Project Title: Play it by Ear
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EECS 149 Project Charter, Fall 2016

Project Goal:

  In this project we will create a robot that plays the guitar. Initially, the robot will simply play notes corresponding to a notesheet (or tab, in guitar lingo) fed to it, but will eventually be able to listen to a human play simple songs and mimic them. If time permits, we will attempt to get the robot to recognize and play chords.

Project Approach:

  Our project is broken up into three parts: processing real time guitar notes picked up from a microphone on our microcontroller, modeling guitar as a state machine, and figuring out how to play a song on a guitar by using electronic and mechanical components. Currently, we are thinking about using a solenoid array on the frets of the guitar to cover the set of all possible notes and we will use a solenoid with a pick attached to pluck each string.

Resources:

  The bulk of the hardware requirements for this project is comprised of solenoids. Each string on the guitar will have a number of solenoids associated with it that can press at a specific fret. Luckily, many notes can be played redundantly on a guitar, since each string can be fretted such that it will produce the same tone as the next highest open string. This means not every fret on every string needs to be actuated, which serves to reduce the number of solenoids required.

  These solenoids will need to be housed in a structure that holds them in the correct orientation relative to the guitar. Our intention is to laser cut simple acrylic paneling with spaces for the solenoids which can be shaped around the neck of the guitar. This can be done on the laser cutters at Jacobs Hall.

  Our plan for the microcontroller is to use either a BeagleBone Black or Raspberry Pi 3. The main advantage of the BeagleBone over the Pi is the number of GPIO pins. The BeagleBone has more than twice as many pins as the Pi, which eliminates the need to multiplex outputs. However, the Pi has a more powerful processor, which may be necessary for the filtering and signal processing.

Schedule:

- 10/20/16: Turn in Project Charter
- 10/24/16: Finalize choice of computation platform and required hardware
- 10/28/16: Finish CAD model of solenoid array
- 11/4/16: Deadline to manufacture solenoid structure
- 11/7/16: Set up Pi/BeagleBone with necessary software libraries (primarily scipy and numpy)
- 11/11/16: Complete wiring of solenoid array into microcontroller
- 11/25/16: Software should be at the point that any arbitrary note can be played
- 12/2/16: Be able to recognize notes through microphone
- 12/9/16: System test, with note recognition and copying working
- 12/15/16: All debugging completed for presentation
- 12/16/16: Report finished

Risk and Feasibility:

One possible risk is the guitar string breaking from excess force from the solenoid. We will need to place the solenoids an appropriate distance from the string to prevent this. Otherwise, we believe that this project is possible given the 6 weeks we have remaining in the semester. We may not get to add more complicated functions to the guitar robot - such as chord recognition and playing - but we are fairly certain that we will be able to overcome the obstacles to single note playing.