

# 6.111 Final Project Abstract

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In our project, we will design and construct a system which will analyze incoming audio and procedurally generate a custom laser light show to accompany the music.

For the visuals, we will acquire a laser galvanometer set, which uses two precision-control motors attached to mirrors in order to project a dot from a laser pointer onto a wall. This setup enables us to move the laser dots position at a rate much faster than what the human eye can see, and so we can create complex visuals from only a single laser pointer.

For the music analysis, we will use a variety of Fourier-based methods popular in the MIR (Music Information Retrieval) field, and implement them on the Nexys 4. Most of these methods are based on the Short Time Fourier Transform. Some examples of features that we can extract from the music are note and beat onsets, as well as pitch detection for notes.

There are various ways we could use the features extracted from the audio in order to control the graphics generated for the laser. One of the most common graphics to draw with laser galvanometers is Lissajous curves, which are parametric curves defined by sinusoids in each of the x and y axes. To start, we can control the number of lobes in each of the axes, the rotation of the figure, and the amplitude of the figure. If time permits, we would like to explore more complex graphics as well.

We ideally would like our system to generate graphics in real-time, as music streams in over USB or UART. However, if this is not feasible due to the signal processing and graphics generation required, we would be okay with processing an entire song at once and displaying the laser light show after the processing is complete.

