

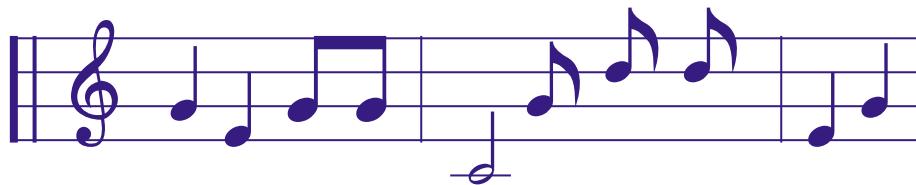


Hope COLLEGE

Self-Playing Bass Guitar

Intro to Engineering Design ENGS 452
Spring 2025

Will Lamm, Carter Mann
Andnet DeBoer, Amy Drelicharz





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

Cost < \$500

Force to pluck string > 4.5N

of Notes = 20

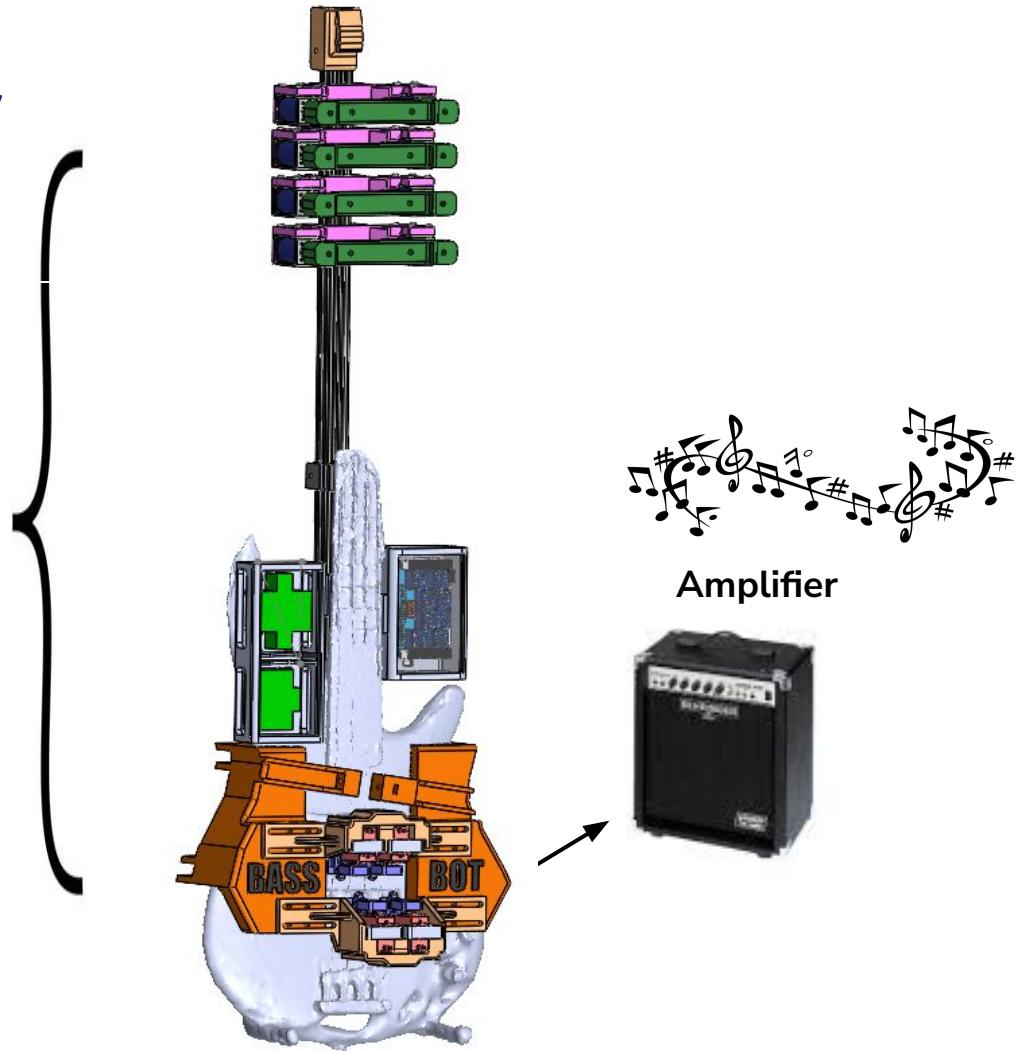
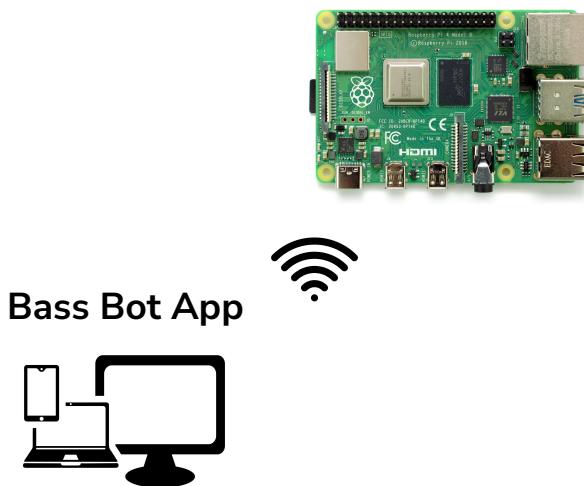
Force to press fret > 70N

Force to damp string > 4.5N



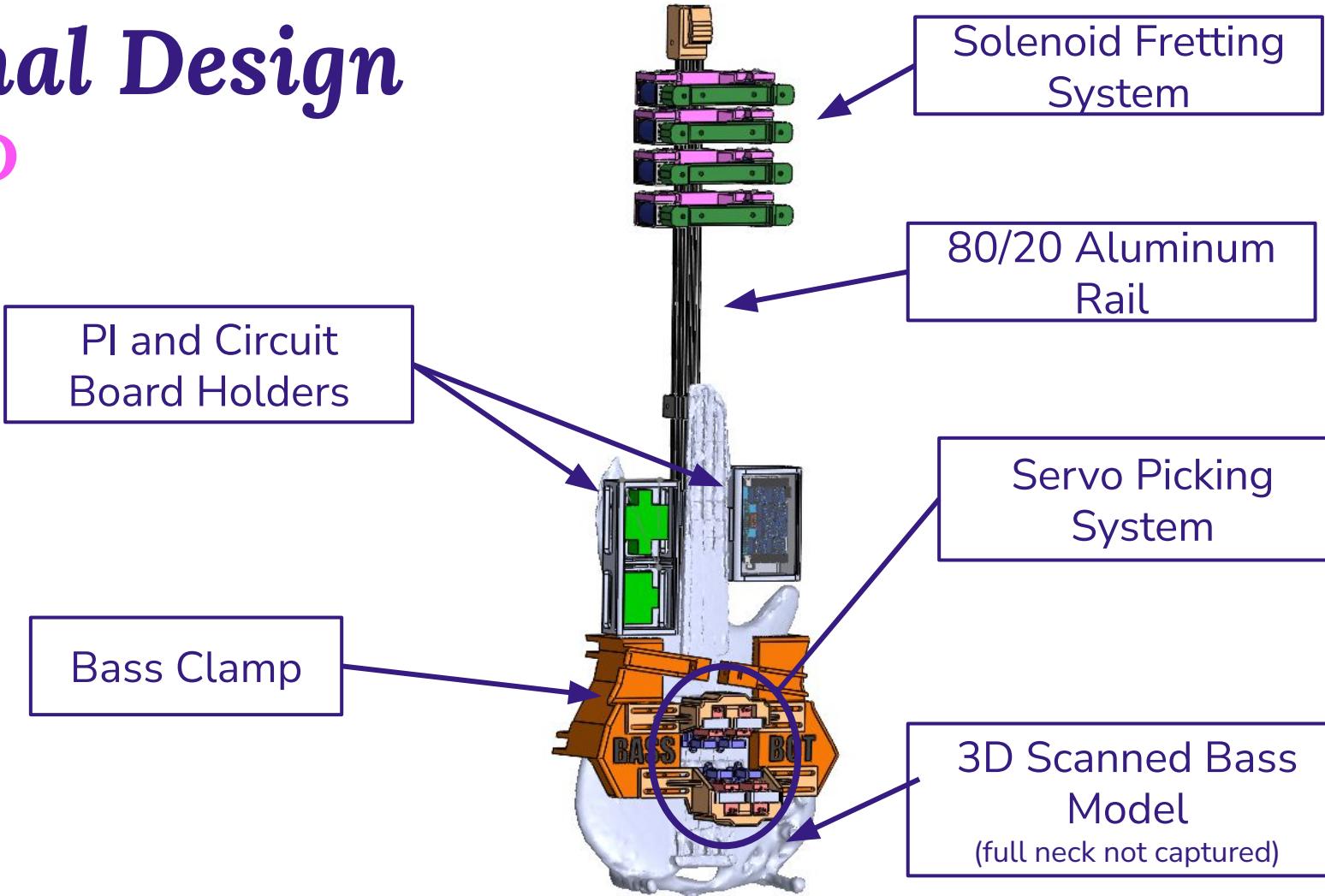
Final Design

Flow Diagram



Final Design

CAD

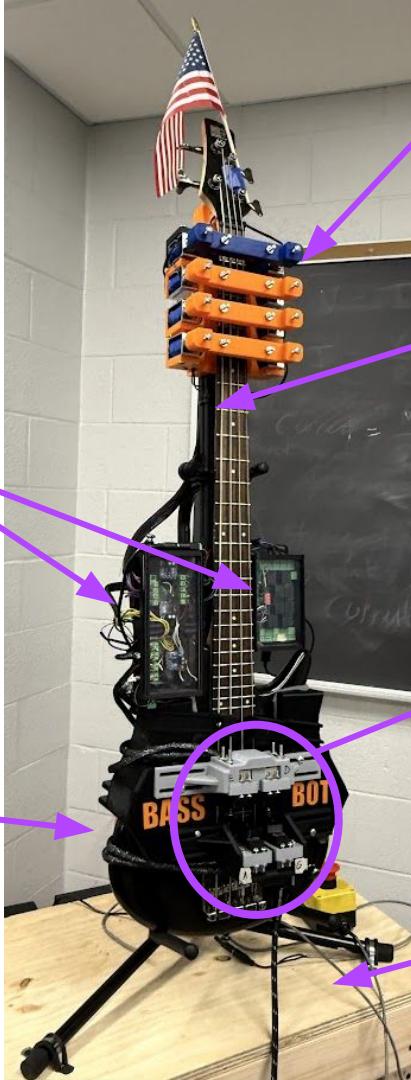


Final Design



PI and Circuit
Board Holders

Bass Clamp



Solenoid Fretting
System

80/20 Aluminum
Rail

Servo Picking
System

Stand and Table

Design Process | Tenth times the charm!



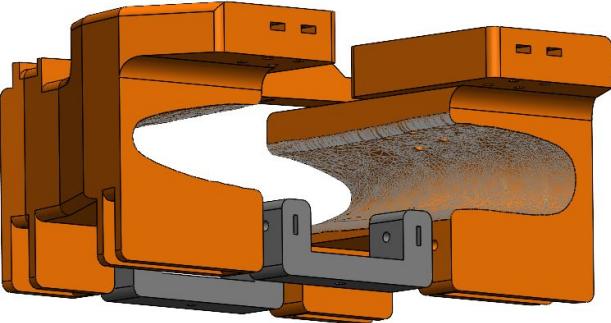
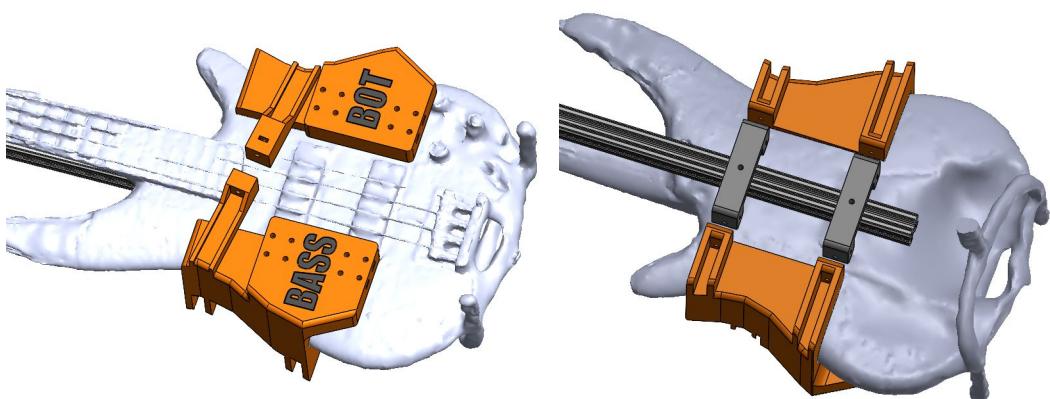
Materials Used

- 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



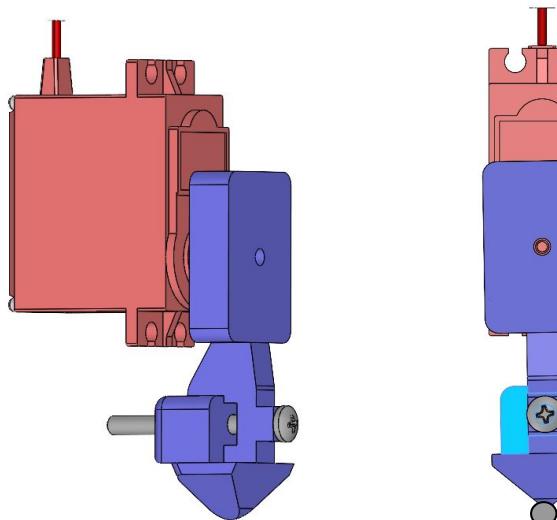
Bass Clamp

- “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

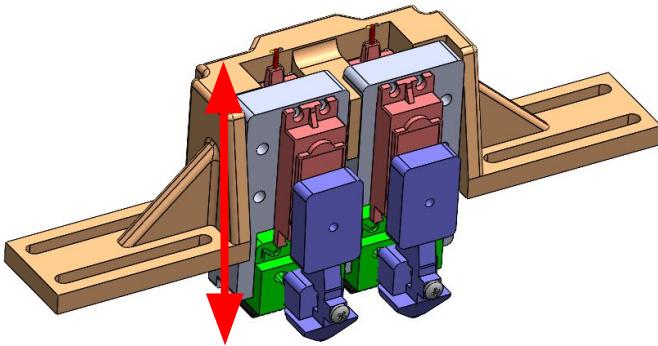


Picking System

- 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

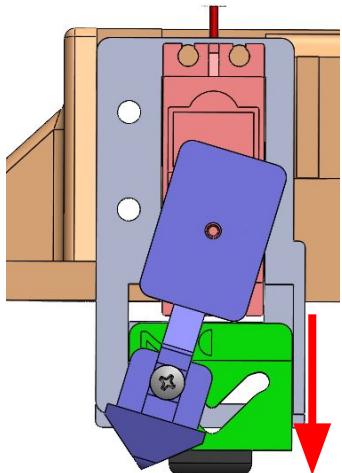


← Bass String

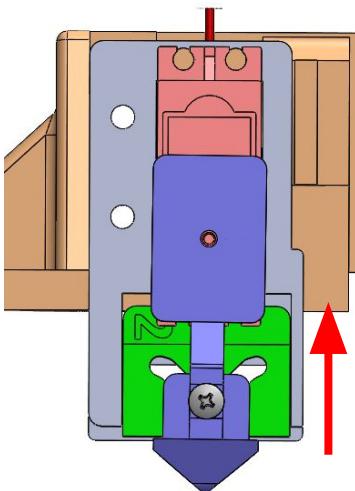


Picking cont. - Damping

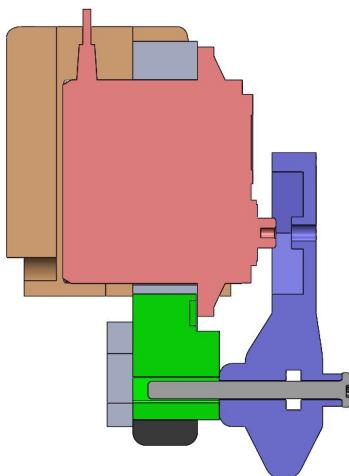
- Screw in pick slides through slot to give vertical motion to “damping block”
- Foam damps strings when pick reaches maximum angle



Pick at maximum angle
= damper down



Picking string =
damper up

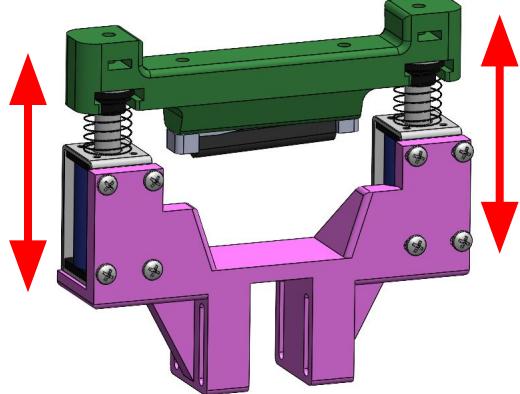
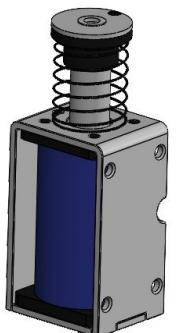


Foam damping
material



Fretting System

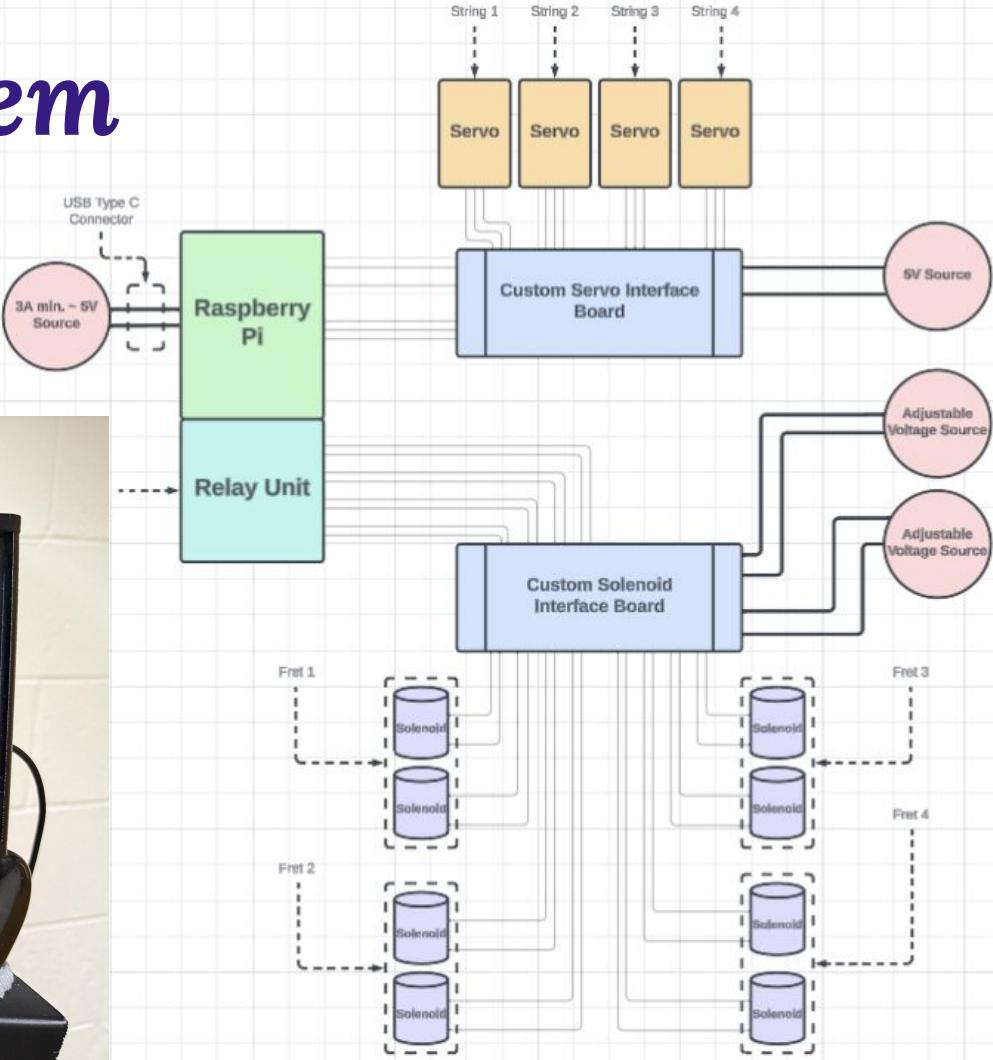
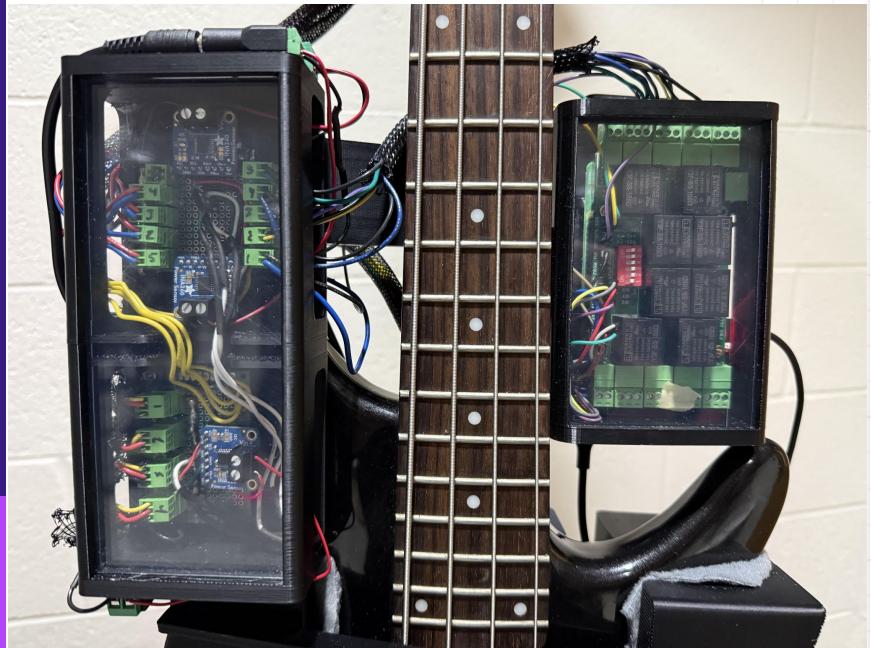
- Bracket uses two solenoids to press capo rubber across all four strings
- Four frets used to access a wide range of notes - 8 solenoids total
- Fixture attaches to 80/20 rail
- Angle of rubber precisely chosen to fret all strings effectively



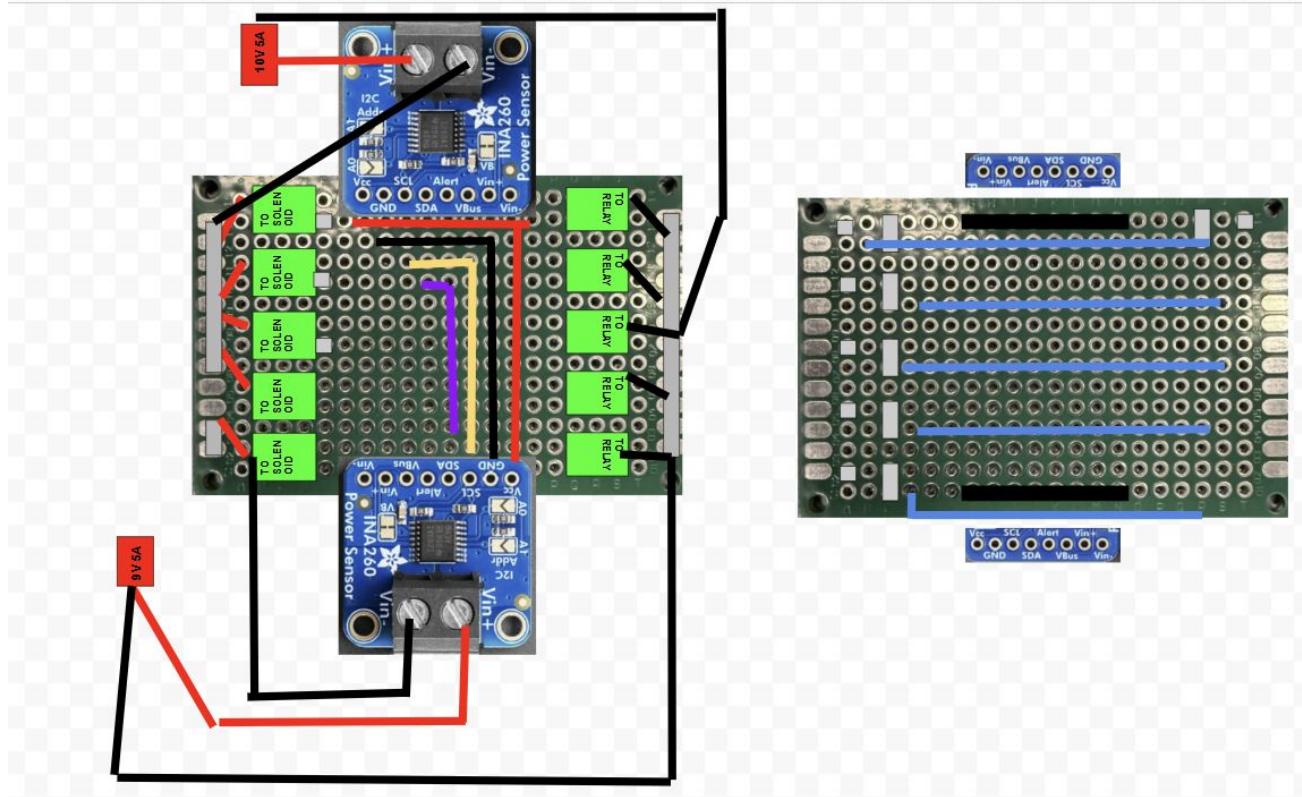
Angled fretting rubber



Electrical System



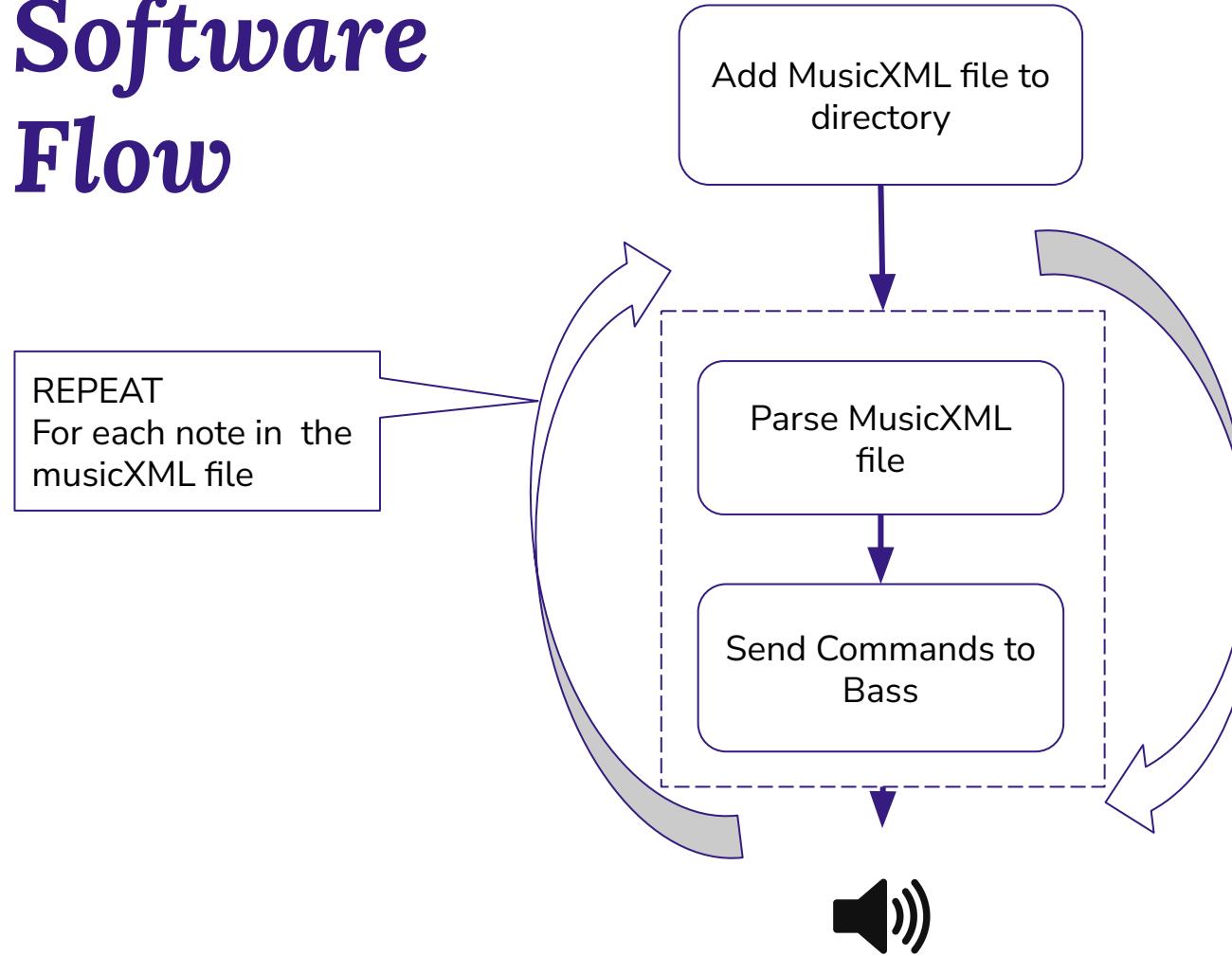
Electrical System



Electrical Design Adjustments



Software Flow



GUI



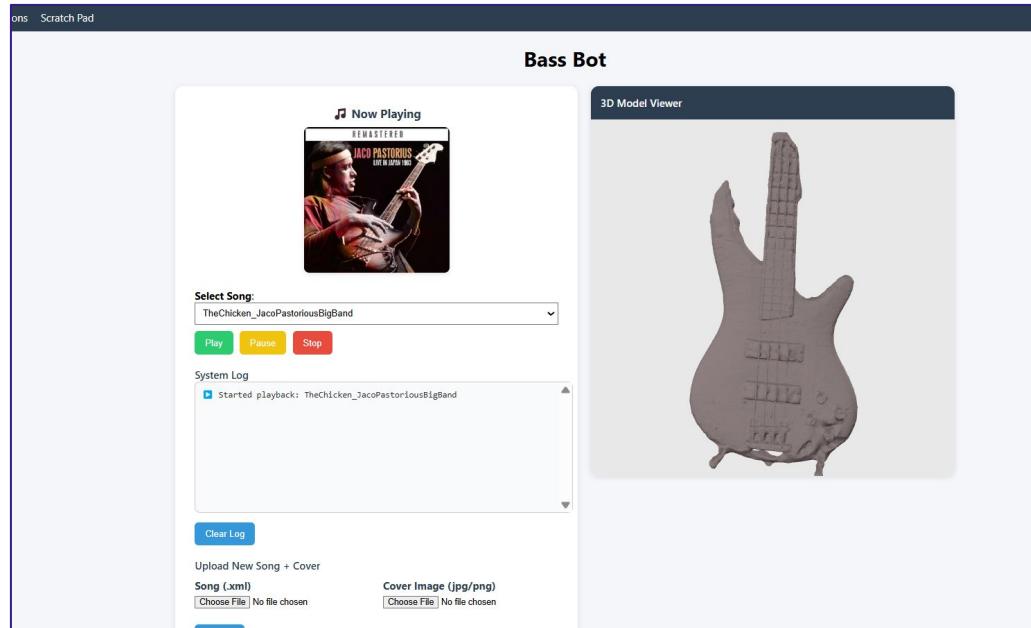
Hardware



HTTP Requests



Graphics
Interface Logic



GUI

Home Configuration Scratch Pad

Configuration Settings

String	Servo GPIO	State	Sustain Factor	Low	High	Zero Offset
E	10	<input type="checkbox"/>	1.3	-10	40	-15
A	18	<input checked="" type="checkbox"/>	1.44	-40	30	0
D	24	<input type="checkbox"/>	1.3	-30	30	15
G	27	<input checked="" type="checkbox"/>	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

The image shows a Scratch Pad interface. At the top, there's a navigation bar with 'Home', 'Configurations', and 'Scratch Pad' (which is highlighted). On the right side of the bar are 'Run Code' and 'Save' buttons. On the left, there's a sidebar with categories: 'Control', 'BassBot Actions', 'My Functions', and 'Values'. The main area is a grid-based workspace where Scratch-style scripts are built. A script is currently visible, consisting of the following blocks:

- A green **repeat [10 times]** control block.
- Inside the loop:
 - An orange **do** control block.
 - Inside the do loop:
 - A green **servo servoE [sustain]** action block.
 - A blue **wait [1 seconds]** control block.
 - A green **repeat [3 times]** control block.
 - Inside the inner loop:
 - An orange **do** control block.
 - Inside the inner do loop:
 - A green **fret1 [on]** action block.
 - A blue **wait [1 seconds]** control block.
 - A green **repeat [3 times]** control block.
 - Inside the outer loop:
 - A green **bk** control block.



Software

ENGS-451---Senior-Capstone-Project Public

Unpin Unwatch 1 Fork 0 Star 0

main 2 Branches 0 Tags Go to file Add file Code

andnet-deboer Configurations fe9bcbc · 3 days ago 31 Commits

Adafruit_CircuitPython_INA260 Relay testing last month

Adafruit_INA260 Relay testing last month

BassBot Configurations 3 days ago

Songs Relay testing last month

Testing Modularizing code last month

AudioSpectrum.py Updated audio driver index 2 months ago

AudioSpectrum2.py Relay testing last month

MusicXML_parser.py Merge branch 'main' into actuatorTesting 2 months ago

README.md Update README.md 4 months ago

servoControl.py Relay testing last month

servoMusic.py Updated project 2 months ago

temp.py Tracking existing test code in repo 5 months ago

webDisplay.py web display and multithreading test 5 months ago

About

Self-playing bass guitar an exploration of robotics in live music

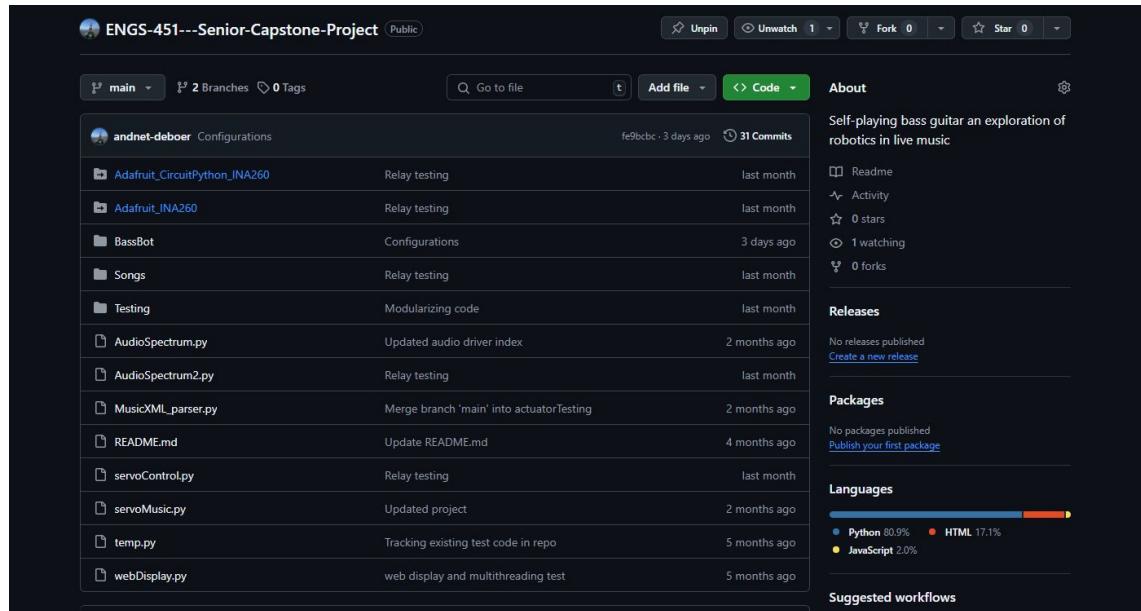
Readme Activity 0 stars 1 watching 0 forks

Releases No releases published Create a new release

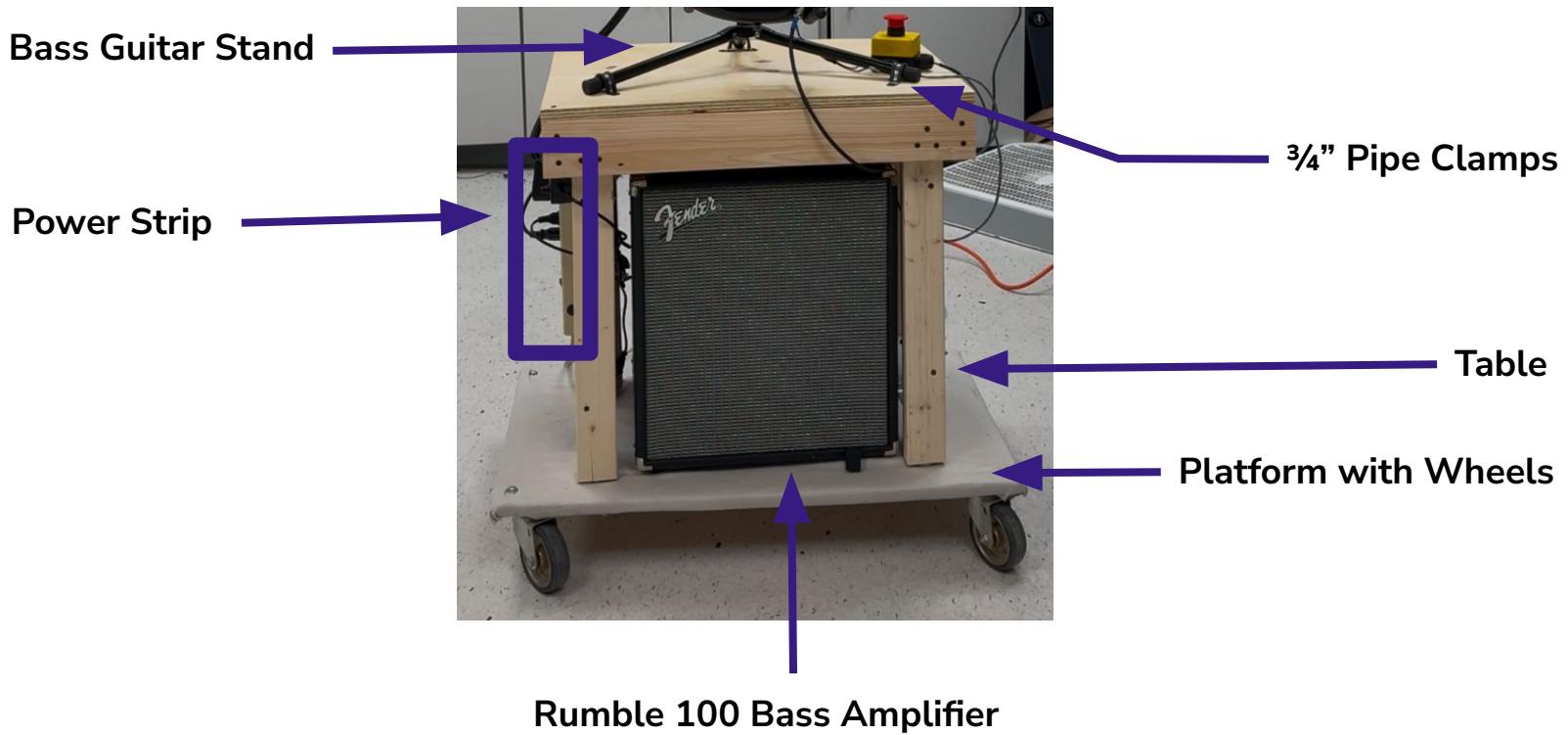
Packages No packages published Publish your first package

Languages Python 80.9% HTML 17.1% JavaScript 2.0%

Suggested workflows



Showcase Display Set-up

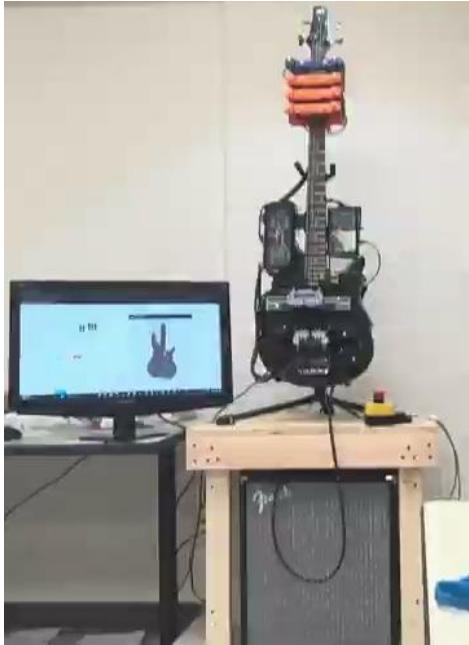


Results

- ❖ \$584.47
- ❖ > 5 Notes/sec
- ❖ Removable



Play Many Different Notes



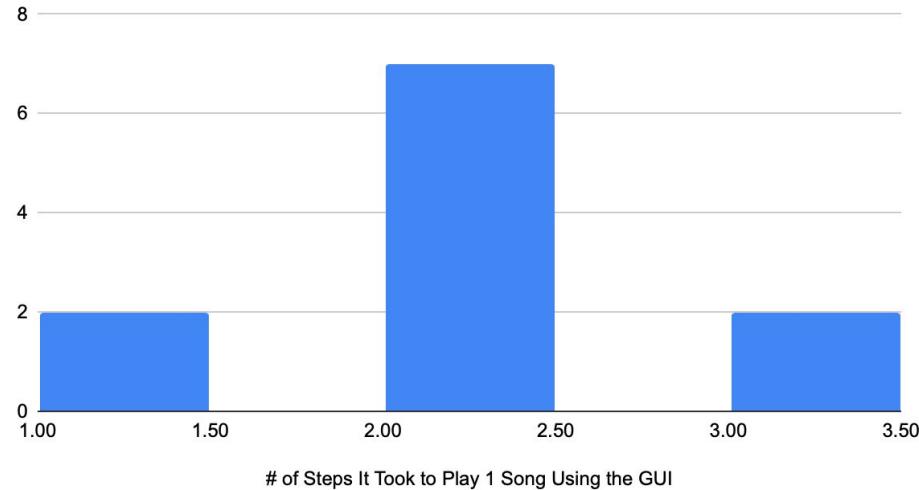
Chromatic Scale



of Notes = 20

Testing GUI Simplicity

Histogram of Number of Steps



Average Time to
Play 1 Song =
9.43 seconds

Steps

<

5

Time

<

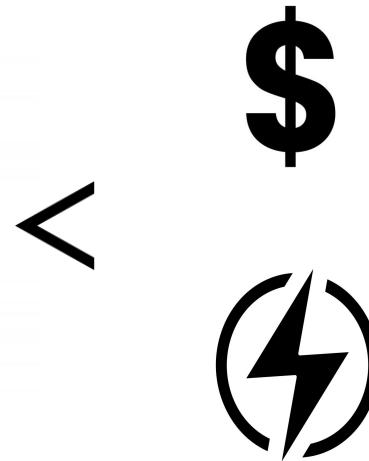
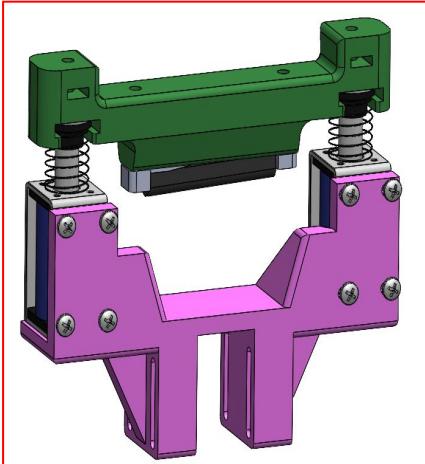
2 min.



Next Steps

Servo Improvements

Ctrl + Alt + Del



+ Encoder



Acknowledgments



Dr. Cuthbert,
Python Music21 Library



Dr. Miguel Abrahantes



Dr. Roger Veldman

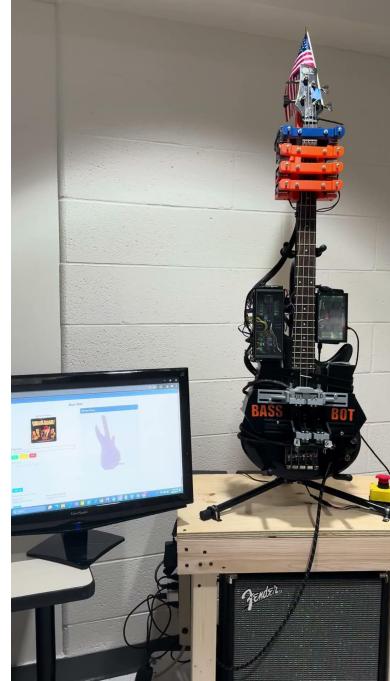


Dr. Matthew DeJongh



Hans Veldman

Thank You



Questions?