Prototype Design & Evalutaion Plan

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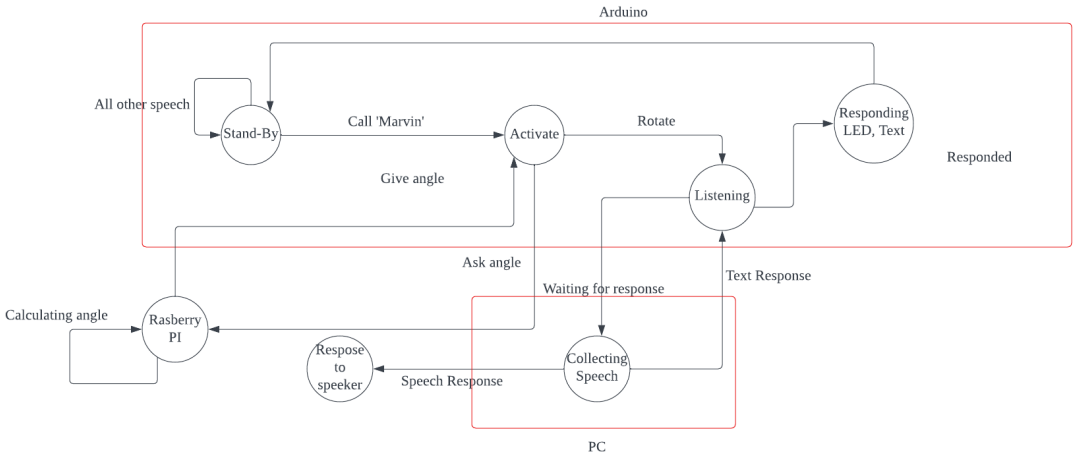
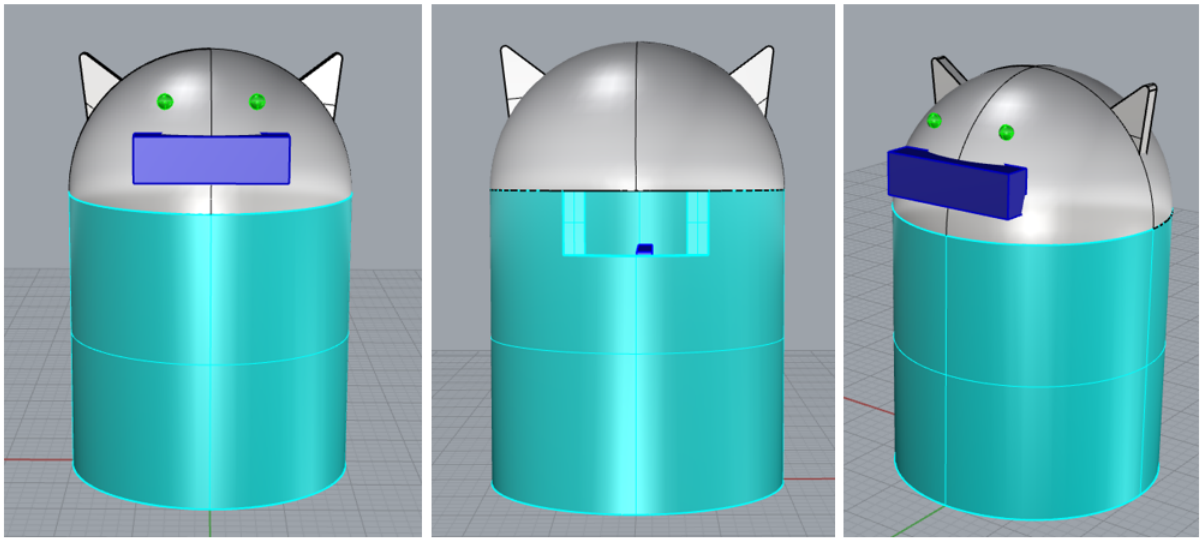
Series of potential designs



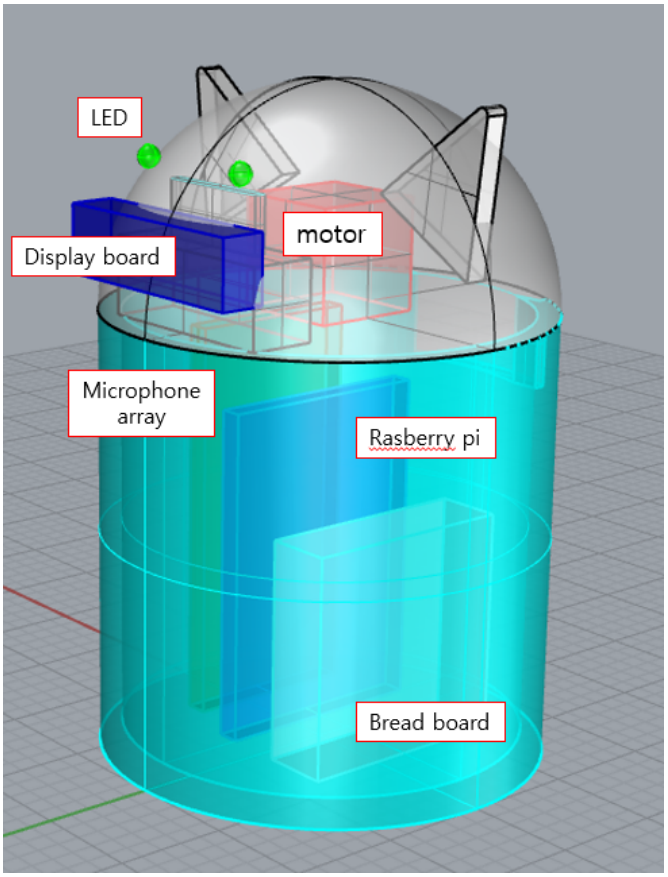
Finite State Machine (FSM)

A robot initially waits in a ‘stand-by’ state, but if someone calls out "marvin," it uses calculations within the Raspberry PI to turn its head in the direction of the person who called "marvin." It then displays the response to the question via both a microphone and text on the LLM (personal laptop). The current plan is to reset after a single response in our prototype with the intent of allowing for more dialogue in the future and resetting after hearing a keyword or a timeout.

Drawings/Sketches
<Robot Design>



Front, Back, Diagonal View of the Robot

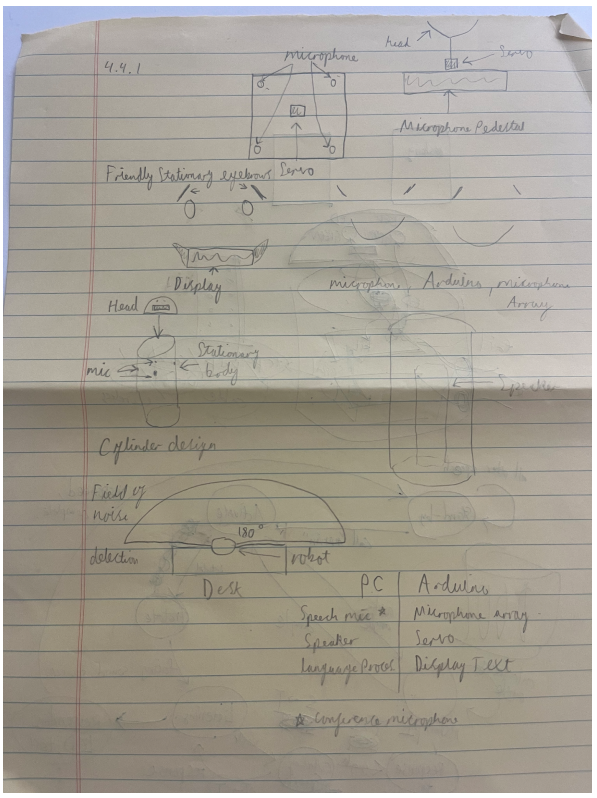


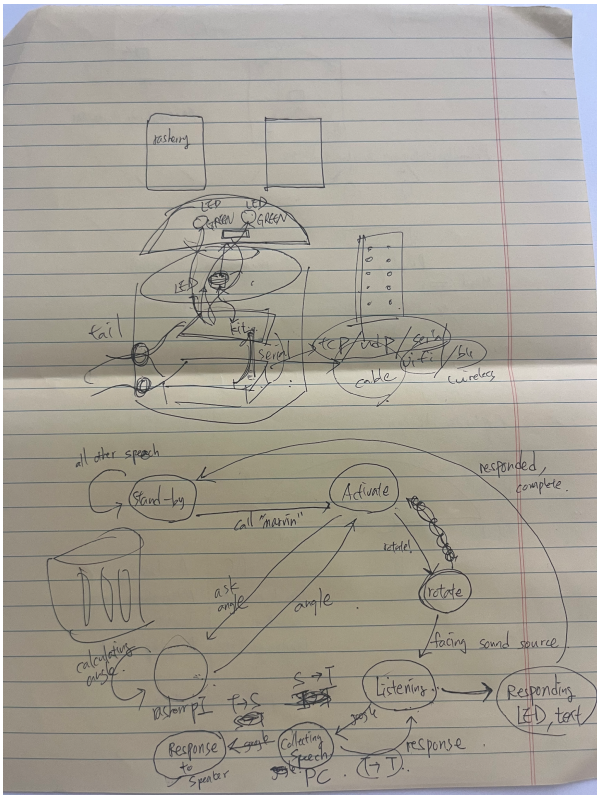
Inner view of the robot

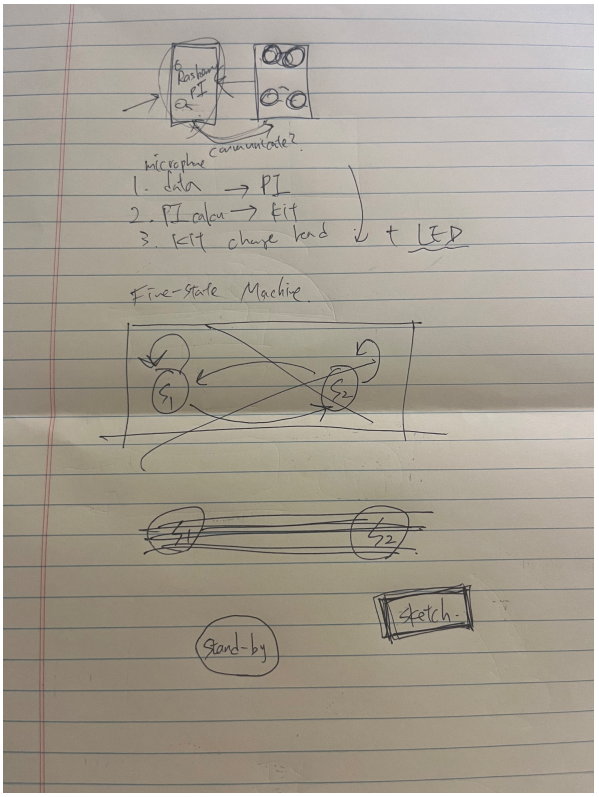
We wanted a user-friendly design, so we designed our robot like a cat. The LED and display board was designed as cat eyes and cat mouth. There is a big hole at the back to connect power cables.
The design is composed of two parts: Head(White) and Bottom(Sky Blue). Inside the head, the motor is attached, so the robot head can turn to the direction of the sound

coming from. The LEDs and display board will show that it is indicating the sound. Inside the bottom part of the robot, we put the microphone array, raspberry pi, and breadboard. We put all the components vertical due to simplification of the design, but the microphone array might be put horizontal because we only need to measure the sound source in 2D. We are thinking of constructing the robot with 3D printers.

<Sketches of plan for our robot>





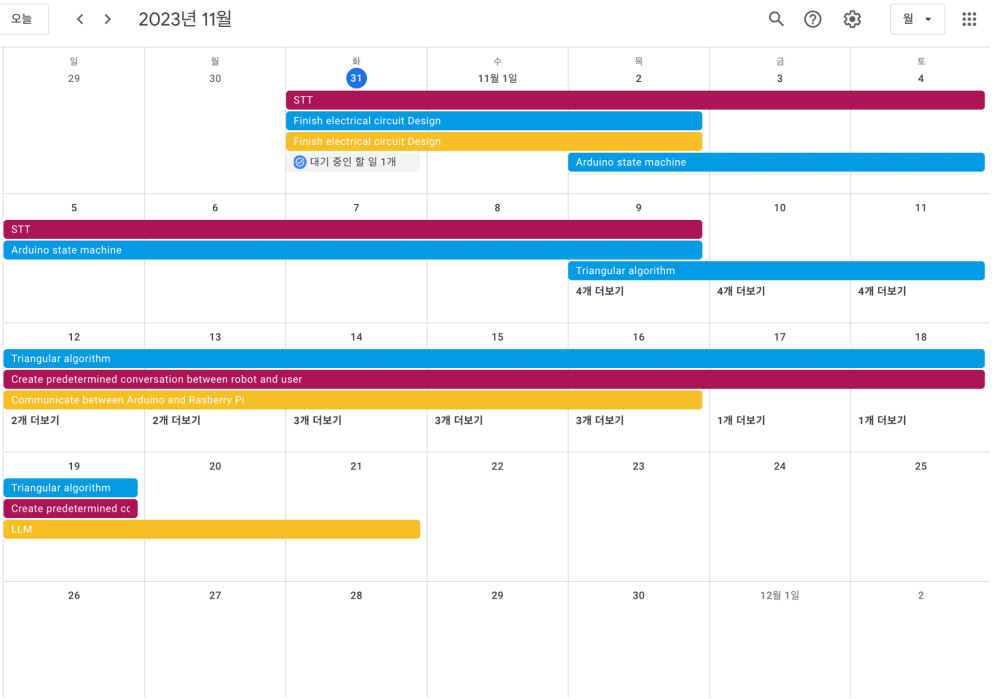


Weekly Plan

[Minkwan]
~11/2: Finish electrical circuit Design
~11/9: Arduino state machine
~11/19: Triangulation algorithm
~11/16: Communicate between Arduino and Raspberry Pi
~11/26: LLM

[Yeeun]
~11/9:STT
~11/16: TTS
~11/19: Triangular algorithm
Create predetermined conversation between robot and user
~11/26: LLM

[Will]
~11/2: Finish electrical circuit Design
~11/9: Arduino state machine
~11/16: Communicate between Arduino, Raspberry Pi, and PC
~11/21: Program Display
~11/26: LLM



Components needed building the robot

- 1x Arduino Uno
- 2x LEDs
- 1x Raspberry Pi
- 1x Mic Array Expansion Module - $19.12
- 1x Conference Microphone - $33.76
- 1x PC Speaker
- 1x Mini Breadboard
- 1x LED Display
- Filament for 3D Printer
- Cable between Raspberry Pi and Arduino

Final evaluation plan

1. Sound Source Detection
    a. robot placed on sheet with measured angles (kind of like a protractor printed on paper) success : error $\leq \pm 5^{\circ}$
    b. Person speaking holds a string taught that is connected to the printed protractor (this indicates the angle they are standing relative to the robot)
    c. Measure the resulting angle when the robot turns to the direction of the sound source.
    d. Calculate the percent difference between the two
    e. Repeat test for 6 different angles each at three different distances to acquire sufficient data
2. Check if **STT** works (the microphone array should recognize the people's word correctly) using predetermined conversations. Only the conference microphone and PC are needed. Ask 2 questions from 3 different angles at 3 different distances. Have three different people repeat this test. So that will make 18 tests for each person.

    Q. Where is the bathroom?
    Q. Where is the professor's office?

    a. If Marvin recognizes the important keywords(bathroom, professor, office) correctly, we can think of it as a success. However, if Marvin fails to recognize the important keywords, it is a failure.
    b. For each person, if there are 15 successes out of 18 tests, it is considered success.

3. Combine the two tests, evaluating both the sound source detection and STT with new participants using the same criteria as the last two tests having established an optimal range from Marvin.