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Fluency Assistance Device

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Fluency Assistive Device

Corey Bean, Michael Jenkins, and Larry Vega

Introduction

There are around seventy million people internationally who have a stutter, a form of a fluency disorder. There are some fluency assistance devices available to the public, but most are highly expensive or unreliable. The Fluency Assistive Device (FAD) team seeks to assist a niche community of these individuals who currently rely on a device known originally as the Edinburgh Masker (see figure 1 below). To best reach this community, FAD is partnering with Dave Germeyer, who has invaluable experience repairing these masker devices for his clientele.

To help with his efforts, FAD seeks to redesign the masker to increase its portability, function, and cost-effectiveness and is developing two versions of the redesign. Version 1.1 will update the original masker circuitry with surface mount devices. This will create a slimmer device, and pave the way for simpler optimizations in the future. Version 2.0 will use a Bluetooth-enabled microcontroller to achieve masker functionality in a digital, wireless form. In the current stage of production, FAD is finalizing Version 1.1 and beginning development on Version 2.0.

Figure 1: Original form factor of the Edinburgh Masker

Figure 2: Fluency Assistance Device team

Specifications

The team desires to produce a replacement product for the Edinburgh masker that is:

- **Affordable**. The client should not have to pay more than $50 for the product
- **Effective**. The client should receive a comparable or improved product compared to the original masker
- **Portable**. The device should fit in the user's pocket, or be able to discretely attach to the client
- **Robust**. The device should be able to withstand the occasional drop and normal wear and tear

Clients

Our team aims to serve those reliant on the Edinburgh Masker for fluency assistance, including and extending beyond Dave Germeyer's clientele.

Version 1.1 Progress

For the purely analog version of the masker, the team is about to purchase their first prototype boards using the PCB design shown below in figure 4. The design mimics the core functionality from the Edinburgh masker our design is based off (shown in figure 3).

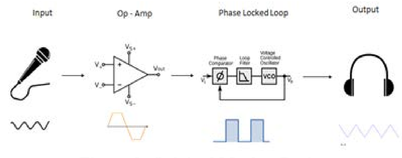

Figure 3: Original Masker Design

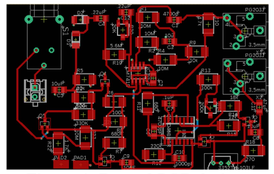

Figure 4: Routed PCB design

Moving an audio device to a smaller form factor raises some issues. If the board isn't carefully designed, there could be issues with sound fidelity, outside interference, and production problems. To combat this, the team has worked with Jared Momose to implement preventative measures such as a ground plane, more direct circuit paths, and the removal of acute angles between the wire lead and the conductive pads. Soon, our first prototype boards will arrive, and the team will be able to test their design for any of these issues.

Version 2.0 Progress

Version 2.0 of the masker is dependent on software embedded in a microcontroller. The team hopes that this new version will accommodate wireless headphones via Bluetooth for the masker, eliminating the need for most or all wires.

To achieve this, the team still has to:

- Experiment between the different potential Bluetooth profiles (HFP, A2DP)
- Create an efficient algorithm for turning the mic input into a masking output
- Design and prototype a PCB to power the device and provide user input
- Optimize power consumption via software

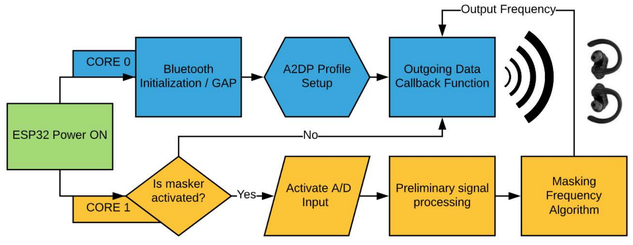

Figure 4: Software flow for Version 2.0

Human Vocal Tract Resonance Experiment

The FAD team seeks to find a more comfortable, concealable, and effective location for a sensor on the body. To accomplish this, the team plans to gather data using different sensors and resonance points on the human subjects of an IRB-approved experiment. Two points of interest are shown as points A and B in figure 5 below. Two types of sensors will be tested: a piezoelectric sensor and a dynamic/magnetic microphone (figure 5). These will be placed on points A and B, as well as on another point at mid-throat.

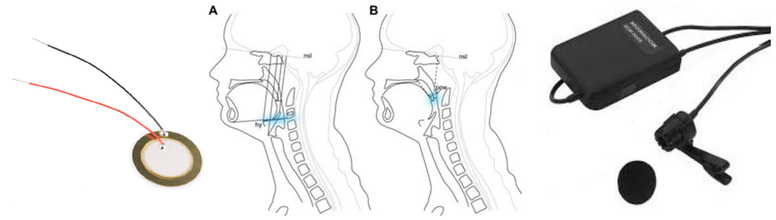

Figure 5: Piezoelectric, points of vocal resonance on the human head, dynamic mic

Key Points:

A: Near the Hyocervical distance (blue line on side A)

B: Velopharyngeal opening (blue region on side B)

Further Information

To visit Dave Germeyer's website on his project, go to:

https://www.mnsu.edu/comdis/kuster/edinburghmasker.html

Conclusions

The Fluency Assistive Device team is providing a modern upgrade to an outdated technology. FAD currently has updated the masker circuit with modern components and have planned an experiment to test different resonance points and sensor placement. FAD currently is researching surface mount components to reduce the physical size of the circuit. FAD also is researching Bluetooth technology to potentially provide a wireless alternative. Moving forward we will be sending out the Version 1.1 PCB that the Eagle software designed to be manufactured. The team will then test the new Masker Design, version 1.1. The team will also continue developing Version 2.0 using Bluetooth technology.

Acknowledgements

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