

# Voice Activated Robot Arm

The Bespectacled Ones  
UCSB ME153 – Spring 2024

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## Problem Background

People with mobility problems may have trouble reaching item or interacting with the environment. Our project explores a human-interfacing robotic solution that enhances the autonomy of the user. The robot arm can interpret the user's voice, pick up a cup with the requested item in it, and place it within reach of the user.



Figure 1. Henry Evans and assistive caregiver robot, Stretch.

## Solution Overview

Our project has two degrees of freedom: horizontal base rotation and vertical arm rotation. The arm can maneuver with a maximum payload of 200 g, though this could be improved with a more powerful motor. The user's voice is picked up by an Arduino Nano 33 BLE Sense that uses the PicoVoice LLM API to parse the words.

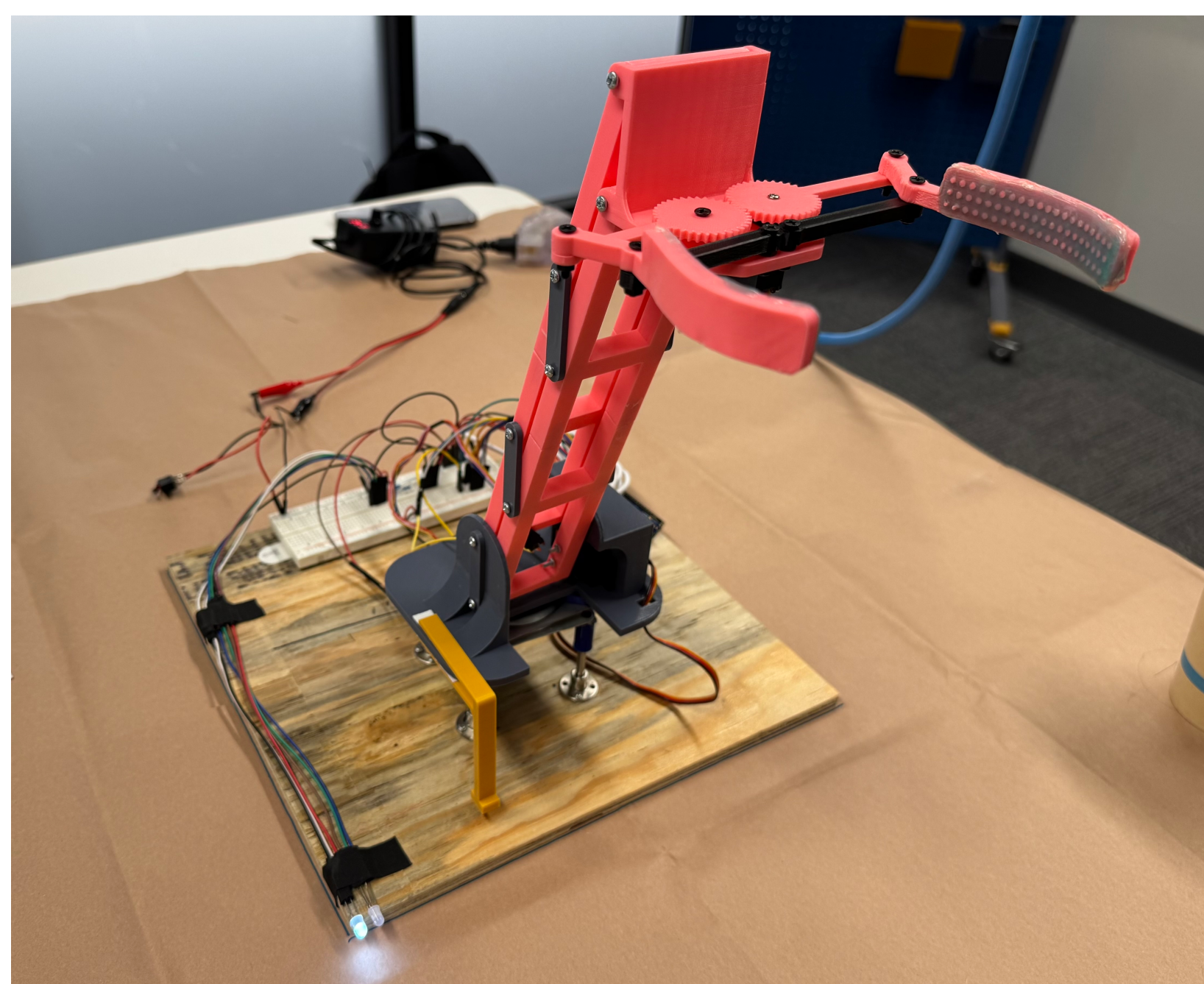


Figure 2. Final assembly of build

## CIRCUIT DIAGRAM STATE DIAGRAM

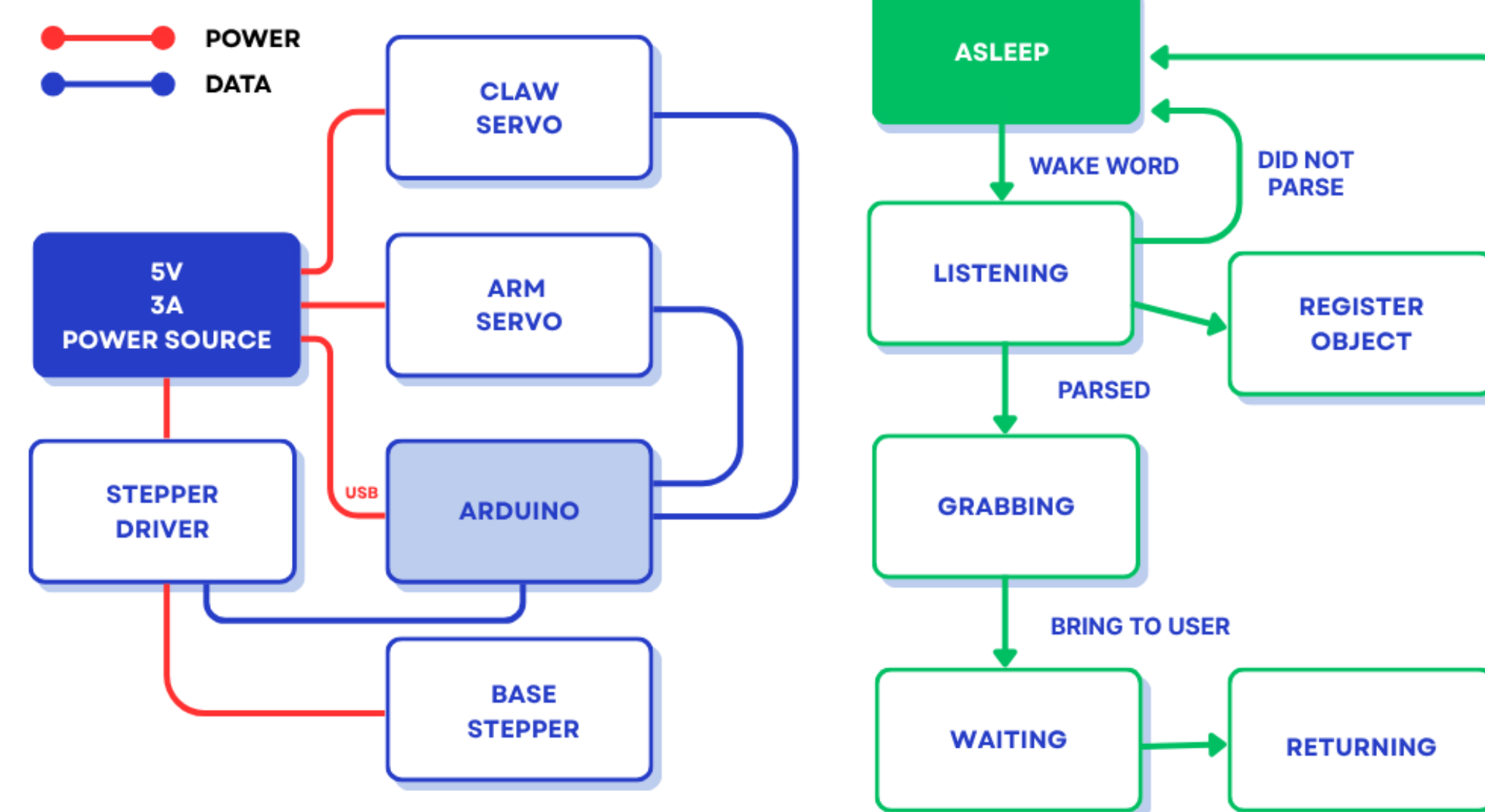
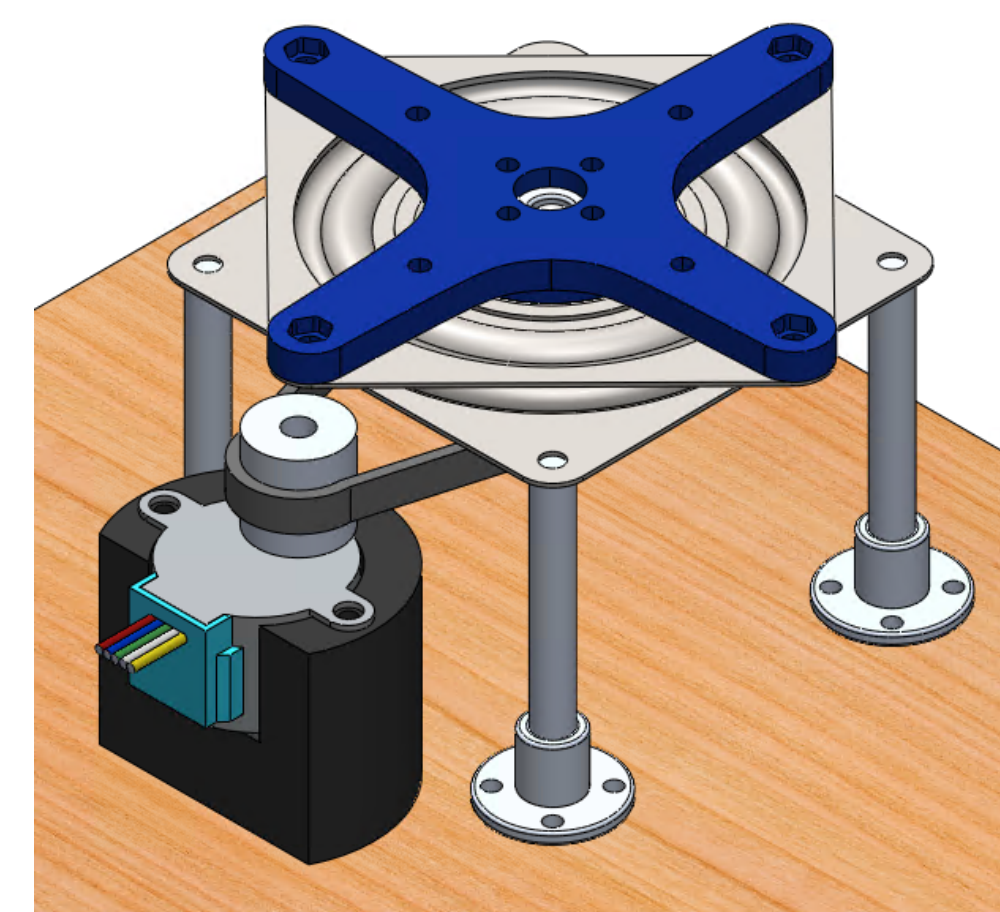


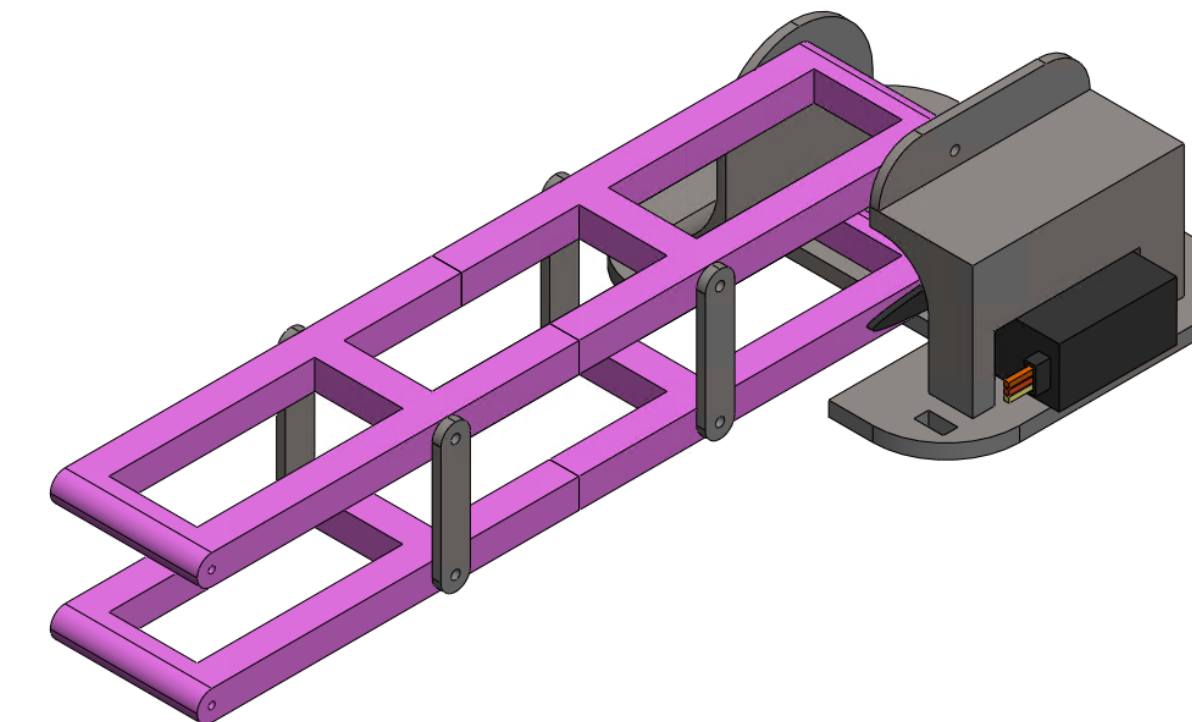
Figure 3. Circuit diagram and state diagram for software.

## Key Components



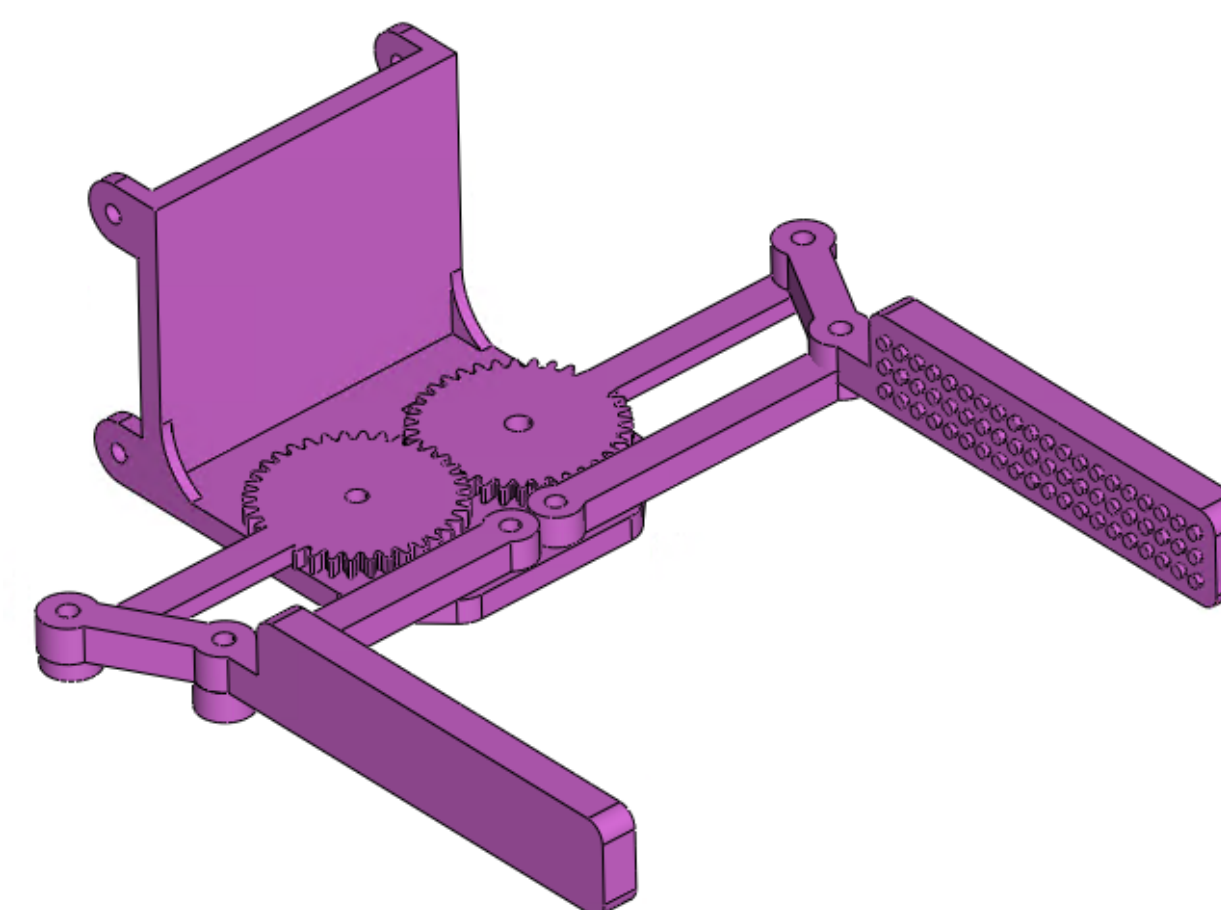
Base

Steel Square turnable powered by 5VDC 32-Step 1/16 Gearing Stepper Motor



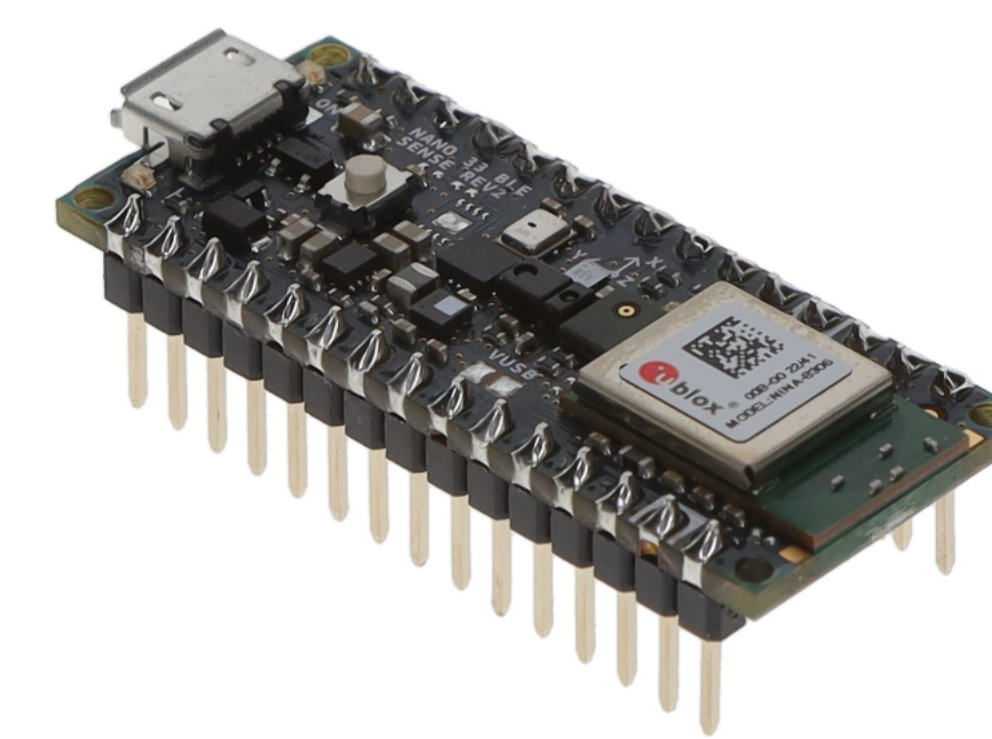
Arm

Parallel linkage arm allows claw to remain independent of vertical rotation. Powered by JX PDI-6225MG-300 servo



Claw

3D printed claw with MG90D servo. Inner claw surface has silicone rubber applied to increase grip.



Microcontroller

Arduino Nano 33 BLE Sense. Has microphone with PicoVoice LLM API flashed on for headless operation.

## Accuracy of arm

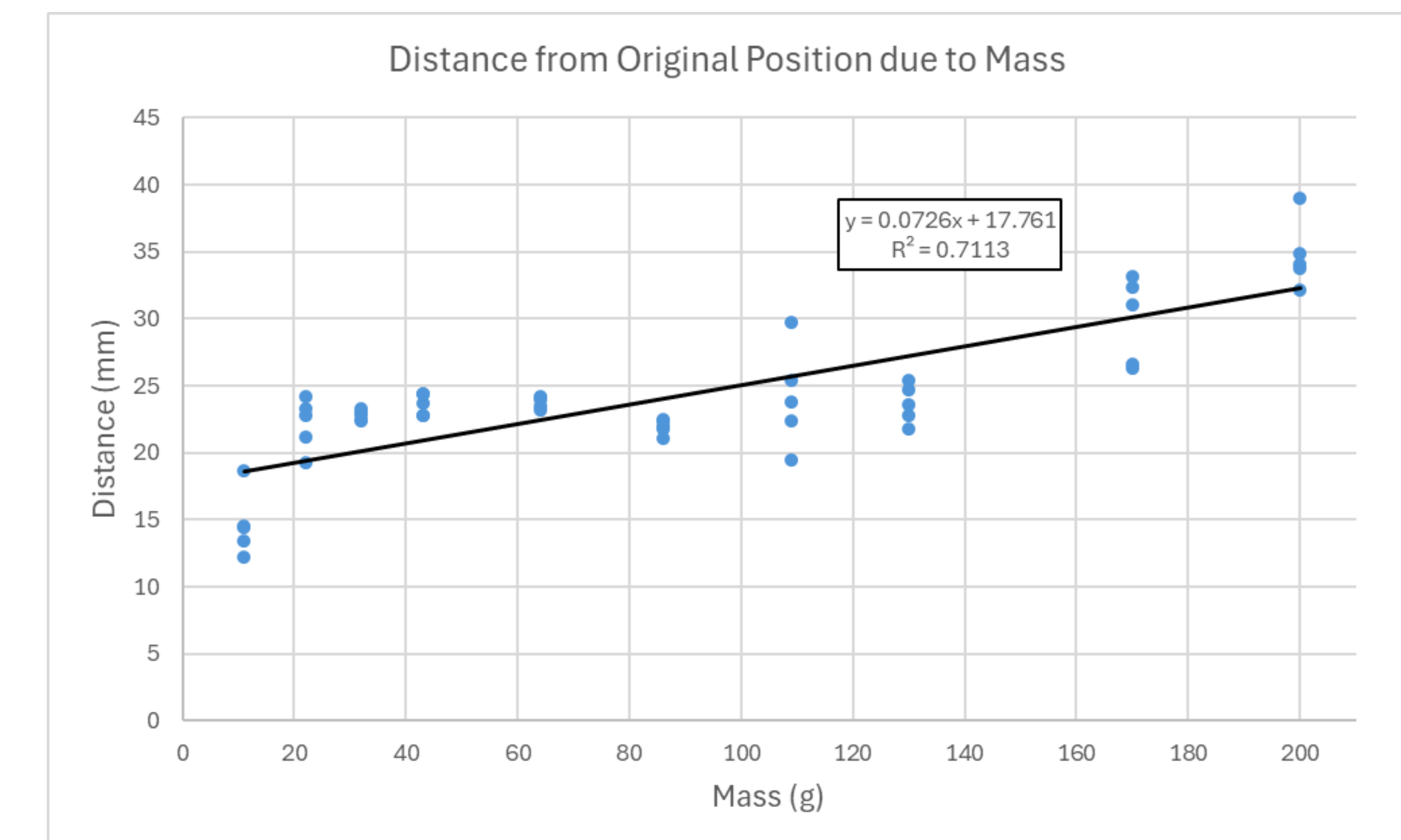


Figure 5. Mass vs. Standard deviation: study of arm's accuracy in positioning payload in original spot as a function of payload mass.

A series of tests was run to determine the displacement to the payload placement from the programmed placement spot. Payloads with lower mass are less susceptible to displacement, while heavier payloads tend to be placed slightly further from their programmed spot.

## Conclusion

That we were able to build this robot system within the allotted two months of work speaks to the scope of how far along human-interfacing robots has developed. Though this design concept is built with general mobility assistance in mind, the scope of this kind of tool could be effective in different environments such as labs or surgical operating rooms.

## Acknowledgments

Prof. Elliot Hawkes, Dr. Trevor Marks, Shehan Seneviratne, Ryan Abell, Ryan Herrick

## References

Claw Design Inspiration: Superb Tech  
PicoVoice API: <https://picovoice.ai/>  
Microcontroller image: <https://www.digikey.com>  
Stepper motor cad model: [grabcad.com](https://grabcad.com)  
Figure 1 credit: <https://spectrum.ieee.org/>