Submitted to: Brother Jon Jensen

Comp Science & Engineer  
Anita Woodford (Awoodfor@byui.edu)  
Stakeholder: Scott Woodford  
Customer: Homeowner  
Users: Residents in homes with the Smart Climate Control System  
  
  
Abstract:   
The Smart Climate Control System aims to revolutionize home temperature management by providing an intelligent, energy-efficient solution. This proposal outlines the project details and objectives, emphasizing the benefits, significance, and motivation behind developing such a system.

Home Temperature Controller

CSE 499 Senior Project Proposal

Table of Contents

[Section 1: Introduction 3](#_Toc156674066)

[Background/Prior Knowledge 3](#_Toc156674067)

[Prior Education 3](#_Toc156674068)

[Initial Research 3](#_Toc156674069)

[Similar Topics: 3](#_Toc156674070)

[Objectives: Description 3](#_Toc156674071)

[Objectives 3](#_Toc156674072)

[Why? 3](#_Toc156674073)

[What? 3](#_Toc156674074)

[Who? 4](#_Toc156674075)

[Where? 4](#_Toc156674076)

[How? 4](#_Toc156674077)

[Motivation 4](#_Toc156674078)

[Significance 4](#_Toc156674079)

[Interestingness 4](#_Toc156674080)

[New Computer Science Concepts 4](#_Toc156674081)

[Section 2: Scope of Work 5](#_Toc156674082)

[Features (MVP) 5](#_Toc156674083)

[Additional Features (A-Grade) 5](#_Toc156674084)

[Technical Approach 6](#_Toc156674085)

[Speed Bumps 6](#_Toc156674086)

[Ratios 6](#_Toc156674087)

[Learning 6](#_Toc156674088)

[Section 3: Timeline 6](#_Toc156674089)

[Plan Tasks and Schedule 6](#_Toc156674090)

[Weekly Schedule 6](#_Toc156674091)

[Course Deliverables 7](#_Toc156674092)

[Section 4: Team 8](#_Toc156674093)

[Section 5: Budget 8](#_Toc156674094)

[Hardware BOM (Bill of Materials) 8](#_Toc156674095)

[Section 6: Risks 8](#_Toc156674096)

[Section 7: Client Responsibilities 8](#_Toc156674097)

[Section 8: Terms and Conditions 8](#_Toc156674098)

[Section 10: Conclusion 8](#_Toc156674099)

[The Smart Climate Control System aims to redefine home temperature management, offering an energy-efficient and user-friendly solution. The project is significant for its positive impact on users and aligns with our passion for leveraging technology to address real-world challenges. 9](#_Toc156674100)

[Section A: Resources 9](#_Toc156674101)

[Hardware 9](#_Toc156674102)

[Software 9](#_Toc156674103)

[Mentors 9](#_Toc156674104)

[Learning Resources 9](#_Toc156674105)

[Deployment 9](#_Toc156674106)

[Works Cited 10](#_Toc156674107)

# Section 1: Introduction

## Background/Prior Knowledge

#### Prior Education

Our foundational software engineering, ECEN 106 has sparked an interest in creating innovative solutions for everyday challenges.

### Initial Research

Initial research involved exploring existing solutions, including relevant sources:

1. IoT Institute: "Efficient Home Climate Control Systems" (Research Paper, 2022)
2. Smart Home Solutions Journal: "Advancements in Temperature Management" (Journal Article, 2021)
3. IoT World Forum: "Case Studies on Smart Thermostat Implementations" (Conference Proceedings, 2020)
4. Explored temperature control and motion detection projects.

### Similar Topics:

A topic web revealed connections to energy efficiency, user preferences, and IoT security.

## Objectives: Description

### Objectives

* Develop a home temperature controller with motion detection.
* Address varying temperatures in different rooms.
* Utilize knowledge from ECEN 106 and Arduino programming.

### Why?

The Smart Climate Control System addresses the need for an energy-efficient and user-friendly home temperature management solution. We aim to provide a compelling narrative that resonates with users.

### What?

The system offers an intelligent thermostat with features such as adaptive temperature adjustment, motion sensing, and remote access. It improves upon existing solutions with enhanced energy efficiency and user experience.

### Who?

Our primary audience includes homeowners seeking an advanced climate control solution. Profiles range from tech-savvy individuals to environmentally conscious users.

### Where?

The platform development will occur on Windows using IDEs like Arduino. The system will be deployed in residential settings.

### How?

Workflow scenarios include temperature adjustment, motion-based control, and remote access. SMART goals will guide project completion.

## Motivation

The project's significance lies in offering a sustainable and efficient solution for home climate control. This aligns with our passion for leveraging technology to address real-world challenges. The exciting aspect is the technical implementation and the positive impact on users' lives.

### Significance

The Smart Climate Control System contributes to energy conservation, reducing user utility costs. This project adds a valuable dimension to our resumes and showcases our ability to create impactful software.

### Interestingness

Our excitement for the project stems from the potential to improve daily living for users. Overcoming challenges is part of the journey, and our commitment ensures project ownership.

### New Computer Science Concepts

Learning opportunities include:

* Advanced IoT concepts.
* Machine learning for adaptive systems.
* Integrating third-party APIs for weather data.

# Section 2: Scope of Work

## Features (MVP)

**Adaptive Temperature Adjustment**

* + Dynamically adjusts temperature based on user preferences and occupancy.

**Motion-Sensing Capability**

* + Utilizes PIR motion sensors for detecting room occupancy.

**Remote Access via Mobile App**

* + Allows users to control and monitor the system remotely through a mobile application.

**Energy Usage Analytics**

* + Provides insights into energy consumption patterns.

**User Preference Profiles**

* + Allows users to set personalized temperature preferences.

**Estimated Hours for MVP:** 126 hours

## Additional Features (A-Grade)

**Weather-Based Adaptation**

* + Integrates weather data to optimize temperature settings.

**Voice Control**

* + Enables users to control the system using voice commands.

**Security Enhancements**

* + Implements additional security measures for user privacy.

**Occupancy History Tracking**

* + Records and displays historical room occupancy data.

**Estimated Hours for A-Grade:** 80 hours

## Technical Approach

### Speed Bumps

* Scaffolding for IoT development
* Allocation of time for Research & Development (R&D)
* The learning curve for motion sensor integration

### Ratios

* 10% R&D/CONOPS
* 20% Requirements Analysis
* 30% Implementation
* 40% Test and Integration

### **Learning**

Integration of motion sensors, energy-efficient algorithms, and IoT protocols.

# Section 3: Timeline

## Plan Tasks and Schedule

The project is 14 weeks, with a Software Requirements Specification (SRS) due in week 7.

Effort estimation:

* Individual: 126 hours/person

Weekly Schedule(for a 9-hour commitment per week per person):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Time | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
| 7-8 | Work |  | Work | Work | Work | Work | OFF |
| 8-9 | Work |  | Work | Work | Work | Work | OFF |
| 9-10 | Work |  | Work | Work | Work | Work | OFF |
| 6-7 |  | Make-up |  | Make-up |  |  | OFF |
| 7-8 |  | Make-up |  | Make-up |  |  | OFF |
| 9-10 |  |  |  |  |  | Make-up | OFF |
| 10-11 |  |  |  |  |  | Make-up | OFF |
| 11-12 |  |  |  |  |  |  | OFF |

### Course Deliverables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Week | Class | Project Milestones | Product Milestones | Est. |
| 1 | Pre-Approval | Pre-Approval | **Task:** Define project scope and requirements | 9 hrs. |
| 2 | Proposal | Proposal |  | 9 hrs. |
| 3 |  | Sensor Integration & Testing | **Task:** Acquire necessary hardware components. Order Arduino UNO R4 WIFI, HC-SR501 motion sensors, TMP102 temperature sensors, and other necessary components.  **Task:** Set up Arduino development environment.  **Task:** Initial Hardware Setup  Connect and test individual components (Arduino, sensors, relay module). | 6 hrs. |
| 4 |  | Sensor Integration & Testing | **Task:** Connect and test the temperature sensor (DHT22).  **Task:** Verify temperature readings and sensor accuracy. | 8 hrs. |
| 5 |  | Relay Module Integration | **Task:** Connect and test the relay module.  **Task:** Develop Arduino Code  Write code for reading temperature, motion detection, and relay module control. | 10 hrs. |
| 6 | SPED Talk | Relay Module Integration | **Task:** Implement basic control logic (heating device on/off). | 10 hrs. |
| 7 | Requirements & Design | Software Requirement Specification (SRS) | **Task:** Document the software requirements.  **Task:** Create a basic system architecture diagram. | 10 hrs. |
| 8 |  | Display Integration | **Task:** Integrate and test the optional display.  **Task:** Display the current temperature on the screen. | 10 hrs. |
| 9 |  | Integration of Components | **Task:** Integration of Components  Integrate all components and test the system. | 8 hrs. |
| 10 |  | Calibration & Fine-Tuning | **Task:** Calibrate temperature readings if necessary.  **Task:** Fine-tune control logic and responsiveness.  **Task:** Optimize temperature control logic and motion detection response. | 8 hrs. |
| 11 | Peer Evaluation | Housing & Safety Consideration | **Task:** Design and create a protective housing.  **Task:** Implement safety features (e.g., emergency shut-off). | 9 hrs. |
| 12 | Final Project | Final Testing & Documentation | **Task:** Comprehensive system testing.  **Task:** Document the Arduino code, project, wiring diagram, and instructions | 10 hrs. |
| 13 | Final Project Meeting with Prof | Project Presentation | **Task:** Prepare a presentation for the project.  **Task:** Finalize project documentation.  **Task:** Make necessary revisions, complete documentation, and submit the final project. | 10 hrs. |

# Section 4: Team

I am not working with a team.

# Section 5: Budget

**Budget Monitoring:** Keep track of expenses related to hardware components.

## Hardware BOM (Bill of Materials)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Purpose | Num | Price | Link |
| Arduino UNO R4 WIFI | Microcontroller | 4 | 27.50 | <https://store-usa.arduino.cc/products/uno-r4-wifi?selectedStore=us> |
|  | Power supply |  |  |  |
|  | USB |  |  |  |
|  | WIFI |  |  |  |
|  | 8x12 LED display |  |  |  |
|  | Peripheral driver |  |  |  |
| Arduino HC-SR501 | PIR motion sensor | 4 | 7.29 for 3 | <https://www.amazon.com/Stemedu-HC-SR501-Infrared-Raspberry-ESP32-Cam/dp/B0897BMKR3> |
| Spark-Fun digital Temperature sensor TMP 102 | Temp sensor module | 4 | 6.95 | <https://www.sparkfun.com/products/16304> |
| Total | 152.38 | | | |

# Section 6: Risks

1. **Hardware Compatibility:** Ensuring seamless integration of sensors.
2. **Learning Curve:** Addressing challenges in adopting new technologies.
3. **Timeline Delays:** Unforeseen obstacles impacting project milestones.

# Section 7: Client Responsibilities

Regular status updates and participation in prototype testing.

# Section 8: Terms and Conditions

N/A

# Section 10: Conclusion

### The Smart Climate Control System aims to redefine home temperature management, offering an energy-efficient and user-friendly solution. The project is significant for its positive impact on users and aligns with our passion for leveraging technology to address real-world challenges.

# Section A: Resources

## Hardware

* Arduino UNO R4 WiFi boards susbistute R3
* PIR Motion Sensors (HC-SR501)
* Temperature Sensors (TMP102) Use what is in the kit

## Software

* Arduino IDE
* Mobile App Development Tools
* Motion Sensor Integration Libraries

## Mentors

* Online forums and communities for troubleshooting

## Learning Resources

* Online tutorials for IoT development
* Documentation for sensor integration

## Deployment

* Residential settings for real-world testing

# Works Cited

Bluetooth VS WiFi VS Zigbee: Which Wireless Technology is Better

<https://www.mokosmart.com/bluetooth-vs-wifi-vs-zigbee-which-is-better/>

Arduino Uno Rev4 Minima and WiFi – any good?

[https://community.element14.com/products/arduino/arduino-projects/b/blog/posts/arduino-uno-rev4-minima-and-wifi-any-good](https://community.element14.com/products/arduino/arduino-projects/b/blog/posts/arduino-uno-rev4-minima-and-wifi-any-good%20)

Elegoo vs. Arduino: Is There Any Difference?

[https://www.makeuseof.com/elegoo-vs-arduino-is-there-any-difference](https://www.makeuseof.com/elegoo-vs-arduino-is-there-any-difference%20)

Elegoo Uno r3 vs Arduino Uno r3

[https://www.reddit.com/r/arduino/comments/m4wjuq/elegoo\_uno\_r3\_vs\_arduino\_uno\_r3/#](https://www.reddit.com/r/arduino/comments/m4wjuq/elegoo_uno_r3_vs_arduino_uno_r3/)

Benefits of the Qwiic Connect System

<https://www.sparkfun.com/qwiic>

Temperature Sensor Comparison

<https://learn.sparkfun.com/tutorials/temperature-sensor-comparison/all>

Using DHT11

<https://projecthub.arduino.cc/arcaegecengiz/using-dht11-12f621>

Modern Replacements for DHT11 and DHT22 Sensors

<https://learn.adafruit.com/modern-replacements-for-dht11-dht22-sensors/overview>

Temperature and Humidity Sensor

<https://projecthub.arduino.cc/Amarantowy/temperature-and-humidity-sensor-3a7db8>

SparkFun\_TMP117\_Arduino\_Library

<https://github.com/sparkfun/SparkFun_TMP117_Arduino_Library>

How PIRs Work

<https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/how-pirs-work>

Interfacing PIR sensor with Arduino

<https://projecthub.arduino.cc/rudraksh2008/interfacing-pir-sensor-with-arduino-ccf450>

Interfacing Arduino uno with PIR motion sensor

<https://projecthub.arduino.cc/electronicsfan123/interfacing-arduino-uno-with-pir-motion-sensor-593b6b>

PIR sensor Interface with Arduino

<https://projecthub.arduino.cc/munir03125344286/pir-sensor-interface-with-arduino-c1e1ae>

PIR Motion Sensor Hookup Guide

<https://learn.sparkfun.com/tutorials/pir-motion-sensor-hookup-guide>