ECE 445 Proposal

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1. Introduction

1.1 Objective:

The Importance of lighting often goes unnoticed. Light, like sound, has a heavy influence on the vibe of a room and can affect the mood of the people in it. People often take notice of this and attempt to control the vibe of their living space by adding various types of lighting fixtures. However, the mood of a room changes constantly, unlike a fixed light source. Constantly adjusting the lighting to adapt to the sudden changes of the environment is too cumbersome and unreasonable for any sane person.

To deal with this issue, we are attempting to create an LED based lamp that can sense various aspects of the changing environment, and adjust itself accordingly. Specifically based on the noise level which changes based on the number of people in the room and based on what they are doing in the same space. The lamp will also be able to change color based on the frequency of loud noise, causing the lamp to "dance" along with whatever music is playing. This lamp would also adjust itself as easily in silence as it would itself dim the LED when the noise level is under a particular threshold, hence the lamp would work like a light sensor in this case and dim the lights incase the noise threshold is very low.

1.2 Background:

Being college students we entertain a lot of guests at home and it's mostly the lights and the music that sets the tone of night. Rather than only music we want our lamp to generally detect the mood in the room with the general noise level. Therefore at times when someone forgets to shut the lamp it will itself dim or luminate based on the noise level in the room currently. It concept of the lamp is to basically adapt to its surroundings based on the number of people and current mood of the room. With the mood we mean the color changing

ability based on different environments and situations, here we do not mean to apply a particular algorithm but rather configure the lamp to illuminate/dim/change the color based on the inputs that we detect from the microphone and send to the microcontroller. So the ‘mood’ essentially is deciphered by how we configure the microcontroller for the different types of inputs and that would be done by setting up thresholds for a particular range of frequency which would be different of different types of things, like for example, frequency of conversation vs frequency of music.

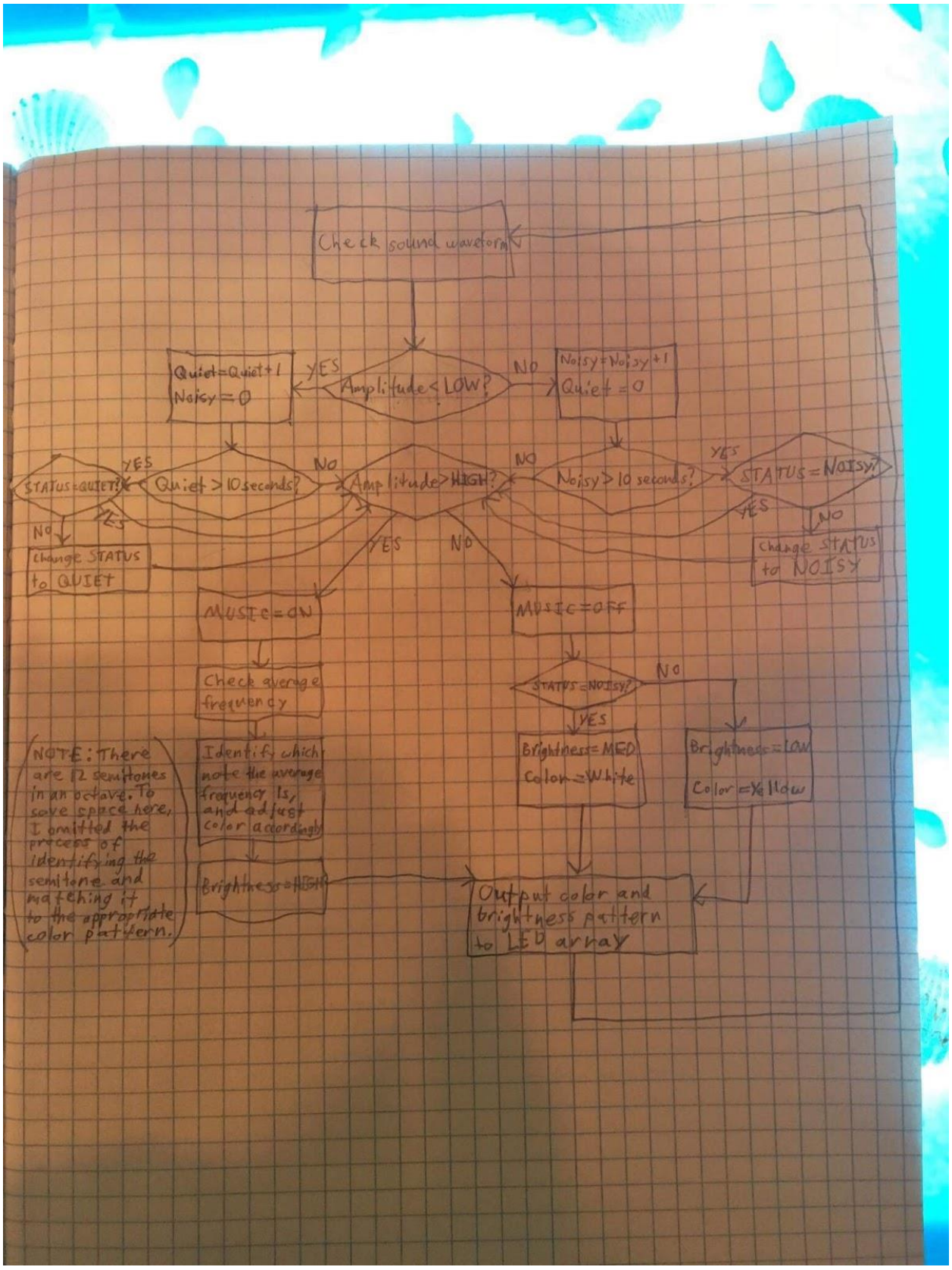
We were specifically enamored by this project because this is something that we see ourselves using and bragging to our friends and family about. We want this to be that ‘one cool thing’ that we did in college. We understand that there are already products that change light based on some input but no product really that detects noise and changes light based on that input . For that reason we realize that this is more of a luxury project rather than a useful one but it helps us implement everything that we have learnt in college into use and put use of two of the most overlooked but important phenomenon of noise and light into good use.

1.3 High-Level requirement

- Lamp responds to changes in the amount of sound in the room
- Lamp reacts differently to loud music than to regular conversation
- Lamp reduces brightness during a prolonged quiet situation

2. Design

The lamp could be divided into four sections: sound detection, microcontroller, LED array, and power supply. The sound detection includes a microphone component to capture noise of environment, and inputs the signal to a BPF circuit to get the required information. Microcontroller receives data and conduct mathematical analysis to manipulate LEDs. LED array is the output of the whole system to provide luminance. Power supply is basically a AC-DC circuit generating steady 5V and 12V voltage to support microcontroller and LED.



2.1 sound detection

The main feature of the lamp is its ability to respond to sound. This is accomplished using a microphone that detects the sound in the room, and then a filtering circuit to get rid of unnecessary data.

2.1.1 microphone

We will use a microphone to convert sound into a voltage waveform which we can then parse with Fourier analysis techniques.

2.2.2 filter circuit

This is a band pass filter circuit that blocks out frequencies that are not useful to detect.

2.2 power supply

Power supply is required to provide 12V and 5V to support microprocessor and LED light tap. It's main function is converting 110V AC from socket to steady 5V or 12V DC.

2.2.1 AC-DC converter

It can not only convert AC to DC but bear maximum power of the whole device to avoid heat up and explosion. In concern of safety we may apply a ready component in our device.

2.2.2 voltage regulator

Since we want the lamp to be powered through a wall outlet, we will need a 120V/12V voltage regulator. However, we will be buying one off the shelf instead of designing our own in the interest of safety. Within the circuit, we will be able to make our own process for converting 12V to 5V or something similar.

2.3 control unit

The control unit consists of the microprocessor on which all logical operations will be performed and a voltage regulator circuit that delivers the correct voltage to the correct devices.

2.3.1 microcontroller

Since our whole system is comprised of sensor inputs, logic, and LED outputs, we merely need a microcontroller with all of the appropriate connections and normal processing speed.

2.3.2 voltage control unit

To deal with DC devices that require voltages other than 12V for power, we will design a voltage control circuit to properly step down from 12V to whatever voltage is needed.
Since the RGB led lamp require three voltage input to control three color separately, the voltage control unit change the voltage continuously to present all color of light.

2.4 LED array

The output section of this device is the LED system. It consists of an LED array and a decoder circuit that processes the information from the microcontroller and converts it to LED output values.

2.4.1 led light

The main advantage of led light is low power consumption for safety and energy saving purpose. It's also easy to control by simple circuit. We consider to apply led light tap in our device for it can provide sufficient luminance and it's waterproof.

2.4.2 decoder circuit

To control led array we need a decoder circuit as a bridge from microprocessor to all led light if there are not sufficient amount of output of microprocessor.

2.5 risk analysis

How we defined "the mood" is the most important part in our project, and it is also the essential core to make our project to just a lamp changing color with sound. In most case the room is filled with a variety of sounds, and separating them into music and chatting is not a easy work to do. The barrier on our way to success include the way how we relate "sound in room" to "mood in room" , and how we get clear signal from environment and analysis it.

To conduct signal processing we need a microprocessor with high speed computing ability. Yet powerful chip does not guarantee it is easy to used. How to strike a balance between performance and convenient is a problem.

3. Safety and Ethics

The main safety concern of our device is about the power supply. With improper design the whole device will heat up to burn due to short circuit or other reasons. To avoid any accidence, we may buy a supply rather than design by ourselves.

The other potential safety problem is about our eyes. Human's eyes are vulnerable so the light luminance should be controlled in a proper range. Some color of light with certain frequency may bring damage to eyes. According to these reasons, the output of the lamp are required to provide sufficient luminance but be gentle at the same time.
There are not any ethical concerns related to our project because it is a lamp. As long as we buy a premade AC/DC converter to deal with wall outlet power, there are also no safety concerns. Although we will have to be courteous to our peers and the lab guidelines and maintain a strict rule of not getting food or drinks to the lab and making sure our workbench is clean before we leave.