ME – GY 7913

Robots for Disability

Term Project Report

12/21/2018

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Introduction

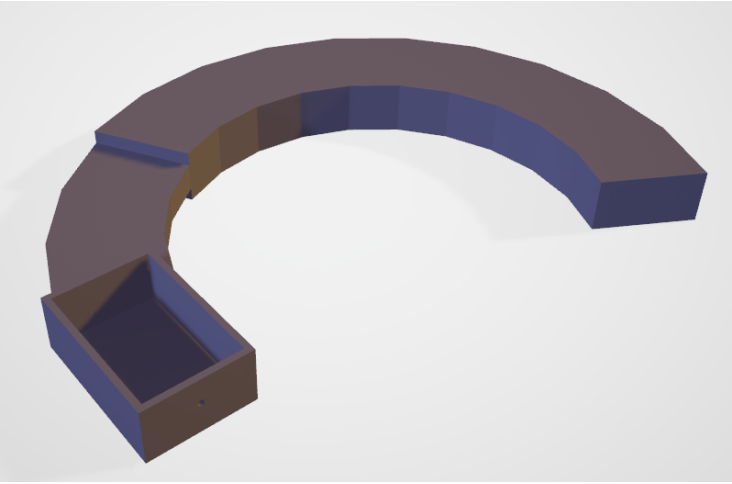
According to the World Health Organization (1977) stuttering is a disorder in the rhythm of speech in which the individual knows precisely what he or she wishes to say, but at the time is unable to say it because of an involuntary repetition, prolongation, or cessation of a sound. The estimated prevalence of stuttering is estimated at about 1% with a ratio of 3 to 1 for male to female. A higher prevalence has been found in children as compared to adults.

Delayed Auditory Feedback (DAF) and Frequency Altered Feedback (FAF) methods have been used on stuttering individuals and several devices are available that use these methods. However, they are expensive and out of the purchasing range of many people. The purpose of this project is to provide a low-cost alternative to those Auditory Altered Feedback (AAF) devices.

Materials

The following materials were used in the project:

- Android mobile device
- Bone conduction transducer
- PAM8302A amplifier
- Adafruit 3.7V/4.2V Li-Ion charger
- Li-ion 3.7V 7.4Wh battery
- 3D printed casing for electronics
- 3D printed headset for bone conduction transducer

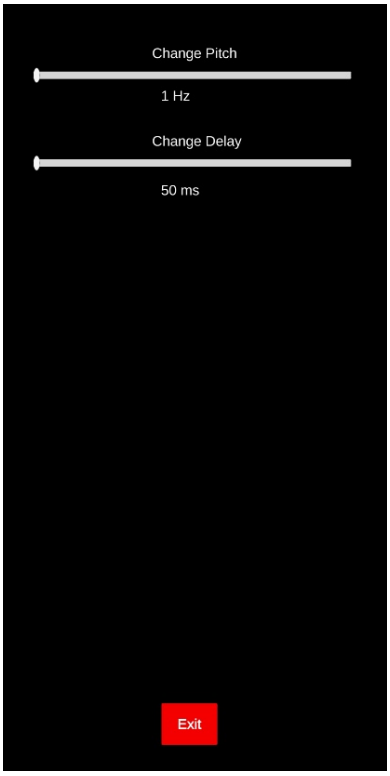


Design

During the preliminary testing, the bone conduction transducer was connected to the PAM8302A amplifier which, in turn, was directly connected to an android mobile device via the audio jack. Upon confirming that the hardware was suitable for prototyping an Altered Auditory Feedback (AAF) device, the work on development of the android application was started.

The Android application was developed using the Unity Engine and the "AudioSource" class was used to capture microphone audio for further processing. The "AudioEchoFilter" class was utilized to introduce delayed echo as a feedback to the user. The amount of delay can be controlled by the user using a slider.

The pitch of the audio feedback was manipulated using the "AudioSource.pitch" property of the class. The pitch of the feedback could also be controlled by the user using a slider. The figure below shows the Graphical User Interface (GUI) of the application.



Usage

The device is very easy to use. The user attaches the earpiece above the ear, connecting the bone conductor transducer to the mastoid process near the ear. Then the user holds the phone close to the mouth, so that the microphone of the mobile device can pick up the voice, and the user starts to speak. Based on the delay and the pitch settings, the speech will be altered by the application and fed back to the user's inner ear via bone conduction through the mastoid process after being amplified by the amplifier.

Once the application is adjusted to the user's desired settings, they should be able to feel immediate relief while speaking and the fluency should improve.

Results

Upon initial testing, the device caused confusion that resulted in speech disfluency. Upon proper adjustment of the delay and the pitch settings, the device immediately started to give positive results. Several observers were shown a video of an individual with stuttered speech without using a device and were asked to compare it with a video in which the individual was using the device. All observers provided positive feedback and reported that there was noticeable improvement in the speech quality and fluency.

Conclusion

The device provided promising results and improved the overall fluency of speech. The initial tests conducted showed a noticeable improvement in speech and the results were corroborated by

several observers. However, long-term testing still needs to be done in order to observe if the effects last over a prolonged usage of the device or does the user get used to the device, rendering its efficacy as questionable.

References

[1] J. V. Borsel, S. Sierens and M. M. d. B. Pereira, "Using delayed auditory feedback in the treatment of stuttering: evidence to consider," *Pró-Fono Revista de Atualização Científica,* vol. 19, no. 3, pp. 323-332, 2007.

[2] J. V. Borsel, G. Reunes and N. V. d. B. (, "Delayed auditory feedback in the treatment of stuttering: clients as consumers," *International Journal of Language & Communication Disorders,* vol. 38, no. 2, pp. 119-129, 2003.