Verification and Validation Report:

March 5, 2024

1 Revision History

Date	Contributors	Notes
Feb 29, 2024	Cassidy	Initial draft and formatting
Mar 4, 2024	Andrew	Filled out table for learning progression
Mar 4, 2024	Stanley	Added test results for performance requirements
Mar 4, 2024	Cassidy	Added test results for tables 2,4,5 and 6

2 Symbols, Abbreviations and Acronyms

Table 1: Naming Conventions and Terminology

Term, Abbreviation, or Acronym	Description
A	Shorthand for Assumption
ASL	Shorthand for American Sign Language. It is a form of sign language primarily used in the US and in parts of Canada
ASLingo	The commercial name for the project
CV	Refers to Computer Vision, the field of technology that involves processing visual input to achieve various means.
CR	Shorthand for 'Cultural Requirements', a subsection of Non-Functional Requirements.
HSR	Shorthand for 'Health and Safety Requirements', a subsection of Non-Functional Requirements.
FR	Shorthand for Functional Requirements
LR	Shorthand for 'Legal Requirements', a subsection of Non-Functional Requirements.
LFR	Shorthand for 'Look and Feel Requirements', a subsection of Non-Functional Requirements.
MSR	Shorthand for 'Maintainability and Support Requirements', a subsection of Non-Functional Requirements.
OER	Shorthand for 'Operational and Environmental Requirements', a subsection of Non-Functional Requirements.

OpenCV	Refers to the Open Computer Vision Library library available for free to developers in order to develop Computer Vision applications.
PR	Shorthand for 'Performance Requirements', a subsection of Non-Functional Requirements.
SR	Shorthand for 'Security Requirements', a subsection of Non-Functional Requirements.
UHR	Shorthand for 'Usability and Humanity Requirements', a subsection of Non-Functional Requirements.

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3 General Information

3.1 Summary

As a maching learning-based image recognition web app, ASLingo has many areas to be tested. The overall software will be broken down into modules. There will be a front-end, a back-end, a database, and a machine learning model which all need to be separately tested, along with physical hardware and compatibility. This document serves as a report of the testing done to ensure that this system has been properly and throughly tested to meet the requirements set by the Software Requirements Specification.

3.2 Objectives

This document aims to outline the testing plan for ASLingo in order to create a functional and reliable product for users that aligns with the specified requirements. The team seeks to build confidence in stakeholders and users that the software is correct and meets or exceeds the initial intended goals, resulting in an overall satisfactory user experience.

3.3 Relevant Documentation

Below is a list of the relevant documentation referenced within the Verification and Validation Plan.

The Development Plan outlines the roles of each team member and the areas that each member will focus on. This breakdown of team responsibilities allows the team to assign testing roles accordingly. This document also contains the tools that the team plans on using for testing.

The VnV Plan outlines the testing plan for the system, as well as outlining the test cases that the team will perform to ensure the project has been properly and throughly tested. This document also contains the tools that the team plans on using for testing.

The Software Requirements Specification lists the functional and non-functional requirements which will aid in testing by formulating a testing plan to meet each requirement. Non-functional requirements should be tested such that

the fit criteria are met.

The Hazard Analysis identifies failure modes to determine the implementation strategies to mitigate them. These will be used as a part of the testing plan to ensure that the failures are covered.

The Module Guide divides the software into modules. The team will build the testing plan around the modules.

The Module Interface Specification further decomposes the software's modules into specific access routines. The team will build the testing plan such that each function and routine works as intended.

4 Functional Requirements Evaluation

4.1 System Tests for Authentication

Table 2: System Tests for Authentication

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID
FRT1-A1	User can make their account	User inputs username and password, then selects 'Sign In'	User successfully makes their account	User is shown successful account creation page	Pass	FR3
FRT1-A2	User can sign into account made previously	Previous user inputs username and password	User successfully signs into their account	User is shown successful account creation page	Fail	FR4

2

FRT1-A3	User can sign out of their account	User selects 'Logout' header	User signs out of account and is taken back to home page	None	Fail	FR5
FRT1-A4	User can reset password	User requests reset password then inputs email	System changes stored password to new password	None	Fail	FR13

4.2 System Tests for ASL Learning Progression

Many of the learning progression tests are redundant, as the development team and some participating users tested multiple ASL signs using the applications 'Quiz' and 'Practice' sections. All letters of the alphabet were tested to ensure correctness of the system, and all quiz levels were tested to ensure their functionality.

Table 3: System Tests for ASL Learning Progression

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID
FRT2-LP1	User performs ASL signs	Alphabetical signs 'a', 'b', 'c'	The letters 'a', 'b', 'c' are correct from user	The letters 'a', 'b', 'c' are shown by user	Pass	FR2
FRT2-LP2	Complete diagnostic quiz	User goes to quiz page	System starts diagnostic quiz until user completes it	Quiz is started and completed by user	Pass	FR6

FRT2-LP3	User attempts progression based course	User completes their diagnostic quiz	System generates new quiz for user based on results	No new course is generated	Fail	FR7
FRT2-LP4	User tracks their progression	User goes to progression tab	Views their progress	None	Fail	FR7, FR12
FRT2-LP5	System Saved User Progress	User completes a quiz	Result is stored and saved	Not saved	Fail	FR8
FRT2-LP6	Get live feedback from user signs	User signs letter 'a'	Systems outputs letter 'A'	System shows user letter 'A'	Pass	FR10

4.3 System Tests for Web Application

Table 4: System Tests for Web Application

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID
FRT3-U1	User can access the web application	User opens web browser with the ASLingo application	User is able to access all pages of the application	User is able to access all pages of the application	Pass	FR9

4.4 System Tests for Hardware

Table 5: System Tests for Hardware

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID

FRT4-HW1	User is able to access the web camera	User goes to quiz page and starts a quiz	System is able to recognize user signs from their camera	System is able to recognize user signs from their camera	Pass	FR1
FRT4-HW2	Monitor web camera usability	User goes to quiz page and starts a quiz	User is notified if their camera is not working correctly	User is notified if their camera is not working correctly	Pass	FR11

5   Nonfunctional Requirements Evaluation

5.1   System Tests for Usability

We tested our usability requirements using a survey for a group of testers to fill out after using the application for 15 minutes. The group of users had an interest in learning ASL, and were willing to fill out this questionnaire to give some perspective on the usability of our application. The survey questions can be found in the Appendix 13.1.

can also include the google form pictures of responses to the survey here and discuss results

Table 6: System Tests for Usability

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID
NFRT1-UT1	User is able to start application with no training	User opens web application	User is able to use application, completes question 1 of survey	User is able to use application, overall test score of **ADD PERCENT**% for survey question 1	Pass	UHR1
NFRT1-UT2	User is able to complete a quiz with no training	User opens quiz page and starts a quiz	User is able to complete a quiz, completes question 3 of survey	User is able to complete a quiz, overall test score of **ADD PERCENT**% for survey question 3	Pass	UHR1

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID
NFRT1-UT3	User is able to use application with various hearing abilities	User opens application	User is able to use application, completes question 2 of survey	User is able to use application, overall test score of **ADD PERCENT**% for survey question 2	Pass	UHR2
NFRT1-UT4	User can personalize their account	User is signed into their account	User can change some personal settings	None	Fail	UHR3
NFRT1-UT5	System should show user if input needs to be adjusted	User tries to complete quiz but their camera is not set up properly	System prompts user to fix camera settings	System prompts user to fix camera settings	Pass	UHR4

5.2   System Tests for Performance

Table 7: System Tests for Performance

Test ID	Description	Input	Expected Output	Actual Output	Result	Req ID

NFRT2-PT1	The application should respond to user input within 1 second.	The user should respond to the application's prompt.	The system should register the user's input and respond to the user quickly.	The system responded with the detected sign almost instantly.	Pass	PR1
NFRT2-PT2	The application should be able to accurately determine if the user has signed the correct response to the prompt 95% of the time.	The user should sign in response to the application's prompt.	The application should register the user's signed input and determine if they have signed the required action correctly.	Static hand signs are recognized with a total testing accuracy of around 98%. Dynamic hand signs are inconsistent, with the accuracy at around 50 - 60%.	Fail	PR2

6 Comparison to Existing Implementation

This section will not be appropriate for every project.

7 Unit Testing

8 Changes Due to Testing

9 Automated Testing

10 Trace to Requirements

Functional Requirements to System Tests

System Test	FR Req.												
	1	2	3	4	5	6	7	8	9	10	11	12	13
FRT1-A1			X										
FRT1-A2				X									
FRT1-A3					X								
FRT1-A4													X
FRT2-LP1		X											
FRT2-LP2						X							
FRT2-LP3							X						
FRT2-LP4							X					X	
FRT2-LP5								X					
FRT2-LP6										X			
FRT3-U1									X				
FRT4-HW1	X												
FRT4-HW2											X		

System Test	UHR				PR	
	1	2	3	4	1	2
NFRT1-UT1	X					
NFRT1-UT2	X					
NFRT1-UT3		X				
NFRT1-UT4			X			
NFRT1-UT5				X		
NFRT2-PT1					X	
NFRT2-PT2						X

Non Functional Requirements to System Tests

11 Trace to Modules

System Tests to Modules

12 Code Coverage Metrics

	Module												
System Test	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
FRT1-A1			X									X	X
FRT1-A2				X								X	X
FRT1-A3												X	X
FRT1-A4												X	X
FRT2-LP1	X	X	X			X		X					
FRT2-LP2									X	X			X
FRT2-LP3										X			X
FRT2-LP4										X			X
FRT2-LP5													X
FRT2-LP6	X	X	X							X			
FRT3-U1									X				
FRT4-HW1								X					
FRT4-HW2								X		X			
NFRT1-UT1									X	X	X	X	X
NFRT1-UT2										X	X		
NFRT1-UT3									X	X	X		
NFRT1-UT4												X	X
NFRT1-UT5	X	X	X					X					
NFRT2-PT1	X	X	X	X	X		X						
NFRT2-PT2	X	X	X	X	X					X			

13 Appendix

13.1 Usability Survey Questions

A link to the survey that participants were given can be found here. Participants were asked to rank how they felt about the following statements, with the response options being Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree.

1. It was very easy to get right into a testing session with little to no hassle.

2. The User Interface is very friendly and it is easy to identify where everything is.

3. During a Quiz, its very easy to understand what to do and how to complete it.

4. While signing, it is very easy to see what sign I am making and whether to make adjustments or not.

5. At my current level of ASL knowledge, it is easy to use the application

6. On a scale of 1 to 10, how would you rate your experience with ASLingo? [1 = terrible, 10 = fantastic]

13.2 Appendix — Reflection

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

1. In what ways was the Verification and Validation (VnV) Plan different from the activities that were actually conducted for VnV? If there were differences, what changes required the modification in the plan? Why did these changes occur? Would you be able to anticipate these changes in future projects? If there weren't any differences, how was your team able to clearly predict a feasible amount of effort and the right tasks needed to build the evidence that demonstrates the required quality? (It is expected that most teams will have had to deviate from their original VnV Plan.)