**CyborgSax Test Report**

Equipment and Setup

The main hardware equipment that was utilized during the prototype testing session consisted of a Teensy 3.6 microprocessor with an attached audio shield, a computer to control and power the Teensy, and an 8 x 8 LED matrix. Several electrical cables were used to transfer power between the Teensy and the matrix, and an 1/8th inch aux cable was used to send the audio shield output to an external speaker.

The audio shield was attached below the Teensy microprocessor so that all the pins from the audio shield would align with the corresponding pins from the Teensy 3.6. The cables used to connect the LED matrix to the microprocessor were +5V, digital input and ground connections. These were attached to the Teensy’s +3.3V pin, GND pin, and pin 26 (assigned as the digital input in the code), respectively. The 5V and ground connections served to power the LED matrix while the digital input was used to control the matrix pattern and light intensity of the LEDs.

For the software setup a computer was used to run the Arduino Software in order to control the microprocessor, which was used to control the LED lighting patterns. A micro-USB cable was used to establish a connection between the laptop and the microprocessor. Before testing loading the program to the Teensy, including all the relative libraries is necessary. For the brightness of the LED matrix, a dimmer version of the LED initiation was chosen. When running the actual test, the Teensy microprocessor was able to receive the signal from the computer and load the correspondent program with the power source. Also, the Teensy served as a WAV player and played the particular selected song based on the program.

Measurements Taken

For the hardware measurements, it was determined the computer could communicate with the Teensy as the computer was able to identify the Teensy when plugged in, and we were able to choose different songs to play from the SD card storage. Utilizing our code, FFT values were recorded based on a song stored on an SD card inserted into the micro-SD slot of the Teensy. The power cables, Teensy and audio shield were determined to have been soldered properly, as the LED matrix lit up based upon the corresponding FFT values in the software. The code mapped out 8 columns, and assigned FFT bins (unique frequency bandwidths) to each column - should the FFT value be high for a certain frequency bandwidth, the corresponding column will light up a number of LEDs - the number of LEDs lit to FFT values is based on an algorithm that we created. This was consistent with our expectations of the code that we utilized to program the LED patterns. The audio shield was working because there was high fidelity sound being sent and amplified by the external active speaker.

In terms of software, the program ran successfully because the code worked as the LED lights lit up to form a spectrum-equalizer pattern based off of the FFT function that was used. The LEDs had different colors to look like that of a volume meter. The bottom 4 LEDs were assigned green, next 3 LEDs above were yellow, and the top LED is assigned red - the higher the FFT value for a column, the more LEDs are lit in that column starting from the bottom (green) and maxing out at the top (red). Different FFT values were displayed on the computer and were refreshed every 0.2 seconds, as did the LED matrix pattern.

Improvements in the future

Even though the prototype presentation was a success, there is still more to be done to meet the client’s requirements. These steps include getting a microphone and integrate it into the system so that the LED matrix and FFT can work in real time to create visual effects (opposed using recorded playback music as we did for the presentation). The next step is to incorporate a second LED matrix to create a 16-channel FFT real time visual EQ. There will also be audio effects on the microphone input that will be implemented such as octave, reverb, distortion and phaser effects. Finally, there are improvements/optimizations that could be made to the visual patterns on the LED.

Conclusion

The prototype presentation went according to the test plan that was written prior to the presentation. Even though everything is going according to plan so far, there will still be challenges in the next several months when it comes to making improvements to our project.