Pill Dispenser & Reminder

Created by Isaac Shin

Purpose:

Utilizes an Arduino Uno to dispense up to seven different types of pills (all different shapes) and remind the user to take their medication daily.

Included:

- Instructions on how to reproduce this design
- STL files of majority of the required 3D prints
- Code for UNO R3

Design Assembly Circuit Program

Preparation

Parts needed

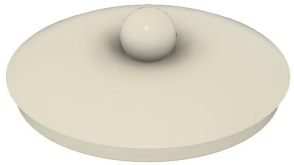
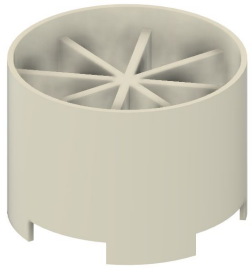
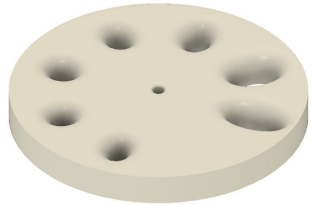
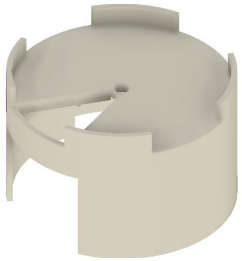
- ELEGOO UNO Project Super Starter Kit (Amazon link, not affiliated)
  Inside you need:
  - UNO R3 Controller Board
  - Stepper Motor
  - LCD1602 Module
  - 830 Tie-Points Breadboard
  - ULN2003 Stepper Motor Driver Module
  - Female-to-Male Dupont Wires
  - Breadboard Jumper Wires
  - Potentiometer 10K
  - 4 Push Buttons
  - Active Buzzer
  - Resistors (Note: requires one 100K, 10K, 5K, and 2K, resistor. All else are 220)
  - USB Cable

Parts needed continued...

- DS1307 RTC Module
- PLA
- Medicine cup
- Super glue

3D Printed Parts needed

Here are the STL files. If you need to slice it, I'll recommend using ***Prusa Slicer****.*

Pill Dispenser Lid A lid to keep the pills in. Not too tight so that it can be accessible to those with weaker hands.	
Pill Dispenser Top Half 7 compartments for pills of different sizes (there is 8 but one is meant to be empty). Attachable to the bottom half.	
Pill Dispenser TurnTable This piece is easily replaceable, meant to filter the pills out by size. Since everyone's medication is different, you'll have to design this yourself (mine is just for reference).	
Pill Dispenser Bottom Half Where the pills drop down into a small medicine cup. Attachable to the top half.	

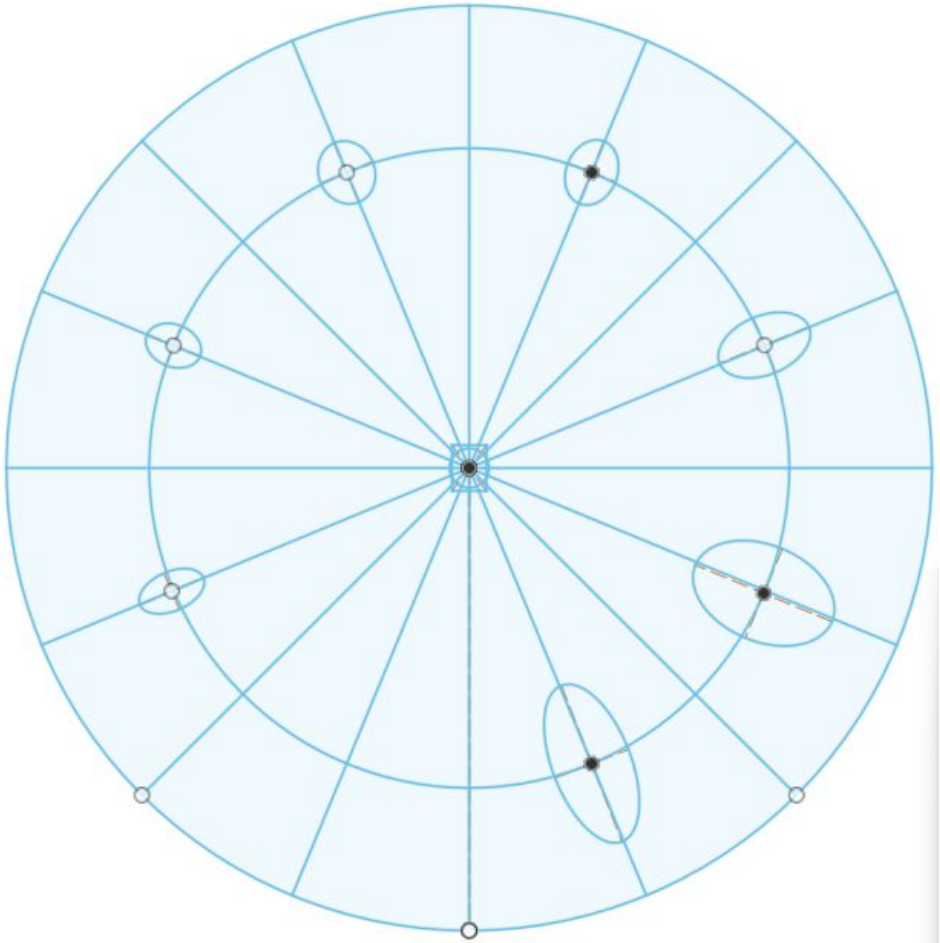
Design

Pill Dispenser TurnTable

As explained before, you'll have to design the turntable yourself in CAD. I used *Autodesk Fusion 360*, but if you don't have a CAD software available, tools like *Tinkercad* in your browsers should work for this simple disk. Use my design (in the STL folder) as reference.

To design the turntable, it has to have these requirements:

- Diameter of 94mm
- ~10mm thickness
- A circular hole with a diameter of 4mm on the top of the disk that is 4mm deep
- A rectangular hole (3.5mm by 4.65mm) at the bottom of the disk that is 6mm deep
- Seven or less holes of decreasing sizes (counter-clockwise) that match the shape of the pills (make sure the holes are in their own different "portion" around 45 degrees from the center apart (with one no hole portion)

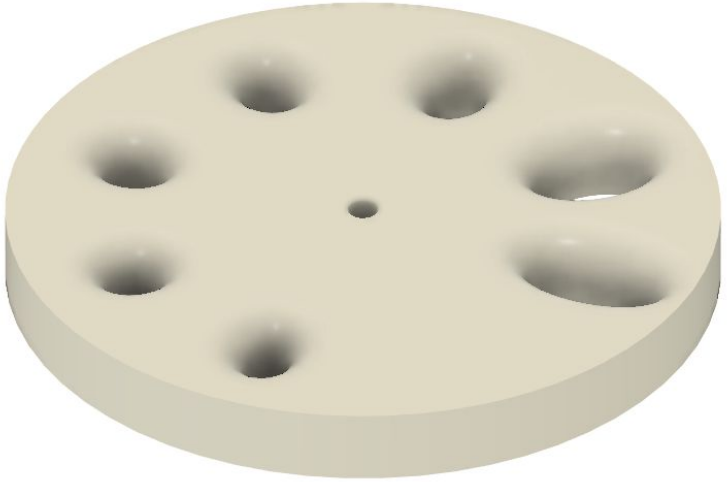


Design

Pill Dispenser TurnTable

Before you print the turntable with a thickness of 10mm, you should do a practice print that is only about .5 mm thickness. This is to make sure the pills properly fit into the holes and the larger pills don't fit into the smaller pill's hole. You can also use this final practice printer as a slot test for the user to make sure they are placing the pills in the right compartment. You may have to design the holes to have different orientation when they fall. I had to design my holes that the pills would fall in vertically for it to filter properly while only having one pill in the hole without having the smaller pills fall alongside the bigger pills.

The different sections I refer to are dividing the circle into 8 different portions with 45 degrees in between. This is to match the top half's 8 compartments, with one section having no hole because below in the bottom half, is a 45 degree portion sized hole so the pills can follow into the cup beneath.



Rectangular hole at the bottom

Design

Extra Additions

If you like, you can make some changes to the designs I gave you, namely, adding engravings to the dispenser. I engraved text to remind the user what the device is, how to turn off the alarm, etc. This is especially important if your user has dementia or other illnesses that may cause them to panic and forget how to turn off the alarm. Of course it isn't necessary, but it is a helpful reminder for users.

Bit hard to see, but the text on there is for my Korean speaking grandma, telling her to take her medicine and press a button to turn off the alarm.

Assembly

Assembling the Dispenser

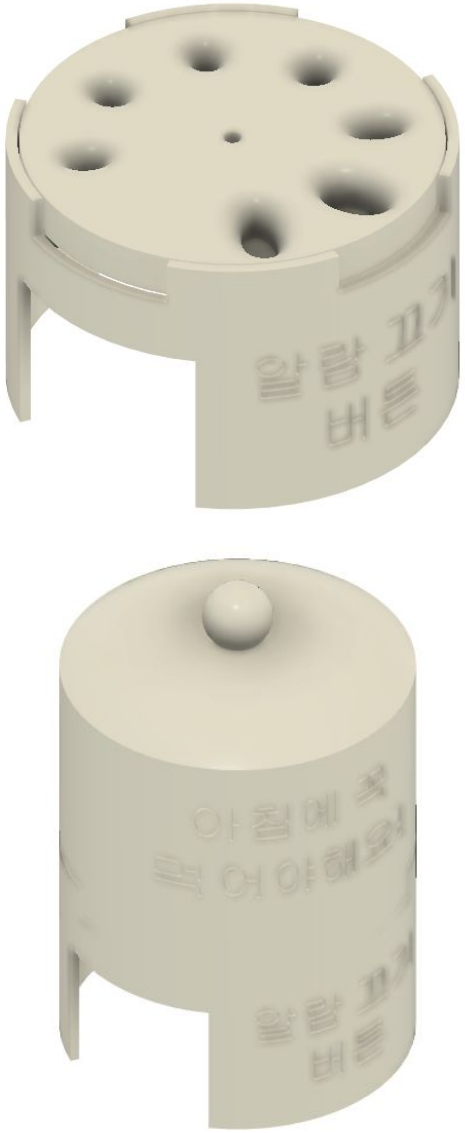
After printing the parts, make sure to smooth the **top of the bottom half**. This is to make sure the weak motor doesn't have to go against the friction force applied by the bottom half against the turntable. You can smooth by already printing it smooth, sanding it, applying a coating, and other methods.

Afterwards, get the stepper motor from the starter kit with the bottom half of the pill dispenser and super glue it together so the motor is underneath the plate like so. **Only glue to the motor's 2 holes on each side so the glue doesn't prevent the motor from turning.** Also have the motor orientated so the wires can go under the notch in the wall.

Assembling the Dispenser

Then, attach the turntable to the motor via the rectangular hole made previously. You should be able to spin the turntable with your hands, but don’t damage the motor.

Then, attach the top half of the dispenser on top of the bottom half to make a flat cylinder. Top the dispenser with the lid. All components (excluding the glued parts) are easy to disassemble for cleaning and replacement.



Circuit

Circuits

This is the most complex part to reproduce on your own, as the previous steps were made to be easily reproducible. If you need help, you can find resources/videos online to learn how an Arduino Uno works. While technically we aren't using an Arduino, it acts the same so it is fine.

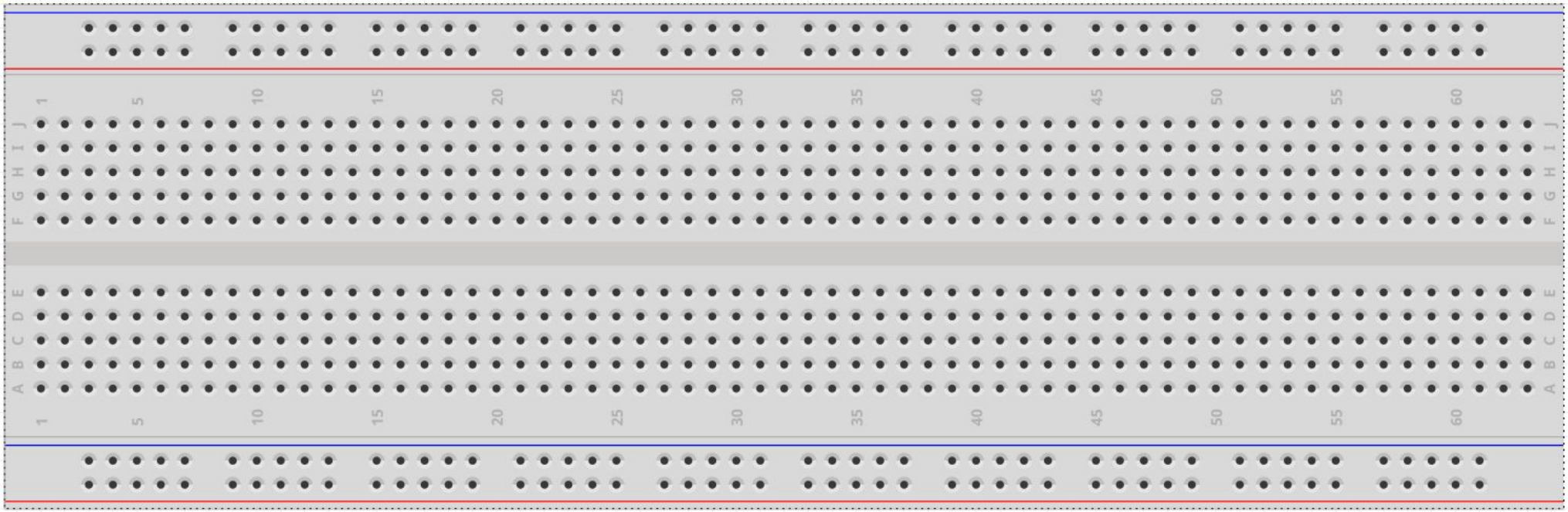
Some basic things that you need to know are that the jumper wires and breadboard allow us to wire without having to solder (joining two metal components by melting them together). They are typically used for prototyping/temporary circuits.

In order for the circuits to function, you need a closed loop, because power is produced by electricity flowing. There is a positive side (5V in our case, represented by red wires) and a grounded side (gnd in our case, represented by black wires). Keep this mind as it help us build our circuit.

Your circuit doesn't have to match my schematic exactly (my circuit doesn't), as long as it stays organized and aligns with which wires goes where.

Breadboards

This is a breadboard, specificular the one you have from the kit. The two rows on each side that are alongside a blue and red line are called *buses/rails*. One row is connected to each other and they allow you to power your circuit.



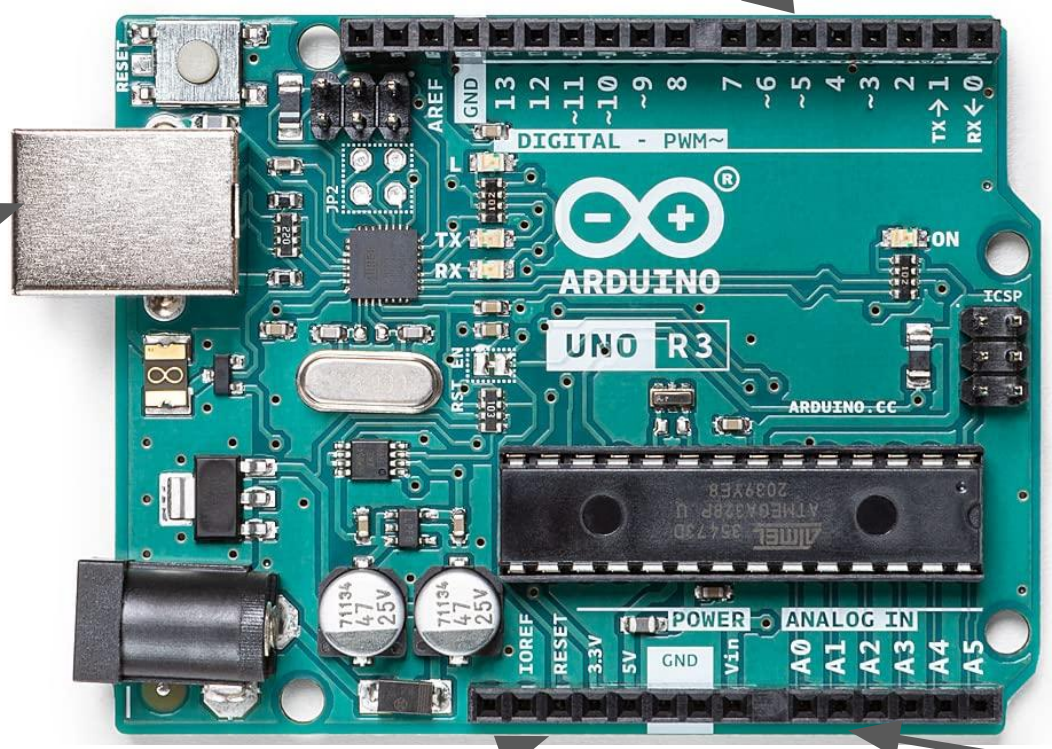
The non rail holes are connected to each other via metal clamps that latch onto the wires and components. The are lined up so only dots that are directly touching and are in the same line (short line) interact. That means you can place any wire or component on the row and as long as it is on the same row it functions the same (does not connect across the dip in the center).

Circuit

UNO R3

UNO R3 is a microcontroller. Beside performing computations, what you need to know is that it has digital pins, pins for power, and analog pins on its sides. Make sure your wires match the schematic numbered pins else my code doesn't work, unless you plan on changing them. If you want to learn how it works, there are great videos online explaining how it works.

Digital pins, input/output 5V to power your circuit based off the code

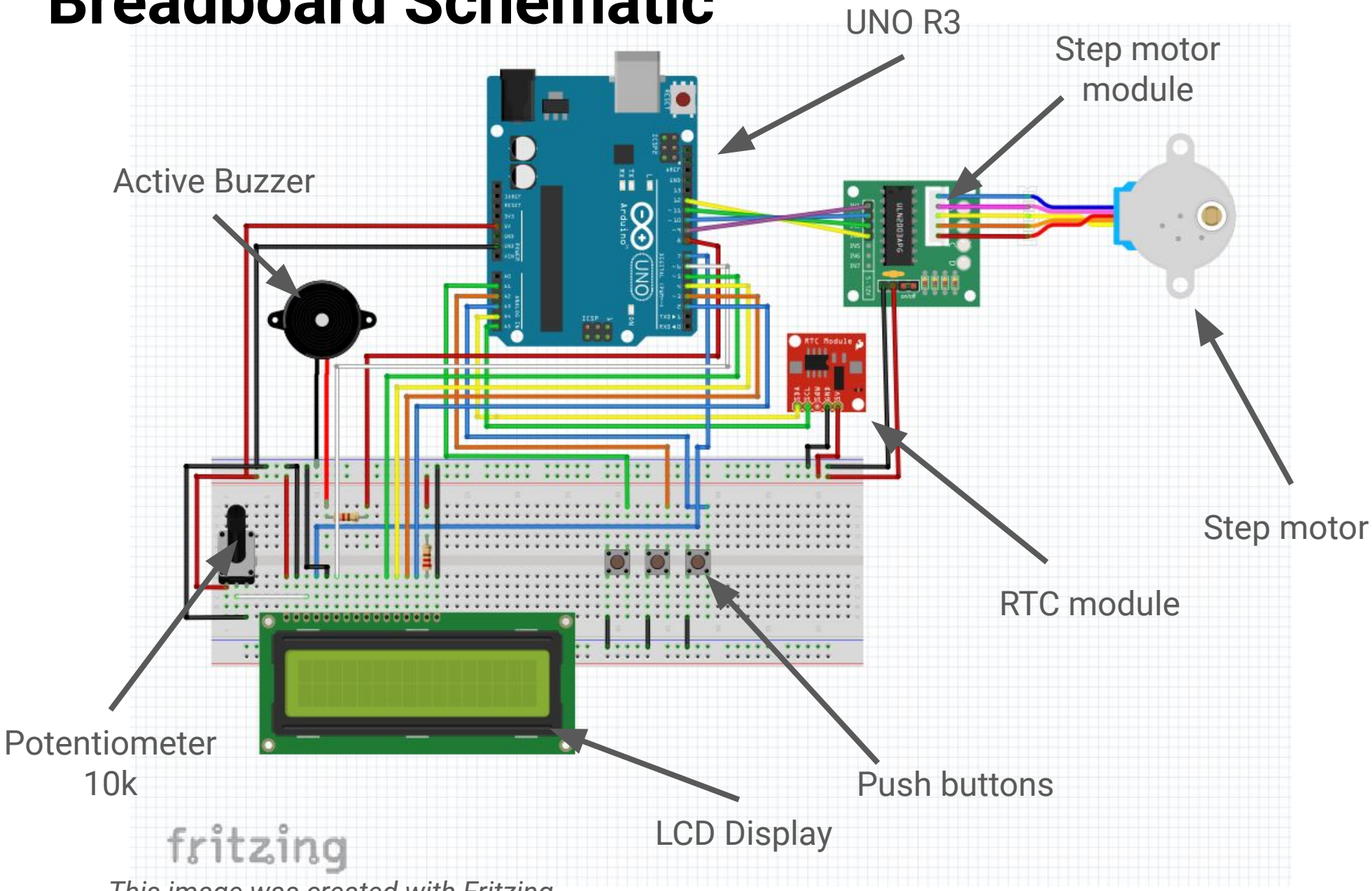


USB, where you upload your code and power your circuit

Power pins, 5V for live, GND for ground

Analog pins, input/output 0V to 5V of power to your circuit

Breadboard Schematic



This image was created with Fritzing

Wiring

The 5V goes into the red positive rail of the breadboard, the ground (GND) goes into the black negative rail of the breadboard. The components, LCD, buzzer, motor module go into the digital pins, while the buttons and rtc go into the analog pins. Here is a chart of what goes where:

LCD Display	Wire to
VSS	GND
VDD	5V
V0	Potentiometer
RS	Digital pin 7
RW	GND
E	Digital pin 6
D4	Digital pin 5
D6	Digital pin 3
D7	Digital pin 2
A	220Ω resistor to 5V
K	GND

Step Motor Module	Digital Pin
1N4	**12**
1N3	**11**
1N2	**10**
1N1	**9**
-	**GND**
+	**5V**

RTC Module	Wires to
GND	GND
VCC	5V
SDA	A4
SCL	A5

Buzzer	Digital Pin
220Ω resistor to 5V	**8**

Buttons	Analog Pin
Button 1 LEFT	**A1**
Button 2 MIDDLE	**A2**
Button3 RIGHT	**A3**

Circuit

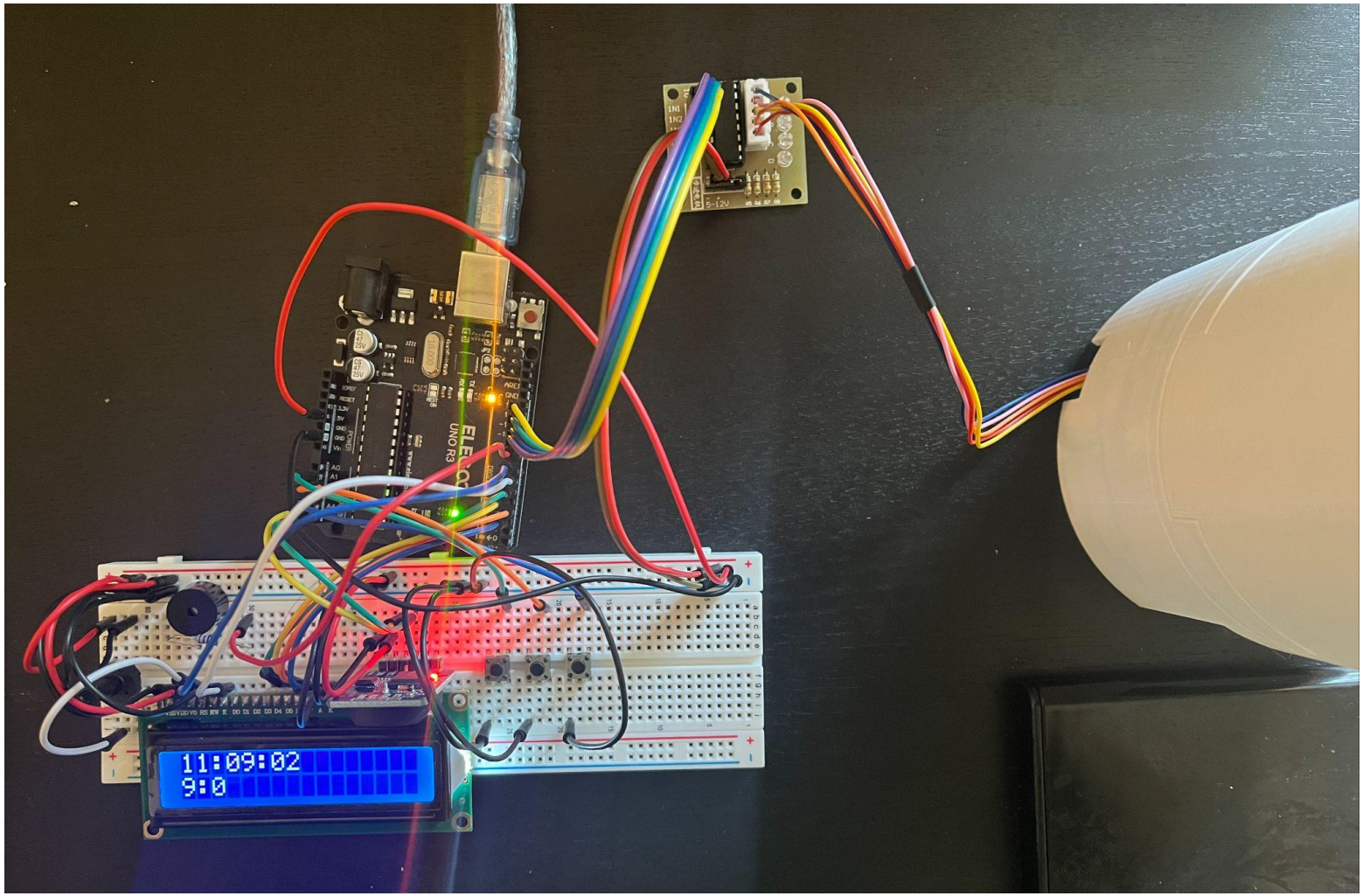
Circuit

Follow the wiring of the schematic, making sure not to place the wires in the wrong plastic holes, or else it does not work. Do not wire with it plugged in. Use different color wires to indicate which goes where. Research other sources for further assistance.

Note that while most wiring use male-to-male wires, the wires between the uno r3 and step motor module are male-to-female wires. Also, while the pins of the LCD display match the ones in the kit, the RTC module's pins do not, so look at the letters.

The components are mostly self explanatory, but adjust the potentiometer to change the LCD display, and the RTC accurately keeps track of the time even when not plugged in due to separate battery.

My Circuit



Note: The black dots on the left are the buzzer and potentiometer. The component glowing the red dot above the LCD is the RTC module.

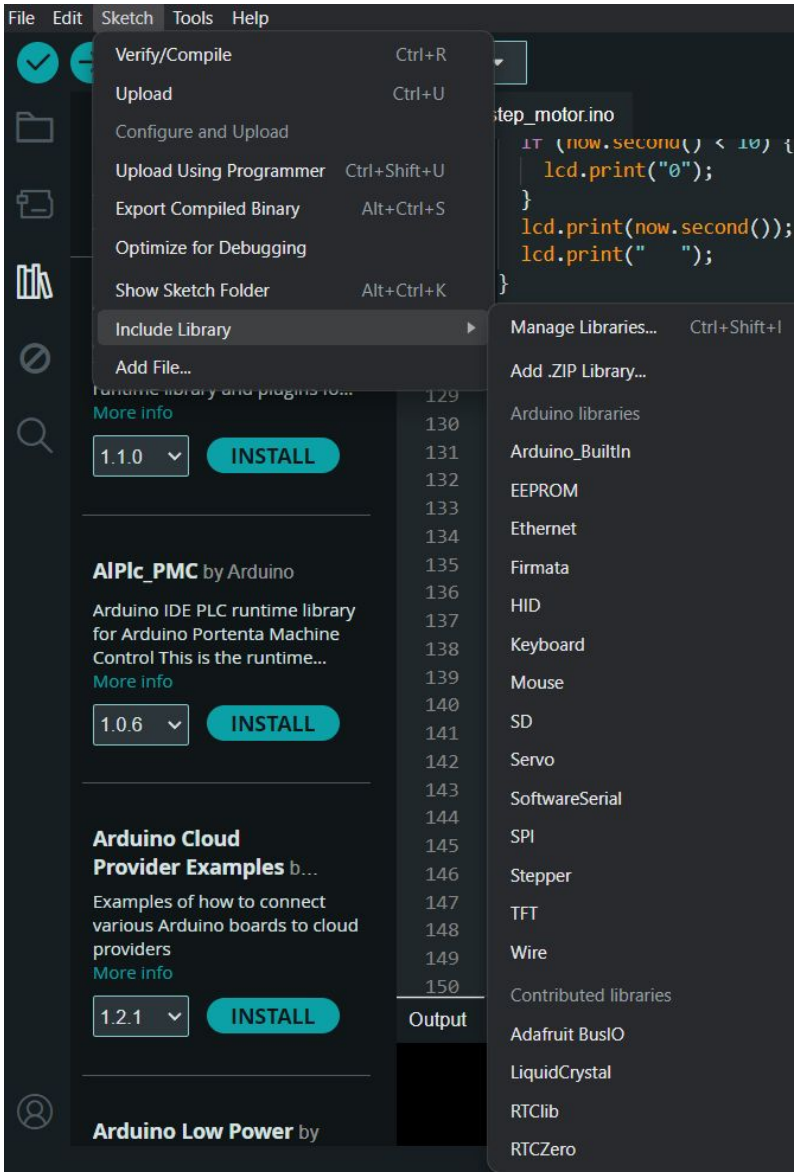
Program

Arduino IDE

The UNO R3 utilizes the Arduino IDE, which is based off C++. So first you have to install Arduino IDE onto your computer, then download libraries. When you open it and files, go to Sketch -> Include Library -> Manage Libraries..

Type in these libraries and install them:

- RTC Lib
- Liquid Crystal
- RTC Zero
- Adafruit BusIO



Code

Delete the code currently in the file, then copy and paste this code (link). Disclaimer, this was my first project coding in Arduino IDE. The code is very unpolished and could be improved. However, it works enough for this project.

After inserting the code, connect the UNO R3 to your computer via the USB cable, set the connection to the Arduino Uno, then upload the code in the top left using the arrow button.

Operation

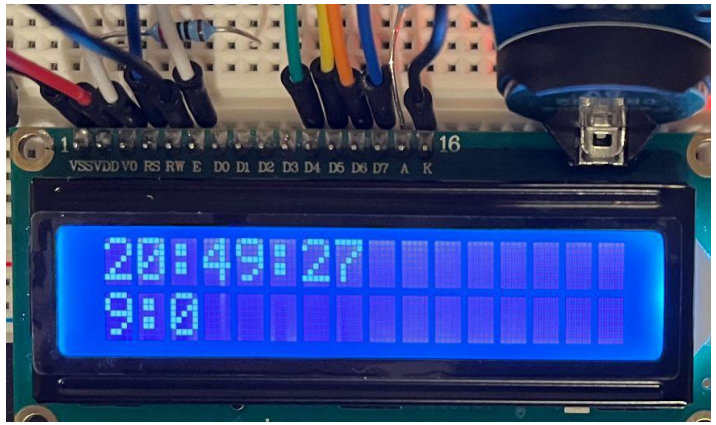
Operation

Plug the USB into the UNO R3 and any USB plug (doesn't have to be the computer).

Rotate the turntable on the pill dispenser to where the portion without any holes is above the bottom half where there are no holes.

Plugging the UNO into power lights off the LCD, adjust the potentiometer for the visibility of the LCD display. This is the display screen:

Top time is the real time, bottom time is the alarm set time. Buttons left to right are buttons 1, 2 & 3. Pressing button 1 makes a * appear next to the real time, meaning you can adjust real time of the RTC. Pressing/holding button 1 increases the hours, pressing/holding button 2 increases the minutes, and the seconds to 0. Pressing button 3 gets rid of the * and sets the time for the RTC to follow.



The alarm time operates the same by pressing button 2 where there are no * so a * can appear at the alarm time. Button 1 increases the hour, button 2 increases the minute.

Operation continued

When the alarm time matches with the real time, the motor does a full counter-clockwise 360 rotation so the pills can fall into the medicinal cup placed underneath. *If the motor doesn't rotate, there might be issue with glue in the motor. Another explanation may be that the friction in the bottom half may be too great, so you'll need to sand it.* After the full rotation and depositing the pills, the buzzer triggers and only turns off if the user holds **button 3** until the buzzer stops. Then the process repeats daily.

FINISHED