Background

Music has been an important part of human existence since we have been civilized. With the rise of technology, music visualization systems are being invented to supplement the music listening experience. These music visualization systems are either preprogrammed to match the music, controlled by a human in real time, or analytically simple. Today, there lies a void in the music enthusiast market for an automatic, real time, intelligent music visualization system.

Objective

The Aurora Project is designed to be a real time, intelligent home entertainment music visualization system that reflects the character of the music played and enhances the music listening experience.

Performance Metrics

- **Real Time**: System is causal, plug and play, and operates in real time.
- **Intelligent**: System automatically decides the ‘best’ way to control the lights.
- **Reflects the character of the music played**: 75% survey agreement with this statement.
- **Enhances the music listening experience**: 75% survey agreement with this statement.

Design

**Hardware**

- **Power Control**: provide stable -3.3V, +3.3V, and 5V from a 5V supply.
- **Analog Front End**: buffer, DC-shift, amplification, voltage limiting, and filtering.
- **MCU**: Teensy 3.6 MCU – 180MHz
- **Light Display HW**: Alitove 5m, 300 WS2812b LED light strand.

**Software**

- **Front End DSP**: Constantly sample, taking 1024 sample FFTs and storing their magnitude in a circular buffer.
- **Measurement**: Measure mean weighted frequency, mean magnitude, frequency density, articulation density, frame-wise volatility, intensity, and more.
- **Light Control**: Use measurements to choose the light control state. Each light control state uniquely uses measurements to control the lights, reflecting the music according to that state’s characteristics.

Implementation

**Light Control Algorithm**: Each state has a unique light control pattern.

**Light Control States**: Intensity measurement drives light control transitions.

**Hardware**: PCB and 3D printed enclosure create a reliable, simple system.

Results

The Aurora Project Survey targeted individuals who are music enthusiasts to test our system. The results of the survey, shown below very that the Aurora Project does enhance the music listening experience and that the Aurora Project lights reflect the character of the music played well. The system is real time and is intelligent, deciding how to best controls the lights with real time music measurements.

Organization

Joseph Hackenbracht: Team Lead, Software Developer
Matthew Acosta: Hardware Design
Juliana Rolandelli: Project Manager

Ethics Statement

We are committed to making our product safe for all users by warning about potential seizure and diffusing light to prevent eye damage. We used only original design and open source code for our system.