Product Description Specification

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TEAM 5
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Executive Summary

The audio visualizer takes an audio input from the user and displays a visual representation of the processed audio signal on an LED panel. This device will be a must have gadget for tech enthusiasts to upgrade their listening space. By utilizing digital signal processing and fast fourier transforms, audio signals are displayed visually as beautiful LED arrays. Just plug the device into a standard DC USB block and turn on the power switch and the device is ready to operate.

Market Analysis

Our audio visualizer is tailored for musicians and music listeners seeking to enhance their listening experience with visual flair. In the current market, the main competitor is software-based solutions that offer real-time music visualization on screens. Our product distinguishes itself by providing a seamlessly integrated audio-visual experience. Considering the cost of components and the product's unique appeal, we expect the price to be around $40.

Requirements

Performance

1. Must continuously visualize the input sound until switched off

2. Must be displaying accurate information (i.e. high LED bar if the frequency is overwhelming)

3. Must be able to use a microphone to process audio of surrounding

4. Should be able to take in sound through an audio jack

    a. Should have a speaker

User Experience

1. Must be portable

2. Must be wall powered through adapter

3. Should be simple to use (plug and go)

4. May use batteries

    a. May be rechargeable

Safety

1. Must not overheat or be at risk of burning out LEDs

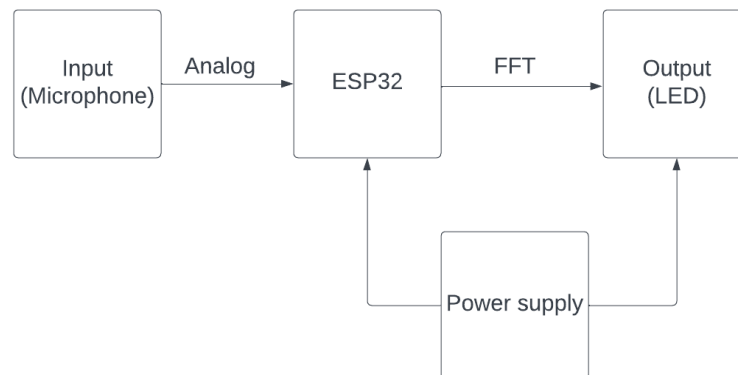2. May be able to withstand being dropped lightly (No shattering?)

Miscellaneous

1. Should be able to switch the audio rails for input/output instead of having two separate lines

System Architecture

Level: 0

```
Microphone  ───────▶   ESP32   ───────▶  LED
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Level: 1

```
┌──────────────┐  Analog  ┌─────────┐   FFT    ┌──────────┐
│    Input     │─────────▶│  ESP32  │─────────▶│  Output  │
│ (Microphone) │          │         │          │  (LED)   │
└──────────────┘          └─────────┘          └──────────┘
                               ▲                     ▲
                               │  ┌──────────────┐   │
                               └──│ Power supply │───┘
                                  │              │
                                  └──────────────┘
```

Design Specification

Power requirements

The project will require dedicated 5v 3A power that will need a dedicated AC wall adapter.

- A **2.1mm** barrel jack will be mounted directly to the board

- A standard USB to 2.1mm cable will attach to a samsung USB block

- The 5v in will attach to the board via a trace (larger duty)

Sensors

- First input will be switchable between a 3.5mm TRS line level input

  - This will run directly to Ain and Din on the ESP32

  - The input TRS 3.5mm jack will be wired directly to a second TRS that routes audio to an external powered speaker.

- INMP441 microphone module

- Inputs will be switchable with only one operating at a time

Actuators

- The output of the device will be an 8x32 LED matrix.

- The display will be a two dimensional spectrogram.

  - X-axis is the different frequencies.

  - Y-axis is amplitude in volts.

- This will be done by individually addressing each light using each frequency as a logic parameter and the voltage reading to determine how many lights from that column illuminate.

- This will be on a purchased breakout board with pwr, gnd and address/clk line being connected to PCB via a 4 pin ribbon cable.

Processing

- All processing will be done on a ESP32 microcontroller.

- Arduino IDE will be used as the programming environment.

- The controller will take in digital audio signals and process them into the frequency domain as a Fourier Transform.

- Different frequencies will be made into control loops for the program output.

- ESP32 will be mounted to the pcb via headers and sockets so the microcontroller can be removed for programming.