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“Virtual ASL”:

An American Sign Language Computer-Assisted Instruction Software

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Computer Science Senior Honors Project

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I. Introduction

Virtual ASL is a computer-assisted instruction software for teaching beginner ASL (American Sign Language). The purpose of this software is to guide users through interactive lessons and quizzes in order to teach this language. In the current state of the software, it covers material taught in a level one ASL class. It will teach similar content as the lessons from the ASL instruction book, *Signing Naturally* (Mikos).

Looking at existing computer-assisted instruction software helped me decide what components should be included in Virtual ASL. Some of the ideas for the features included in Virtual ASL came from the popular language learning software *Rosetta Stone*. For example, *Rosetta Stone* has very interactive lessons with images to help the user learn the material. Similarly, Virtual ASL also includes images to help the lessons be more interactive and enjoyable for the user.

Developing this software involved following the process described in the book *Software Engineering: A Practitioner's Approach* (Pressman). This report presents the details of creating "Virtual ASL" in the following sections.

II. Software Design

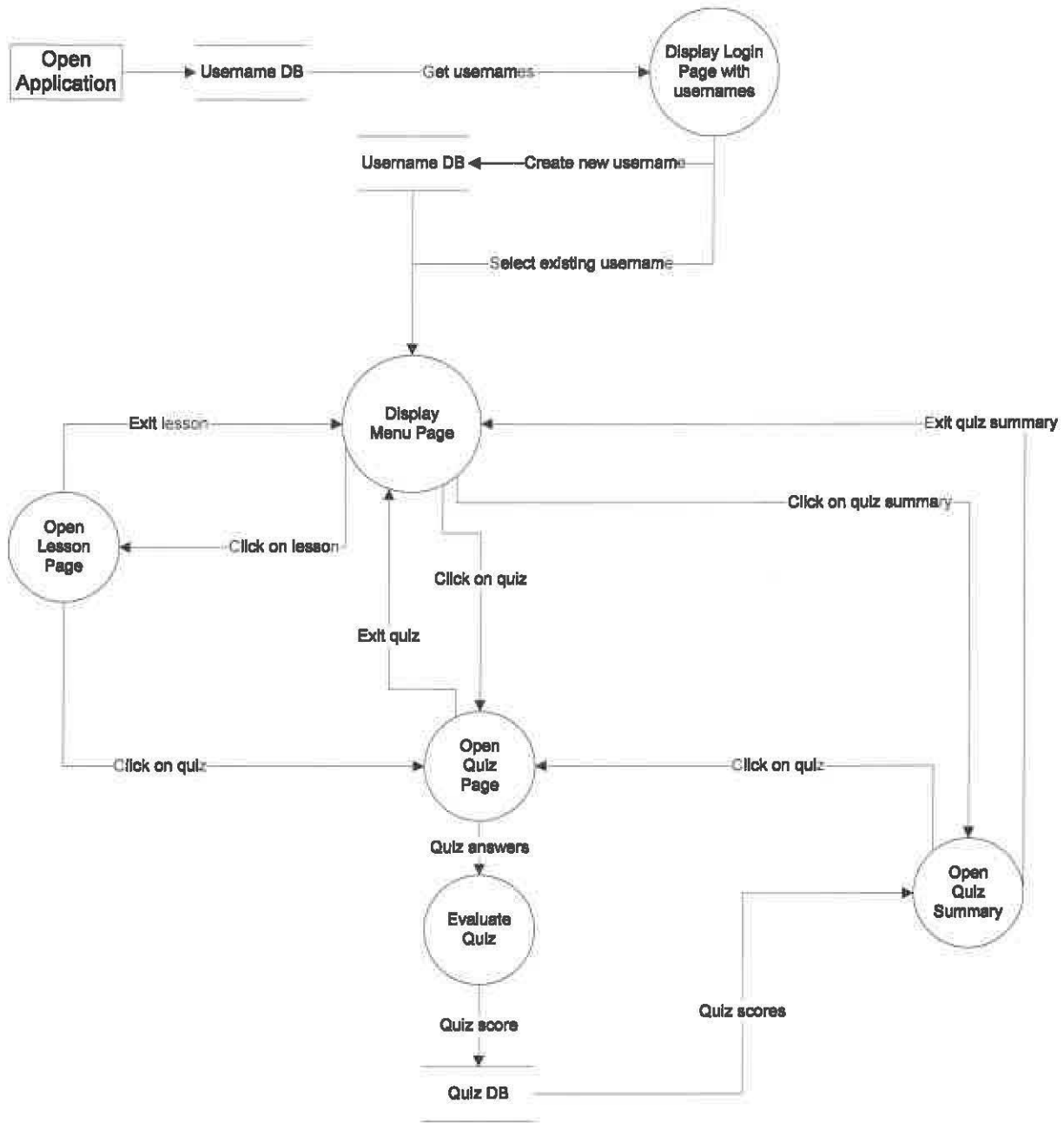
i. Language and Environment

The programming language used to create Virtual ASL is Java. While C++ was an option considered, it was eventually decided against because Java can provide a more visually attractive user interface. It does this by providing GUI (Graphical User Interface) components through an API (Application Programming Interface) known as Swing. It seems that there is a lot more you can do with Java than with C++ in this sense. Since there is a lot of interaction between the user and the software, it was a high priority to include an interface that was both appealing as well as

user-friendly. The other languages that were used in creating this software were PHP and SQL. In order to save and load user information, the application uses an online database. This database will store information such as usernames, the current lesson the user is on, and quiz scores. The Java application is able to interact with the database by using PHP and SQL.

An IDE (Integrated Development Environment) is an application where programmers write code and develop their software. After choosing Java as the main programming language, I had to decide an IDE to create Virtual ASL in. The IDE chosen was Eclipse, as it provides features that make programming more time efficient, such as auto-imports as well as real-time error checking.

ii. Data Flow Diagram (DFD)



The image above shows an overview of the system design as a whole. It shows the flow of data throughout the software. Each of the circles in the DFD indicates a component of the software that will be discussed in further detail in the next section.

iii. User Requirements

In the current state of the software, there are two different types of users. The primary type of user is someone aspiring to learn ASL for the first time. These users will create a personal username for the software. The second type of user is one who signs in as a guest, which could possibly be someone who is already familiar with some ASL and would like to review, or perhaps an ASL instructor. The user type will determine how the user can move through the lessons and quizzes after logging in.

A standard first-time user will need to create a new account, which will require a username. Another requirement that will be added in the future is for the user to indicate whether or not they wish to follow the lessons in numerical order. However, this requirement is not yet implemented into the current state of the system. Typically, a first-time student of ASL would want to do this, as the lessons are cumulative, such that the material in the later lessons may contain information from the earlier lessons. A student who perhaps wishes to freshen up on some of their ASL or a professor teaching an ASL class may like the option to skip around lessons to topics of their choosing. In the current state of this software, however, all users must follow the lessons and quizzes in sequential order. This differs from a user who logs in as a guest, in which case they will be able to select any lesson or quiz with no restriction on what lesson to begin on or what order the user needs to proceed in. The guest user is allowed a little bit more freedom than a standard user. The table below shows the use case for creating a new account.

USE CASE Create New Account 01	
Actors	User
Goal	A user sets up a new account so that their progress can be saved.
Preconditions	None
Scenario	1. The user opens the application.

	<ol style="list-style-type: none"> 2. The user inputs the required information <ol style="list-style-type: none"> (i) Username 3. The user clicks "Create". 4. The system confirms user has entered a valid username. 5. The system stores this information in a database. 6. The user is taken to the menu page.
Exceptions	<ol style="list-style-type: none"> 1. The username is already taken. The system will inform the user and they will need to change their username. 2. The user does not input a username before clicking "Create". The system will display an error message informing the user to input a username.
Priority	High
Use frequency	Moderate
Interfaces	Standard GUI
Issues	<ol style="list-style-type: none"> 1. Is there more information needed from the user?

For a user who has already created an account and would like to continue again at another time, they will need to log in. In order to do this, the user will select their username from a list of active accounts after they have started the application. The user will then be taken to a menu page, which shows all the lessons and quizzes. Since these users must follow the lessons in order, all of the lessons and quizzes the user has not yet reached will not be available for the user to click on. If logging in as a guest, however, all of the lessons and quizzes are available for the user to click on every time they are taken to the menu page. Shown below is the use case for logging into the system.

USE CASE Login 02	
Actors	User
Goal	The user will log into the system to reach the menu page.
Preconditions	User already has created an account.
Scenario	<ol style="list-style-type: none"> 1. The user selects their username from a list of already existing usernames. 2. The user will be taken to a "home" screen, where they can view and select a lesson or quiz. The lessons available to the user depend on how far along they have gotten in the lessons. They must follow them in sequential order.
Exceptions	<ol style="list-style-type: none"> 1. The user logs in as a "Guest". They are able to select all of the lessons and quizzes, but their quiz scores will not be saved in a guest account.

Priority	High
Use frequency	High
Interfaces	Standard GUI
Issues	

A major component of this software is the lessons. From the menu page, there will be interactive lessons on various topics in ASL available for the user to select. Each of these lessons will take the user through a series of pages, teaching them material that the particular lesson covers. They will cover various topics from a beginning level class of ASL (fingerspelling, cardinal numbers, ordinal numbers, question words, etc.). The lessons will be broken up into multiple pages. First, the user will be shown a set of new signs, either through images or videos. Once the user has looked over this new material, they will then have the chance to practice these signs in an interactive way. The images and videos are important tools used to instruct the user on the new vocabulary. The user also has the option to leave the lesson at any time by selecting on the "Home" button. Selecting this button will take the user back to the menu page. Once the user reaches the end of a lesson, they may choose to continue on to the next lesson or return back to the menu page. While most of the lessons will focus on learning new vocabulary, there will be some history or information about Deaf culture as well, as this is also important to be aware of when learning ASL. The use case in the table below shows the requirements for starting a lesson.

USE CASE Start a Lesson	
03	
Actors	User
Goal	A user will proceed through an ASL lesson to learn more about the particular topic.
Preconditions	The user has an account and has logged in successfully.
Scenario	<ol style="list-style-type: none"> 1. The user clicks on the lesson he/she wants to learn about. The database keeps track of the furthest lesson the user has reached, which determines what lessons are available for the user to click on. 2. The user is taken to the first page of the selected lesson, and they can begin learning about the topic.

Exceptions	1. If the user is logged in as a guest, they will be able to select any lesson or quiz.
Priority	High
Use frequency	High
Interfaces	Standard GUI
Issues	

A quiz will become available to the user after every two lessons, which the user may retake any number of times. These quizzes will test the user on information learned from the previous two lessons, and will display and save their score at the end of the quiz. If the user decides to retake any quizzes, only their highest earned score will be saved, replacing any lower scores they may have had. These quizzes will include the images and videos shown in the lessons. Since the quiz is testing whether or not the user has learned the material, they will only get one attempt at answering each question. The use case below shows again how the user will take a quiz.

USE CASE Take a Quiz	
04	
Actors	User
Goal	The user completes a quiz to test what they have learned in the previous lessons.
Preconditions	The user is logged in.
Scenario	<ol style="list-style-type: none"> 1. The user clicks on a quiz. 2. The quiz loads. 3. The user answers questions relating to the topic. 4. The system lets the user know if they answered correctly or not, and updates their score at the top of the page. 5. The system displays the user's score at the very end of the quiz. 6. The system saves the user's score in the database if they score higher than any previous scores (or if it is their first time taking the quiz). 7. The user may move on to the next lesson, or return back to the "home" page.
Exceptions	
Priority	Moderate
Use frequency	Moderate to High
Interfaces	Standard GUI
Issues	

Finally, there is a quiz summary page that will show the user's scores for all the quizzes. The user can reach the quiz summary page from the menu page. From here, the user can then select on any quiz in order to retake it to try and improve their score. The chart below shows the use case for viewing the quiz summary page.

USE CASE View Quiz Summary 05	
Actors	User
Goal	The user can view their quiz scores, and see which quizzes they still need to complete.
Preconditions	The user is logged in.
Scenario	<ol style="list-style-type: none"> 1. The user clicks on "Quiz Summary" 2. The user is taken to the "Quiz Summary" screen. 3. Next to each quiz, there will be a link that will allow the user to take the quiz. 4. If the user clicks, "Take Quiz", (corresponding to a particular lesson), the system will load the quiz. 5. Once the user is finished reviewing their quiz summary, they can click "Home" to return back to the menu screen.
Exceptions	
Priority	Medium
Use frequency	Moderate
Interfaces	Standard GUI
Issues	

In order to include videos into the lessons and quizzes, an API (Application Programming Interface) called Java Media Framework (JMF) was used. Adding videos was a high priority for this application as it is much easier to learn new signs from actually watching the movements and facial expressions of a person signing as opposed to looking at a flat image that is describing the motions with arrows and/or text. Once JMF was incorporated into my project, it was very easy to add videos to the lessons and quizzes. The videos also include a control bar underneath it so that the user may rewind or replay them any number of times.

The user should be able to quit the application at any time. The user will not need to worry about losing quiz scores as their scores have been saved and will be available to see every

time they use the application. For those users not logged in as a guest and must follow the lessons in order, the software will also keep track of the furthest lesson the user has reached. This ensures that the user does not have to start over from the first lesson every time they log in. The same is true for when the user logs out but does not quit the application. If the user logs out, it will take them back to the login page.

iv. Database Organization

This software involves an online database where user information is stored. The information that is being recorded in this database include usernames, the current lesson of the user, and the quiz scores.

As mentioned earlier, one of the tasks of the software is to ensure that the user (not signed in as a guest) follows the lessons and quizzes in sequential order. In order to accomplish this, there will be a column in the database which keeps track of the “current” lesson, or furthest lesson, that the user has reached. When a user creates a new account, this number will be set to one, so that the only lesson available to the user is lesson one. At the end of every lesson, the Java application will send the lesson number that the user has just reached to a .php file. This file will then check the database to see if the current lesson needs to be updated. If the lesson the user has just reached is greater than the current lesson already stored in the database, then the database will overwrite the current lesson with this higher lesson number. This means that the user can now have access to the next lesson. The application will disable access to any lessons higher than the lesson number stored in the database for that particular user to ensure that they are following the lessons in the correct order.

As for the guest user, the database does not need to keep track of the current lesson because this type of user will be allowed access to all lesson and quizzes at all times. The

database does not currently have a row for the guest user, so the quiz scores are not being saved after they complete a quiz. Allowing the quiz scores for the guest user to be saved is a modification that needs to be made in the future. However, after the guest user logs out, these quiz scores will need to be erased for when the next guest user logs in. When the software is later modified to allow a user to select whether or not they wish to follow the lessons in order, the users that choose to have access to all lessons and quizzes will also not need the database to keep track of their current lesson. The database will still save the user's quiz scores, however.

v. Test Cases

For each of the features included in this software, test cases were implemented to determine if these features worked properly. The following is a list of these test cases:

- Creating a new user name

Step	Action	Expected System Response	Pass/Fail
1	Open the application.	The system displays the login screen.	Pass
2	Enter a username that is already taken in the text field – “Heather” – and clicks “New User” button.	The system displays an error message informing the user that the username is taken.	Pass
3	Click “New User” button without entering a username.	The system displays an error message informing the user to enter a username.	Pass
4	Enter a new username into the text field – “Luke” – and click “New User” button.	The system opens up the menu page, with only lesson 1 and the quiz summary page available to click on. “Luke” is saved in the database	Pass

- Logging in as either an existing user or as a guest (separate test cases for each)

Step	Action	Expected System Response	Pass/Fail
1	Open the application.	The system displays the login screen.	Pass
2	Select username from the list of current users – “Heather”.	The system will open up the menu page with “Welcome Heather” displayed at the top. Only lessons and quizzes up to lesson 3 should be available to click on (current	Pass

		lesson saved in database is 3).	
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Step	Action	Expected System Response	Pass/Fail
1	Open the application.	The system displays the login screen.	Pass
2	Select "Guest" button from login screen.	The system will open up the menu page with "Welcome Guest" displayed at the top. All lessons and quizzes will be available for the user to select.	Pass

- Starting and completing a lesson

Step	Action	Expected System Response	Pass/Fail
1	From the menu page, select "Lesson 1: The Alphabet".	The system opens the first page of lesson 1.	Pass
2	Click "Next".	The system will open up a new page of the lesson as the user continues to click next.	Pass
3	Click "Back".	The system will open up the previous page of the lesson.	Pass
4	Reach the last page of the lesson.	If normal user, the system will update the database if necessary. If guest, nothing happens.	Pass
5	Click "Home".	The system returns back to the menu page.	Pass

- Taking and completing a quiz

Step	Action	Expected System Response	Pass/Fail
1	Select "Quiz 1: Lessons 1 & 2" from the menu page.	The system will open up the first page of quiz 1.	Pass
2	Select "Next".	The quiz will begin with the score displaying 0/20 at the top.	Pass
3	Select incorrect answer.	The system will inform the user they answered incorrectly, move on to the next question, and the score will still read 0/20.	Pass
4	Select correct answer.	The system will inform the user they answered correctly, move on to the next question, and increase their score to 1/20.	Pass
5	Reach the end of the quiz.	The system will display the user's total score and percentage.	Pass

		The database saves this score if it is higher than any previous attempts at this quiz.	
6	Select "Home".	The system returns to the menu page.	Pass

- Viewing the quiz summary page

Step	Action	Expected System Response	Pass/Fail
1	Select "Quiz Summary" from the menu page.	The system will open up the quiz summary page. The system will display the user's quiz scores for each of the quizzes.	Pass – for normal users *Fail – for guest user
2	Select "Home".	The system returns to the menu page.	Pass

* The quiz summary page will not show any quiz results for the guest user. This is due to the fact that there is no row in the database for the guest user, so their quiz scores are not being saved. The quiz summary page will display "null" for each of the quiz scores.

- Logging out/Exiting the software

Step	Action	Expected System Response	Pass/Fail
1	Select "File" from the menu bar at the top.	The system will display the contents of the JMenu.	Pass
2	Select "Log out".	The system will log the user out and return to the login screen.	Pass
3	Select "File" from the menu bar at the top.	The system will display the contents of the JMenu.	Pass
4	Select "Exit".	The system will close.	Pass

III. Possible Extensions

Virtual ASL is not yet a finished product, as there are still modifications that need to be added in the future. The first feature that is not yet implemented into this software is a fingerspelling practice page. Fingerspelling is an ASL term that simply means spelling out words letter by letter. Since learning how to fingerspell well and understanding others who are fingerspelling require a lot of practice, it would be nice if there was a separate page users could go to in order to practice more with fingerspelling. There will be a "video" that fingerspells a

word, and the user must type in the word that was spelled. To create the fingerspelling video, the word being spelled is broken down into individual letters, which are then displayed on the screen one at a time for one second intervals. The user can replay the video any number of times (in the first lesson), and then they type in their guess at the word being fingerspelled. Once answered correctly, the video will change to a new word. While the first lesson includes some practice with fingerspelling similar to the description just mentioned, it does not allow the user to control the difficulty. For this fingerspelling practice page that will be added at a later date, there will be different levels of difficulty that the user can control, such as the speed of the word being fingerspelled and the length of the words.

As with any unfinished product, more content needs to be added to the software. This means more lessons and quizzes, as well as more instructional videos. It would be great if this software could include material covered in higher levels of ASL and not just beginner level material. There are not any lessons that cover d/Deaf history or culture yet. This would be a helpful addition as the user is learning a language that is so important to the d/Deaf community.

Currently, the user interface is somewhat plain and not very attractive. Java Swing allows the “look and feel” of the GUI components to be altered. Spending more time on creating a more visually appealing user interface is another way in which this software can be extended. Finally, Virtual ASL is only able to run inside of Eclipse. Since I am using JMF to include videos, when the application is run outside of the IDE it will not display the videos. Further research is required in order to allow this software to be run on any computer.

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