Design Review 1

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Major Subsystems

- Temperature Sensors: This subsystem is utilized to detect and measure the ambient temperature of the climate control unit. Two digital temperature sensing devices will be incorporated as a means to ensure that both are operating properly. The sensors will communicate with the control unit via SPI communication. The sensors we are currently planning to use are DS1722 Digital Thermometers.
- Control Unit: This subsystem is utilized to coordinate and control both the Wi-Fi connectivity and the temperature sensors. The control unit processes the digital temperature measurements from the temperature sensors and interprets them based upon pre-programmed instructions. Once the temperature reaches the first low-temperature threshold, an alert will be generated to be sent over Wi-Fi to the owner of the dorm room. At the second low-temperature threshold, an additional alert will be prompted. Finally, when battery level is low (in need of maintenance) or any of the temperature sensors are detected to be malfunctioned, a maintenance alert will be generated to be sent over Wi-Fi to hall staff. This control unit will utilize an ESP-WROOM-02D Wi-Fi module.
- Wireless Communication: This subsystem is utilized to transmit messages to the dorm room owners or hall staff depending on the type of alert generated by the control unit. This subsystem utilizes Wi-Fi for wireless communication, and it will interface with the online server / web-app. This subsystem also utilizes the ESP-WROOM-02D Wi-Fi module.
- Online Server / Web App: This subsystem processes the wireless message alerts from the various systems within each dorm room and organizes them such that they are relayed to the correct recipient. This ensures that a temperature alert message from a specific dorm room is sent just to the owner of that dorm room, or that a maintenance alert is sent to hall staff. Finally, this subsystem is also

incorporated such that that recipient information can be updated considering that the owners of specific dorm rooms change over time. This subsystem is created by running Python on a Raspberry Pi.

Major Components

- XCL206B333CR-G DC-DC Converter: This component is used to convert the 5V battery voltage to 3.3 V which will be used as the power supply for both the MCU and temperature sensors. Compared to a voltage regulator, these converters typically have higher power efficiency
- DS1722 Temperature Sensor: This component is used to measure temperature of the surrounding air. This particular sensor is true temperature-to-digital converter and utilizes SPI communication to transmit digital temperature readings
- ESP-WROOM-02D: This component incorporates both the microcontroller and Wi-Fi connection capabilities. The microcontroller is utilized as the central processing unit
- ESP PCB Antenna: This antenna is attached to the ESP-WROOM-02D. This antenna will be used for establishing a connection through Wi-Fi, and must be positioned on the PCB such that it is hanging off the side of it.
- TTL-232R-3V3 UART-USB Adapter: This is utilized for programming the ESP module. The USB side connects to a PC that can run the Arduino IDE, and this IDE is used for programming. The programming instructions are then communicated through UART to the ESP module.

Component Important Connections

- 3.3 V DC-DC Converter
    - Connect a 4.7 uF capacitor between the Vin pin and Vss pin/ground
    - Connect a 10 uF capacitor between the Vss pin/ground and the Vout pin
    - Wire together the two Vss pins, L2 and Vout, and L1 and LX

- Power/GND
    - Connect GND trace on PCB to Vss pin on DC-DC converter
    - Connect power trace on PCB to Vin pin on DC-DC converter
    - Connect a 10 uF and 0.1 uF capacitor between power trace and GND trace
        - This is used for the ESP8266 Module
- Temperature Sensors (DS1722)
    - Connect power trace to VDDD or VDDA pin (Not sure which)
    - Connect GND trace to GND pin
    - Connect the SERMODE pin to the VDD pin
    - Connect SDO pin to HSPI_MISO pin of ESP8266 module (pin 5 -> pin 4)
    - Connect SDI pin to HSPI_MOSI pin of ESP8266 module (pin 6 -> pin 5)
    - Connect SCLK pin to HSPI_CLK pin of ESP8266 module (pin 3 -> pin 3)
    - Connect CE pin to HSPICS pin of ESP8266 module (pin 2 -> pin 6). ESP8266 module only possesses one CS pin?? so we will need to use another pin to serve as the chip select line for the second temperature sensor
- ESP8266 Module (Use HSPI for temperature sensors, SPI bus used for flash)
    - Connect a 10 K resistor between power trace and pin 2
    - Connect 0.1 uF capacitor between GND and pin 2
    - Connect a 10 K resistor between GND trace and pin 6
    - Connect GND trace to pin 9
    - Connect GND trace to pin 18 and 19
    - Connect the RXD pin to the TXD pin of the UART-USB converter
    - Connect the TXD pin to the RXD pin of the UART-USB converter

Current Problems / Action Plan

- How will we connect the on-chip network controller to the online server?
    - Action Plan:
        - Ask Prof. Schafer

        - Chip-specific protocol, or is there an integration with Python in some way?
- How will we package the device, and how will it be mounted to the fan coil unit?
    - Action Plan:
        - Conduct basic testing on various mounting positions with a temperature sensor reading out to a serial monitor.
        - Analyze this data to determine the thermodynamically optimal position.
- How will we set up the programming pins on the MCU, and what connectors will we utilize to connect from the computer to the board?
    - Action Plan:
        - Investigate UART - USB converter options.
        - Ask Prof. Schafer about options already in the lab
- How will we control both temperature sensors on the same SPI bus with only one select pin?
    - Action Plan:
        - Ask Prof. Schafer if it makes sense to repurpose a general I/O pin as another select line