System Test Plan

For

Speech Recognition for Air Traffic Control

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1 All	9/17/22
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1. Introduction

1.1. Purpose

This document is a test plan for Speech Recognition for Air Traffic Control System Testing, produced by the Scrum 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 customer prior to release. It contains separate details for how to test both the website and the neural model. If these tests are completed, they validate that the system is complete. The system is not considered to be complete until all of the tests run successfully.

1.2. Objectives

Features that will be the objects of testing that are identified and classified into a hierarchy.

- 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.

2. Functional Scope

The Modules in the scope of testing for the Speech Recognition for Air Traffic Control System Testing are as follows:

- Interactive map on website
- Aeronautical map on website
- Nvidia Nemo Model

3. Overall Strategy and Approach

3.1. Testing Strategy

Speech Recognition for Air Traffic Control System Testing will include testing of all functionalities that are in scope (Refer to Functional pe Section) identified. System testing activities will include the testing of new functionalities, modified functionalities, screen level validations, workflows, functionality access, testing of internal & external interfaces.

Website

The website will be tested using Puppeteer to validate the presence of required elements on the page. Test cases will be written to navigate through the website and assert that the required items are present. The test cases will be generated from the requirements document.

Neural Model

The neural model will be tested using prepared labeled testing data made from the provided ATC data. Using this data, we will calculate word error rate and word error rate per utterance for each of the models. We will be targeting a word error rate and word error rate per utterance of around ~.20. The current best word error rate claimed in industry is around ~.05[1]. However, this is achieved using the resources accessible by large corporations and thus is not within the scope of our project.

3.2. System Testing Entrance Criteria

In order to start system testing, certain requirements must be met for testing readiness. Readiness can be classified into:

Website:

The website will be ready for testing when all components that are required from the backlog to be included

are present. The website must be hosted on the desktop machine provided and publicly available with a static IP address. Both versions of the maps must be functional with planes visible. The neural model must be fully functional, and the website must be connected to the neural model.

Neural model:
The entrance criteria for the neural model testing is that the model(s) have been trained on the labeled ATC data. The testing scripts have been prepared and debugged and novel training data has been prepared.

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.)

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 customer as outlined in the:

- Functional Requirements
- Business rules or conditions
- Issue resolutions
- Feedback

3.4. Suspension Criteria and Resumption Requirements

This section specifies 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.

4.

Website Incidents:

- Website goes offline during testing
- Assertion test failed
- Unit test encounters exception
- Unable to get data from flight tracker
- Update of VFR map failed

Neural Model Incidents:

- Model fails to load
- Training data is not novel to the model

4.1.1. Resumption Requirements

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

4.1.2. Website Resumption

- Check to see if data from Opensky API is writing to the correct file(s) if no issues found attempt to run Opensky outside of website
- Check to see if FAA map API is saving data to correct file(s) is no issues found check if FAA map download link functions

4.1.3. Neural Model Resumption

- Check for issues in model file e.g., corrupted file, check all dependencies installed if no issues found attempt to reload model
- Get data novel to the model either from provided datasets or other methods

4.1.4.

5. Execution Plan

5.1. 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.

Test Cases

ID	Name	System	Actions	Success Criteria
W1	Website load	Website	Load website	The website shall load without any errors and display the interactive map with a toggle to switch to the other map.
W2	Map buttons zoom in	Website	Click map zoom in button on the interactive map	The map zooms in.
W3	Map buttons zoom out	Website	Click map zoom out button on the interactive map	The map zooms out.
W4	Map buttons zoom in 2	Website	Click map zoom out button on the VFR map	The map zooms in.
W5	Map buttons zoom out 2	Website	Click map zoom out button on the VFR map	The map zooms out.
W6	Map zoom max out	Website	Click the map zoom out button 13 times on the interactive map. Then click once more	On the last click, the map should not zoom out anymore. It should stay the same.
W7	Map zoom max in	Website	Click the map zoom in button 5 times on the interactive map. Then click once	On the last click, the map should not zoom in anymore. It should stay the same.

			more	
W8	Map zoom max out 2	Website	Click the map zoom out button 4 times on the VFR map. Then click once more	On the last click, the map should not zoom out anymore. It should stay the same.
W9	Map zoom max in 2	Website	Click the map zoom in button 1 times on the VFR map. Then click once more	On the last click, the map should not zoom in anymore. It should stay the same.
W10	Map pan	Website	Click on the interactive map and drag the mouse to the right.	The map moves, keeping the same mouse above the same spot on the map as before the pan started.
W11	Map pan 2	Website	Click on the VFR map and drag the mouse to the right	The map moves, keeping the same mouse above the same spot on the map as before the pan started.
W12	Plane loading on interactive map	Website	Load page	The interactive map should load on the page with at least one airplane icon. The map should contain Daytona Beach on it.
W13	Plane loading on VFR map	Website	Load page and click toggle button	The VFR map should load on the page with at least one airplane icon. The map should contain Daytona Beach on it.
W14	Plane movement on interactive map	Website	Viewing interactive map	The planes on the map are updated with new coordinates every 15 seconds. The plane is removed from the old location and placed in the new location.
W15	Plane movement on VFR map	Website	Viewing VFR map	The planes on the map are updated with new coordinates every 15 seconds. The plane is removed from the old location and placed in the new location.
W16	Validate plane coordinates 1	Website	Viewing interactive map, click on any plane	Copy and paste the coordinates listed into Google Maps. Validate that the plane on the interactive map is in the same geographical location as on the Google map with a 100ft margin of error.
W17	Validate plane coordinates 2	Website	Viewing VFR map, click on any plane	Copy and paste the coordinates listed into Google Maps. Validate that the plane on the VFR map is in the same geographical location as on the Google map with a 100ft margin of error.
W18	Validate plane heading 1	Website	Viewing interactive map, click on any plane.	The plane icon should be rotated the number of degrees clockwise starting with 0 pointing upwards based on the value of the heading field that is displayed.

W19	Validate plane heading 2	Website	Viewing VFR map, click on any plane.	The plane icon should be rotated the number of degrees clockwise starting with 0 pointing upwards based on the value of the heading field that is displayed.
W20	Toggle button	Website	Click toggle button	The map is toggled between the interactive map and the sectional map.
W21	Info box is updated	Website	Click any plane. Wait 15 seconds	The values of the information inside the popup box for the plane are updated. This includes the coordinates.
W22	Click plane for details	Website	Locate a plane and click on it	An information panel is shown after clicking on the plane. The sections are checked to ensure the fields are filled in with plane information.
W23	Live transcription	Website	Locate a plane and click on it	The transcription text is present.
W24	Live transcription update	Website	Locate a plane and click on it. Wait 15 seconds.	The live transcription changes, adding new transcription text below the existing text and removing the oldest existing text.
W25	Live transcription validation	Website	Locate a plane and click on it.	Visit LiveATC and type in the airport code from the airplane's popup box. Listen to the audio and write down what is said for 15 seconds. Wait 15 seconds, and check that what was written and what's displayed on the website are the same to a degree of 75%.
W26	Text box drag	Website	Click on a plane. Click on the floating textbox and drag it to the right.	The textbox will move with the mouse to the right.
M1	Word error rate	ASR Model	Run testing scripts for word error rate	The model achieves a word error rate of .2 or less
M2	Word error rate per utterance	ASR Model	Run testing scripts for word error rate per utterance	The model achieves a word error rate of .2 or less
M3	Precision, Recall, F1 scores	ASR Model	Run testing scripts for precision, recall, f1	The model achieves scores in those

6. Traceability Matrix & Defect Tracking

6.1. Traceability Matrix

Requirements that start with an "A" indicate advanced requirements. These are not going to be addressed until a later sprint.

Requirement	Test Case
SIR 3	W23, W25
SIR 4	W24
SIR 5	W12, W13
SIR 6	Coming soon
SIR 8	W21, W22
SIR 9	W22
SIR 10	W21
SIR 11	W1
SIR 12	W10, W11
SIR 13	W12, W13, W14, W15, W16, W17
SIR 14	W22
SIR 15	W21
SIR 16	Coming soon
SIR 17	Coming soon
SIR 18	W18, W19
USR 1	W20
USR 2	W22
USR 3	W26
USR 4	W2, W3, W4, W5, W6, W7, W8, W9
USR 5	W10, W11
AUSR 1	Coming soon
AUSR 2	Coming soon
AUSR 3	Coming soon
AUSR 4	Coming soon
AUSR 5	Coming soon
AUSR 6	Coming soon
AUSR 7	Coming soon
AUSR 8	Coming soon

6.2. Defect Severity Definitions

Critical	● API data is corrupted ● Server is down ● Model data is corrupted ● Configuration Files from ATC Stream corrupted
Medium	● Plane loads into incorrect location ● Text Box doesn't appear ● Toggle Button doesn't work as anticipated ● Word Error rate is higher than 0.2 for the model
Low	● Website map positioning loads incorrectly ● Word Error rate is 0.2 for the model ● Website takes longer than 5 seconds to load ● Text Box loads incorrect text

7. Environment

7.1. Testing Tools

The System Testing Environment will be used for System Testing.

Website:

- Puppeteer

Neural Model:

- Manual validation of statistics

7.2. Testing Environment

The System Requirements for testing are as follows:

Hardware

- Dedicated Nvidia NeMo-compatible graphics card

Software

- Desktop: RedHat Enterprise Linux V8.6 or Ubuntu 22
- Laptop: Windows 11 Pro Version 21H2
- Python Version 3.6 to 3.8
- PyTorch Version 1.8.1
- Opensky Version 1.3.0
- Pandas Version 1.5.1
- Pytz Version 2022.6
- Python-dateutil Version 2.8.2
- Requests Version 2.28.1

8. Assumptions

- Testers have access to a compatible NVIDIA GPU
- Puppeteer test cases are run using Node.js
- Testers have followed the Opensky-install.txt file to get the package(s) for the Opensky API

9. Risks and Contingencies

Risk	Contingency
Plane coordinate fetching API not working	Display the last locations of the planes until the API comes back.
Model outputs poor transcription	Deploy an additional website for closed crowd-sourced model transcription validation.
Website is offline	Display an error message in place of the website indicating that the website is temporarily unavailable.
Model is unavailable	Temporarily pause transcriptions and replace with a message saying, “Temporarily unavailable”.

10. Appendices

a. Links

[1] https://smartaction.ai/blog/does-word-error-rate-matter
[2] The OpenSky Network, https://opensky-network.org