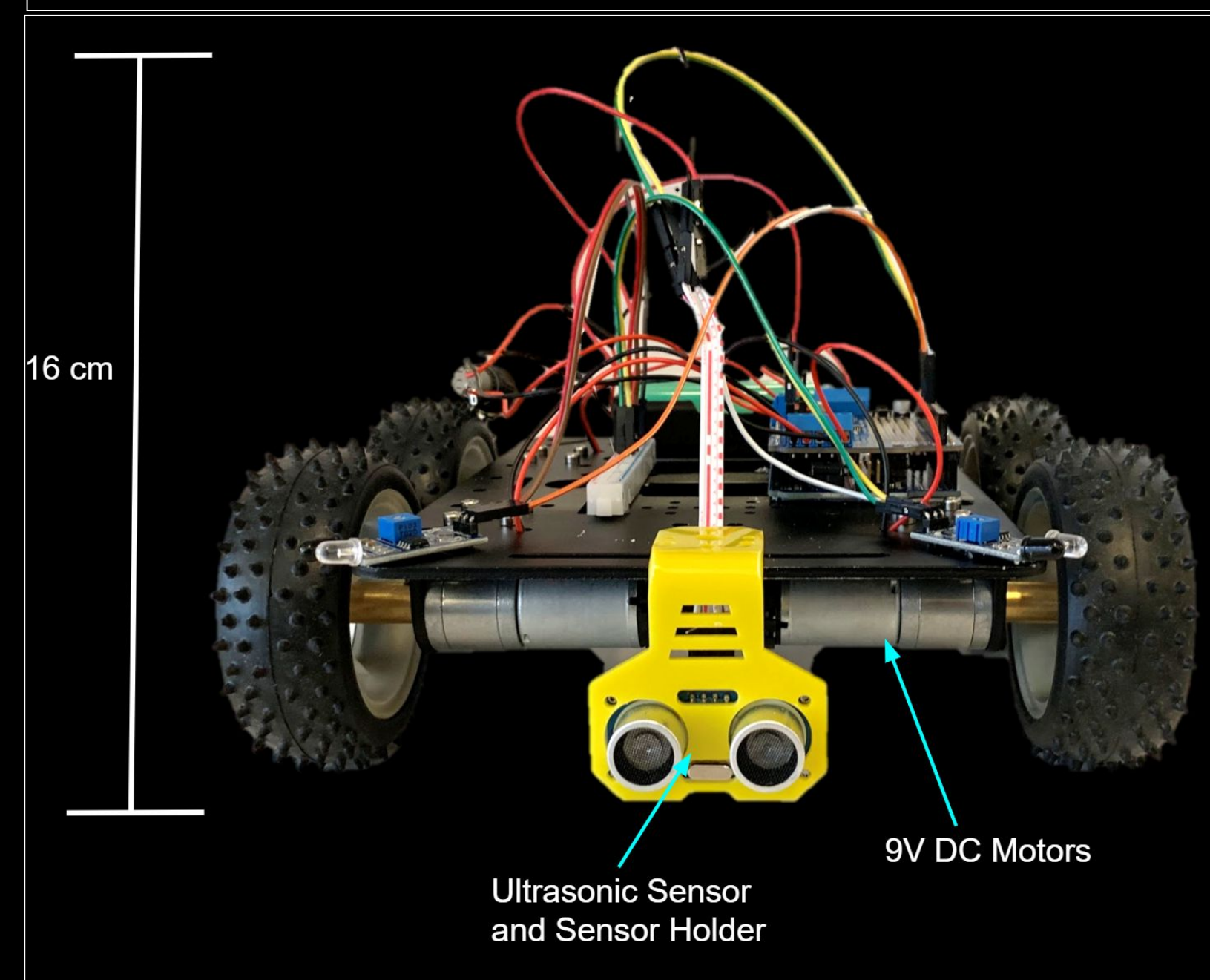
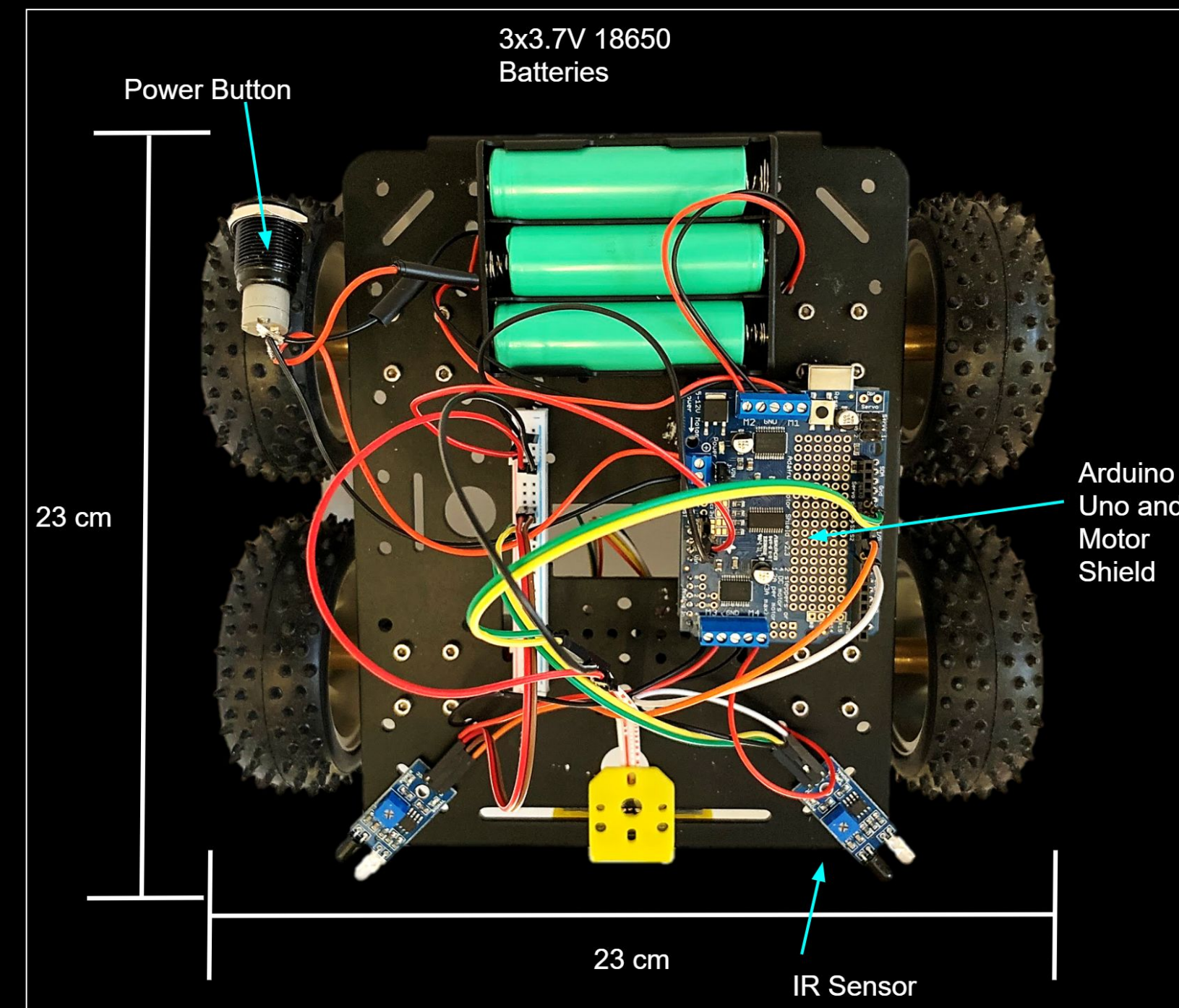
Qualitative Requirements

- Must look aesthetically pleasing
- Must have an entertaining characteristic
- Must be safe for children (No choking hazards, dangerous/flammable electric circuits)
- Must not infringe on existing toy patents or directly copy an existing toy

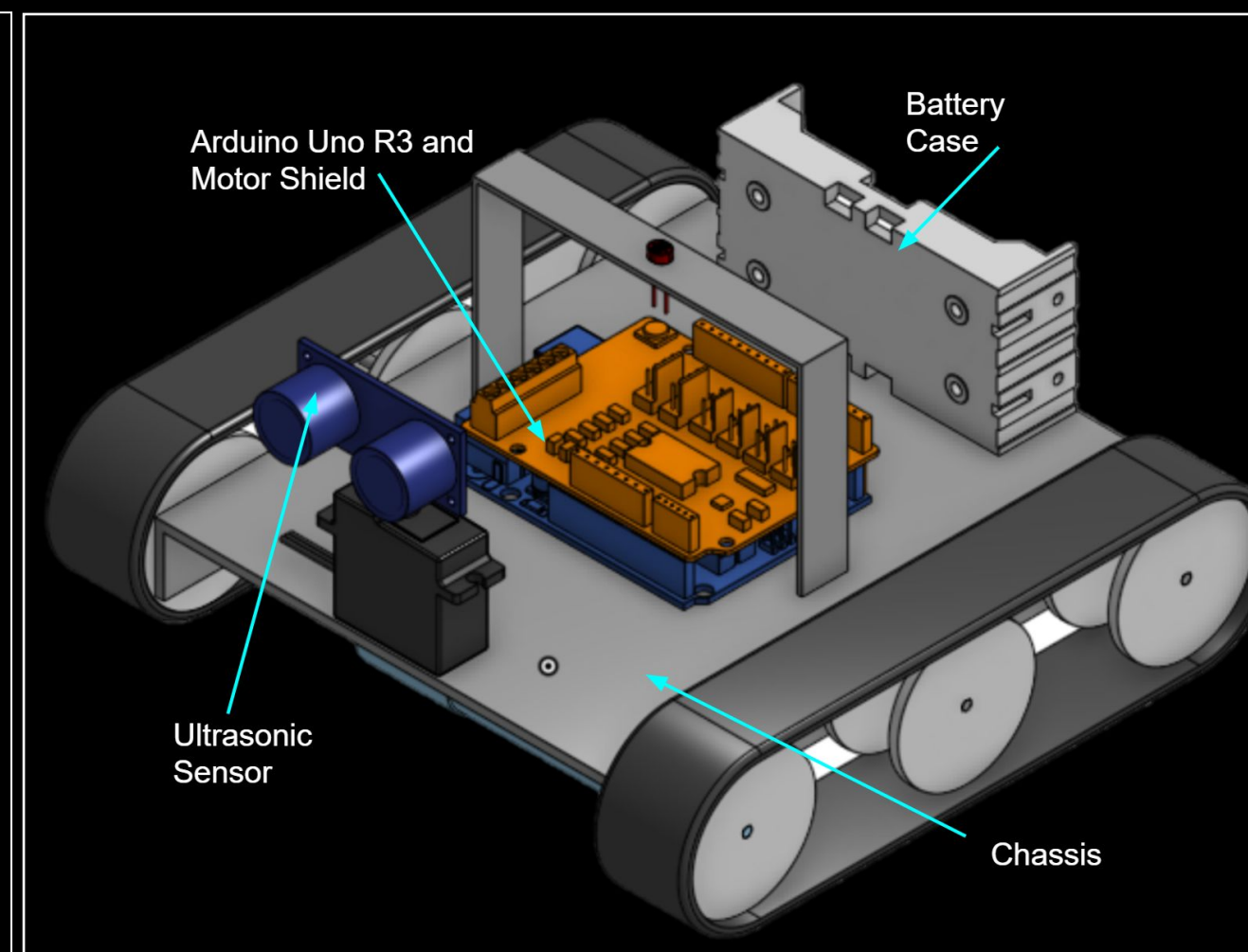
Key Components and Cost

- HC SR04 Ultrasonic Distance Sensor - \$1.95
- Sensor Holder - \$1.09
- Infrared Sensors - \$2.60
- Adafruit Motor Shield v2.3 - \$19.65
- Arduino Uno R3 - \$16.98
- 3 18650-25R 20A 2500mAh Rechargeable 3.7V Battery \$21
- Battery Case - \$8
- Push Button Switch - \$8.49
- ABS plastic sheet- \$4

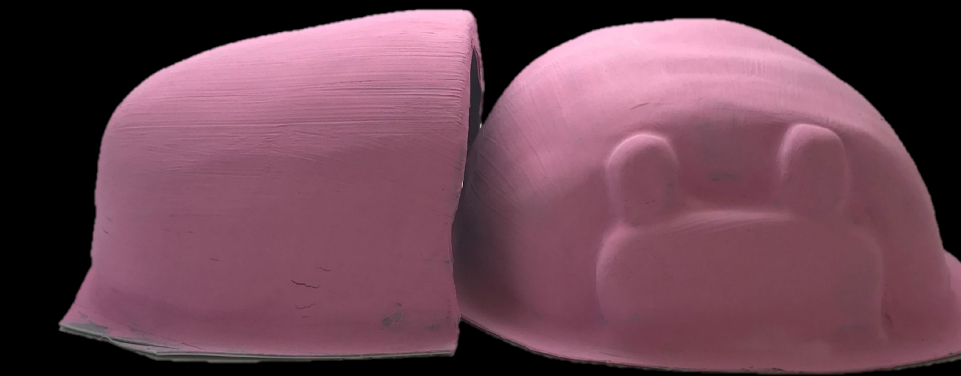
Internal Structure



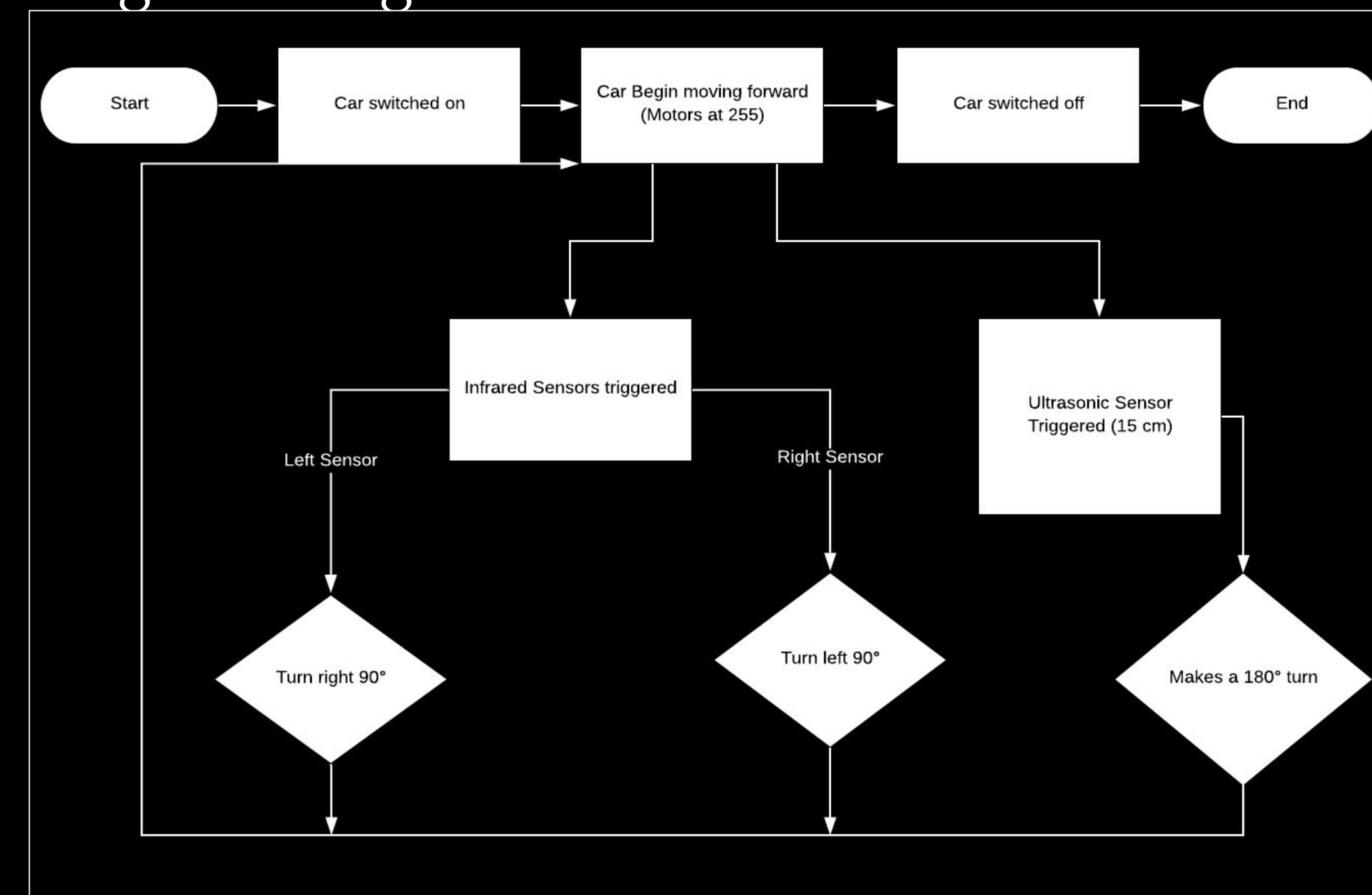
Original CAD Layout



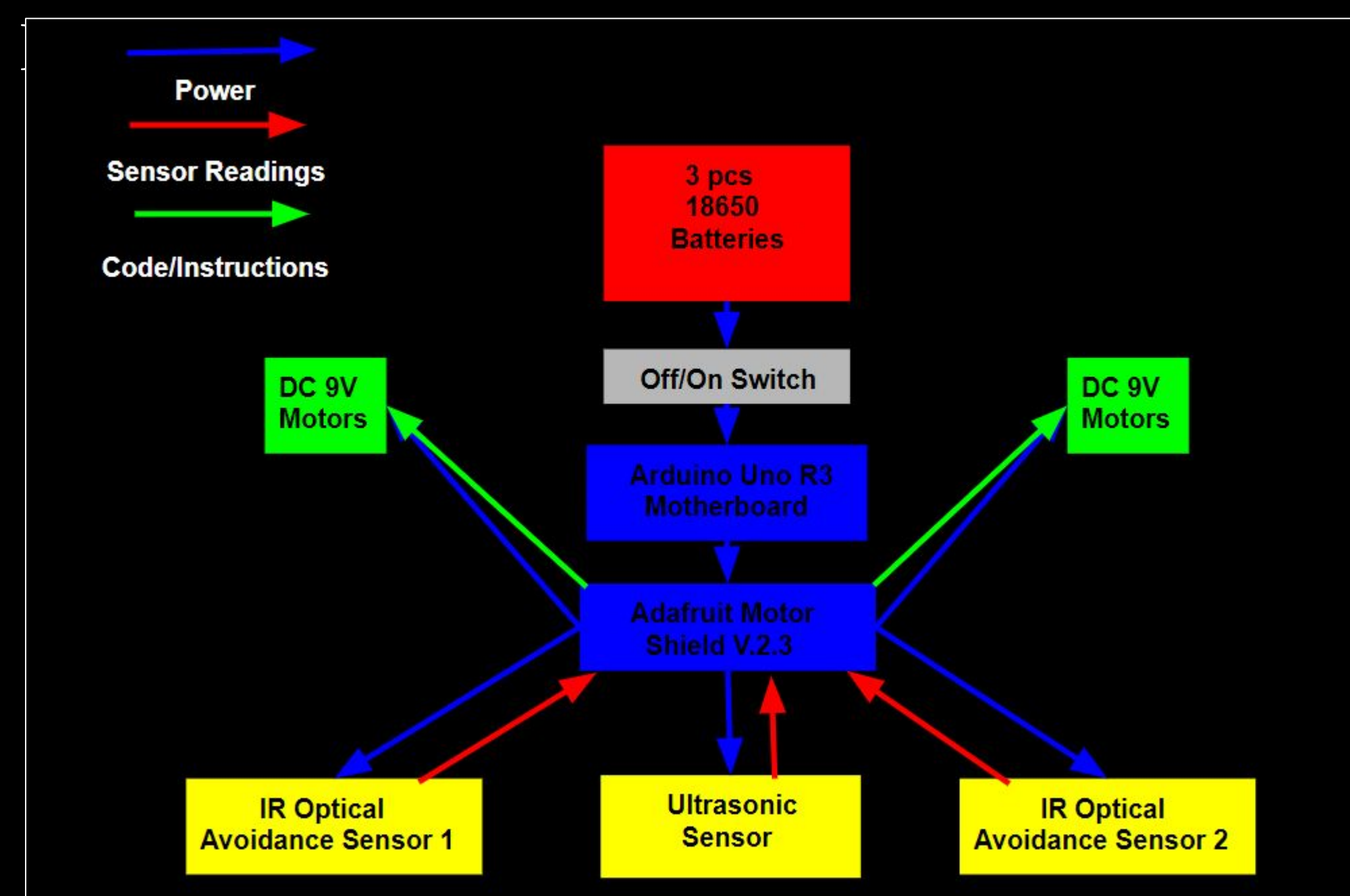
External Structure



Programming Flowchart

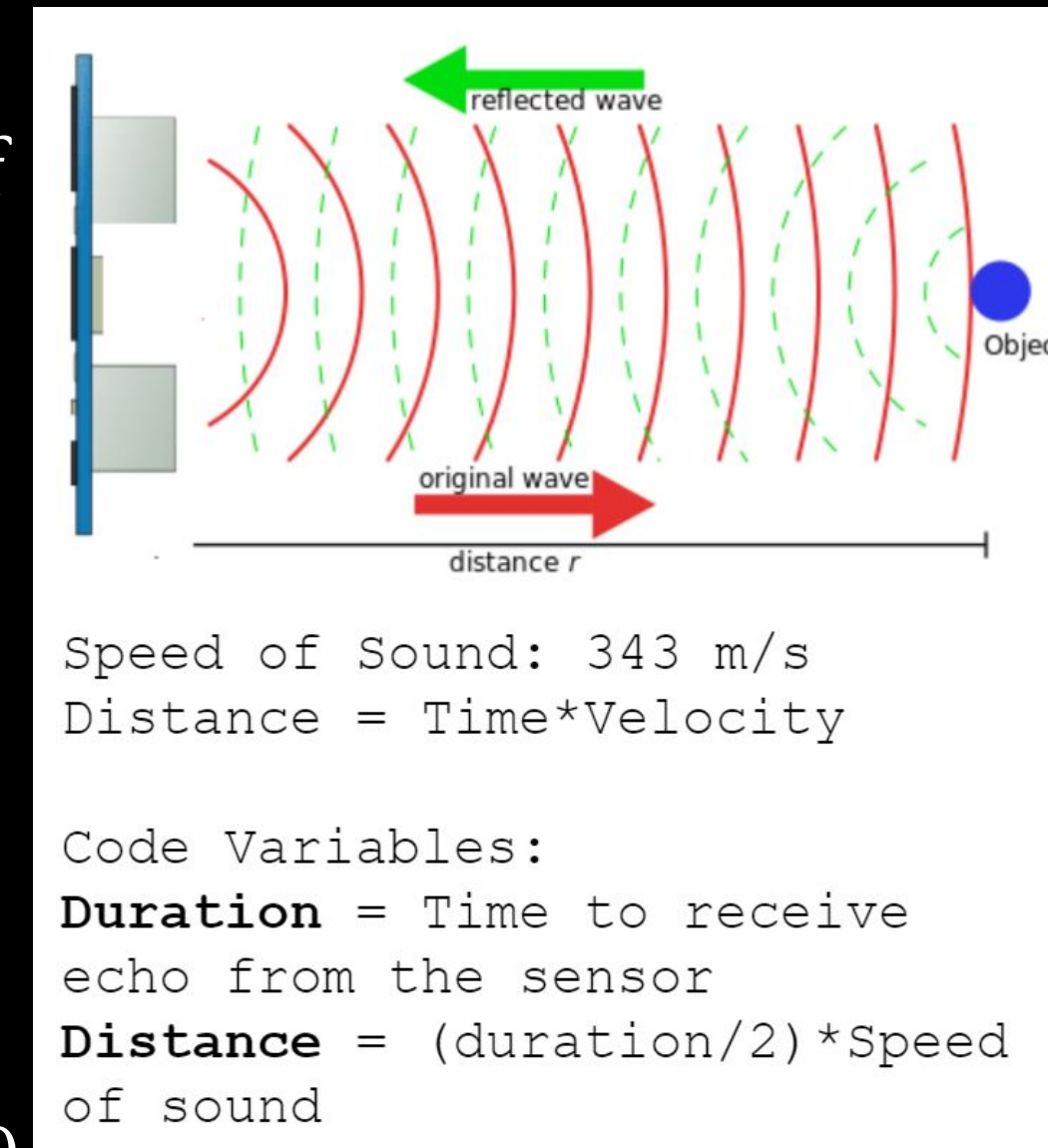


Electronics



Analysis and Testing

Ultrasonic Sensor
The most critical part of our design was the car's ability to detect objects with utmost accuracy. To do this, our team came to the conclusion that the HR04 Ultrasonic Sensor was the best sensor we could incorporate into our design. The sensor works by sending out 10 sound waves that reflect back by objects. The sensor can tell the distance from the object by knowing the total time and speed of sound.



With this equation incorporated into our coding, we are able to tell, to the exact centimeter, how far away an object is in front of the car. Then, with some “if else” statements, we are able to tell the car to turn away from the object “if” the distance is less than 15cm. However, outputs of the sensor are very one-directional and somewhat narrow, and we came to the problem of not being able to detect objects to the side of the car. To fix this, we decided to use two IR obstacle avoidance sensors on the corners of the car to detect objects along with the ultrasonic sensor. This improved the accuracy substantially and the car is now able to accurately detect any object in front of or off to the side.

Future Work

If we were able to acquire more time and money for this project, we would definitely improve the power output and motor capability in order to make the car go faster to run away from children. We would also improve the sensor capability to base the motor control off of where the kid was running.

Acknowledgmen

We would like to thank Mo Woods, John Mah, Brooke Shade, Thomas Noll, and Dan Godrick for their support throughout this project.

Project Description

The “Robo Pig” is an electronic car that detects and avoids ground objects for the purpose of entertainment and motor skill enhancement in children. The device works by sending in signals of detection of certain objects and outputting specific information to the motors. This lets the car intelligently make decisions on how to avoid certain obstacles in front of it. Please see the electronics and circuit diagram for a more detailed description.