NITK Surathkal

THINK. CREATE. ENGINEER 2018

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Air piano-MIDI Band

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Abstract/Aim of Project:

Air piano is our version of the musical instrument piano, the difference being that you don't actually need to press the keys but just hover your hand in the air to play notes!

The current interface involves a segmented foam board divided into 16 segments for 16 different notes. Each segment has an IR sensor which send the reading to Arduino Nano and 3x2 LED matrix which indicates the corresponding note being played.

The readings from the IR sensors are sent to the Arduino and then the software Hairless MIDI <->Serial Bridge is used to establish communication between COM Port and MIDI channel. This MIDI channel can be accessed from any music software like FL Studio, Cubase or Garbage Band.

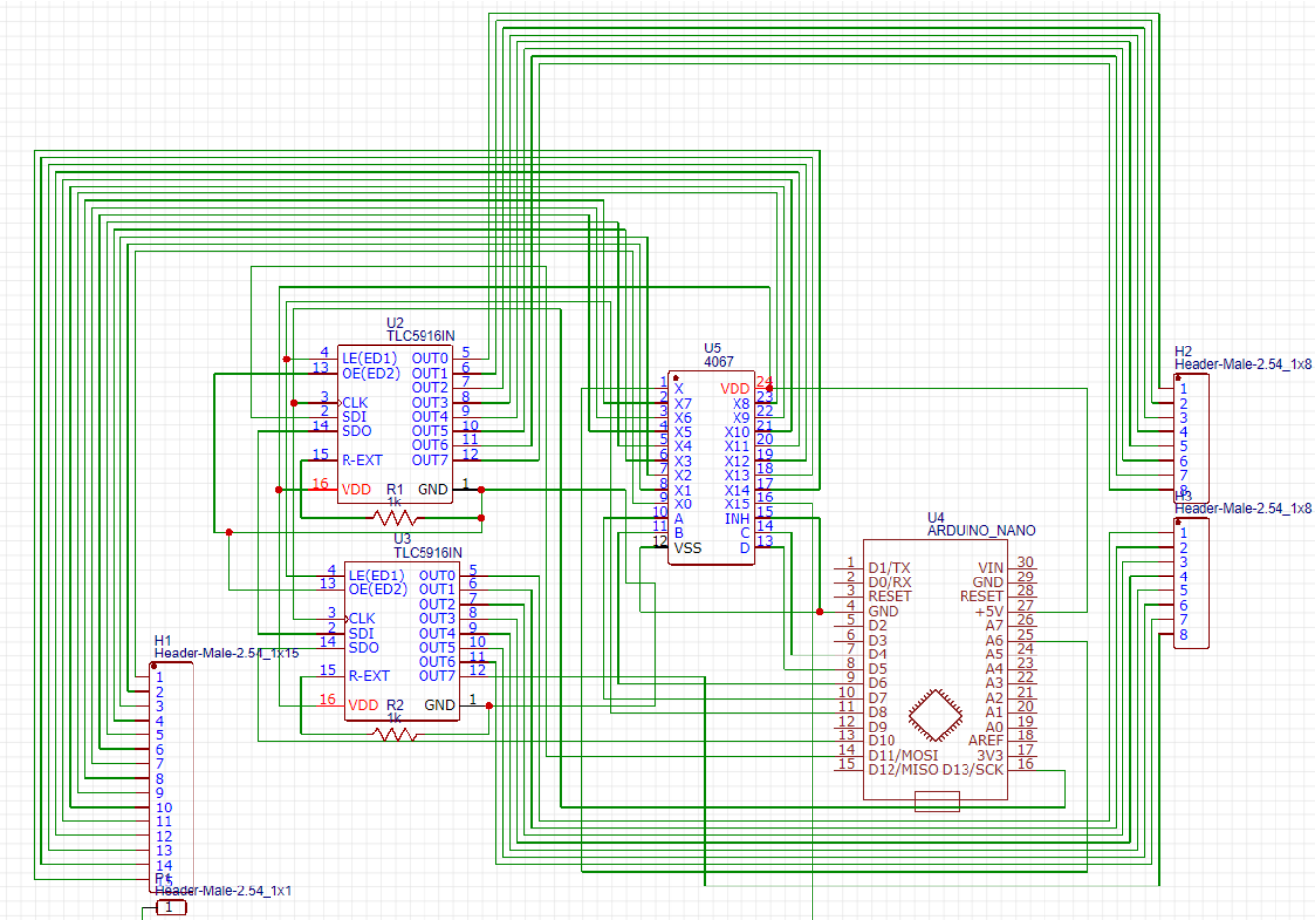
The LED matrix is controlled using TLC5916IN which is a constant-current LED sink driver.

Parts Needed/Used:

- Hardware Required
    1. Arduino Nano
    2. CD74HC4067(16x1 Analog Mux/Demux)
    3. TLC5916(LED sink driver)
    4. Photo diode
    5. IR LED
    6. Blue LED
    7. Resistors(47k,1k,330)
    8. Perforated board
    9. Flat cables
    10. Connecting wires

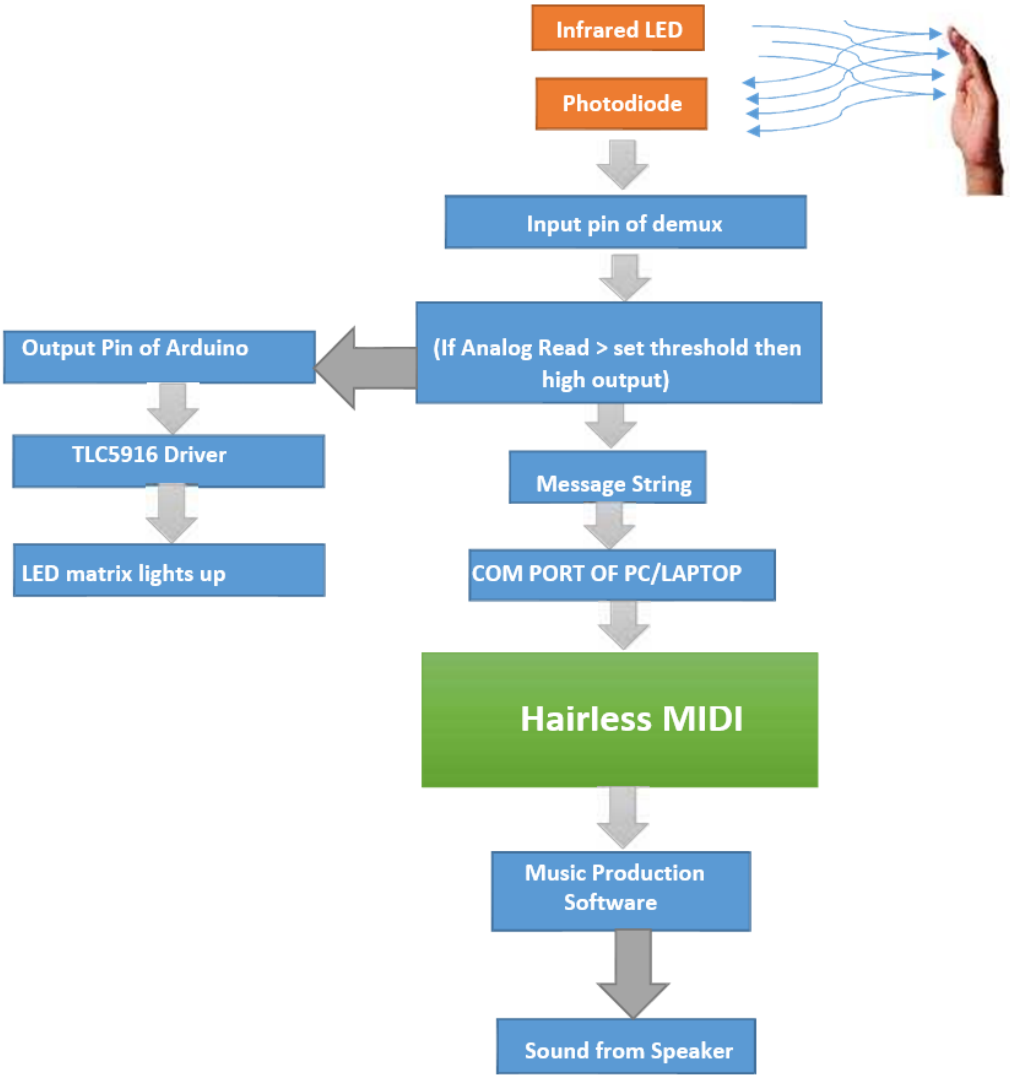
- Software Required
    1. Arduino IDE
    2. Hairless MIDI
    3. Loop MIDI
    4. FL Studio

How it works:



All 16 outputs of the IR sensor are connected to CD74HC4067(16x1 Analog Mux/Demux), working as a demux. The 4 select lines of the demux are connected to the D4 to D7 of the Arduino Nano. The Arduino processes the input and sends corresponding command to the TLC5916 led driver to light up the led matrix corresponding to the note being played.

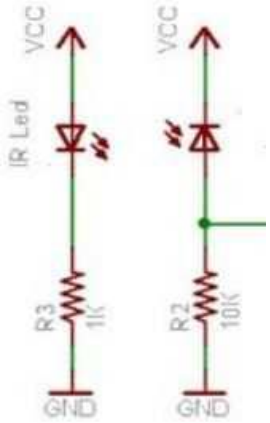
Block Diagram



Hairless MIDI<->Serial Bridge is the easiest way to connect serial devices (like Arduinos) to send and receive MIDI signals. To convey Windows MIDI data from one bit of software to another, you'll need a Virtual MIDI passthrough driver, like

loopMIDI. LoopMIDI is used to create virtual loopback MIDI-ports to interconnect applications on Windows that want to open hardware-MIDI-ports for communication.

IR SENSOR SCHEMATIC



Steps:

1. The first step is downloading the required software that are FL studio, Loop MIDI and Hairless MIDI.
2. Open loop midi and select a loop midi port. Open hairless midi and select serial port and midi out port. Also ensure that the baud rate is same by going to File→ preferences→Serial port settings.
3. Open FL Studio and go to Options→Midi settings then select midi port and enable it.
4. Now we are done with the interfacing part basically. Next step is the hardware part.
5. The hardware part involves the making of IR sensors. We are given perf boards, ir led's , photodiodes and resistors. So, in total we have to make sensors equal to the number of keys in the piano that was 16 in our project.
6. Now comes the checking of the IR sensors. So, we individually check the sensors through the Arduino uno using the analog read code given in the examples of the Arduino IDE.

7. Make sure all the sensors show the same behaviour by checking the values on the serial monitor. If all the sensors work fine, then we are done with 70% of our job.
8. The material for making the base and the keys of the piano is cut from the board and glued to make the structure ready.
9. The IR sensors are then glued to the board and partitions are well maintained so that the IR sensors work properly.
10. The wiring part of the project should be done carefully. Make sure you know the initial and final destination of the wires. (that would help you in deciding the length, flexibility). Please use very flexible wires for all the wiring purpose (only multistranded, not single stranded).
11. After getting this done, again we have to check whether IR sensors are working fine or not. NOTE - each sensor should show the same behavior, if not then adjust accordingly by making suitable changes. (for e.g. cover the partition slots with black paper or align the IR led and the photodiode properly)
12. The above troubleshooting takes a long time and one needs to be patient at that time. This completes 90% of the project.
13. Once the PCB which contains the Arduino Nano and the shift registers IC's is soldered properly (that's the most difficult part of the project and so it is done by seniors) is ready, you are ready to connect all the wires through headers.
14. Once all the connections are made properly, we are ready to upload the code and our air piano is ready.

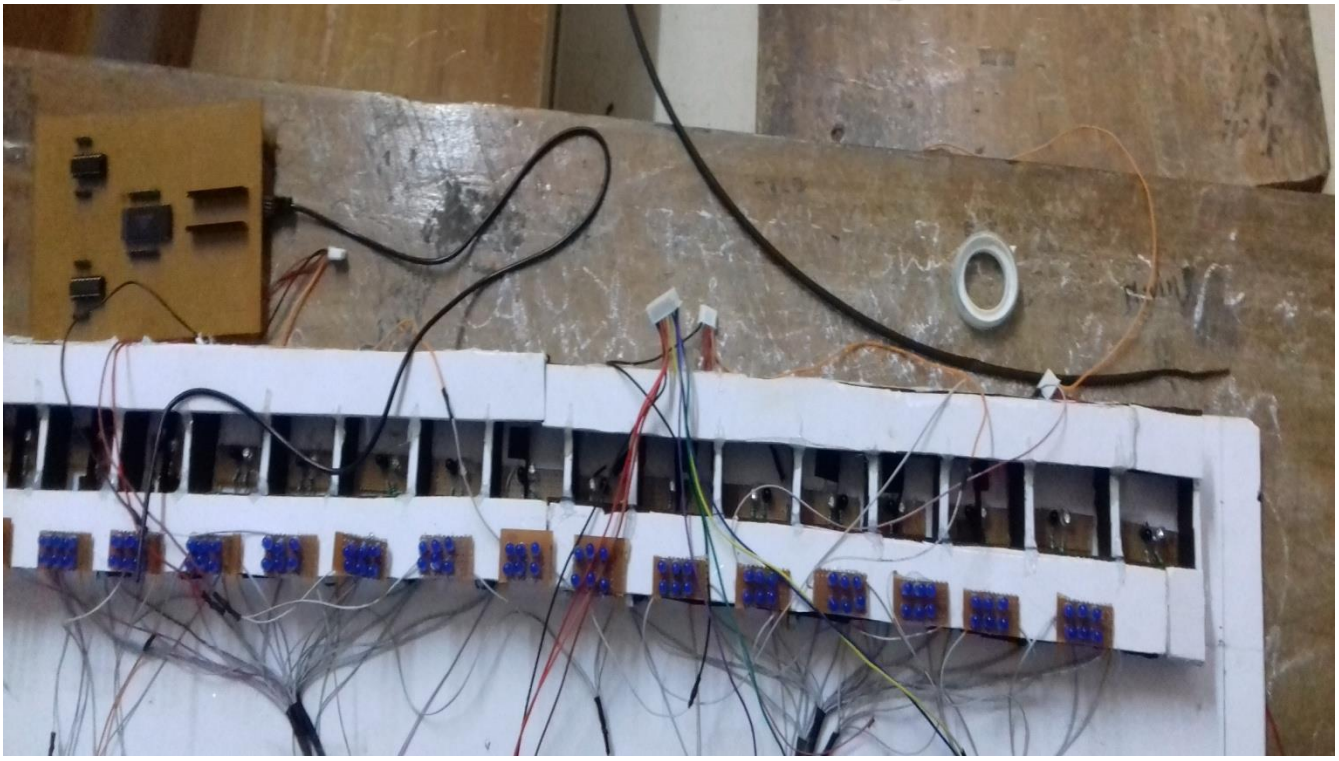
Troubleshooting:

- The output wire from the sensor, where insulation was being removed, was getting shorted with either ground or Vcc. Then we checked the connection of sensors using multi-meter.
- The minimum and maximum values of the sensors were very near because there were enough IR rays from sunlight. We put a black strip between IR LED and photodiode in order to get proper range of values.
- Due to smooth surface of compartment, IR rays were getting reflected. Hence, we put black strips over the walls of compartment.
- One of the biggest problem was to set the threshold for the output values of sensors because the values were fluctuating and we were not getting a proper range. Hence, we used software thresholding to overcome it.
- After all were done there was some connection problem with PCB. Finally, we checked the connectivity using multi-meter

Problems Faced:

- We used 16 IR sensors and soldering them and taking out wires for ground, Vcc and output from each sensor made the connections loose and fragile.
- Since we were using IR sensors and due to IR rays during daytime our project was not working properly during day.
- Once we set up all the sensors on board it was very difficult for us to analyze the sensors which were not working.
- The sensors and PCB were not powered from the same source. It caused distortion in the output signal.

Demo and Pictures



Piano circuit

Important links

LINK TO THE CODE USED:

sketch_oct12b.zip

LINKS TO RELEVANT SOFTWARE USED:

FL STUDIO 12

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwj-iofjv-DfAhVKMI8KHaAKAsMQFjAAegQIDBAB&url=https%3A%2F%2Fwww.image-line.com%2Fflstudio%2F&usg=AOvVaw1ZSlg3iVWUbU9UjIUrBzUC

HAIRLESS MIDI

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwjF7Im4weDfAhUDTI8KHXVgAccQFjAAegQIBBAB&url=http%3A%2F%2Fprojectgus.github.io%2Fhairless-midiserial%2F&usg=AOvVaw3IYvFu9rx4d8bvay2s6vAu

LOOP MIDI

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&uact=8&ved=2ahUKEwiz_M6AwuDfAhWSFYgKHd1pDS0QFjADegQIBxAB&url=https%3A%2F%2Floopmidi.software.informer.com%2F1.0%2F&usg=AOvVaw06k2ErhWDp1soXXTPP9XWF

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