Synesthesia Wear: System Verification and Validation Plan for SE 4G06, TRON 4TB6

Team 26, STRONE
Jordan Bierbrier
Azriel Gingoyon
Taranjit Lotey
Udeep Shah
Abraham Taha

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1 Revision History

Date	Version	Notes
10/31/2022	1.0	Added Section 6 - Unit Test Description
Date 2	1.1	Notes

Contents

List of Tables

[Remove this section if it isn't needed —SS]

List of Figures

[Remove this section if it isn't needed —SS]

2 Symbols, Abbreviations and Acronyms

symbol	description
T	Test

[symbols, abbreviations or acronyms – you can simply reference the SRS (Author, 2019) tables, if appropriate —SS]

This document ... [provide an introductory blurb and roadmap of the Verification and Validation plan —SS]

3 General Information

3.1 Summary

[Say what software is being tested. Give its name and a brief overview of its general functions. —SS]

3.2 Objectives

[State what is intended to be accomplished. The objective will be around the qualities that are most important for your project. You might have something like: "build confidence in the software correctness," "demonstrate adequate usability." etc. You won't list all of the qualities, just those that are most important. —SS]

3.3 Relevant Documentation

[Reference relevant documentation. This will definitely include your SRS and your other project documents (MG, MIS, etc). You can include these even before they are written, since by the time the project is done, they will be written. —SS]

Author (2019)

4 Plan

[Introduce this section. You can provide a roadmap of the sections to come. —SS]

4.1 Verification and Validation Team

[You, your classmates and the course instructor. Maybe your supervisor. You shoud do more than list names. You should say what each person's role is for the project. A table is a good way to summarize this information. —SS]

4.2 SRS Verification Plan

[List any approaches you intend to use for SRS verification. This may just be ad hoc feedback from reviewers, like your classmates, or you may have something more rigorous/systematic in mind.. —SS]

[Remember you have an SRS checklist —SS]

4.3 Design Verification Plan

[Plans for design verification —SS]

[The review will include reviews by your classmates —SS]

[Remember you have MG and MIS checklists —SS]

4.4 Implementation Verification Plan

[You should at least point to the tests listed in this document and the unit testing plan. —SS]

[In this section you would also give any details of any plans for static verification of the implementation. Potential techniques include code walkthroughs, code inspection, static analyzers, etc. —SS]

4.5 Automated Testing and Verification Tools

[What tools are you using for automated testing. Likely a unit testing framework and maybe a profiling tool, like ValGrind. Other possible tools include a static analyzer, make, continuous integration tools, test coverage tools, etc. Explain your plans for summarizing code coverage metrics. Linters are another important class of tools. For the programming language you select, you should look at the available linters. There may also be tools that verify that coding standards have been respected, like flake9 for Python. —SS]

[The details of this section will likely evolve as you get closer to the implementation. —SS]

4.6 Software Validation Plan

[If there is any external data that can be used for validation, you should point to it here. If there are no plans for validation, you should state that here. —SS]

5 System Test Description

5.1 Tests for Functional Requirements

[Subsets of the tests may be in related, so this section is divided into different areas. If there are no identifiable subsets for the tests, this level of document structure can be removed. —SS]

[Include a blurb here to explain why the subsections below cover the requirements. References to the SRS would be good. —SS]

5.1.1 Area of Testing1

[It would be nice to have a blurb here to explain why the subsections below cover the requirements. References to the SRS would be good. If a section covers tests for input constraints, you should reference the data constraints table in the SRS. —SS]

Title for Test

1. test-id1

   Control: Manual versus Automatic

   Initial State:

   Input:

   Output: [The expected result for the given inputs —SS]

   Test Case Derivation: [Justify the expected value given in the Output field —SS]

   How test will be performed:

2. test-id2

   Control: Manual versus Automatic

   Initial State:

   Input:

   Output: [The expected result for the given inputs —SS]

Test Case Derivation: [Justify the expected value given in the Output field —SS]

How test will be performed:

5.1.2 Area of Testing2

...

5.2 Tests for Nonfunctional Requirements

[The nonfunctional requirements for accuracy will likely just reference the appropriate functional tests from above. The test cases should mention reporting the relative error for these tests. —SS]

[Tests related to usability could include conducting a usability test and survey. —SS]

5.2.1 Area of Testing1

Title for Test

1. test-id1

   Type:

   Initial State:

   Input/Condition:

   Output/Result:

   How test will be performed:

2. test-id2

   Type: Functional, Dynamic, Manual, Static etc.

   Initial State:

   Input:

   Output:

   How test will be performed:

5.2.2 Area of Testing2

...

5.3 Traceability Between Test Cases and Requirements

[Provide a table that shows which test cases are supporting which requirements. —SS]

6 Unit Test Description

[Reference your MIS and explain your overall philosophy for test case selection. —SS] [This section should not be filled in until after the MIS has been completed. —SS]

6.1 Unit Testing Scope

The scope of the unit testing will involve evaluating the microphone, bluetooth, classification, feedback, noise filter, and interface modules to see if they adhere to respective functional and non-functional requirements found in Synesthesia Wear's SRS document.

6.2 Tests for Functional Requirements

[Most of the verification will be through automated unit testing. If appropriate specific modules can be verified by a non-testing based technique. That can also be documented in this section. —SS]

6.2.1 Microphone Module

[Include a blurb here to explain why the subsections below cover the module. References to the MIS would be good. You will want tests from a black box perspective and from a white box perspective. Explain to the reader how the tests were selected. —SS]

1. test-id1

Type	Functional, Dynamic, and Manual.
Initial State	No data in buffer and requesting microphone input.
Input	Sample Recording.
Output	The sample recording in the memory buffer.
Test Case Derivation	The output has to be the digital representation of the input.
How test will be performed	3 Different sample sounds will be supplied near the microphone. Will compare the output with expected output. The test succeeds if all the outputs match the expected outputs within some tolerance.

6.2.2 Bluetooth Module

1. test-id1

Type	Functional, Dynamic, and Manual.
Initial State	Data in buffer and send request received.
Input	Digital sound recording.
Output	The same digital sound recording at the receiver.
Test Case Derivation	The module is a communication module and no change has been made to the data. Hence the data has to be the same as the output.
How test will be performed	A large audio recording will be sent to the data buffer of the sender and send request will be asserted. The receiver should receive the data. The data will be compared manually to check if the test was passed.

2. test-id2

Type	Functional, Dynamic, and Manual.
Initial State	Classification detected asserted.
Input	Sample classification signal asserted on software.
Output	Feedback signal asserted on hardware.
Test Case Derivation	The module is a communication module, and the classification signal received from the software has to tie into its respective feedback signal.
How test will be performed	A classification signal will be asserted manually in the software, its respective feedback signal needs to be asserted in the hardware for the test to pass.

6.2.3 Classification Module

1. test-id1

Type	Functional, Dynamic, and Automatic.
Initial State	Sound classification settings already preconfigured.
Input	Stored sound data in the memory buffer.
Output	Classified sound data.
Test Case Derivation	The output should be digital sound data that has been classified under one of the categories that were preconfigured in the sound classification settings.
How test will be performed	Sound data from the Microphone module testing will be used for this test. The classification code ingrained in the Synesthesia Wear app will automatically try to classify stored sound data in memory. The test succeeds if all outputs are classified under their expected categories.

2. test-id2

Type	Functional, Dynamic, and Manual.
Initial State	Sound classification settings are empty or already preconfigured.
Input	New classification settings.
Output	Classification settings have been changed.
Test Case Derivation	The output should match the new sound classification settings verbatim.
How test will be performed	New sound classification settings will be inputted into a menu on the Synesthesia Wear app and a save button will be used to preserve those settings. The test succeeds if after going back to the sound classification settings menu, the newly inputted settings are displayed.

6.2.4 Feedback Module

1. test-id1

Type	Functional, Dynamic, and Manual.
Initial State	Classification received.
Input	A feedback signal is asserted.
Output	Vibration detected at the end that coincides with the feedback signal.
Test Case Derivation	Tests how our feedback structure performs.
How test will be performed	A feedback signal pertaining to a particular classification is asserted, the output has to be equal to the set vibration specified by the classification.

6.3 Tests for Nonfunctional Requirements

[If there is a module that needs to be independently assessed for performance, those test cases can go here. In some projects, planning for nonfunctional

tests of units will not be that relevant. —SS]

[These tests may involve collecting performance data from previously mentioned functional tests. —SS]

6.3.1 Microphone Module

1. test-id1

Type	Dynamic and Manual.
Initial State	No data in buffer.
Input	Sample recording.
Output	The sample recording in the memory buffer.
Test Case Derivation	The output has to be within at least a 95% confidence level of the input.
How test will be performed	3 different sounds found online will be taken and played on some speakers that will project the sounds into the microphone. Taking the initial sound files and the sound data from the microphone, an online software tool will compare the sound data and measure their similarities/confidence level. The test succeeds if the similarities/confidence level is at least 95%.

2. test-id2

Type	Dynamic and Automatic.
Initial State	No data in buffer and the device is powered on.
Input	Random ambient sound.
Output	Continuously updated sound buffer with sampling frequency fs.
Test Case Derivation	Tests if the device is able to continuously update when turned on.
How test will be performed	Random sounds will be inserted into the microphone. The sound buffer will be copied at the frequency of the sampling frequency into a file. The device has to be able to update the sound buffer continuously until the device is turned off to receive a conditional pass. For a complete pass, all the sound data has to have a distortion of less than 5%.

6.3.2 Bluetooth Module

1. test-id1

Type	Dynamic and Manual.
Initial State	Bluetooth device not paired.
Input	Introduce a new bluetooth connection.
Output	Connect with the bluetooth connection in under a minute.
Test Case Derivation	The device has to be able to connect with the hardware easily.
How test will be performed	A new bluetooth device will be introduced to the hardware, on performing the bluetooth connection procedure the connection should be established within a minute for the test to pass.

2. test-id2

Type	Dynamic and Manual.
Initial State	Bluetooth device not connected but paired.
Input	Disconnect bluetooth abruptly.
Output	Auto-reconnection of the bluetooth.
Test Case Derivation	The device has to be able to reconnect without any issues.
How test will be performed	The device will be paired to the hardware initially, by taking the device out of range we will simulate abrupt interruption. It should automatically connect back when back in range, this should not take any longer than 10 seconds after the device is back in range.

6.3.3 Noise Filter Module

1. test-id1

Type	Dynamic and Automatic.
Initial State	Is empty and waiting for an input to process.
Input	Digital data with one or more sounds.
Output	The same digital sound recording but with less noise.
Test Case Derivation	The background noise in the sound file is reduced/removed and a main/singular sound is more notable than others.
How test will be performed	After receiving sound data over bluetooth, Synesthesia Wear's app will automatically send this data over to the corresponding device's noise filtering hardware that will process and return a filtered version of the data. This test passes if it is clear that there is notably less noise in the filtered sound file compared to the original one.

6.3.4 Classification Module

1. test-id1

Type	Dynamic and Automatic.
Initial State	Waiting for sound input and classification settings to be preconfigured.
Input	Sample sounds that fall into classifications and those that do not.
Output	Classification signals asserted for sounds that are in the classification.
Test Case Derivation	Tests the performance and effectiveness of the classification module to be able to distinguish classified and non-classified signals.
How test will be performed	A sample set of different sounds (6 different types of sounds with each one supplied 20 times, each time with a random distortion added to make them all digitally different) will be run through a pre-configured classification set. If the output of the module is correct 90% of the time, it is considered to be a pass.

6.3.5 Feedback Module

1. test-id1

Type	Dynamic and Manual.
Initial State	Classification received.
Input	A feedback signal is asserted.
Output	Vibration detected at the end that coincides with the feedback signal and is not intrusive.
Test Case Derivation	Tests how our feedback structure performs.
How test will be performed	A feedback signal pertaining to a particular classification is asserted such that the output has to be equal to the set vibration specified by the classification. A sample group of 5 will be asked to feel the vibration and then reply if said vibration was sufficient and non-intrusive. If 4 of the 5 answers are yes, the test is passed.

6.3.6 Interface Module

1. test-id1

Type	Structural, Dynamic and Manual.
Initial State	N/A.
Input	Sample group user inputs.
Output	UI should behave as required in terms of appearance and style.
Test Case Derivation	Gathering information on the wants of the users to ensure that the interface adheres to their preferences and that they are pleased with their user experiences.
How test will be performed	A sample group of 5 people will have the opportunity to interact with the UI and device first. They will later be asked questions regarding certain features of the product. These questions are listed in the appendix. If a satisfying result is obtained over the sample group, then the test is passed. This test has multiple subsections where each can be passed or failed separately.

2. test-id2

Type	Dynamic and Automatic.
Initial State	User interface opened up.
Input	User input.
Output	UI response within 1ms.
Test Case Derivation	The device has to be able to respond quickly to any user input.
How test will be performed	It will be too hard to measure the response time manually as most humans have a response time greater than 1ms. Hence this test will be done with the help of helper code which will calculate the time between a user input detected and a corresponding change in the UI.

3. test-id3

Type	Dynamic and Manual.
Initial State	User interface opened up.
Input	User input.
Output	Expected UI response on all the different devices.
Test Case Derivation	The UI has to be able to work the same on all platforms.
How test will be performed	The UI will be installed on different systems (Android, Windows, IOS). If it is capable of all functionality within all the platforms, it receives a pass.

6.4 Traceability Between Test Cases and Modules

[Provide evidence that all of the modules have been considered. —SS]

References

Author Author. System requirements specification. https://github.com/..., 2019.

7 Appendix

This is where you can place additional information.

7.1 Symbolic Parameters

The definition of the test cases will call for SYMBOLIC_CONSTANTS. Their values are defined in this section for easy maintenance.

7.2 Usability Survey Questions?

7.2.1 Appearance Requirements

1. How did the finish and look of the device appeal to you?

2. How was the appearance of different pages in the UI software?

Expected answers for pass condition: Satisfied or better for both questions above.

7.2.2 Style Requirements

1. Did you feel that there was consistency between different elements of the UI?

Expected answers for pass condition: Yes.

7.2.3 Ease of Use Requirements

1. Out of 10, how easy do you find it to interact with the UI?

2. Out of 10, what would you rate the usability of the system?

3. What do you find most frustrating about the system?

Expected answers for pass condition: For the first two questions, the average score has to be greater than 7. The last question should not have the same answer repeated between different members. If so, it would suggest an issue with the system.

7.2.4 Personalization and Internationalization Requirements

1. Were you satisfied with the personalization choices of the UI?

Expected answers for pass condition: Should be yes for 85% of the sample group.

7.2.5 Learning Requirements

1. How long did it take you to understand and use the software on your own?

Expected answers for pass condition: Should not be longer than 5 minutes for each person in the sample group.

7.2.6 Understandability and Politeness Requirements

1. How difficult was it to read information off the screen?

2. Were you satisfied with the arrangement of content on the screen?

3. Were you displeased with the language or content used on the UI?

Expected answers for pass condition: For the first condition, the difficulty should not be more than 6 out of 10. For the second condition, it should be yes for 85% of the sample group. For the third condition, it should be no for all members of the sample group.

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Lifelong Learning. Please answer the following questions:

This section deals with what knowledge and experiences each team member will need to acquire so that the capstone project can be completed successfully. With that in mind, before identifying what each member is going to learn/master, some approaches of learning need to be established. Firstly, we believe that one of our main approaches to learning/mastering new skills is by scouring the internet for resources, videos, websites, blogs, or any other notable sources for relevant information. Another approach would be to look through books at McMaster's library to see if there is any applicable details that could be used for this project. Furthermore, one could also master their new skills via practice and trial-and-error by following tutorials and then trying to do them in real-time. Lastly, a final approach could be to find someone with relevant expertise and ask them for advice or some lessons on relevant skills/knowledge that would be beneficial for the project as a whole.

1.

2.