COVID Hearing Aid

ECE 445 Design Document

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1 Introduction

1.1 Problem and Solution Overview

Due to the COVID-19 pandemic, people around the world have been recommended or even required to wear masks to prevent themselves and others from becoming infected. There is consistent scientific evidence that this levels the curve of infection, and thus mask-wearing is now an important societal norm. However, this causes significant communication issues for people with hearing loss, as mask-wearing muffles sound and prevents lip reading. Existing solutions such as clear masks to allow lip reading or wearable amplification systems must be used by the talker, and would require every person to use one in order for the hard of hearing to be able to understand everyone. Furthermore, clear masks actually muffle a speaker's voice even more than cloth masks because they are made of plastic. And standing closer to the speaker is not a good solution because physical distancing is also necessary to curb the infection rate.

To solve this issue, we must focus on the perspective of the listener alone. Our solution is a hearing aid device that can amplify sounds that come from a good distance in front of the listener. This device should be able to receive input audio, amplify sounds that are understood as human voice, and filter out the background noise coming from other directions. The hearing aid will be lightweight so that it is easy for the user to wear and carry around. Furthermore, it should be easy to use, easy to produce, and relatively inexpensive compared to other hearing aids, especially since this is a time of financial hardship for many.

1.2 Background

1.3 High-Level Requirements

- A portable and rechargeable power delivery system should allow the device to function on the go for at least 6 hours while turned on.
- The microphones should be able to pick up on sounds that are at least 60 dB and from 20 to 20,000 Hz.

- The device should be able to amplify sounds to about 90 dB in order to accommodate those with profound hearing loss.

1.4 Visual Aid

2 Design

2.1 Block Diagram

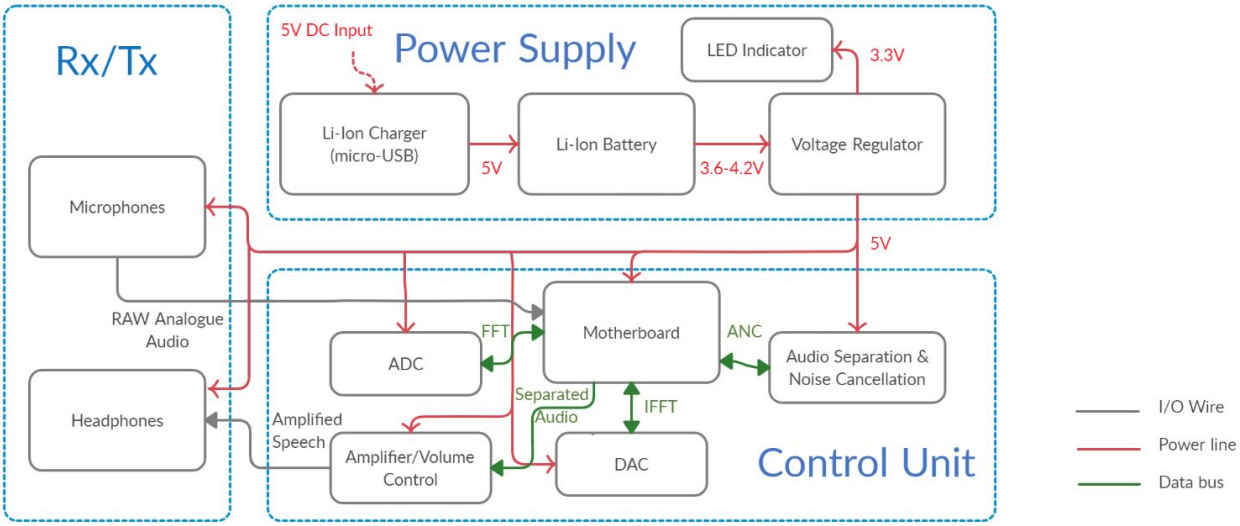
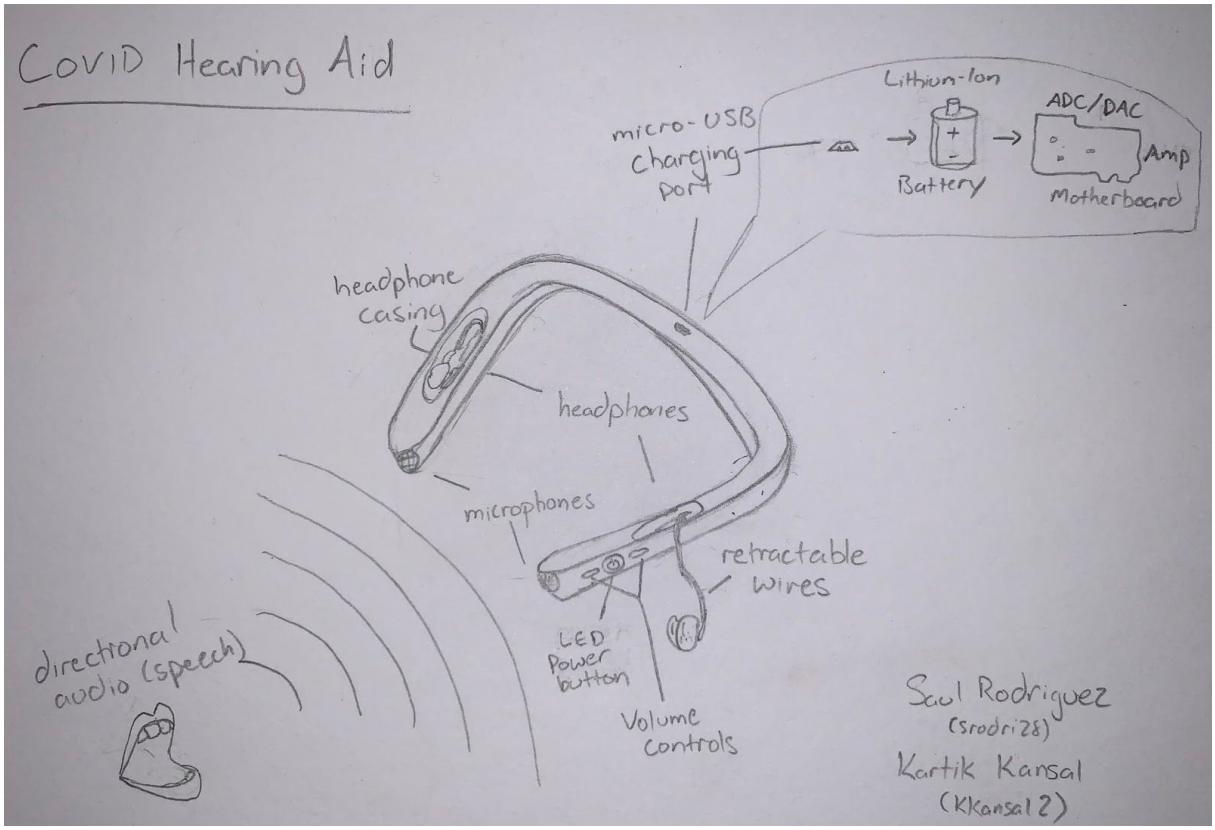


Figure #. Block Diagram

2.2 Physical Design



2.3 Subsystems

2.4 Requirements and Verification Tables

Requirements	Verification
Voltage Regulator 1. Provide 3.3V, with 5% regulation, from a 3.7V battery source. 2. Can operate current within 0-800mA. 3. Maintain thermal stability below 125°C.	1A. Measure the output voltage using a multimeter ensuring that the output voltage stays within 5% of 3.3V. 2A. Connect the output of the voltage regulator to ALICE Desktop analyzer 2B. Use a potentiometer resistor to analyze max current flowthrough ALICE. 3. Use an IR thermometer to ensure the IC stays below 125°C.
Microphone 1. Must be able to pick up sounds between 20 and 20,000 Hz	a. Use

2.5 Tolerance Analysis

3 Cost and Schedule

3.1 Labor

Name	**Hourly Rate**	**Hours**	**Total**	**Total × 2.5**
Kartik Kansal	$35	160	$5,600	$14,000
Saul Rodriguez	$35	160	$5,600	$14,000
Total				$28,000

Table #: Labor Costs

3.2 Parts

Part #	Description	Manufacturer	Vendor	Quantity	Cost/ Unit	Total Cost
1833	USB Micro-B Breakout Board	4UCON Technology Inc.	Adafruit	1	$1.50	$1.50
RK-0500500	USB Wall Charger	ZOpid	Amazon	1	$9.00	$9.00
2165	Linear Voltage Regulator	STMicroelectronics	Adafruit	1	$1.25	$1.25
1478	LED Switch		Adafruit	1	$1.95	$1.95
668-1184-ND	Condenser Microphone	PUI Audio, Inc.	Digi-Key	2	$2.44	$4.88

Table #: Component Costs

3.3 Schedule

4 Ethics and Safety

While building this project we will be sure to adhere to the IEEE Code of Ethics—in particular, “to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design…” [1].

One of the safety concerns is the use of the lithium ion battery, which could potentially overheat and cause damage to someone’s skin/hair. The other electrical components, like wires, pose a similar concern. In order to prevent this, we will ensure that all electrical components are properly encased in the plastic open necklace. If necessary, we could also add a thermal regulator to prevent overheating.

Another safety concern is the possibility of audio being over-amplified. Although this device is mainly meant for people who are hard of hearing, there is still the risk of audio becoming too loud and unpleasant. In order to prevent this, we are incorporating a volume control option for the user. Also, we should not amplify the sound to more than 90 dB, because although the most severe hearing loss before deafness is about 90 dB, sounds above 85 dB are considered harmful to human ears [2].

References

[1] “IEEE Code of Ethics”, Ieee.org, 2020 [Online]. Available: https://www.ieee.org/about/corporate/governance/p7-8.html. [Accessed: 20- Sep- 2020].

[2] Harmful Noise Levels. (n.d.). Retrieved September 21, 2020, from https://www.healthlinkbc.ca/health-topics/tf4173