Senior Design
ENG EC 463

Memo

To: Professor Pisano

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Team: EchoView.AI

Date: 4/4/24

Subject: Final Prototype Testing Report

1.0 Pre-Test Summary

This semester has been a productive semester with many advancements in many aspects of the EchoView.ai AR glasses. Last semester our testing was limited to our OLED Display and our Live Transcription on the mobile applications, both with very limited use.

This prototype round we have an improved design with multiple aspects working together with each other. Most notably, we have achieved the milestone of running our transcription model locally on the ESP32-C3 in conjunction with the OLED display and Bluetooth microphones.

This forms the foundation of our product and has allowed us to iterate quickly as we test and change certain features. Most recently we have managed to establish a handshake connection from the mobile application to the ESP32. Our current improvements utilize Bluetooth connection so that our hardware can communicate the live conversation data to the database on the mobile application.

Overall, we have been able to produce a speech-to-text transcription system designed to assist individuals who are deaf or hard of hearing. Featuring a wearable device equipped with a ESP32-C3, OLED display, and Bluetooth microphones for capturing and transcribing spoken language into text. The system focuses on affordability, functionality, and user friendliness. With ongoing efforts to minimize latency and improve accuracy.

2.0 Required Materials

- ESP32-C3
- Bluetooth Microphone
- OLED Display
- Echoview.ai_v0.1.1.py (test file)
- 5v Power Supply
- Keyboard
- Mouse
- Optical Combiner
- EchoView.ai Mobile App

3.0 Mobile Application

- The mobile application features a user-friendly interface that is simple to use and allows the user to easily navigate between different transcriptions as well as delete and name any past transcriptions.
- The app successfully uses Bluetooth to connect to the ESP32-C3.

App Design:

Fig. 1

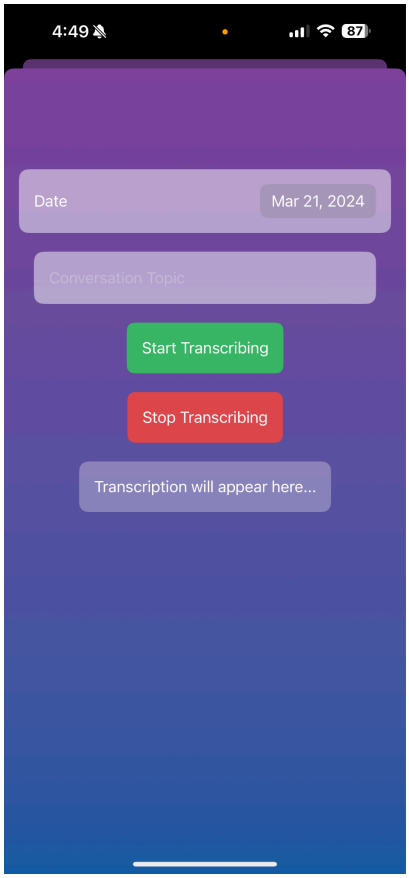

Fig. 2

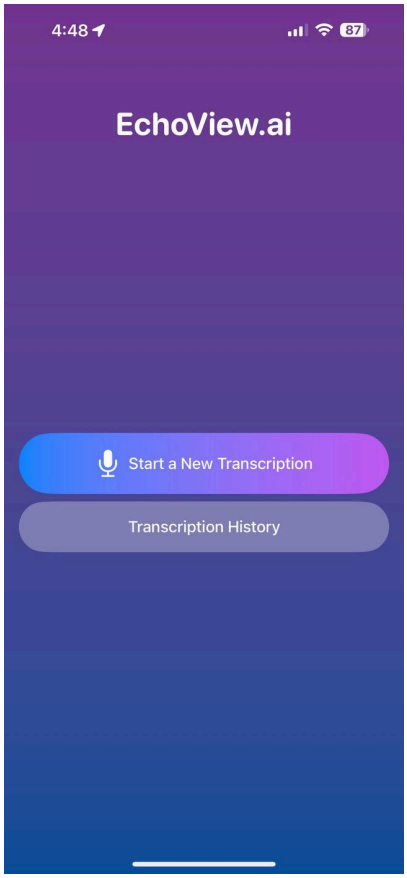

Fig. 3

Fig. 4

3.1 Testing Procedure

New Conversation Test (New Conversation)

1. Navigate to the EchoView.ai IOS application
2. Press **Start a New Transcription**
3. Select a Conversation topic
4. Modify date *if needed*
5. Press **Start Transcribing**
6. Speak into microphone
7. Press **Stop Transcribing**

Conversation History Test (Access/Delete)

1. Navigate to the EchoView.ai IOS Application
2. Press **Transcription History**
3. Select a conversation to view past transcriptions
4. Swipe left to **Delete** a conversation from history

4.0 Hardware

- The ESP32-C3 has met the criteria of affordability, offers sufficient power for handling our speech to text transcription tasks
- The OLED display provides clear readability through our optical combiner, it is lightweight making it suitable to integration of our CAD designed glasses
- The Bluetooth microphones capture highly sensitive audio input to capture clear audio in noisy environments, and can be configured for directional sensitivity

4.1 Testing Procedure (Transcription)

1. Connect the ESP32-C3 to 5v (2A) power
2. Run the XCode/Swift files to store and send transcription
3. Run the Ardino file for the OLED to display our real time transcription
4. Start conversation

4.2 Testing Procedure (Bluetooth)

1. Verify that the device can be paired with the application
2. Test the pairing process on mobile operating system (iOS)
3. Assess range of bluetooth connectivity

5.0 Measurable Criteria

The criteria for successful running and output is as follows:

- Transcription Accuracy - The system is able to accurately transcribe words correctly in various environments (quiet, noisy, outdoors, etc.)
- Latency - The time taken for the device to detect and transcribe speech from the microphones and display it on the OLED display is less than 4 seconds.
- Bluetooth - The range of Bluetooth connectivity between the ESP32-C3 and the EchoView.AI application works effectively within a range of 10 meters.
- Battery Life - The device should be able to stay functioning and powered on for 6 hours.
- Wearability - The user should be able to easily read the words displayed on the OLED display.

Objective	Category (ESP/app)	Pass/Fail
Transcription Accuracy	Both (ESP/App)	Pass
Latency	Both (ESP/App)	Pass
Bluetooth Connectivity Range	Both (ESP/App)	Pass
Battery Life	ESP	Pass
Wearability	ESP	Pass

6.0 Discussion of Test Results

6.1 Transcription Accuracy

Similarly to our first prototype testing, we tested the transcription accuracy of our device and found it to successfully and accurately transcribe speech-to-text in both a quiet and noisy environment.

6.2 Latency

Initially, we had an issue of a delay of 4 seconds from the time the microphone captured and displayed the audio input onto the OLED display, however during testing we were able to solve this problem. We are now using bluetooth microphones to directly and instantaneously send the audio input to both the mobile application and the OLED display.

6.3 Bluetooth Connectivity Range

We tested the bluetooth device connection to the ESP32-C3 and the mobile application from opposite ends of the lab room and found the device to remain working with seamless communication and succesful pairing achieved in seconds.

6.4 Battery Life

After purchasing a rechargeable battery pack of 5V and 5000 mAH, we are able to achieve 6 hours of battery life for the user, making this device practical for everyday use.

6.5 Wearability

We have 3D printed our modified enclosure for our system and have significantly improved the wearability. The glasses fit comfortably on the user and additionally the OLED display is easily readable and does not cause any eye strain for the user. Moving forward, a potential improvement we could make would be to miniaturize the optical combiner technology, making the glasses even smaller and more discreet, however this may not be possible considering our time constraint.

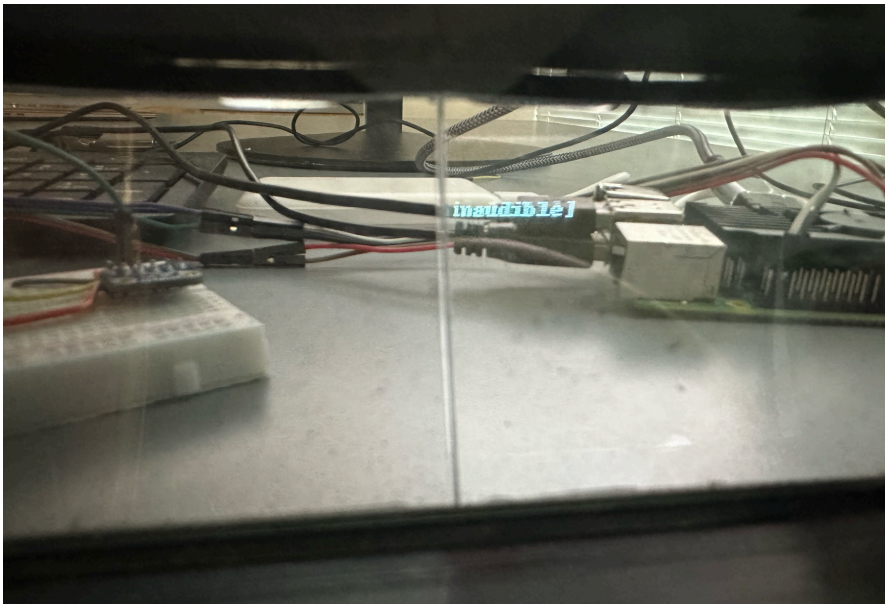

Fig. 2: User's view through glasses

Fig. 3: 3D Printed Enclosure

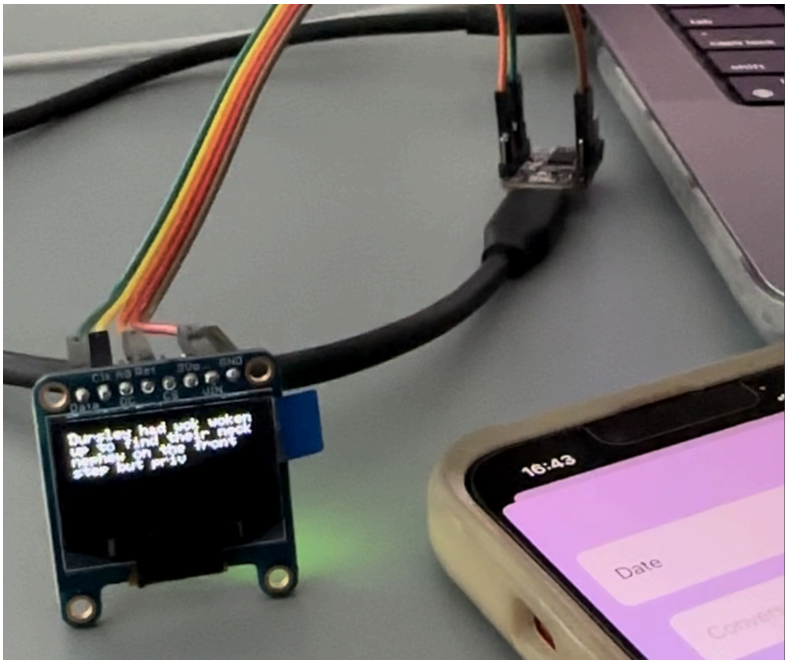

Fig. 4: OLED Real Time Transcription, Swift App, ESP32-C3 Connection

7.0 Conclusion

The final prototype testing of our assistive glasses for EchoView.AI has demonstrated substantial progress. We have made progress towards our goals in transcription accuracy, reducing latency, enhancing Bluetooth connectivity, extending battery life, and optimizing wearability. Moving forward, our focus will be to continue to refine our overall enclosure for optimal comfort, purchasing and installing additional bluetooth microphones for reduced latency, configuring directional microphones, dditional sensors for environmental awareness, and addressing potential improvements to our device. Furthermore, exploring machine learning techniques for continuous improvement of speech recognition accuracy and language support expansion are areas of interest. The feedback and results from this second prototype testing phase are crucial for our team to continue to develop a device that can make a meaningful difference in the lives of our users.

We extend our sincere gratitude to Professor Pisano for his guidance and support throughout this project. Additionally, we would like to thank our fellow team members, Hassan Hijazi, Nicholas Hardy, Riya Deokar, Marybel Boujaoude, and Jazmyn Walker, for their dedication and collaborative efforts. Special thanks to our mentors and end users for their valuable feedback and support, which have been instrumental in shaping the development of the EchoView.AI AR glasses.

As we move forward, we remain committed to our mission of developing a device that can make a meaningful difference in the lives of individuals who are deaf or hard of hearing. With continued innovation and collaboration, we are confident that the EchoView.AI AR glasses will provide a valuable assistive tool for enhancing communication accessibility and inclusivity.