

LED Cube

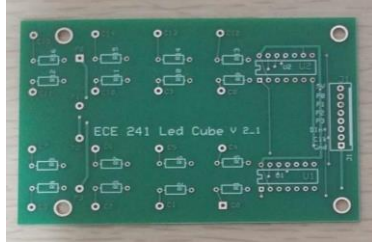
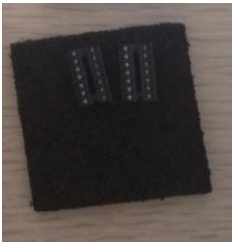


List of Supplies:

- ❖ 64 LEDs (you'll have a few extra)
- ❖ Wire for LEDs (not pictured)
- **These will be provided to you during the LED building classes so make sure to sign up.**

- ❖ Printed circuit board
- ❖ 2 Shift registers/chips
- ❖ 2 Chip holders
- ❖ 16 resistors
- ❖ Board to solder cube

- **These will be available in the building classes and for check out**



To Receive the Wire for your LED Cube You Must Sign Up for the LED Cube Soldering Class, sign up located here: <https://www.signupgenius.com/go/60B0845ACA72DA2FC1-ledcube4>

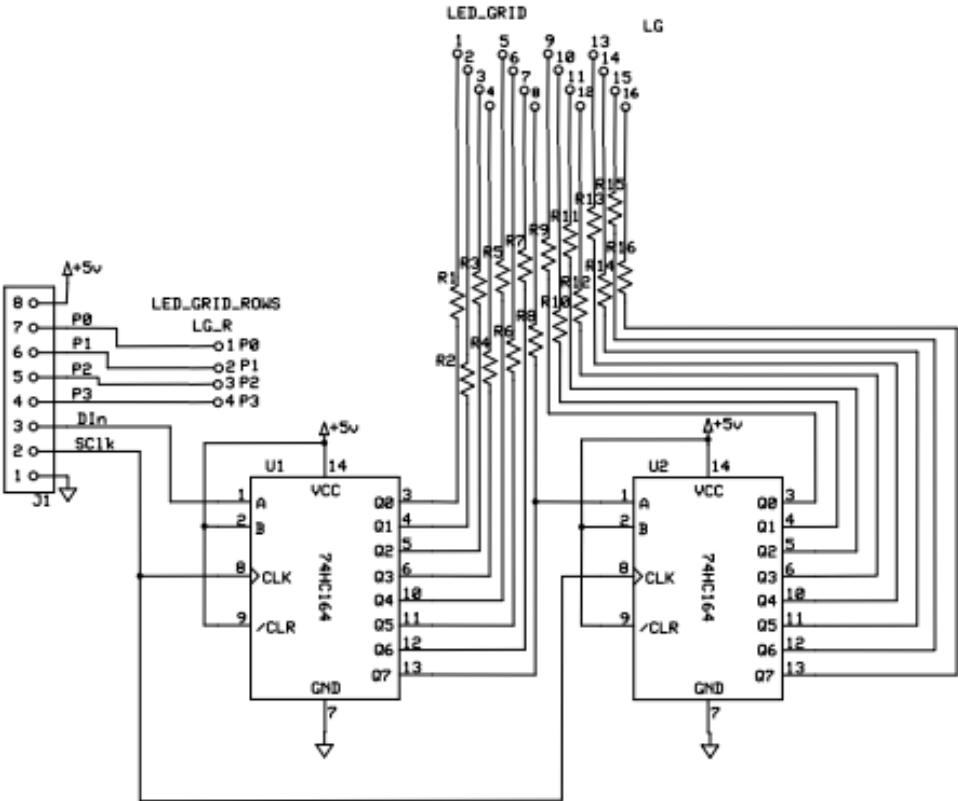
Grading Scale (15 points total)

1. At least three separate modes of operation (flash pattern) for the cube
One of the patterns needs to demonstrate and test that each LED is addressable (7)
2. Mode change should be changed by pressing a button, which is properly debounced (5)
3. Presentation skills (3)

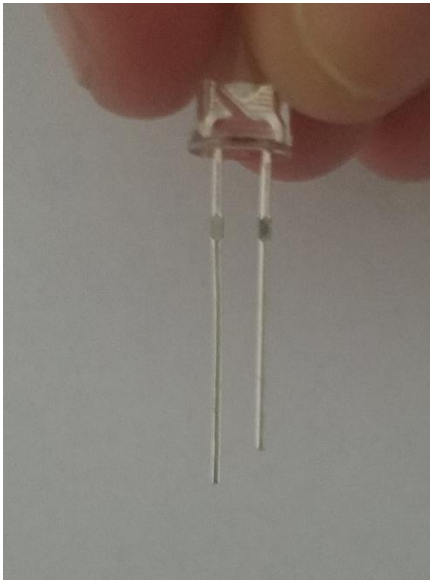
Tips and Resources:

- ❖ <http://www.instructables.com/id/4x4x4-LED-Cube-Arduino-Uno/?ALLSTEPS>
Instructables step by step for constructing an LED cube
- ❖ https://www.youtube.com/watch?v=vf_lpvMiFU
Youtube walkthrough that is similar to the way you will be setting up hardware and soldering the LEDs
- ❖ Make sure to check all of the LEDs as you build with a power source so you know that they are all functional before finishing the whole cube

Important Schematics:



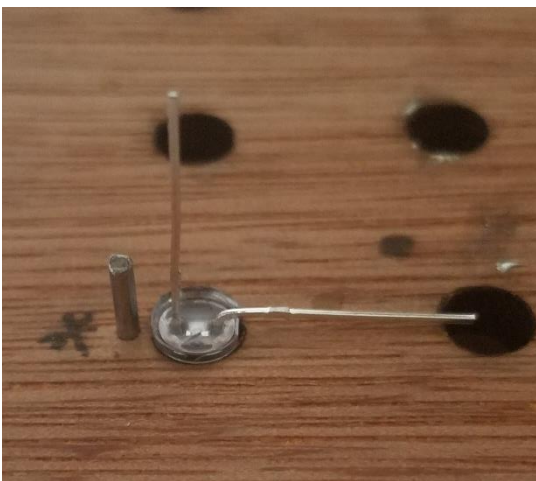
Building Instructions:



Step 1: Take the LED and hold it with the cathode (the shorter wire) on the right, and the anode (the longer wire) on the left.



Step 2: Take the LED and place it into the hole by the nail so that you can bend it into shape. Make sure that the cathode (the shorter wire) is still on the right, and the anode (longer) is the one that is by the nail.



Step 3: Take the cathode (shorter) and bend it straight back. You still want it to be in line with the nail and anode, but you want it to be flat.



Step 4: Take the anode (longer) and wrap it around the nail as tight and close to the LED as you can, and then press it down so that the anode is also as flat as it can be. Make sure you're still able to slide it off of the nail.



Step 5: You're going to take some wire cutters and snip off both of the leads as close to the LED as you can, as pictured. **DO NOT cut off the loop from the anode.**



Step 6: Line up four of the bent and cut LEDs on the LED board. Make sure that all of the cathodes and anodes are in the same direction.



Step 7: Place on of the **horizontal (shorter than the vertical)** LED wires across the four LEDs as close to the cathodes as possible. The wire is a little longer than the leads so make sure to have a little overhang on each side of the LEDs.



Step 8: Very carefully solder the wire to each of the cathodes of the LEDs. Make sure that the wire is soldered to ONLY the cathodes, if it's touching both of them you can burn out the LED. Also make sure that the anodes (looped) are perpendicular to the wire, as nicely as possible, this is very important for soldering the layers together later.

Repeat this process three more times so you have four rows of LEDs.

IMPORTANT: Make sure to check that each row is working properly. Use one of the power supplies available on the labs to make sure each LED is lighting up. Hold the ground to the wire across them and then hold the power to each LED anode individually. If you're not sure how to work the power supply feel free to ask Dr. Day or one of the students volunteering to help at the workshops.

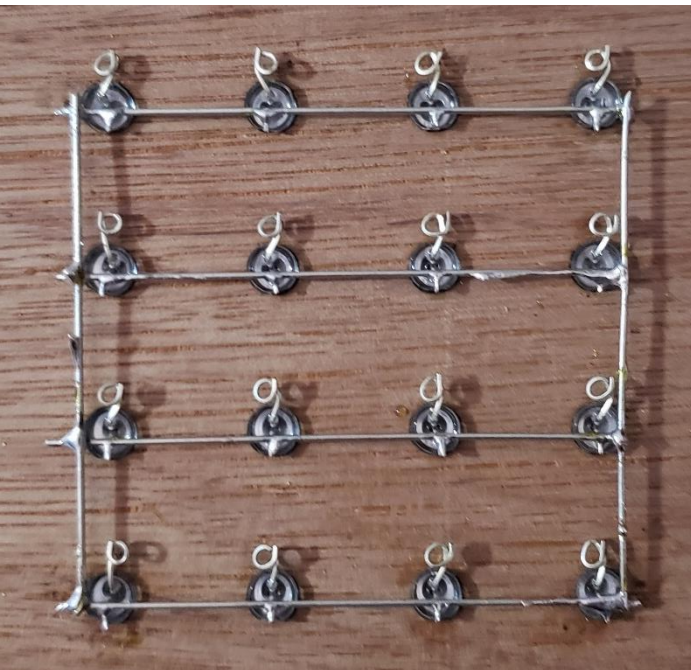


Step 8: Line up the four of the LED rows as shown in the picture to the left.

Make sure that all the anodes are facing in the same direction, this is important for connecting the cube to the PCB.



Step 9: Lay one of the horizontal wires across the rows, over the ends of the row wires. Then very carefully solder it securely to all four rows. This may take a few times to get it there, so my advice is to solder one end and then adjust it, so you can easily solder the other three connections.



Step 10: Solder the last horizontal wire to complete the layer. After this wire is soldered you can trim off the remaining of the wires very carefully to help for a cleaner look, but it's not required.

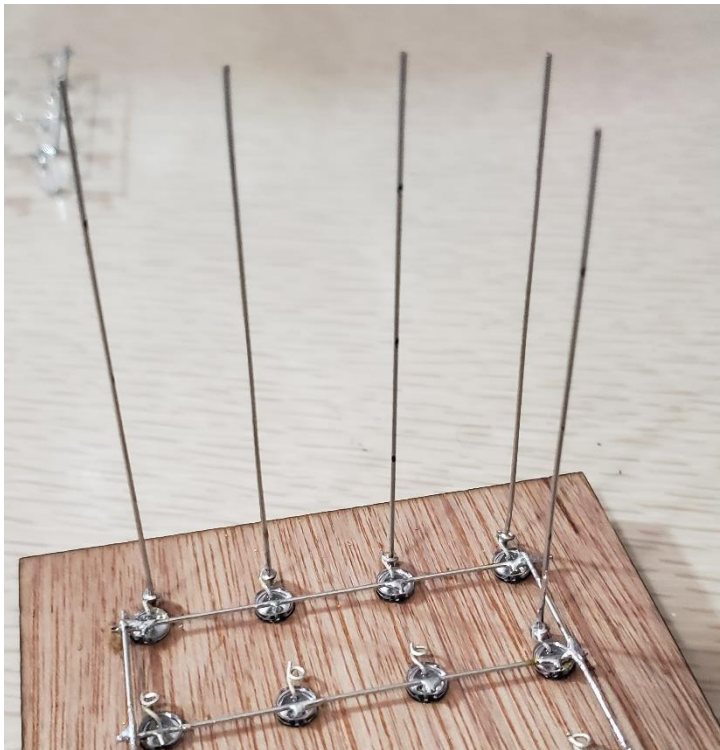
Repeat this process three more times so that you have all four layers completed.

IMPORTANT: Before continuing to solder everything vertically, make sure to test out each of your layers with the power supply again. Make sure that all of the wires are connected securely, and that you can turn on each LED with the ground connected to any of the wires.

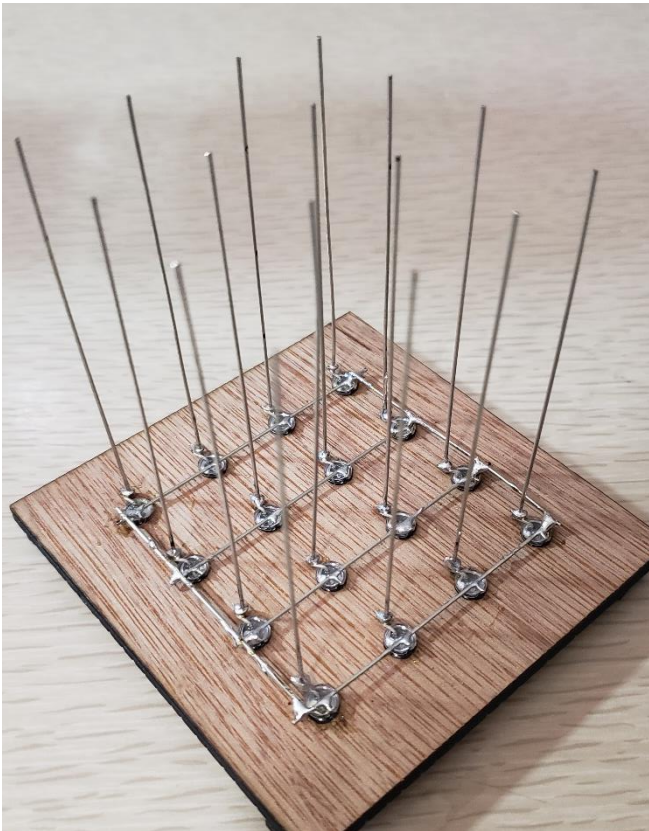


Step 11: Soldering vertically is going to be the hardest part of making this LED cube, so take it slow and make sure you do it properly.

My recommendation for soldering the vertical wires is to put one end of the wire in the loop and have it lean there, then apply the solder to it. Then you can reheat the solder and adjust the wire so it's standing up straight by moving it from the other end (just avoid burning yourself).



Step 12: Complete soldering a row of the vertical wires. Try to get them all to be as straight as possible so it's easier to add the other layers.

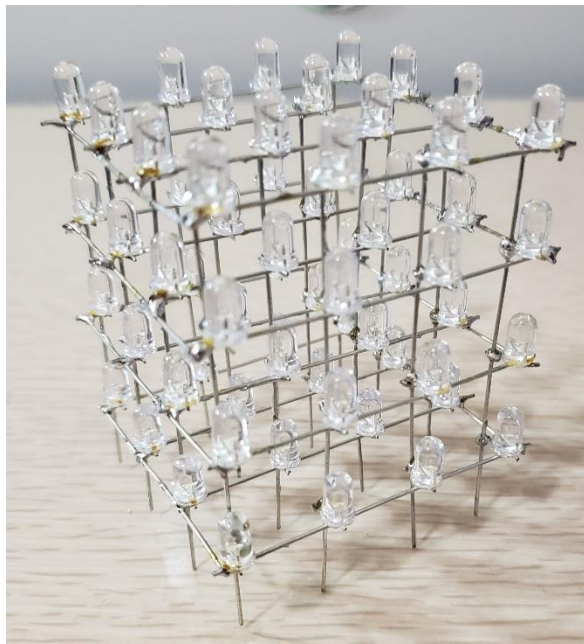
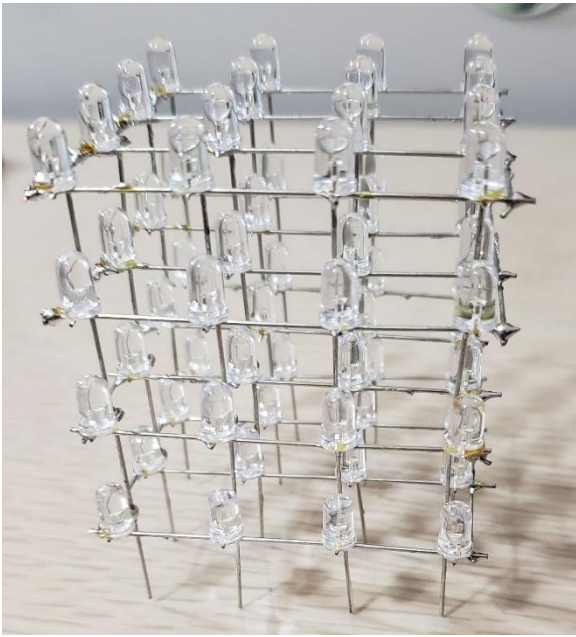


Step 13: Complete the process of soldering all of the vertical wires. Before moving on to the next step make sure they are all straight and connected well.

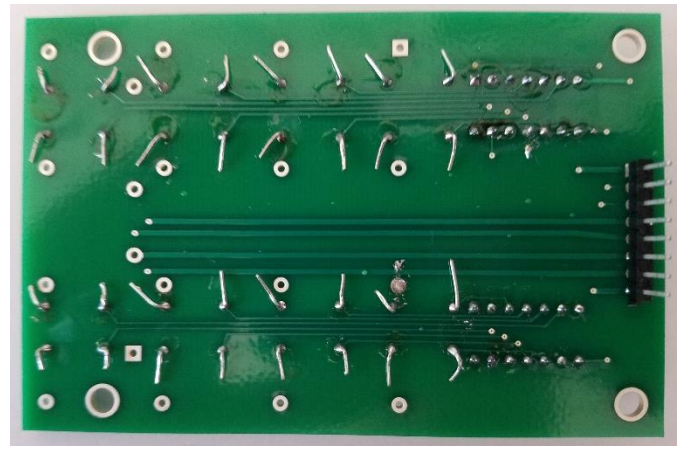


Step 14: Add the first layer. You have a board available to separate the layers with the proper measurements. Be careful not to bend any of the vertical wires trying to line up the loops of the layers, once you have all the wires in the loops it should slide easily to the proper position and then rest the layer on the board provided so that the layers are spread evenly.

Repeat this step with the other two layers.



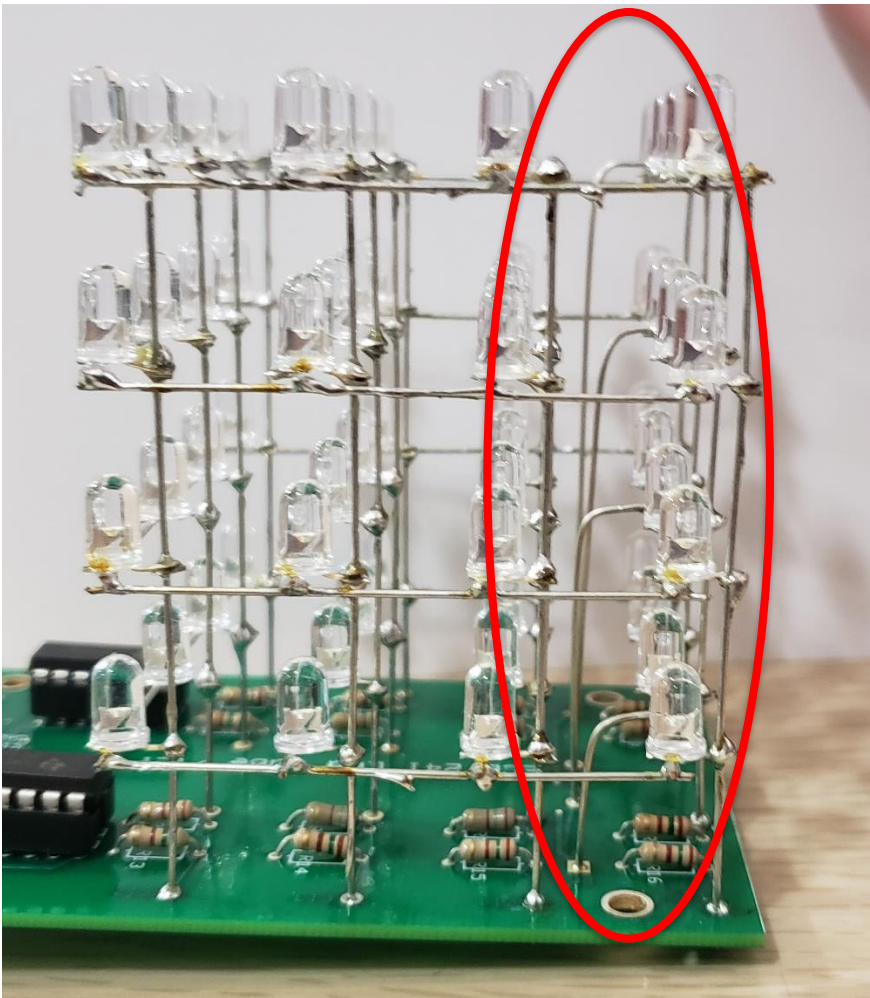
Step 15: Your physical cube is completed! Make sure to check each layer and LED before soldering it to the board, just to be sure there's nothing you have to fix.



NOTE: Make sure that when you are soldering the pieces, you solder in the shift register **HOLDERS**, **do not solder the shift registers in directly**, they will be inserted with the proper orientation into the holders after the soldering is complete.



Step 17: Solder the LED cube into the actual board. You will want to insert the completed stacked layers into the board by inserting the bottom cathodes. Solder each of the corners into place and then carefully make the solder joint strong with each of the columns and the board.

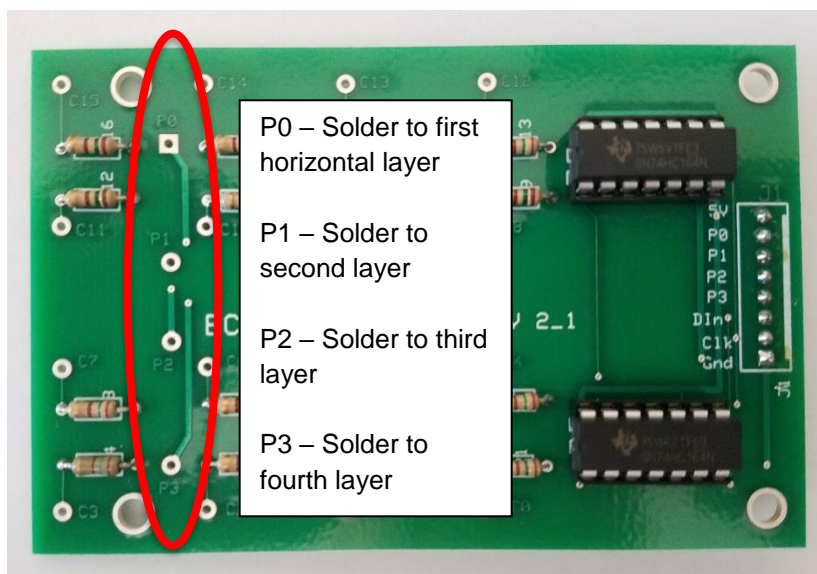


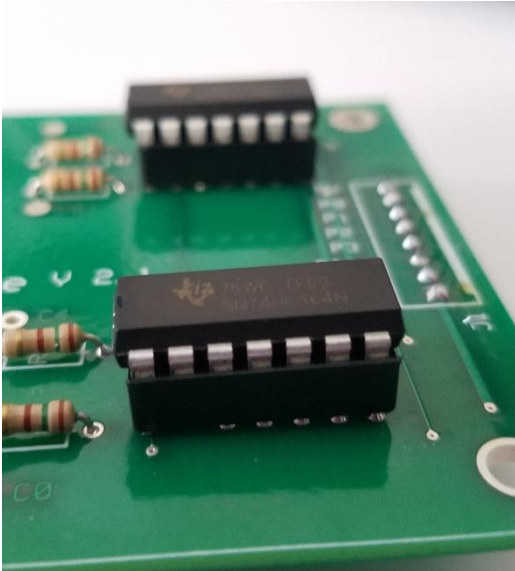
Step 18: This is a very important step, do not skip it!

Make sure to solder wires from each plane to the P0, P1, P2, and P3 places in the board or else you will not be able to program your cube.

Each of the holes will be soldered to one layer of anodes on your board, as seen in the picture. You can either get a few pieces of the LED wire to connect the planes or use some jumper wires.

Below is a picture of the board with the plane holes circled.





Step 19: Make sure to add the shift registers to the board or else you won't be able to program the cube at all. Do not confuse the chips for their holder.

Be careful of chip orientation, look at where the little indentation is on the chip and orient it like it is on this board.

Congratulations! You've completed your cube!