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ECE 110/120 Honors

Final Project Report

Introduction

Our project set out to design a new form of audio manipulation by allowing the user to define notes with colors. The Piano Board was made with color sensing and sound output as the foundation of it's design. The board would scan colors shaded on its surface, and produce notes based on the value produced by that color. The ability to play music in this style would prove to be useful in teaching allowing younger audiences to play with musical notes using only markers and erasers.

The design of our project utilized a motor circuit that allowed the color sensor to traverse the a linear path of the board, a wooden base that suspended the motor circuit above the whiteboard, and an arduino circuit that would scan the colors on the surface of the whiteboard, while the the breadboard holding it was mounted to the motor circuit. The arduino circuit would use a color sensor pointed at the board to scan and output a signal based on the color detected. The signal varied in frequency, which would then be outputted to the breadboard holding a hobby loudspeaker. The motor circuit had wheels connected to the motors, and sat along rails upon the whiteboard. The arduino and its sensor circuit use this linear path to scan all the colors shaded along the center of the board, and produce a sequence of notes through the loudspeaker as the colors changed.

Analysis of Components

Color Sensor Description

Given that the basis of our design was the T3200 Color Sensor, much of our characterization was based upon the details given in the datasheet. The color sensor had pins relating to the voltage and signal pins. The 4 input signal pins were S3,S2,S1, and S0, and these input pins served as control signals that controlled the state of the color filter in the sensor. These signals would be generated by the arduino digital input pins, which would generate a high or low voltage and connect that to each state pin. The output signal is generated as a result of the state of the device as well as the color being detected. The this signal would be read back into the arduino and manipulated using the program, whether we wanted to offset, amplify, or distort the signal.

The following two charts are taken the TCS3200 datasheet, and represent the states derived from the pin combinations.

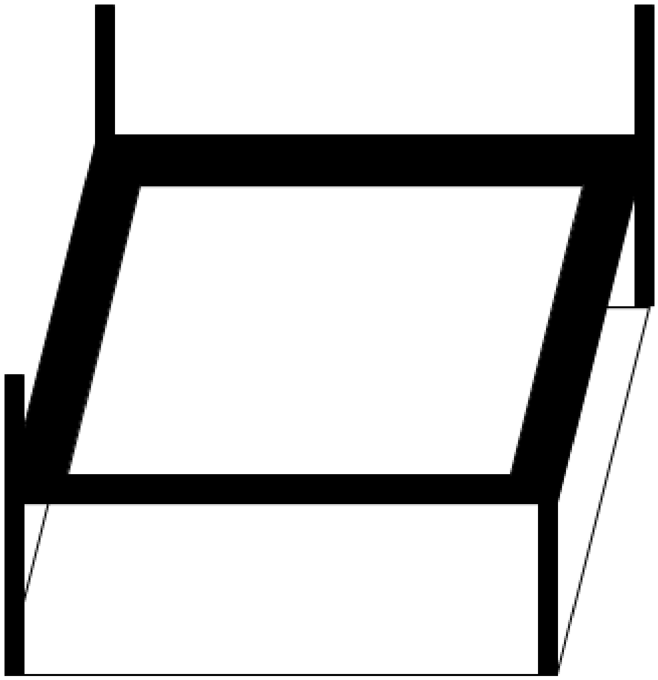
S0	S1	OUTPUT FREQUENCY SCALING (fo)
L	L	Power down
L	H	2%
H	L	20%
H	H	100%

S2	S3	PHOTODIODE TYPE
L	L	RED
L	H	BLUE
H	L	Clear (no filter)
H	H	GREEN

Due to the color sensor outputting a digital signal, we realized there was no need to implement any modules related to midi, as a digital signal by itself running through a loudspeaker should be able to produce a noise. Given that the frequency of the signal changed based on the color detected, we realized that producing different sounds wasn't too difficult to implement. Initially, we were going to implement two color sensors for the board, one serving as any offset for the frequency, mimicking an octave control for our device; however, that idea wasn't utilized due to the difficulties of implementing the code into arduino.

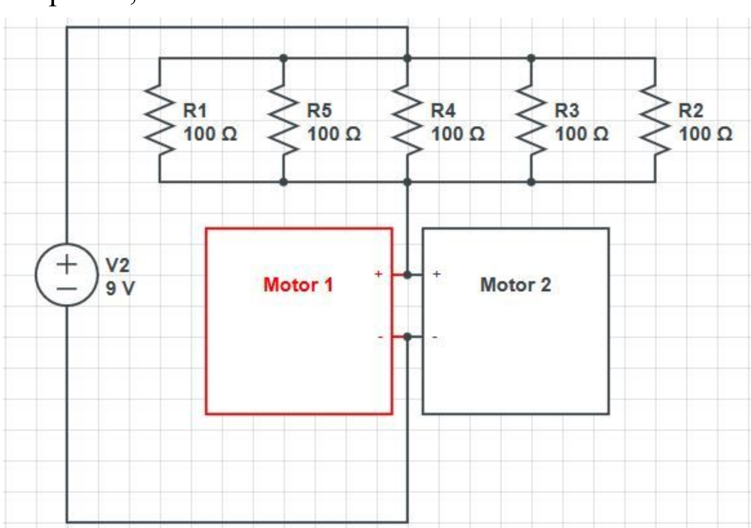
Design Description

Our design was pretty simple in conception. We were to use a color sensor to determine the color of two different blocks at one time, with one determining an octave, while the other determines a key. After being processed, it would send out a signal to a speaker which would play a key based on that information and the coding. We designed a rectangular prism. The bottom was where we were gonna place our whiteboard. Using the pillars on each corner as a support, we would create another level where we would place a kart that would carry the color sensor, and a speaker on top of it. A diagram is shown below:



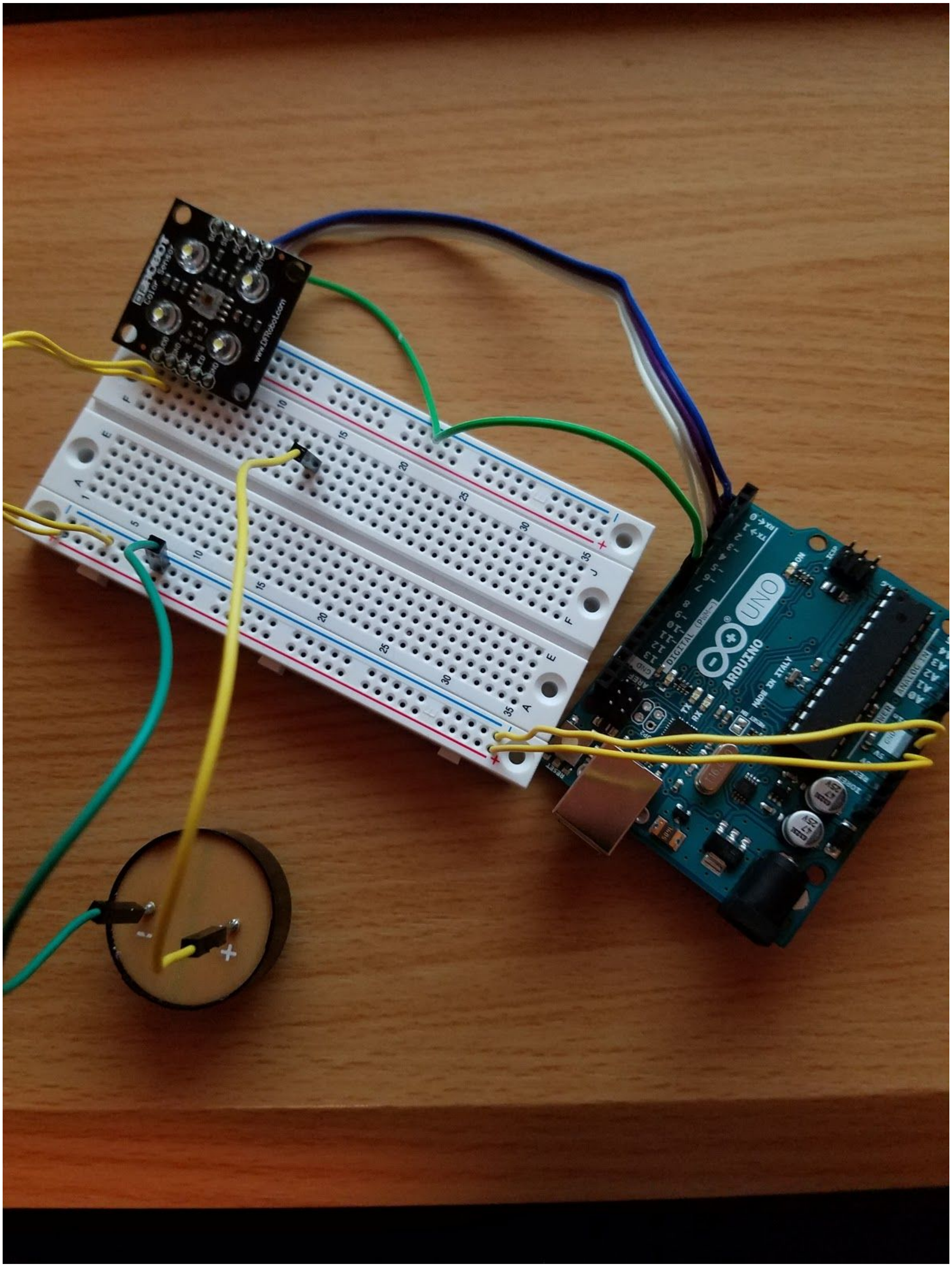
The top level(outlined in black) would have the cart with the color sensor attached to the bottom of it, while we kept the speaker on top. In terms of hardware itself, we would have a switch which would control the cart speed, allowing it to create different tempos for the music. In terms of the code, arduino refreshes fast enough for us to create a continuous loop of the color sensor sensing and processing frequencies for the speaker to produce.

The motor circuit used to transport the color sensor was based off of one of the beginning car circuits taught in 110 lab. The circuit loaded both of the motors in parallel branches, while most of the power and was being dissipated by an array of 100 ohm resistors. There were 5 100 ohm resistors aligned in parallel branches, mimicking a 20 ohm resistor, but with a much greater power dissipation, as a means to slow down the motors. Shown below is the motor circuit design.

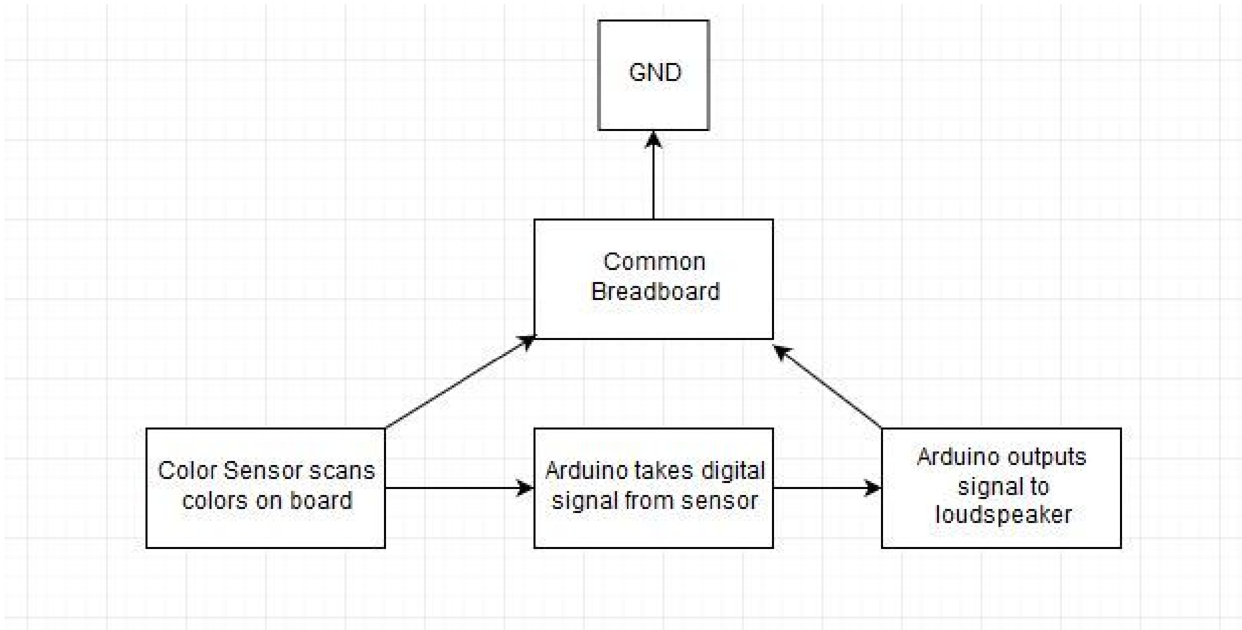


The loud speaker circuit was made up of only 3 elements: The speaker, the TCS3200 color sensor, and the arduino. This circuit was mounted below the vehicle using duct tape, and served remained plugged into the laptop as a means to supply power to the arduino without the need of another 9 volt battery. This circuit didn't turn out ideal in the final product, due to the lack of any other elements, as we believed that a simple digital signal running straight through a loudspeaker would automatically produce a noise. This was wrong as it didn't take into account the need for circuit buffing in order to protect the loudspeaker from being harmed in it's connection with the signal. Male pins, S0, S1, S2, S3, and OUT on the color sensor were connected to digital female pins 4, 5, 6, 7, and 8 on the arduino, respectively. The arduino connected another digital pin, 9, to the breadboard, which served as the signal output from the arduino to the breadboard, after manipulating the signal using the code. The positive terminal of the loudspeaker was aligned with the wire connected to pin 9, while the negative terminal was connected to the negative rail of the breadboard. Finally, the arduino supplied the ground and 5V input to the negative and positive rails, while the color sensor had its respective voltage pins connected to the rails, in order to receive power to be used.

Shown below is the loudspeaker circuit by itself.



Block Diagram



<u>Conclusion</u>

At the end of our endeavour we were unable to meet our vision unfortunately. We were able to design the hardware component relatively well, but due to issues with our sensors, and coding, we were unable to debug it enough for it to work. Our hardware did have a few issues with stability. We also opted out of using two color sensors, and instead just using one to determine the code. This limited our change of octave, which we changed to color depth, instead of color itself. What this means that since the color sensor can detect the amount of Red, Green, and Blue in each code, we can use this to our advantage by assigning different octaves to the different color depths. Unfortunately we were unable to create a user friendly way to switch between the different colors, other than simply switching with the different versions of the code.

<u>Future Plans</u>

Overall project was based on being more of a playful tool which people can use in order to create music, but we can see it being used as a sort of educative tool to round out senses. It could also be a more fun way to keep children interested in music and other areas. We would consider more development of this project, but as its main purpose would be to just have fun, the potential for social benefits is less defined.