Forest Fire Sensor

Senior Design Project

Kailee Saunders, Ed Stifter, Verlee Richey, Mitchell Turner, Joey Canfield

Introduction

The Problem

- Forest mismanagement lead to a buildup of underbrush, along with climate change
- Now, there is hotter and drier weather due to climate change, making forest fires inevitable
- Forest fires are actually natural and good for the environment
- Controlled burns are a good way to combat, but were stopped for a while because they affect air quality
- There isn’t a good way to minimize unnecessary damage to air quality while also protecting people from inevitable forest fires

The Solution

- Develop a sensor that monitors climate factors to notify appropriate parties of impending forest fires
- Sensors will be placed around high risk areas and will send data to a central station
    - Using RF signals at LoRa frequency ranges (government frequencies for actual implementation)
- Station will analyze data based on a database containing climate factors before and during known forest fires
- Station will share warnings with residents as well as fire patrol
- Climate factors: temperature, humidity, wind

Features

- Accurate detection of temperature, wind, and humidity by device
- Successful RF communication with LoRa between device and station
- Ability to access database containing information on property in surrounding area
- Prediction of potential forest fire based on analysis of climate factors
- Analysis of next steps (can we fight against fire)
- Alert of forest fire risk

Available Technologies

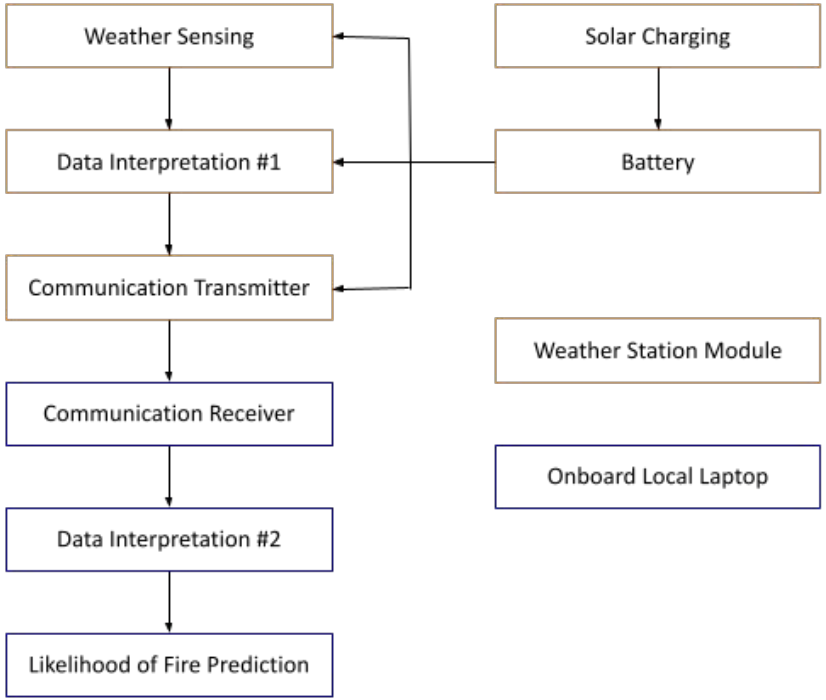
- Temperature and Humidity Sensor: SHT30-DIS-B2.5KS
  - Combined temperature/humidity sensor
  - Low cost sensor: $3.98; available on Digikey to ship immediately
  - Has native support for I^2C
- Wind Sensor: Adafruit Anemometer
  - Low cost anemometer: $44.95; available on Digikey
  - Outputs analog signal that will require parsing; testing and calibration in our software
  - Not waterproof: will need to be properly sealed
- Pressure Sensor: LSP22
  - Low cost: $3.79; available on Digikey
  - Native I^2C and SPI interface

Available Technologies, cont.

- Communication: RFM96W LoRa Transceiver
  - Low cost: $8.12; available on Digikey
  - Can be used for transmitting and receiving
  - Native SPI interface
- Communication: ANT-916-HETH Antenna
  - Surface mount antenna to increase wireless link performance
  - Low cost: $1.33
- Microcontroller: ESP32-C3
  - Low cost: $1.10; available on Digikey
- Power: ADP1109AAN-3.3
  - DC-DC converter
  - Necessary for getting the 3.3V from the batteries to our sensor devices
  - Low cost: $0.44

Engineering Content

- Solar Charging/Battery: provide power for Weather Station Module
- Weather Sensing: Create hardware that accurately measures atmospheric changes
- Data Interpretation #1: Use microcontroller to store data to measure trends
- Communication Transmitter/Receiver: Transmit data to LoRa from laptop
- Data Interpretation #2: Use local computer to compare measured values from Weather Station Module to data gathered from historical fires
- Likelihood of Fire Prediction: Present user with prediction of possible fires as well as nicely organized summary of weather trends



Conclusion

- Remote weather station with unique implementation of monitoring for potential forest fires
- Hardware component: sensor for collection of data
- Software component: transmission and analysis of data
- Protect forest environments and the people who live in them