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Computer Science 207: Building interactive Gadgets

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My grand project idea:

I originally got the idea to make a theremin from an instructables.com /*
http://www.instructables.com/id/DIY-Matryomin-Open-Source-Theremin-in-Matryoshka/
*/ post called Open Source Theremin in Matryoshka. After doing some more research
on the Open.Theremin shield, two things were obvious. One, that I really want a
theremin. And two, that as cool as the Open.Theremin shield is, it's over $200 dollars
before shipping all the way from Europe and its already perfect meaning there isn't
much to improve on or hack around with.

More research on simpler theremins eventually led me to the electrominds
website /* http://www.electrominds.com/projects/simple-arduino-theremin-theremino */
then problem then was that I couldn't think of an idea to hack/improve the theremin until
my lab instructor Prof. Alex Clarke gave me the idea to try and connect it to my
computer using this Ableton software called Max for Live. I liked the idea of making a
theremin for a couple reasons. The first and biggest one is the fact that the hardware
part didn't seem too difficult to make which is nice since I have never used an arduino
outside of the lab and I am not a computer science student. The second reason is that
my favorite comedian hosts a podcast and he plays around with a theremin on every

single episode for no reason other than that he likes it. He even always has an extra theremin laying around for his guests to use through the show as well.

The main difference between my theremin and the theremin above from electrominds is that instead of the sound coming out of the small speaker he wired onto the breadboard, I am going to somehow try and hook up a midi breakout shield so that the sound will come out of my laptop instead where I can change the sound to whatever I want. In addition, I would like my theremin to be easily turned on only when a button on my breadboard is pushed and also have a LED light to signal when it's on. The reason I went with a midi breakout shield is because not only because it should connect my sound outputs to my computer, but it was also fairly cheap at only $25 on ebay from China. The only other thing I had to order was the ultrasonic PING sensor which was only a little over $7. I may have made a mistake by ordering the wrong ultrasonic sensor since 95% of the projects I see online seem to all use 4 pin ultrasonic sensors compared to the 3 pin ultrasonic sensor I am now stuck with.

So to summarize, when the button is held down the LED turns on as the signals from the ultrasonic PING sensor go through the midi breakout shield where my computer with Max for Live will convert the sensors values into different pitches to come out of the speakers.

Problems, problems and more problems!

When I had the idea to make a theremin that I can connect to my computer to change the sounds, I initially thought that setting up the hardware was going to be the

easy part and programming through Ableton/max for live being the hard part. Boy was I wrong.

I ran into many problems throughout the course of this project, the most annoying by far being simply how long the parts took to arrive here from China. I finally received my midi breakout shield and ultrasonic PING sensor only the Friday before December 9th leaving me only 6 days to complete the project along with my other assignments due that week for other classes. This was really frustrating since this is my first ever arduino project outside of the lab for this class, as well as my first time trying to use parts I have never used before. In hind sight maybe I should have just sucked it up and ordered the more expensive versions from America instead of trusting China but what's done is done.

My biggest failure by far was accidentally breaking/frying my original arduino uno. I am still not entirely sure how I managed to do beak it. I think I accidently plugged a wire that was meant to go to ground into a 5 volt pin on my breadboard or something by accident. What made is particular failure so much worse is the fact that I spent a whole night of my very time sensitive project researching what on earth could possibly be wrong with my laptop ports making this port error keep preventing me from uploading anything! Eventually I gave up and went to bed, it wasn't until the next day when I went back to my project that I realized no lights were flashing or turning on whenever I plugged the arduino uno in no matter what I did. A quick Google search told me that indeed my arduino was dead and done far, so I posted a Facebook status and luckily I was able to find a knock-off Chinese uno to buy for $20 that very same day!

My first goal was simply to get the ultrasonic PING sensor to display proper outputs in the serial monitor using code I got from the internet /* https://www.arduino.cc/en/Tutorial/Ping */ . I got the code as example code posted by a guy named David Mellis which converts the ultrasonic rangefinder into how far away another object is in centimeters. I consider myself extremely lucky for finding this code because ALL the other example code I could find for an ultrasonic PING sensor all used a 4 pin ultrasonic sensor instead of a 3 pin sensor like I'm stuck with. The ultrasonic PING sensor worked fine when I had it connected straight to the arduino uno, however I had a real hard time getting it to work though/with the midi shield on the arduino. It turned out that my problem was that the knock-off midi shield I bought from China was not set with the pins in the same place as the sparkfun schematics /* https://www.sparkfun.com/datasheets/BreakoutBoards/BOB-09598-MIDI_Breakout-v11.pdf */ that I was using. I was not able to find the proper schematics for my midi shield so I had no choice but to keep trying different pins until I found the ones I want.

After I finally was getting outputs in my serial monitor from a working ultrasonic PING sensor through my midi shield, I happened to find some code and blueprints online of a guy who successfully made an arduino theremin with both an ultrasonic sensor and midi shield like I have.

His code is found here: https://pastebin.com/rY5pZPUX

His outline I tried to imitate is found in the picture below:

fritzing
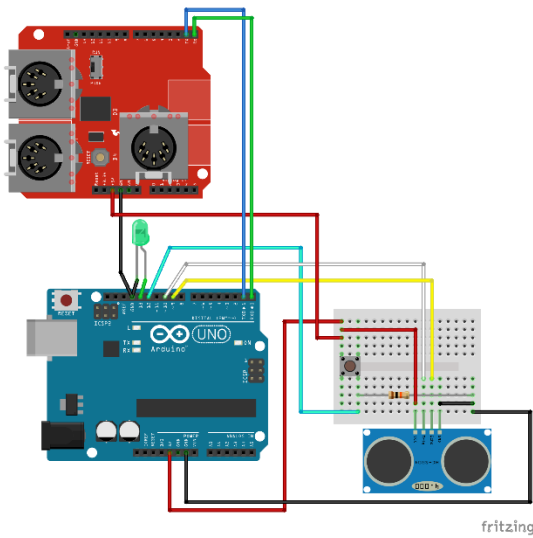
I really couldn't understand why he wouldn't put the midi shield on top of the theremin like it was designed to. And since I spent literally days just trying to get the ultrasonic sensor to work through the midi shield, I really wasn't willing to undo all my hard work just to copy his outline so instead I tried to recreate a similar set up myself.

My results own imitation is below:
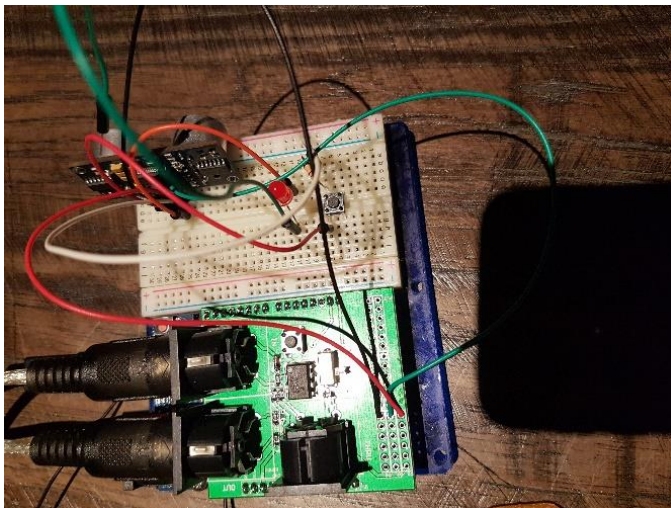
First I must say running his code on my imitation didn't work. But regardless I am still very proud of my failed project. Firstly because I am sure that all of my wiring is a correct imitation of his outline to the left even though I have my midi shield mounted and he does not. As someone who has never done anything like this I am proud to have been able to learn this much about circuits and wiring throughout just the course of this class that I can recreate something like this by myself. Secondly, I have never soldered before in my life. I have never even seen anyone else solder. I successfully bought my own soldering iron and taught myself how to do it off of YouTube. I can't even begin to describe the sense of accomplishment I felt doing it.

However, it did not work. Eventually I figured out that my midi shield just wasn't sending anything to my computer. I wasn't sure if this was my computers fault or my projects fault so the first thing I did was look for any and all related drivers I could download/update for my computer involving midi. After that didn't work I assumed maybe my computer was picking up the midi signals, but I had no program to interpret them. So I downloaded the free trial for Ableton but no matter how much troubleshooting and browsing the web I did I just couldn't figure out how to get and midi input to show up on my Ableton software. I then decided to try running some test code for just the midi shield to see if I could get it to work while ignoring the ultrasonic sensor completely.

Most of the test code I found online for a midi breakout shield turned out to be for very different versions of the shield that had all kinds of extra knobs and buttons that mine did not have. Eventually I found some test code, images, and diagrams for my exact breakout shield /* http://practicalusage.com/the-arduino/ */. But after debugging the errors (apparently Serial.print(var, BYTE); has been outdated to Serial.write(byte(var)), took me long enough to figure that one out) I still could not get my computer to detect it at all. I ended up downloading some software called 'Midi Monitor' and it was through that software that I realized that no matter what I did, I simply could not get this midi breakout shield to work on my computer.

Final project, finally!

Feeling both depressed and defeated, I realised I had bit off more than I could chew with this project. I just simply could not get this midi shield to work meaning there

is no way for me to get sound to go through my computer or any software on it. I decided to instead use this female aux cord I have to see if I can get any theremin like sound to get the input from my ultrasonic sensor to go out of my headphones which would be plugged into the aux.

By this point, I have completely given up on playing/adjusting anyone else's code to make what I want. After getting rid of my midi breakout shield I hooked up my female aux cable to pin 3 instead. Then all did was borrow pieces of the code I got from the arduino website for my ultrasonic sensor /* https://www.arduino.cc/en/Tutorial/Ping */ to put in both a playFuntion I made as well as the void loop to work only when the button (pin 1) is pushed.

My schematics and my final build:
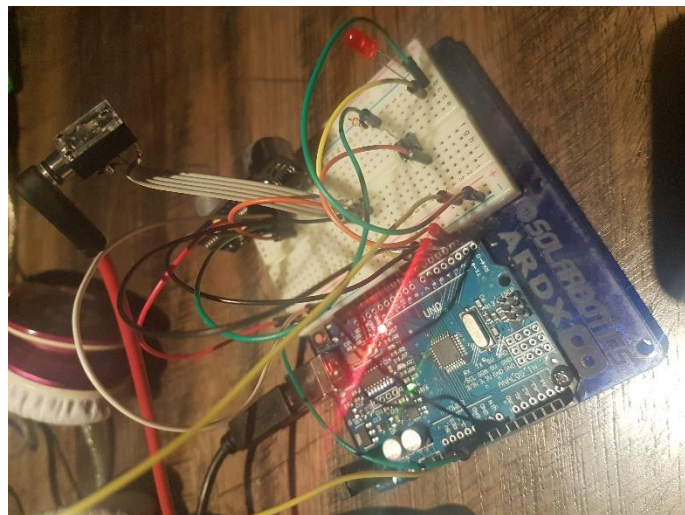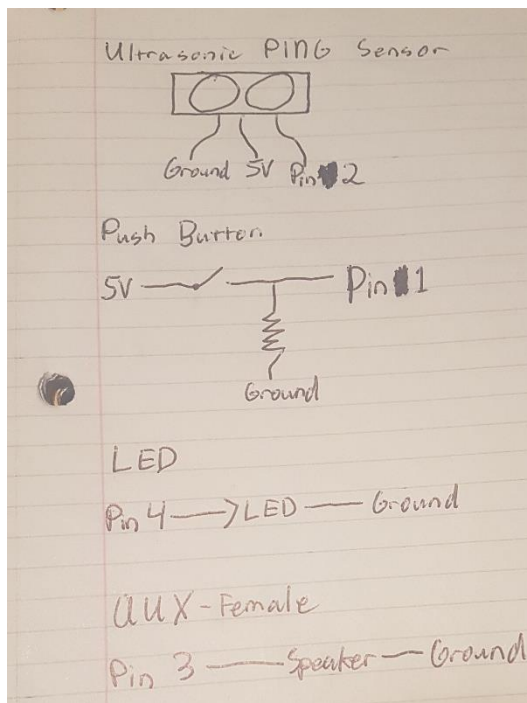
My final code is found here: https://pastebin.com/0aA3cD1J

Manual:

All you have to do is hold the button in the middle of the bread board which will turn on the LED light as well as create a very loud screeching sound through the AUX cord. That loud screeching noise will change as to different pitches of loud screeching noises as you move your hand closer to and away from the ultrasonic sensor at the edge of the bread board.

Last thoughts:

For my very first computer science class I think it went very well. I learnt so much and can now do things I never thought I could before. I am disappointed I couldn't make the dream theremin I wanted to make in my project proposal, but I am still shocked with how much I've learned along the way. I was successfully able to make a theremin, I just wasn't able to connect it to my computer to change the sound to whatever I want. It seems he more I learn, the more I learn how little I really know about this world programming hardware. The best part of this class was by far buying an arduino instead of a textbook, I can't wait to see what else I can think of to make although I am still fully set on buying a Raspberry Pi just to see if I can pull off my own RetroPi!