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# **StraightenUp Success: Sustaining Spinal Well-Being**

**ECE 196 – FA23**

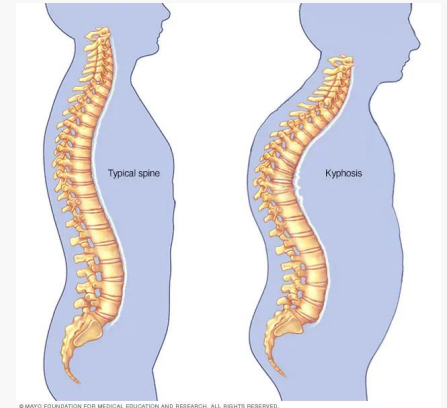
Oct. 26, 2023

Team SUS

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# What is the Problem?

**Forward Head Posture** is common among those who are spending many hours sitting in front of a desk, like **students** and **office workers**, which can result in health problems later in life.

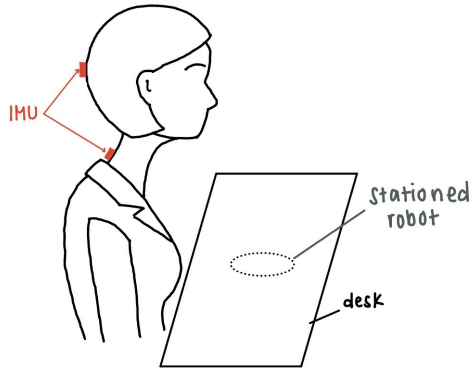


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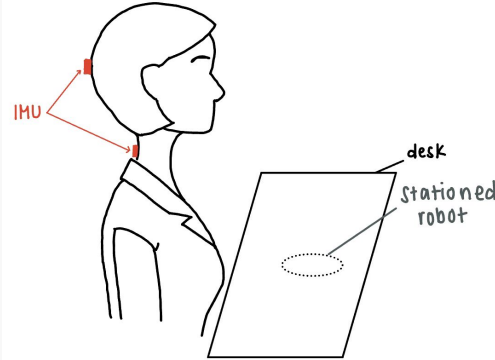
# StraightenUp Success

IMU sensors will detect when head and/or cervical angle is out of a defined range. Robot will initiate tap response until user corrects their posture to acceptable range.

(A) Forward Head Posture

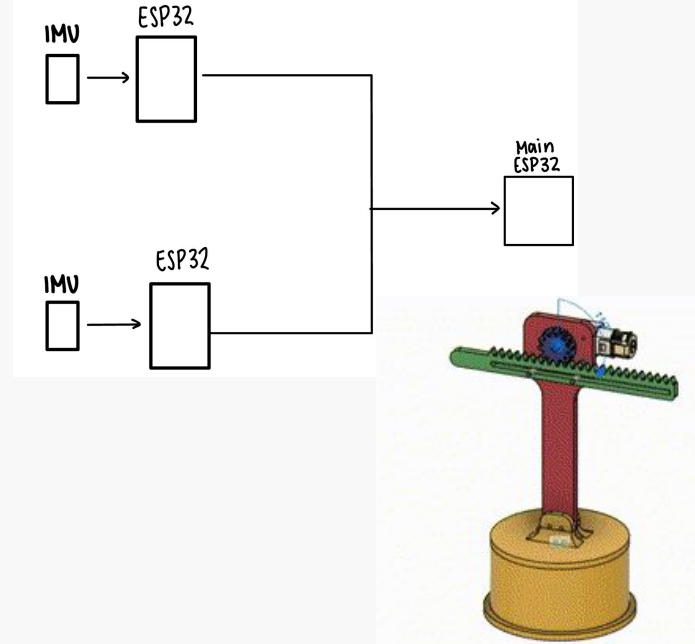


(B) Healthy Posture



## Key Components:

- ESP32
- 2 IMU
- Geared Motor
- WROOM 32



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# Hypothesis

*We can implement a stationary robot in addition to equipping the user with IMUs to monitor and remind proper neck posture.*

## Control Group

- ❖ Equipped with both IMU's
- ❖ **No tap response**
- ❖ Log count of bad posture

## Experimental Group

- ❖ Equipped with both IMU's
- ❖ **Tap response enabled**
- ❖ Log count of bad posture

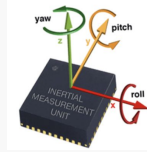
# Key Milestones

1

## IMU

11/22/2023

Ensure we are able to detect neck posture with 2 IMU's.



4

## Analytics

12/3/23

Monitor and display neck posture analytics.

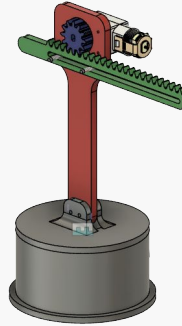


2

## Tap Response

11/22/2023

Ensure our arm device is able to tap the user with bad neck posture.



5

## Third IMU

Integrate a third IMU to improve accuracy of forward neck posture.

3

## Mechanical Design

11/30/23

Ensure the mechanical design of the robot is feasible

6

## Intensify Response

Ensure our device can intensify the response when the user continues to stay in bad neck posture.

# Challenges

- Functioning Motor ✓
- Ensuring real-time wireless communication ✓
- Ensuring Deterministic Start/Stop behavior for Motor ✓
- Mechanical tolerances ✓
- Hardware Wiring ✓

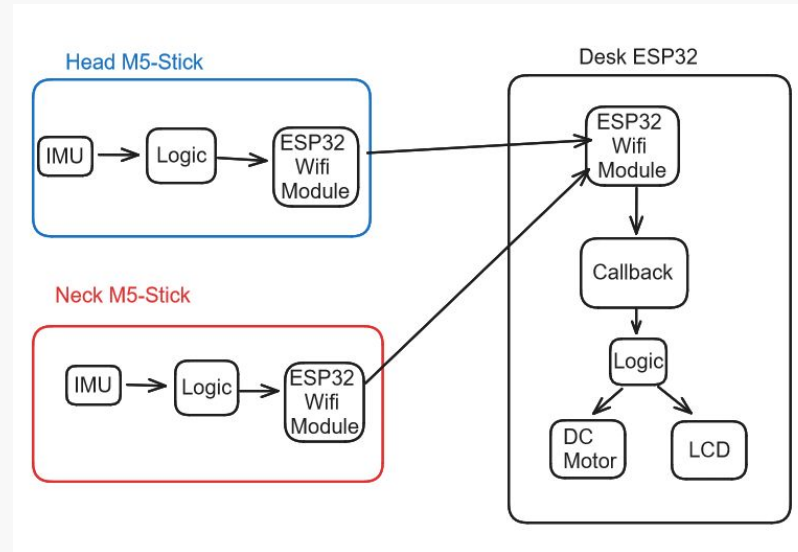
# Prototype - IMU

$$\theta_{head\ pitch} = 90 - \tan^{-1}\left(\frac{z_1}{y_1}\right)$$

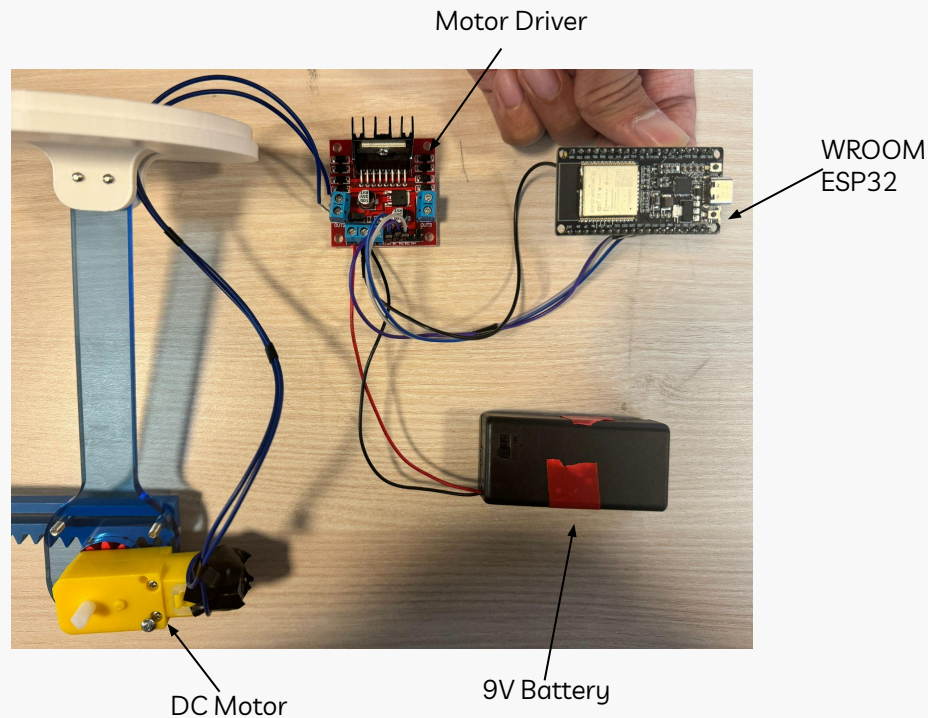
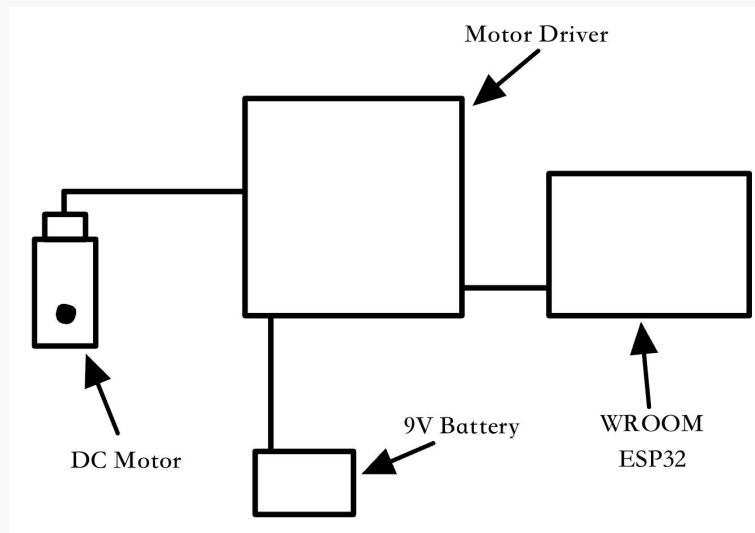
$$\theta_{cervical\ pitch} = 90 - \tan^{-1}\left(\frac{z_2}{y_2}\right)$$

Bad Posture:

- Head Pitch > 30°
- Cervical Pitch > 45°

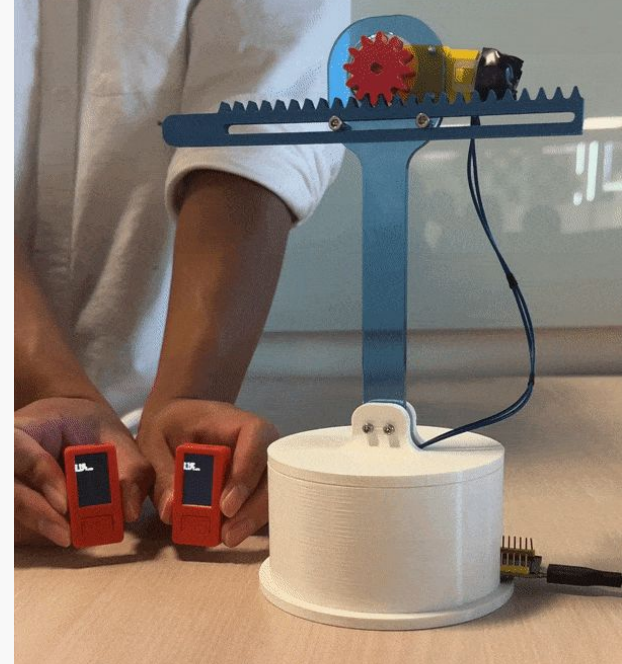
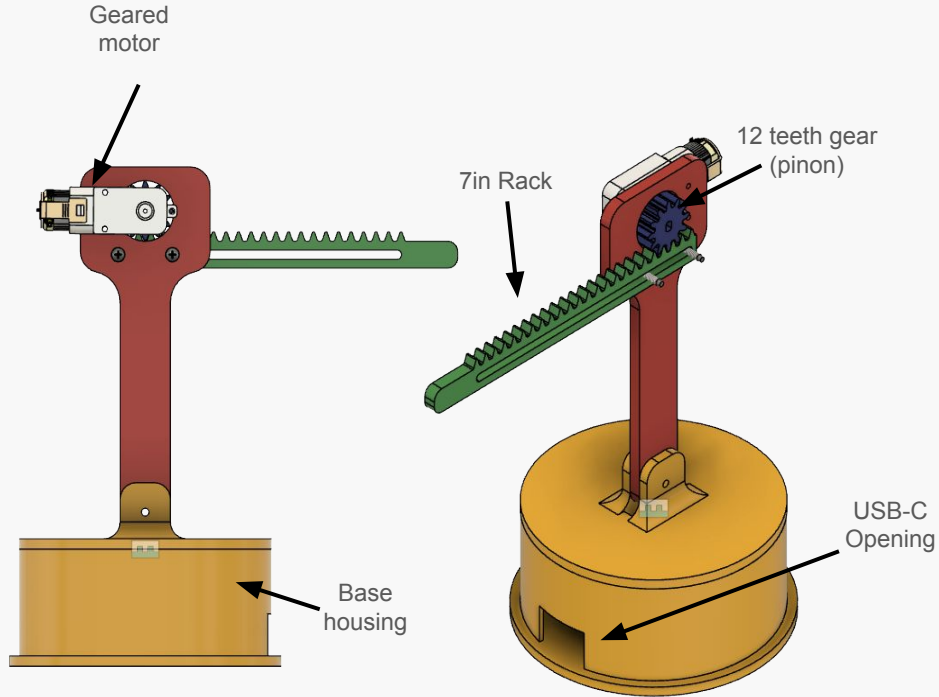


# Prototype - Hardware



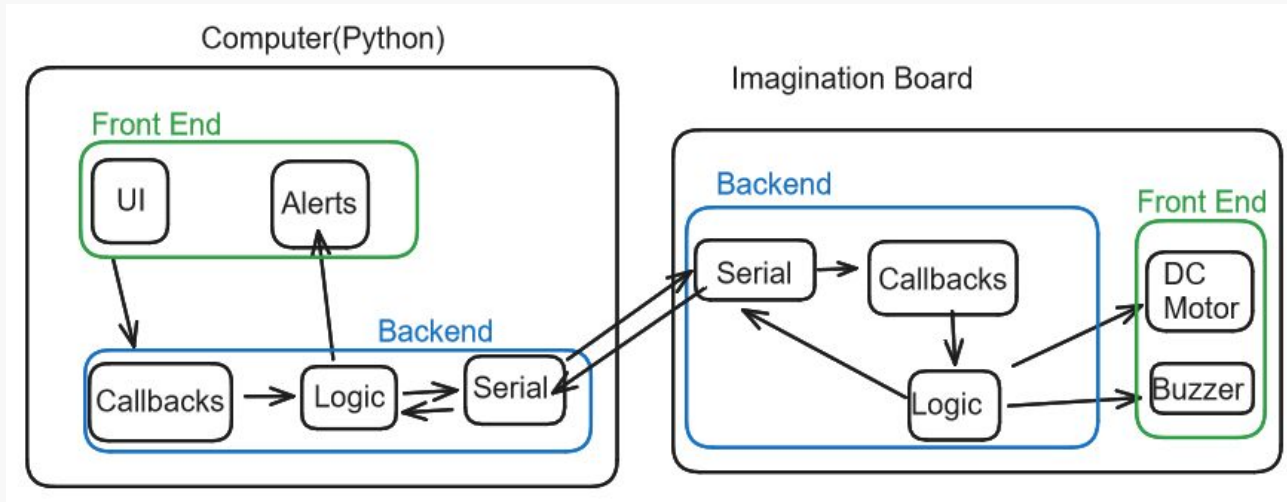


# Prototype - AlignBot



# Tutorial: DC Motor & Piezo Buzzer

Utilizing the Imagination Board to control the speed of a DC motor, while simultaneously controlling the frequency of a Piezo Buzzer.



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# References

1. **Head and Neck Desired Angles:** Helps define “good posture”
2. **IMU Placement:** Aids in determining IMU body placement
3. **Effects of bad posture:** Why bad posture is detrimental to quality of life
4. **IMU Basics:** Guide on how IMU's work
5. **M5StickC-Plus:** Guide to convenient development board with ESP32 and IMU
6. **ESP-Now:** Guide to using a wireless protocol for real-time communication
7. **Driving a Motor Using an ESP32:** Programming resource
8. **Arduino Reference:** Guide on how to navigate Arduino
9. **I2C LCD:** Guide on how to implement LCD using ESP32

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# Thank You

Questions?