Senior Design Project: ShowerSync

Electrical & Computer Engineering

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Team Introduction

Project Objective

The Problem:

1) How can we develop a cost-effective shower system that streamlines user interaction by minimizing presetting time through innovative temperature settings and shower knob adjustments?

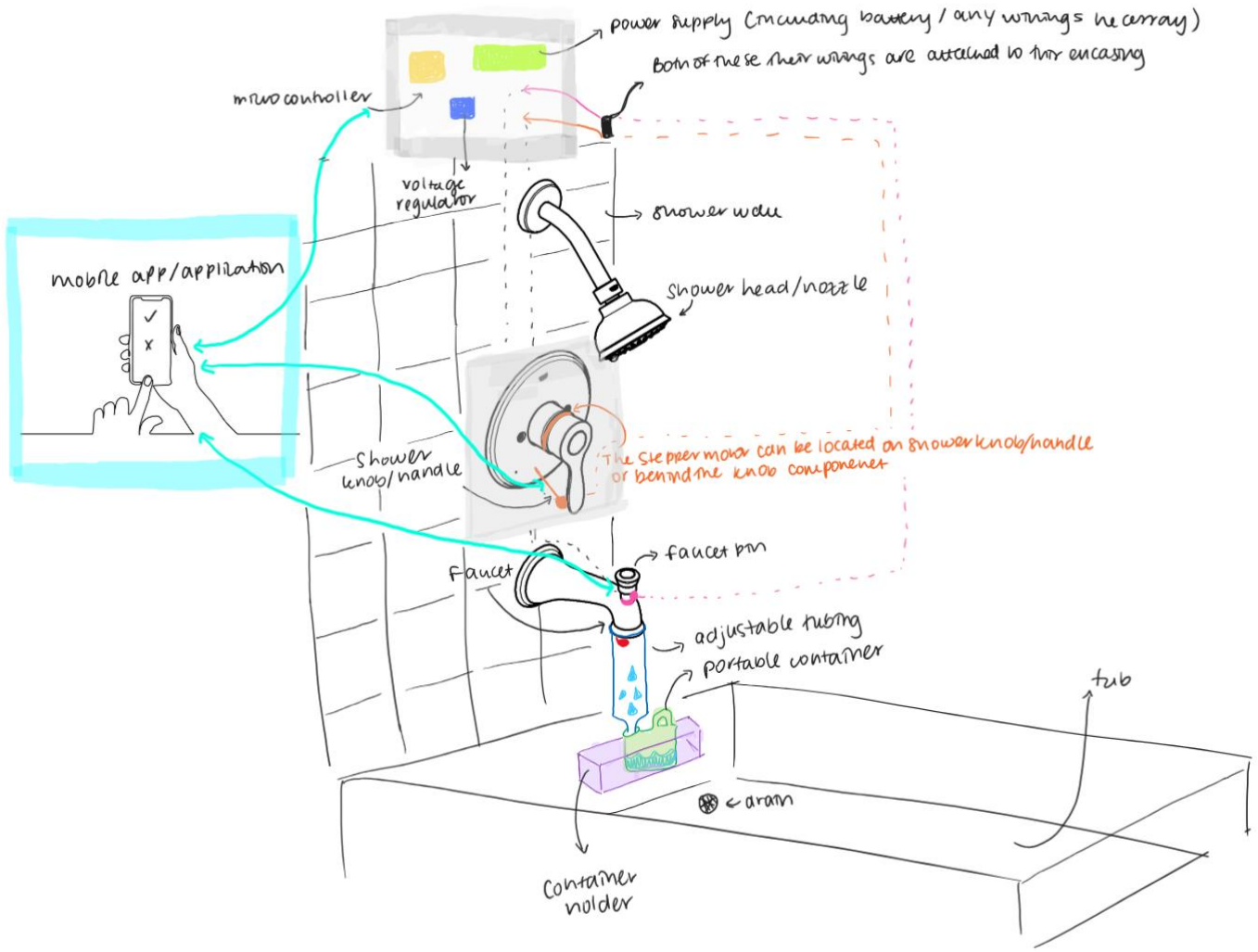
2) How can we seek to reduce water and energy consumption with an aspect of alternative uses, thus enhancing the overall showering experience?

Project Objective

The Solution:

- A self-adjusting shower system integrating a motorized knob mechanism for precise control with a temperature sensor to regulate water flow
- A prototype-based tubing system to divert excess water for reuse.
- Controlled by a microcontroller (ESP32), users can adjust settings remotely via web app, ensuring a personalized and eco-friendly shower experience

Review of Original Design



Shower System:

1) Shower Knob Subsystem
2) Faucet-Pin Subsystem
3) Water-Saving Subsystem
4) Transmission Subsystem
5) Microcontroller Subsystem
6) Power Subsystem

Review of Original Design

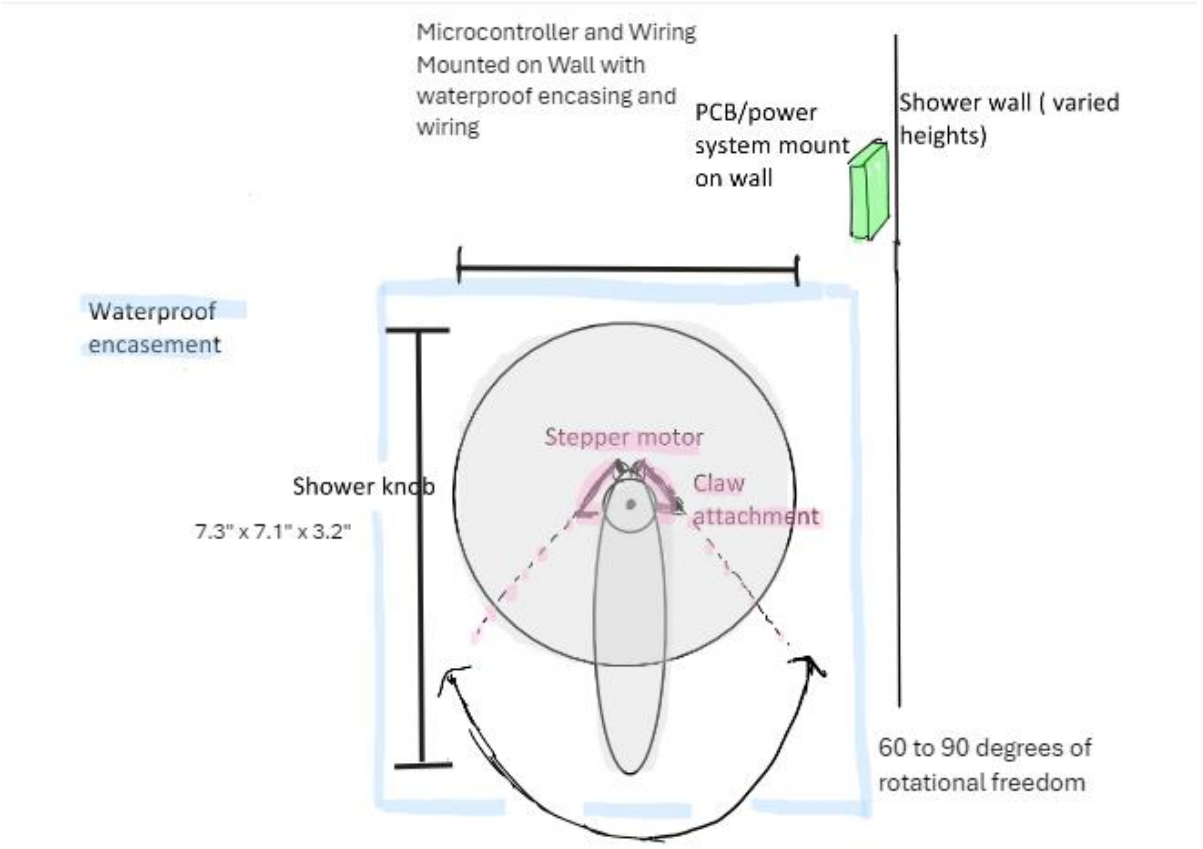


Figure 1: Physical Design

Review of Original Design

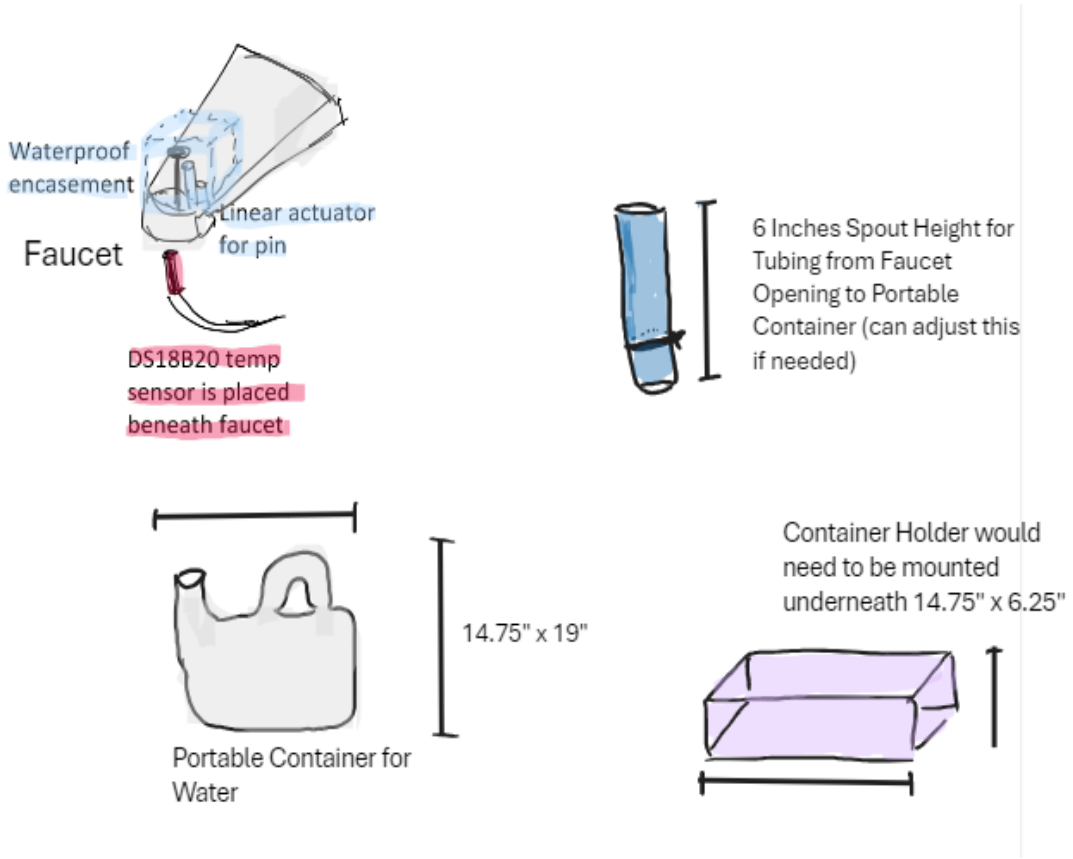


Figure 1.2: Physical Design

Review of Original Design

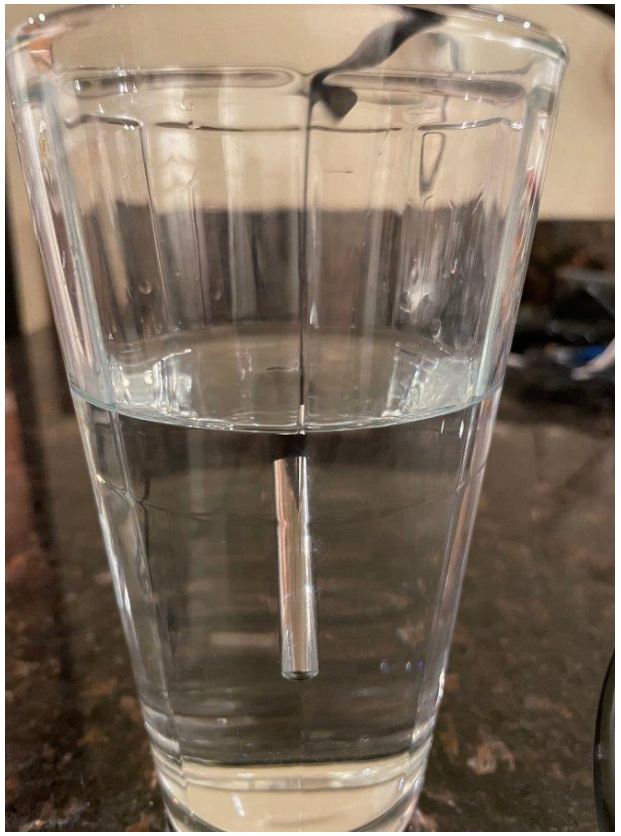


Figure 1.3: Physical Design of Temperature Sensor

Review of Original Design

Original Block Diagram:

1) 12 V Power Source (nominal voltage for motor)

2) Bluetooth + App

3) LM317 Voltage Regulator

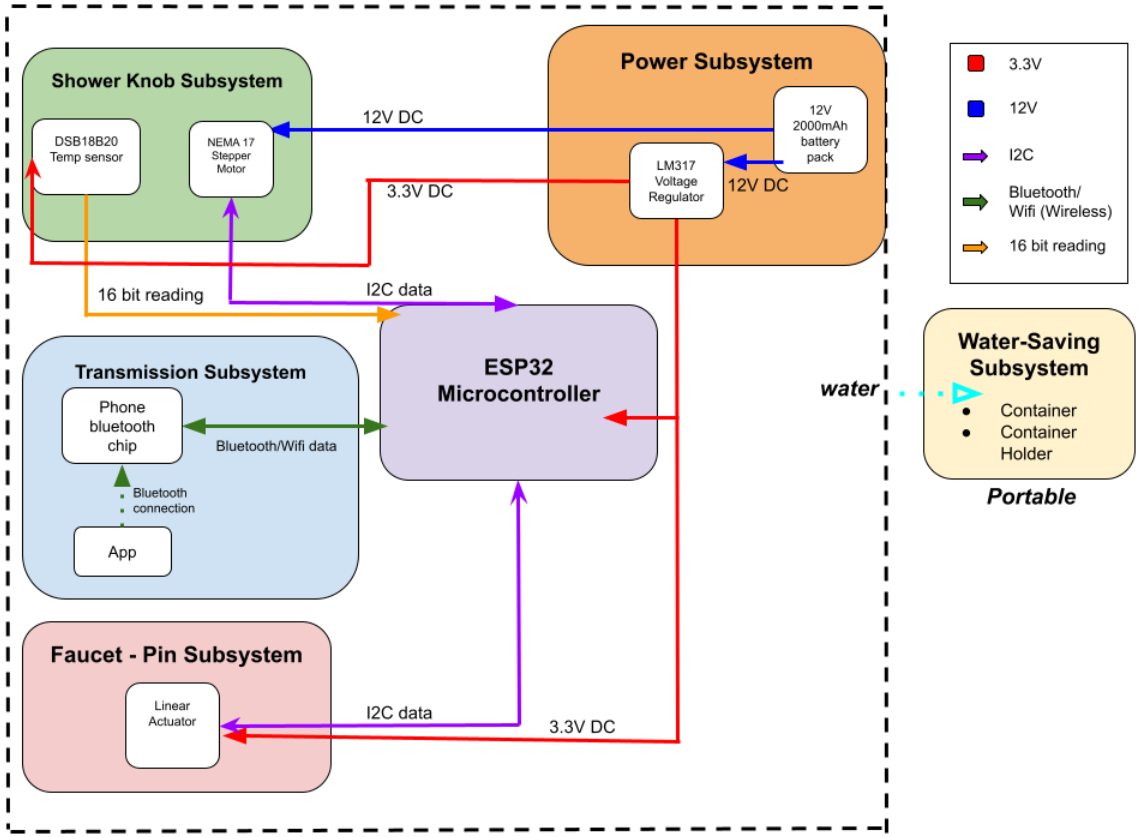


Figure 2: Old Block Diagram

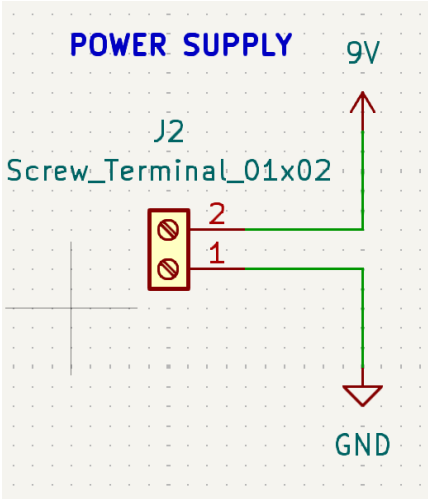
Review of Original Design

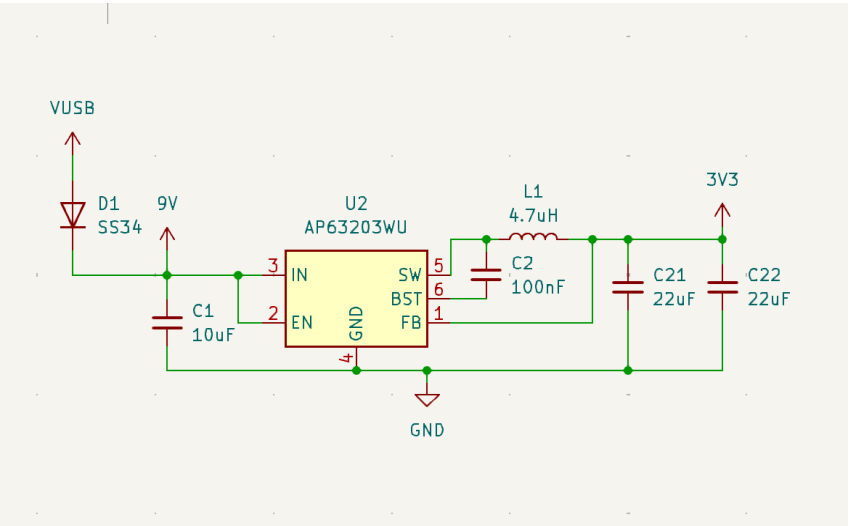
Areas of Design That Changed:

1) Power source: 9V Operating Voltage

2) Transmission: Wi-Fi + ESP Access Point

3) Regulator: Buck Converter





Review of Original Design

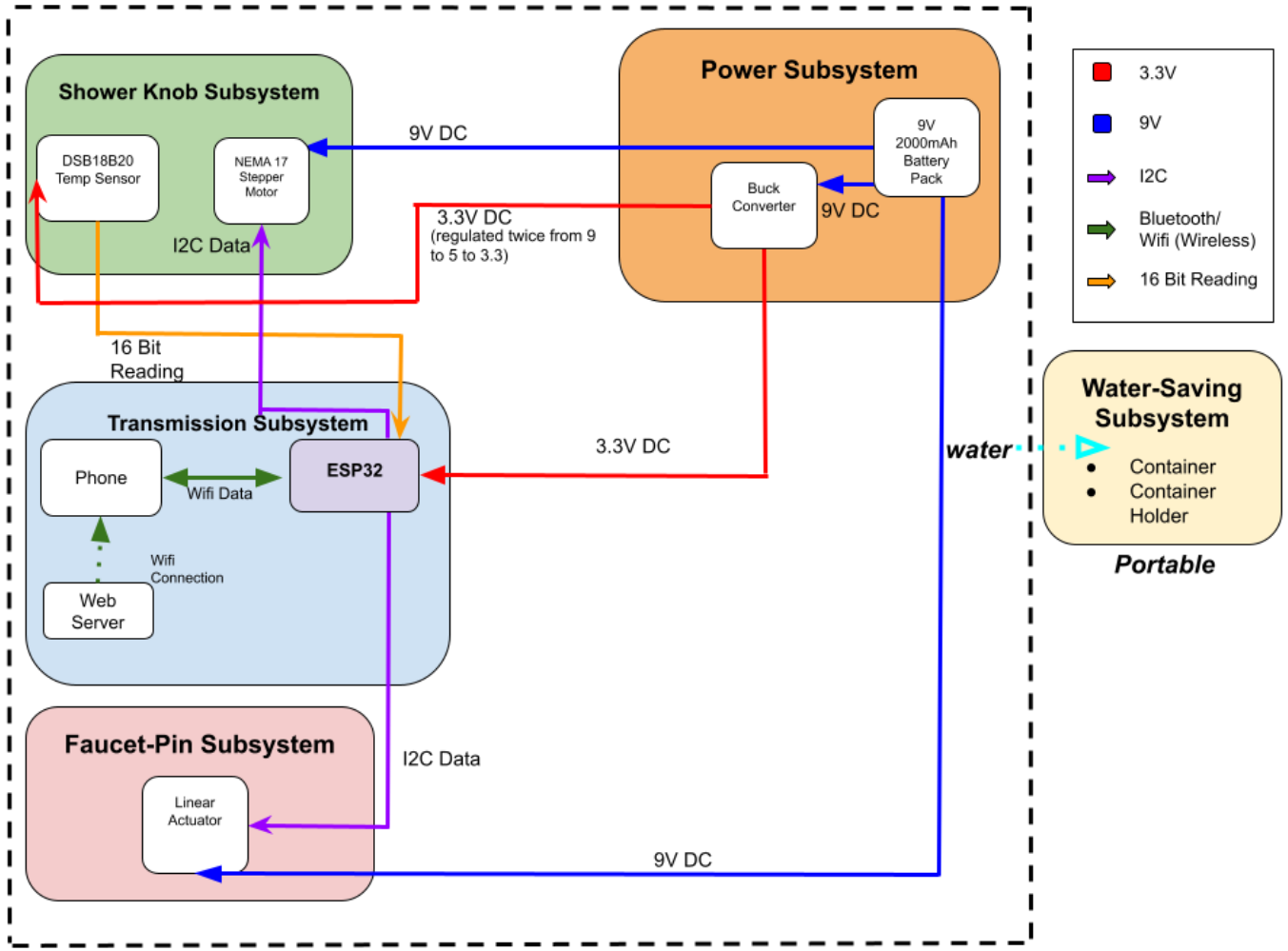
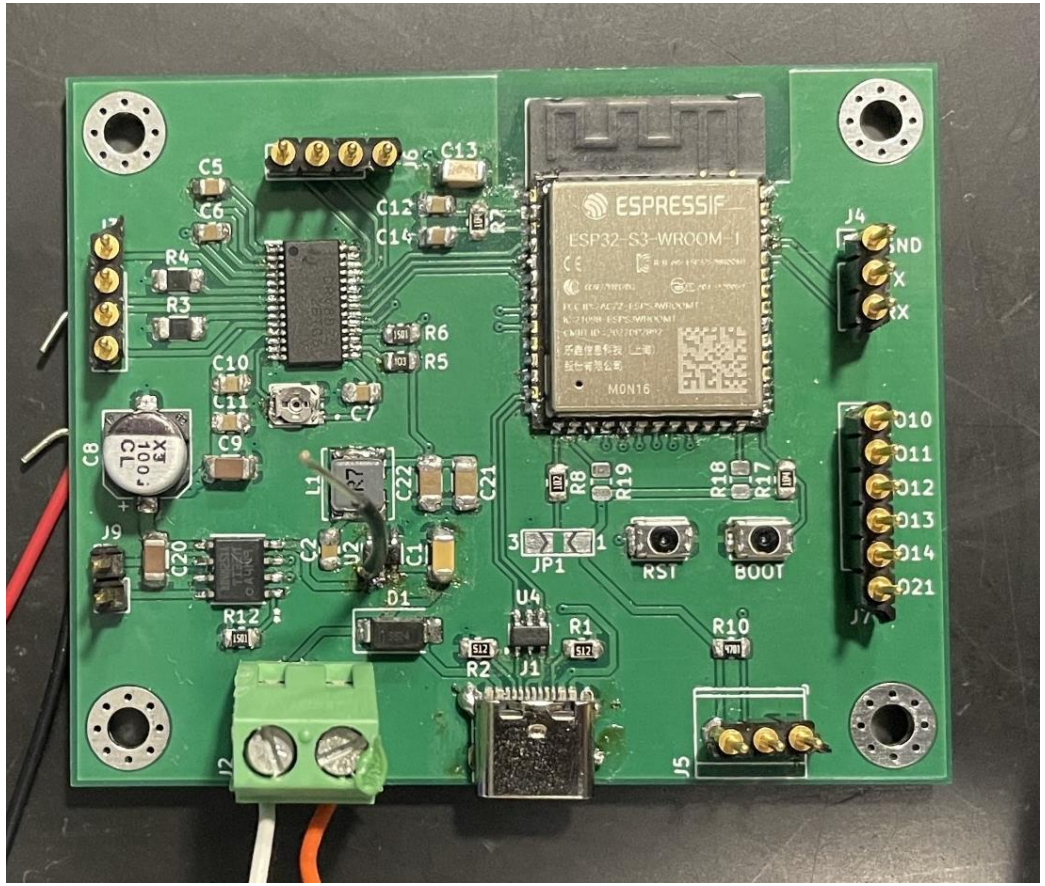


Figure 3: Overview of Each Block Requirement

Review of Original Design



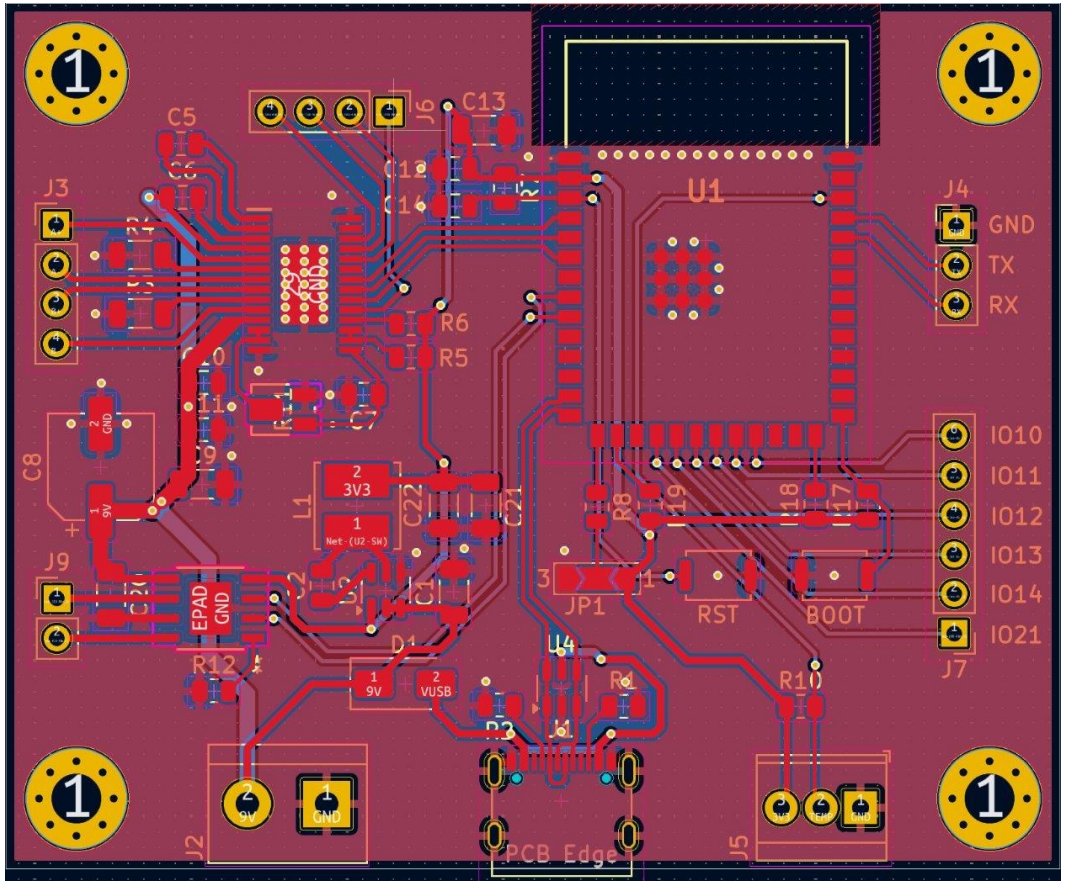
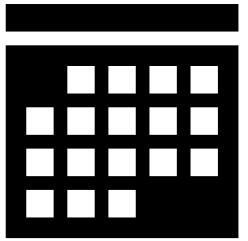


Figure 4: Actual PCB with the Design

Processes and Test Results

Project Build Timeline:



1) ESP Programming
2) Temperature Sensor
3) Stepper Motor
4) Wi-Fi Module

Requirements and Verification

High Level Requirements:

- When user requests, ShowerSync rotates shower handle and diverts water until user's desired temperature is reached (within ±4 degrees).
- Shower system notifies user when desired temperature is attained, initiating faucet-pin subsystem within 25 seconds.
- Entire device process begins within 10 seconds of remote command.

Requirements and Verification

Stepper Motor:

- Rotate 60-90 degrees both ways.
- React correctly to updated temperature information

Temperature Sensor:

- Accurately read temperature to 4 degrees

Transmission:

- Transfer data and update info from user through web app to and from microcontroller and shower knob subsystem

Microcontroller:

- Works as the brains of the system and communicates throughout the subsystems.
- Handles all logic and calculations.

Requirements and Verification

Faucet-Pin:

- When the shower turns on due to user input, the pin goes up.
- When the shower turns off after reaching due to the water reaching the right temperature or the user inputs a stop, the pin goes down.

Power:

- Supplies 9V to motor and buck converter supplies 3.3V to ESP + temperature module

Water-Saving (Prototype Implementation):

- A portable container underneath the faucet that catches excess water as the shower is reaching desired temperature

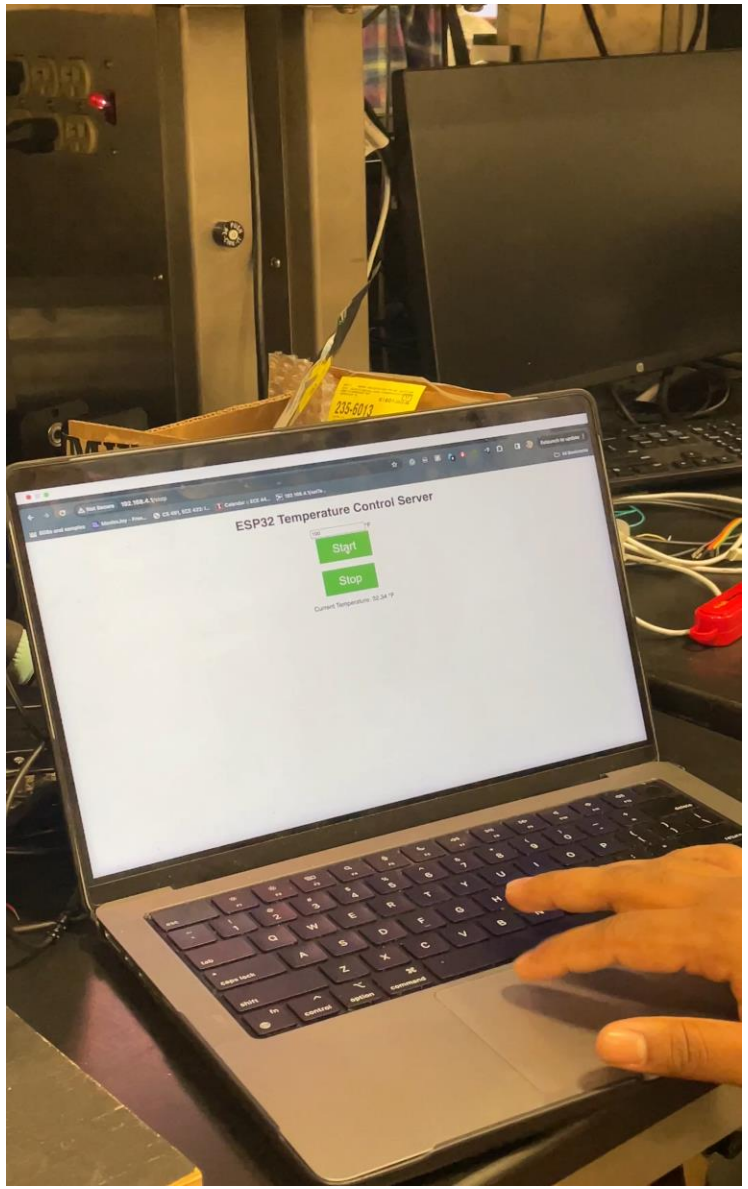


Figure 4: Video of ShowerSync's Functionality

Project Overview

Challenges:

1) PCB design and fabrication.
2) Integration of various subsystems.
3) Hardware restrictions and adjusting to issues on the fly.
4) Scheduling issues, anticipated certain parts to take longer and some to be shorter.

Successes:

1) Interactions between various subsystems.
2) Interactions between user and the project
3) Able to effectively test for the requirements from our R & V table

Key Takeaways:

- Skills required for effective PCB design and fabrication.
- Techniques for creating a product and testing it.
- It is important to celebrate wins regardless of how small or big for encouragement.

Conclusion

Learning Points:

- Hardware interactions between different parts.
- Adapting to issues on the spots and being flexible.
- Effective communication with other members of the group.

Conclusion

Alternative Approach:

- Working on finer details such as various ways the faucet reacts to the temperature to make the rotations smoother
- Bigger scale changes such as redesigning our PCB to use an alternate design for the power subsystem

Recommendations for Further Work:

- Switch from Wifi access point to a phone app
- Switch to a higher torque motor.
- Test initial versions of faucet pin and water saving subsystems
- Improve testing on the PCB

Questions?

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