Mock Design Review

Danger Detecting Headphones

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1. Block Diagram

![Block Diagram](image)

2. One Circuit Schematic

**Op Amp Circuit**

Since the signal from microphone is really small, it’s required to use an op amp. The op amp that we use needs to have high gain bandwidth, rail to rail, low DC voltage offset and drift. Therefore, we decided to use AD8067. Figure 1 shows the connection diagram. Figure 2 shows the simplified input schematic.
3. One Calculation

The following figure (Figure 3) shows the configuration of a non-inverting amplifier.

We know that voltage gain is equal to $\frac{V_{out}}{V_{in}}$.

In the case above, the current that goes through $R_g$ is equal to $\frac{V_i}{R_g}$.

Therefore, $V_{out} = V_i + \frac{V_i}{R_g} \times R_f = V_i \times (1 + \frac{R_f}{R_g})$. 
4. One Plot

Small Signal Frequency Response

Figure 4 shows the small signal frequency response of AD8027

![Figure 4. The Small Signal Frequency Response](image)

5. One Block Description

Control Module

- Microcontroller (Arduino)

Arduino has an analog-to-digital converter inside. Its bit-resolution is 10 so it reads the analog voltage value from the input and converts the value from 0 to 1023. In terms of C code, the function called, analogRead() returns a number between 0 and 1023 based on the input voltage being applied to the pin. Moreover, Arduino has its own library for filters. It mimics analog types of filters which are either RC or RLC type. The filters implemented by Arduino is IIR filters which operate in real time. By subtracting the lowest cutoff frequency of car horn from its highest cutoff frequency, we can compute the frequency range of the bandpass filter. This bandpass filter will attenuate the signals that are not in the frequency range of vehicle horn.

By using Matlab we are going to model the frequency spectrum of vehicle horn which will be used to compare with the filtered input signal. If our frequency spectrum matches the filtered input signal, Arduino will send the signal to the analog switch in the processing module to turn off the music.
6. R&V for power module

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
<th>Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB Port</td>
<td>Charges the power supply when it is connected to the USB charger.</td>
<td>1.Connect the USB Port with USB charger and measure the voltage and ampere with the multimeter. Check if the voltage at the hub port is around 5.00V, and the current is 500mA. Use 10Ω to drain the current of 500mA out of 5 volts. Break the circuit if DC voltage goes above the 4 V.</td>
</tr>
<tr>
<td></td>
<td>Protect the circuit board if the voltage goes up to the 4v</td>
<td></td>
</tr>
<tr>
<td>Lead Battery</td>
<td>Provides enough power supply to the entire circuit. Our estimated power consumption is Must be rechargable through the USB Port</td>
<td>1. Check if the voltage of the battery without any load is around 3.7v 2. Check with a multimeter if the fully charged Lead Battery supplies 3.7v</td>
</tr>
</tbody>
</table>
7. Safety Statement

1. Since we are using an op amp microphone, we need to be cautious when we modify its gain. Therefore, we need to make sure that everything is wired correctly before we attach the power supply or any signals to it so we do not burn anything.

2. In the worst case, there is possibility that the user of our headphones can be electrocuted. However, if the earpads perfectly insulates so they prevent the user from contacting wiring inside.

3. In terms of minor safety concerns, the headphones can damage user's audibility if the volume regulation does not work perfectly.

4. Our team is exposed to the possibility of being electrocuted and burn while we are testing our circuit or soldering.

8. Citations


