**Introduction**

Piano illumination is an innovative way to learn piano skills at your own convenience for a revolutionary low cost. The piano illumination will convert music data from synthesis into a readable signal that is outputted via LED lights on a piano.

![Figure 1: LED lighting up piano keys](image)

There are millions of individuals with physical disabilities who are unable to learn piano due to physical impairments. Our device is unique and allows physically impaired individuals to play their favorite songs on piano; or any other consumers who wish to learn piano step-by-step. Piano Key Illumination can benefit millions with and without disabilities as our product will give them the chance to learn their favorite songs on the piano.

**Methodology**

**-Why MIDI?-**

MIDI (Musical Instrument Digital Interface) files allow us the ability to send and read musical data. We decided to work with it because it has been the music industry standard for over 30 years. Mostly all musical equipments, instruments, and programs have been integrated to work with MIDI files.

The sound of each piano key note is different because they all have inherently different frequencies. Our choice of utilizing MIDI files for musical manipulation allows us to simplify any analog to digital conversion as any device integrated with MIDI does it on its own. Another reason we chose MIDI is because they store a wide array of information such as velocity, pitch, and volume with minimal storage use when compared with other file formats.

**-Continuation-**

Part 2 involves how the user utilizes the device: the user presses a key, the controller recognizes that the wrong or right note was played, and either return to the previously highlighted key or continue until the song is complete. Our biggest challenge will be linking the Raspberry Pi microcontroller and LEDs together. Getting them to work together is imperative to the overall success of the product.

**Block Diagram: Closed-Loop System**

![Figure 2: Basic design of project](image)

We used a closed loop system that enables us to continuously retrieve MIDI data as the system outputs onto the LEDs. It will also allow for instant response to wrongly inputted keys made by the user. It consists of 4 main components that culminate the entirety of our key system. Synthesia, Raspberry Pi, OLED display, and LED strip. The OLED display is mainly for user customization, preference, and settings.

**Product Components**

- Synthesia
- Raspberry Pi 4
- OLED Screen
- LED Strip

![Figure 4: Products used in our Project](image)

Our systems uses Synthesia as our main source of input data. It receives the MIDI data as input which allows us to program it to our desire. The Raspberry Pi 4 assigns LED’s to specific notes we were able to use the MIDI data received from Synthesia to light up the corresponding keys on the piano.

We also integrated an OLED screen that allows for customization, settings alteration, and song selection. One of its most important settings is allowing the number of keys and width of the keyboard set i.e. the product can be used for small MIDI-enabled keyboards. With the screen, users can pick a song in the playlist to learn with; moreover, they can choose the speed of the song to play with.

**Analysis and Results**

When testing our project we confirmed the following:

- Corresponding LEDs to keys were lighting up.
- Raspberry Pi 4 was able to detect if proper key was pressed.
- OLED allowed for user preference customization.
- Song selection was working.
- Width/keyboard length adjustment was available.

**Product Components**

- Synthesia
- Raspberry Pi 4
- OLED Screen
- LED Strip

![Figure 5: Circuit Diagram](image)

To have the Raspberry Pi 4 light up our LEDs, all we needed to do was connect it to the General Purpose Input/Output (GPIO) pins. Since we decided to integrate an OLED screen for more customization, we were required to use a 3 input cable to connect our LED to the Raspberry Pi 4 GPIO pins, as shown in Figure 6.

**Summary/Conclusions**

In conclusion, our Piano Key Illumination project was designed to help physically impaired individuals learn how to play the piano.

This was achieved by having the piano key physically lit by its corresponding LED. In addition, our device includes a feature where it waits for the user to press the correct key before continuing the song. This way the user can learn the song at whatever pace they desire.

**Key References**


**Acknowledgements**

During the process of making this device, we specially want to thank the following for their help and guidance:

- Professor Sotoudeh Hamedi-Hagh
- Muqtadir Ansar
- JaMike Photography & Production