

# Raspberry Pi Weather Station

## Software Test Plan

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# Version History

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# 1 Introduction

## 1.1 Purpose

The purpose of this document is to detail the means with which the weather station application will be tested. The tests all have their own specific goals that they are testing the application for to ensure that requirements has been met.

# 2 Functional Testing

## 2.1 Approach

Functional testing has been part of the full project since day one. During each stage of the project we have and will continue testing in two stages: piece by piece (weather station output, encryption, etc) and then putting it all together and doing a full end-to-end test of what is currently developed. This allows us to determine if an error occurs before integration.

## 2.2 Pass/Failed Criteria

Inorder for a test case to be considered a passed or failed, the following criteria will apply:

- To be considered a passed test case, the expected result of the test must be the actual result that outputted by performing the test
- To be considered a failed test case, the expected result of the test must be different from actual result that is outputted by performing the test

## 2.3 Entry/Exit Criteria

The Entry Criteria of functional testing is:

- A basic implementation of each functional requirements has been completed

The Exit Criteria of function testing is:

- All functional test cases has been executed
- The pass rate of the executed test cases is 100%

## 2.4 Suspension/Resumption Criteria

Testing will be suspended if a test case fails. The failed test case will then be logged and passed to a team member to fix the issue. Testing will resume once the team member has fixed the failed test case.

## 2.5 Risks

There are a couple of potential risks while performing these tests. The first potential risk is the sensors on the Raspberry Pi. If the sensors were to go bad, it will greatly affect the outcome of each potential tests. Another risk is the AWS server, if something were to happen to AWS, our whole site can be down and test cases will fail. Another potential risk is the SQL scripts that populate the database. If there should there be a bug within the scripts, then it would cause issues for the validity of the test cases.

## 2.6 Items To Be Tested

View Station Health		
Test Case ID	Title	Description
TC - 01	No Stations Connected	There are no stations that have sent sensor data to the server
TC - 02	Connected Station	Display a connected station
TC - 03	Disconnected Station	Display a disconnected station
TC - 04	List Mode	There is at least one station that has sent weather data and the page is in the list view mode
TC - 05	Grid Mode	There is at least one station that has sent weather data and the page is in the grid view mode
TC - 06	Good CPU Usage	CPU Usage retrieved from sensor is below 30% and text color is GREEN
TC - 07	Bad CPU Usage	CPU Usage retrieved from sensor is above 70% and text color is RED
TC - 08	Moderate CPU Usage	CPU Usage retrieved from sensor is between 30% and 70% and text color is

		ORANGE
TC - 09	Good RAM Usage	RAM Usage retrieved from sensor is below 30% and text color is GREEN
TC - 10	Bad RAM Usage	RAM Usage retrieved from sensor is above 70% and text color is RED
TC - 11	Moderate RAM Usage	RAM Usage retrieved from sensor is between 30% and 70% and text color is ORANGE
TC - 12	Test Station Battery Percentage	Display weather station battery percentage
TC - 13	Master Battery Percentage	Display "Connected to power source" for battery percentage on weather station
TC - 14	Master Battery Percentage With 'm'	Display "Connected to power source" for battery percentage on weather station
TC - 15	View Mode is Saved	If the user sets the view mode, navigates away from the site, and comes back to the stations page the view mode is what it last was

View Station Health Details		
Test Case ID	Title	Description
TC - 16	User View	The user clicks on a station card to bring up the additional detail view
TC - 17	Good CPU Usage	CPU Usage retrieved from sensor is below 30% and text color is GREEN
TC - 18	Bad CPU Usage	CPU Usage retrieved from

		sensor is above 70% and text color is RED
TC - 19	Moderate CPU Usage	CPU Usage retrieved from sensor is between 30% and 70% and text color is ORANGE
TC - 20	Good RAM Usage	RAM Usage retrieved from sensor is below 30% and text color is GREEN
TC - 21	Bad RAM Usage	RAM Usage retrieved from sensor is above 70% and text color is RED
TC - 22	Moderate RAM Usage	RAM Usage retrieved from sensor is between 30% and 70% and text color is ORANGE
TC - 23	Test Station Battery Percentage	Display weather station battery percentage, total battery life, and remaining battery
TC - 24	Master Battery Percentage	Display "Connected to power source" for battery percentage on weather station and "-" for total battery and remaining battery
TC - 25	Master Battery Percentage With 'm'	Display "Connected to power source" for battery percentage on weather station and "-" for total battery and remaining battery

Filter Historical Data		
Test Case ID	Title	Description
TC - 26	Filter By CPU Usage	Filter the graph data by CPU usage
TC - 27	Filter By RAM Usage	Filter the graph data by RAM

		usage
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SMS Alert With Twilio		
Test Case ID	Title	Description
TC - 28	Moderate CPU Usage	Send a SMS alert to user to notify them of abnormal CPU usage
TC - 29	Bad CPU Usage	Send a SMS alert to user to notify them of high CPU usage
TC - 30	Moderate RAM Usage	Send a SMS alert to user to notify them of abnormal RAM usage
TC - 31	Bad RAM Usage	Send a SMS alert to user to notify them of high RAM usage

LoRa Communication		
Test Case ID	Title	Description
TC - 32	Servant device broadcasting data	Verification that LoRa communication is working by decrypting the servants message on the master device and comparing it to the original message sent before encryption.
TC - 33	Devices obtains current location - GPS	Verification that the GPS component on the LoRa HAT is working by obtaining accurate latitude and longitude readings.
TC - 34	Master device receiving data from multiple servant devices	Verification that the master device can receive data from multiple node devices.



Test Lambda functions		
Test Case ID	Title	Description
TC - 41	Post data to AWS Lambda	Submit weather data to the server using CURL request and get a successful response.
TC - 42	Bad data to AWS Lambda	Attempt to submit weather data with invalid parameters to the server using CURL request.
TC - 47	Verify Weather API Key	CURL request to verify weather api key, which returns a successful response
TC - 48	Unsuccessful verify weather API using Lambda	Attempt to verify an invalid Weather API key using the lambda endpoint

## 3 Non-Functional Testing

### 3.1 Approach

AWS Lambda script will be used to crash the server and see if the website is still up and running. The lambda script will stop specific instances that are running on AWS Cloud. The human tester will follow very specific instructions in the test case and view results.

To test the load balancer, locust testing framework will be used. Manual test will be used to check encryption data in transit to RDS.

### 3.2 Pass/Failed Criteria

In order for a test case to be considered a passed or failed, the following criteria will apply:

- To be considered a passed test case, the expected result of the test must be the actual result that outputted by performing the test
- To be considered a failed test case, the expected result of the test must be different from actual result that is outputted by performing the test

### 3.3 Entry/Exit Criteria

The Entry Criteria of functional testing is:

- A basic implementation of each Non-functional requirements has been completed

The Exit Criteria of function testing is:

- All Non-functional test cases has been executed
- The pass rate of the executed test cases is 100%

### 3.4 Suspension/Resumption Criteria

The Suspension Criteria of non-functional testing is:

1. If a test case fails or a bug is found that prevents any further test executions.

Testing Resumption Criteria of non-functional testing is:

1. Failing test cases has been taken care of or the bug is being fixed already.

### 3.5 Risks

There are a couple of potential risks while performing these tests. The first potential risk is the server that are running the Web application. If the the load balancer or auto scaling group were to go bad or not response to failure, it will greatly affect the outcome of each potential tests. If the database instance that is running the MySQL database stops running would cause issues for the validity of the test cases.

### 3.6 Items To Be Tested

Test AWS Cloud servers and security		
Test Case ID	Title	Description
TC - 40	Crash a server for high availability	Force a server to shutdown to simulate what happens if one of the instances dies off due to unknown errors.
TC - 43	Performance testing Lambda function	This is to see how much RAM is required to run the function. If it requires more then the script could be optimized or the RAM could be increased in Lambda.

TC - 44	Load testing Lambda function	This test will determine how long it takes for Lambda function to execute.
TC - 45	Successful connection with public key- Data in transit encryption test for RDS instance	Attempt to connect to database instance using valid public key
TC - 46	Unsuccessful connection without key- Data in transit encryption test for RDS instance	Attempt to connect to database instance without using a public key
TC - 49	Verify weather token - Testing API Gateway accessibility with Invalid x-api-key	Attempt to verify weatherApi without using x-api-key
TC - 50	Post sensor data - Testing API Gateway accessibility with Invalid x-api-key	Attempt to submit data to lambda through API Gateway without using valid x-api-key

Encryption		
Test Case ID	Title	Description
TC - 37	On boot-up, Weather Station generates encrypted weather data	When weather data is being collected by the external sensors it will encrypted and then stored on the device in a text file.
TC - 38	Encryption Data at Rest on Weather Station	All data will be encrypted while it is stored on any of the weather stations deployed.
TC - 39	Encryption Data from Servant Station to Master Station	Data that is encrypted on the servant Pi is sent to master device to be uploaded to web server and database.

LoRa
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Test Case ID	Title	Description
TC - 35	Verification that encrypted message being broadcast is 128 bytes	Verification that the message being broadcasted is 128 bytes so that no error is thrown when the decryption algorithm is executed.
TC - 51	LoRa communication range	Establishing a range base for the weather communication system.

## 4 Integration Testing

### 4.1 Approach

Throughout the project we have been handling each stage of the development and integration in stages and regression testing to ensure the previously integrated items were not affected negatively.

### 4.2 Pass/Failed Criteria

Pass and fail are relatively straight forward, using regression testing we do a full end-to-end test of what we have currently implemented as the “final” product of that time and ensure all pieces of the previously working project are still function. After that we test the newly implemented portion and ensure the new functionality works as intended, if it at any point during this process it is a fail.

### 4.3 Entry/Exit Criteria

Entry criteria must be that a new tool, functionality or otherwise meaningful entry to the code exists.

Exit criteria is that all regression testing has come back without error and the new code has been thoroughly tested to ensure it is working as intended.

### 4.4 Suspension/Resumption Criteria

List of possible suspension criteria:

- Master device does not have internet access

- Web server is down
- Database is not available for any reason
- Servant or master devices LoRa not properly broadcasting and receiving

Resumption criteria in order of suspensions:

- Internet access returned to master
- Web server is operational
- Database is operational
- Broadcasting/Receiving is fixed, either by reboot of device or manually executed on device.

## 4.5 Risks

Risks are most crucial in this section. All new integration items will need substantial regression testing to ensure no errors were caused with the new codebase being added to the current version of the program.

Specific risks expected:

- Posting data to server malfunctioning.
- Deletion of data on Pi not occurring at proper time or in error.
- Data model incomplete or incorrect.
- Transfer of master device incorrectly choosing a device that is not suitable for the task resulting in unknowable issues.
- LoRa GPS module issues including but not limited to: hardware failure, low uptime/availability, inaccurate readings.

## 4.6 Items To Be Tested

Data handling on Raspberry Pi		
Test Case ID	Title	Description
TC - 35	Post Data to Server	Master will be able to make post request to the server.
TC - 36	Delete Data on Master Pi after posting	After master successfully makes a post request, it will then remove the oldest file.

LoRa		
Test Case ID	Title	Description
TC - 52	LoRa GPS Module	Using the onboard GPS

		module to get accurate location readings of all the devices in the system.
TC - 53	Verification of master device being connected	The capability of switching to the master to a new device in the case that the original master device goes offline.
TC - 54	Storm Alert	Using the weather data stored in our database to determine if there is the possibility of an incoming or existing storm.

## 5 System Testing

### 5.1 Approach

We will use an “End-To-End” to determine that all functionality is working as intended. The test will follow all the steps that a user would be expected to perform during normal operation. Afterwards determining if an error or unpredicted outcomes occurred.

### 5.2 Pass/Failed Criteria

Pass and fail criteria will be based on the end-to-end: the servant device creating an encrypted file, sending it via LoRa. Once the master has it, decrypting the file and POST to the server. Assuming all these events occur without error in broadcast, POST and storing in database we would give it a pass. Alternative outcomes could include the message not sending LoRa to LoRa, POST request failing, or database having an error.

### 5.3 Entry/Exit Criteria

The entry criteria consists of at least one master and one servant being operational with power and the master device having internet access. The server should be available for POST requests, and the database ready to receive the data from the master device. Furthermore the website should be available for viewing to confirm the data is being shown properly. The exit criteria will be data displayed on the website at the expected intervals. This can be verified by checking the database and determining if the time series data is consistent with expected results.

## 5.4 Suspension/Resumption Criteria

List of possible suspension criteria:

- Master device does not have internet access
- Web server is down
- Database is not available for any reason
- Servant or master devices LoRa not properly broadcasting and receiving

Resumption criteria in order of suspensions:

- Internet access returned to master
- Web server is operational
- Database is operational
- Broadcasting/Receiving is fixed, either by reboot of device or manually executed on device.

## 5.5 Risks

No major risks are present during this type of testing. Some plausible but not impactful risks:

- Backlogged data on the master device: Without internet connection we are storing data on the master until such time that the master is online again.
- Wrong data: If the sensors malfunction or run the Weather Station without sensors attached it will cause the data being uploaded to the server to be invalid but still be inserted into database.

## 5.6 Items To Be Tested