Prototyping New Systems for White Light Solar Flare Observation and Data Collection

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IMSA Summer Symposium

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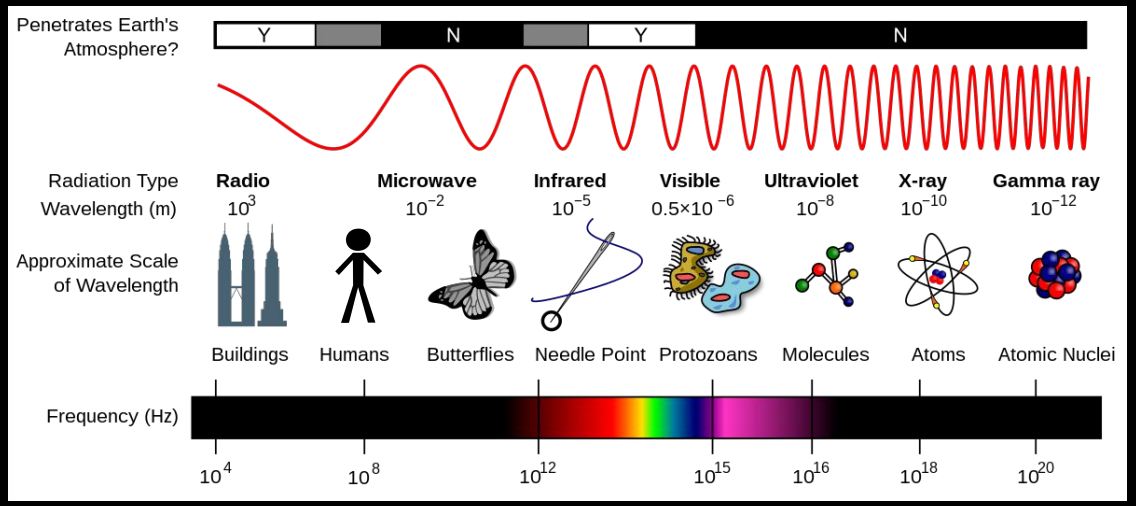
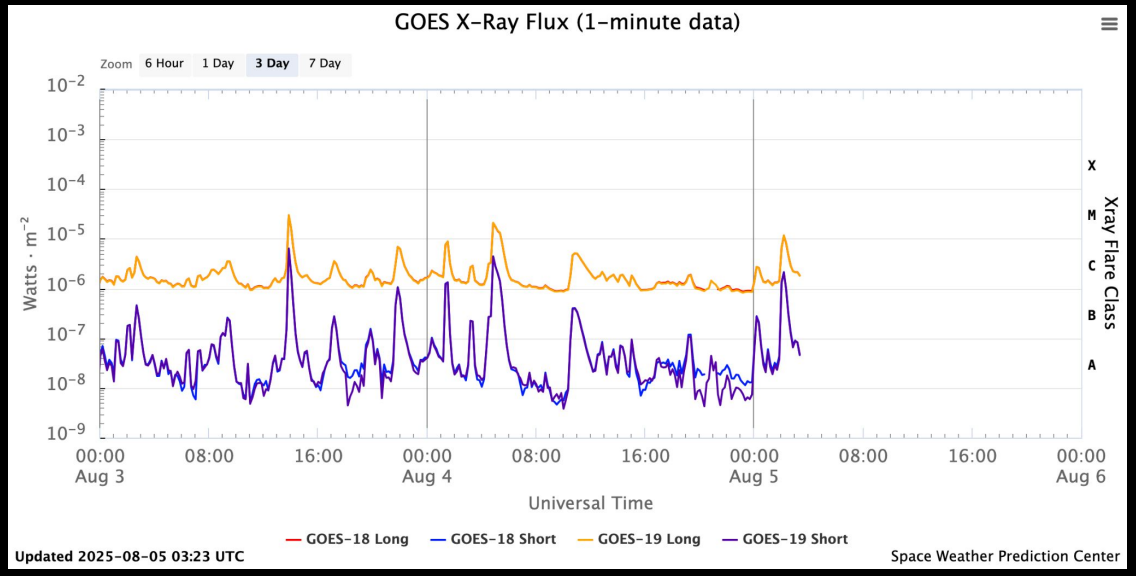
Electromagnetic Spectrum





- ★ Electromagnetic (EM) Energy
- ★ Frequencies and Wave Propagation
- ★ Solar Observations
- ★ Geostationary Operational Environmental Satellites for Solar X-Rays

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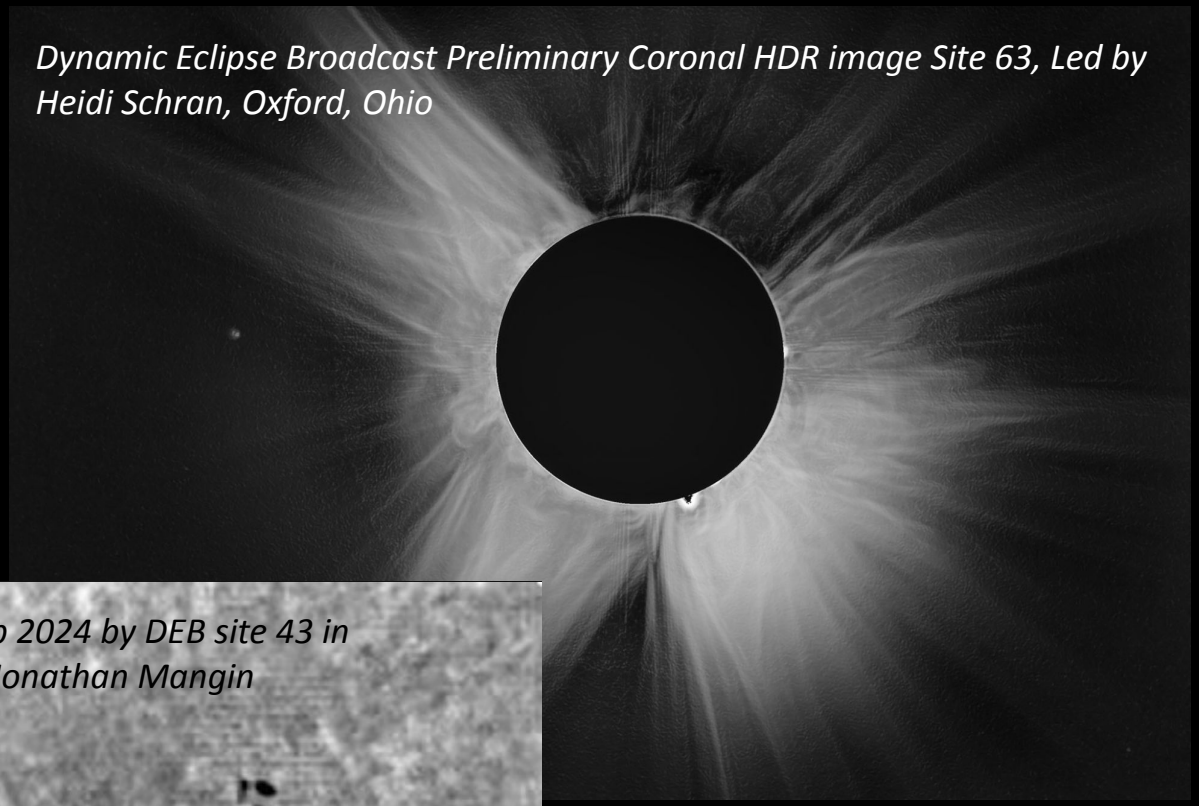
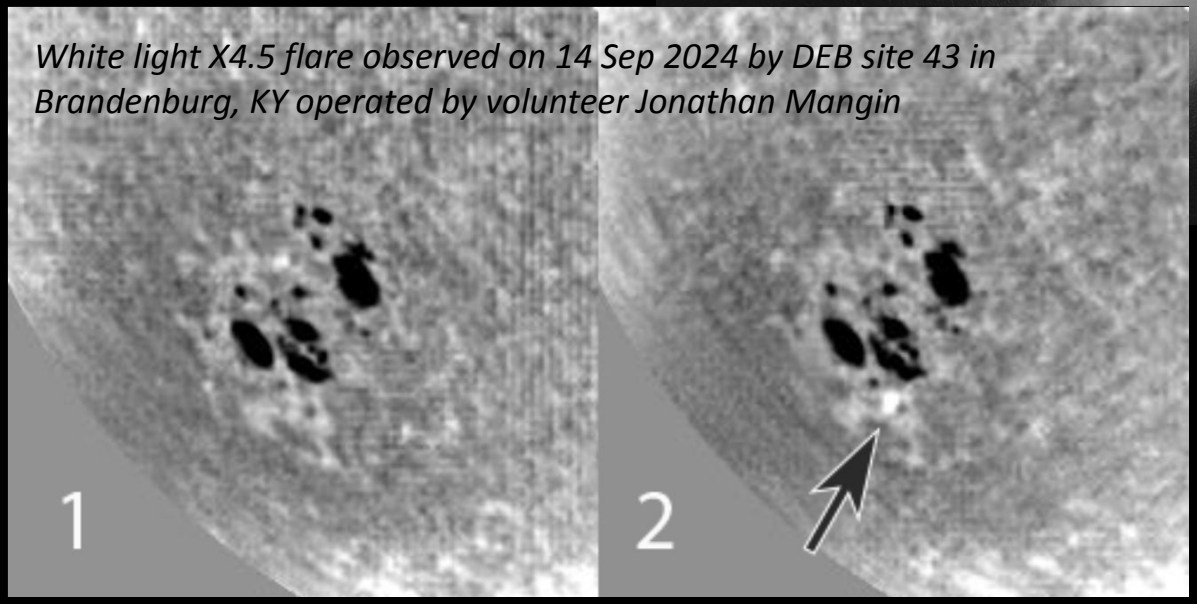
White Light Solar Flares

- ★ Coronal Mass Ejections
- ★ Solar Flares
- ★ White Light



Dynamic Eclipse Broadcast Preliminary Coronal HDR image Site 63, Led by Heidi Schran, Oxford, Ohio



White light X4.5 flare observed on 14 Sep 2024 by DEB site 43 in Brandenburg, KY operated by volunteer Jonathan Mangin

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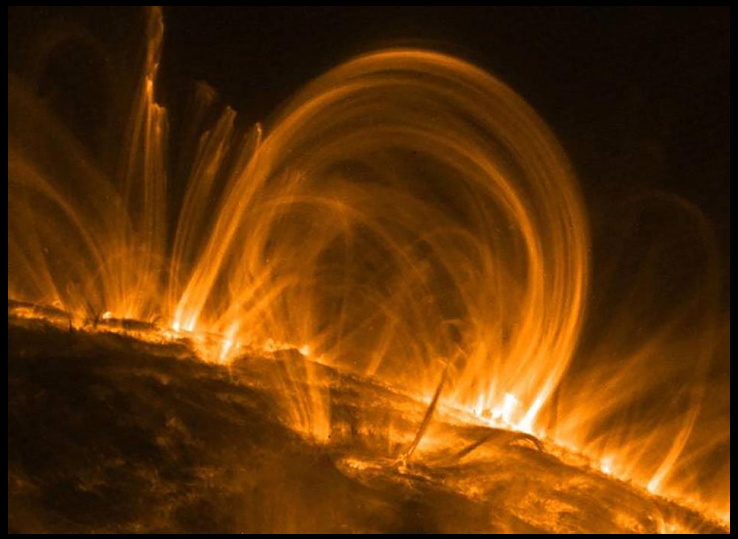
Impacts & Coronal Features

- ★ Previous Research
  - ○ Plasma Physics
  - ○ Thick Target Models
  - ○ Coronal Loops
  - ○ Magnetic Field Lines



- ★ Risk to Infrastructure
  - ○ Radio Comms
  - ○ Power Grids
  - ○ Global Positioning Systems

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Current Observational System

- ★ Setup
  - ZWO AM5 Mount
  - Askar FMA 180 Pro Telescope
  - Rainbow Symphony Solar Filter
- ★ Programs
  - ASCOM Controller
  - SharpCap
  - Cartes du Ciel (Skymap)
  - Planetary System Stacker (PSS)

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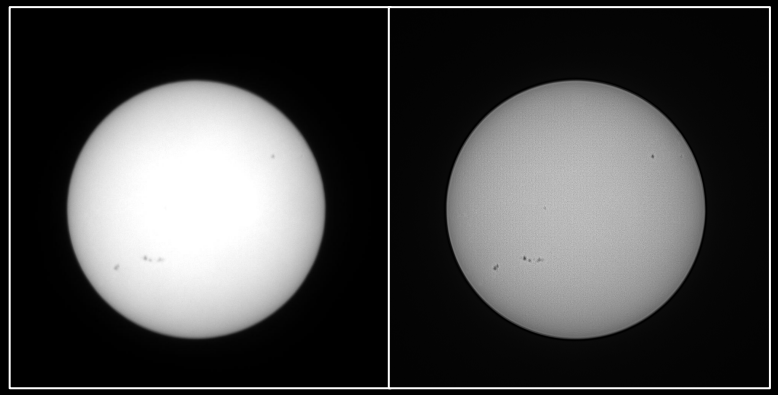
Reasons for Automation

- ★ Remote Desktop Setup
- ★ Weather Conditions
  - ○ Clouds
  - ○ Aircraft
  - ○ Humidity
  - ○ Precipitation
  - ○ Storms
- ★ Manual Start/Stop



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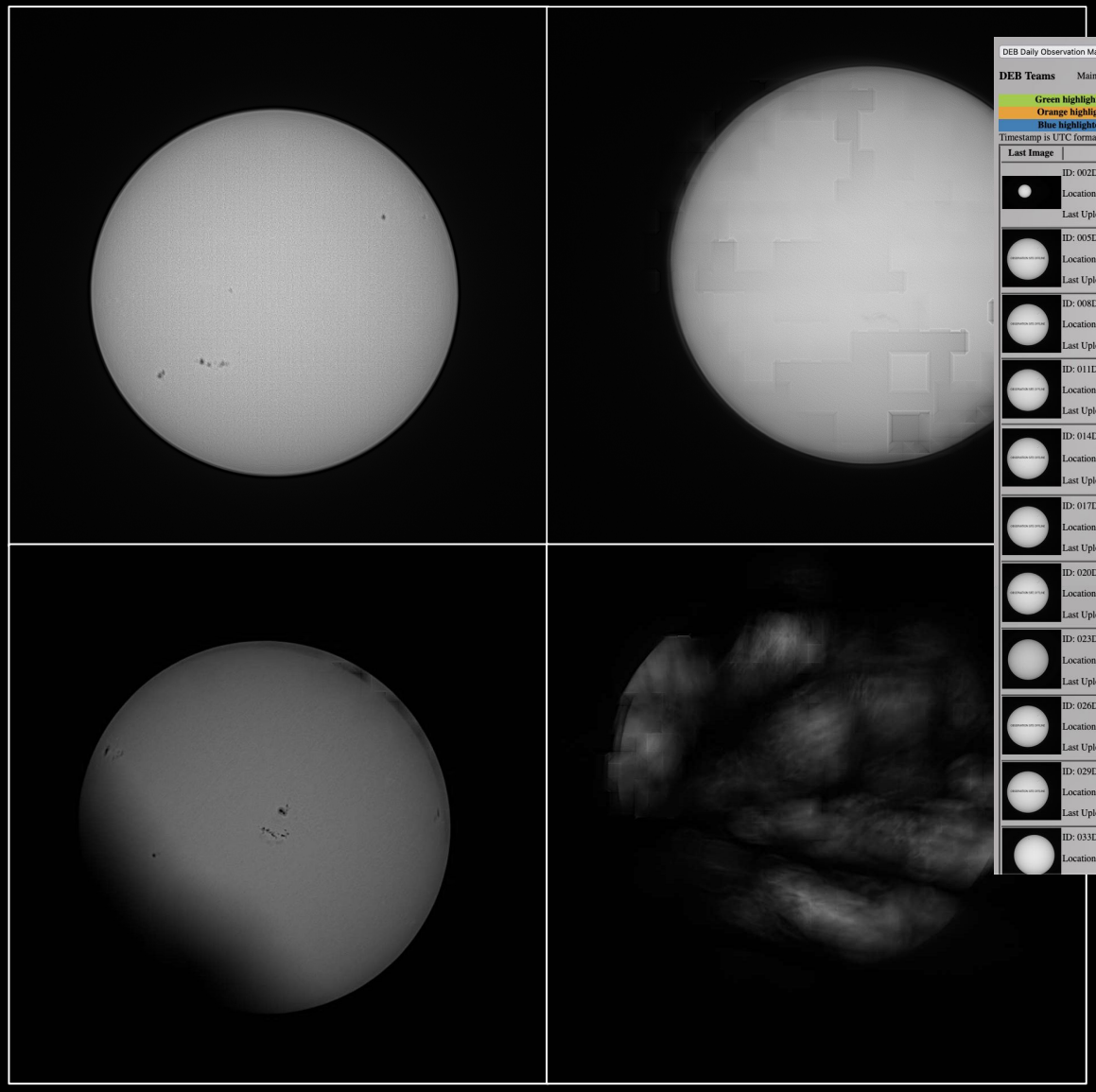
Examples of Data



DEB Daily Observation Map | DEB Eclipse Observation Map

DEB Teams Main DEB Page: debitiative.org

Green highlighted: Active within 1 HOUR.
Orange highlighted: Active within 1 DAY.
Blue highlighted: Active within 1 WEEK.

Timestamp is UTC formatted as {Year-Month-Day Hr:Min:Sec}

Last Image	Team Information	Last Image	Team Information	Last Image	Team Information
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	ID: 005DEB, Iadevaia Location: Tucson, AZ Last Upload: N/A		ID: 006DEB, MacBride Location: Ann Arbor, MI Last Upload: N/A		ID: 007DEB, Erickson Location: Vail, AZ Last Upload: N/A
	ID: 008DEB, Whiting Location: Grand Junction, CO Last Upload: N/A		ID: 009DEB, Carter Location: Evansville, IN Last Upload: N/A		ID: 010DEB, Fuentes Location: Del Rio, TX Last Upload: N/A
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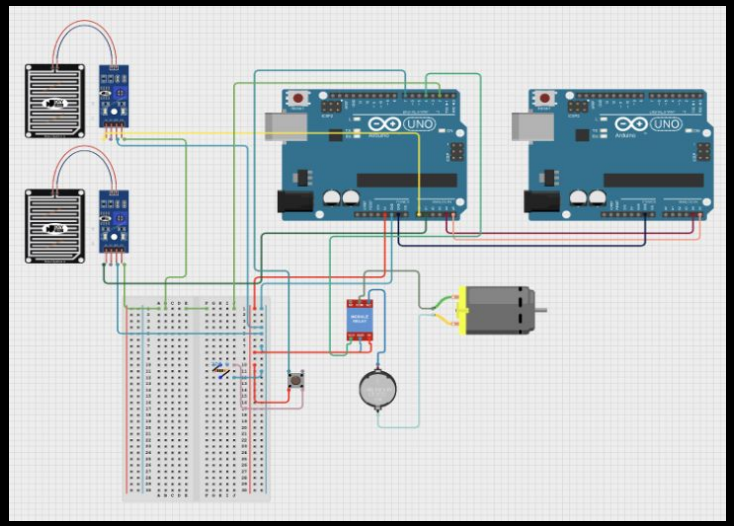
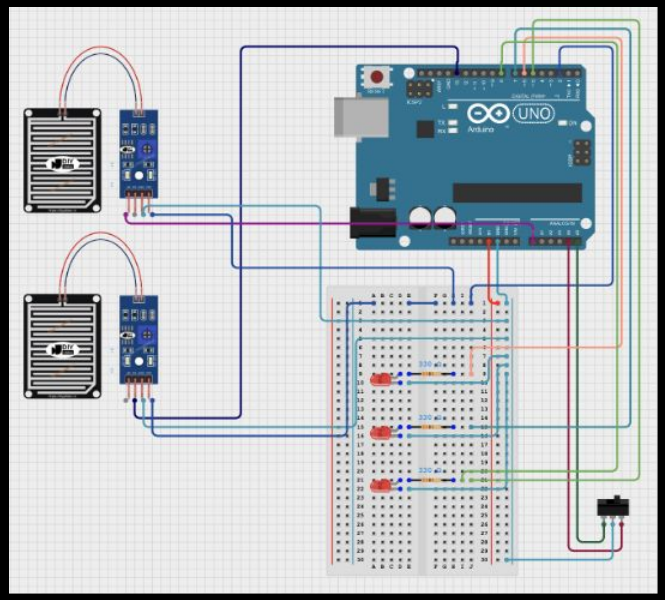
Prototype Development

- ★ Prototype
  - 2 Rain Sensors
  - 3 LEDs
  - 1 Switch
  - 1 Arduino Uno





- ★ Real Implementation
  - 6 Rain Sensors (AO/DO)
  - 2 DC Motors
  - 2 Relays
  - 1 External Power Source
  - 1 Arduino Uno

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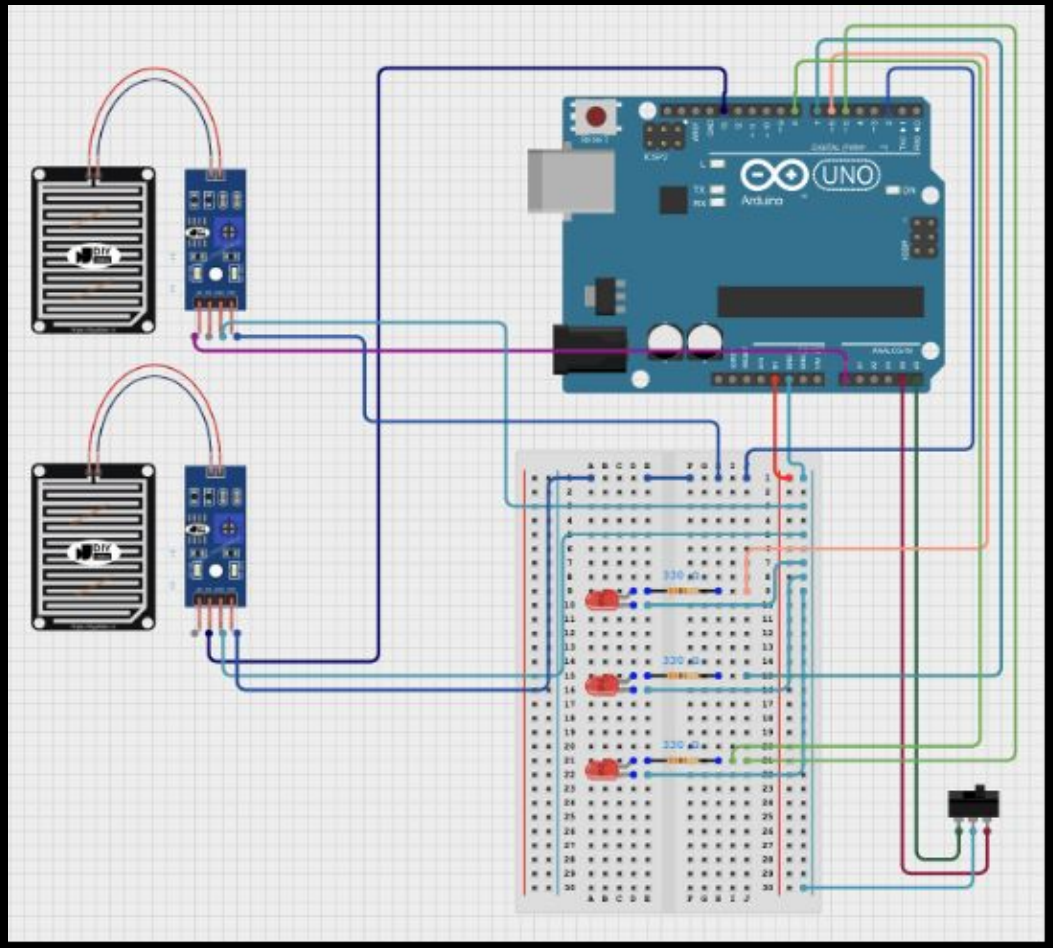
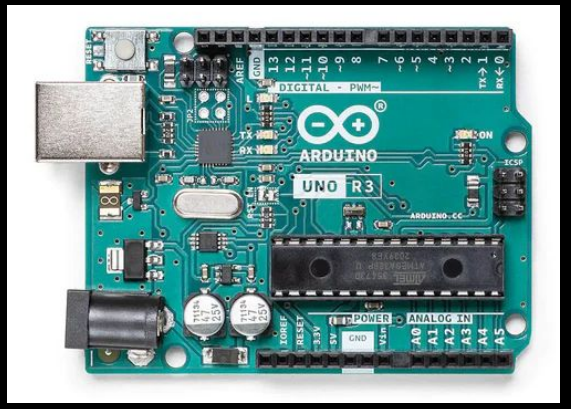
Prototype Development





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Challenges in Automation

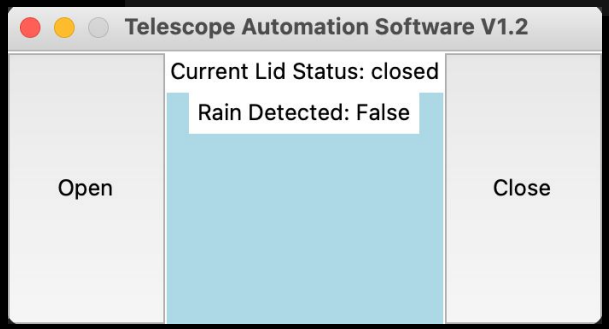
- ★ PySerial and Serial Communications
- ★ PyFirmata and Firmware
- ★ Main Loop Code
- ★ Code Structures
  - ○ Separation of Python and Arduino Scripts
  - ○ Communications
- ★ GUI and Alerts

```
# set up arduino port
arduinoPort = "/dev/cu.usbmodem101"
arduino = serial.Serial(port = arduinoPort, baudrate = 9600, timeout = 0.1)
```

```
def writeRead(x):
    arduino.write(bytes(x, "utf-8"))
    time.sleep(0.05)
    data = arduino.readline().decode("utf-8")
    return data
```

```
# set up arduino port
arduino = pyfirmata.Arduino("/dev/cu.usbmodem101")
pyfirmata.util.Iterator(arduino).start()

# set up arduino pins using pyfirmata
arduino.digital[6].mode = pyfirmata.OUTPUT
arduino.digital[7].mode = pyfirmata.OUTPUT
arduino.digital[8].mode = pyfirmata.INPUT
arduino.analog[4].mode = pyfirmata.INPUT
arduino.analog[5].mode = pyfirmata.INPUT
arduino.analog[4].enable_reporting()
arduino.analog[5].enable_reporting()
```



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Summary & Future Work

- ★ Summary
  - Intro to Solar Flares
  - Past Observations
  - Automation
  - Prototyping
  - Challenges
  - Prospects for Future Observations
- ★ Future Work
  - Continue Development
  - New Observatory on Roof of SIUC

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