System Test Plan

For

emStart---Emulator for Satellite Transceiver (communications) and Radio Telescope

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1.0 All	10/17/2021
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Table of Contents

1. Introduction

1.1 Purpose

This document is a test plan for emStart System Testing, produced by the System Testing team. It describes the testing strategy and approach to testing the team will use to verify that the application meets the established requirements of the business prior to release.

1.2 Objectives

- Meets the requirements, specifications and the Business rules.
- Supports the intended business functions and achieves the required standards.
- Satisfies the Entrance Criteria for User Acceptance Testing.
- Follows any FCC Communications Standards or Restrictions

2. Functional Scope

The Modules in the scope of testing for the emStart System Testing are mentioned in the document attached in the following path :

1. The System Requirement Specification document:
   System Requirements Specification
2. Section 3.1 of this document

3. Overall Strategy and Approach

3.1 Testing Strategy

emStart System Testing will include testing of all functionalities that are in scope (Refer Functional Scope Section) identified. System testing activities will include the testing of new functionalities, modified functionalities, screen level validations, work flows, functionality access, testing of internal & external interfaces.

3.2 System Testing Entrance Criteria

In order to start system testing, certain requirements must be met for testing readiness. The readiness can be classified into usability testing, and functional testing.

3.3 Testing Types

3.3.1 Usability Testing

User interface attributes, cosmetic presentation and content will be tested for accuracy and general usability. The goal of Usability Testing is to ensure that the User Interface is comfortable to use and provides the user with consistent and appropriate access and navigation through the functions of the application (e.g., access keys, consistent tab order, readable fonts etc.)

System Requirement Specification, 3.1.1: “Diagram showing current longitude angle of antenna.”

System Requirement Specification, 3.1.2: “Diagram showing current latitude angle of antenna.”

System Requirement Specification, 3.1.3: “Button allows the user to stop movement of the antenna.”

System Requirement Specification, 3.1.4: “Button that allows manual control of the antenna for testing.”

System Requirement Specification, 3.2.1 The Earth System shall be comprised of a computer connected to a 3-DOF robotic arm via a USB cable.

System Requirement Specification, 3.2.2 The Ground Station shall consist of a computer connected to the antenna microcontroller via a USB, which is used to control the 2-DOF antenna.

System Requirement Specification, 3.3.1: “The Ground Station shall control a 2-DOF antenna.”

System Requirement Specification, 3.3.2: “The antenna shall be utilized using a microcontroller connected to a computer via USB.”

System Requirement Specification, 3.3.5: “The “Earth” will be fully controlled by a computer, working without reference to the other systems via a 3-DOF robotic arm connected to a computer via USB.”

System Requirement Specification, 3.4.2: “The Ground Base shall use the astronomical program to aid in tracking the signal by converting the data into movements for the 2-DOF Antenna.”

System Requirement Specification 4.3.3.5: “The system shall transmit at a frequency of 1.4ghz in order to emulate that of an actual received frequency of a ground station.”

System Requirement Specification 4.3.3.6: “The system shall receive a frequency of 1.4ghz in order to emulate that of the actual frequency transmitted from a satellite.”

3.3.2 Functional Testing

The objective of this test is to ensure that each element of the component meets the functional requirements of the business as outlined in the:

- Business / Functional Requirements
- Business rules or conditions
- Other functional documents produced during the course of the project i.e. resolution to issues/change requests/feedback

System Requirement Specification, 3.2.3: “The Ground Station shall work independently from the Earth System, meaning that the antenna must compensate for the movement of the “Earth”.”

System Requirement Specification, 3.2.4: “The System in Space shall work using a computer connected via USB to a SDR and GPSDO with a fixed antenna, sending the frequency towards the Ground Base.”

System Requirement Specification, 3.3.3: “The microcontroller will be fed the astrological data, which then can be converted into movements for the antenna.

The system in space will only be sending signals, which will then be received by the antenna."

System Requirement Specification, 3.3.4: "The software-defined radio will be used to communicate analog signals to the Ground Station.
The Earth system shall use the 6 DOF arm to move the "Earth" in different positions, thus causing the Ground Base to be utilized to keep the antenna aligned with the space object."

System Requirement Specification, 3.4.1: "The Ground Base shall track the analog signal that is being transmitted by the System In Space."

3.4 Suspension Criteria and Resumption Requirements

This section will specify the criteria that will be used to suspend all or a portion of the testing activities on the items associated with this test plan.

3.4.1 Suspension Criteria

Testing will be suspended if the incidents found will not allow further testing of the system/application under-test. If testing is halted, and changes are made to the hardware, software or database, it is up to the Testing Manager to determine whether the test plan will be re-executed or part of the plan will be re-executed.

If from the outputs of the GUI, it is found that proper signal integrity is not found as defined by the software defined radio signal, testing will be halted to remediate the issue. If any piece of hardware does not function as specified in the requirements, testing will also be halted. Finally if any piece of the User Interface does not display or react as listed in the requirements, testing must be halted and ensure that proper data display is achieved.

3.4.2 Resumption Requirements

Resumption of testing will be possible when the functionality that caused the suspension of testing has been retested successfully.

4. Execution Plan

4.1 Execution Plan

The execution plan will detail the test cases to be executed. The Execution plan will be put together to ensure that all the requirements are covered. The execution plan will be designed to accommodate some changes if necessary, if testing is incomplete on any day. All the test cases of the projects under test in this release are arranged in a logical order depending upon their inter dependency.

Requirement (From SRS)	Test Case Identifier	Input	Expected Behavior	Pass / Fail
4.3.3.5 & 4.3.3.6	TC01	Inputted Transmitted signal on the 1.4ghz band transmitted on a Hack RF SDR.	Successful reception of a 1.4ghz signal received on the RTL SDR.	

3.1.1 3.1.2	TC02	Enter the following into the windows terminal in the location of the “Earth” program: python emStart.py -g	Successful launch of the web interface, displaying an empty plot alongside some data input fields	Pass
3.2.1 3.3.5	TC03	Astronomical data and azimuth angle.	The robot arm will adjust and move to a new position.	

5. Traceability Matrix & Defect Tracking

5.1 Traceability Matrix

List of requirement, corresponding test cases

Requirement LOW: System Requirement Specification, 3.1.1: “Diagram showing current longitude angle of antenna.”

Test Cases: As the emulation time progresses, the graphical user interface should display the angle of the antenna on a plot.

Requirement LOW: System Requirement Specification, 3.1.2: “Diagram showing current latitude angle of antenna.”

Test Cases: As the emulation time progresses, the graphical user interface should display the angle of the antenna on a plot.

Requirement MEDIUM: System Requirement Specification, 3.2.1 The Earth System shall be comprised of a computer connected to a 3-DOF robotic arm via a USB cable.4

Test Cases: Check connection between ARM and Laptop.

Requirement CRITICAL: System Requirements Specification, 3.2.3: “The Ground Station shall work independently from the Earth System, meaning that the antenna must compensate for the movement of the “Earth”.”

Test Cases: Verify that the only connection between the Earth subsystem and the ground station is a UART transmitting the current date and time of the emulator

Requirement CRITICAL: System Requirement Specification, 3.3.5: “The “Earth” will be fully controlled by a computer, working without reference to the other systems via a 3-DOF robotic arm connected to a computer via USB.”

Test Cases: Verify that the program can control the robot arm without other systems involved.

Requirement CRITICAL: 3.2.2 The Ground Station shall consist of a computer connected to the antenna microcontroller via a USB, which is used to control the 2-DOF antenna.

Test Cases: Verify Ground Station Controls are isolated to just the servo

Requirement CRITICAL: 4.3.3.5 The system shall transmit at a frequency of 1.4ghz in order to emulate that of an actual received frequency of a ground station

Test Cases: Verify that the SDR correctly transmitted the signal at the frequency 1.4ghz.

Requirement CRITICAL: 4.3.3.5 The system shall receive a frequency of 1.4ghz in order to emulate that of the actually frequency transmitted from a satellite

Test Cases: Verify that the SDR correctly received the frequency signal at 1.4ghz

5.2 Defect Severity Definitions

Critical	The defect causes a catastrophic or severe error that results in major problems and the functionality rendered is unavailable to the user. A manual procedure cannot be either implemented or a high effort is required to remedy the defect. Examples of a critical defect are as follows: ● System abends ● Data cannot flow through a business function/lifecycle ● Data is corrupted or cannot post to the database
Medium	The defect does not seriously impair system function can be categorized as a medium Defect. A manual procedure requiring medium effort can be implemented to remedy the defect. Examples of a medium defect are as follows: ● Form navigation is incorrect ● Field labels are not consistent with global terminology
Low	The defect is cosmetic or has little to no impact on system functionality. A manual procedure requiring low effort can be implemented to remedy the defect. Examples of a low defect are as follows: ● Repositioning of fields on screens ● Text font on reports is incorrect

6. Environment

6.1 Environment

- The System Testing Environment will be used for System Testing.

  In order to conduct the testing the tester needs to have the following installed onto their computer:
  Python version 3.9.7 and up
  Arduino version 1.8.16 and up

7. Assumptions

Earth
- The astronomy data downloaded by astropy is accurate
- The astropy calculations are correct
- The latency of sending commands to myCobot is constant

Ground Station
- The antenna mount will never rotate more than 360 degrees
- The antenna mount will never rotate more than 90 degrees vertically
- The received radio signals will be noisy

System in Space
- The transmitted radio signals are weak enough to be contained in the lab

8. Risks and Contingencies

Define risks and contingencies.

Risk #	Risk	Impact	Contingency Plan
1	Signal given too much power.	High	Keep possible max strength low.
2	Incompatible Compiler	High	Testing can only be done through python compliant IDEs.
3	Incorrect data given to Ground Base	High	Add redundancy to double-check the data given.

9. Appendices