

Informal Proposal

Caleb Markley

Name TBD (Xylophone-Playing Robot)

EEL5666: IMDL

Instructors: Dr. A. Antonia Arroyo, Dr. Eric M. Schwartz

TAs: Andy Gray, Josh Weaver, Nick Cox

Table of Contents

1. Abstract	2
2. Introduction	2
3. Integrated System.....	2
4. Platform.....	3
5. Actuation.....	3
6. Sensors.....	3
7. Behaviors.....	4
8. Experimental Layout and Results.....	4
9. Conclusion.....	4

1. Abstract

I am building a xylophone-playing robot that comes up with its own melodies. The melody will use the chords played on the connected keyboard, the color it senses, and the proximity of onlookers to the robot to change the way it plays. The system will consist of a xylophone, 12 small solenoids that will be used to play the xylophone, a Sharp IR sensor to detect the proximity of onlookers, an Arduino Due to drive the solenoids and read the IR sensor, a laptop with a wired connection to the Arduino, a webcam built in to the laptop for color detection, and a MIDI keyboard connected to the laptop through USB.

2. Introduction

Great melodies, regardless of the period in which they are written, can stand the test of time and be meaningful years after their inception. They inspire new arrangements to fit these classic melodies with current trends. However, enduring melodies are hard to write. It takes practice, talent, and often influence from other great melody-writers to produce good melodies. People also peak creatively, gradually ceasing to produce material that is as inspired as what they once wrote.

The goal of my robot is to have an autonomous system for creating and playing melodies inspired by great songwriters and influenced in real-time by the robot's surroundings. It has a useful function of creating new melodies, has sensors to react to its environment, has a special sensor to get more information from its environment, and a special algorithm. This paper discusses the integrated systems, platform, actuation, sensors, behaviors, experimental analysis and results, and conclusions in regard to the robot.

3. Integrated System

The system will consist of a MIDI keyboard, laptop with webcam, Arduino Due board, sensors and actuators, and a xylophone. Figure 1 shows an overview of the system. The keyboard will be connected to the laptop via USB and will be used to give a starting point for the melody generation algorithm. The webcam used for color detection is part of

the laptop. The Arduino Due is also connected to the laptop via USB. The IR sensor and solenoids are connected to the Arduino and the solenoids play the xylophone.

The software provides the functionality, the IR sensor and webcam observe the surroundings, and the special algorithm will also be implemented on the laptop.

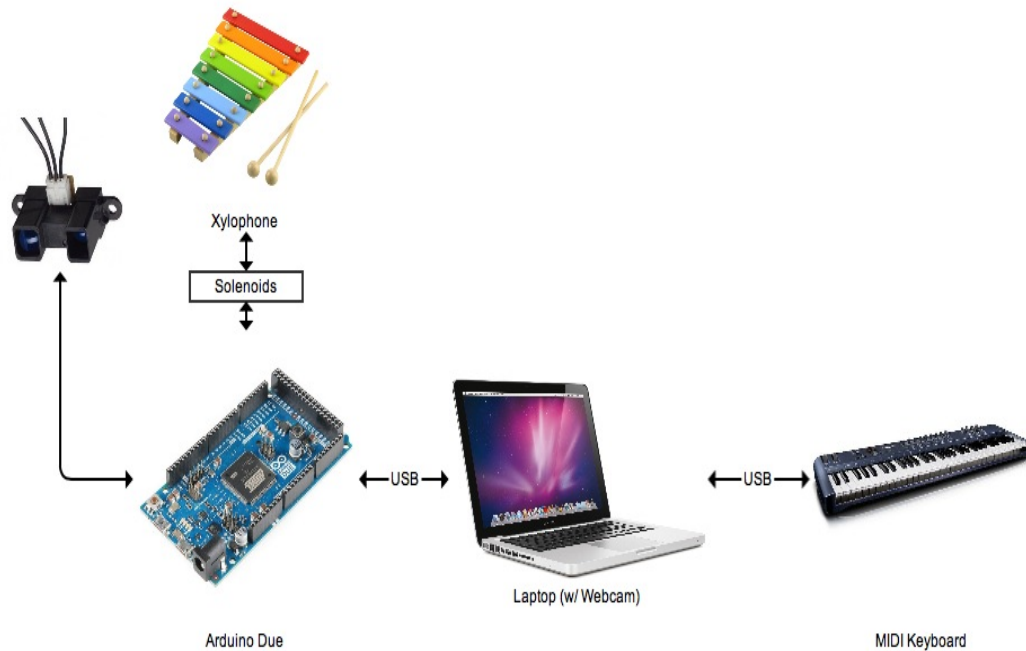


Figure 1, the system overview of the robot.

4. Platform

The robot platform will simply be a plane with the solenoids and IR sensor attached. It will have to be mounted over the xylophone and within reach of the Arduino and laptop. All connections will be physical.

5. Actuation

The actuation in this design is the solenoids striking the xylophone keys. Each of the 12 solenoids is powered with 5V. The Arduino Due runs on 3.3V, but is able to send 5V out if powered by USB. This 5V can be used with MOSFETs to power the solenoids. Each solenoid will be positioned to hit one key when powered.

6. Sensors

The sensors used for this robot are a Sharp long-range IR sensor and a webcam built into the laptop. The IR sensor will be used to detect how close spectators are to the robot.

The closer spectators get, the “faster” the robot will play. The webcam will be used for average color detection. The average color of the robot’s environment will influence the kind of artist the melody generation algorithm favors.

7. Behaviors

My initial plan for generating the melodies is to use Markov chains. Markov chains take an input state and compare it to its chain that gives a set of potential next states in the chain, each with a different probability based on the learning set. The learning set will be developed from the works of great melody-writers. This system would form the basis for the melody generation. The keyboard input will tell the robot what key to play in and the time signature. The proximity sensor will cause the robot to play more or less notes in a measure (play “faster” or “slower”), while color detection may influence something like which artists to place an emphasis on (Blue for McCartney-esque, green for Brian Wilson, etc.).

8. Experimental Layout and Results

The only experiments I have done so far are testing the IR sensor and a solenoid. I was able to interface both with the Arduino successfully. The solenoid is able to actuate quickly and should be able to get the xylophone to produce enough sound.

9. Conclusion

So far I have ordered all my parts, done most of the requisite research, and have started preliminary testing. I plan to get the hardware and platform work done as soon as possible, preferably by the second week of February, so that I can dedicate most of my time to the challenging software work.