MIDI MENTOR♬

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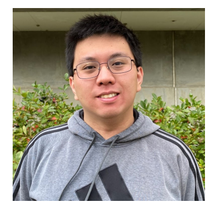
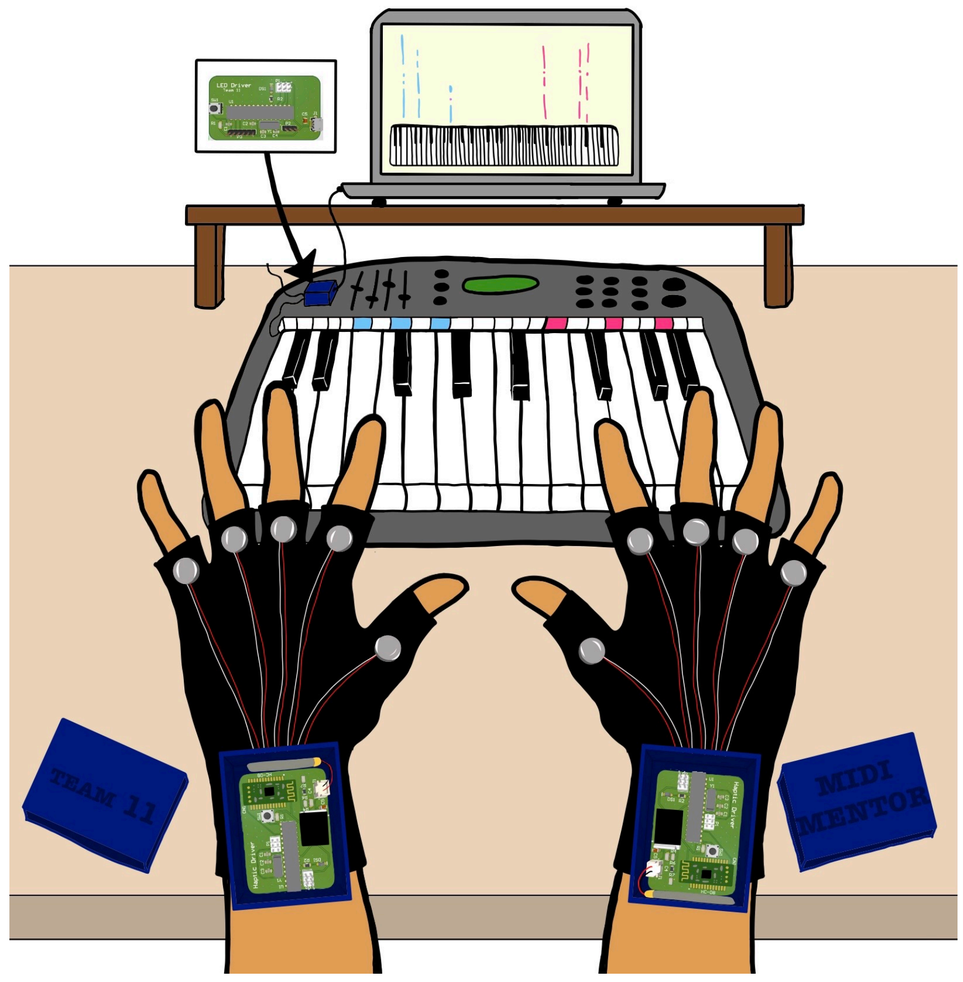


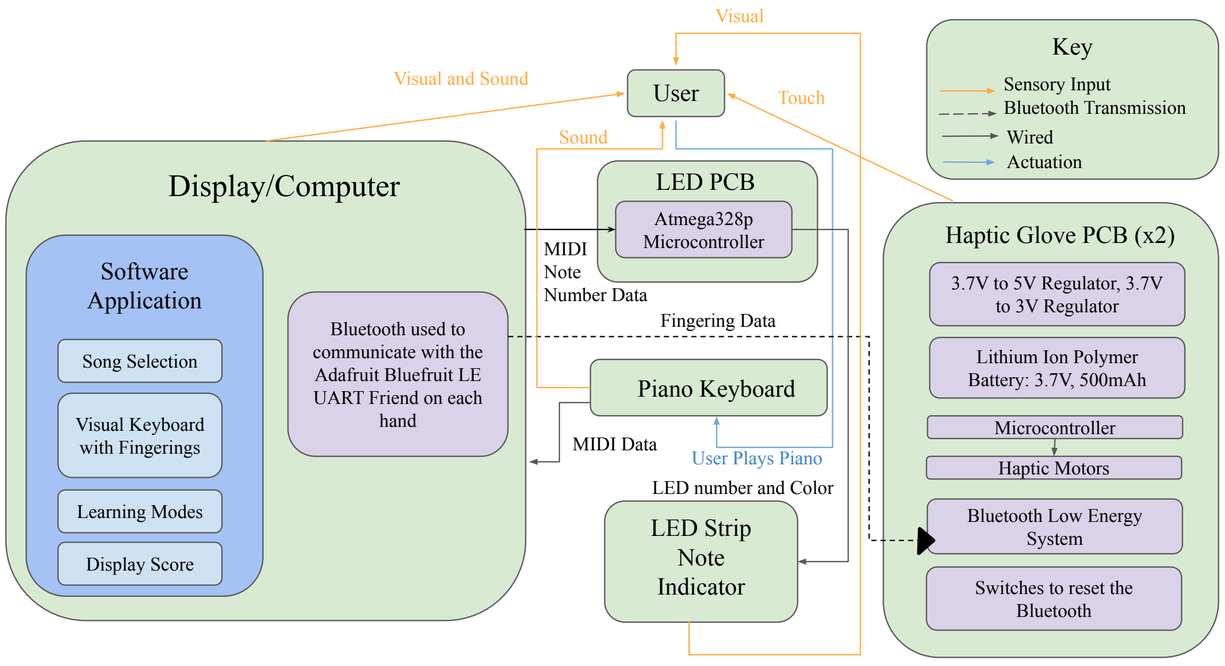
Abstract

Piano is one of the most difficult instruments to play well due to the various requirements. Due to such restrictions, it can be daunting for any musician to pick piano as their first instrument. Many of the existing teaching methods are quite tedious in their methodology and traditionally are expensive. The MIDI Mentor is designed to solve these issues by providing users with an easy method of learning piano at the fraction of the cost of traditional lessons. Our system has a working prototype that is designed to work with 61 key piano, and it includes two function glove systems that receives Bluetooth signals and turns on haptic motors according to the finger data process on the laptop. Additionally, our system also has an LED strip that indicates to the user what keys they should press along with a GUI that allows the user to have different learning modes and a song selection menu.

System Overview



Block Diagram



Specifications

Requirement	Specification	Value
Portable	Battery life	at least 1 hour
	Convenience	freely bend joints, while secure
	Range	at least 5m for gloves
Functionality	Auditory assist	delay within 100ms
	Sensory assist	delay within 100ms
	Visual assist	delay within 100ms
	Overall system	delay within 100ms
	Versatile	replicable for different keys

Results

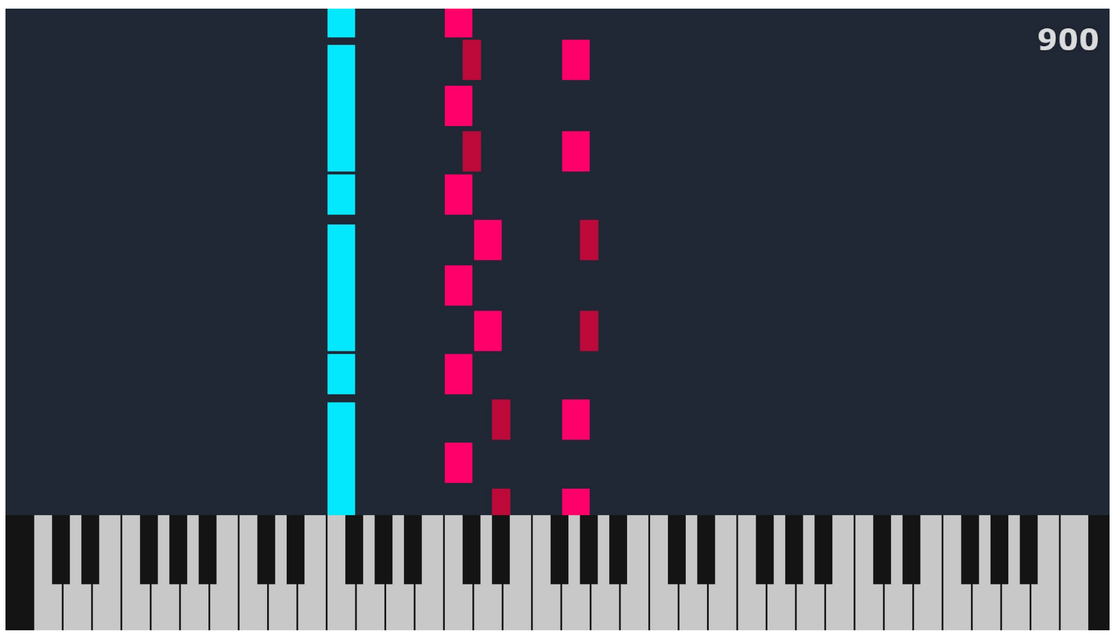
MIDI Mentor is composed of four main subsystems:

- Laptop Computer
  - Uses any MIDI file to generate fingering and note data
  - Transmits data over to two separate Bluetooth Low Energy Protocol Connections
  - Sends Note data to the LED PCB via serial communication
  - Displays the GUI of the generated falling notes
  - Provides the corresponding note audio
  - Computes the scoring based on player's performance
- LED PCB with a LED strip attached to the keyboard
  - An LED strip is controlled based on the ASCII value sent via serial communication to the microcontroller
- PCBs with the Haptic motors and Bluetooth on gloves
  - The haptic motors vibrate based on the automatic fingerings data generated from MIDI files that was sent via Bluetooth from the laptop
- MIDI piano keyboard
  - Outputs MIDI data after the user finishes playing that then is used to calculate the player's score.

Acknowledgement

We would like to thank everyone who has helped us with our project, especially everyone at M5. Everyone there has guided us and helped better our project. Additionally, we would also like to thank our Evaluators, Professor Noh and Professor Soules, for their guidance and feedback. Finally, we would like to thank Professor Anderson for guiding us through this project, and for always being positive and encouraging. We are very appreciative of his time and patience.

GUI Application



Display

- Projects the current played notes on to keyboard
  - Includes next sets of notes
  - Length of note matches with delay
  - Left hand = Blue
  - Right hand = Pink
- Process MIDI data received, and outputs score for user
  - Displayed on top right and updates whenever user plays correct note

Haptic Glove(s) Sub-System

Haptic PCB

- Atmega328P Microprocessor
- HC-08 Bluetooth Component
- Haptic Motors

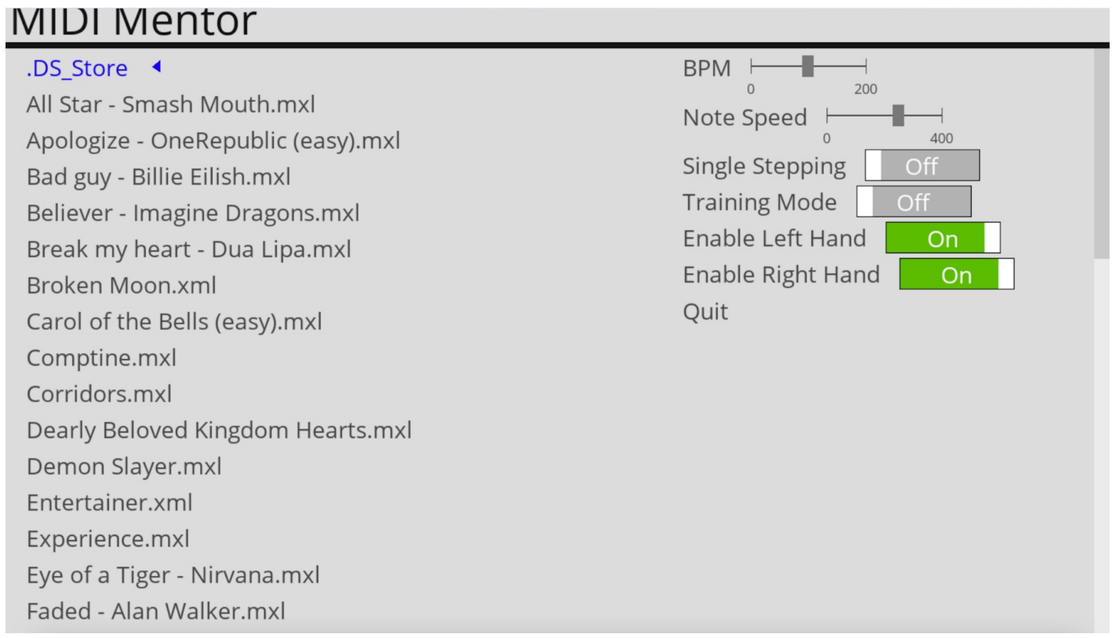
Functions:

ATmega328P receives transmitted data over Bluetooth and drives the corresponding GPIO pin(s) to turn on Haptic motors according to the finger generation

Costs

Part	Development	Production (1000)
Haptic Vibration Actuator	$12.00	$12.00
HC-08 Bluetooth Components	$9.98	$8.40
Voltage Regulators	$2.80	$2.54
Resistors (220Ω,1kΩ,100kΩ,10kΩ,2kΩ,68kΩ)	$5.30	$0.96
Lithium Polymer Batteries	$15.90	$15.90
Atmega328p	$9.33	$7.74
1N4001 Diode	$15.00	$12.00
P2N2222AG NPN Transistor	$3.36	$1.10
JST to Wire Cable Connector	$0.30	$0.13
Capacitors (0.1uF, 22pF, 0.47uF, 1uF, 4.7uF)	$10.15	$2.73
16 MHz Clock	$0.54	$0.29
Micro USB Connector	$4.10	$2.78
LEDs (WS2812B LED)	$7.52	$7.52
FTDI Serial Converter Cable	$19.95	$15.96
PCB(s)	$30.08	$16.63
3D Printed Circuit Housing	$5.00	$4.50
Total	$146.31	$123.31

Display Menu



Selection Menu

- Allows users to control song, speed and mode
- Sends Fingering Data to Haptics via Bluetooth
- Sends MIDI note number data to Led Strip via FTDI Converter Cable
- Left column contains list of song available to play
- Right column contains controls to mode and speed
- Speed
  - Beats Per Minute (Tempo)
  - Note Speed
- Mode
  - Single Stepping (Play by note)
  - Training mode (Play by measure)

LED Sub-System

LED PCB

- Atmega328p Microcontroller
- USB to Serial Cable
- LED Strip

Functions:

- Receives converted Note Numbers (36 - 96) (from pitch (A0 - C8) values) from python via serial communication
- C++ code receives ASCII value then turns on LED number accordingly
- Lights up to indicate which notes to press
  - Left hand = Blue
  - Right hand = Pink

Testing Results