Ryan Stoltz & Charlotte Fanning

**Project Summary**

We designed an arduino controlled piano using a piezo buzzer and a joystick. The piano’s notes are controlled by the joystick, which inputs frequencies corresponding to the x and y values that are based on the position of the joystick. As such, we designed this device with the intention of assisting people with disabilities (ex: have had a stroke, suffer from parkinsons, amputees) regain the ability to make music on a piano. We worked off of the question: how can we design a piano that, without the ability to apply any pressure, could play at least 8 notes?

We started by testing and experimenting with the functionality of the joystick. We attached LED lights to the breadboard, and we set the output of the LEDs to correspond with the directional inputs of the joystick. Once we were able to get this working, we removed the LEDs and began building the circuit using the piezo. We used a set of resistors to carry current from the piezo to the arduino, then connected it to the joystick. We then attached the joystick directly to the breadboard, used wires to connect the joystick and buzzer to the arduino, and the circuit was done.

The code was more difficult to get correct. We began by setting up resting coordinates, determining the central position of the joystick, and ensuring that no sound was produced when the joystick was at this position. We followed by creating a set of nested if and if-else statements that bounded both the x and the y value of the joystick. The bounds were determined by readings we got from the serial monitor. Through these, we were able to map frequency values to certain notes, setting the piezo buzzer to play at a note’s frequency when the joystick’s x and y values fell into a certain range. Then, in order to get more playable notes, we added a variable denoting the octave of the notes being played, using a frequency multiplier to shift octaves based on the settings within the code. The lowest octave we were able to fully play all 8 notes at was octave 2, although the sound was quite distorted, and the highest octave we were able to play all 8 notes at was octave 8. Overall, we were able to achieve a full range of function for the piano, making the project a success.

In terms of solving the problem to our satisfaction, I think we made a brilliant POC (proof of concept) that, given more time and resources, could become a useful tool. We had a bit of trouble with bounding the frequency ranges. For example, if two ranges were too close together , slight shifts in the joystick would lead to a rapid change in tone from one note to another. This meant that certain directions on the joystick would be far more sensitive than others. We also had an issue where, on different days, the frequency ranges that correspond with the x and y values on the joystick would shift, thus necessitating a recalibration for those values. In terms of solving the problem, I think we created a solution, but not an implementation. As it stands, the device is fully capable of playing 8 notes in rapid succession, thus creating music. In implementation, one would want to consider creating avenues for producing chords, creating mechanisms to shift octaves on the piano, and allowing for some form of recorded playback.

In the future, we would like to see our idea fleshed out into a commercial, yet specialized, product. To do so, we learned some valuable lessons. Firstly, the joystick being used is highly important, especially based on the internal mechanisms. In this use case, a high end joystick with haptic feedback and a high degree of precision would be necessary. Additionally, a larger speaker capable of higher and more complex frequency ranges would be vital to the success of such a product. Finally, I think the biggest component we are missing from the project is a functional GUI. When taking a product, such a piano, and compressing it into another interface, establishing the connection between the original product and the interface is vital. For that reason, I would say there is a lot of potential for a product such as this one, and there are many options and possibilities in this field.