Project Summary

Issues

The first issue I encountered was converting code from MicroPython to CircuitPython. Adafruit provides CircuitPython libraries to use with a lot of their products, and for ease of use I decided to make the switch from MicroPython. While both were similar, the manner in which GPIO pins and libraries are used felt noticeably different and took some time to get used to and convert code properly. Another relatively big issue was that I prioritized the development of the Weather Station side while incrementally testing parts of the Smart House. Every component worked when individually testing them, but by the time I was testing all of the Smart House actuators together I had power supply issues due to oversight by using a standard 5V 1A outlet. With a servo, LEDs, LCD, and motor connected, the power supply was insufficient so I opted to remove the motor to prioritize getting everything else properly functioning and built. This was a huge "how did I miss that" moment and while I could have added an internal battery, it would take away from the simplicity of just plugging in a USB-C cable. With that– as it stands the measured light is the only parameter that changes physical states of the Smart Homes' actuators (LEDs, shutters).

Unique Features

The primary unique feature employed was the use of LoRa wireless data transmission. When most people think of wireless communication, the first things that come to mind are WiFi, Bluetooth, and cellular. While these provide high bandwidths, they come at the cost of range and power consumption. As IoT (Internet of Things) devices are becoming more and more prevalent, LoRa provides an elegant solution for long range, low-power applications. While the amount of data it can transfer at a time is limited (256 bytes at a time), this is more than sufficient for applications like relaying sensor data or short messages.

Another unique feature is that the system pair is completely automated other than the need to supply / connect power. Once the solar station is up, it takes care of itself and intermittently reads and sends weather data. The Smart house, on the other hand, waits for weather data and automatically adjusts the interior controls.

One last unique feature that I added last minute was a standalone LoRa receiver and website host. This keychain-sized package is set up to connect to my phone's hotspot and host a website that displays the latest received weather data as well as the average data for the last hour. This bit runs on a SeeedStudio Xiao-ESP32C6, which has an incredibly small footprint in addition to WiFi and Bluetooth capability. Had I learned about this uC prior to starting this project, I would have likely chosen another

small form-factor board from SeeedStudio's Xiao line of uC's. I primarily used vibe coding (AI prompted coding) to program this, as I have no prior experience with programming on Arduino IDE with C/C++ and this was an extra system that I was curious to see if I could add to the project.

Future Changes

As far as changes I would make, it primarily boils down to the Weather Station housing. I would like to spend more time looking into different ways of making it rain-proof while still allowing for good airflow through the system. One downside of having the solar panels mounted on the roof was that it noticeably increased the temperature inside the station due to them being a dark color and absorbing heat from the sun. Another contributor to this temperature increase was likely insufficient air flow going through the station. Another "quality of life" improvement I'd make would be to adjust how the station pieces connect to each other– because of the design of how everything comes together it becomes a time consuming task for even just connecting the power inside. To go with that, the addition of a waterproof switch would make the process of turning on the station much easier.

I also want to redesign the power supply of the model house in order to use a motor for a fan. This would also allow for additional physical state changes based on things like temperature and humidity.

Further changes would be integrating the Smart Home with the internet, and LoRaWAN in general. This would make the stations' data available from anywhere in the world, and truly make it an Internet of Things device. To go with that, adding a website host/handler directly to the smart home would be ideal instead of another separate device.

Total Cost: $496.26