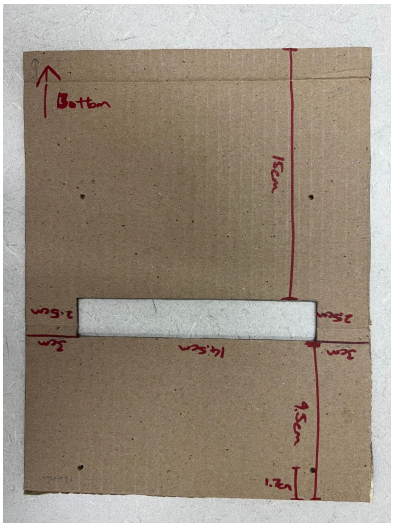
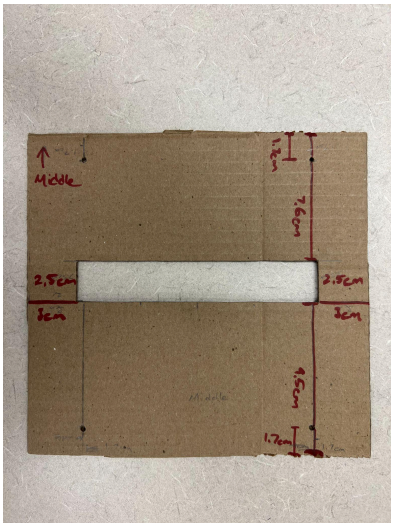
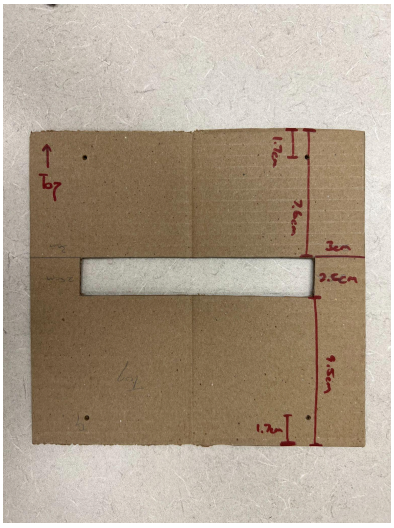
**Simple Robot Development Documentation**

## 1. Prototyping the chassis

There were a lot of ideas for partitioning various components of the Simple Robot and ultimately we decided to split it up into three distinct layers. Each layer is supported by standoff screws and is responsible for holding various components that would be needed for the autonomous AI robot to function.

**Three main layers of the Simple Robot**

| | | |
|---|---|---|
|  |  |  |
| Bottom | Middle | Top |

To the left is the bottom layer, it will be responsible for wheel/motor attachment, for storing the battery holder (powers the motors) including batteries and the L298N motor driver. The speaker box/container will be installed at the front of this layer (represented by the location of the red arrow).

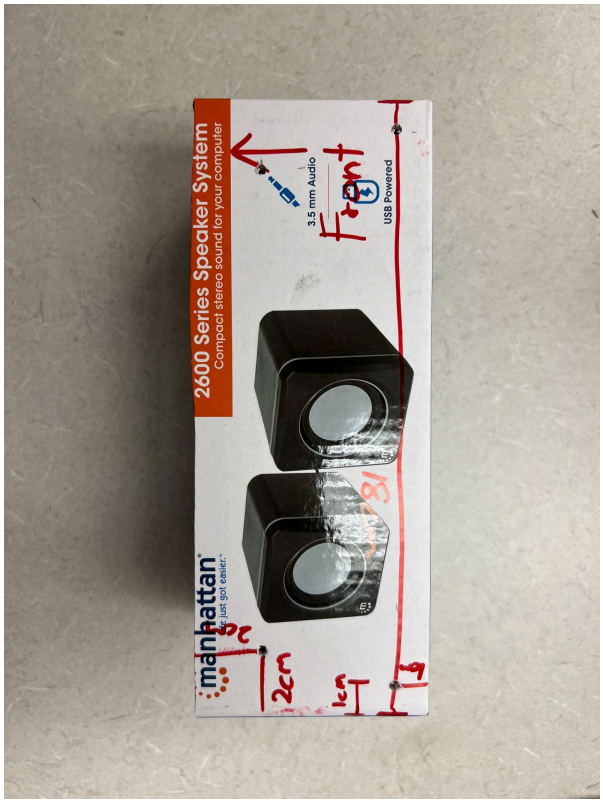
In the center we have the middle layer. This layer is responsible for storing the raspberry pi and powerbank.

Finally, we have the topmost layer to the right. This top layer is responsible for storing the omni-directional microphone as well as providing some stability for the LCD screen holder.

Rectangles were carved out in the middle of all layers to allow for wires to interweave between them instead of dangling by the sides.

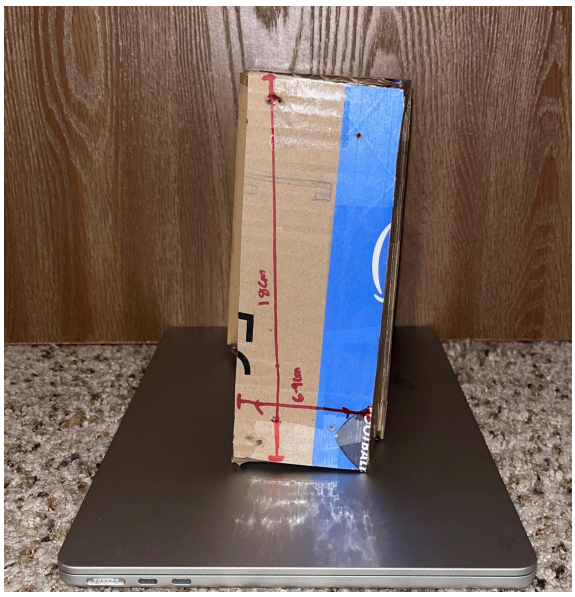
This is the speaker container which will be installed at the front of the bottom layer. It will also be the base for installing the LCD screen holder. Rectangles have also been cut out to let the speaker wires pass through through the back.

Inside




Topside

Front side



Bottom side

Right side

Left side

This is the LCD screen holder that is designed with 1 cm extensions at the top and bottom on the front side to accommodate external connection pins that extend outward like hdmi and other pins. This holder will be mounted onto the speaker box (shown above) and secured using screws for stability. Additionally, the camera will be mounted directly on the screen, ensuring proper alignment and integration with the overall setup.

Three ultrasonic sensors will be attached in the space between the screen and the speakers—one on the left, one on the right, and one in the center.

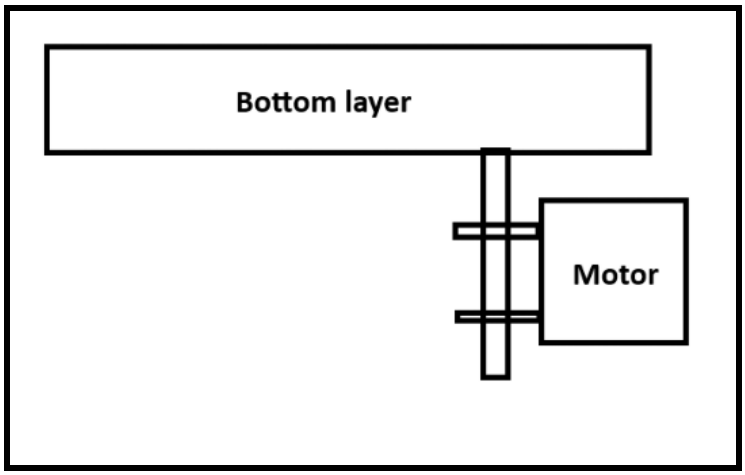
The following are some views for when the chassis is assembled (excluding wheel motors for now).

| | | |
|---|---|---|
|  |  |  |
| Front | Side | Top |

As you can see, while somewhat structurally sound, not all components have been placed on the layers yet as cardboard is not sturdy enough to support all of the components' combined weight (notice the downward bending of the layers). Thus, it is at this point that we had decided to get into contact with the software engineering team to model and 3D print a chassis based on this working prototype.

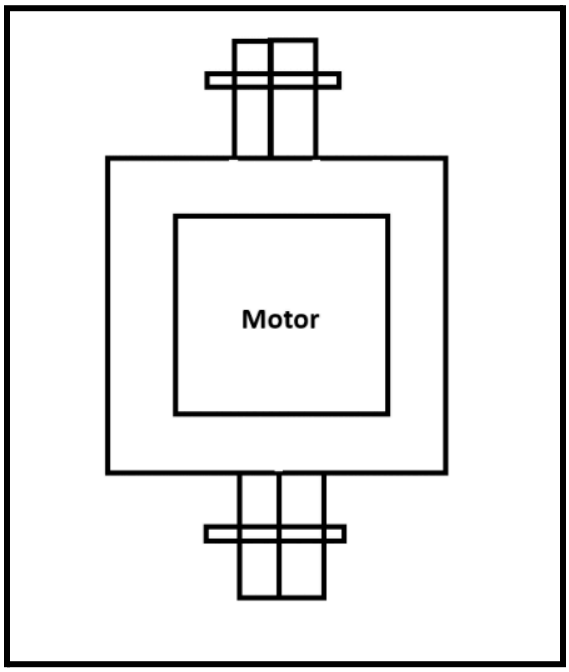
There were a number of suggestions on how the motors could be attached to the base layer of the chassis.

1) Have rectangle protrusions for the attachment of the motor. At first, this was thought of as a fairly good choice. It was easy to 3D print as it allows for motors to be attached to its sides. However, this design poses some stability issues and making it thicker would cause the standoff screws to not fit through the protrusion.



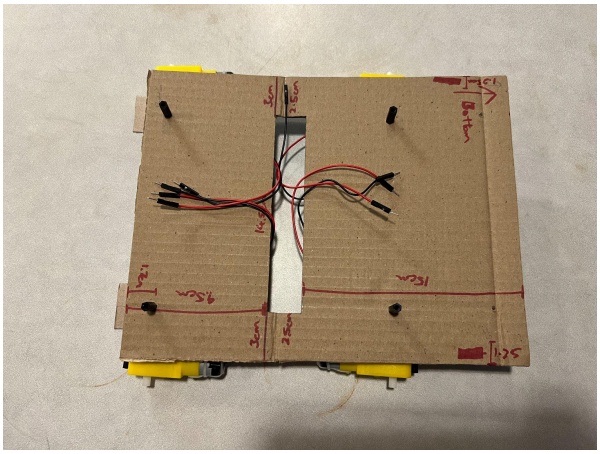

Suggestion 1

2) Have a clamp to secure the motor. However, attaching the clamp itself to the base would be challenging since it would be hard to be 3D printed together with the bottom layer. There were also concerns with the structural integrity of the attaching points.

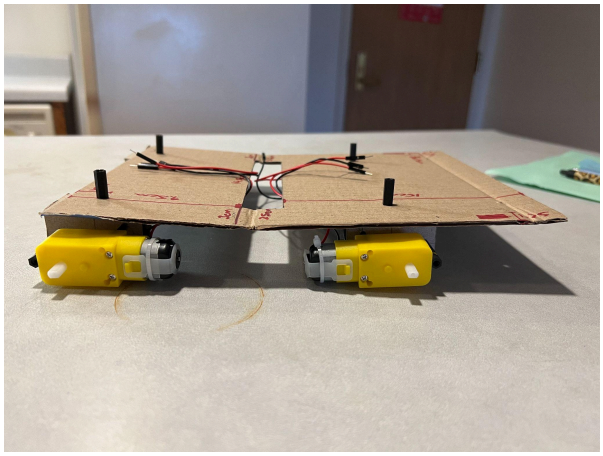



Suggestion 2

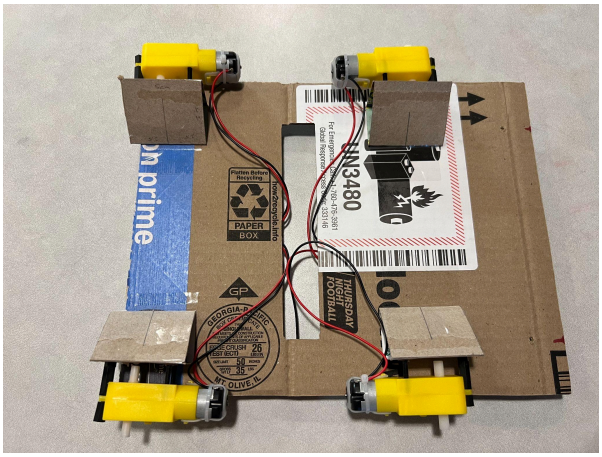
3) Use triangles to create extensions that can attach to both the bottom layer as well as the wheel motors. The usage of triangle extensions was that it would distribute the weight of the entire robot to the wheel motors effectively and maintain the stability of the overall structure. The following are pictures detailing the third suggestion.



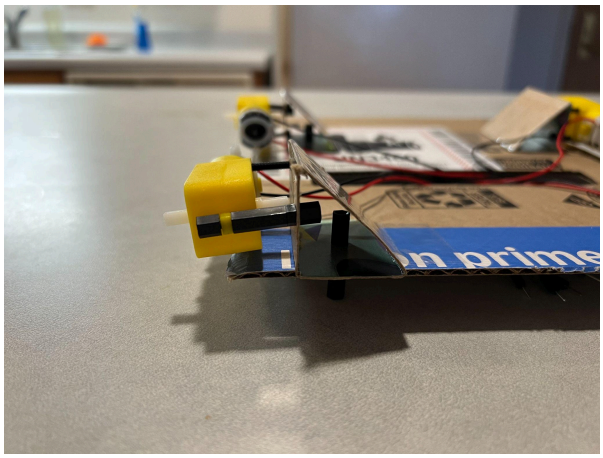
Top



Side



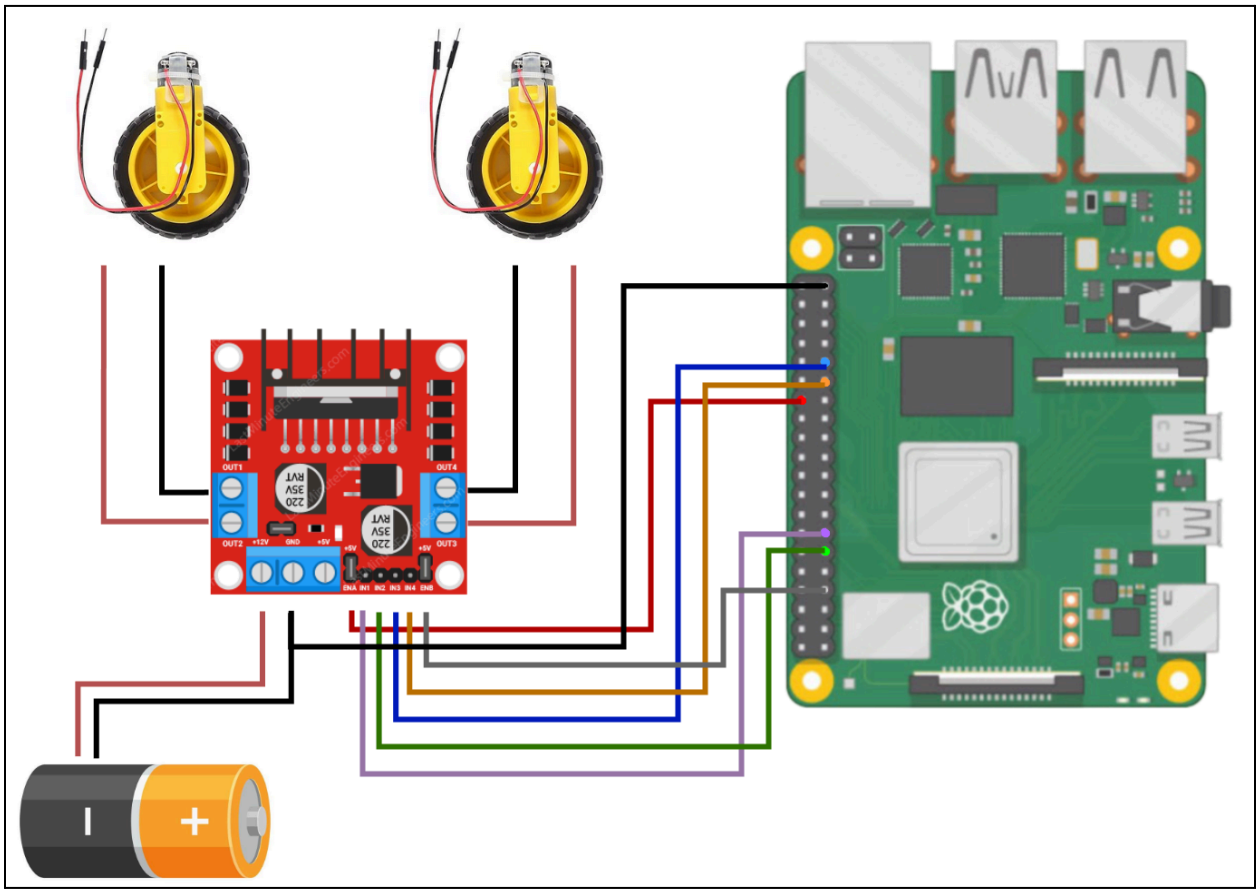

Bottom



Closeup

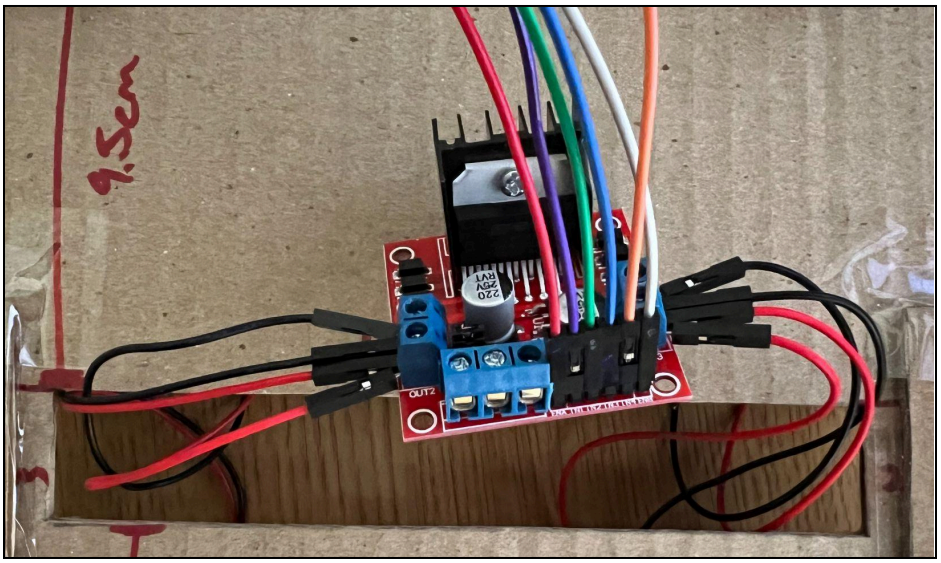
**2. Assembly of a remote-controlled, movable robot prototype using the cardboard chassis.**

The following wiring diagram has been created to illustrate the overview of how the raspberry pi, DC wheel motors, L298N motor driver, and batteries are wired together to create a remote-controlled, movable robot.



Robot Wiring Diagram

**i) Connection between the DC wheel motors and the L298N motor driver**




Wiring the wheel motors to the L298N motor driver was divided into two sections: one for the **left-side wheels** and one for the **right-side wheels**.

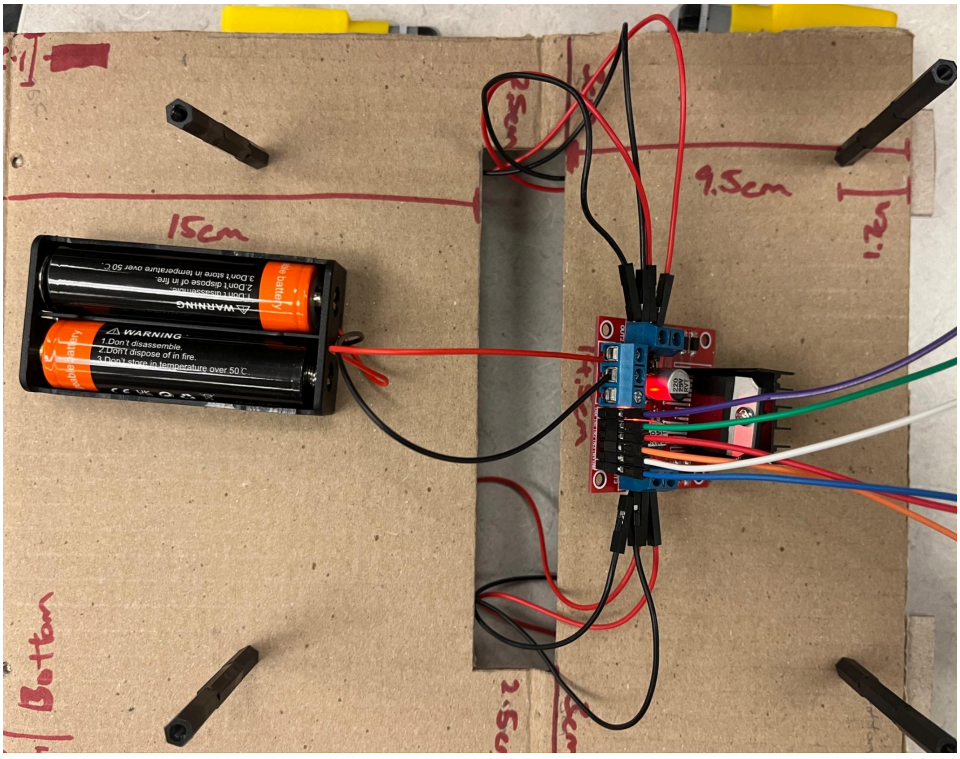
- For the **left-side motors** (front and back):
    - The **negative wires** are connected to the **OUT2 terminal** of the L298N.
    - The **positive wires** are connected to the **OUT1 terminal**.
- For the **right-side motors** (front and back):
    - The **negative wires** are connected to the **OUT4 terminal**.
    - The **positive wires** are connected to the **OUT3 terminal**.

As you can see, both the front and rear motors on each side are paired together and connected to either side of the motor driver. This is because from the raspberry pi's perspective, the robot only has two wheels, left and right, when in reality there are actually four. This is to simplify the process of moving and turning the robot and is shown in the table below.

| Movement | Left Side<br>(Left front and rear wheels) | Right Side<br>(Right front and rear wheels) |
|---|---|---|
| Forward | Forward | Forward |

| | | |
|---|---|---|
| Reverse | Reverse | Reverse |
| Left | Reverse | Forward |
| Right | Forward | Reverse |

**ii) Connection with the Raspberry Pi to the L298N motor driver.**




**L298N Motor Driver Pins (6 control pins)**

1. ENA - Controls power output (speed) and duration of rotation for the wheel left wheel motors.
2. IN1 & IN2 - Controls clockwise or counterclockwise rotation of the wheel motor.
3. IN3 & IN4 - Controls clockwise or counterclockwise rotation of the wheel motor.
4. ENB - Controls power output (speed) and duration of rotation for the wheel left wheel motors.

**Raspberry Pi GPIO Connections**

Female-to-female jumper cables (with pin headers) were used to connect:

- ENA → GPIO 1 (pin 28)
- IN1 → GPIO 17 (pin 11)
- IN2 → GPIO 27 (pin 13)
- IN3 → GPIO 6 (pin 31)
- IN4 → GPIO 5 (pin 29)
- ENB → GPIO 4 (pin 7)

The raspberry pi GPIO pinout was referenced to ensure all connections were correct. Since the raspberry pi has no hardware protections in place, an incorrect pin connection may result in permanent damage to the entire board. Caution is advised.

**Battery to L298N motor driver Connections (including raspberry pi)**

- 12V+ → negative wires of battery
- GND → positive wires of battery
- GND → pin 36 (to ground the connected components)

**2. 3D printing the chassis**

TBD

**3. Assembly**

TBD

**4. Testing basic movement commands**

TBD