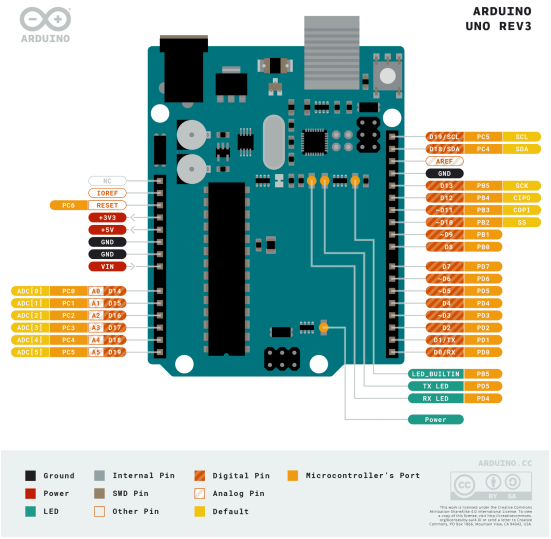
Identify the Problem:
We must create a self-propelled, self-controlled, sensing robot to force another Sumo Robot outside a four-foot competition ring.

Design Brief and Requirements:
We will utilize two light-dependent resistors and an ultrasonic sensor to find the objects and ensure we do not cross the white outer line. To steer the robot, we are going to use an Arduino. Additionally, these components will be soldered together on a perf board for stability. We will have two motors to propel the robot left, right, backward, or straightforward.

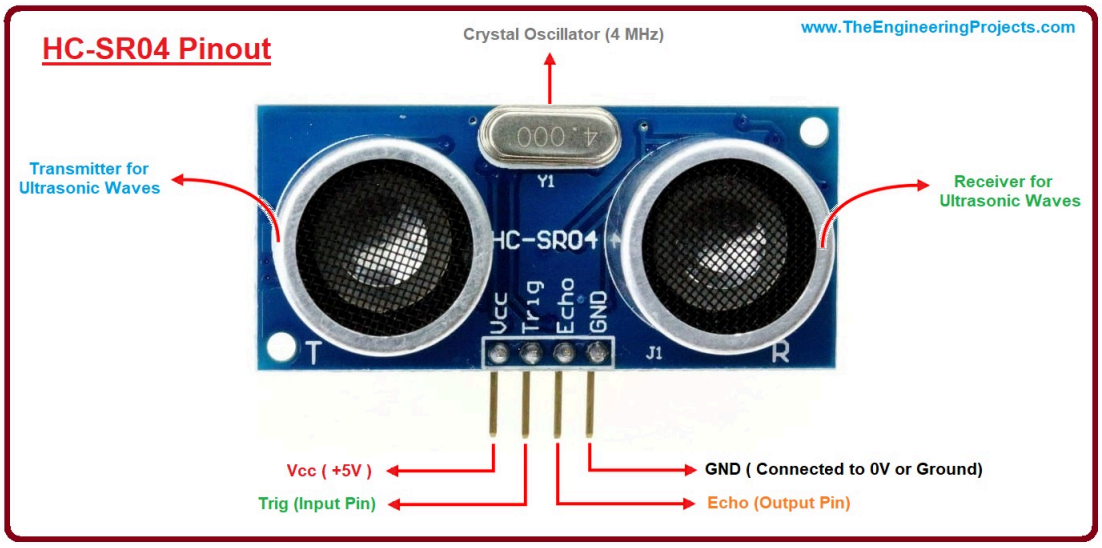
Research:

- How will the aArduinArduino work as an open-source electronic platform to develop and build interactive electronic projects? It consists of a physical programmable circuit board (often called a microcontroller) and a software-based Integrated Development Environment (IDE) used to write and upload code to the board.
    - To use an Arduino, you first need to connect it to your computer using a USB cable. Then, you can write your code in the Arduino IDE, which uses a simplified version of the C++ programming language. The code is compiled and uploaded to the board via the USB cable. Once uploaded, the code can interact with various sensors, actuators, and other electronic components connected to the board's input/output pins.

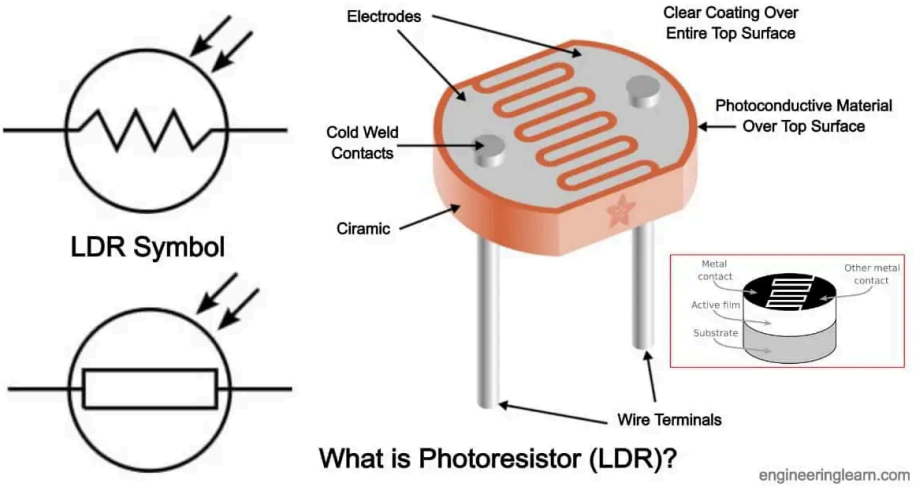


- How will the ultrasonic sensor work?
    - An ultrasonic sensor is a device that uses sound waves to measure distance. It emits high-frequency sound waves (typically between 20 and 200 kHz) from a transducer, a small electronic device that converts electrical energy into sound waves.
    - The sound waves travel through the air until they hit an object; at this point, they bounce back and are detected by the same transducer. The sensor then measures the time it takes for the sound wave to travel to the object and back, which is known as the "time of flight."

- Using the speed of sound (approximately 343 meters per second at room temperature), the sensor can calculate the distance to the object by multiplying the time of flight by half the speed of sound. This distance calculation is then converted into a digital signal that a microcontroller or other electronic device can read.

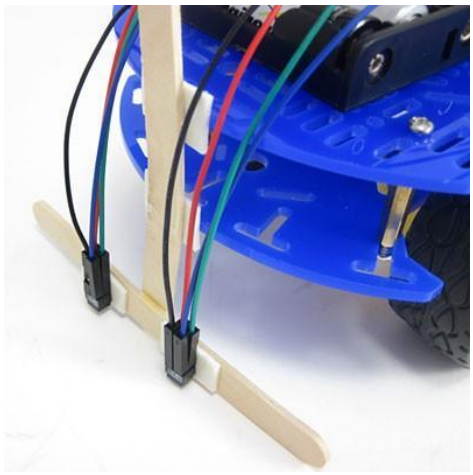


- How will the Light Dependent Resistor work?
  - We will use LDR sensors. This is a photoresistor, a type of light-sensitive resistor that changes its resistance value in response to changes in the amount of light it is exposed to.

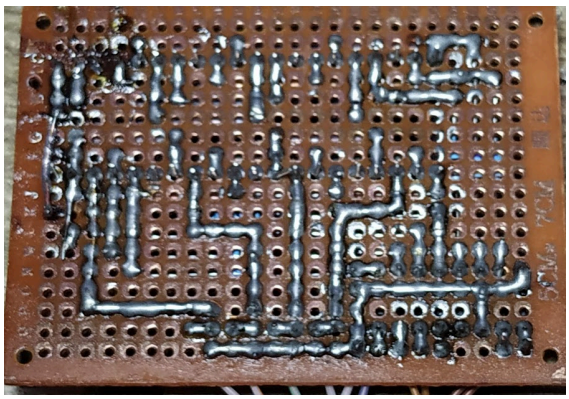


- How will changing the sensors' distance from the ground affect the robot's ability to follow the line?
  - Suppose the sensor is placed too far away from the ground. In that case, it will not be able to accurately detect the black line, as the white surface of the ground will reflect a significant amount of light to the sensor, making it difficult to distinguish between the light and dark areas. On the other hand, if the sensor is placed too close to the ground, it will not be able to detect the changes in light

quickly enough to make the robot change direction. This is because the light is too dispersed, and the changes will be too subtle for the sensor to detect quickly.



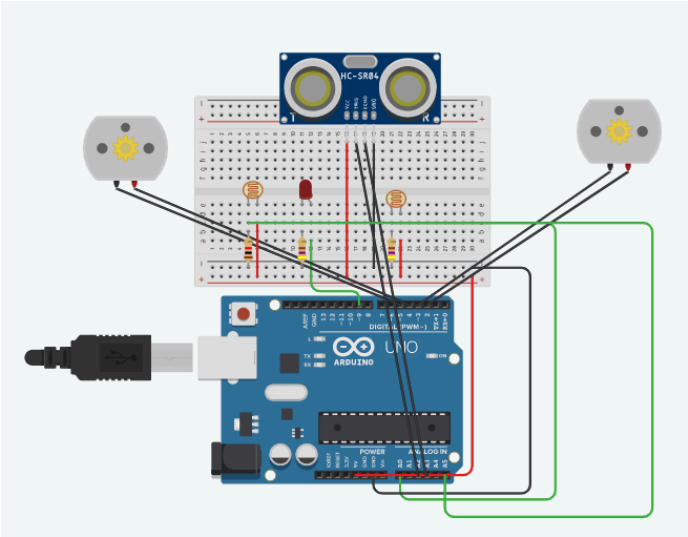
- How will we attach the components to the perf board?
    - We will use solder to attach the components to the perf board. This will be done by heating it with a soldering iron.



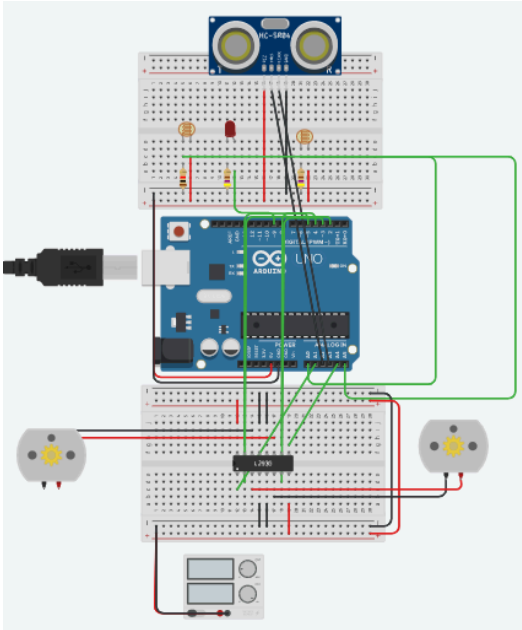
Brainstorm:

Develop Solutions:

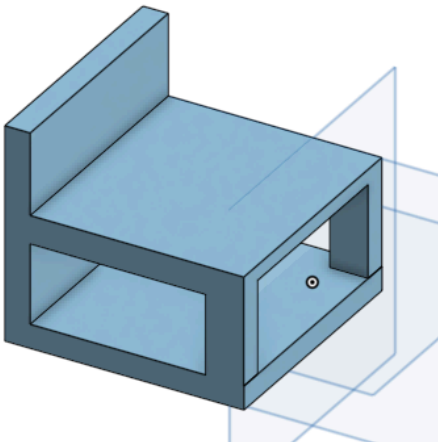
Circuit:
1st Version:
https://www.tinkercad.com/things/cYZm2nFQisV-sumo-robot/editel?sharecode=mGBa6IlBzU51wZy5JBA14QZZQ0Mhb-Xzfxijcx5GNVU



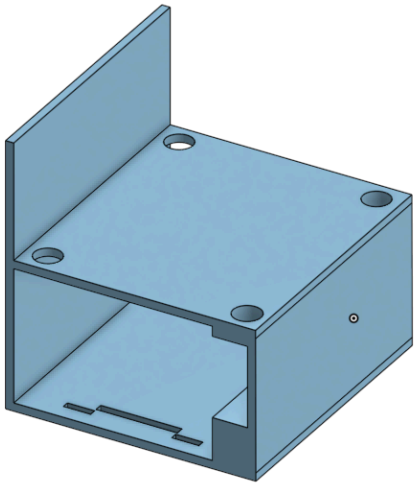
2nd Version:
https://www.tinkercad.com/things/45okDCQW8DG-copy-of-sumo-robot/editel?sharecode=uOKvJxQPsbaUGyQlpGhCGVqKVPBQV89KNXPkvdOpMqc



Cad Model:
Version 1:



Version 2:



Choose a Solution:

Circuit:

Requirements	1st Circuit	2nd Circuit
Power Distribution	Single power source for all components.	Separate power sources for motors and Arduino using L293D.
Stability and Reliability	Potential for power fluctuations and disruptions.	Minimized risk of voltage drops or spikes, enhancing stability.
Motor Performance	Limited power supply, restricted torque and responsiveness.	Increased power allocation, improved torque and responsiveness.

- 2nd Circuit: Including the L293D component addresses the requirement for separate power sources, enhancing stability and enabling increased power allocation to the motors.

- 1st Circuit: The single power source may pose risks of power fluctuations and limitations on motor performance compared to the 2nd Circuit.

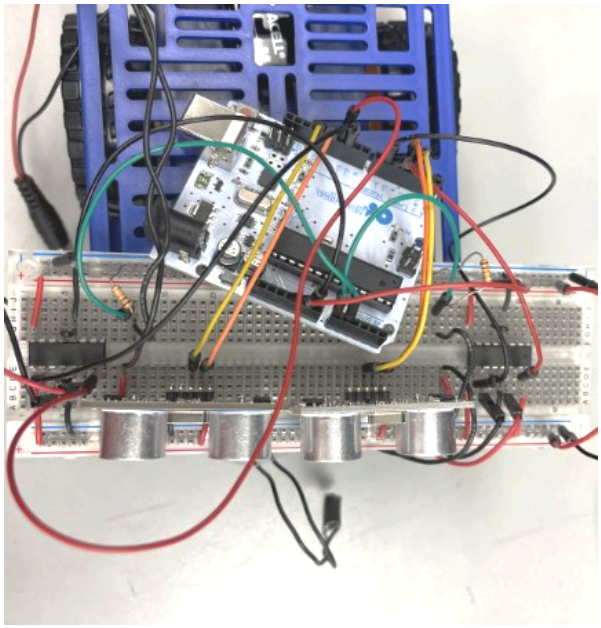
Robot Design:

Requirements	1st CAD Model	2nd CAD Model
Wire Management	No specific wire holes, potential for tangling or damage.	Wire holes for efficient wire management and organized design.
Motor Integration	No designated space for motor placement.	Dedicated area for motor installation, enhancing stability.
Resource Efficiency	Larger flooring area, higher consumption of plastic filament.	Smaller flooring area, minimizing plastic filament usage.

- 2nd CAD Model: It meets the requirements for wire management, motor integration, and resource efficiency by including wire holes, designated motor space, and a smaller flooring area.

- 1st CAD Model: It lacks specific features for wire management, motor integration, and resource efficiency present in the 2nd CAD model.

Modeling and Prototyping:



The first thing we did was create the circuit that we chose in the prior step and attach it to the blue chassis. This would allow us to make sure that everything we had done would be right and would allow us to transition to the model we made ourselves quickly. After much trial and error, inputting the correct values for the LDRs and the ultrasonic sensors, we found that the model worked fine, allowing us to move to the next steps.

https://drive.google.com/drive/u/1/folders/1hLTJjC-KJK01xQFhrdNGYEAzK-z0l1fX

Our next step was to create the frame out of cardboard as this would allow us to make sure that all the parts in the CAD design were in the correct position, and it would allow us only to use one take rather than finding a mistake and redoing the entire thing.

Testing and Evaluation:

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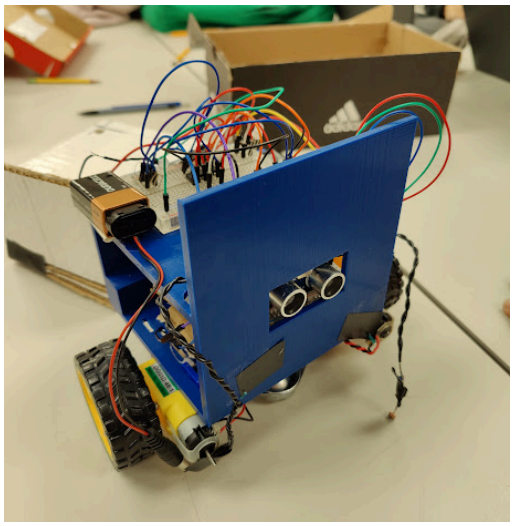
Finally, we created the final chassis using the 3d cad model and our changes to the cardboard model. These changes include wider holes, a smaller front, and a thicker floor to minimize the amount of plastic filament used. We also needed to redo the new robot's LDR and ultrasonic values.

Redesign:



We plan to use more than one ultrasonic sensor for the following design, giving us a greater field of view when finding the competitor's sumo robot. Additionally, we plan to implement a plastic ramp for our 3D-created chassis, allowing us to turn over other robots and making it harder for the robot to come at us head-on.