

# Product Requirements Document

EGR 314 Fall Project

Sky Scout

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Version 1

## Introduction

Weather stations are important to more people than just News Stations, as farmers, outdoor enthusiasts, and more rural communities rely heavily on weather predictions. Farmers need an accurate method of knowing weather conditions for crop timing and in Arizona, they rely on weather stations to know when they should compensate for lack of natural rain. Many outdoor enthusiasts rely on weather forecasting to know when they can safely travel to certain areas or when they should pack extra resources for their trips. The main limitations to current designs are their positioning and accuracy for rain measurements with many customers struggling to find the perfect location for data collection or setting up the weather station in a secure location. Most designs can support wireless data transfer over WiFi so this iteration would need to maintain that along with the accuracy of readings.

## Objectives

This project aims to develop and study the applications of a mobile weather station on a medium-sized property. Ideally, the design is improved so that there is no need for multiple weather stations on a property and instead the users can buy a single one that can take readings at multiple locations. The target is to maintain the relatively high accuracy of most of the readings and improve the reliability of the rain measurements. Most competitor models also include very clunky or obvious designs so the other main goal of this project is to expand on the colors to offer a design that can blend in. For a list of some of the current competitors, see Appendix.

## Stakeholders

**Target group.** Users are heavily interested in meteorology and ready to invest in their personal technology. They also have a larger, unpopulated property that doesn't contain multiple biomes.

**Target purchaser.** Target group profile with a history of meteorology purchases in the \$150 to \$250 price range.

**Customer Service.** Prefers easy-to-repair, recyclable, and easily resourceable fixes to fit with a low-effort user experience.

**Marketing & Sales division.** Looks for an affordable, and unique selling point reflexive of user experience.

**Manufacturers.** Prefer product designs that are easily put together with a process that can be implemented with little instruction and low safety concerns.

## Use Cases

**User Story #1:** Joe is a farmer who relies on precise weather data to produce the most amount of crops from his farm. By constantly tracking temperature, humidity, and rain, a smart device helps the farmer make informed decisions about daily farm operations. For example a device that can predict future rainfall can inform the farmer so they can reduce the amount of water waste for Their crops. A simple device that can monitor weather conditions can save many farmers a lot of valuable time and money.

**User Story #2:** Megan is a normal homeowner but still wants to be informed about general weather conditions that can impact her life. By tracking local humidity, temperature, and rain chances, the device helps inform her about watering her plants or how she might need to dress for the day. Also, real-time updates on storms or extreme temperatures inform her to close windows or adjust the home air conditioning, protecting the home and saving money on adjusting the home air conditioning system.

## Aspects

1. Product Design -
  - 1.1. The device will contain at least 2 separate serial sensors that measure a specified aspect of the environment.
    - 1.1.1. Any analog sensor subsystems shall be custom-designed, non-trivial, hardware-based, amplification and filtering.
  - 1.2. The device will contain at least one serial actuator and one motor or linear actuator with bidirectional control ability.
  - 1.3. The device will utilize surface-mount components.
    - 1.3.1. The resistors and capacitors should be at least a size 0805.
  - 1.4. The device shall contain at least one voltage regulator of the switching type with a voltage specification of 3.3 V.
  - 1.5. The device will utilize the Curiosity Nano 18F47Q10 & ESP32.
  - 1.6. The device shall support a weather-proof design so that it can function in a variety of environments.
  - 1.7. The device shall be able to be placed anywhere for easy weather data gathering.
    - 1.7.1. The device should be able to reposition itself for the optimization of data collection.
    - 1.7.2. The device should contain a design aspect that aids in securing placement.
  - 1.8. The device shall have a long battery life of 1 year.
    - 1.8.1. The device should contain some sort of battery recharge port.
  - 1.9. The device shall have durable and lasting sensors.
    - 1.9.1. The sensors should be properly weather tested.
    - 1.9.2. The sensors should be encased or otherwise built into the device so as to offer better protection.

- 1.10. The device shall maintain an easily accessible, and simple structure for telecommuted troubleshooting.
- 1.11. The board will be a maximum of 100 x 100 mm.
2. Functionality -
  - 2.1. The system shall respond to the environment using serial sensing and actuation for a mobile weather station.
  - 2.2. The system shall broadcast the environmental data to the internet over WiFi using the MQTT protocol.
    - 2.2.1. The device should utilize non-personal applications for read/write functionalities.
    - 2.2.2. The device should have a long range of over 100 meters.
  - 2.3. The actuator shall be controlled by a motor controller communicating over the I2C or SPI-based protocol.
  - 2.4. Main communication between subsystems shall be completed using UART.
  - 2.5. The device will utilize 8 or 16-bit Microchip PIC families.
  - 2.6. This project will utilize C (MPLAB X) and MicroPython.
  - 2.7. The digital gauge shall accurately communicate measurements.
  - 2.8. The communications subsystem shall prioritize accuracy and timely alerts in relation to rain measurements by focusing on sprinkling or light rain applications.
  - 2.9. The communications subsystem should prioritize readability in the visual representation of the data.
3. Interactivity & User Experience -
  - 3.1. The interactivity subsystem shall format and create a website or internet-based location for user interaction with data and configuration settings.
  - 3.2. The device should be integrated into an app that allows users to configure notifications.
  - 3.3. The device shall display the collected data on the user's phone.
  - 3.4. The device should connect to a home smart app or AI for ease of use.
  - 3.5. The instructions for use and setup shall be clear and concise.
    - 3.5.1. There shall be a clear method or process for the user to follow for integration and use.
4. Customization -
  - 4.1. The device shall have a screen that is easily readable in strong sunlight.
  - 4.2. The device shall have a manually set-up clock.
  - 4.3. The device should have the option for a variety of colors.
  - 4.4. The display should have some level of customization based on templated options that the user can choose from.
5. Manufacturing -
  - 5.1. The sensors should be easily replaceable as a unit change so as to prevent the need for a complete device swap.
  - 5.2. The device shall have a consistent quality in production.
  - 5.3. The device shall be built to last for at least ten years without detrimental decay.
    - 5.3.1. The device should have a functioning lifespan of at least 5 years.
  - 5.4. The device will stay within the target budget of \$240.
    - 5.4.1. The device should cost somewhere between \$60 and \$160.

- 5.5. The device should provide weather trends and make attempts to predict future weather events.
- 5.6. The device should have a mounting capability that comes as an attachment.
6. Safety -
  - 6.1. The device shall produce accurate data without access to non-proprietary information.
  - 6.2. The device should produce reliable information for the user to be able to use.

## Open Questions

- How can data from these devices be used by other smart home devices to optimize energy and reduce prices?
- How could the data be used by the general public in a local community network to better predict various weather scenarios?
- What sets small consumer weather devices apart from professional-grade machines?
- What are the possible privacy and security spencers with using weather monitoring devices that are all connected to the internet?
- How can all this data being collected in the home setting be utilized to predict and help with climate change?

## Milestones

### August

Team Organization Charter: August 30, 2024

### September

User Needs, Benchmarking, and Requirements: September 4, 2024  
 Design Ideation: September 6, 2024  
 Team Checkpoint 1: September 9, 2024  
 Block Diagram: September 16, 2024  
 Component Selection: September 18, 2024  
 Microcontroller Selection: September 25, 2024  
 CATME I: September 27, 2024

### October

Hardware Orders: October 2, 2024  
 Software Proposal: October 2, 2024  
 Subsystem Design: October 7, 2024  
 Hardware Proposal: October 9, 2024  
 Hardware Implementation V1: October 18, 2024  
 CATME II: October 21, 2024  
 Team Checkpoint 2 (Presentation Preparation): October 21, 2024  
 Team System Prototype (Initial): October 25, 2024  
 Subsystem Verification: October 28, 2024

Team Checkpoint 2 (Materials Submission):      October 28, 2024

## **November**

Innovation Showcase Info Submission:      November 4, 2024  
Team System Prototype (Final):      November 8, 2024  
Hardware Implementation V2:      November 8, 2024  
Team System Verification - Part 1:      November 13, 2024  
Team Protocol and Controller Design:      November 18, 2024  
Innovation Showcase Poster Submission:      November 22, 2024  
Software Implementation (Checkoff):      November 25, 2024  
Software Implementation (Submission):      November 27, 2024

## **December**

System Verification Final Deadline:      December 2, 2024  
Team Checkpoint 3 Demonstration:      December 6, 2024  
CATME III:      December 9, 2024  
Team Checkpoint 3 Report:      December 9, 2024

## Appendix: VOC Benchmarking

### Search 1

**Keywords:** “mobile weather station”

#### Selected Products

##### 1. [Tempest Weather Station](#)



- **Price:** \$339.00
- **Vendor:** Tempest
- **Description:** Centered around the Tempest Weather Station and the powerful Tempest app with a guaranteed better forecast, the Tempest Weather System is the ultimate tool for managing your smart home, garden, and all weather-driven decisions.

#### Positive Comments

Summarized User Comment	Restated Customer Need
The customer service is reliable and generally a pleasant experience.	(Explicit) The device shall maintain an easily accessible, and simple structure for telecommuted troubleshooting.
The device provides generally accurate data without being invasive.	(Latent) The device shall produce accurate data without access to non-proprietary information.
The device was easy to install and configuration was made easy by pairing it with the app.	(Explicit) The device shall have a clear method for set up and use.

## Negative Comments

Summarized User Comment	Restated Customer Need
Rain measurement and alerts are not satisfactory in timing and accuracy.	(Explicit) The communications shall prioritize accuracy and timely alerts in relation to rain measurements by focusing on sprinkling applications.
The longevity of the device does not live up to the price tag.	(Explicit) The device shall be built to last for at least 10 years without detrimental decay.
The integration with other products is a hit or miss, and most users' ability to read the data is made difficult by the app's layout.	(Explicit) The communications shall prioritize readability in the visual representation of the data.



## 2. [WS-2902](#)

- **Price:** \$189.99
- **Vendor:** Amazon
- **Description:** Monitor your actual home and backyard weather conditions with our wireless and Wi-Fi-enabled sensor array measuring wind speed/direction, temperature, humidity, rainfall, UV intensity, and solar radiation. Includes (1) Osprey Sensor Array with Rain Cup, and (1) Brilliant, Easy-to-Read LCD Color Display

**Positive Comments**

Summarized User Comment	Restated Customer Need
The data is highly accurate and provides highly applicable data at a reasonable price.	(Explicit) The device will stay within the target budget of \$240.
	(Latent) The device shall aim for a market price of \$160 or lower.
Relatively easy setup and connection that allows the user to check out information regardless of where they are.	(Latent) The communications shall be consistently available up to a distance of 100 meters.
While the digital gauge might not read accurately at all times, the information uploaded to the website is always accurate.	(Explicit) The digital gauge shall accurately communicate measurements.

**Negative Comments**

Summarized User Comment	Restated Customer Need
It is difficult to find a place to properly mount the unit so that it stays put and provides quality data.	(Latent) The device shall contain an actuator that moves it to a better position in cases where the original placement prevents it from gathering data.
	(Explicit) The device shall contain a secure method of placement.
There is a minor issue of it jumping ahead by an hour in places where daylight savings time is a concern.	(Latent) The device shall have a clock that is manually set up.
Directions for WiFi setup are not elderly-friendly.	(Explicit) Instructions for use and setup shall be clear and concise.



## Search 2

**Keywords:** “Home weather device”

### Selected Products

#### 3. [Home Temperature Humidity Sensor](#)



- **Price:** \$12.96
- **Vendor:** Amazon
- **Description:** This wireless remote thermometer is small enough to fit in reptile vivariums, potted plants, and other small spaces. Meet your needs for any corner. You can also mount this thermometer hygrometer indoors on the wall or in other places with the sticker or screws. Connecting with 2.4 GHz WiFi, you can remotely monitor the WIFI Thermometer Hygrometer. Smart temperature sensor supports App Notification Alert, View History Records, Temp Humidity Graphs, °F/°C Reading, and Intelligent linkage functions

#### Positive Comments

Summarized User Comment	Restated Customer Need
Very easy to set up and user-friendly	(Explicit)The device shall cost under 20
Cheap and easy to set up multiple devices in a lot of different locations. All the devices can easily be found in the same app.	(Latent)The device should cost 12\$ to keep it adorable.
Connects to the existing Amazon Alexa system for ease of use to other smart home items.	(Explicit)The device shall connect to your phone to show the data.

#### Negative Comments

Summarized User Comment	Restated Customer Need
Can break somewhat easily and quickly with a short lifespan on occasion	(Latent)The device should be able to have a lifespan of longer than 5 years
Small battery lifespan, have to change batteries fairly often.	(Explicit)The device shall be able to be set up very easily so anyone can do it with minimal instructions.
Have to be in the range of a wifi router.	(Explicit)The device shall be able to be mounted anywhere for ease of use

#### 4. [Eve Weather](#)



- **Price:** \$51.40
- **Vendor:** Amazon
- **Description:** Track outdoor temperature, humidity, and barometric pressure over time and see the weather trend at a glance – on your iPhone or directly on the display.

#### Positive Comments

Summarized User Comment	Restated Customer Need
A smart app that shows all the weather data gathered	(Explicit)The device shall connect to a home smart app for ease of use.
Easily able to place the device anywhere that you want the weather data gathered.	(Latent)The device shall have a screen that is easily readable in strong sunlight.
Outdoor weather history visible through the Eve app helps look at local trends.	(Latent)The device should cost less than \$60 and be affordable.

### Negative Comments

Summarized User Comment	Restated Customer Need
Poor range of use of the device.	(Explicit)The device shall connect to wifi and have a long range of over 100m.
Very often disconnects from the app or from the wifi.	(Latent)The device should give weather data trends and try to predict future weather events.
Very dim light, not easy to read the screen.	(Latent)The device should be able to be placed anywhere for easy weather data gathering.

### Search 3

**Keywords:** “Temperature sensor”

#### Selected Products

##### 5. [YoLink](#)



- **Price:** \$35.99
- **Vendor:** Amazon
- **Description:** Many applications, including pool/hot tub & fish tank water, wood boiler, fridge, and deep freezer, livestock water trough, milk, beer, wine, water, steam, and pipe temperature monitoring. Additional uses include composting, and HVAC/heating/cooling/ventilation management. And no WiFi is required! YoLink utilizes a unique wireless format very different from WiFi. Based on LoRa, our devices boast a 1/4 mile open-air wireless range, long battery life, and superior obstruction penetration (allowing for placement inside freezers, etc.). Communication is two-way encrypted, protecting your network security and privacy.

**Positive Comments**

Summarized User Comment	Restated Customer Need
Works in a variety of environments.	(Explicit) The device should not require iCloud read/write access to function.
Alerts can be set depending on what is set in the app.	(Latent) The device shall have durable and lasting sensors.
Extremely high battery life.	(Latent) The device should have consistent quality in production

**Negative Comments**

Summarized User Comment	Restated Customer Need
Sensor accuracy degrades over time.	(Explicit) The device should be integrated into an app that allows users to configure notifications.
Requires iCloud access to read/write which causes privacy concerns.	(Latent) The device should work in a variety of environments
Poor quality control.	(Latent) The device should have a high battery life.