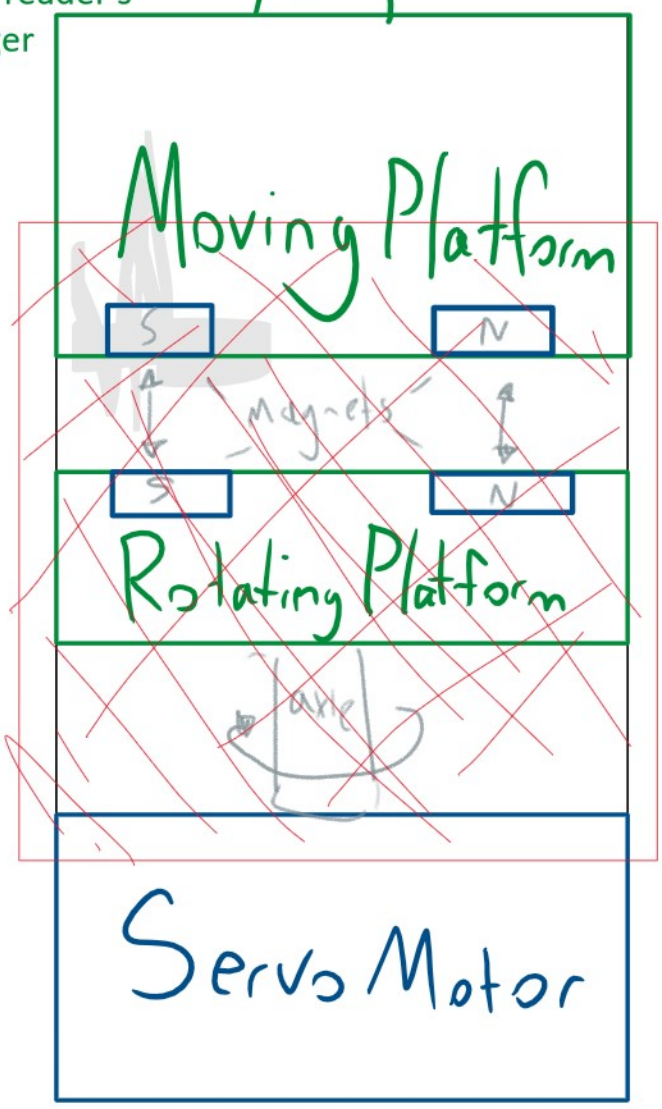
Oct 18

Diagram:

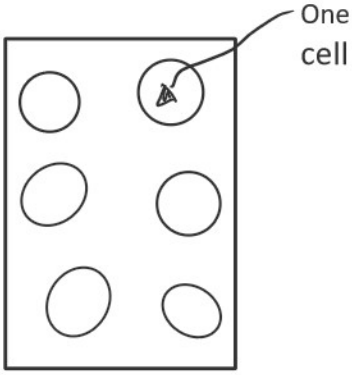
One Braille Cell (side view)



Plastic Covering

Platform is raised when bottom polarity is reversed caused by the rotation of the bottom platform.

Top View:



Oct 19

Slide 1: Objective

The goal of this innovation is to allow sight-deprived people to read without having to pay large amounts of money for Braille Readers.

The e-reader should stick to the following rules:

A. Remain affordable
B. Plus: Should not waste any batter unless switching to the next fragment of text

Prices:

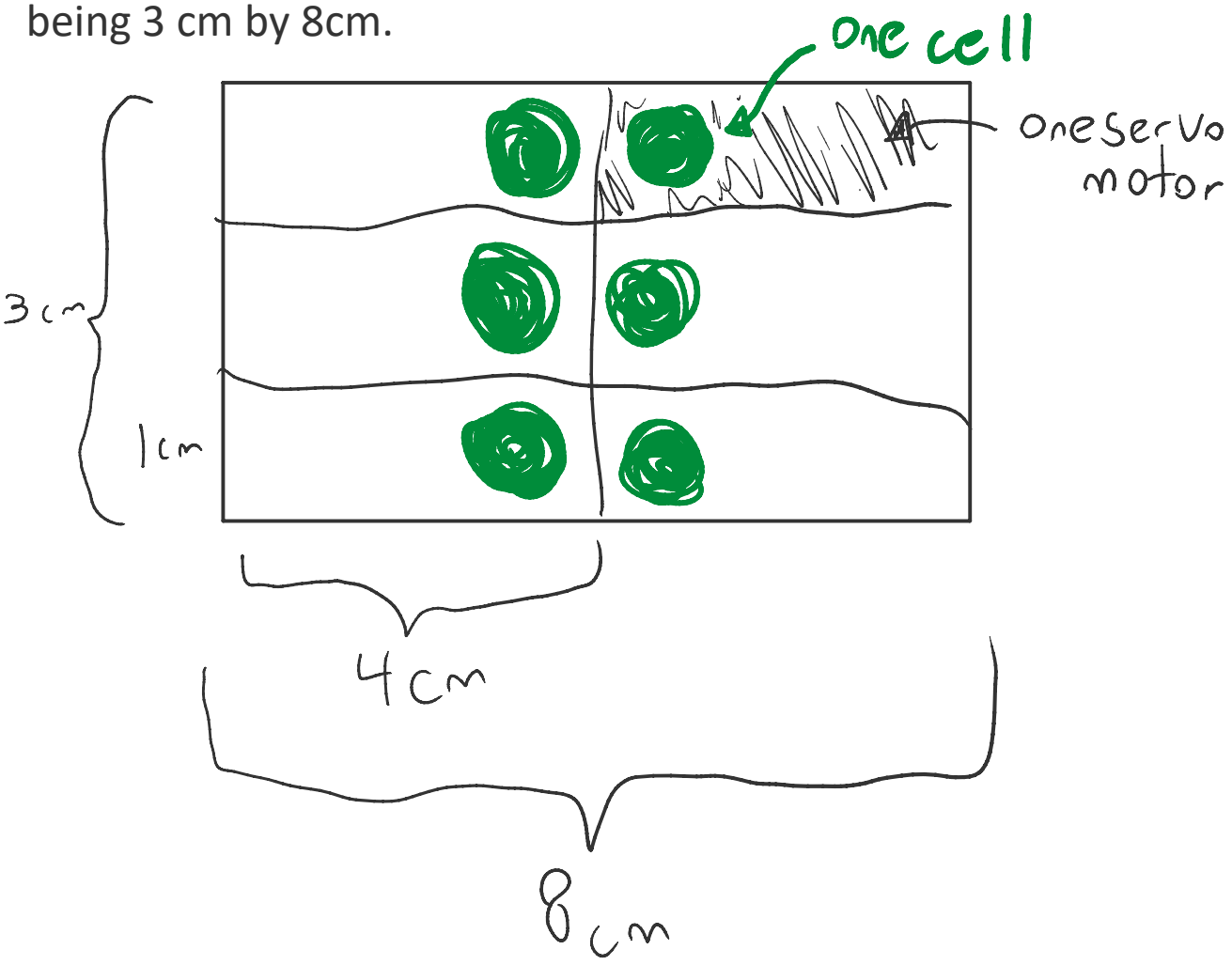
Brailliant BI 40 Braille Display

$3175 for 40 characters

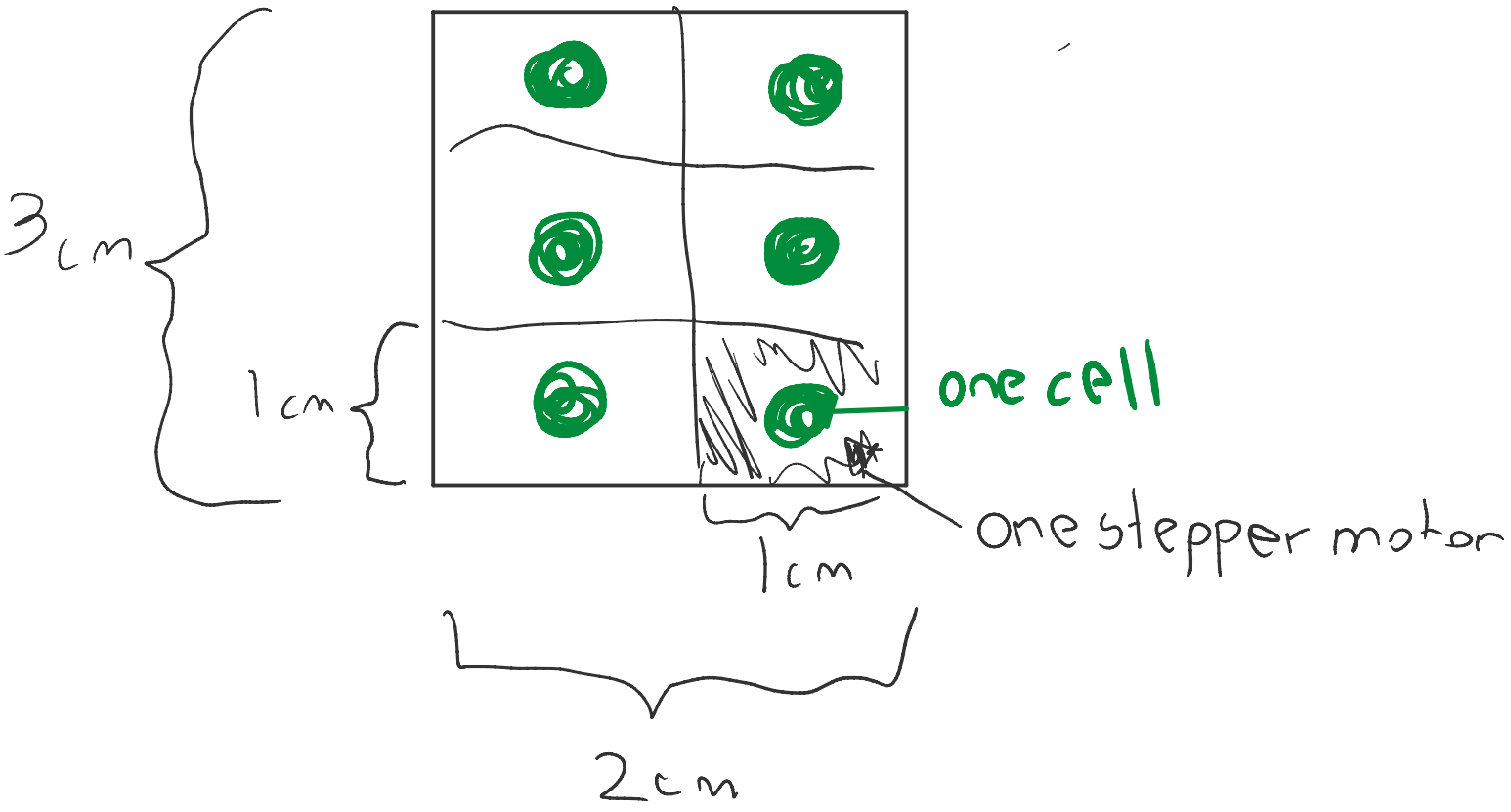
Website: Humanware

Oct 21

I realized my servo motor would be too big for my task of making one character with six motors.
One cell measures approx. l cm by 4 cm which will result in one braille character being 3 cm by 8cm.



Instead I decided to use stepper motors that measure 1 cm by 1cm resulting in the braille character being 3cm by 2cm.


3cm
1cm
one cell
one stepper motor
1cm
2cm

Nov 8

I ordered micro stepper motors from Amazon. The supplier was unidentified but I'm hoping for the best. They come in 10.
price: $12
I also ordered magnets with a diameter of 3cm, used to repel & raise the platform. They come in packs of 300.
price: $10

Nov 10

My stepper motors and magnets arrived! The magnets seem to be in great condition but four of the stepper motors have their microscopic wires cutoff. The supplier seems to have soldered them all of recycled breadboards.

I checked how the magnets were polarized because I needing them To be on the top & Bottom (Fig. 1), not on the two sides (Fig. 2) Thankfully, it was correctly done.

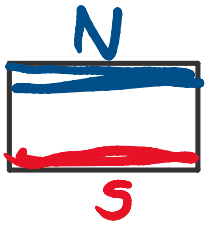
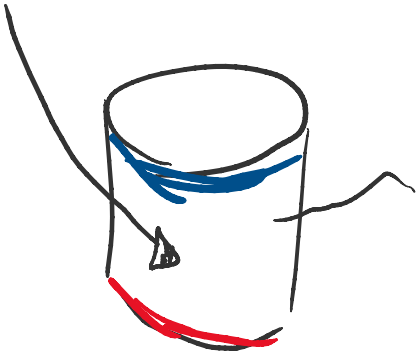


Fig.1

(Side View)

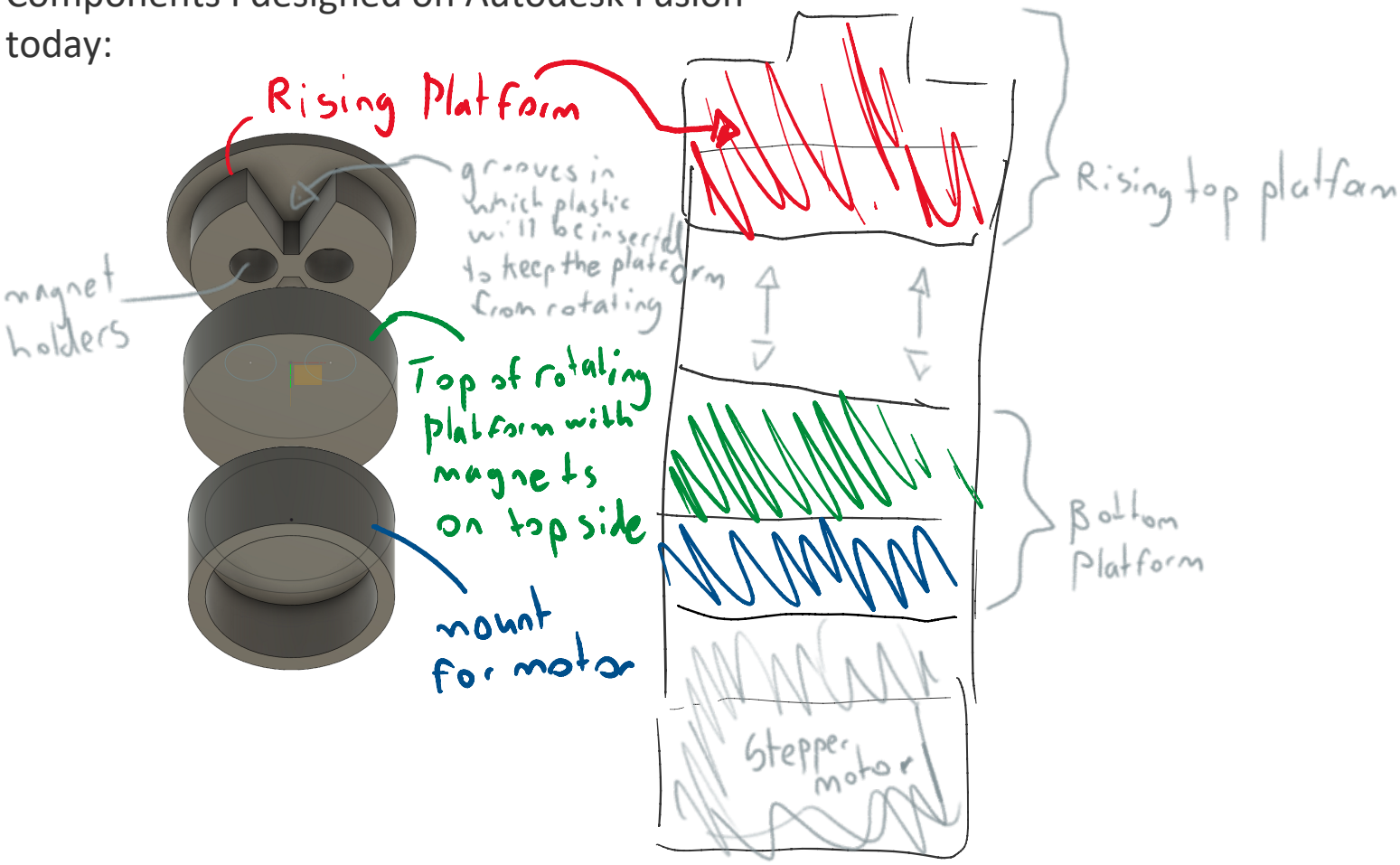
Fig. 2



(side of circular magnets pictured)

Nov 11 & 15

Here is a detailed diagram of each of my Components I designed on Autodesk Fusion today:



Nov 16

I attempted to 3D print my model on my school's Flash Forge Printer. I flipped it on it's side so the support would be easier to break off.
The model printed but since it was so small the supports won't come off. I will try to change the refinement from hyper to normal.

Jan 31

I have recorded in detail the dimensions used for my 3D design. They were all measured using a caliper.

Motor axle radius: 1.25mm
Motor axle height: 3.3mm
Braille cell combined diameter: 7.5mm
Braille cell height: 4mm
Magnet diameter: 3.4mm
Magnet height: 2.8mm

Feb 1

I finished designing al my models and when printed, the bottom two disks fell apart. Because of this, I adjusted the platform to a diameter of 7.7mm. When printed, the component held together and I popped in the magnets. Because the magnets connected with the top platform and came out of their holes, I glued them in with epoxy. They fit in well but I had to adjust the tube several times by 1/5th of a millimeter for the components to fit inside it.

Feb 7

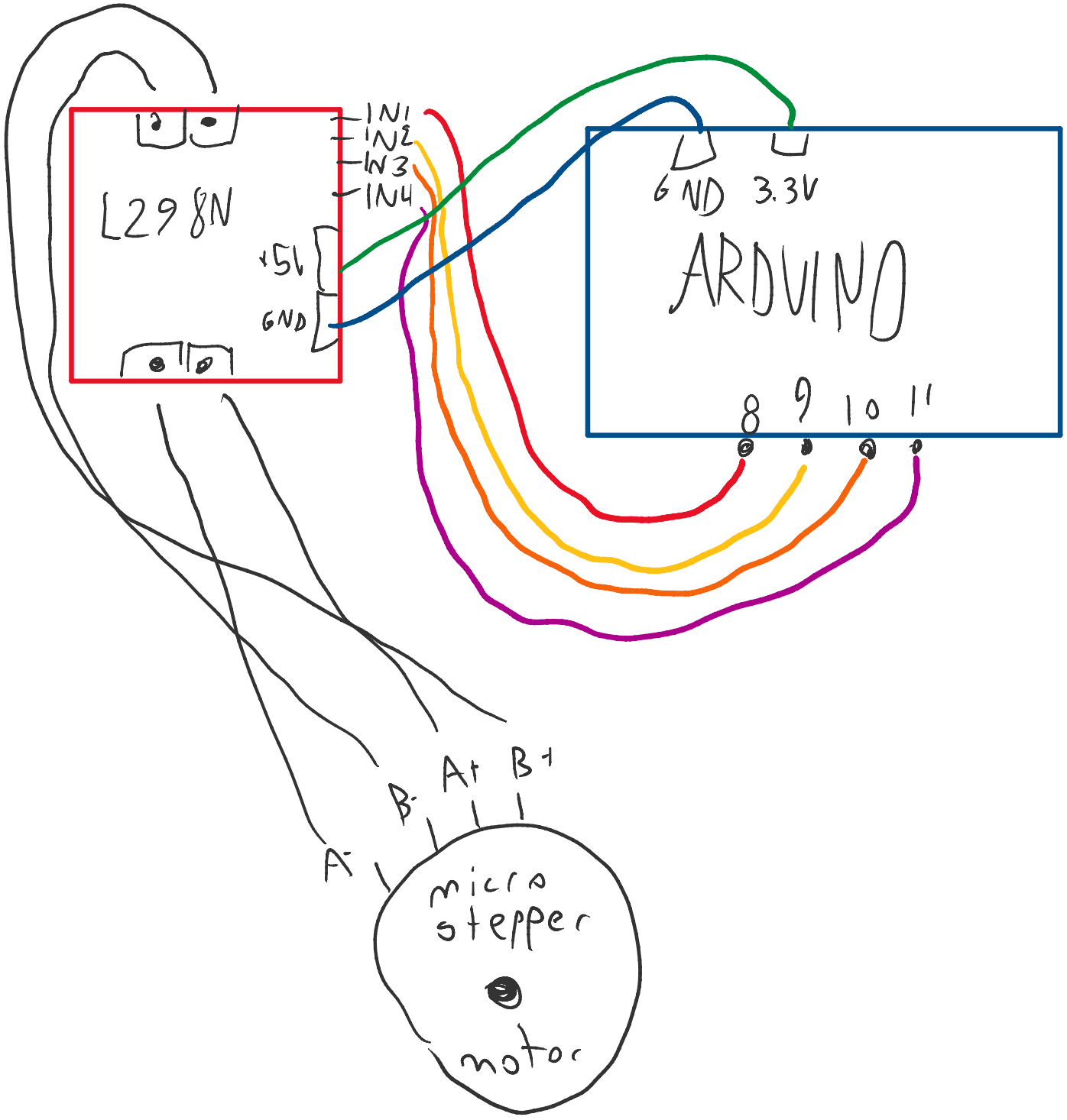
In order to find out what each one of the electrical contacts were controlling I used a multimeter to check which ones were connected. Next I connected them to an Arduino using my L298N motor drivers which was connected to the wall.

The Code was as follows:

```
#include <Arduino.h>
#include <Stepper.h>
const int stepsPerRevolution = 24;  Steppe
r myStepper(stepsPerRevolution, 8, 9, 10,
11);
void setup() {
  myStepper.setSpeed(60);
  Serial.begin(9600);
}
void loop() {
  Serial.println("clockwise");
  myStepper.step(stepsPerRevolution);
  delay(500);
  Serial.println("counterclockwise");
  myStepper.step(-stepsPerRevolution);
  delay(500);
```

```
}
```

Pictured here is the schematic for how my stepper motor was wired:

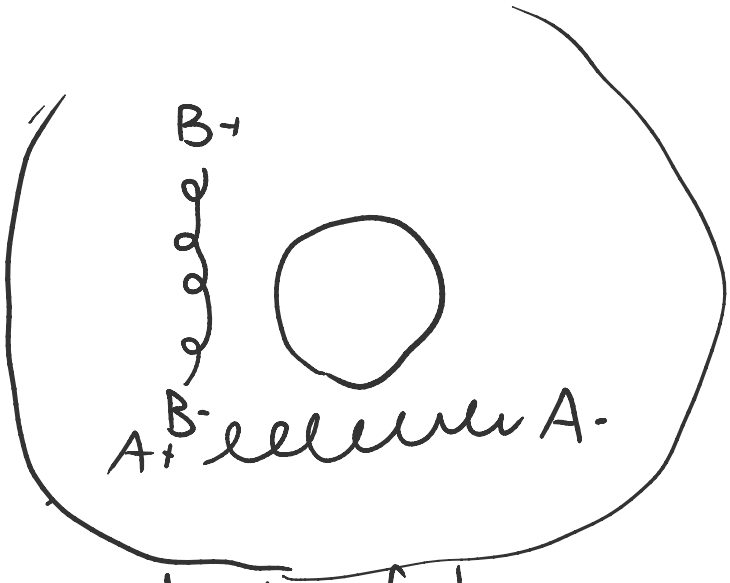

L298N
IN1
IN2
IN3
IN4
+5V
GND
GND
3.3V
ARDUINO
8
9
10
11
A+
B+
B-
A-
micro
stepper
motor

Feb 14

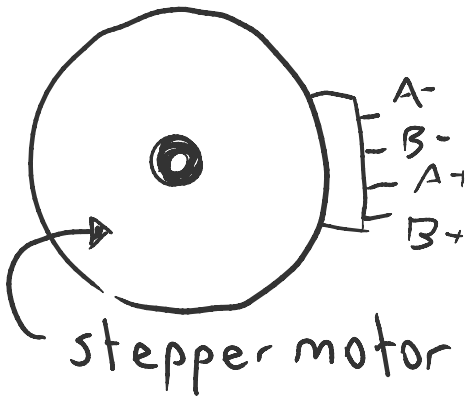
I tried connecting the bigger stepper motor to figure everything out
Using the oscilloscope to find out to which pins the current is running through. The bigger stepper motor worked, indicating everything was working fine with the motor driver. I suspect I just wired the mini stepper motor incorrectly.

Feb 21

I worked for a long time trying to wire the stepper motor to the motor driver until my dad explained to me that I was wiring it all wrong. The A- & the A+ pins were supposed to go on one side of the driver while the Bs on the other.



inside view of stepper coils



stepper motor

I found out the two groups using a multimeter (the a- is connected to the a, same with the b's). My motor would still not work so I amped up the current to 1. It finally worked! The motor was very unstable as seen through the waves on the oscilloscope.
I made it do 2 half circles but when I put the tube on, it was not powerful enough to continue spinning.

Feb 28

I enlarged the tube to give the stepper motors some space to turn. I printed it on our printer but it did not work out so well. I will print it tomorrow on the school one.

Mar 1

Success! The tube printed and allows the stepper motor to spin. Now I have to add a cap because the platform flies right out. Too much magnetic force!

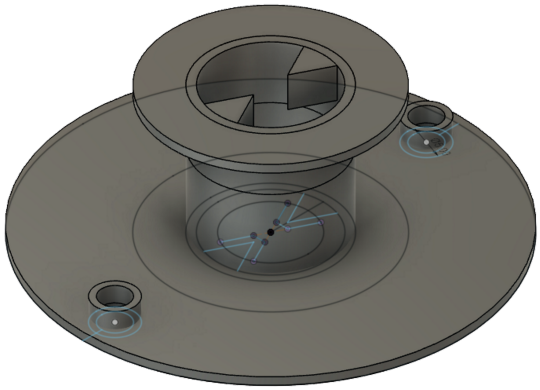
Mar 2

I am having a lot of trouble to get the platform spinning because the motor is very weak. The magnetic force is just holding it in place and not allowing it to rotate. I tried to lengthen the tube to decrease the force but still no success. The motor still only spins when moved in at an angle. I am going to try to replicate it all with a bigger stepper motor to still show the braille technology I'm developing.

New Dimensions:
Axle diameter: 10mm
Platform diameter: 30mm

Mar 5

I printed the design with a light modification to the tube, adding an extra cover so the platform won't fly right out. The tube can now be attached to the stepper motor with screws:



Mar 8

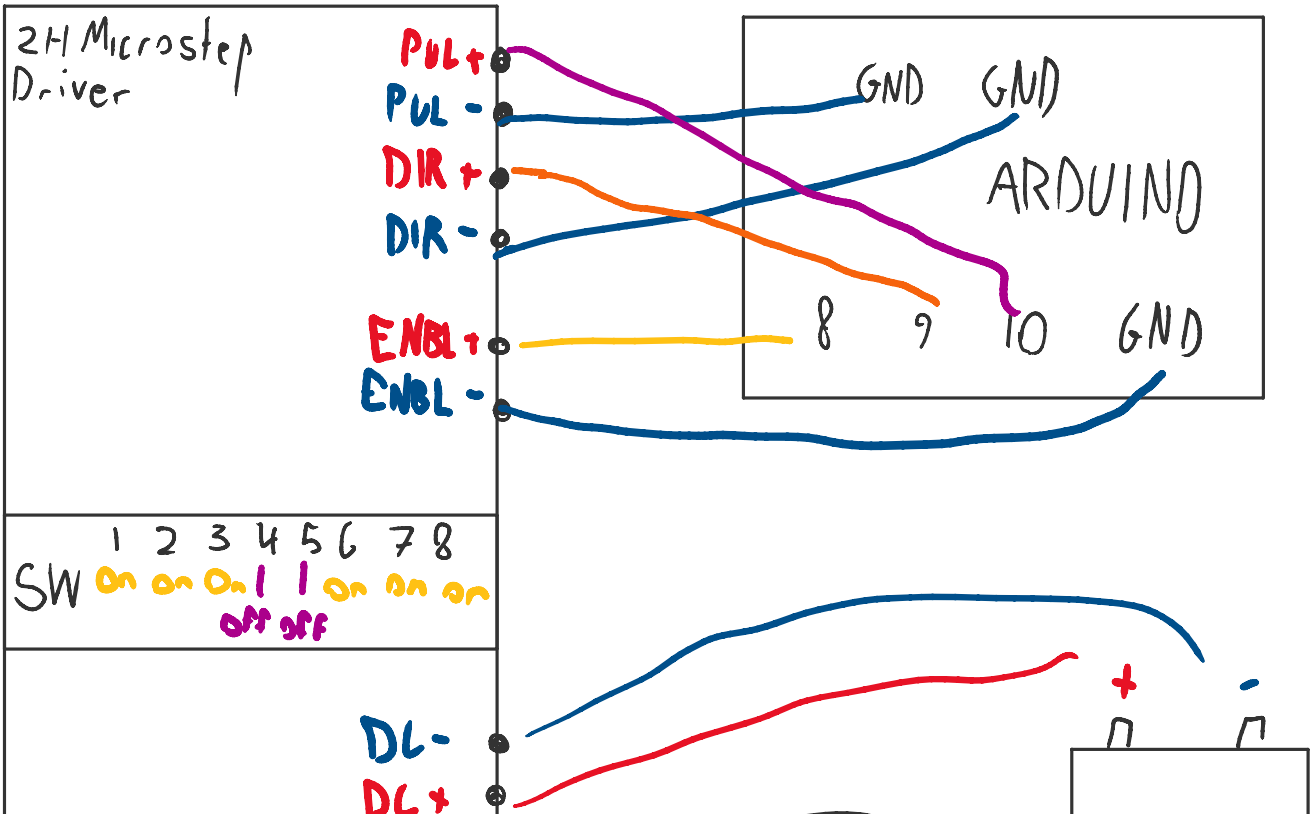
For the stepper motor I could not use the Stepper Library I used because I was not using a L298N motor drive. I therefore wrote a new code.

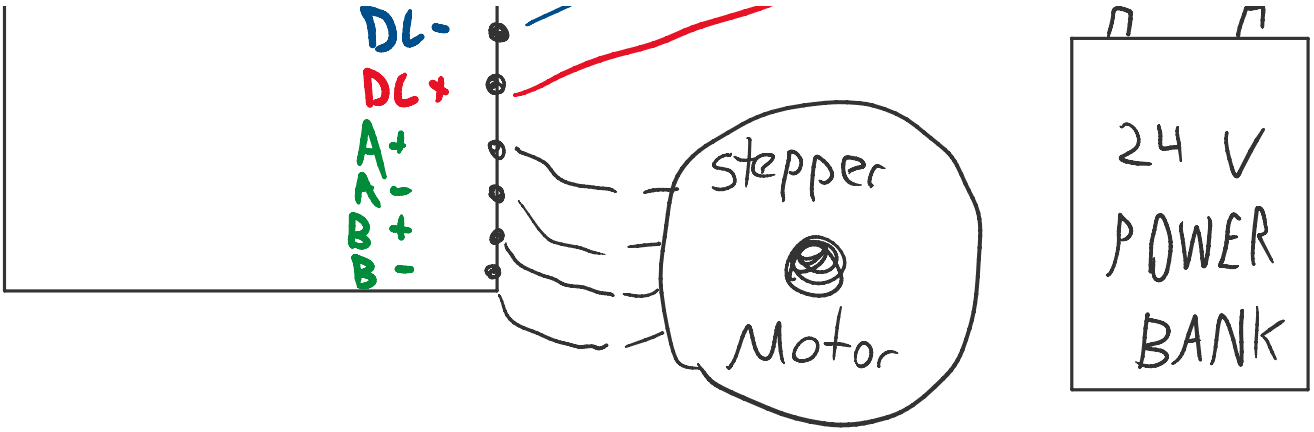
New Code:

```
#include <Arduino.h>
#define PULSE_PIN 8
#define ENABLE_PIN 10
#define DIRECTION_PIN 9

void setup() {
    pinMode(PULSE_PIN,OUTPUT);
    pinMode(ENABLE_PIN,OUTPUT);
    pinMode(DIRECTION_PIN,OUTPUT);
    digitalWrite(ENABLE_PIN,HIGH);
}
void loop() {
    digitalWrite(PULSE_PIN,LOW);
    delay(10);
    digitalWrite(PULSE_PIN,HIGH);
    delay(10);
  }
```

Success! The motor spun! I left it on to watch the half rotations and when my dad came to check on it, he got burned. The motor heated up to 140 degrees! There is something really wrong. Apparently this motor is only designed to be turned on in short bursts at a time. I am glad to know though that the braille technology works! When I came back to my motor, the whole 3D printed apparatus had melted and was drooping. I then printed more at school and cautiously turned on the motor for a few short bursts. I still heated up like crazy. After school, my Dad brought a real stepper motor driver meant for stepper motors and I used it. Here is the schematic:




DL-
DL+
A+
A-
B+
B-
stepper
Motor
24 V
POWER
BANK

Mar 9

The motor no longer heat up insanely and I took a video today to show the judges. It worked beautifully: 

I then did an estimate of how much it would cost if my braille cell technology was compiled into an e-reader of 40 cells, comparing it to the Brailliant BI 40 Braille Display:

Material	Price
Filament	$1-$2
12 mini magnets	$0.5
Stepper Motor	$0.75-$4.5
1 cell	$2.25-$7
1 character (6 cells)	$13.5-$42
Braille Display with 40 Characters	$500-$1680

As you can see, prices may vary according to the type of filament and motor but overall, ends up being not much compared to the e-readers currently available on the market. Prices can also decrease drastically if the components are bought in bulk directly from the seller.