Automated Ream Opener

Mazin Chater
Youssef Jalwaj-Soubai
Abdullah Qureshi

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Problem

The Center for Disability Services Mailing Center processes an enormous amount of paper daily.

They use about 50,000-100,000 paper sheets per day.

Problem

To get the paper, it must be manually opened from reams containing 500 sheets each.

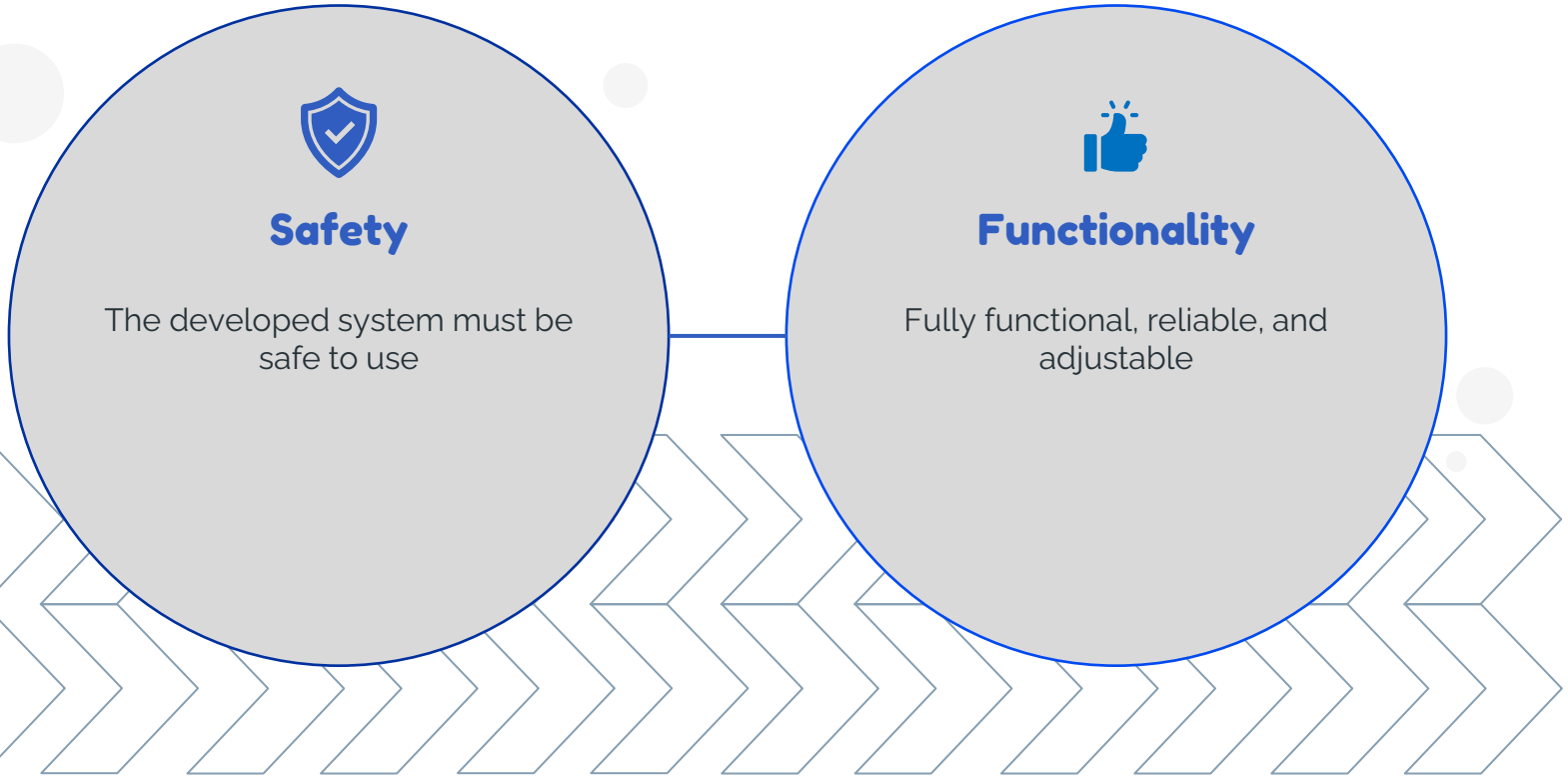
This translates to about 100-200 reams per day.

Problem

For disabled individuals, opening large volumes of reams presents many issues:

1. Damages internal paper
2. Paper cuts
3. Needs supervision

System Requirements



System Requirements

Accessibility

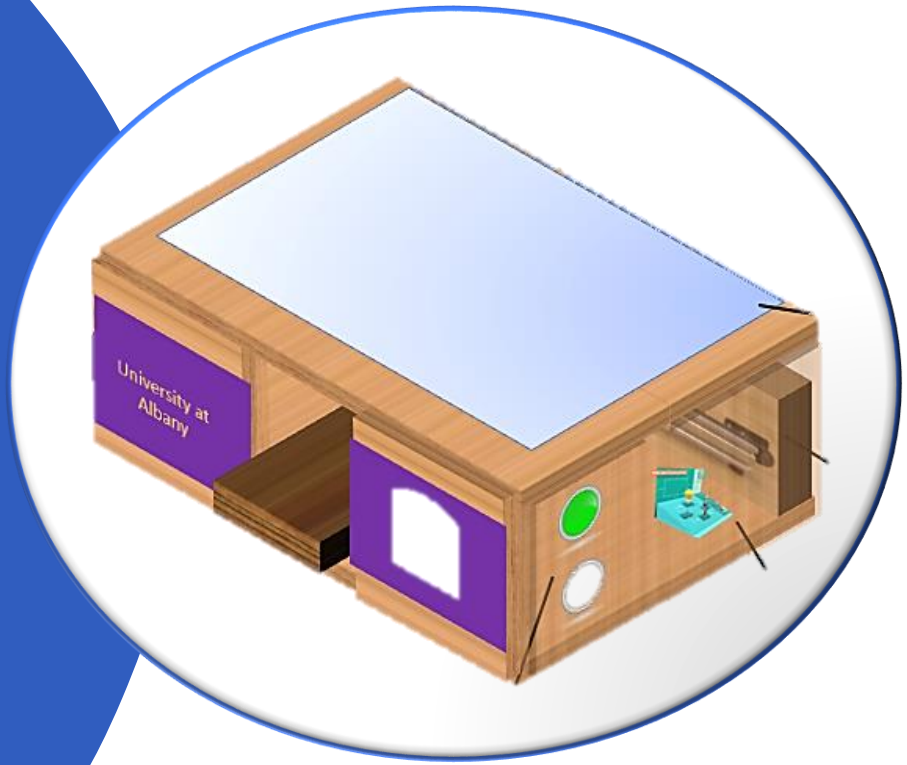
Simple and easy to use

Timing

Considered a bonus to balance efficiency with the worker's sense of contribution

Solution

How does it work?



Function

1) Insert Wrapped Ream Into Tray

2) Green Button Initiates Operation

3) Blades Slice Outside Layer

4) Unsealed Ream Returns

Safety Features

Emergency Stop

If any issues arise, an emergency stop button ensures operations halt

Blade Position

Analog blade holders ensure the blades are exposed to a minimum

Cart Position

The carts are set in the back of the machine and only move towards the ream upon the start sequence

Button Position

The buttons are on the side of the machine to prevent any accidental presses

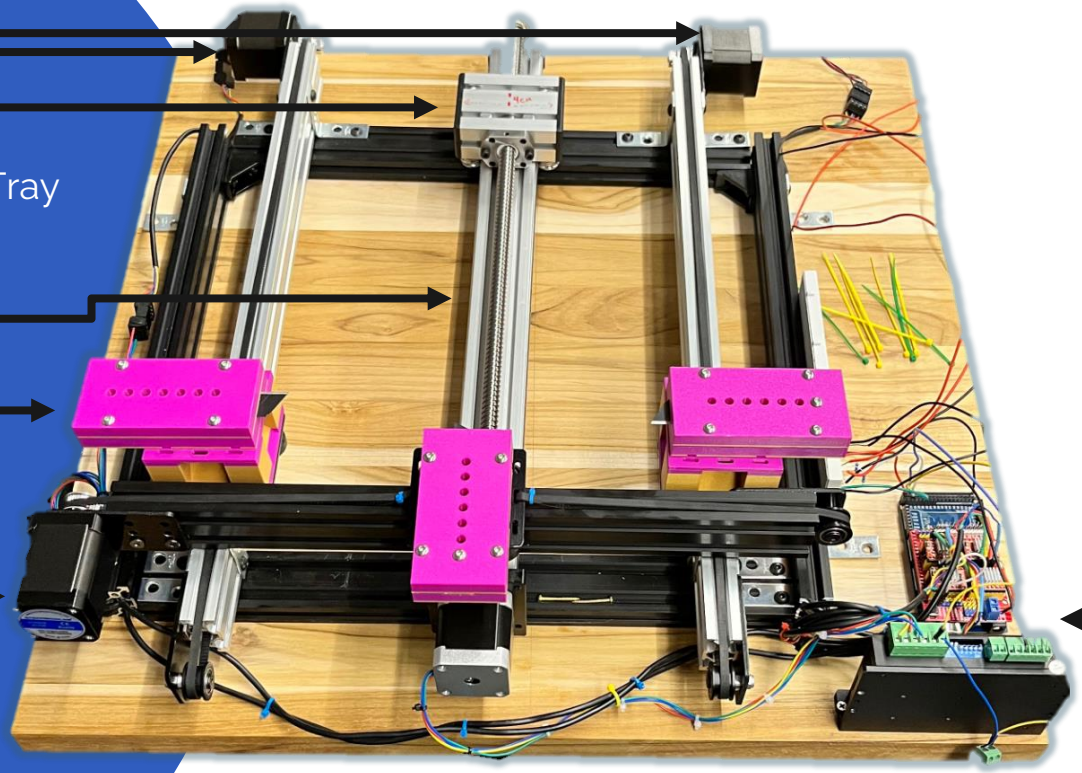
Key Improvements

→ Disabled workers can independently use the device

→ Design is reliable:
200+ reams have been opened with a ~95% success rate

→ Takes only a press of a button & 30 seconds to open a ream

Key Components



Analog Blade Holders

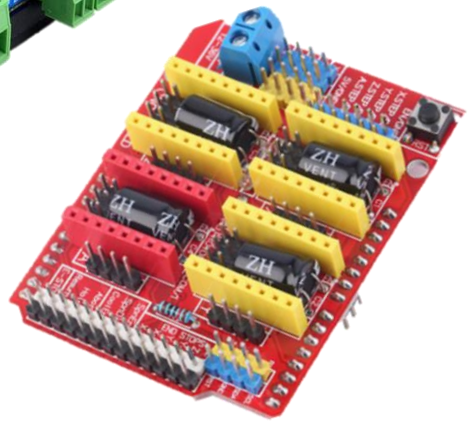
→ Allows blades to be just barely exposed

→ Blades are easily interchangeable

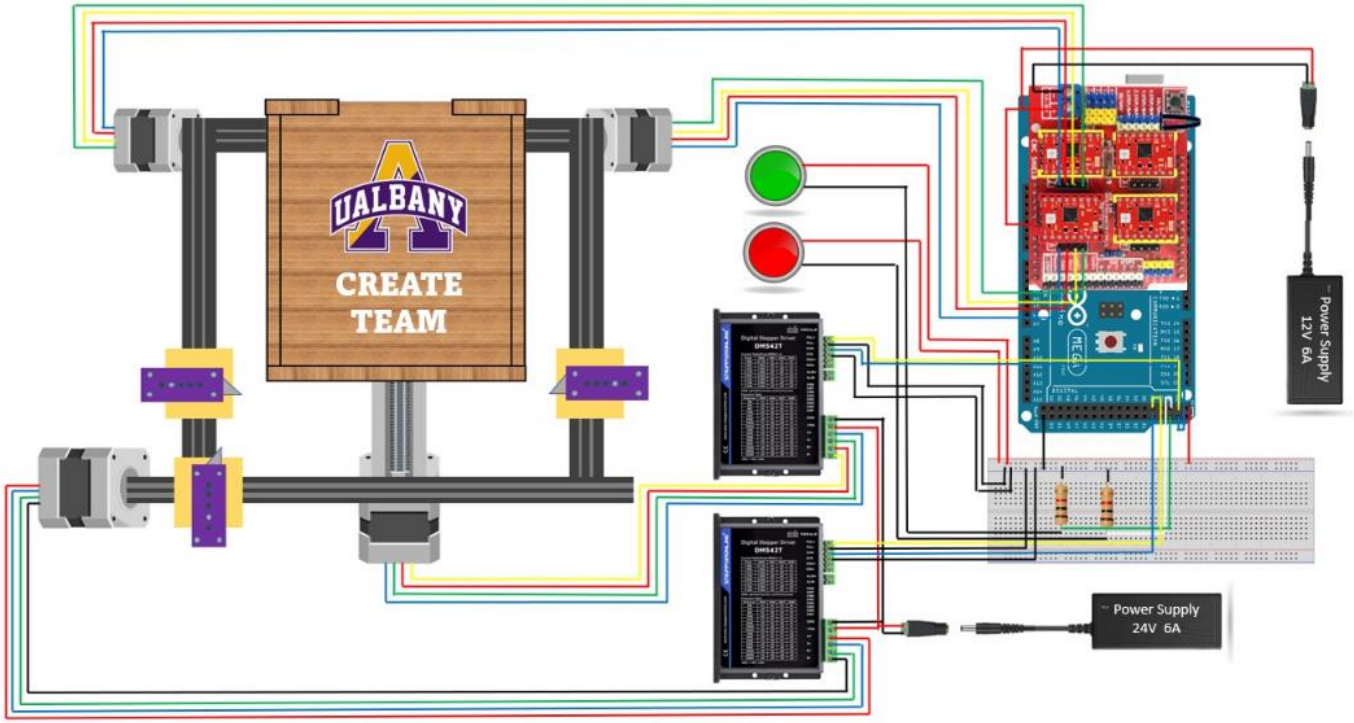
→ Blades can be adjusted to hit the outside layer of paper without damaging inner contents

DM542T & CNC Shield

Drives top NEMA 23 stepper motor, threaded rod stepper motor, and the two side NEMA 17 motors.



Circuitry



Code

```
  StartButtonState = digitalRead(StartButtonPin);
  pinMode(StartButtonPin, INPUT);

  if (StartButtonState == HIGH) {
    fullCycle();
  }
```

```
const int StopButtonPin = 24;
pinMode(StopButtonPin, INPUT);
StopButtonState = digitalRead(StopButtonPin);
 if (StopButtonState == HIGH) {
   resumeFun();
   }
 void resumeFun() {
 StartButtonState = digitalRead(StartButtonPin);
 if (StartButtonState == HIGH) {
   return;
 }
 else {
   Serial.println("Stop");
   resumeFun();
 }
}
```

Code

```
digitalWrite(DirX, LOW); // set direction, HIGH for clockwise, LOW for anticlockwise
digitalWrite(DirY, LOW); // set direction, HIGH for clockwise, LOW for anticlockwise
digitalWrite(DirN, HIGH);

for (int x = 0; x < 13500; x++) { // loop for 200 steps
  StopButtonState = digitalRead(StopButtonPin);
  if (StopButtonState == HIGH) {
    resumeFun();
  }
    digitalWrite(StepN, HIGH);
    delayMicroseconds(500);
    digitalWrite(StepN, LOW);
    delayMicroseconds(500);
}
//delay(1000); // delay for 1 second

for (int x = 0; x < 400; x++) { // loop for 200 steps
  StopButtonState = digitalRead(StopButtonPin);
  if (StopButtonState == HIGH) {
    resumeFun();
  }
    digitalWrite(StepX, HIGH);
    digitalWrite(StepY, HIGH);
    delayMicroseconds(1000);
    digitalWrite(StepX, LOW);
    digitalWrite(StepY, LOW);
    delayMicroseconds(1000);
}

digitalWrite(DirZ, LOW);

for (int x = 0; x < 1250; x++) { // loop for 200 steps
  StopButtonState = digitalRead(StopButtonPin);
  if (StopButtonState == HIGH) {
    resumeFun();
  }
  digitalWrite(StepZ, HIGH);
  delayMicroseconds(1000);
  digitalWrite(StepZ, LOW);
  delayMicroseconds(1000);
}
```

Code

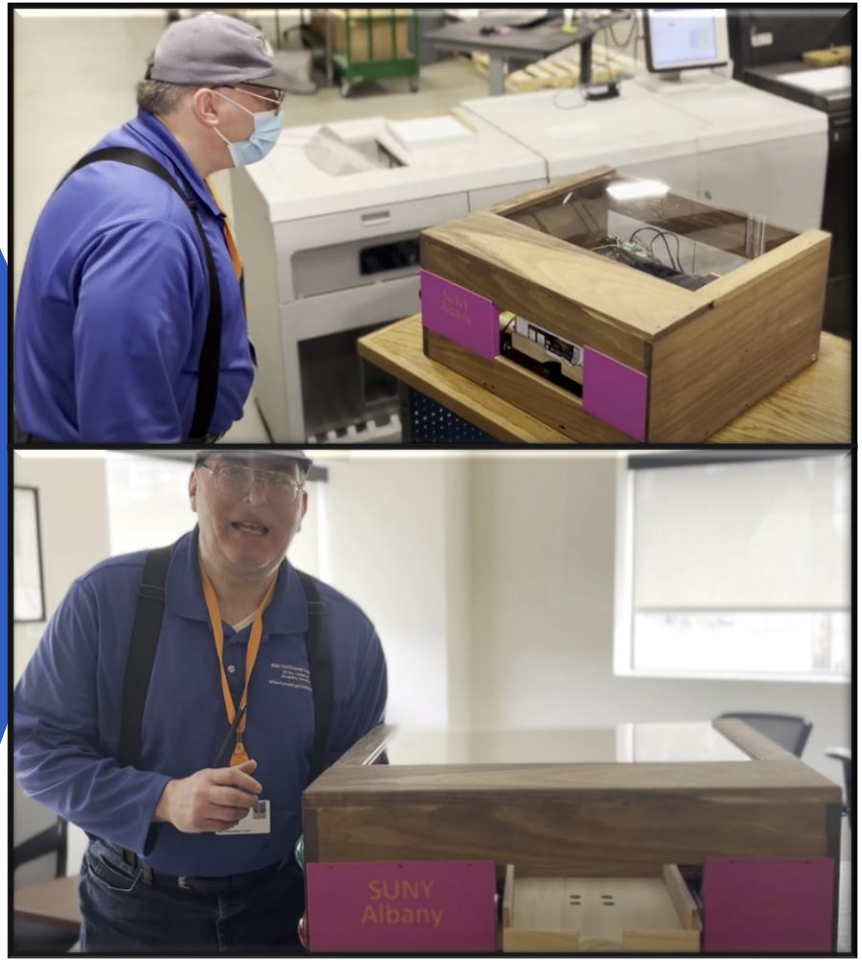
```
const int StepX = 4;
const int DirX = 7;
const int StepY = 3;
const int DirY = 6;
const int StepN = 22;
const int DirN = 23;

digitalWrite(DirX, HIGH);
digitalWrite(DirY, HIGH);
digitalWrite(DirN, LOW);

for (int x = 0; x < 13300; x++) { // loop for 200 steps
  StopButtonState = digitalRead(StopButtonPin);
  if (StopButtonState == HIGH) {
    resumeFun();
  }
  if (x < 400) {
    digitalWrite(StepX, HIGH);
    digitalWrite(StepY, HIGH);
    digitalWrite(StepN, HIGH);
    delayMicroseconds(500);
    digitalWrite(StepX, LOW);
    digitalWrite(StepY, LOW);
    digitalWrite(StepN, LOW);
    delayMicroseconds(500);
  }
  else {
    digitalWrite(StepN, HIGH);
    delayMicroseconds(500);
    digitalWrite(StepN, LOW);
    delayMicroseconds(500);
  }
}
```

```
const int StepZ = 28;
const int DirZ = 29;
digitalWrite(DirZ, LOW);
for (int x = 0; x < 1250; x++) { // loop for 200 steps
  StopButtonState = digitalRead(StopButtonPin);
  if (StopButtonState == HIGH) {
    Serial.println("S");
    resumeFun();
  }
  digitalWrite(StepZ, HIGH);
  delayMicroseconds(1000);
  digitalWrite(StepZ, LOW);
  delayMicroseconds(1000);
}
```

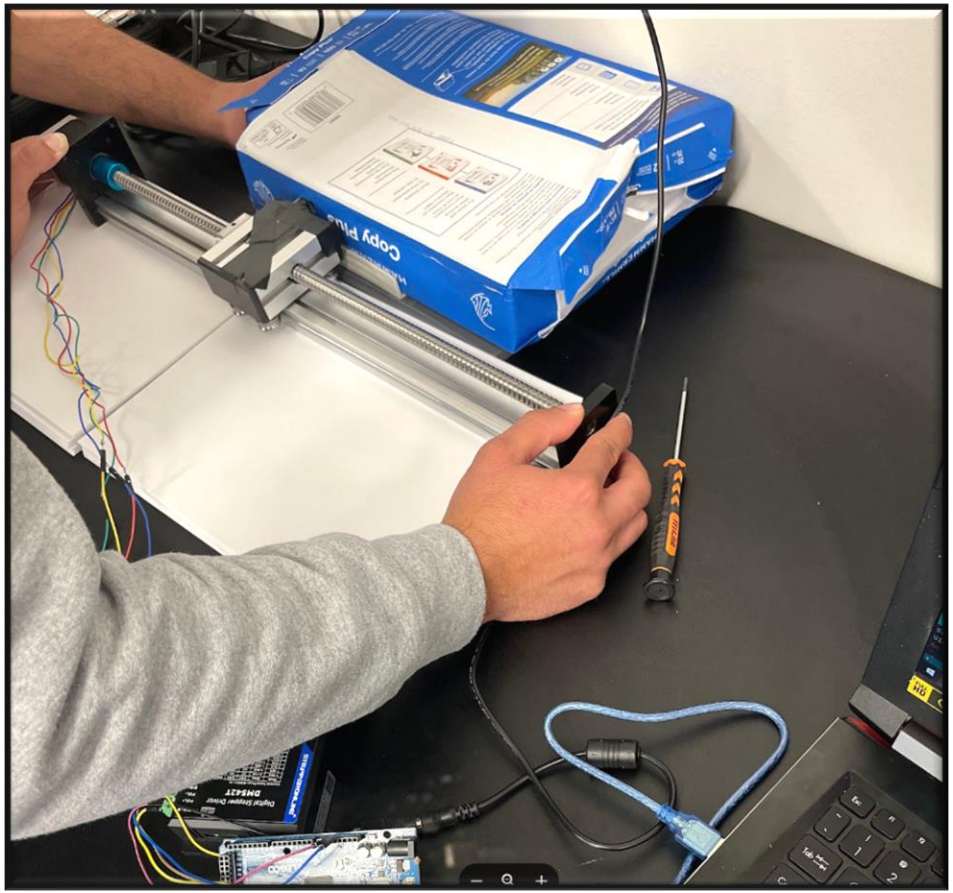
Impact

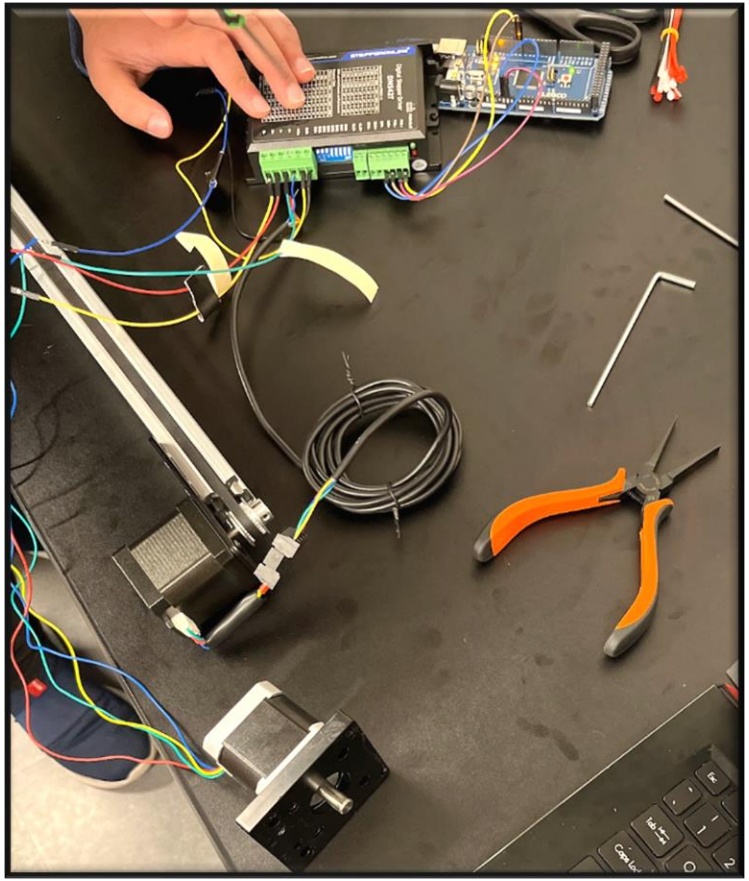
The Center for Disability Services Mailing Center has expressed interest in hiring full-time disabled staff to use the machine

Current disabled employees have also been using it at the facility



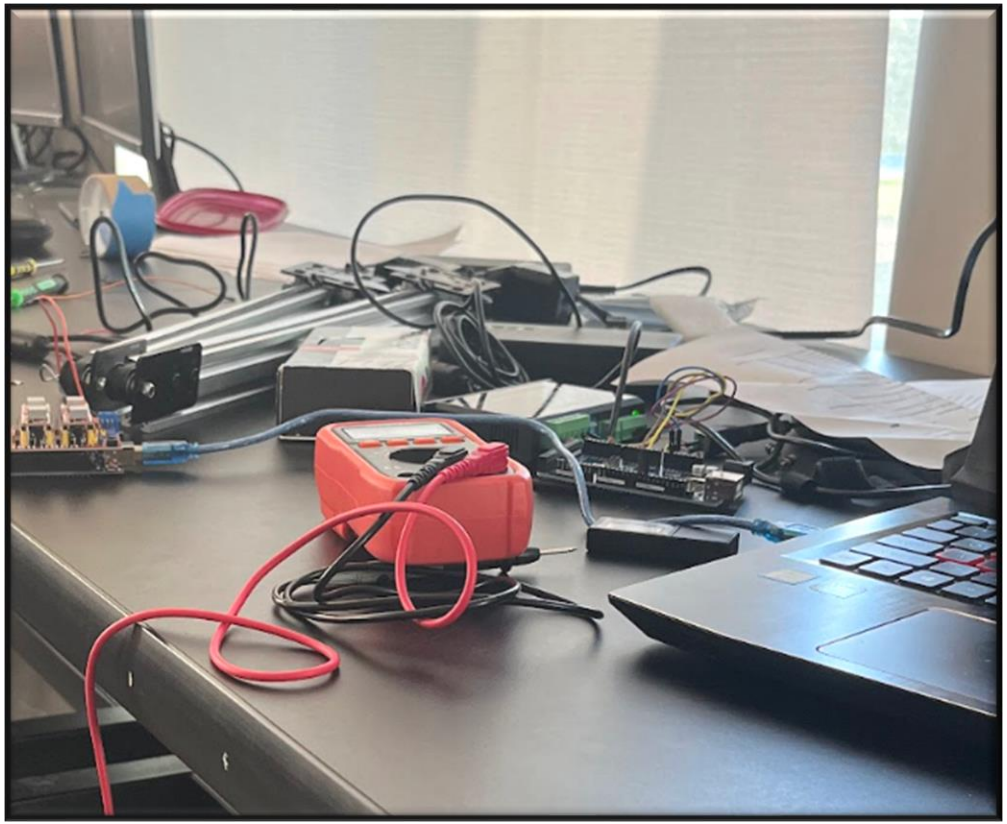
September





October

November

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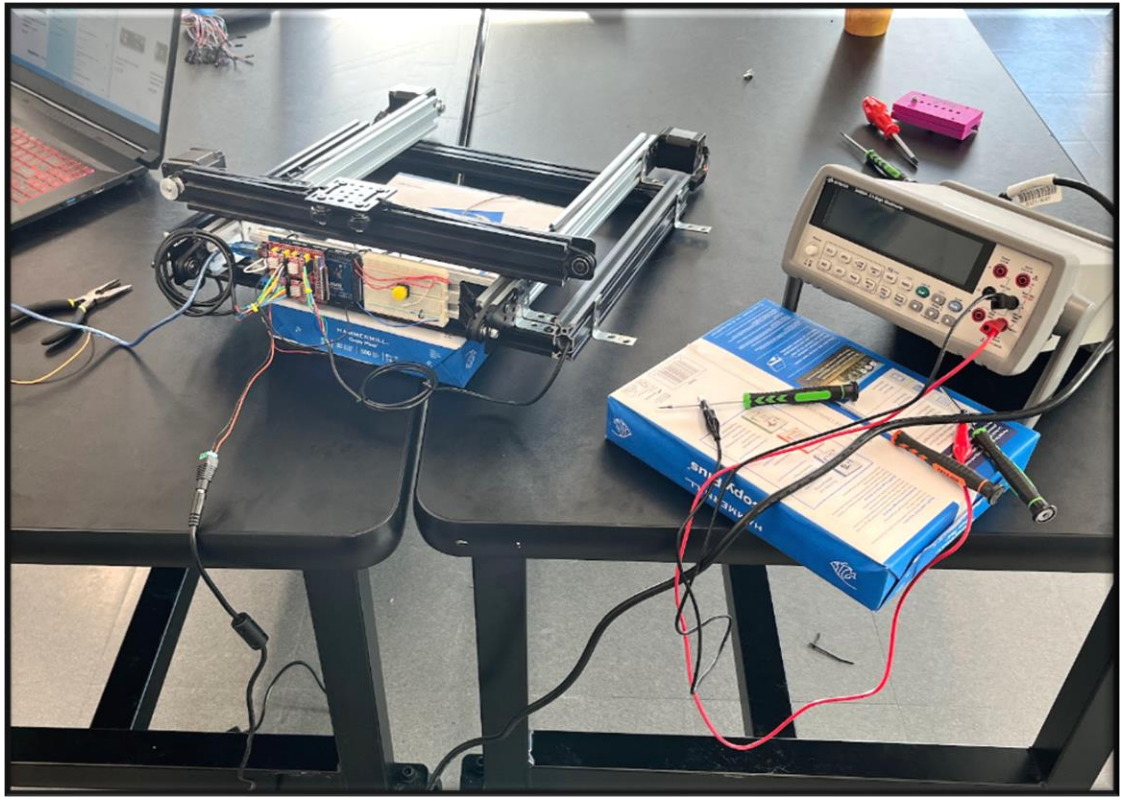
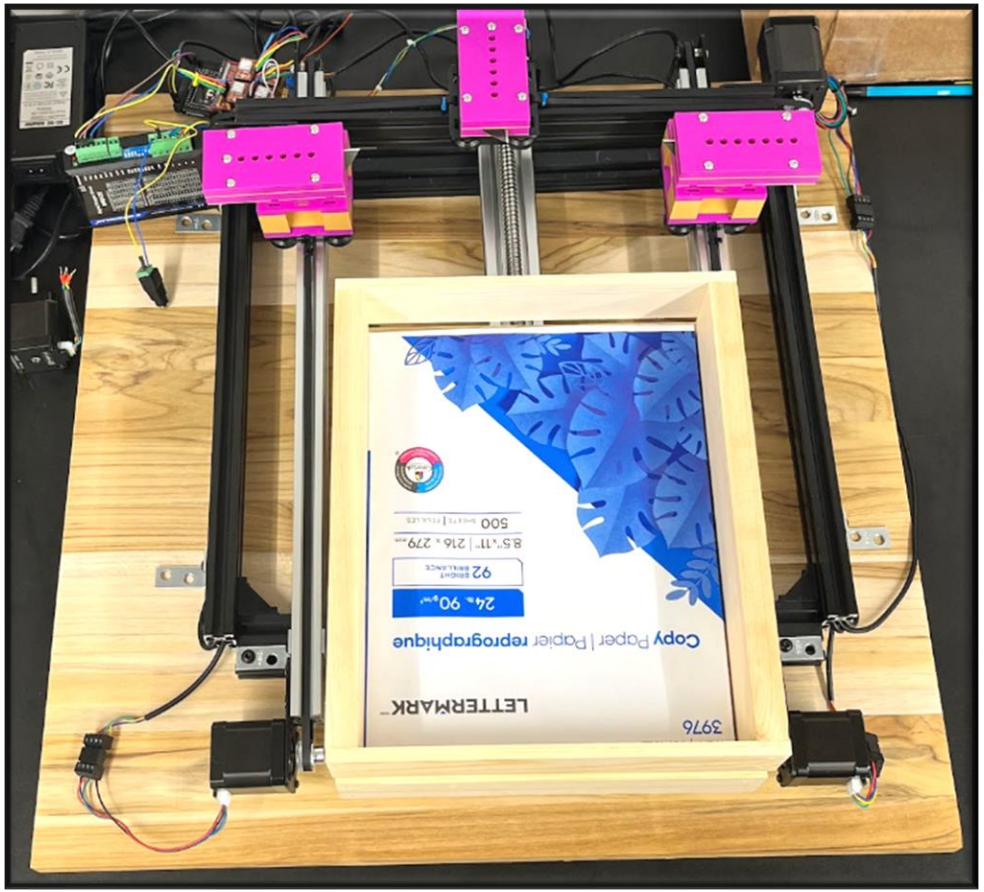
December

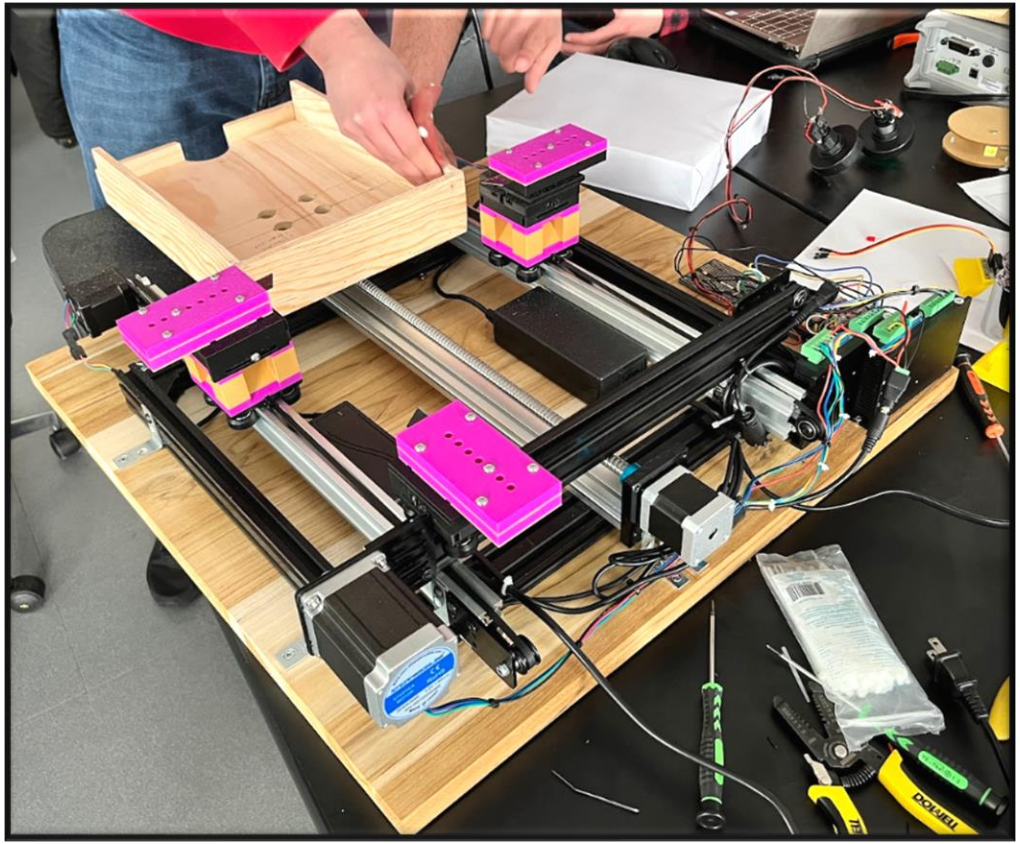
January




LETTERMARK
3976
Copy Paper | Papier reprographique
24lb 90g/m²
92 BRIGHT
500 SHEETS | FEUILLES

February

March



April

Thank you

Any questions?