Verification and Validation Report: SE 4G06, TRON 4TB6

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1 Revision History

Date	Version	Notes
Date 1	1.0	Notes
Date 2	1.1	Notes

2 Purpose

This VnV report's establishment is to support development of the product Synthesis Wear. The actions taken in the document are linked with testing to ensure reliability and robustness of the product for adequate detection of particular sounds.

3 Scope

The focus of this document is on the output results of Synthesis Wear when given arbitrary input. We will using black box testing on important aspects of the output and input rather then how the results are generated. These tests will be based on certain implementations we have put into place to handle unexpected inputs.

4 Background

Synthesis wear is designed with a mobile application which allows users to toggle certain sounds on and off to improve usability of the watch. This allows customization to occur right from the mobile. Synthesis wear will be able to detect key words and sound which are custom to the user, to help aid their hearing. This will help them focus on someone calling on their name, emergency situations and much more.

5 Functional Requirements Evaluation

Id	**Ref**	**Description**	**Input**	**Expected Result**	**Actual Result**	**Result**
FRT1	FR1, FR2	Testing ability to differentiate sounds	Five different sounds	Device produces five different feedbacks		Pass

FRT2	FR1	Testing in different environments	Same sound in different environments	Same feedback in all enviroments		Fail
FRT3	FR1	Testing at different ranges	Same sound at specified distances	Same feedback at specified distances		TBD
FRT4	FR1	Testing its ability to ignore ambient noise	No input	No output		
FRT5	FR2	Testing its ability to classify correctly	Different specified words	Feedback based on correct classification		
FRT6	FR2	Testing variability in speech	Same word said by four different people	Same feedback for all		
FRT7	FR2	Testing its ability to ignore high amplitude random sounds	Random not specified sounds	No haptic feedback		
FRT8	FR3	Testing newly set classifications	A newly set classification sound	The specified haptic feedback		

FRT9	FR3	Testing removed classifications	A removed classification sound	No feedback		
FRT10	FR3	Testing reboot and memory retention	Power switched on and off and test FRT5 run again	Feedback based on correct classification		
FRT11	FR4	Testing haptic feedback with the device worn	Specified sound	Haptic feedback based on the sound's classification		
FRT12	FR4	Testing variability in haptic feedbacks	Three different specified sounds	Different haptic feedbacks that convey the specified sounds		
FRT13	FR4	Testing different wearable orientations	FRT12 run on different orienations	All orientations give consistent output		
FRT14	FR4	Testing intensity of feedback wearing different clothes of varying thickness	FRT12 run on three different clothes	All clothes give consistent results		
FRT15	FR5	Testing real-time application of device	Specified sound	Correct classification within one second		

6 Nonfunctional Requirements Evaluation

6.1 Manual

Id	Ref	Description	Input	Expected Result	Actual Result	Result
NFRT3	NFR1	Testing button functionality based on button colour	Open Application	Different coloured buttons perform different functionalities	Buttons with similar colour performed similar functions	Pass
NFRT6	NFR1	Testing usability, accessability, findability of application and device	N/A	Achieve average score of 8 from 10 participants (rated out of 10)		TBD
NFRT7	NFR2	Testing user interface's consistency in appearance	N/A	Achieve average score of 4 out of all questions from participants		TBD
NFRT12	NFR4	Testing ability to configure different keywords on application	Click keyword selection button	Keyword configuration screen	Reached keyword configuration screen on application	Pass
NFRT13	NFR4	Testing ability to select language of use on application	Preferred Language	Application translated to preferred language		TBD

NFRT14	NFR4	Testing ability to select language of use on already set-up device	Change Language	Application translated to chosen language		TBD
NFRT15	NFR4	Testing accuracy of translated languages on application	Team translates manuals	Translated manuals		TBD

6.2 Stress

Id	Ref	Description	Input	Expected Result	Actual Result	Result
NFRT11	NFR3	Check if you can configure an unrecognizable keyword	unrecognizable keyword	Keyword not supported	Keyword not supported	Pass
NFRT24	NFR11	Feed 6 samples 20 times each with randon noise added. Check if correctly classified 90 percent of the time	Sound clips	90 percent correct classification	82 percent classification	Fail
NFRT25	NFR12					Pass
NFRT29	NFR16					Pass

6.3 Performance

Id	Ref	Description	Input	Expected Result	Actual Result	Result

NFRT1	NFR1	Checking what the initial state of application is.	Open Application	Home Page of Application	Home Page of Application	Pass
NFRT2	NFR1	Can users find the pairing button of the application.	Open the Application, Click pair button	User clicks pair button under 10 seconds	Users found pairing buttons under 10 seconds	Pass
NFRT4	NFR1	Checking if application correctly goes to pairing page.	Open the Application, Click pair button	Pairing page of Application	Pairing page of Application	Pass
NFRT5	NFR1	Checking if application correctly goes to keyword selection page.	Open the Application, Click keyword selection button.	Keyword Selection page of Application	Keyword Selection page of Application	Pass

NFRT8	NFR3	Check to see if the application connects to the device through bluetooth	Open application, click pair button on both device and application	Device pairs to Phone	Device Pairs to Phone	Pass
NFRT16	NFR5	Checking if users can pair a device to phone in under 5 minutes	Open application, click pair button on both device and application	3/4 Users fully pair device in under 5 minutes	4/4 Users pair device under 5 minutes	Pass
NFRT19	NFR9	A sound will be fed to the device that includes a keyword device should be able to provide feedback in under 1 second 8/10 times	Sound that includes a keyword	8/10 keywords detected in under 1 second	9/10 Keywords detected	Pass
NFRT20	NFR9	Checking how fast the UI of application responds to user input	User Input	Average of 100 inputs is under 1ms		TBD

NFRT21	NFR9	Checking that application can separately connect to 5 independent devices	Pairing button on both application and device	5/5 devices pair in under 1 minute	All 5 paired in under 1 minute each	Pass
NFRT30	NFR17	Let 10 people use device for 3 days record how many say it inhibits their lives	unpaired device and unopened application	8/10 participants do not the device to inhibit their lives		TBD
NFRT32	NFR17	Check to see if users can install the application on IOS and Android	Click Install	installed application on IOS and Android	Installed on Android	Fail

6.4 Security

Id	**Ref**	**Description**	**Input**	**Expected Result**	**Actual Result**	**Result**
NFRT9	NFR3	Checking if application pairs to device that is not in pairing mode	Click pair Button	Device not found	Device not found	Pass
NFRT10	NFR3	Check if user can Login to application without a registered account	Invalid Login Credintials	Account not found	Account not found	Pass

7 Comparison to Existing Implementation

This section will not be appropriate for every project.

8 Unit Testing

Id	Ref	Description	Input	Expected Result	Actual Result	Result
UT1		Testing accuracy of the microphone to detect sounds	3 Different Sample Recordings	3 Distinct Sample Recordings in memory buffer that match the inputs respectively	The detected sounds matched the input sounds	Pass
UT2?		Testing bluetooth's ability to transfer digital sound recordings accurately	Digital Sound Recording	Same digital sound recording at the receiver		Fail
UT3		Testing bluetooth's ability to send signals accurately	Sample classification signal asserted on software	Feedback signal asserted on hardware		TBD
UT4		Testing classification module's ability to accurately categorize sound data	Stored samples of sound data in the memory buffer	Accurately classified Sound Data		

UT5		Testing classification module's ability to change its sound classification settings	New Classification settings	Classification settings have been changed on the app	The settings displayed on the settings page match the newly inputted classification settings	Pass
UT6		Testing feedback module's ability to transmit accurate feedback signals according to the settings	Feedback signal is asserted	Vibration detected in the bracelet that coincides with the feedback signal	Vibration motor went off appropriately with respect to the settings configured on the app	Pass
UT9		Testing bluetooth connection ability	Enable bluetooth connection	Bluetooth connection connected in under a minute	Bluetooth connection was established within 10 seconds	Pass

UT10		Testing bluetooth connection's ability when devices go in and out of range	Separate the connected devices 10 or more metres away, wait at least 5 seconds, then bring the devices closer together	Bluetooth will disconnect and reconnect when devices are back in range to each other		
UT11		Testing noise filtering module's ability to remove noise from a sample sound	Digital data with one or more sounds	Same digital sound recording but with less noise	The output still had noise but notably less compared to the original sound file	Pass

UT15		Testing app interface's ability to respond quickly to a user input	User input	User Interface response within 1ms	The app was appropriately able to respond as soon as a button was clicked or an input was submitted	Pass
UT16		Testing app interface's ability to respond the same across different systems (Android, Windows, IOS)	User Input	Same User Interface response on all the different devices	N/A (The app has not yet been implemented on different IOS systems)	N/A

9 Changes Due to Testing

10 Trace to Requirements

11 Trace to Modules

12 Code Coverage

Code was reviewed by various group members before pushing to the repository. The functionality of the code was summarized to the other individual so that functionality was understood properly.

13 Traceability Matrices

All of our tests can be traced back to either functional requirements, non-functional requirements and modules.

Test	**Requirements**				
	FR1	**FR2**	**FR3**	**FR4**	**FR5**
FRT1	X	X			
FRT2	X				
FRT3	X				
FRT4	X				
FRT5		X			
FRT6		X			
FRT7		X			
FRT8			X		
FRT9			X		
FRT10			X		
FRT11				X	
FRT12				X	
FRT13				X	
FRT14				X	
FRT15					X

Table 7: Traceability between functional requirement tests and functional requirements

Given our size of non-functional requirements, we have grouped some of the tests into test types for ease of understanding.

Test Cases	Requirements
Manual Non-functional	NFR1
	NFR2
	NFR4
Stress Non-functional	NFR3
	NFR11
	NFR12
	NFR16
Performance Non-Functional	NFR1
	NFR3
	NFR5
	NFR9
	NFR9
	NFR17
Security Non-Functional	NFR3

Table 8: Traceability between test cases and non-functional requirements

Appendix — Test results

Model confusion matrix

Histogram of 50 testing runs

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

	ABRAHAM	FIRE ALARM	JORDAN	_NOISE	_UNKNOWN	UNCERTAIN
ABRAHAM	97.2%	0%	0.4%	1.4%	0.4%	0.7%
FIRE ALARM	0%	100%	0%	0%	0%	0%
JORDAN	0.3%	0%	87.7%	2.4%	3.1%	6.5%
_NOISE	0%	0%	0%	99.0%	0.3%	0.7%
_UNKNOWN	1.4%	0%	2.4%	3.8%	86.7%	5.6%
F1 SCORE	0.98	1.00	0.92	0.96	0.91	

Figure 1: Confusion matrix

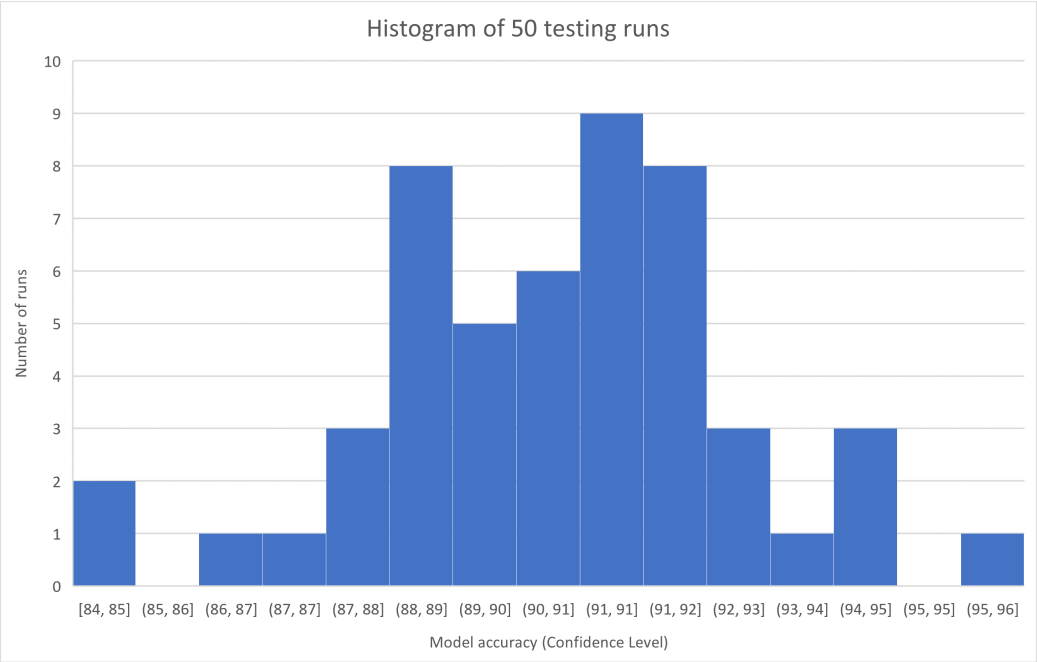

Figure 2: Histogram

Modules	Unit Tests									
	T1	**T3**	**T4**	**T5**	**T6**	**T9**	**T10**	**T11**	**T15**	**T16**
Login Module M1										
Bluetooth connection Module M2						X	X			
Keyword Selection Module M3										
Output Signal Module M4	X				X			X		
Profile Module M5									X	X
Battery Status Module M6										
Sound Classification Module M7			X	X						
Bluetooth Communication Module M8		X			X	X				
Microphone Module M9	X						X			

Table 9: Traceability between modules and unit tests.

questions:

1.

2.