C2: StudyBuddyBot

Design Review Presentation

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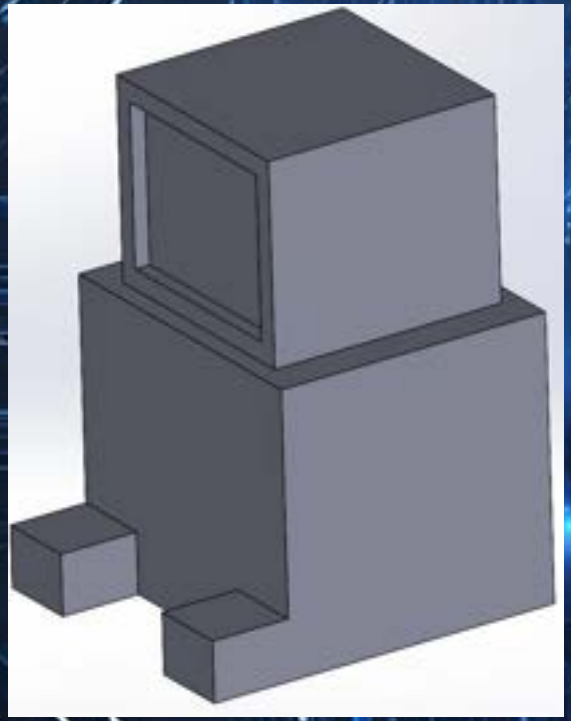
Use Case:

A robot study companion meant to:

- Motivate student studying
- Track studying habits
- Provide relaxation when they take breaks during studying



Quantitative Design requirements

Features	Design Requirements	
Greet Users	Power On, LCD Display set -up	<=3 s
	Respond to audio cues	<=3 s
	Display Loading Screen	<=1 s
RPS Game	Button press Response Time	<=100 ms

Quantitative Design requirements

Features	Design Requirements	
Studying Session	Ultrasonic sensor detection	<=100 ms
TTS Functionality	Accuracy	>= 90%
Break Reminders	Response Time	<= 250 ms
	Power	~12V

Solution Approach

Studying Features

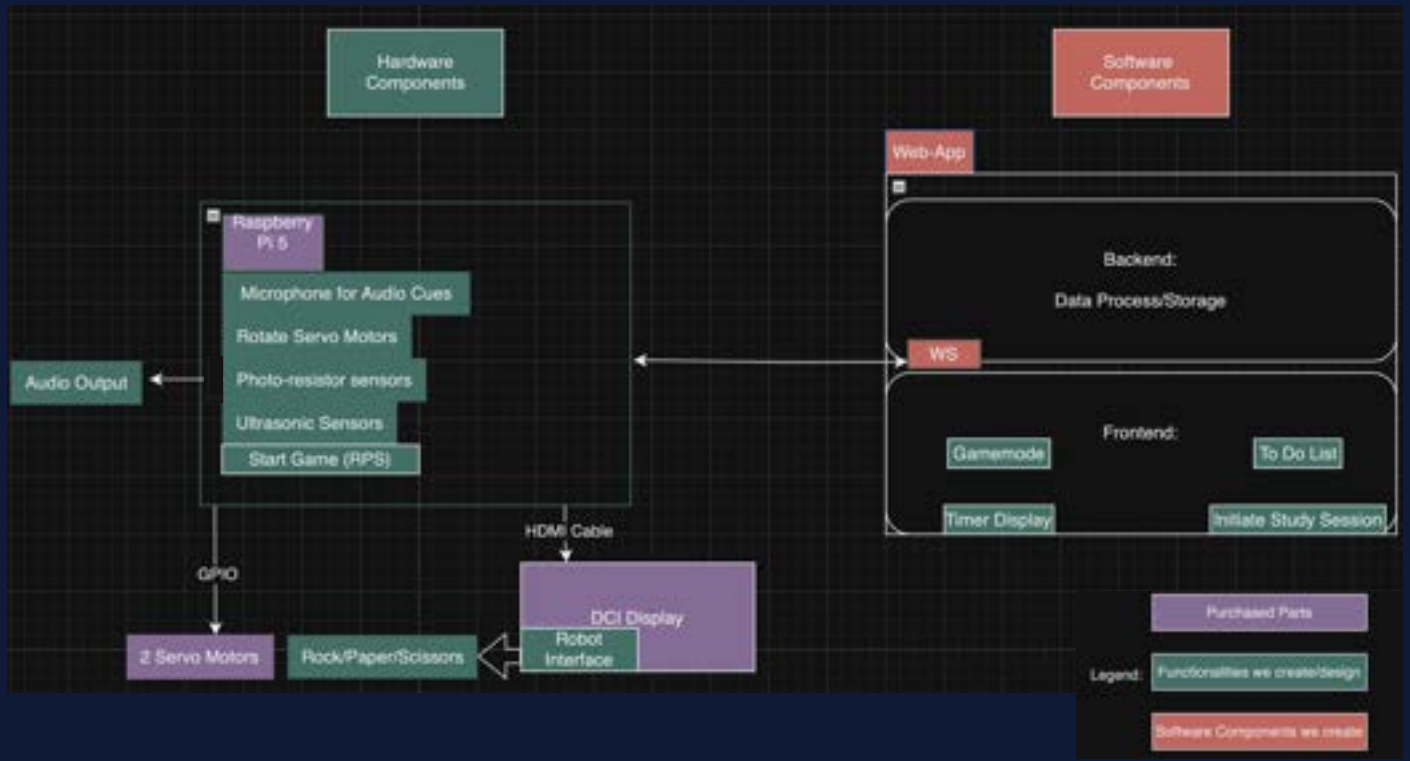
Web App

Ultrasonic Sensor

Interaction Features

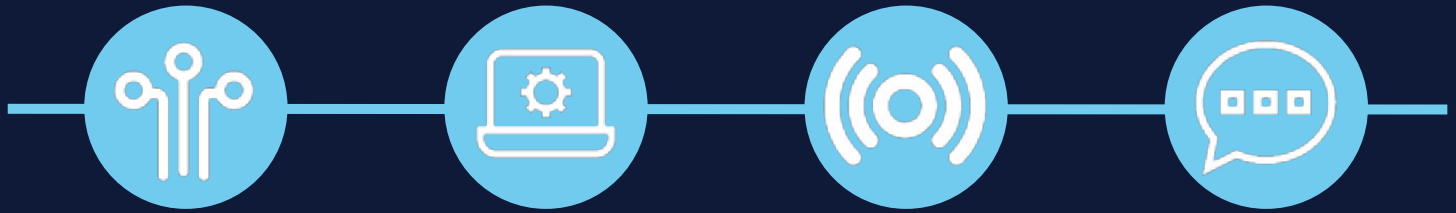
Inputs: Microphones, Servo Motors

Outputs: Display Screen, Speakers



System Specification

Implementation Plan



Base Structure
Servo Motors

LCD Display

Model Base

Web App Features
Additional tool to pair with robot's limited UI functionalities

Robot Outputs
Speakers to motivate student

LCD Display for interaction purposes

Final Model Goal
Student can sit at desk, robot will help monitor their studying and keep them motivated.

Other Considerations

Privacy

- Using ultrasonic sensor
- Taking specific audio inputs

User's Emotional Needs

- Express Positive Emotions
- Customizable Timers
- Facilitation of learning
- Maintain good work-life balance

Unit Testing

Audio cue

Input: Signal from different distances

Output: Signal captured within 3 feet radius

Study components

Input: Setting timers, starting studying sessions

Output: Timer counts down, Study session timings recorded with past history

TTS and display

Input: Input string to RPi

Output: Audio from RPi(speaker)

Servo, Power

Input: Test neck rotation of the robot

Output: Current drawn by servo, desired rotation

RPS function

Input: Button press, game mode activation

Output: Game outcome, DCI display start game

Ultrasonic sensor

Input: Detects user leaving during study session

Output: Pause timer on DCI display and WebApp

Verification and Risk Management

Audio cue

Verification: Audio cues in various noise environments

RM: change distance, analyze microphone

TTS and display

Verification: Webapp can send text/display data to RPi

RM: External TTS engine integration

Servo, Power

Verification: Ensure motor rotation within specified parameters (+/- 5°)

RM: Restrict motor movement to a smaller range

Break Reminders

Verification: Reminders are sent at correct intervals

RM: WebApp will send reminder

Integration Testing

WebApp(WA)

Input: Study timers, break reminder text for TTS to Hardware, todo lists

Output: WebApp inputs are properly processed and can function concurrently

RM: Failure mechanisms and error handling

WebApp+Hardware

Input: Study component and Game from Webapp to Hardware display, Send sensor data from HW to WA

Output:
WA: Pauses timer based on user presence with low latency
HW: Responds to game mode, displays accurate data, speaker output

RM: WiFi, Ethernet cable

Hardware(HW)

Input: Run servo motors, process in sensor data, speaker, mic input

Output: Race conditions don't occur and accurate data processing

RM: Handle each case with different priorities and use freeRTOS for multithreading

Project Management

Task Title	Task Owner	Status	Week 4	Week 5	Week 6	Week 7
WebApp						
Creating frontend pages	Shannon	In pr…				
Write code for Timing features	Shannon	Com…				
Write code for Todolist feature	Shannon	In pr…				
Write code for Studying Session analysis	Shannon	Not …				
Connect and set up TTS function	Shannon/ Mahlet	Not …				
Robot						
Identify audio and robot movement components	Mahlet	Com…				
Set up motors for rotation and U/D motion	Mahlet	Not …				
Logic for robot neck motion	Mahlet	Not …				
Set up TTS functionality	Mahlet/ Shannon	Not …				
Rock-paper-scissors game logic	All	In pr…				
Set up and test Hello/Goodbye logic	Jeffrey	Not …				
Synchronize various tasks	All	Not …				
LCD/DCI display	All	Not …				
Audio triangulation math	Mahlet	In pr…				
Manage button inputs to device	All	Not …				
Build Robot base	Mahlet/ Jeffrey	Not …				

Integration/Testing		Not …	Week 6	Week 7	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14
Incorporating WebSockets	Jeffrey/ Shannon	Not …								
Rock-paper-scissors with human-input	All	Not …								
Testing speakers for robot output	Jeffrey	Not …								
Testing tasks synchronization	All	Not …								
Power device and testing	All	Not …								
Test motor for Robot Neck	Mahlet	Not …								
Robot base testing	Jeffrey/ Mahlet	Not …								
Final Testing										
Test Hello/Goodbye from voice activation	All	Not …								
Test Timers and Study Break reminders	All	Not …								
Test TTS function with large input files	All	Not …								
Test RPS function	All	Not …								
Test for interference between features	All	Not …								
Test for DCI display	All	Not …								
Slack	All	Not …								