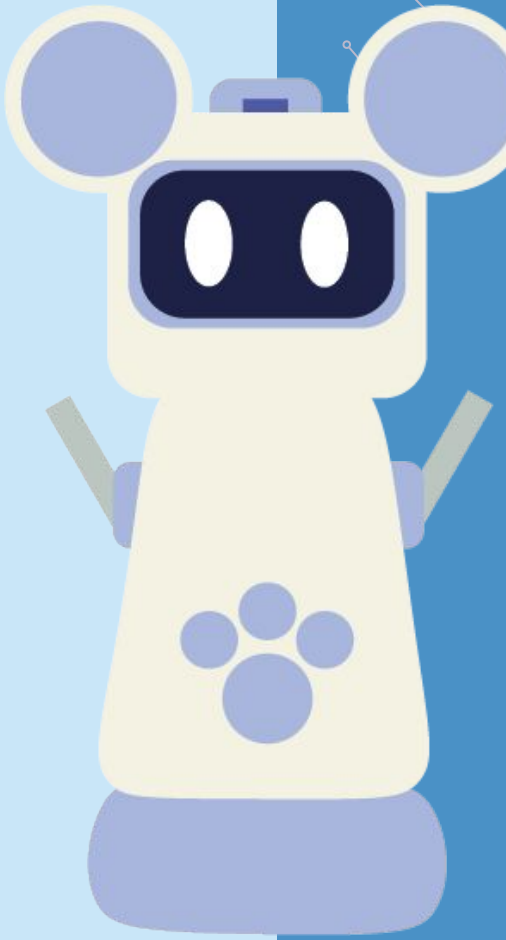
# Team E6: Study Bearbot

Taylor Kynard and Kayla McFarlane

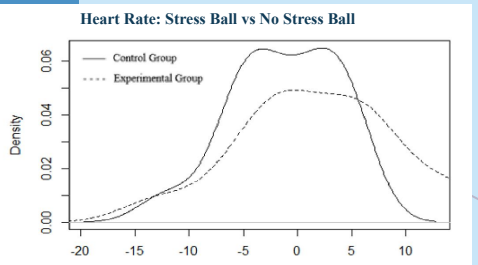


# Use-Case

## Research

- PARO

  - Therapeutic robotic seal used to reduce stress and anxiety in patients [1]
  - 5 different kinds of sensors for the user to interact with
- Aromatherapy & Stress Balls
  - Calming scents **proven** to be therapeutic and aid in relaxation
  - In a study, aromatherapy improved sleep quality by **46%** and quality of life by **39.7%** [2]
  - Studies have shown that **stress balls helped reduce stress** [3]




## Goal

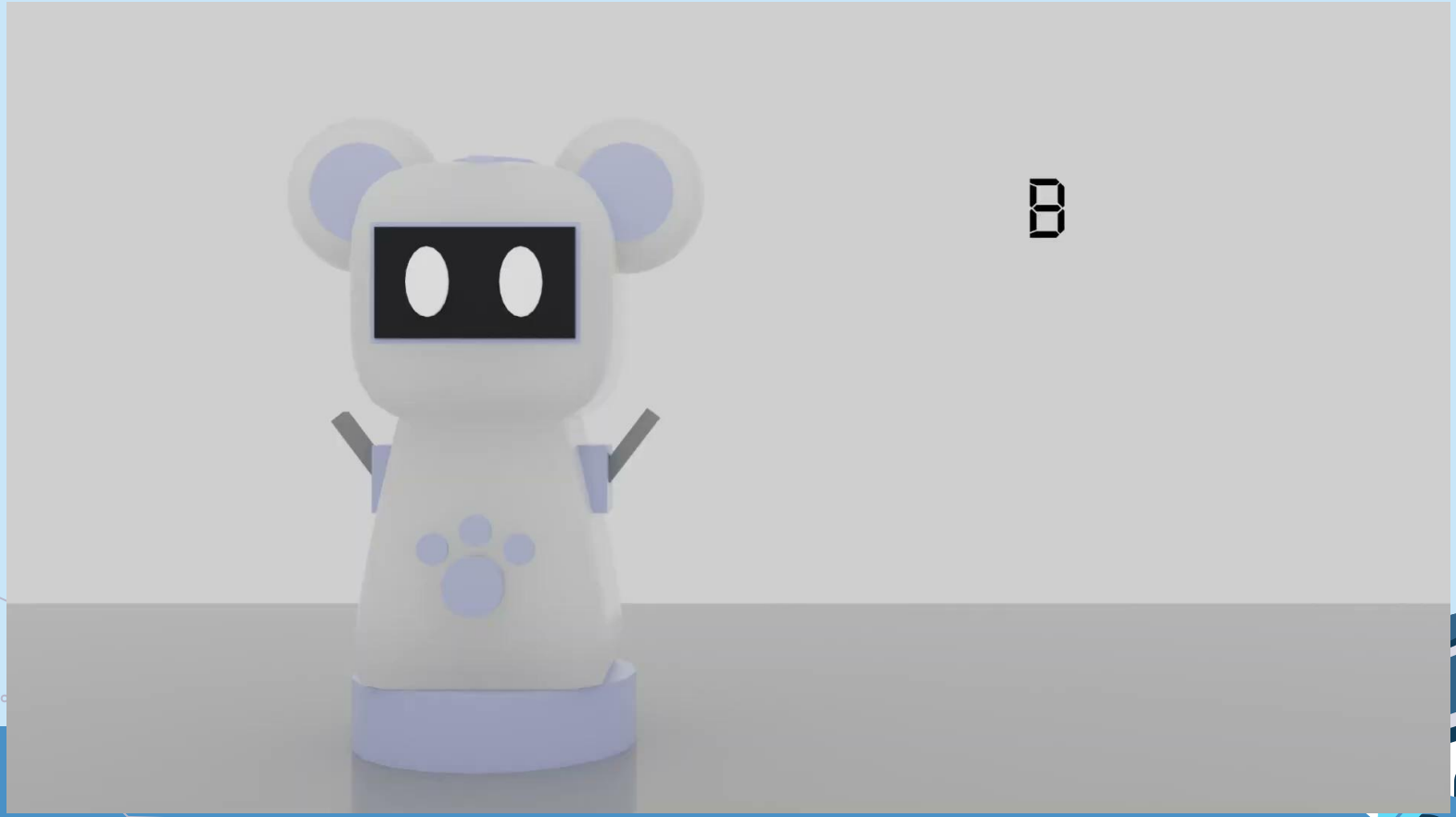
- Make Studying a Little Less Stressful and a Little More Fun!
  - A StudyBuddy that serves as an interactive desktop companion
  - Transportable, with multiple features catered to studying
  - Additional fidgeting component
  - Soft and Squeezable
- Target Audience: Teens & Adults
  - Enjoy virtual pets
  - Struggle to stay on task
  - Get stressed easily


**References**

[1] Rashid NLA, Leow Y, Klainin-Yobas P, Itoh S, Wu VX. The effectiveness of a therapeutic robot, 'Paro', on behavioural and psychological symptoms, medication use, total sleep time and sociability in older adults with dementia: A systematic review and meta-analysis. Int J Nurs Stud. 2023 Sep;145:104530. doi: 10.1016/j.ijnurstu.2023.104530. Epub 2023 May 19. PMID: 37348392.

[2] Tisserand, Hana. "Aromatherapy Blend Inhalation for Better Quality of Life - Tisserand Institute." Tisserand Institute, 9 Apr. 2021, tisserandinstitute.org/learn-more/aromatherapy-blend-better-sleep/.

[3] Alvarez, J. Garcia et al. "Effectiveness of Stress Balls in Reducing the Physiological Symptoms of Stress." (2015).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# Use-Case Requirements

- Response Time ≤ 1 Second
  - Most remote controls have a response rate of **100 ms** [1]
  - Raspberry Pi can give a reaction time as short as **22 ms** [3]
- Scent Diffusion Lasts for ~ 1 Hour
  - An **hour** of scent diffusion is enough to **fill a whole room** [4]
  - Minimize refill rate
- Battery Life of 2 Hours
  - The Eilik Robot has a battery life of **1.5** hours
  - On average, full-time college students **study** 15 hours a week [2] → **~2 hrs/day**
- Limitations of Bearbot & Safety
  - Can't shake aggressively **X**
  - Liquid is cold & harmless ✓


**References**

[1] Ali, Al-Sabri Akram, and Xianan Bao. "Design and Research of Infrared Remote Control Based on ESP8266." OALib, vol. 08, no. 04, Scientific Research Publishing, Jan. 2021, pp. 1–14, https://doi.org/10.4236/oalib.1107314. Accessed 3 Feb. 2025.

[2] Bart, Mary. "Students Study about 15 Hours a Week, NSSE Finds." *Faculty Focus | Higher Ed Teaching & Learning*, 17 Nov. 2011, www.facultyfocus.com/uncategorized/students-study-about-15-hours-a-week-nsse-finds/#:~:text=Findings%20released%20today%20show%20that,study%2015%20hours%20a%20week. Accessed 3 Feb. 2025.

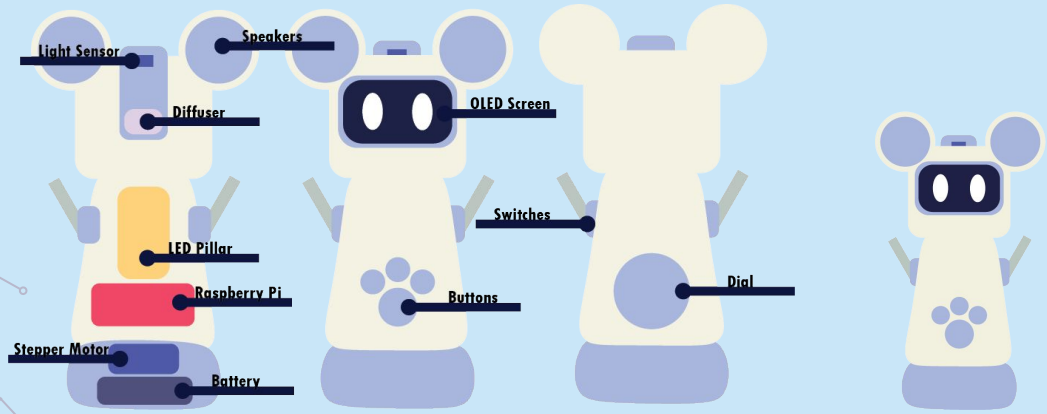
[3] Ricard Franch Argullol, "Analysis of Raspberry Pi PLC pinout time response" Industrial Shields, 13 June 2023 https://www.industrialshields.com/blog/raspberry-pi-for-industry-26/analysis-of-raspberry-pi-plc-pinout-time-response-540

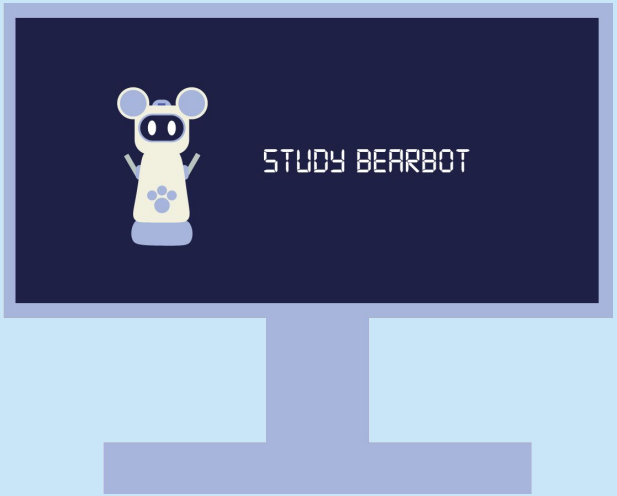
[4] Laura Garvin Gomez, "How many Drops of Essential Oil in a Diffuser" Nikura, 26 Feb, 2023 https://nikura.com/blogs/discover/how-many-drops-of-essential-oil-in-a-diffuser#:~:text=Most%20diffuser%20models%20can%20run,whole%20of%20your%20sleeping%20period.

# Technical Challenges

- Silicone Cover & Stress Ball Material
  - User must be able to **feel and squeeze a comfortable exterior**
  - User must be able to **see the light from inside** the bearbot
- Touch Sensor Placement & Interactivity
  - User must be able to have **interactivity** with the bearbot
- Syncing
  - User must be able to interact with the bearbot i**n a quick manner** (in all 3 modes: physical buttons, web-app buttons, voice-control)
- Web App Interface
  - User must be able to f**ind interface intuitive and simple to use**

# Solution Approach



# Solution Approach - In Detail

**Hardware**

**Inputs:**
Buttons
Switches
Microphone
Dial
Light Sensor
Touch Sensor

**Firmware**

**Outputs:**
OLed Screen
Stepper Motor
Leds
Speakers
Scent Diffuser

**Software**

- Voice-controlled commands
- Web App Interface (Possibly)
- Study Timer (Robot displays time)
- Another mode for controlling the robot (i.e turning on/off sound, scent diffusion, etc)
- Fidget mode
  - On: buttons and switches are inactive
  - Off: buttons and switches are active

**Raspberry PI**

**Buttons**

- Giant Button switches between fidget mode and study mode
- Smaller three buttons:
  - left button: decrease
  - right button: increase
  - middle: selects option

**Microphone**

- Used for user-controlled voice-commands
- If the user says "bearbot", it will turn towards the user.

**Switches**

- non-dependent on user input
- "arms" of the bear go up when the timer is up, down other.

**Stepper Motor**

- lets the robot rotate around (180 degrees)

**LEDs**

- Illuminates the inside of the robot
- (Thinking of using CoD LED)

**Dial**

- Controls speaker volume (if !fidget_mode)
- Acts as a fidget component (if fidget_mode)

**Speaker**

- Plays calming sounds
- reacts to timer and mode switches

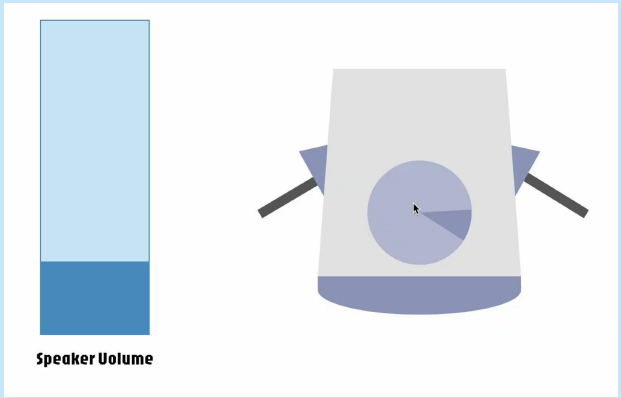
**OLED Screen**

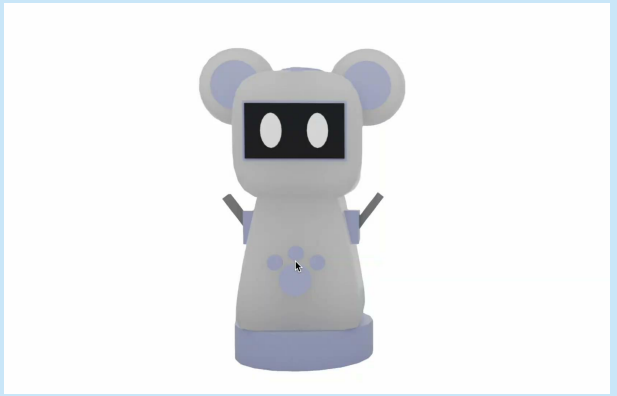
- reacts to user inputs
- used for timer, clock, and eyes
- would show the different faces the studybearbot would make. Reactive to touch on its body. Maybe sleepy eyes if it's dark, smiling eyes, etc

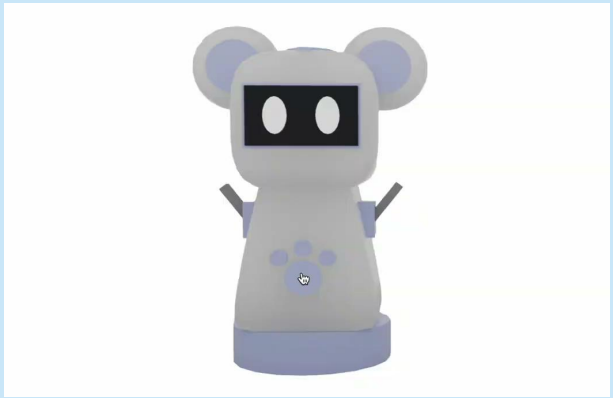
**Touch Sensor**

- Used for turning on the light inside

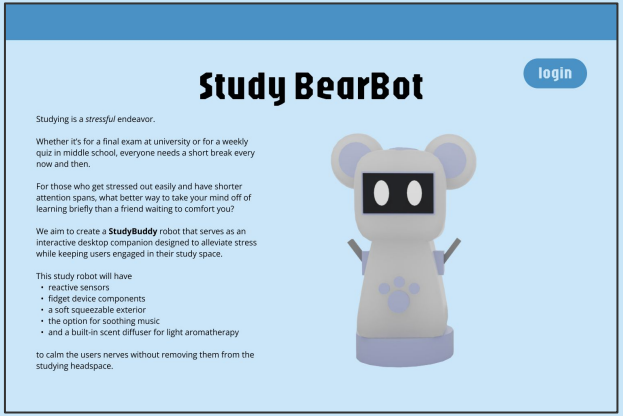
# Solution Approach - Prototype Demos



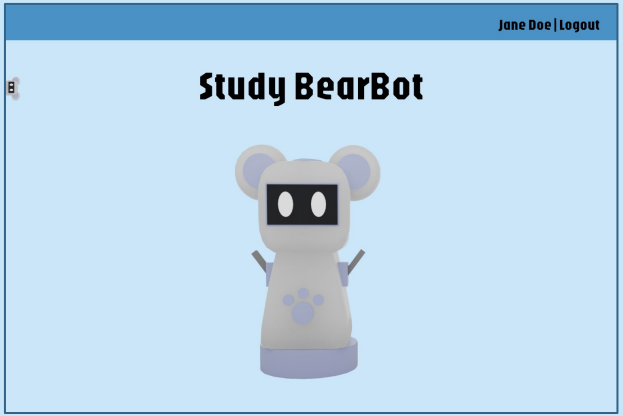



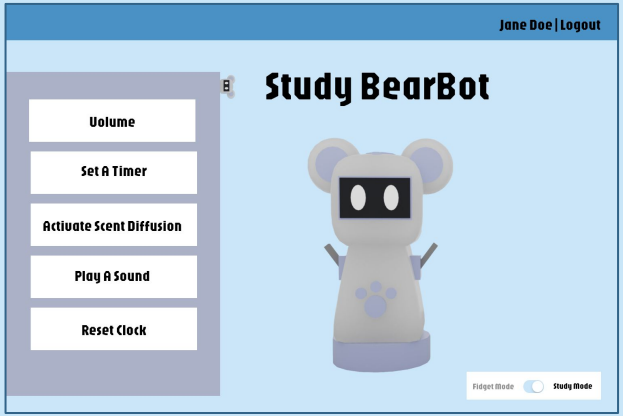


# Solution Approach - Web App Wireframes



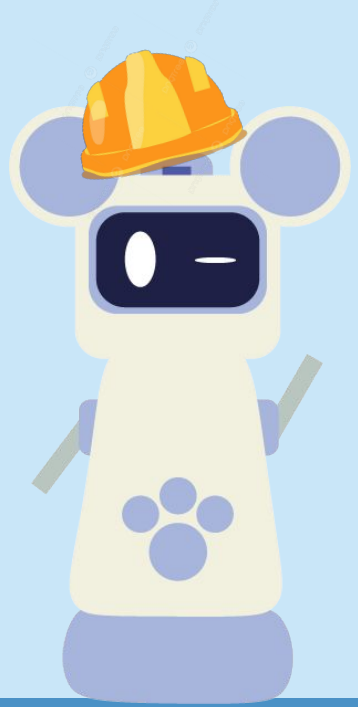




# Testing, Verification and Metrics

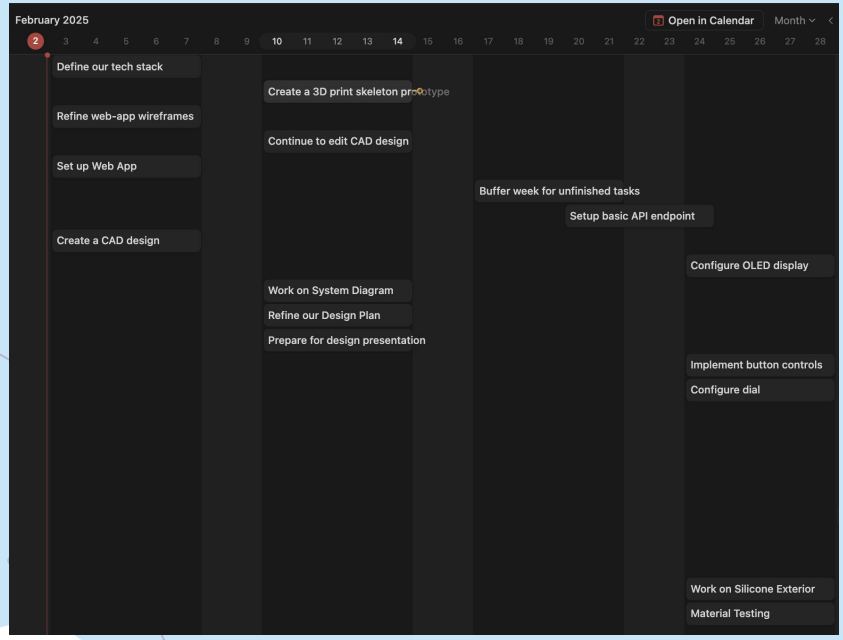
- Conduct a Survey with 5-10 Students for 1 Hour Questions on a Scale of 1 - 10
  - Measure stress relief
  - Measure ability to focus on the task at hand
  - Measure enjoyment
- Take a Video Recording of the Study Session
  - Measure amount of times interacted with Bearbot
  - Measure reaction time of Bearbot

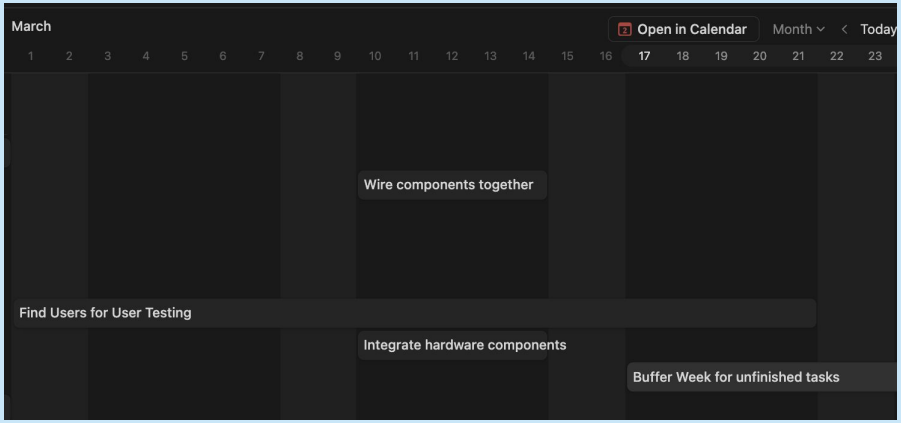


# Tasks and Division of L

| Category | Tasks | Assigned To |
|---|---|---|
| Software | • Define our technology stack<br>• Refine web-app wireframes<br>• Develop web-app backend/frontend<br>• Have basic API endpoint setup to connect the web app with the robot | Kayla |
| Firmware | • Configure OLED display (eye/facial expressions, clock, timer)<br>• Configure dial for volume control<br>• Implement button controls (modes, timer, scent diffusion) | Kayla |
| | • Integrate hardware components | Kayla & Taylor |
| Hardware | • Create CAD design<br>• Create a 3D print skeleton prototype<br>• Wire components together<br>• Assemble the Robot<br>• Work on Silicone Exterior<br>• Material Testing<br>• Go back and make some changes if needed & reprint | Taylor |
| User Testing | • Small-scale user study (~10 students)<br>• Survey to evaluate effectiveness | Kayla & Taylor |

# Schedule


February 2025
Open in Calendar
Month
Define our tech stack
Refine web-app wireframes
Set up Web App
Create a CAD design
Create a 3D print skeleton prototype
Continue to edit CAD design
Work on System Diagram
Refine our Design Plan
Prepare for design presentation
Buffer week for unfinished tasks
Setup basic API endpoint
Configure OLED display
Implement button controls
Configure dial
Work on Silicone Exterior
Material Testing


March
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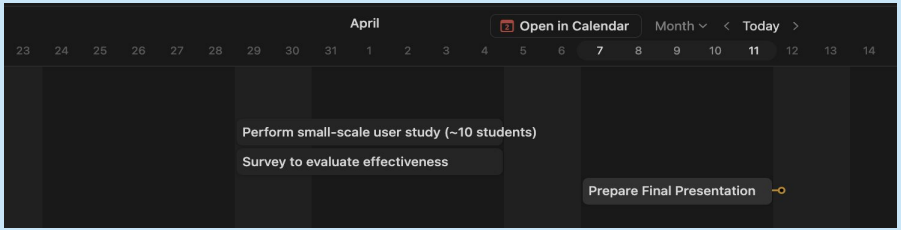
Month
Today
Wire components together
Find Users for User Testing
Integrate hardware components
Buffer Week for unfinished tasks


April
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Month
Today
Perform small-scale user study (~10 students)
Survey to evaluate effectiveness
Prepare Final Presentation