Hope COLLEGE

Self-Playing Bass Guitar

Intro to Engineering Design ENGS 452

Spring 2025

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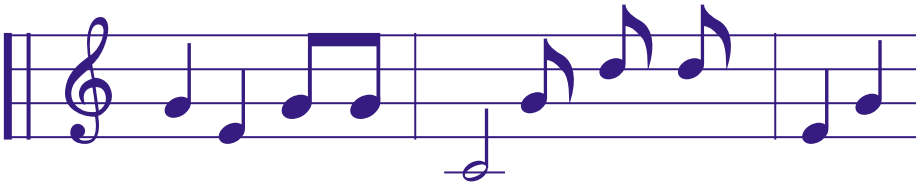
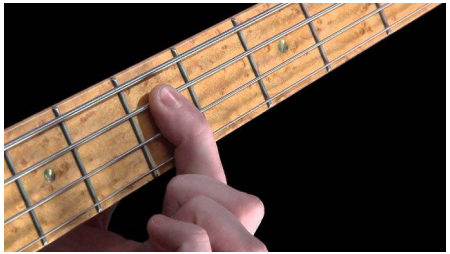


Project Goals

Investigate the ability of incorporating modern robotics into the creative and technical space of making live music.

How to play the Bass Guitar

Fretting Notes



Plucking String
(using fingers or pick)

Damping String
(with plucking hand or
fretting hand)

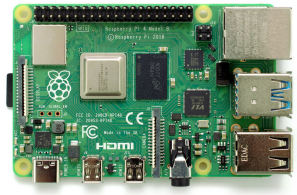
Requirements

Notes Per Second	>	5 notes
Force to pluck string	>	4.5N
Force to press fret	>	70N
Force to damp string	>	4.5N

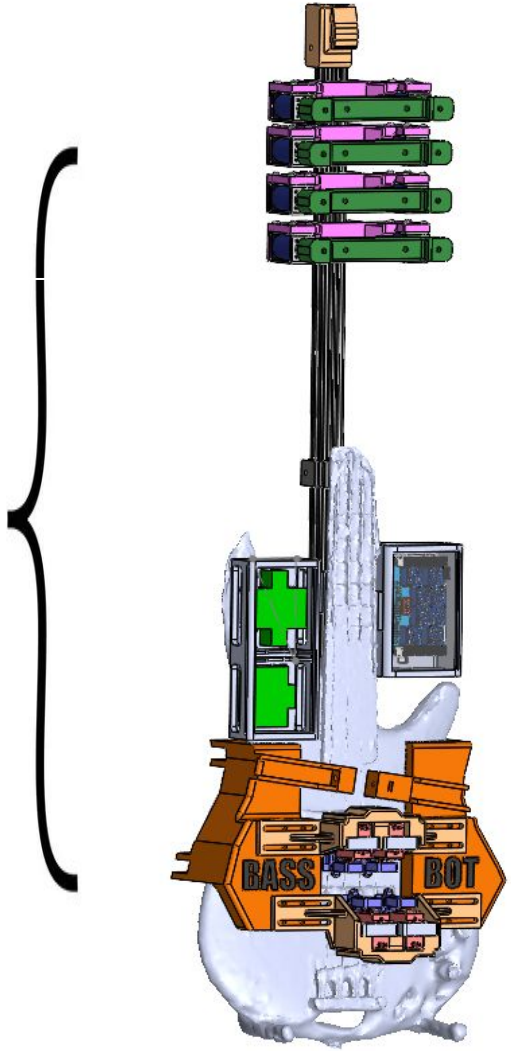
Cost	<	$500
# of Notes	=	20

Final Design

Flow Diagram



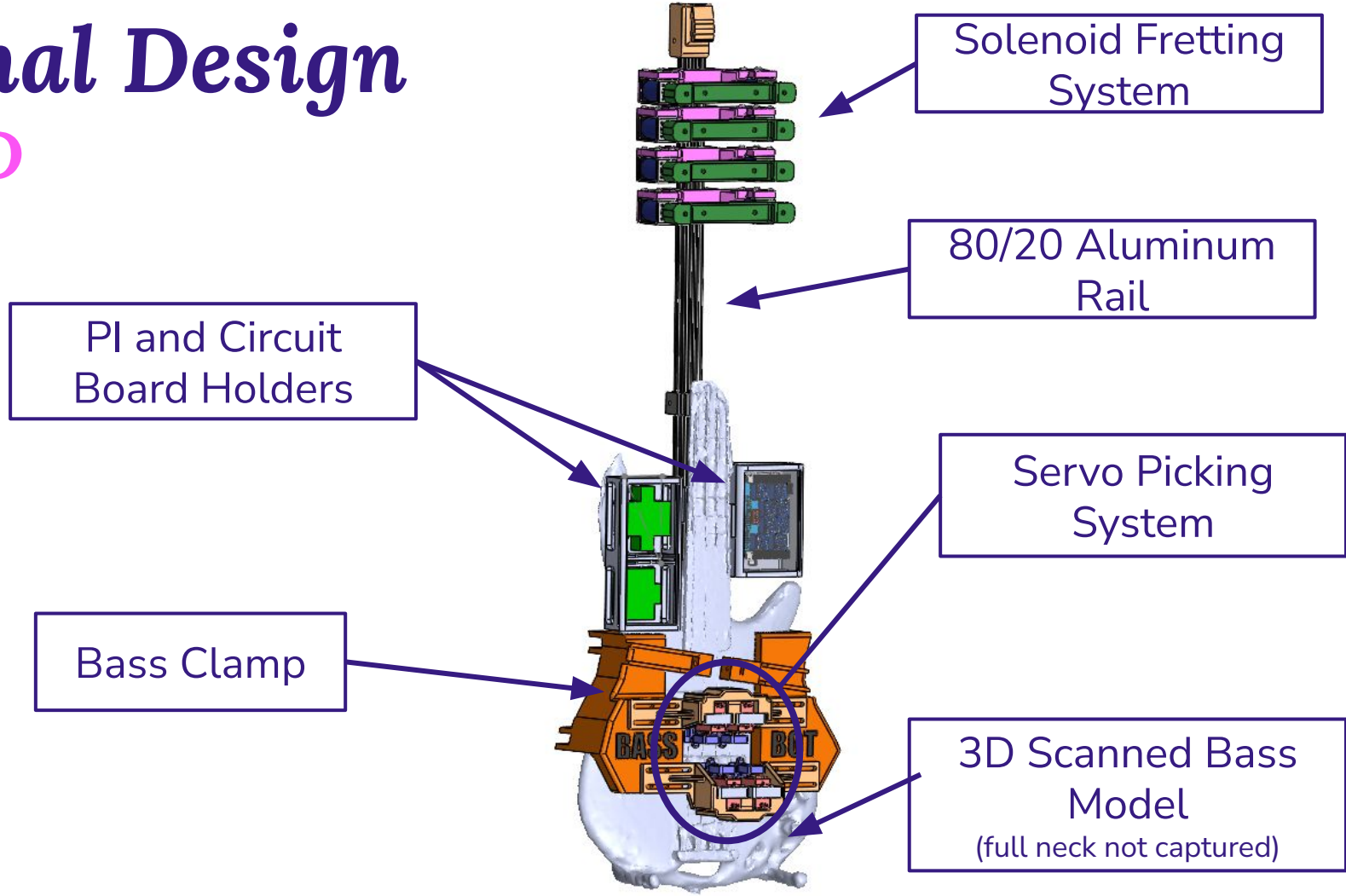
Bass Bot App



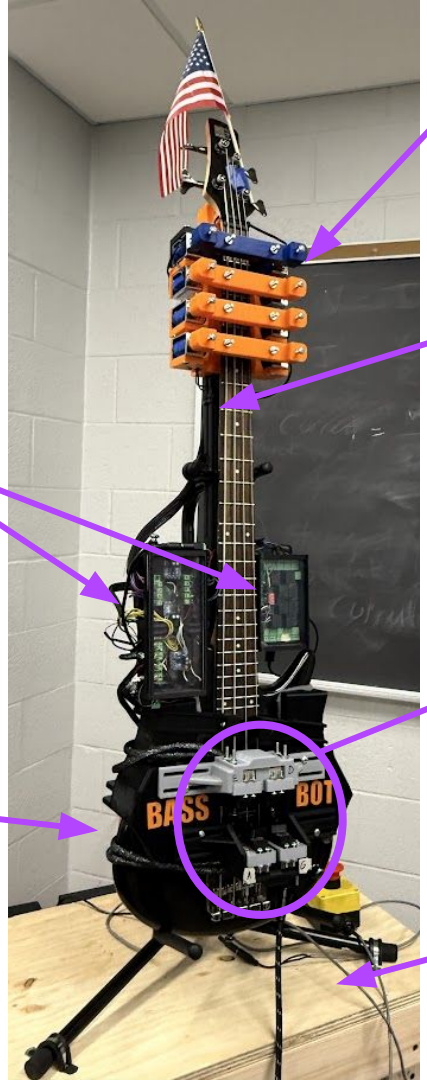
Amplifier

Final Design

CAD



Final Design



Solenoid Fretting System

80/20 Aluminum Rail

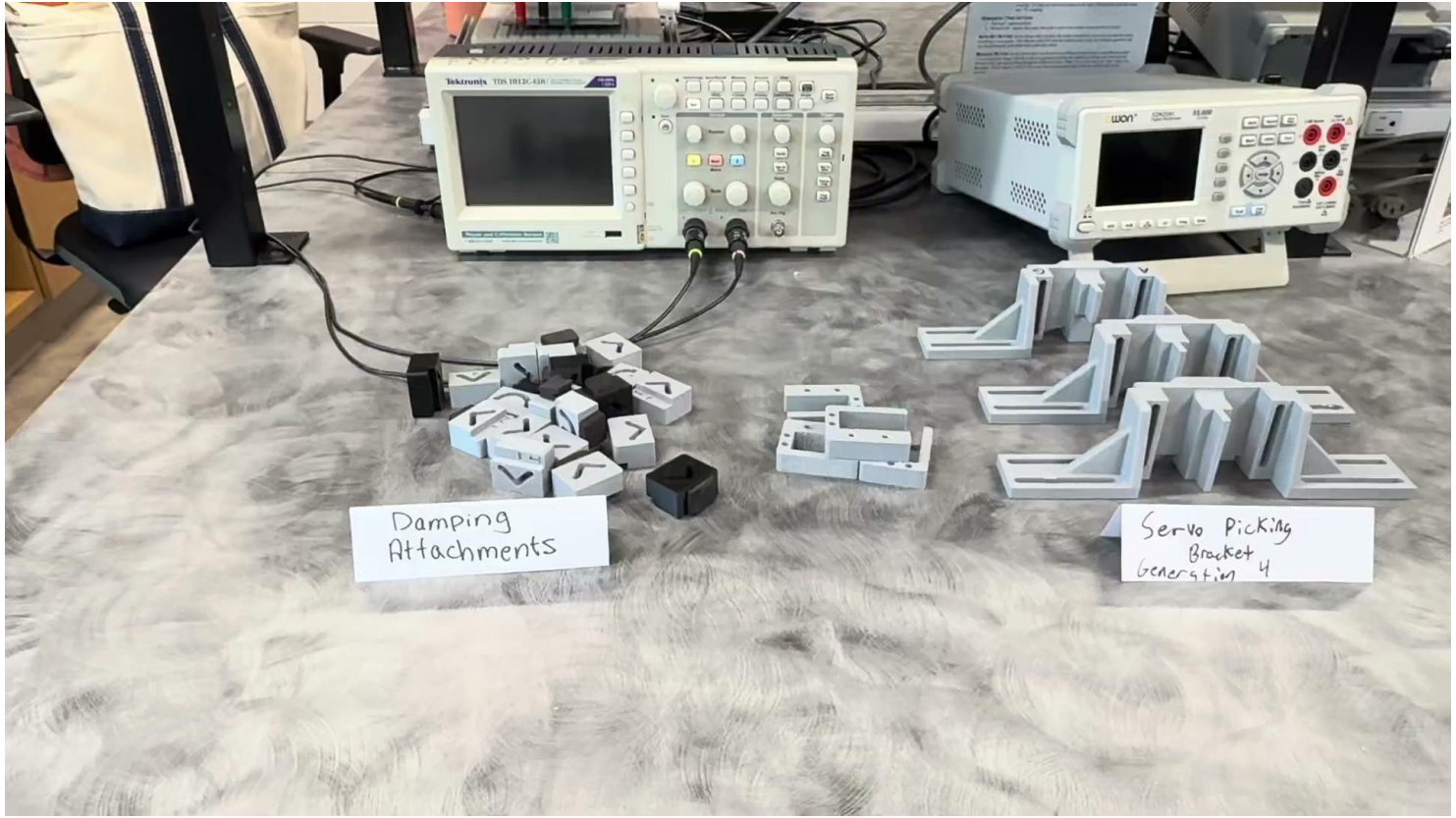
PI and Circuit Board Holders

Servo Picking System

Bass Clamp

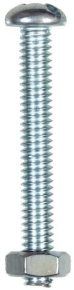
Stand and Table

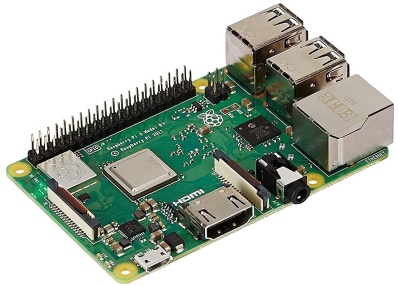
Design Process | *Tenth times the charm!*



Materials Used

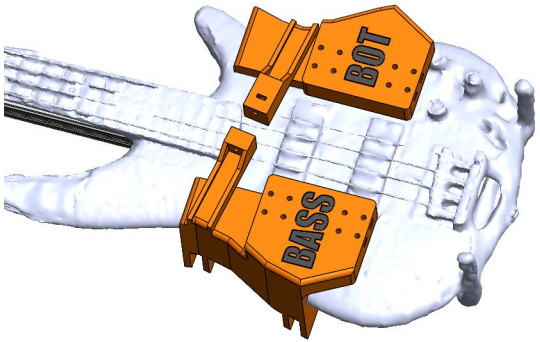
- 3D printed PLA:
  - Bass clamp
  - Fretting brackets
  - Servo brackets and damping system
  - PI and circuit board holders
- Purchased:
  - 80/20 aluminum extrusion
  - Picking servo motors
  - Fretting solenoids
  - Fasteners
  - Bass stand
  - Relay Board
- Misc:
  - Already owned bass guitar and amplifier
  - Built wooden table
  - Found Raspberry PI
  - Custom built circuit boards and wiring systems

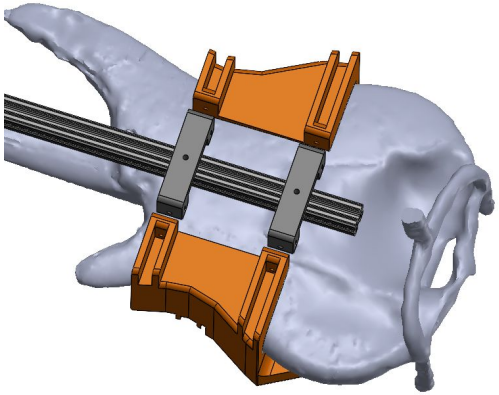


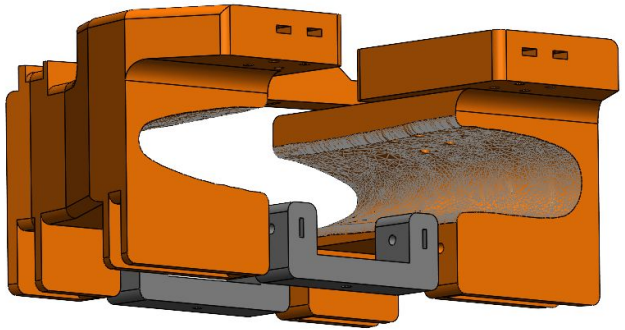


Bass Clamp

- “Clamps” around contours of bass body
- Foundation for all components
- Uses 3D scanned bass to perfectly match surface and clamp effectively
- Holes for attaching picking system
- Linkage piece attaches to 80/20 rail

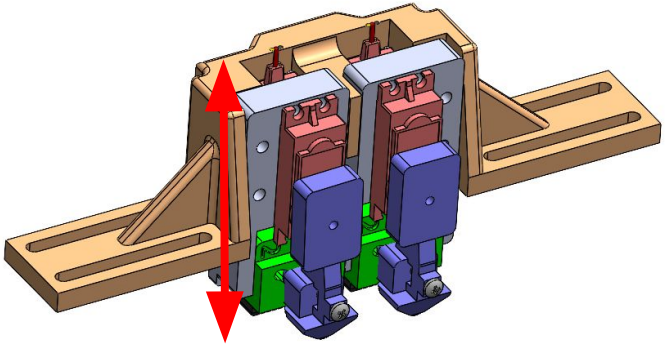


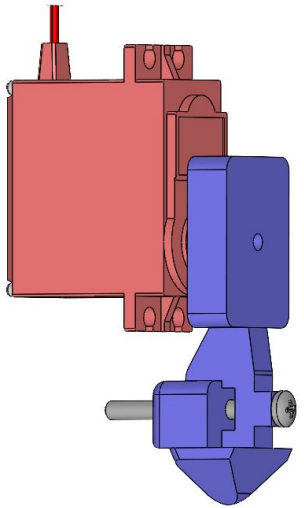


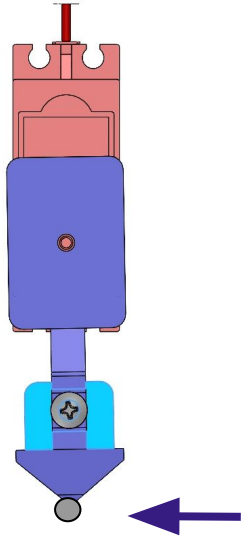


Picking System

- Servo motors pick each string (4)
- Slotted holes allows for left/right adjustability to place picks over strings
- Additional bracket (gray) is height adjustable to precisely set picking action



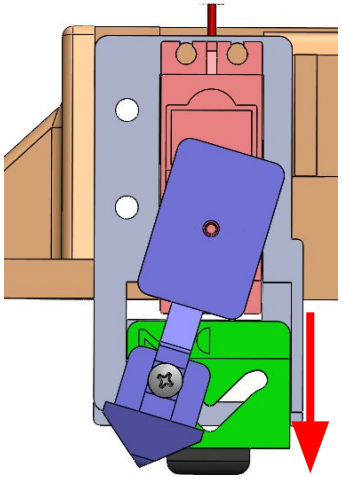




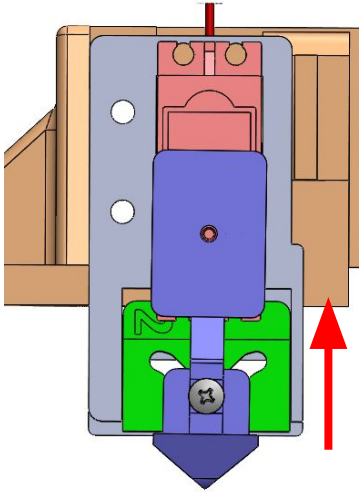
Bass String

Picking cont. – Damping

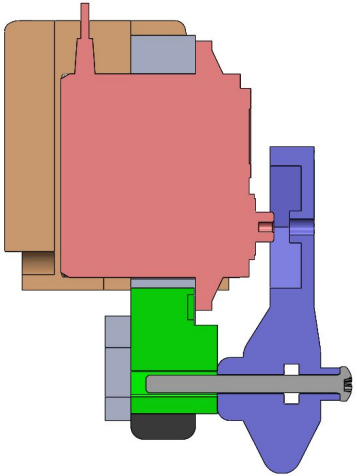
- Screw in pick slides through slot to give vertical motion to “damping block”
- Foam damps strings when pick reaches maximum angle

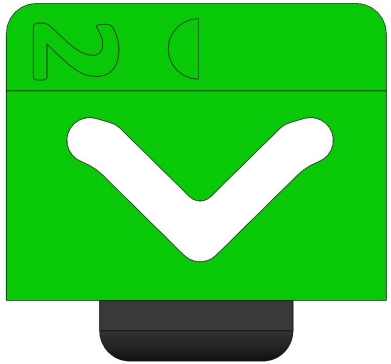


Pick at maximum angle = damper down



Picking string = damper up

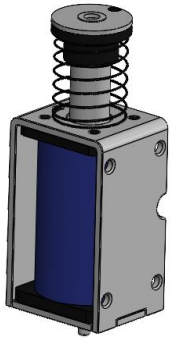


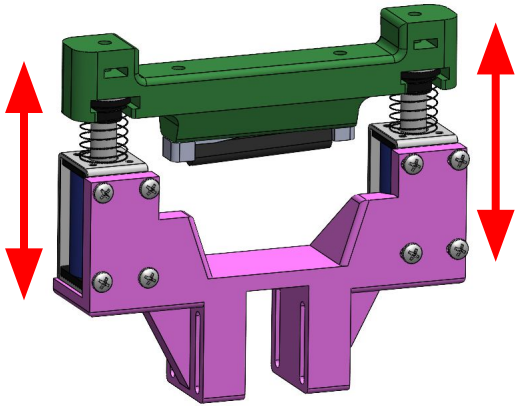


Foam damping material

Fretting System

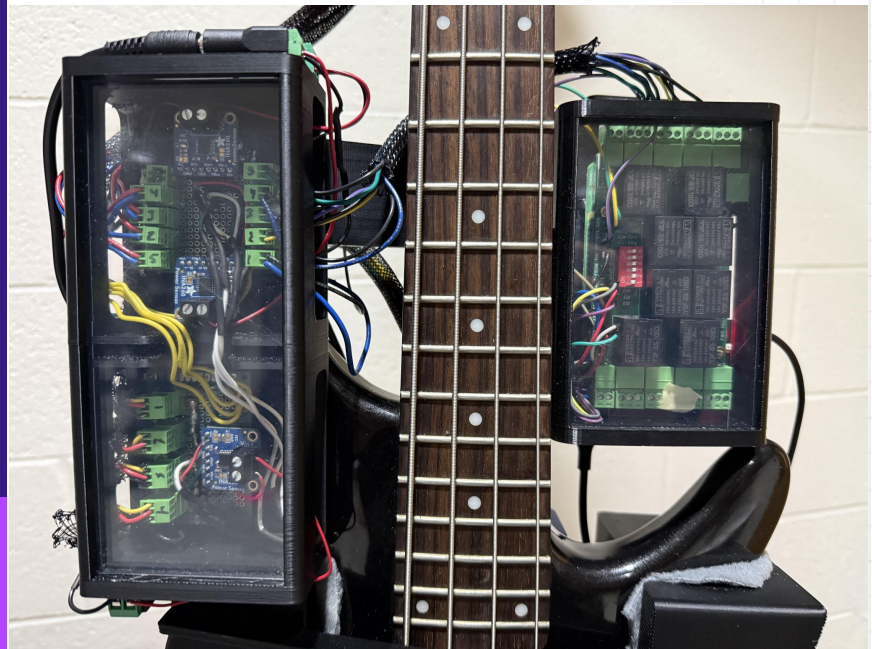
- Bracket uses two solenoids to press capo rubber across all four strings
- Four frets used to access a wide range of notes - 8 solenoids total
- Fixture attaches to 80/20 rail
- Angle of rubber precisely chosen to fret all strings effectively

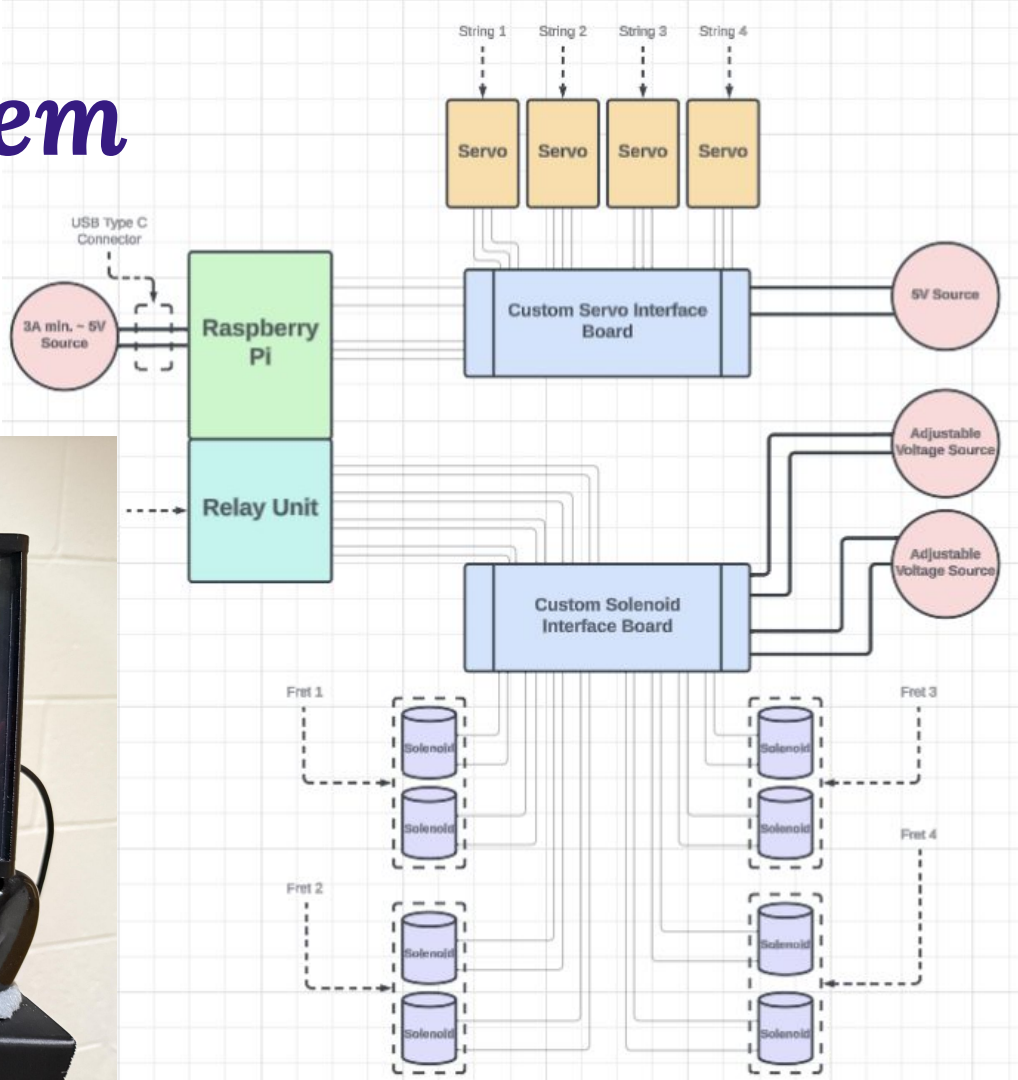




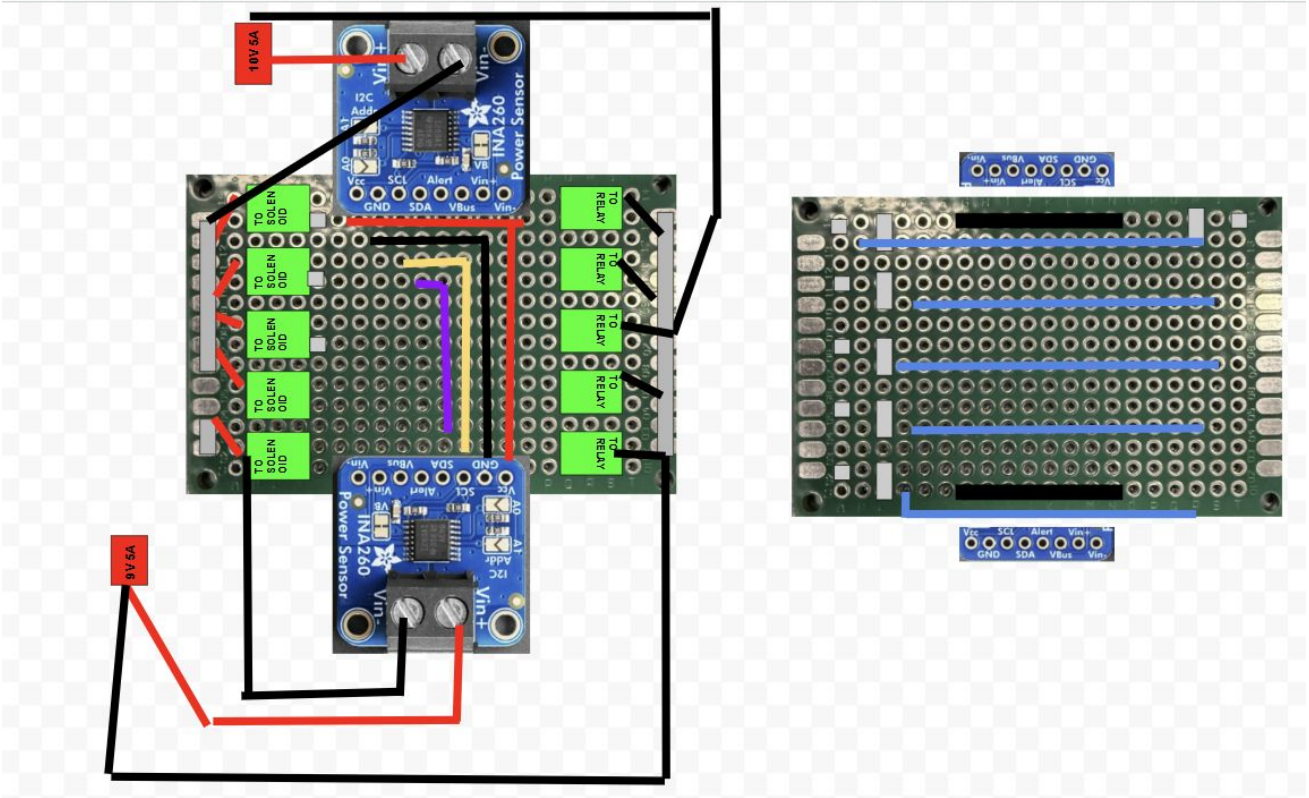
Angled fretting rubber

Electrical System



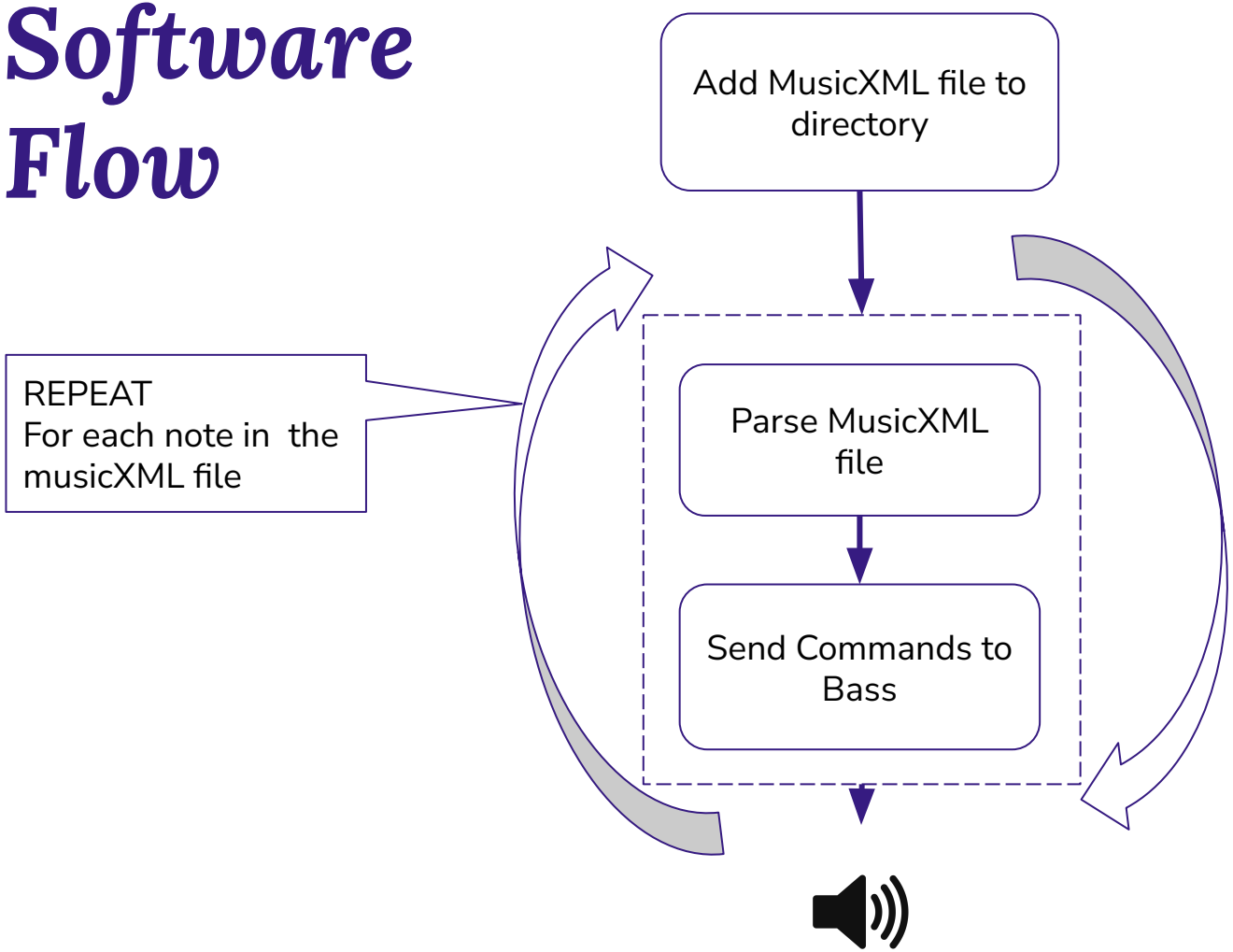


Electrical System



Electrical Design Adjustments

Software Flow

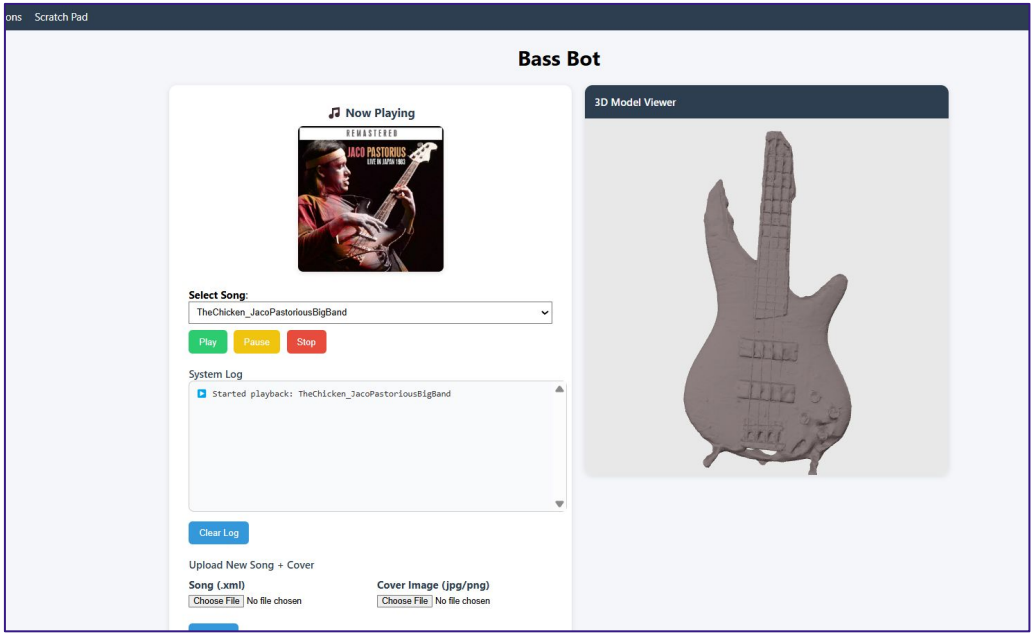


GUI

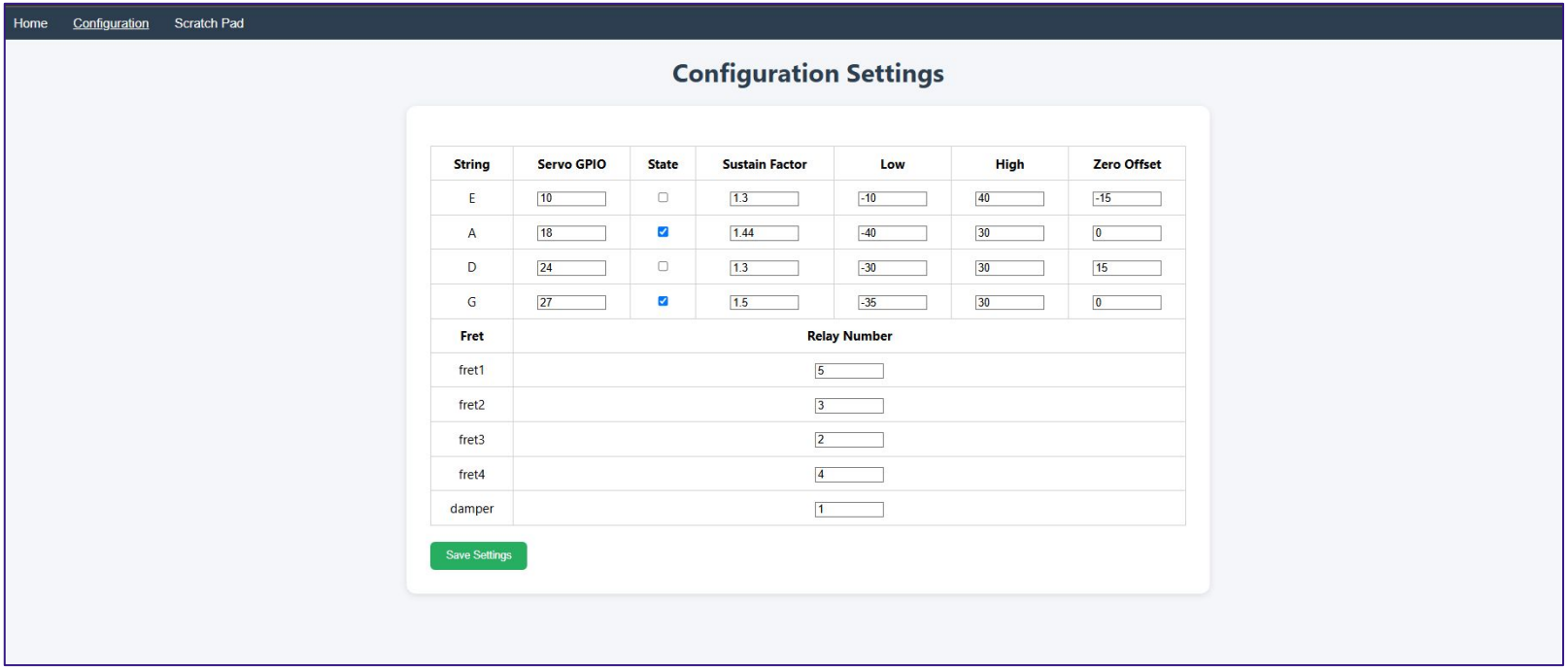
Hardware

HTTP Requests

Graphics
Interface Logic



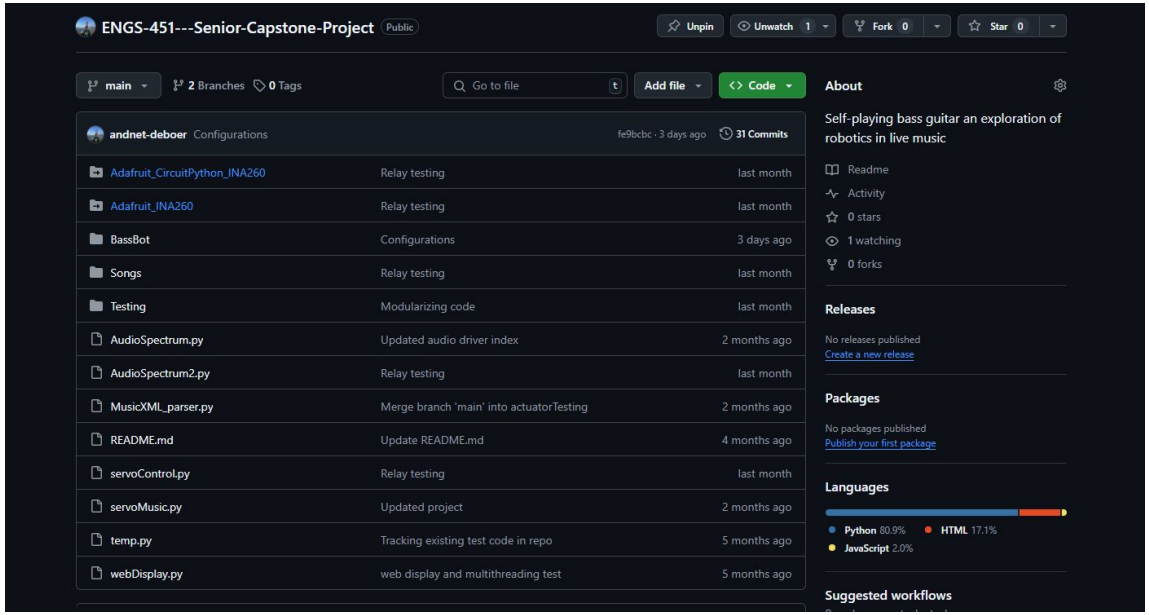
GUI


Home
Configuration
Scratch Pad
Configuration Settings
String
Servo GPIO
State
Sustain Factor
Low
High
Zero Offset
E
10
1.3
-10
40
-15
A
18
1.44
-40
30
0
D
24
1.3
-30
30
15
G
27
1.5
-35
30
0
Fret
Relay Number
fret1
5
fret2
3
fret3
2
fret4
4
damper
1
Save Settings

Scratch Pad

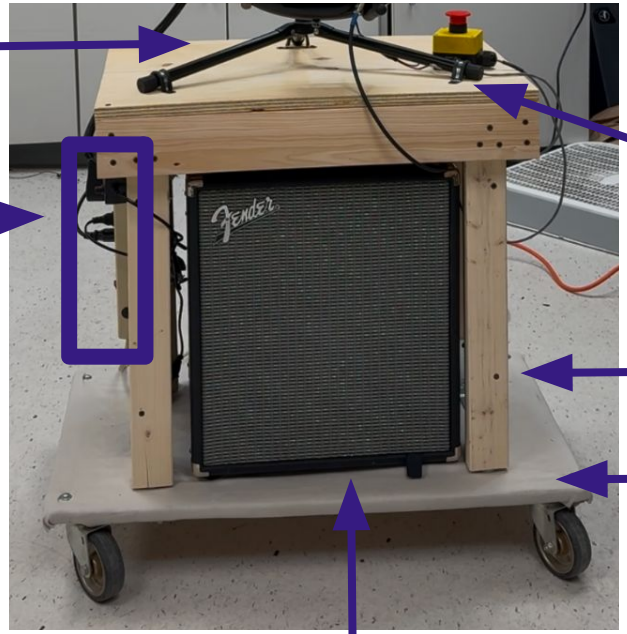
Friendly for Non-programmers

Software



GitHub

Showcase Display Set-up



Bass Guitar Stand

Power Strip

¾” Pipe Clamps

Table

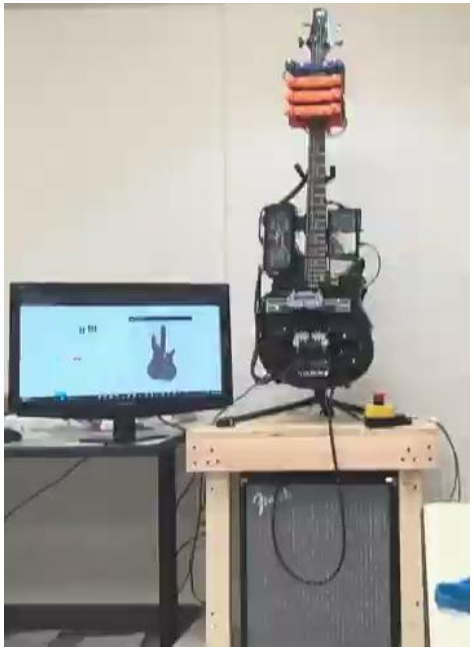
Platform with Wheels

Rumble 100 Bass Amplifier

Results

- $584.47
- > 5 Notes/sec
- Removable

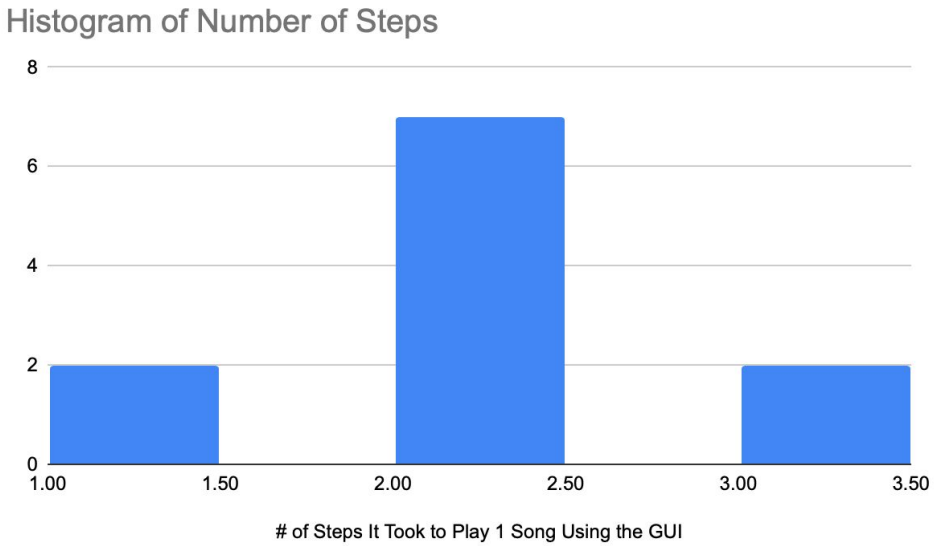
Play Many Different Notes



← **Chromatic Scale**

# of Notes	=	20

Testing GUI Simplicity

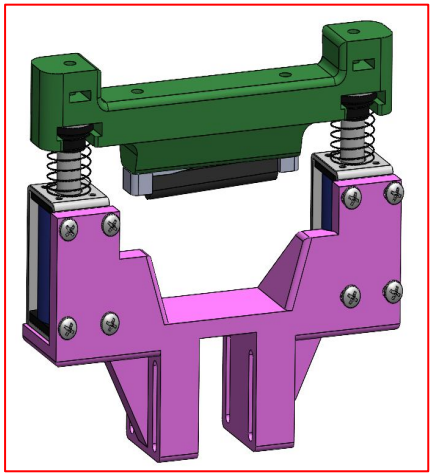


Average Time to Play 1 Song = 9.43 seconds

Steps < 5

Time < 2 min.

Next Steps



Servo Improvements

< $

< ⚡

+ Encoder

Acknowledgments

Dr. Cuthbert,
Python Music21 Library

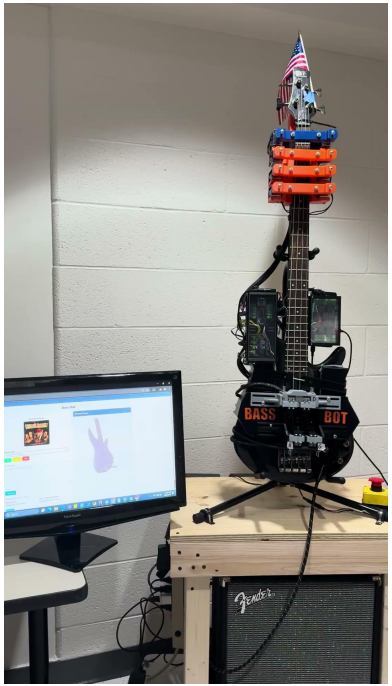
Dr. Miguel Abrahantes

Dr. Roger Veldman

Dr. Matthew DeJongh

Hans Veldman

Thank You



Questions?