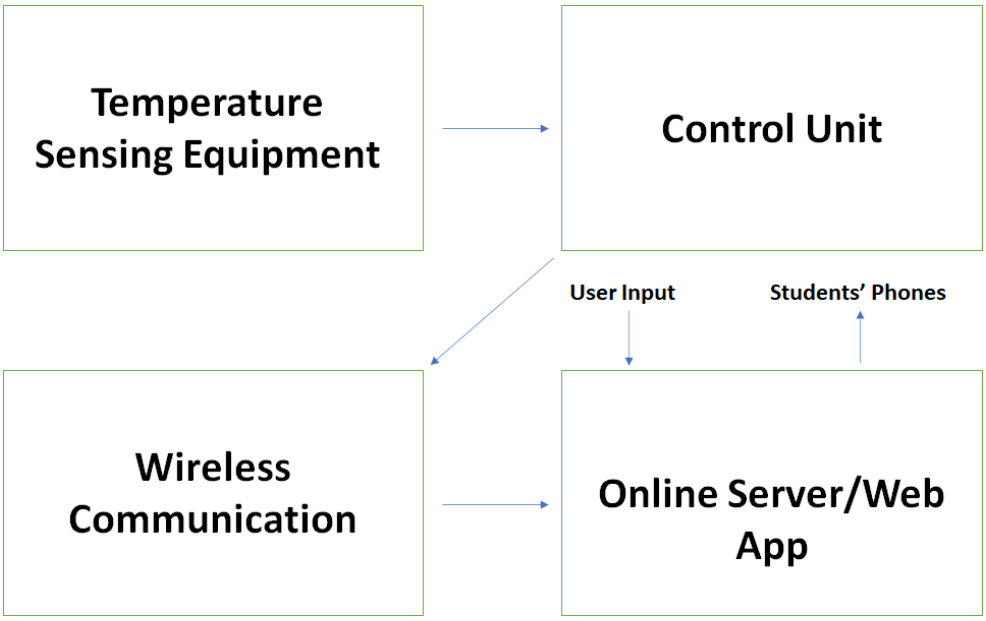
System Block Diagram:



Major Subsystems:

- Temperature Sensors
    - Need to accurately measure temperature data to a level of precision relevant for this application. In our case, students simply need to be alerted whenever the pipes are in danger of freezing, not whenever they reach the exact freezing point of water within metal pipes. As such, temperature sensing equipment with only one decimal point of precision.
    - Need to ensure that all necessary passive components for the temperature sensors are included, such as pull-up resistors.
    - Need to utilize temperature sensors that are capable of performing wired serial communication with the control units. The temperature sensors should also be programmable by the control unit.
    - Need to ensure that the measurement is reliable and that the sensing equipment is operating as intended (i.e. it has not broken). This will entail some sort of redundancy or multiple measurements such that any decision made by the control unit is not reliant on the efficacy of one measurement.
    - Need to set up sensing equipment in a way that's easy to access. This will ensure that any maintenance is easy to perform if necessary.
    - Need the sensing equipment / overall system to be small enough and light enough to be easily installed in the climate control area where the pipes are located

- Control Unit

    - Need the control unit to interpret temperature data and compare it to preset thresholds
    - If temperature is below a certain threshold, need the control unit to determine which message must be sent based on which threshold has been crossed, and relay the message to wireless communication
    - If the device is low on battery, need control unit to prompt wireless communication to send a low battery alert
    - If the temperature sensing equipment is malfunctioning, need control unit to prompt wireless communication to send a maintenance alert
    - Need to include all necessary components for operation of the control unit. Since this unit will be a microcontroller, we will need to include passive components such as decoupling capacitors for the power pins.
    - Needs to be programmable with MPLAB such that it can configure the temperature sensing and wireless communication interfaces, and communicate with them.
    - Need a control unit with ample processing power for wireless communication. For some protocols such as Wi-Fi, this will require a lot of processing power.

- Wireless Communication
    - Need to receive alert message prompts from the control unit through some form of wired communication.
    - Need a wireless interface that can be easily programmable from the control unit.
    - Need to include all necessary components, such as decoupling capacitors, for operation of the wireless interface.
    - Need to connect the device to a wireless network. This network must be accessible everywhere in the dorms where the units are located, and must have the bandwidth required to transmit many messages from many devices simultaneously. Must also be able to reliably transmit information in the presence of physical obstacles.
    - Need to transmit the determined alert message over the internet to an internet server. These alert messages include temperature and maintenance alerts. This communication is relatively low-range: (inter-dorm communication)

- Online Server and Web App
    - Need an online server that can receive the alert messages from the temperature sensing units and relay those messages to student's phones. This communication requires a much longer range (needs to reach students wherever they are located).
    - Needs to be easily developed with a software language that we are already knowledgeable of, or that we can figure out with limited difficulty.
    - Need to be able to communicate with the server wirelessly through the internet

- Need an online user interface where phone numbers can be added to and removed from the online server

Plan for First Design Review

1. The first step we need to do is access the climate control area and assess how much space we have to place the temperature sensing system. Additionally, we will need to assess where we can place the system.
2. The next step we need to do is identify the specific primary components necessary for the system. These include the temperature sensors, PIC32 microcontroller, and the Wi-Fi network controller. After this, we need to acquire the data sheets for these components and make sure we understand the specific passive components needed for operation
3. Once this is done, we need to assess how long ordering the parts will take. This will determine whether we need to order any parts before we start design of the board
4. After this, we need to look into how we can create a proper web-app and interface it with the Wi-Fi network controller. This is something we are more uncertain of how to do so this will take some research
5. Finally, before we move onto the design, we need to address final questions that we are still uncertain of.
    a. Find a way to measure battery life
    b. Potentially add a status LED with push-button
    c. Ensure that the Wi-Fi network controller we use can communicate with a web app, and that we know how to accomplish this
6. After this, we can move into constructing the schematic and PCB layout for the system itself.
7. Record any consistent problems so that we can present them at the design review.