Weather Forecast Automation for the Ground Station Antenna and Software

This code will pull weather forecast data from Dark Sky, a weather API service, and adjust the operation of the Ground Station antenna according to local conditions. Antenna shutdowns will occur during periods of wind higher than 44 mph, which would normally put the antenna at risk of structural damage. Shutdowns will also occur during National Weather Service Alert periods of High Wind Watch or any Warning (including Severe Thunderstorm, Flash Flood, Blizzard, etc.). The code includes a debug mode for integration and acceptance testing; the associated instructions and input stubs can be found in this folder (SpaceGrantWarpDrive>Projects>GroundStation>600-Software>weather\_automation).

# Running the Automation

Since the Ground Station (GS) Computer is synced wi th Google Drive, the main file “weatherForecastMain.py” is found in the same folder in File Explorer as it is online, as are the rest of the files mentioned in this readme.

1. Open “change\_mode.txt” and make sure that the word “auto” or “automatic” is included in the file.
2. Verify that variables “logger.DBG” in weatherForecastMain.py and “DBG” in log\_mod.py equal 0, which takes the automation out of debug mode.
3. Run a Python-enabled IDE such as PyCharm, or a command line such as PowerShell.
4. Run the script “weatherForecastMain.py” and check the command window or command line for the hourly forecast and current conditions. Double check that the printed weather information matches what you can see outside or see on your phone’s weather app.
5. If no satellite tracking apps (SDR#, SatPC32, WxToImg) are open, wait a few minutes for the code to open them and set them up automatically.
6. Check the log “runtime.log” found in (SpaceGrantWarpDrive>Projects>GroundStation>600-Software>weather\_automation>logs) for the success of requesting weather data, making alert shutdowns/startups, making scheduled shutdowns/startups, sending Slack messages, running check\_mode, and running hourly\_two\_day.

# Manual Mode

Under certain conditions it may be desirable to prevent the weather automation scripts from shutting down or starting up the station. In manual mode, the scripts will still request weather forecasts and schedule shutdowns and startups but will be prevented from executing these routines. Manual mode is set by changing the text of “change\_mode.txt” to “manual”. Please note that if both “manual” and “auto” included in the file, the mode defaults to automatic mode. Manual operation and configuration of the station is documented on the [Space Grant Thinker Wiki](http://thinker.colorado.edu/projects/ground-station-uhf-vhf/wiki); here are some important operations:

Manual control of the power supply:

Open Outlet Control - SGC DHD application from the taskbar

Login with standard ground station credentials

Click the switch on/off links for the relevant hardware

[Controlling the rotator](http://thinker.colorado.edu/projects/ground-station-uhf-vhf/wiki/How_To/Use_the_Antenna)

[Tracking a satellite with SatPC32](http://thinker.colorado.edu/projects/ground-station-uhf-vhf/wiki/SDR_Starting_Guide)

# Troubleshooting

All of the weather data are zeros and/or the summary is “computer generated”

The script is in debug mode. Make sure both logging.DBG (in weatherForecastMain.py) and DBG (in log\_mod.py) are set to 0 if this is not the desired operating mode.

The console displays a message that shutdown/startup jobs have been missed by several hours

The script is in debug mode and is using an old test input

The script has run for >24 hours and has reloaded the same test input from 24 hours ago

input\_stub.py did not run successfully before you started weatherForecastMain.py and the script is using an old test input.

Not all of the downlink automation programs are running

On the next station startup all of these programs should be started and configured correctly.

Or you can start the missing programs manually using the instructions on the [Space Grant Thinker Wiki](http://thinker.colorado.edu/projects/ground-station-uhf-vhf/wiki)

Closing all of the downlink automation programs and killing weatherForecastMain.py then restarting weatherForecastMain.py after a short pause should start all downlink automation programs and configure them correctly

Shutdowns and startups are scheduled but the station never shuts down or starts up

Manual control mode is active. If automatic operation is desired, open “change\_mode.txt” and edit the file so that it contains the word “auto” or “automatic” instead of “manual”

Downlink automation programs start or stop and the rotor starts or stops unexpectedly

Automatic control mode is active. If manual operation is desired, open “change\_mode.txt” and edit the file so that it contains the word “manual” instead of “auto” or “automatic”. A list of stop and start times is listed in the weather automation log, in the console running the script, and via slack messages.

There is a discrepancy between the alert description and the alert severity in the log.

Input the following URL into your internet browser’s search bar: “<https://api.darksky.net/forecast/8d92b5778ac6f73e8de298d4f4fb761b/40.0100,-105.2600>” (or just click the hyperlink). Hopefully your browser will nicely format the text automatically.

Beneath the data blocks “currently,” “hourly,” “minutely,” and “daily,” you will find the data block labeled “alerts.”

Compare the “title” key to the “severity” key.

If the title (ex. “Winter Storm Warning”) does not match the severity (ex. “watch”), then DarkSky has incorrectly entered the data for this weather alert. There is nothing we can do about this issue.

If the title does match the severity, then a yet-unknown error exists in the code that prints the weather alert data to the log.

# Errata

Timezone inconsistency

The times from raw DarkSky weather data and from the logger are given in Mountain Time (UTC -6/-7 depending on daylight savings). The scheduler, the weather alerts, and the weather forecast use UTC +0, aka UTC (not affected by daylight savings).

We tried to fix this inconsistency by converting all data to UTC. However, DarkSky’s timezone cannot be changed without removing alert data entirely and the logger is specified as UTC in the code yet actually displays Mountain.

We cannot change all data to Mountain Time either. The scheduler needs to be in UTC to communicate with the applications properly; and the weather alerts and forecast are converted to UTC to communicate with the scheduler.

An NWS alert called “...Warning” sometimes appears in the log as a “watch”

We have seen DarkSky give us the alert “Winter Storm Warning” with the severity labeled as “watch.” The automation code cannot account for this error. In this case the antenna will not be shut down, when it really should be shut down.

# Integration and Acceptance Testing

Integration and Acceptance testing documents are available on Google Drive in the folder ([SpaceGrantWarpDrive>Projects>GroundStation>400-TestProceduresAndResults>Weather\_Automation\_Testing](https://drive.google.com/drive/u/0/folders/1mWzA71dmMxER46q4WVmf5_v7ce9ovugd))

The standard test procedure is as follows:

1. Open “change\_mode.txt” and make sure that the word “auto” or “automatic” is included in the file
2. Change variables “logger.DBG” in weatherForecastMain.py and “DBG” in log\_mod.py equal to 1 to activate debug mode
3. Run the script “input\_stub.py” on the command line with an argument specifying the test ID. Example: python input\_stub.py IT1\_1
4. Then, run the main script, weatherForecastMain.py, and let it run for a specific length of time, which is specified in the test instructions. If none of the satellite tracking apps are open, you should wait for them to open even if this takes longer than the specified wait time.
5. Then, kill weatherForecastMain.py and open integration\_testing.log in the logs folder.
6. All of the information required to verify the operation of the script is in the log file but some conditions like weather alerts and job lists are also reflected in output to the console.

# Authors

Zachary Hayden

Alan Tett