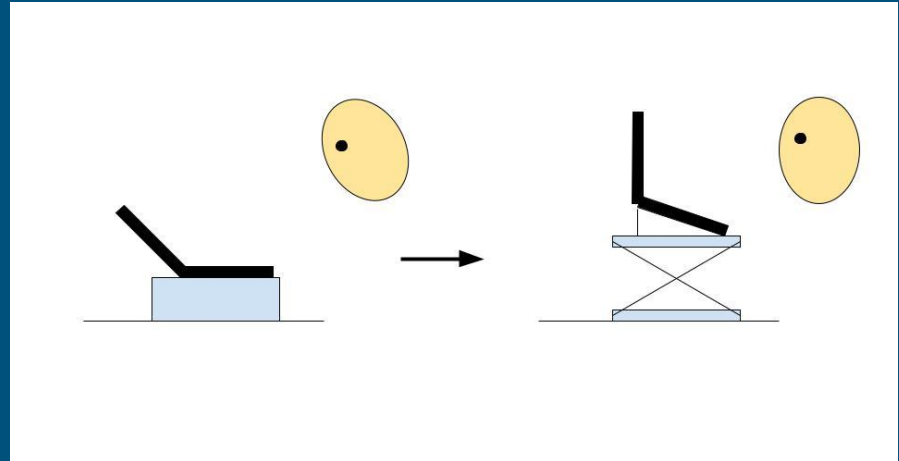


Uses Case Review

Problem: Laptops are not **ergonomic** and most computer stands require **manual** adjustment

Solution: a computer stand that automatically **lifts** and **angles** your laptop

- Also detects slouches
- Limits eye fatigue
- Displays posture progress



Quantitative Design Requirements

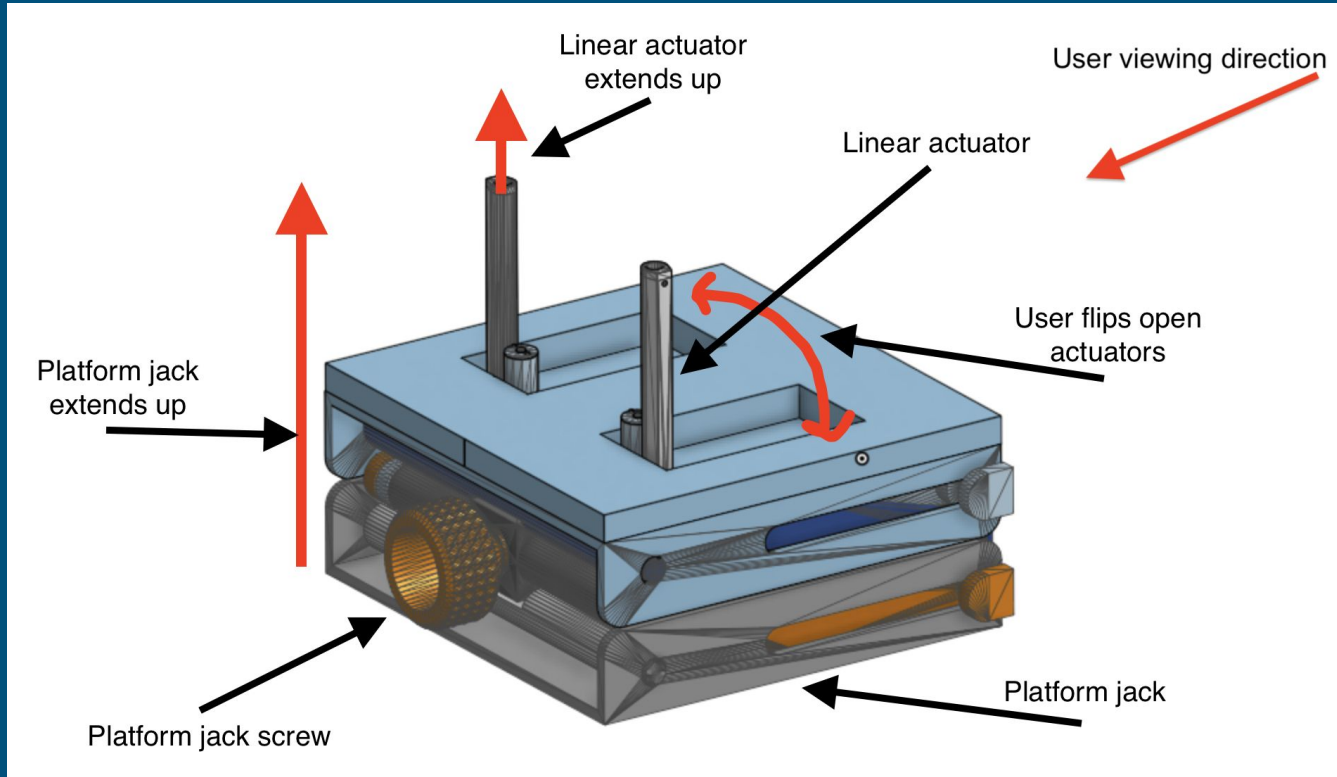
User Interface

- User can angle screen of PC to arbitrary angle
- Device weight < 4 lbs
- Device battery lasts 8 hrs
- Notifications for slouching and eye fatigue
- Progress tracking through GUI

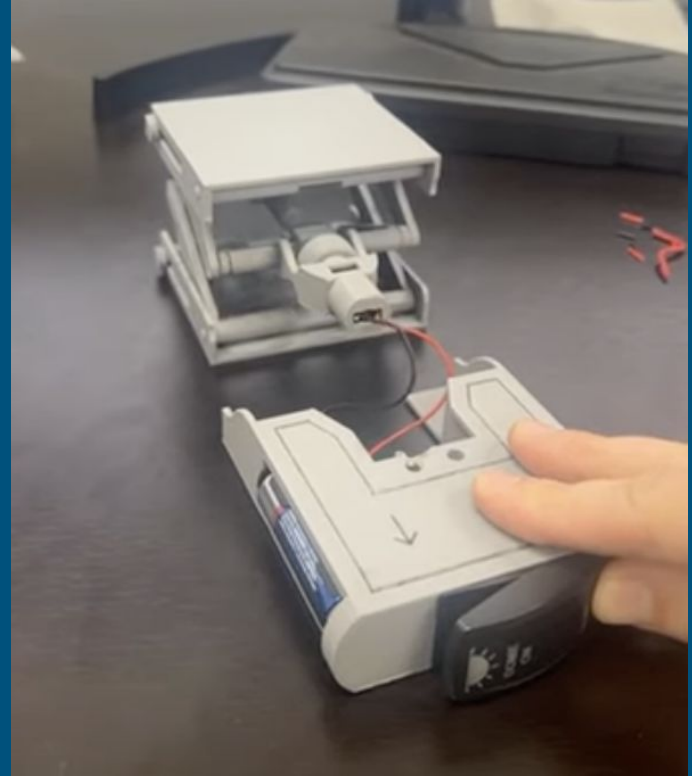
Height Adjustment

- Stand lifts up to 12 in
- Stand angles PC up to 45 deg
- Max angle error < 5 degrees
- Max height error < 3 inches
- Slouch detection within 1 sec
- Ideal height reached < 5 sec

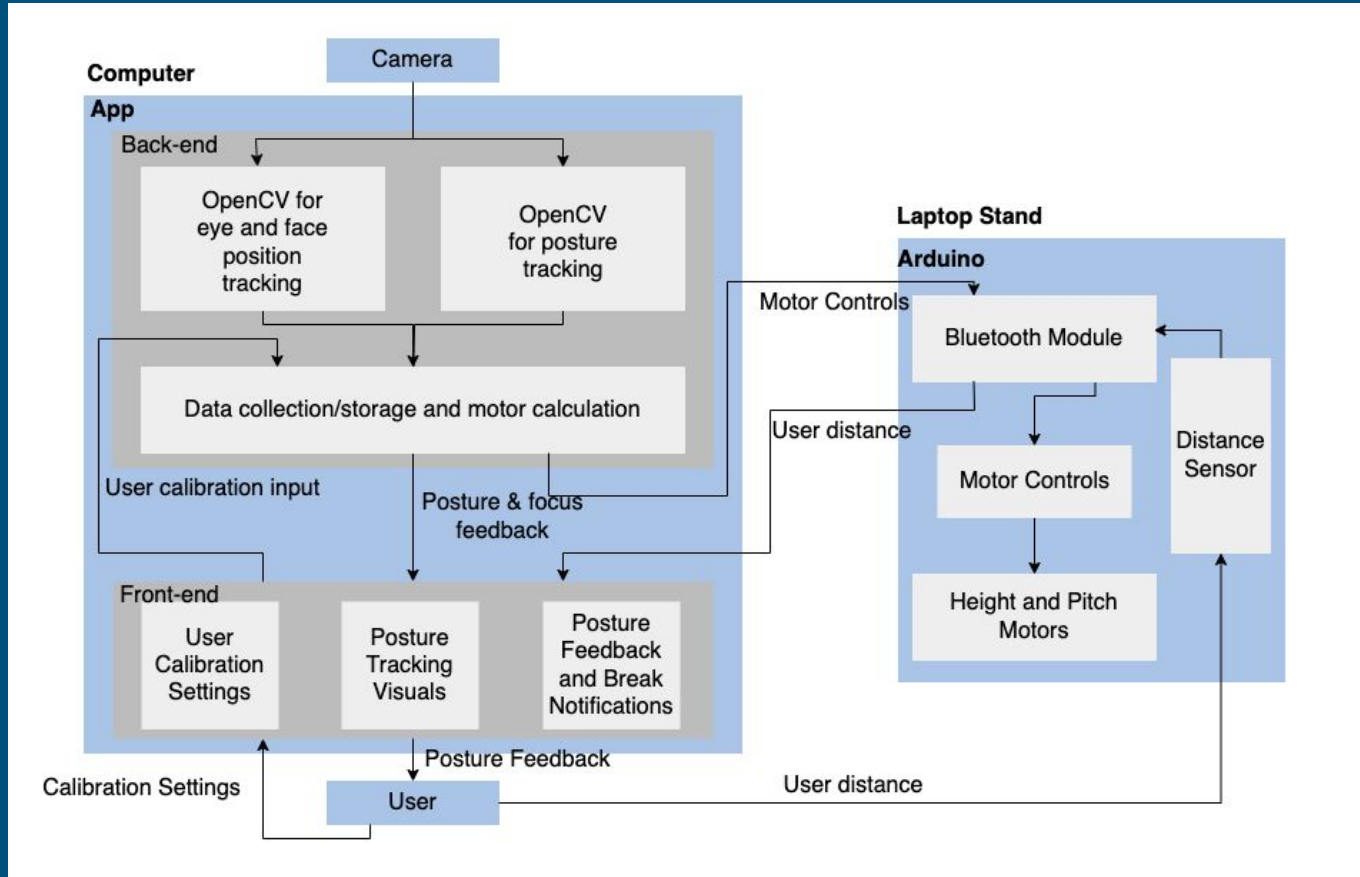
Overall Solution Approach



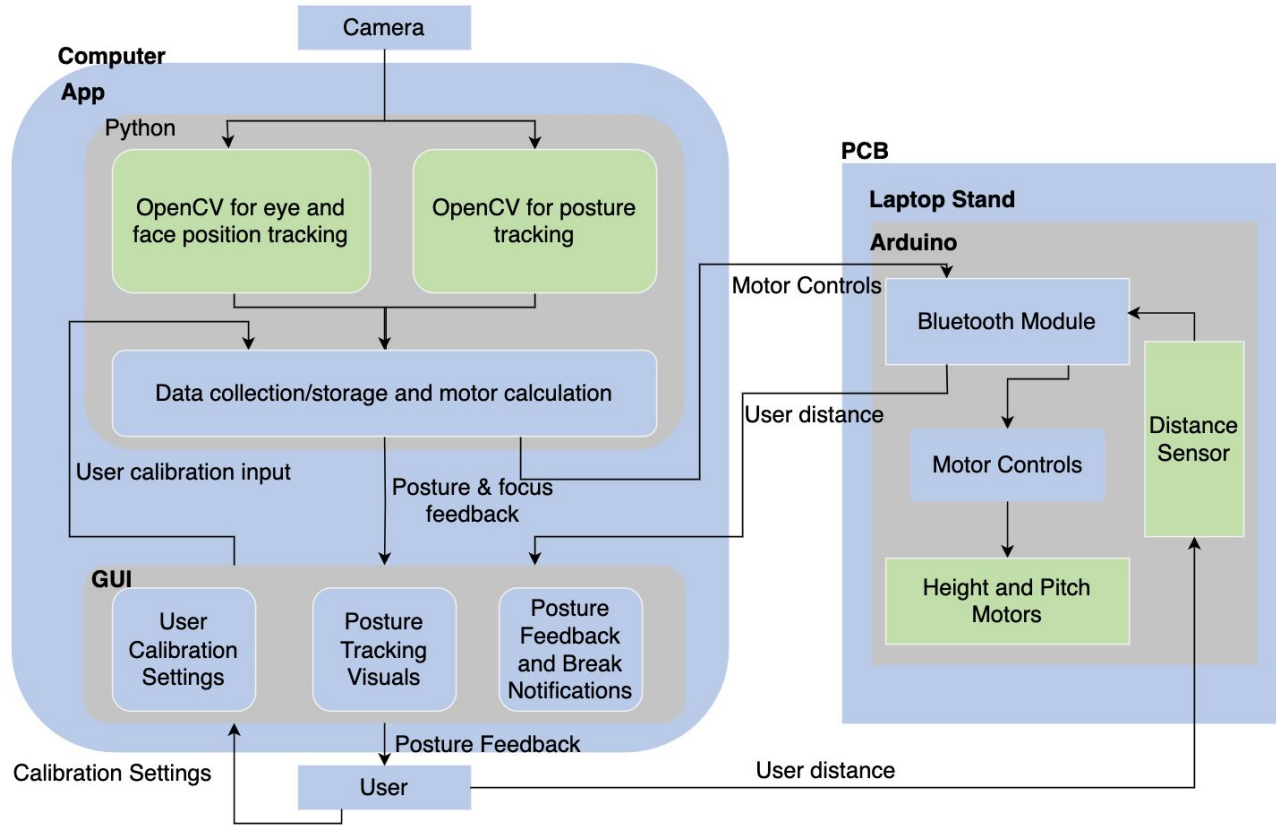
Overall Solution Approach Continued



Overall Block Diagram



Implementation:



Key:

Newly Coded

Off the Shelf

Software

Hardware

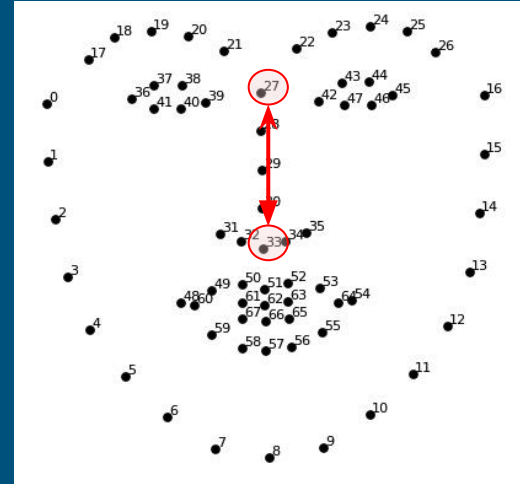
Software for Stand Adjustment

Dlib 68 Facial Landmark Detection

- Pre-trained model that detects faces in a frame and 68 facial landmark positions

Use Python, OpenCV, and faceLandmarkDetector to:

- Calculate the distances between sets of landmarks.
- Determine the position of a user's face relative to the screen.
- Raise/lower the stand based on distances measured at calibration.



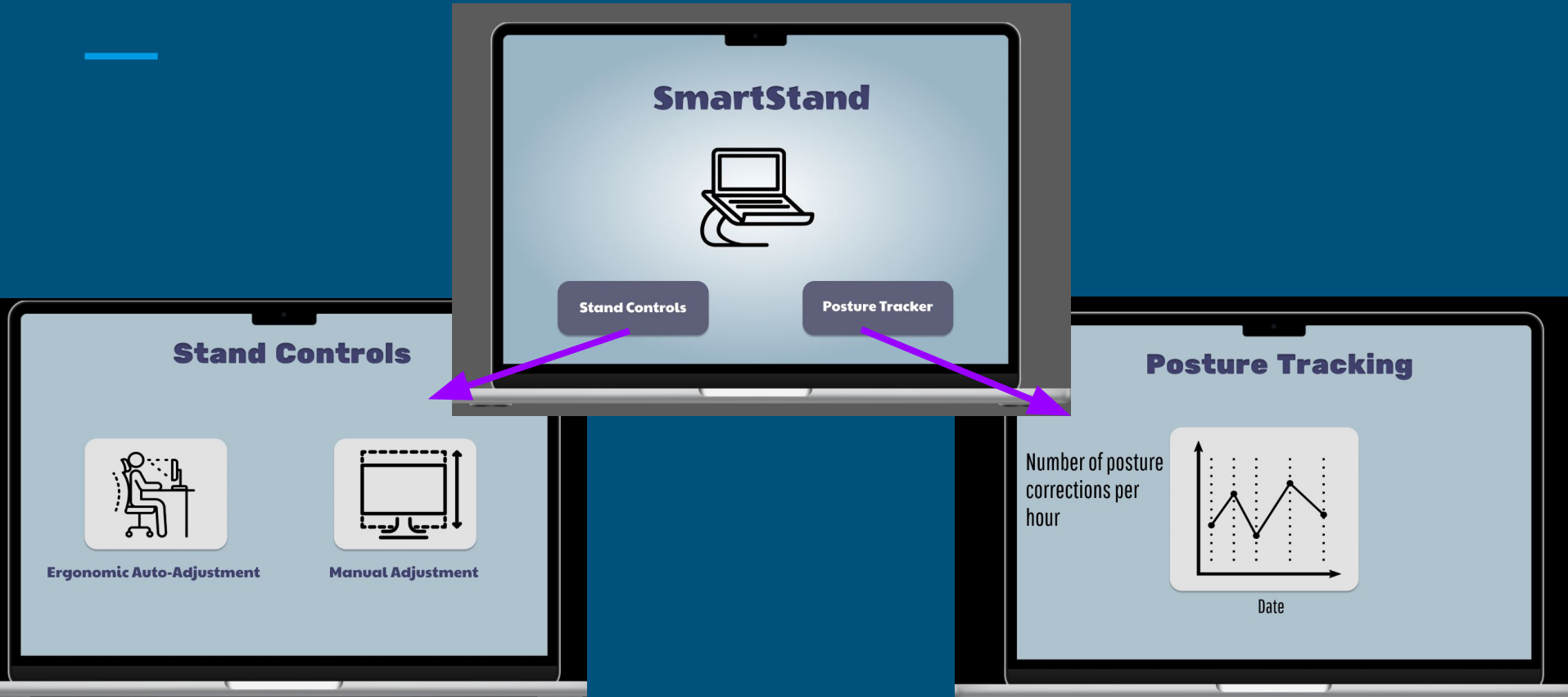
Software for Posture Detection (OpenCV)

- **Shoulder landmarks** used for slouch detection
- **Neural network** will be trained to classify slouches
- Shoulder and facial landmarks inputted to network

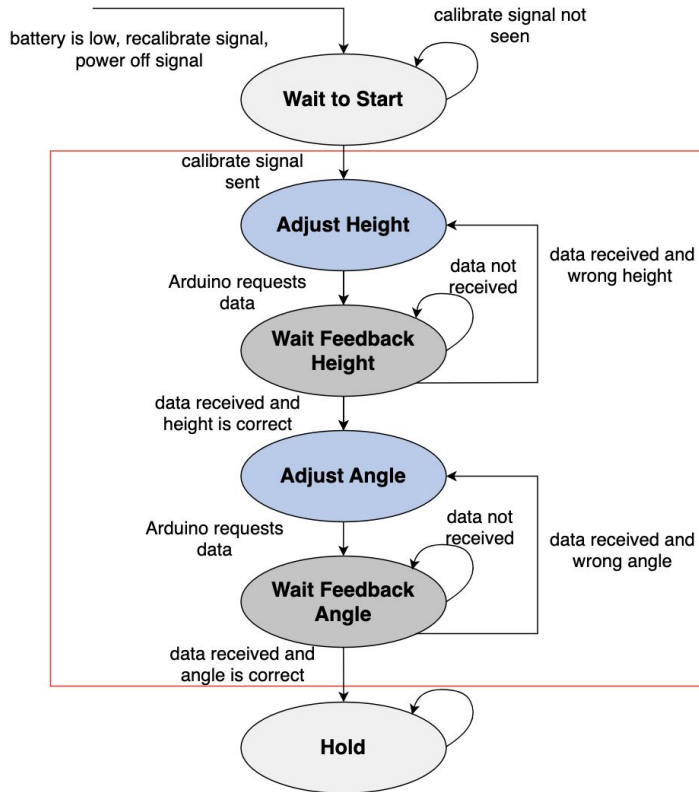


[Source](#)

Implementation: UI Design



Implementation: Hardware



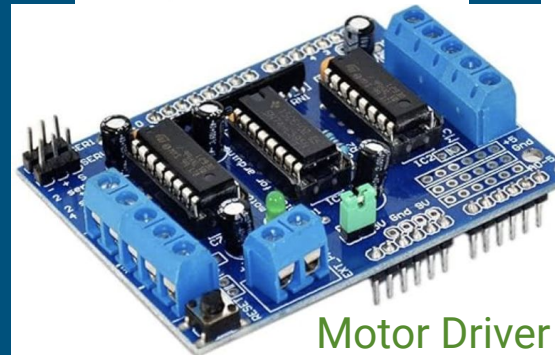
Arduino



Motor



Linear Actuator



Motor Driver

Testing:

Metrics	Test	How to Measure
Height Accuracy	Send known motor control information to arduino, for height of the stand	Output current state to serial monitor, measure stand height to ensure behaved correctly, ensure that maximum error is within 3 inches
Angle Accuracy	Send known motor control information to arduino for angle of the stand.	Output current state to serial monitor, measure stand angle to ensure behaved correctly, ensure that angle is within 5 degrees.
Speed	Send motor control information to arduino to raise to maximum height	Record the time needed for stand to ensure that it is within 5 seconds.
Slouch Detection	Calibrate the stand, then have a user slouch for 1 second	Ensure that the Python data collection recorded the slouch.

Project Management

Category	Task Title	Task Owner	Wk of 1/28	Wk of 2/4	Wk of 2/11	Wk of 2/18	Wk of 2/25	Wk of 3/3	Wk of 3/10	Wk of 3/17	Wk 3/24	Wk 3/31	Wk of 4/7	Wk of 4/14	Wk of 4/21	Wk of 4/28	Wk of 5/5
			SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS	SMTWTFSS
Course ▾	Proposal Presentation	Done ▾ Everyone ▾															
Course ▾	Design Presentation	Done ▾ Everyone ▾															
Course ▾	Design Report	In progr... ▾ Everyone ▾															
Course ▾	Intern Demo	Not started ▾ Everyone ▾															
Course ▾	Final Presentation	Not started ▾ Everyone ▾															
Course ▾	Final Demo	Not started ▾ Everyone ▾															
Course ▾	Final Report	Not started ▾ Everyone ▾															
Slack ▾	** slack **	Not started ▾ Everyone ▾															
Course ▾	Choose materials/parts to purchase	Done ▾ Everyone ▾															
Course ▾	Order materials	Done ▾ Everyone ▾															
ML/CV ▾	Learn OpenCV for Eye/Face tracking	In progress ▾ Olivia ▾															
Software ▾	Integrate camera with OpenCV	Done ▾ Olivia ▾															
ML/CV ▾	OpenCV eye tracking	Not started ▾ Olivia ▾															
Software ▾	Python for eyeline detection analysis	Not started ▾ Olivia ▾															
Software ▾	Motor position computation	Not started ▾ Olivia ▾															
Software ▾	Test for eye detection & computations	Not started ▾ Olivia ▾															
Slack ▾																	
ML/CV ▾	Learn OpenCV for Posture Detection	In progress ▾ Sebastian ▾															
Software ▾	Integrate camera with OpenPose	In progress ▾ Sebastian ▾															
ML/CV ▾	OpenCV posture recognition	Not started ▾ Sebastian ▾															
ML/CV ▾	Categorize posture types	Not started ▾ Sebastian ▾															
Software ▾	Posture recognition data computation	Not started ▾ Sebastian ▾															
Software ▾	Testing for posture recognition	Not started ▾ Sebastian ▾															
Slack ▾																	
Software ▾	Bluetooth communication: PC -> Arduino	Not started ▾ Mary Rose ▾															
Software ▾	Testing for Bluetooth communication	Not started ▾ Mary Rose ▾															
Mechan... ▾	Design stand's raising mechanism	Done ▾ Everyone ▾															
Mechan... ▾	Design stand's angle mechanism	Done ▾ Everyone ▾															
Mechan... ▾	Create CAD design for the stand	Done ▾ Mary Rose ▾															
Firmware ▾	Code for motor control via Arduino	In progress ▾ Mary Rose ▾															
Mechan... ▾	3D print stand	Done ▾ Everyone ▾															
Mechan... ▾	Put together stand	Done ▾ Everyone ▾															
Hardware ▾	Breadboard components	Not started ▾ Mary Rose ▾															
Slack ▾	** slack **																
Firmware ▾	Test motor & sensors arduino code	Not started ▾ Mary Rose ▾															
Hardware ▾	Test motor controls	Not started ▾ Mary Rose ▾															
Firmware ▾	Bluetooth connection: Arduino -> PC	Not started ▾ Mary Rose ▾															
Firmware ▾	Test bluetooth connection to computer	Not started ▾ Mary Rose ▾															
Hardware ▾	Create schematic for PCB	Not started ▾ Mary Rose ▾															
Hardware ▾	Layout PCB	Not started ▾ Mary Rose ▾															
Hardware ▾	Send PCB for printing	Not started ▾ Mary Rose ▾															
Integrat... ▾	Integrate PCB with other components	Not started ▾ Mary Rose ▾															
Integrat... ▾	Test stand with PCB	Not started ▾ Everyone ▾															
Slack ▾	** slack **																
Hardware ▾	Battery Circuit																
Slack ▾	** slack **																
Slack ▾	** slack **																
Slack ▾	** slack **																
Software ▾	Develop basic GUI functionality	Not started ▾ Olivia ▾															
Software ▾	Refine GUI for user experience	Not started ▾ Olivia ▾															
Software ▾	Create application package	Not started ▾ Olivia ▾															
Slack ▾	** slack **																
Software ▾	Python for eye tracking/focus detection	Not started ▾ Olivia ▾															
Integrat... ▾	User testing	Not started ▾ Everyone ▾															
Integrat... ▾	Incorporate changes	Not started ▾ Everyone ▾															
Integrat... ▾	User interface testing	Not started ▾ Everyone ▾															
Integrat... ▾	Incorporate changes	Not started ▾ Everyone ▾															