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E-ccordion

Design Proposal/Concepts:

For this project our goal was to build an electronic accordion. The "E-ccordion" consists of a middle box, a foot petal, and two bowls that rotate freely on either side of the box to control note velocity. The middle box consists of three vertical sliders, four momentary switch buttons, and three potentiometers. The three sliders allow the user to manipulate the filter frequency, amplitude envelope, and vibrato. The four momentary switches allow the user to choose between seven different channels, each giving a different MIDI sound. On three sides of the middle box are the three potentiometers. The two horizontally positioned potentiometers allow the side bowls to rotate freely in order to manipulate note velocity. On the bowl for the right hand there are 13 momentary switch buttons positioned similarly to piano keys. The bottom row of buttons plays natural notes and the top row sharps and flats. Also on the right hand, are two more momentary switch buttons that cumulatively control the octave. The bowl for the left hand consists of 5 buttons which allow the user to choose between playing the lower fifth, root, third, 5^{th}, and the whole chord. The user can select a chord using the foot pedal which also contains 5 buttons representing the C, F, G, A minor, and E minor chords.

Construction:

Middle Box

Four holes were drilled on the front panel of the box so the four momentary switch buttons could be inserted. Above each of the four momentary switch buttons five holes were drilled so LEDs could be inserted to light up to indicate which channel had been selected. In the end the LEDs were not used so the holes were covered. Right above the momentary switch buttons six holes were drilled in order to insert three sliders. Superglue was then used to secure the sliders in place. A larger hole was drilled on the left, right, and bottom sides of the middle box. A potentiometer was placed in each of these three holes allowing the bowls and middle box to rotate freely. By rotating the bowls on the x-axis the user could manipulate the note velocity and by rotating the middle box on the y-axis the user could manipulate modulation. In order to secure the vertical potentiometer, a hole the size of the potentiometer was drilled into both a small square piece of wood and an equally as small piece of foam. The piece of wood and piece of foam were kept together using screws drilled into both. The

vertical potentiometer was placed through both the foam and wood and then glued in place for extra support. This forced the shaft to remain stationary while the rest of the potentiometer moved; this allowed for more accurate potentiometer readings. Finally the entire the vertical potentiometer was placed inside the microphone stand. Lastly a saw was used to cut two rectangular pieces out of the back panel of the middle box. This allowed us to feed the wires from the right and left bowls and foot pedal into the breadboard attached to the back panel.

Right Hand

For the right hand bowl, holes were poked in order to easily insert the four nodes of each button. First, the spacing of the buttons and nodes were marked on paper. Then that paper was taped on the right hand bowl and used as a guide. Hammers were used to drive the nail through the plastic at the marks so that later the buttons could be inserted inside. Once the buttons were inserted wires were soldered to the upper right and lower left nodes of each button. There were two rows of buttons situated like piano keys. The bottom row had eight buttons representing the natural notes. The top row had five buttons representing the sharps and flats. After those holes were poked another hole was drilled in the lid of the bowl in order to attach the other end of a potentiometer. Finally the bowl was cut into using a dremel in order to put on the straps. The straps had Velcro on the ends and went through the inside of the bowl and back out again in order to allow the user to adjust the tightness around her/his hands/wrists.

Left Hand

The left hand allowed the user to play chords with ease. Similarly to the right hand holes were poked in order to easily insert the four nodes of each button. Once the buttons were inserted wires were soldered to the upper right and lower left nodes of each button. Five momentary switch buttons were then inserted allowing the user to choose between playing the lower fifth, root, third, 5^{th}, or whole chord. Again this bowl was cut into using a dremel in order to put on the straps.

Foot Pedal

Five holes were drilled about three inches apart into the top of a wooden piece with dimensions of approximately 21x6x0.4 inches. Five momentary switch buttons were then placed inside these holes and eventually glued in place. The spacing of the buttons makes it difficult for the user to accidentally step on more than one button. Supports were then added to the sides of the top piece by bolting brackets to the corners. In order to allow for easy wire access the pedal has no bottom. The wires were taped and secured to the bottom of the wood and easily fed through an opening at the top. A ribbon cord was used to combine all the wires from the five buttons. This made it very simple to connect and disconnect the foot pedal to the rest of the E-ccordion as the cord went up the stand into a male/female connector.

Breadboard

Two wires were soldered to each momentary switch button. On the breadboard one wire end was connected to ground while the other was connected to 5-Volts. On the end of each button row was placed a 10K resistor. Wires were placed in the sole empty column of each row and went from the breadboard to the arduino. After each button was hooked up in the breadboard the sliders on the middle box were then connected. The brown slider wires were connected to the power (5 Volts) and the white wires were then connected to ground. As for the potentiometers the horizontal potentiometers only had one wire which went to power. The vertical potentiometer had two wires one of which (blue) went to power and the other of which (green) went to ground.

The **Max Patch** consists of four subpatchers.

Right hand:

When the right hand is played a selector filters out notes from left hand and other notes that should not be played by the right hand. An instrument is changed in reason when a note is picked out by a select object which changes the channel of the noteout. Lastly, the octave is changed by a select object that picks out two notes and raises or lowers the octave when they are pressed.

Foot pedal/Left hand:
The instrument channel for the foot pedal works similarly to the right hand. If one of the five buttons is pressed a selector picks out five notes which represent the chords the user can choose to play. After a chord is chosen a selector chooses which notes to play in that chord (lower fifth, root, third, 5^{th}, and the whole chord). After the notes to be played are selected noteouts are sent to the output.

Channel:
When a note is sent out, its channel is read. This current channel is changed when the command to change is sent in a message box. This system prevents more than one channel from being changed at a time.

Controllers:
The velocity for both hands are manipulated by controllers in Max. This Max patch receives 10 to 13 controller ins (ctlins) and, using the channel patch, gives out respective channels and sends controller outs (ctlouts).

Reason Patch

There were 7 different patches in Reason which were copied twice so that the left and right hands could each play a different instrument simultaneously. The NN-19 digital sampler included the "female-ahh", violin, and clavinet. Four Subtractors offered the sounds "Monsterbell", "Accordion", "Harponic", and "Hip Hop". The amplitude envelope, filter frequency, and modulation are all controlled by the sliders on the middle box. The velocity is controlled by the rotation of the side bowls.

Final Performance

Sadly, the E-ccordion did not play anything the day of the performance. As of yet it is not known where exactly the issue lies. However, efforts are being made to search the wiring for shorts and other errors. The Max and Arduino code are also being explored for errors.

In general the buttons were much easier to work with as opposed the buttons used in the first version of the E-ccordion. I did not have to stretch or arch my fingers as much to reach the them. It also worked much better having the buttons that controlled the chords on the foot pedal versus the left hand as having both sets on the left hand got a bit tedious and confusing. The stand was also much more secure which was useful when we wanted to rotate the E-ccordion along the y axis in order to manipulate the modulation. Thankfully, for this variation we were able to easily adjust the height of the stand as well which allowed us to stand and play. The straps on this version were more comfortable than the last as they allowed us to more easily adjust the tightness.

Future Work

If I had more time to work on this project I would definitely investigate why Max would not recognize signals from any of the buttons. While I did look at the wiring in search of possible shorts or errors nothing stood out.

For the right hand it might be interesting to see if I could decrease the amount of surface area taken up by the buttons by implementing a system similar to that of the left hand. It could possible only

have 5 notes or so and then, similar to the Samchilean, play a note using relationships (up one or down one note).

Because we used a mic stand it might have been interesting to incorporate the stand a little more. Maybe we could put FSR sensors on the base of the stand which when pressed would start a loop. Or maybe the FSR on the base could provide a drum beat.

For the next variation it might be fascinating if we got rid of the middle box completely. A pole could run through each bowl allowing each bowl to move horizontally along the pole. This would enable us to manipulate more parameters depending on the distance the bowls are apart. This way the bowls would still be able to rotate along the a-xis (the pole) maintaining our ability to control note velocity as well.