Project Specification

PEDAL BOARD AUTOMATOR

Project Charter

Project Overview

- Guitar pedals are vital for guitarists for producing various tones and sounds. However, tuning them by adjusting the knobs can be a difficult task while performing. Even between songs, this can be a difficult task that is time consuming.
- Our idea is to have a device that attaches to the pedalboard and can make adjustments. Guitarists can control the device with an app, creating presets beforehand or minor adjustments when live. By automating most of the tuning process, we're hoping to minimize the time and effort it takes to get the perfect sound.

Project Approach

- Design a pedal block using Solidworks, based on currently available pedals and 3D print it.
- Attach rods or mechanical support to the block and attach servos to turn the knobs.
- Control the motors using a Raspberry Pi.
- Create an application on phone or computer which controls the Raspberry Pi using Bluetooth /WiFi.
- In short: application on user's device -> Raspberry Pi -> block of servos on pedalboard
- List the team members and their roles.
    - Peter Tueller - Mentor/Guide
    - Hitesh Sonawala - Solidworks Design and Raspberry Pi programming
    - Ronnie Lusk - Application Development
    - Sneh Shah - Application Development, Raspberry Pi programming
    - Sivasankar Palaniappan - Application Development and Pedal interface

Project Objectives, Milestones and Major Deliverables

- Objectives:
  Design an automated pedalboard controlled via a phone or computer app. The app needs to allow different presets, and the mechanical interface should be modular.
- Milestones:
    1. Design of pedal block

2. 3D printing
3. Design of servo motor with shaft (interfacing with pedal)
4. Raspberry Pi to control the servo motors
5. Fixing knobs to motors (along with power jack, input and output)
6. Creation of application
7. Testing

The goal for this quarter would be to build a working model for a given pedal board. However, this project can be extended so that it can work for any pedal board.

- Deliverables:
    1. 3D printed pedal block
    2. Raspberry Pi interface
    3. Pedal setup with Raspberry Pi and servo motors
    4. Application
    5. Report

Constraints, Risk and Feasibility:

- Mechanical design might take some time as designing on Solidworks is time consuming. This also involves 3D printing, ordering parts and fixing them which may take more time than expected.
- Hardware will always cause a problem as it will cause issues sporadically.
- The individual aspects of this project - the automated pedalboard block, Raspberry Pi, and the app - are all pretty simple alone, but putting them all together will definitely be a huge obstacle to overcome.
- Our development of the app is limited by getting the pedalboard working as it's hard to test the app until we have the actual board to test it on. Hence, we will focus on the hardware first, while app development takes a backseat. It will still get worked on in tandem, but the mechanical board takes precedence.
- We are constrained by the number of setups we can test. Although one of our members is in a band, there are a lot of different pedalboard configurations. We probably cannot be modular enough for every pedal, especially when we do not have access to them. We will focus our design on being modular enough to support the pedals we personally have available, at the very least.

Group Management

What are the major roles in your group's management?

- Major roles are guide (Peter Tueller) and technical developers (rest of us). There are no other major roles in our group's management as all decisions will be taken based on voting and consensus and not based on hierarchy.

How will decisions be made? By leader, consensus?

- Decisions will be taken as a group based on consensus. An idea will be suggested by one of us and votes will be taken on it. In case of a tie, Peter will be the deciding vote. A single decision will be passed on to Peter for his approval and suggestions.

How will you communicate? Email, meetings in the lab, discussion board?

- Communication will be through email and slack. We also plan to meet up during weekends.

How will you know when you're off schedule, and how will you deal with schedule slips?

- Being off schedule would be evident while discussions during weekly meetings and when we are unable to meet the weekly milestones. If the task is too difficult, we might want to add a person or two to help finish the task at the earliest.

Who is responsible for which deliverables and milestones?

- All the team members are responsible for one/two deliverables or milestones.
  Pedal board design- Hitesh, Sneh
  Raspberry Pi interface - Sneh, Hitesh
  Pedal system with raspberry pi - Sivasankar, Sneh
  Application - Ronnie, Sivasankar
  Report - Ronnie

Project Development

What are the development roles and who will handle them?

- HW development (Raspberry Pi) - Ronnie, Sneh, Hitesh
- SW development (Application) - Ronnie,Sivasankar
- Mechanical development (design of pedal)- Hitesh,Sneh
- System Integration (Combining raspberry pi interface with pedals)- Sivasankar

What hardware/software will you use? What do you have available? What do you need?

- Hardware: Servo Motors, Raspberry Pi, knobs, metal shafts, nuts and bolts, 3D printer
- Software: Android Studio, Solidworks
- Solidworks was obtained for free from the UCSD ETS services. Raspberry Pi is already available with us. For the application, we plan to use Android Studio or any GUI based system which is open source and available for free.

If there is software/hardware that is needed, provide a justification for its cost. Where will you order it? When will it arrive?

On the hardware front we need to buy servo motors, metal shafts, nuts and bolts, etc. as well as the material for 3D printing. We plan to use the 3D printing services available in the University. For the servo motors and, nuts and bolts we plan on buying them from Amazon which will arrive within a couple of days. The cost of these put together is less than $50 ($18 for motor, $7 for nuts and $8 for bolts). Quantity will vary depending on the number of predefined settings we plan to incorporate and based on requirements during the course of the project.

How will you do testing?

We plan to test our device by asking a guitar player to use our application (Peter). We plan to test it in the following ways:

- Similarity of the sounds obtained by automatic tuning of our application and a guitarist manually tuning them , that is checking if the knobs have been rotated correctly by Raspberry Pi.
- Checking if the settings chosen by the user in the application correspond to the correct knobs - by comparing with our list which we used to create the system
- Obtain feedback from the user based on the comfort and ease of use (technically not testing)

How will you do documentation?

- We plan to document the tasks we perform on Google docs as and when we do them.
- This will make it easier while compiling the final report.

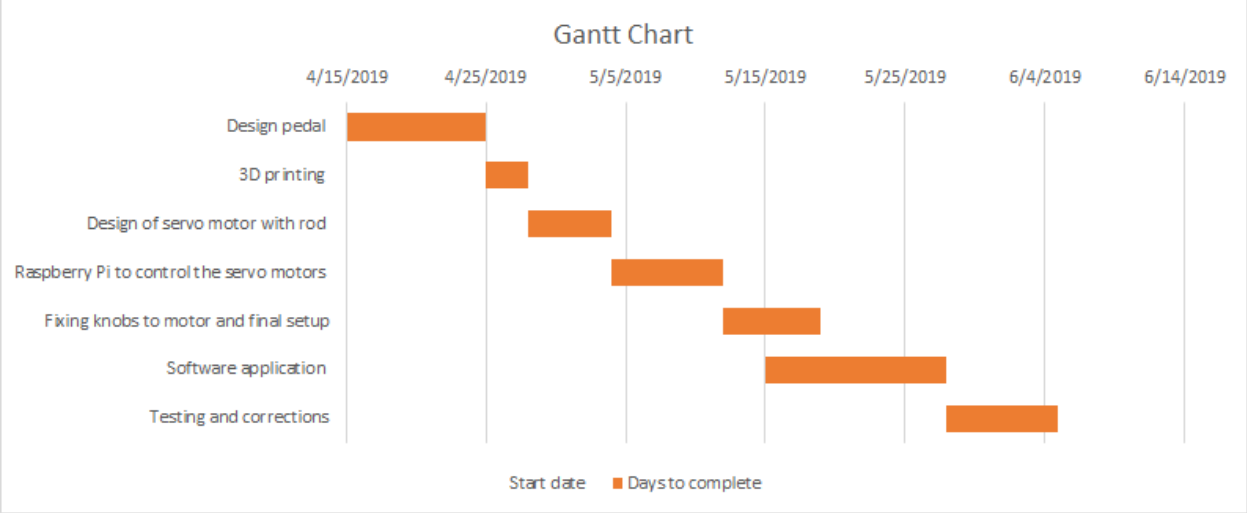
- We plan to have a solid document before each milestone, so that we can just add to it for every milestone which will give a good final report without having to do work at the last minute.
- As we change the document over time, it will be a useful resource to track how development and product goals have shifted as progress is made.

Project Schedule

High level schedule:

1. 3D printed pedal block (4/28/2019)
2. Raspberry Pi interface (5/12/2019)
3. Pedal setup with Raspberry Pi and servo motors (5/19/2019)
4. Application (5/28/2019)
5. Report (6/6/2019)

Gantt chart:



Milestone wise schedule:

1. Design pedal block
   - Generate a rough blueprint of the pedal block by taking measurements of the pedal board setup
   - Create a 3D model for this in Solidworks
2. 3D printing
   - Print the 3D model generated in Solidworks.
   - This process will have to be repeated (correcting errors each time) until we get the perfect fit for the pedal board
3. Design of servo motor with rod
   - Design a mechanism to connect the servo motor shaft to the knobs on the pedal
4. Raspberry Pi to control the servo motors
   - Program and write efficient code in order to control the servo motor
   - Initially we will try to control the servo using command line interface

- However, later the servos will be controlled using a an application which runs on PC or cellphone

5. Fixing knobs to motor and final product
    - Consolidate all components into the final hardware setup
6. Software application
    - Develop computer or mobile application using Android Studio
    - The application should have basic GUI to tune the pedalboard and create different presets
7. Testing and corrections
    - Test and evaluate the final product in a real world setting
    - Make improvements according to feedback