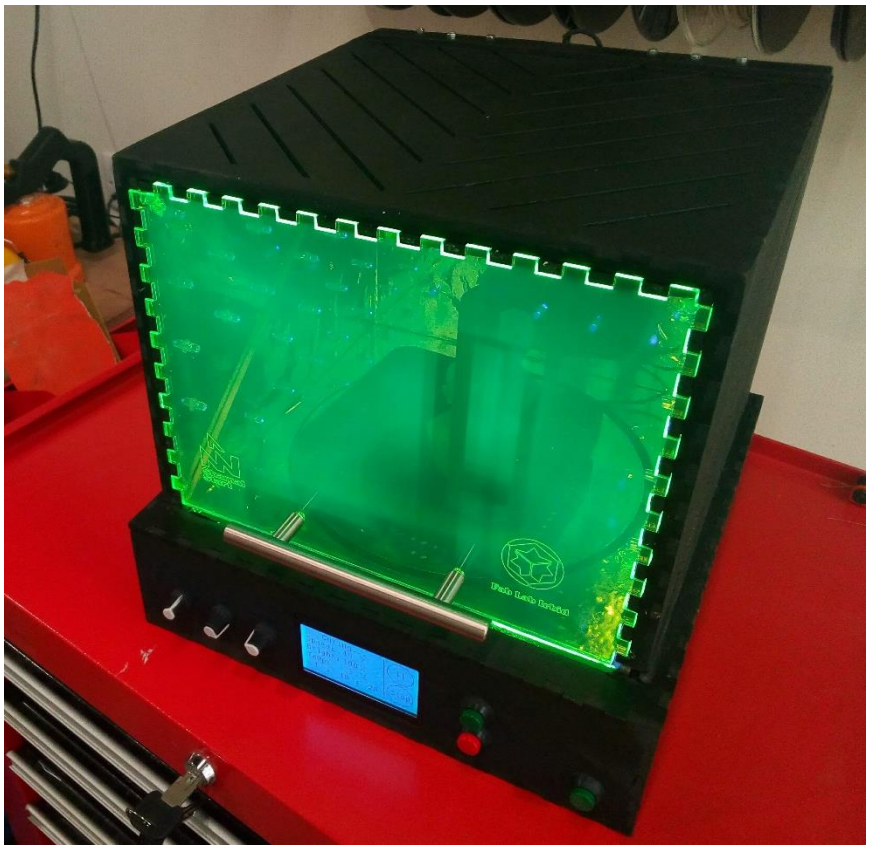
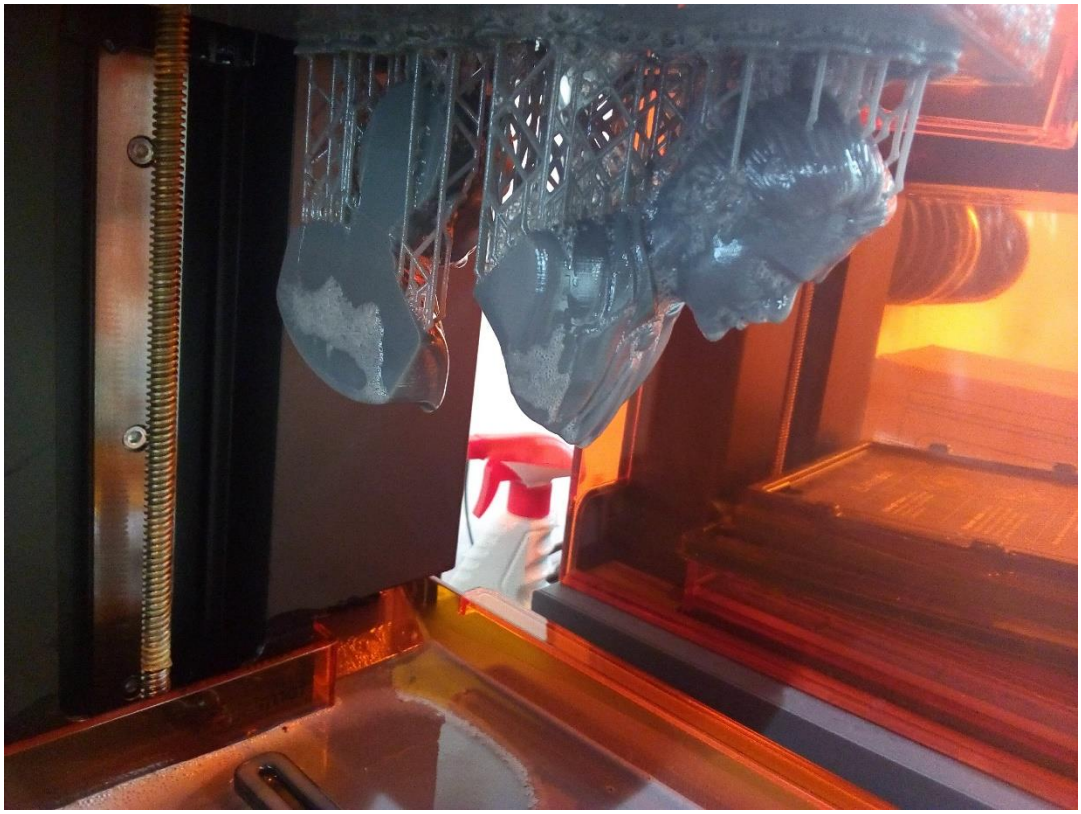
Post-cure SLA-3D-Prints

FabLab Irbid



After SLA prints are finished, they are in a “green state” (1), which means that while parts have reached their final form, the polymerization reaction is not yet completed, and full mechanical properties are not yet achieved. Through exposure to light and heat. post curing unlocks this last mile of material behavior.



All FormLabs SLA printers use a 405nm wavelength laser beam (2), and take up resins that range from the Standard: Clear, white, Grey and black to the functional resins: Tough ,Castable and Flexible. each resin has finely-tuned property that is developed engineered and tailored to the 405nm lased wavelength.

And since the prints material is extremely toxic and tacky in its green state and mechanically less strong and stable. That makes handling prints difficult and dangerous, post-curing is required for many FormLabs resins. After post-curing, Engineering Resins reach their best functional properties and Castable Resin burns out cleanly. Post-curing is absolutely mandatory for using biocompatible materials like some of our Dental Resins (1).

At its basic level, exposure to light triggers the formation of additional chemical bonds within a printed part, making the material stronger and stiffer. Even sunlight will post-cure parts, though exposure and effectiveness are weather-dependent (1).

Objective

Creating a UV Curing Chamber features a 360° turntable and a reflective inner surface. that use UV LEDs, temperature motoring, time control, light intensity control and turntable speed control.

Specs

The curing box can cure prints up to these dimensions: 22cm diameter, 20cm tall cylindrical volume.

Bill of Materials

	Quantity	Cost per Unit(in dollar)	Cost(in dollar)
Gear Dc motor	1	9	9
Acrylic Board (6mm)	1	44	44
Wood Board (6mm)	1	5	5
Steel Rod (8mm)	1	6	6
Arduino Uno	1	2	2
UV LEDs (404 nm wavelength)	100*	-	2.5
LCD screen-12864	1	13	13
Push buttons-12mm	2	1.52	3.04
Switch button-12mm	1	2.55	2.55
Wires 3 colors	-	-	-
Hinges	2	5	10
Stainless Steel Handle	1	1.54	1.54
1k Ohm resistors	100	-	6
Mosfet IRF540N	2	-	4
Power supply	1	5	5
Heat shrink	-	-	-
Potentiometer 1k	4	2.68	10.72
LM 35 temperature sensor	1	2.28	2.28
Prototyping board (2cm*8cm)	1	2.68	2.68
			129.31

Make sure have

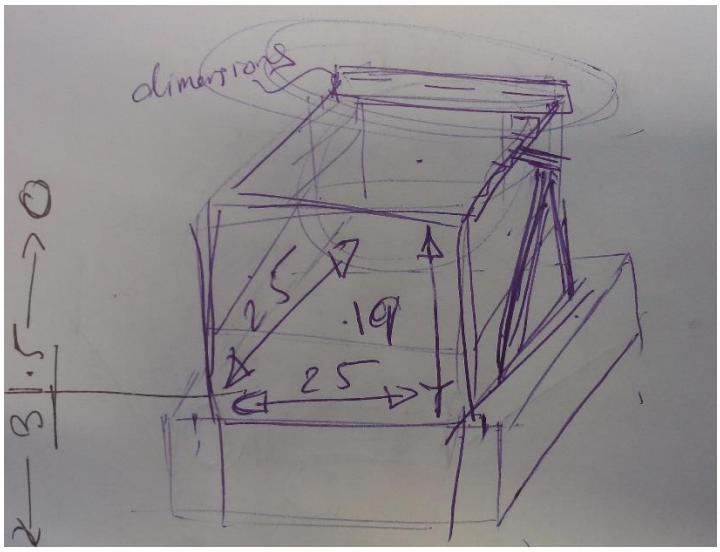
Access to Laser cutting machine.

Electronic welding kit.

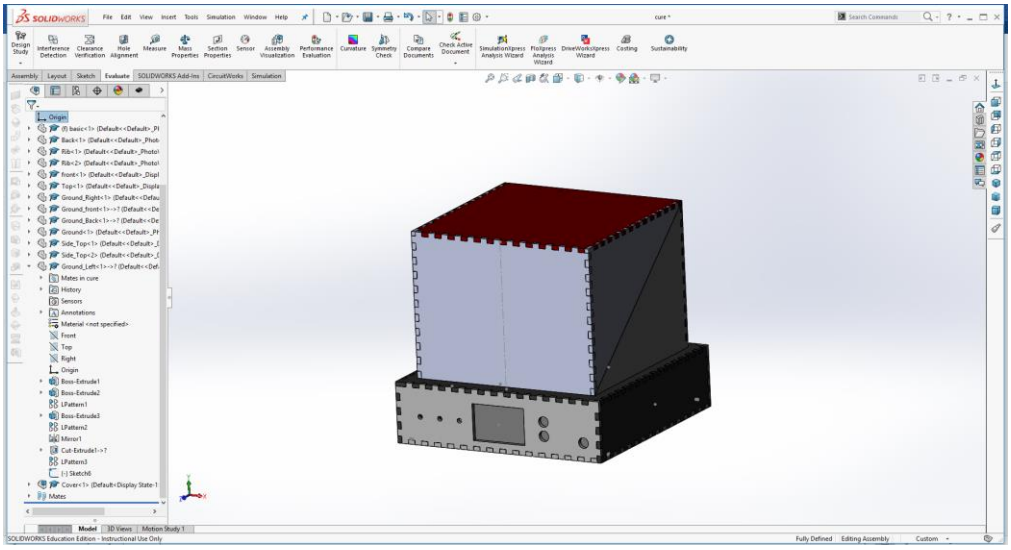
Process

Step 1: CAD design

We started our quits as in every project, on the drawing board. we discussed the shape and dimension of our curing box based on the maximum print size produced by FormLabs SLA printer and the space we had for the curing unit in the Lab. After researching online and agreeing on the mechanism of function taking in mind what technologies we have in FabLab Irbid as well as parts we need. we decided on a basic design.



The next step is to implement our design on a CAD software we chose Solidworks for the mission, we drew the parts and tested them on suitability and functionality in the assembly before heading to the next step



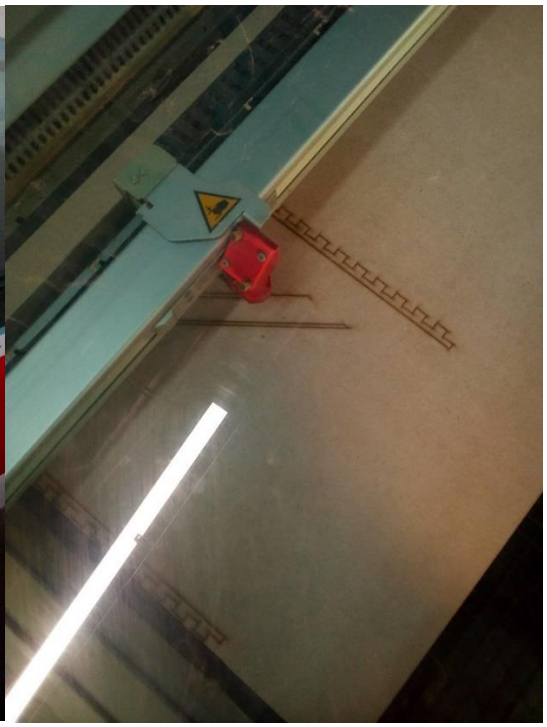
Turn table and gears design:

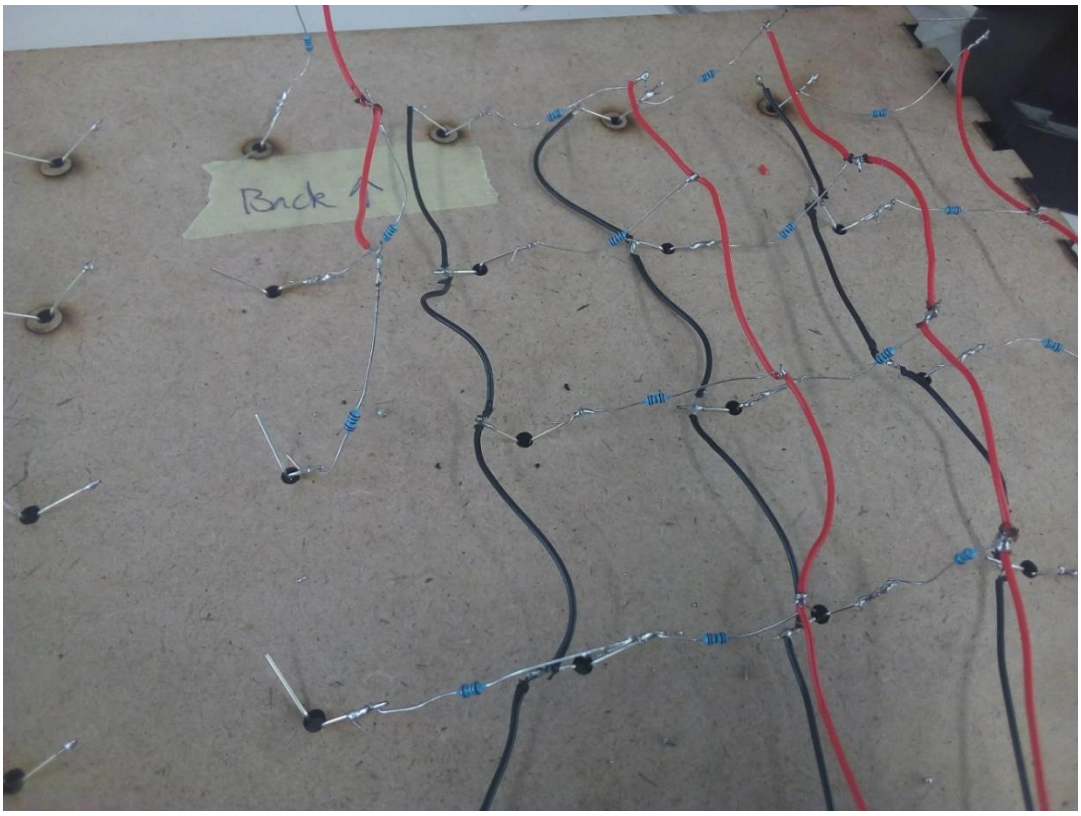
The turn table is designed to work at very low speeds which required making a reduction gear set. The reduction gear ratio was 10 to 1 which was designed using solid works spur gears library.

Step 2: Cutting the parts

Using a 6mm ply-wood we cut the parts on the Laser cutting machine, there we encountered our first issue; we were counting on buying a UV LED Strip that we can stick to the inside of the box but what we managed to find are the normal ultraviolet LEDs so we had to cut holes for the LEDs in the box sides.

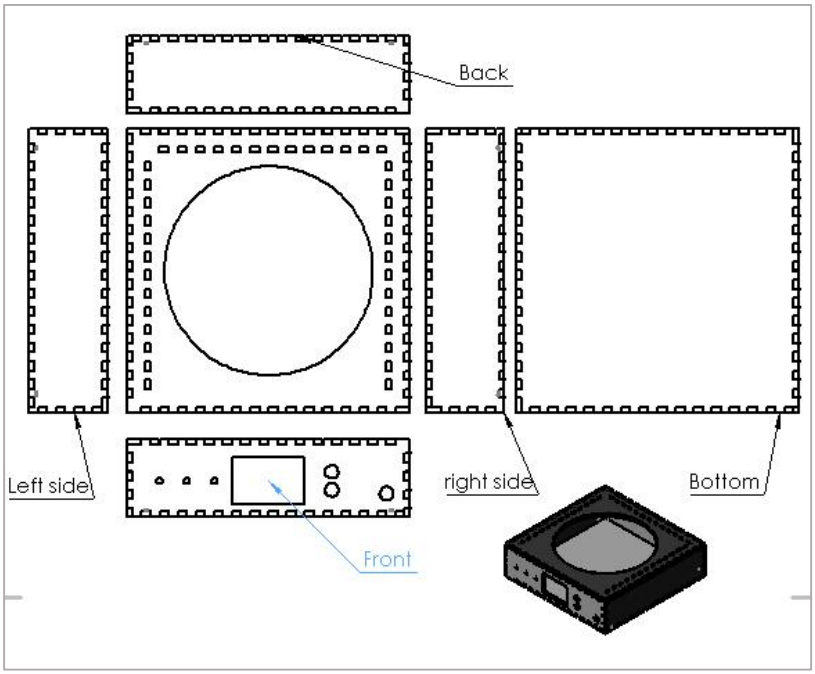
It may be a good idea to tag your parts once you cut them to ease the assembling process.





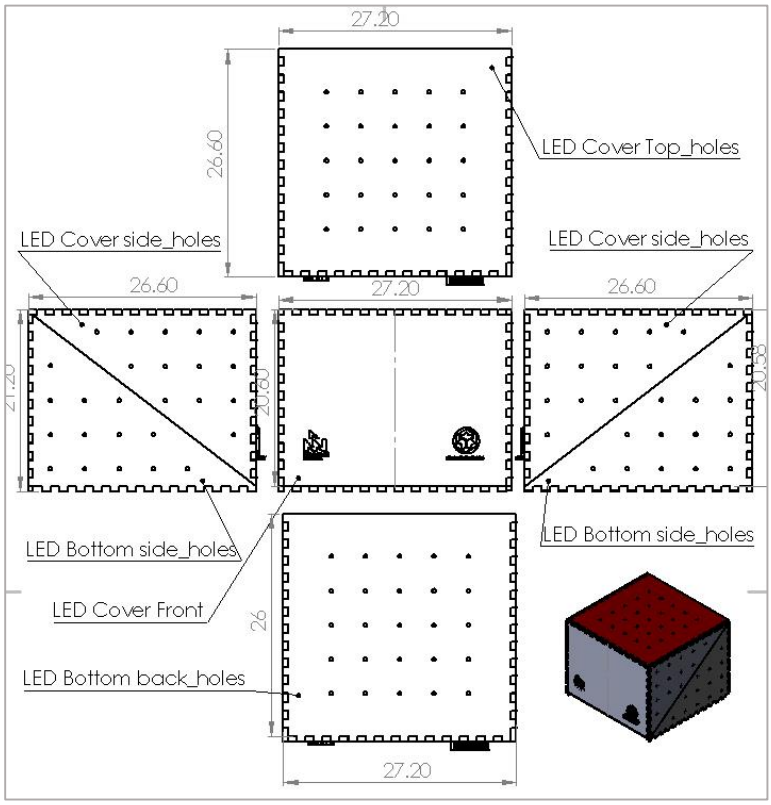
1-Cutting the base

Remember to tag your parts and their orientation at this stage to make it easier in assembly.

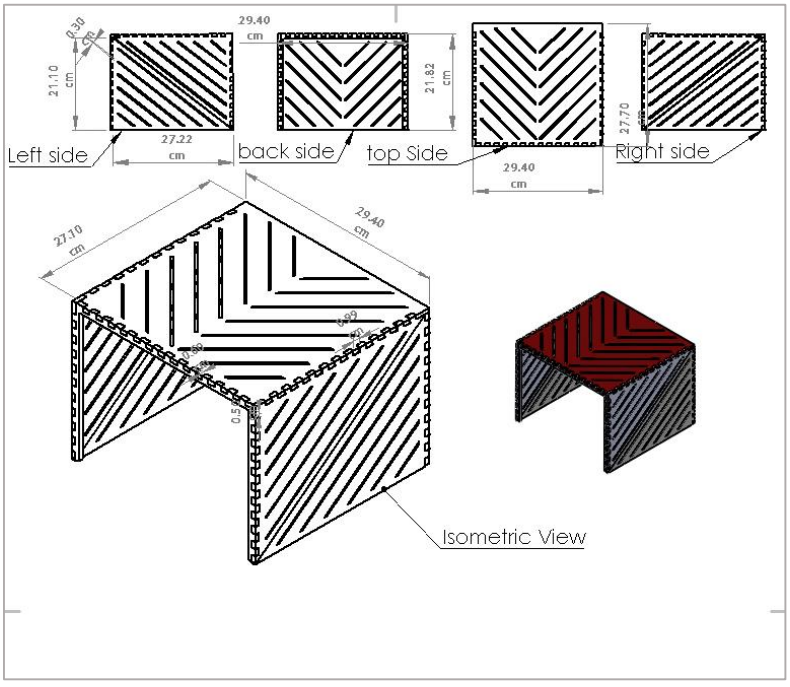


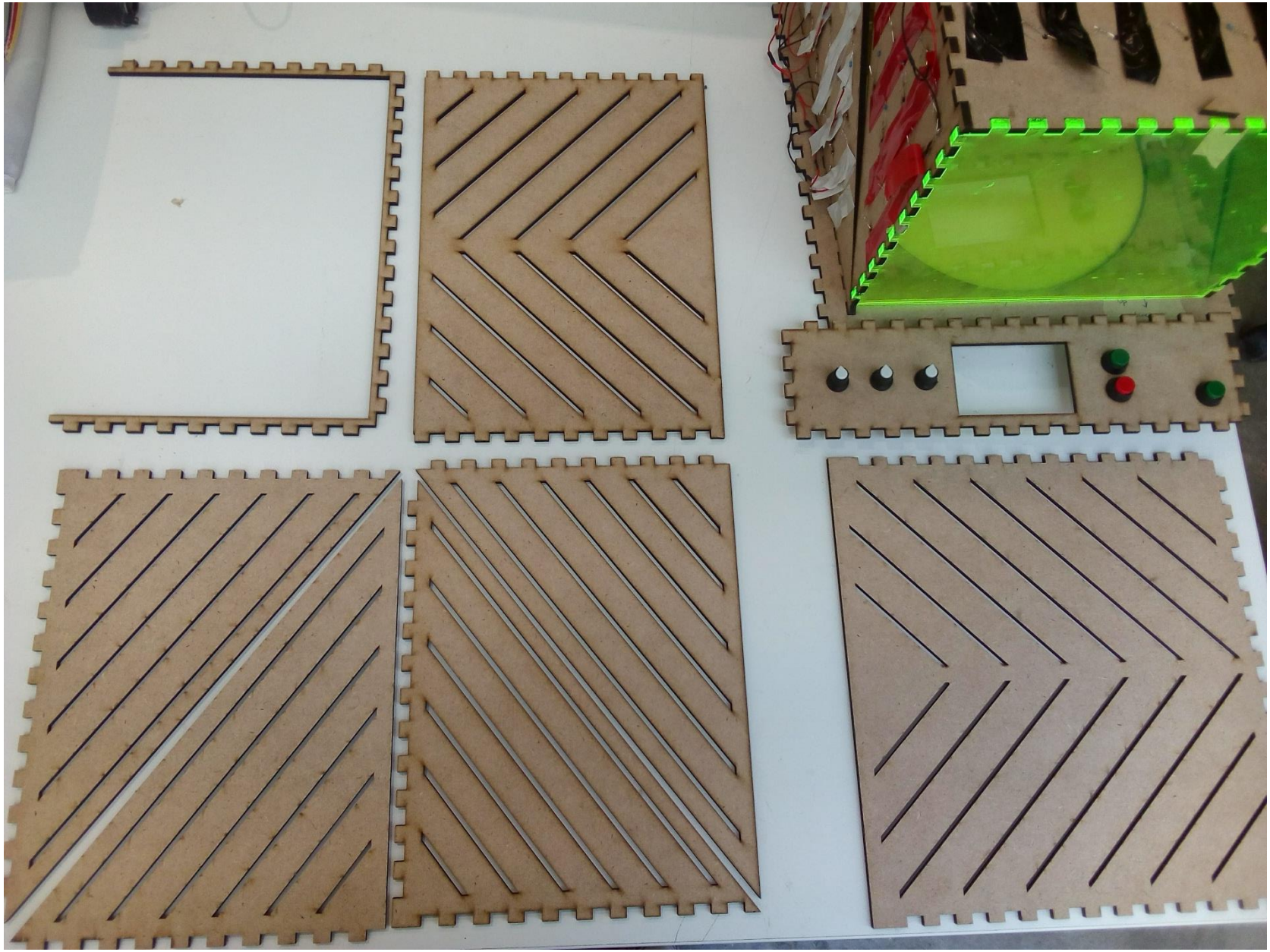
2- cutting the top

The front in this is was cut in transparent green acrylic to enable us to see the part as it cures, the acrylic front blocks UV light from leaking out side.



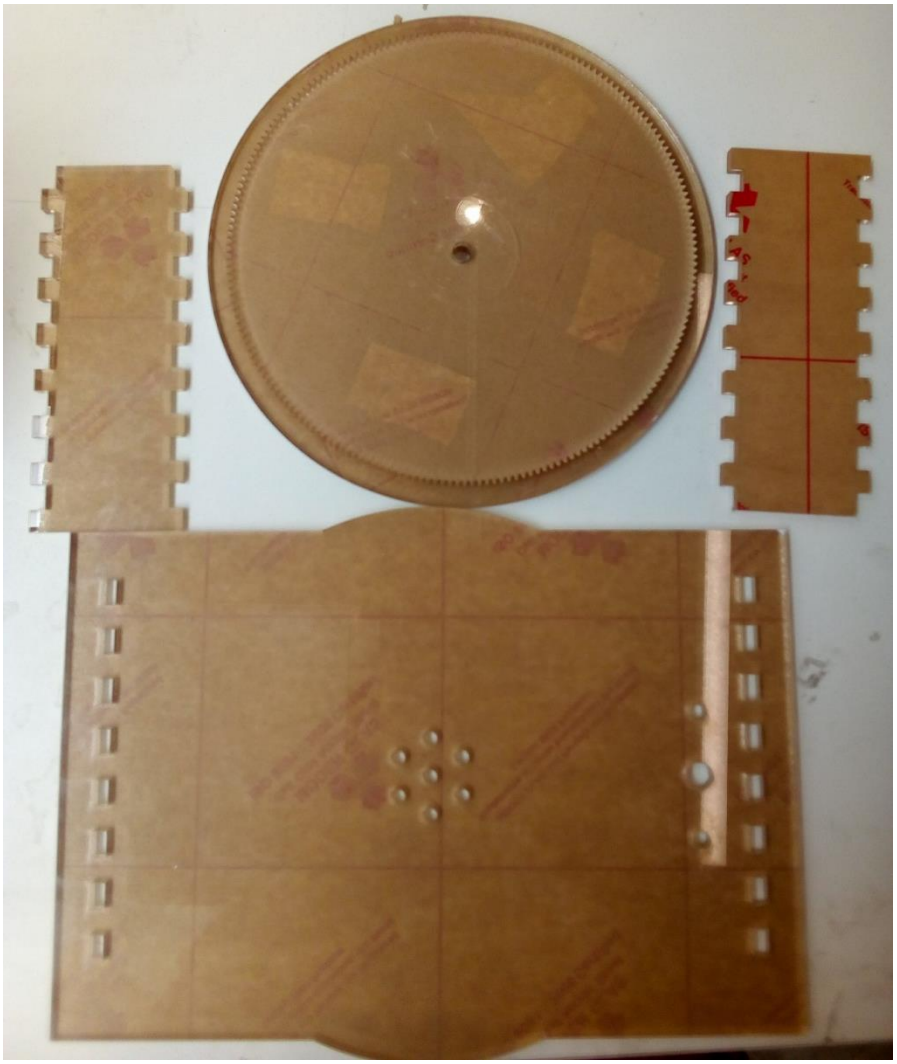
3- cutting the cover





4-cutting the turn table and gears

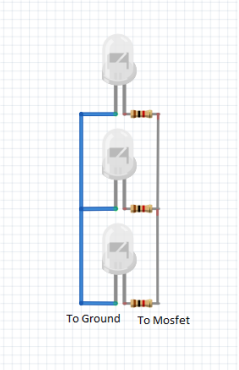
We used the acrylic board here as well, the small gear here might be the first thing to wear off so we recommend cutting more than one of it as spare parts.



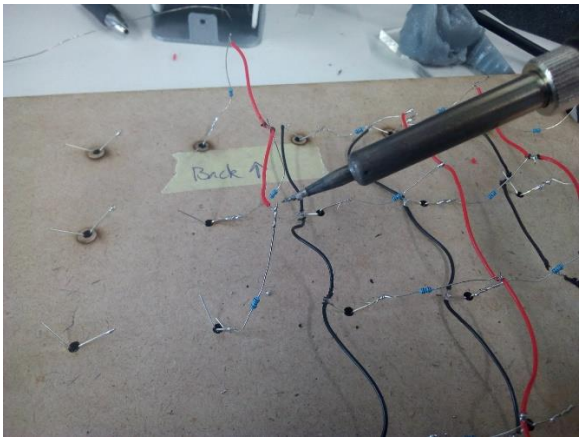
Step 3: Electronics Connections

We can split the electronic part to two phases, mounting and welding the UV led circuit, and connecting the Arduino circuit.

Connect the UV resistance circuit as the following diagram,



The blue wire in the diagram represent the black one in the photo, and the grey is the red one.



As you can see the UV LEDs are connected in parallel, with a 1k resistance connected to each LED.

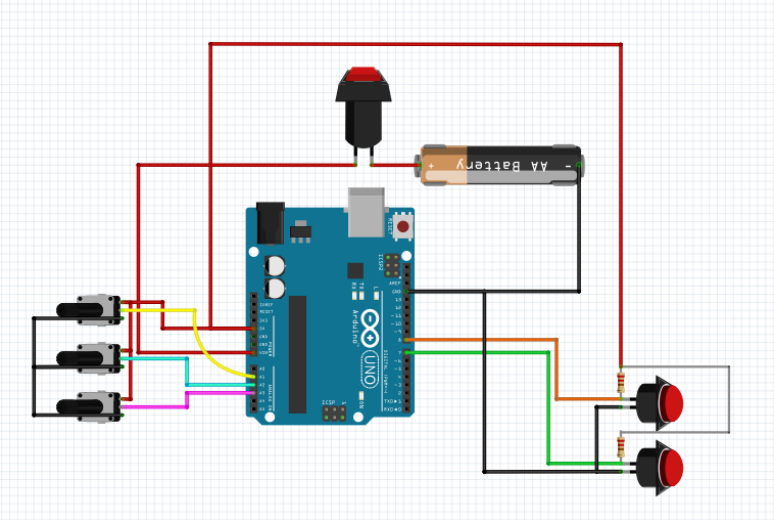
To control the LEDs and the geared dc motor 12 V power supply is needed. In order to get variable voltage from the power supply using Arduino you need to use Mosfets.

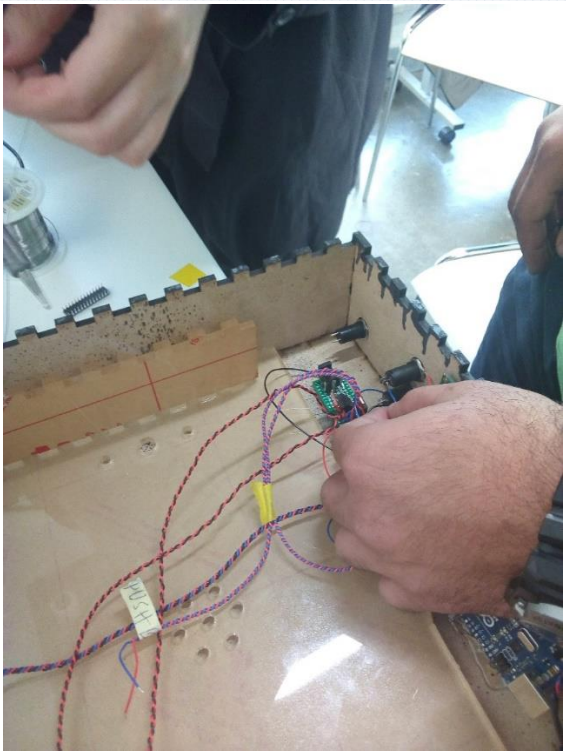
Here we used N-Channel MOSFET, make sure the Mosfets is rated to be able to pass as much current and voltage as you need.

now let’s head to the main board connection

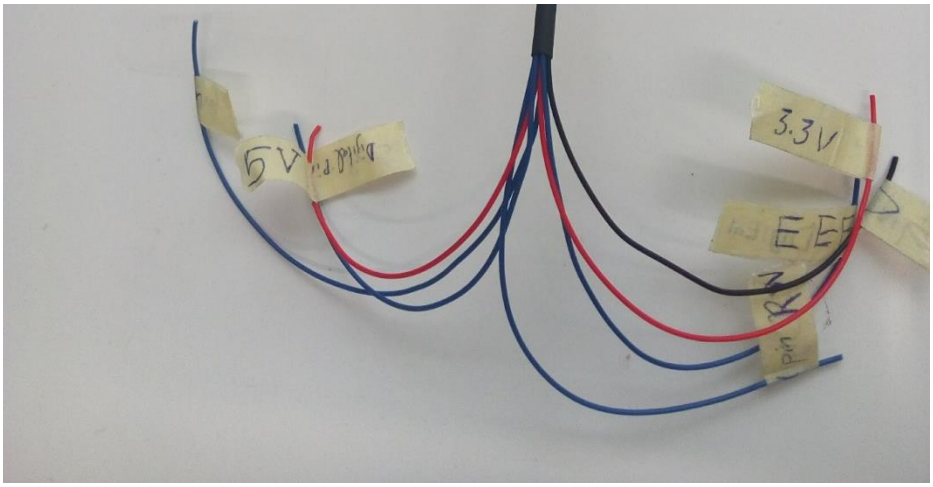
Control Panel connections

Connect the Push buttons and potentiometers as in the diagram.



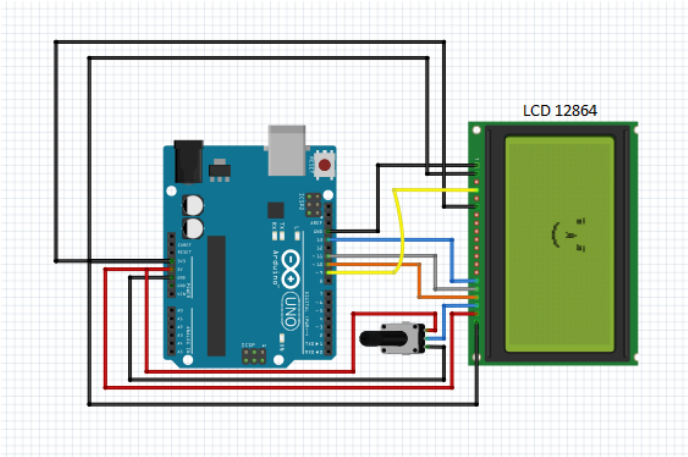


Use the heat shrink to group your wires together as it will make it easier in the final assembly, it might be a good idea to tag each of wire to avoid confusion.



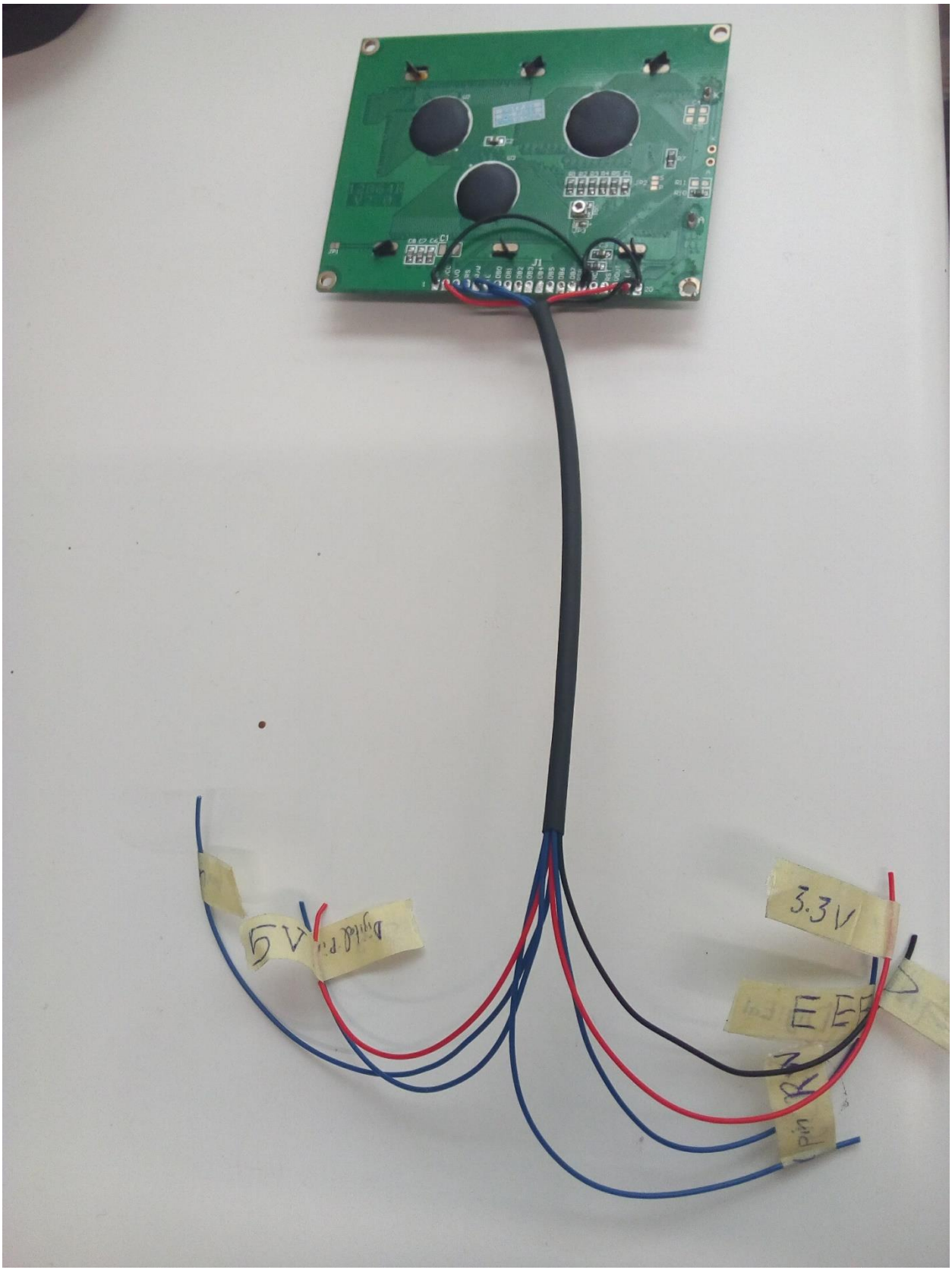
LCD connection

Connect the LCD as in the diagram and according to the table



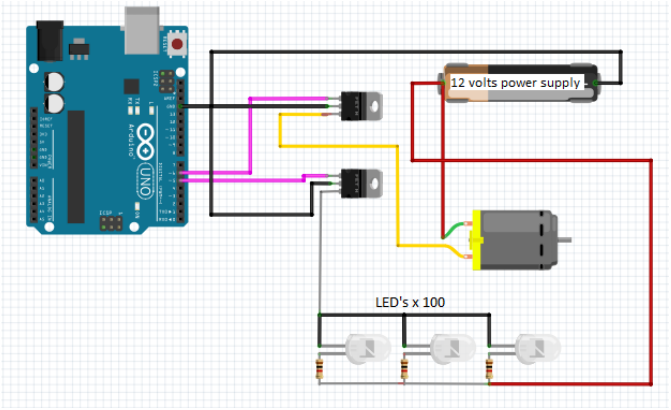
LCD pin	Arduino pin
BLA	3.3v
BLK	GND
PSB	GND
E	13
R/W	11
R/S	10
RST	9
Vo	Wiper
Vcc	5v
GND	GND

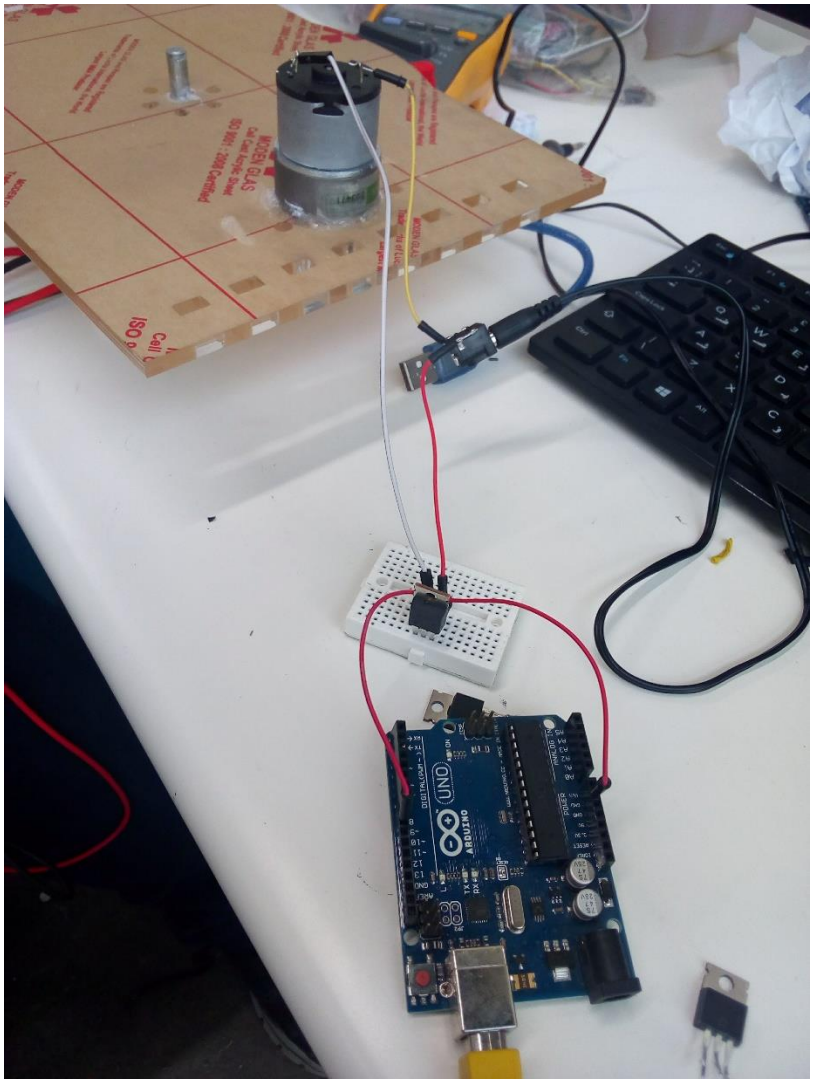
Use the heat shrink to group your wires together as it will make it easier in the final assembly, it might be a good idea to tag each of wire to avoid confusion.

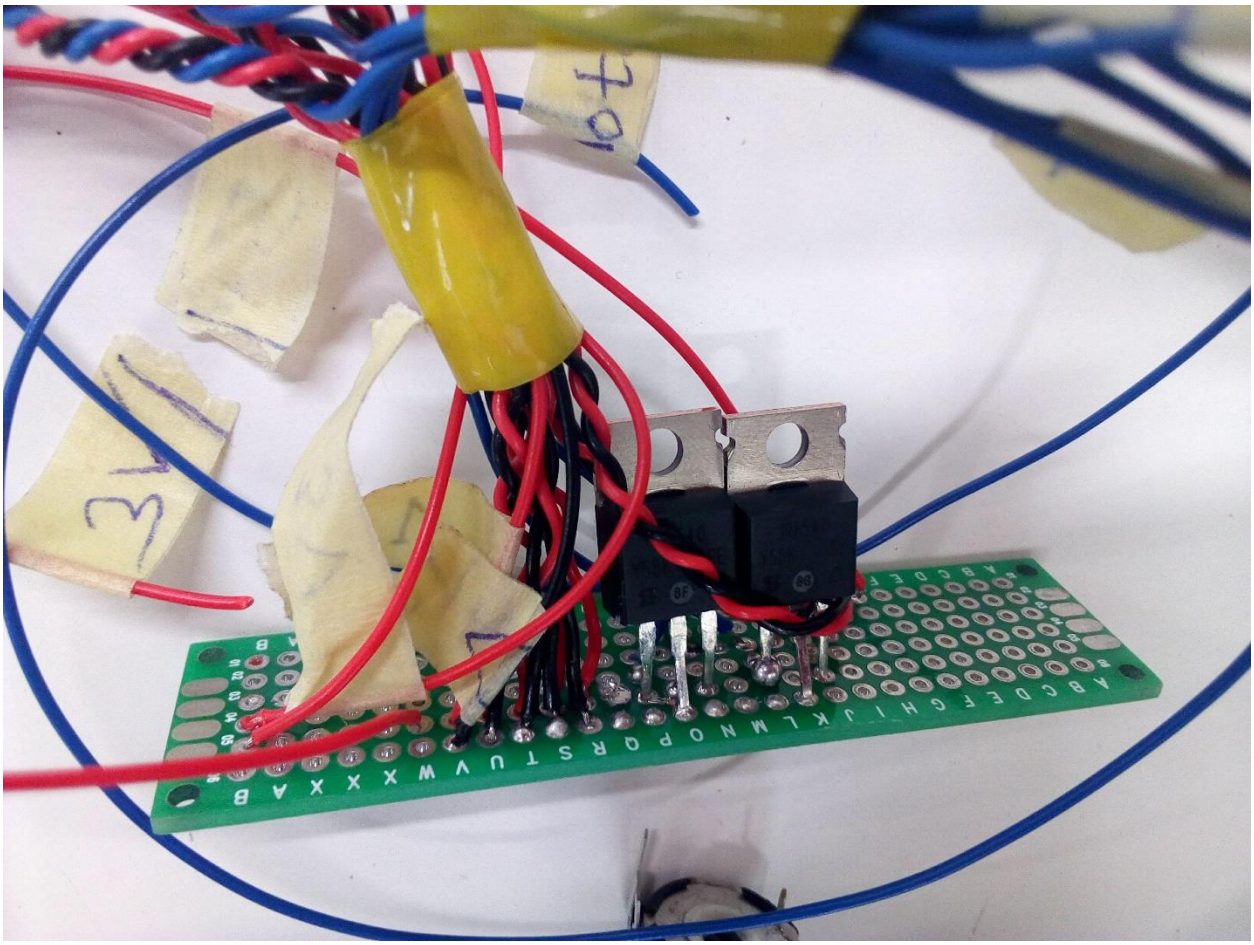

3.3V

Motor and LED's with Mosfets connections

Connect the motor and the LED lines as in the diagram.

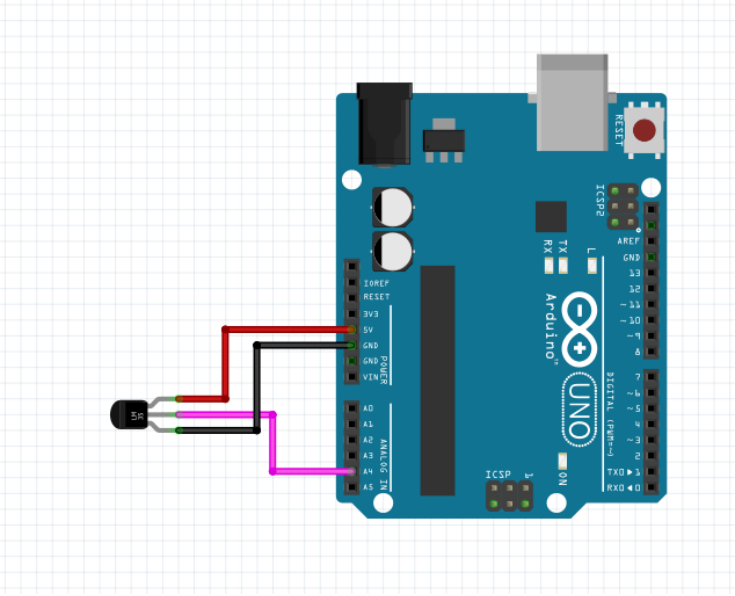






Temperature sensor connections

And finally connect the temperature sensor as in the diagram



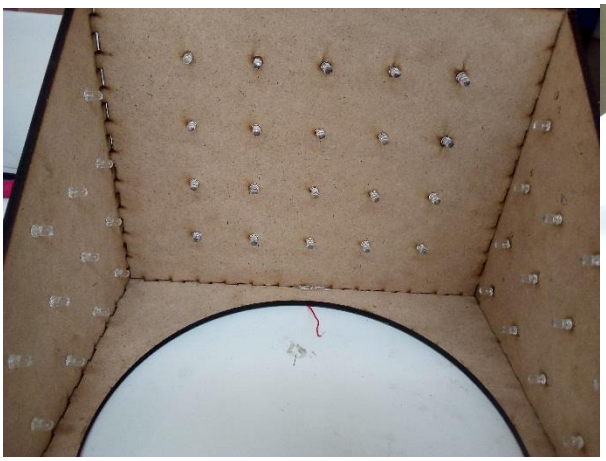
Step 4: Coding

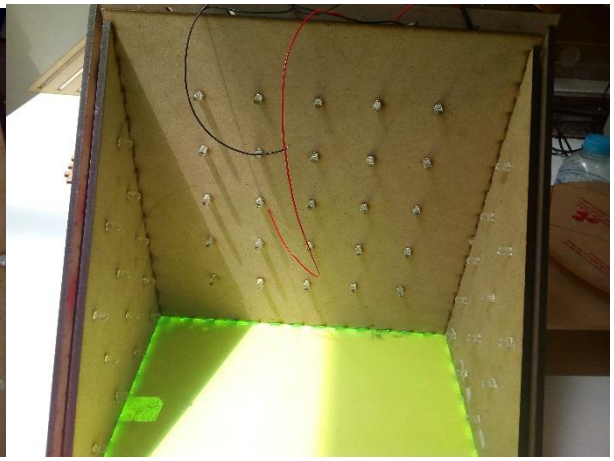
Attached here is the Arduino code for our electronic assembly .

Step 5: Assembling the box

Using superglue, we fixed the assembled parts of the box, while assembling be careful of the orientation of the piece and make sure the box is **completely** assembled correctly before super- gluing it together.

the tag on the should be a big help here.





The small triangles are anchors between the inner and outer shells of the box so glue them to make sure that the space between is 5mm.

Assembling the hinges was done by drilling three holes on the lid and other three holes on the back for each hinge. For the lid, the hinge part was on the inner face of the box, but at the back the hinge was at the outer face. This configuration will maximize the stability. We recommend putting constant torque hinges for better opening and closing mechanism.

Step5: Finishing

The decoration of the device is all up to you. We started by sanding the surfaces to get an optimal finish. Then we spray painted the box, we also added a reflective sheet of sticking paper on the inner surface to reflect and concentrate the light on the cured part.

(1) https://formlabs.com/blog/introduction-post-curing-sla-3d-prints/
(2) https://formlabs.com/media/upload/How-Mechanical-Properties-of-SLA-3D-Prints-Are-Affected-by-UV-Curing.pdf