Documentation

Digital Piano with Practice Mode

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Submitted By

Team Number: 2

Zarif Hossain, 170042019

Fahmida Tasnim Lisa, 170042020

Sharmin Naj Mou, 170042074

Submitted To

Md. Nazmul Haque

Lecturer, Islamic University of Technology (IUT)

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1 Overview

Digital Piano with Practice Mode

Our project will be to make a digital piano with practice mode using arduino so that anyone can learn how to play the piano.

Features:

- Digital Piano upto 2 octaves
- 28 keys piano
- Three level of practice mode: Easy, Medium and Hard
- Reward system after each level completion

In our Arduino project, we made a piano with 2 octaves and a Practice mode where the user can practice hearing. The training is in three levels: Easy, Medium and Hard mode. If the user presses on these training mode buttons, the Piano will make sound of several notes and the user must play the notes similarly as they heard. If the user answers correctly, the green LED will light up and the reward system messages will light up in the LCD screen. Again, if the user plays the wrong notes incorrectly, the red LED will light up and we will also prompt messages on the LCD screen. The LCD screen is also used to display the notes played.

2 Project proposal

2.1 Motivation

Many of us have a liking for music. Music exerts a powerful influence on us. It can boost memory, build task endurance, lighten the mood, reduce anxiety and depression. Because of our liking of music, many of us want to learn musical instruments. Piano is one of the most played and popular instruments. Although anyone can acquire a digital keyboard, the learning curve is pretty steep. So, Our idea is to build and mimic a Digital Keyboard (midi) with practice mode. With the help of practice mode, our user can learn to play piano.

2.2 Social Impacts

As stated before, people are fond of music and they try to learn instruments to play, but the learning curve is steep and it's a barrier. We're trying to break this barrier, with our practice mode integrated into our piano anyone can learn basic tunes and then can play themselves afterwards. In the era of digitalization, people would be more eager towards digital piano, and our digital piano with integrated practice mode, would help them to not only play the piano but also learn without any prior knowledge.

2.3 Related Works

There have been many works related to digital pianos. Some of them are:

- Paper piano with Arduino
- Electronic Piano with preset songs
- Arduino controlled piano robot

2.4 Challenges

- It's a challenge to synchronize and manage notes of Piano with push buttons
- Adjusting tone duration

3 Components

The components used in our project are described below:

- **1x Arduino UNO**

  Arduino UNO is a microcontroller board having 14 digital input/output pins and 6 analog input pins, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It is one of the most popular microcontroller boards in the Arduino board family.

- **28x Pushbuttons**

  We used 28 push buttons for our project. Of which 25 are notes and the rest 3 are for choosing the difficulty level Easy, Medium and Hard.

- **Multiple Resistors**

  We use the resistors to work the pushbutton circuit and we arrange them in an incremental pattern in such a way that its helps the value in the analog inputs go up constantly.

- **1x Piezo Buzzer**

  Piezo Buzzer in a tiny speaker connected directly to Arduino. We use it to make our notes with specific frequency audible as it is a digital piano.

- **4x Solderless Breadboards**

  We use 4 breadboards so we can complete our circuit. We use 3 breadboards where we use the 25 button for our notes where we arrange in such a way that there is 8 in two breadboards and 9 in one. And we use another breadboard(small) for the three buttons for 3 types of practice mode Easy, Medium and Hard.

- **2x LED - Red, Green**

  We use these LED lights during practice mode. For when the user will complete it correctly green LED will light up and if the sequence is wrong then red LED will light up.

- **LCD Screen**

  We will use this LCD screen to make a kind of reward system where will display encouraging messages for the user after each level completion.

- **1x Potentiometer**

  A potentiometer is a simple knob that provides a variable resistance. We use it to control the brightness of LCD Screen.

4 Workflow

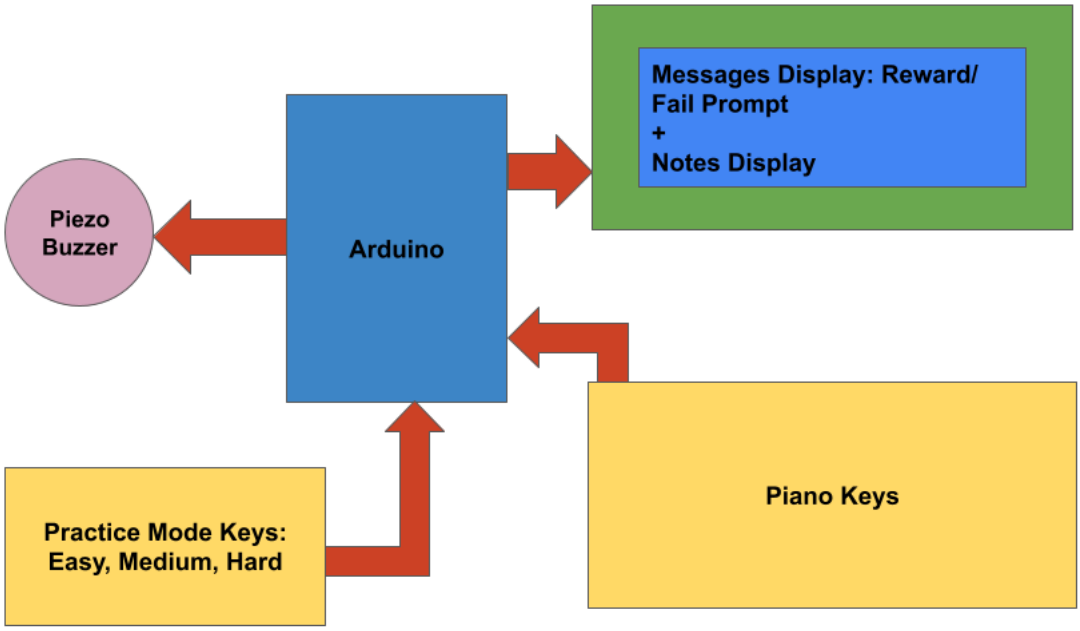

Figure 1: Digital Piano with Practice Mode Workflow

In this project, Arduino uses push buttons as the notes input through analog pin A3-A5. For the speaker, we used the Piezzo buzzer in Tinkercad.
Workflow with observation:

- We built the circuit in Tinkercad. We place the breadboards of the circuit and the other components to create the total of 25 notes or 2 octaves for the piano. We decided to split the piano into multiple breadboards to the make the analog input value more wider.
- Now we take the components needed to the workspace. We have the Arduino UNO, Piezzo Buzzer, breadboards, some push buttons and some resistors. After connecting all the wires, voltages, pins and to the three breadboard, we put all the push buttons into the three breadboard. There are 3 breadboards, so we divided it into 8 on the first and second breadboard, and 9 on the third breadboard.
- The resistors are arranged in such a pattern that the first resistor 2000Ω to connect from Arduino to the push button, then the second resistor that connect first pushbutton to other push button is from 200Ω, and go up 2 times from it. So we got 200, 400, 800, 1600, 3200, 6400, and finally 12800. This is done so that the value in analog inputs will go up constantly.

Notes	Frequency	Notes	Frequency
C	261	C#5	554
C#4	278	D5	587
D4	294	D#5	622
D#4	312	E5	660
E4	330	F5	698
F	349	F#5	739
F#4	371	G5	783
G	392	G#5	830
G#4	416	A5	880
A4	440	A#5	932
A#4	467	B5	987
B4	493	C6	1046
C5	523		

Table 1: Notes and their Frequency (Hz)

- We take a small breadboard for the 3 types of practice mode, Easy, Medium and Hard. We need 3 pushbuttons,3 resistors for pushbuttons, 2 LED(red and green), and 2 resistors for LED.
- We write the Arduino code for the melody of the piano. In this piano, we make the 2 octaves piano from C to C6. The main goal here is when we press the pushbutton, we can hear the exact same sound as a real piano. Table 1 shows what frequency we set for each of the notes used in this project
- We placed an LCD screen for displaying the notes. Also if the user plays any of the training mode correctly, then the LCD screen will show encouraging message prompts. For example, If user completes a melody, it will show 'Congratulations!'. If the user plays it incorrectly, then the LCD screen will show failure prompts or will encourage the user to try again. For example, If user presses wrong key, it will show 'Wrong Key Pressed'.

5 Experimental Setup

We built our project in Tinkercad. Here is a snapshot of our design:

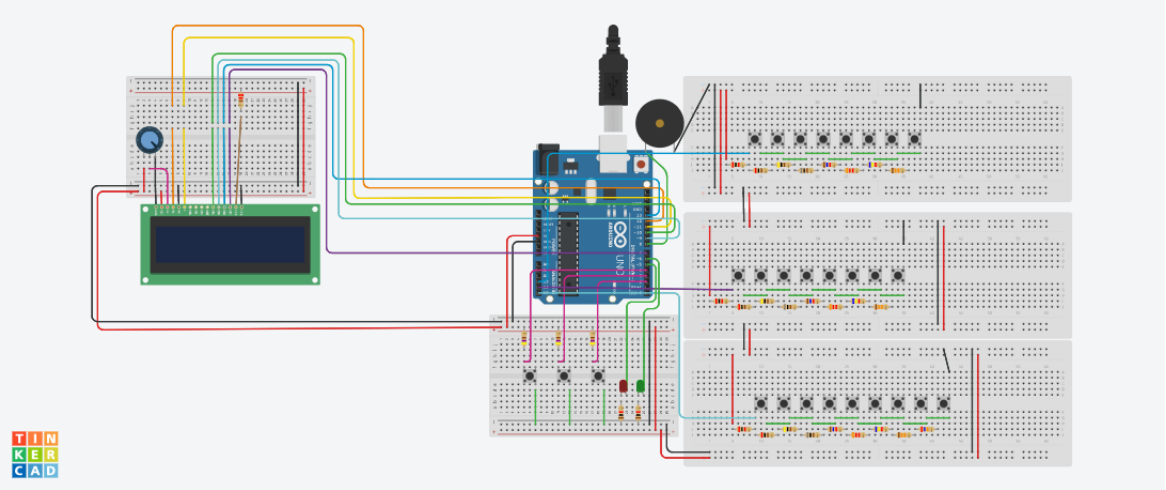

Figure 2: Virtual setup of Digital Piano with Practice Mode in Tinkercad platform

6 Manual

User Manual for using the Arduino project of Digital Piano with Practice Mode:

- After starting the simulation in Tinkercad, you can click any pushbuttons to play any of the notes. We attach labels to each of the pushbuttons so the user can tell which piano notes they're playing.
- The users can choose any level of practice mode: Easy, Medium and Hard. The user can choose any of the three pushbuttons from the separate small breadboard on our project to select the practice modes.
- After selecting a practice mode, the user needs to listen to the notes being played on the Piezzo buzzer. Then he/she should try and play the notes similar to the way he/she heard on the speaker and displayed on the LCD screen. If the user can play the complete sequence of notes correctly, then the green LED light will light up and also there will be an encouraging message on the LCD screen. If the user makes a mistake during the playing of notes during practice mode, then the red LED light will light up and there will also be prompts message on the LCD screen.

Here is the google drive link with demo and audio description of our project: `https://drive.google.com/drive/folders/1Jqt8PtPgB6PHtDZnDSRjCmF6h3AEvNkX?usp=sharing`

Here is the GitHub repository with whole project (circuit design, code, demo, documentation):

`https://github.com/lisa1704/digital-piano-arduino`

7 Limitation

- We are getting slightly distorted sound quality because of doing the project on Tinkercad.
- We are not able to maintain the tempo because the project is heavier on Tinkercad.