Affordable Braille Printer Using Ultraviolet Resin

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Problem Statement

For smaller businesses, providing access to braille literature for people with visual impairments can be difficult due to the cost and lack of durability of the most common forms of braille.

Engineering Goal

We aim to create an affordable Braille printer that produces conventionally-sized and durable Braille Dots onto paper.

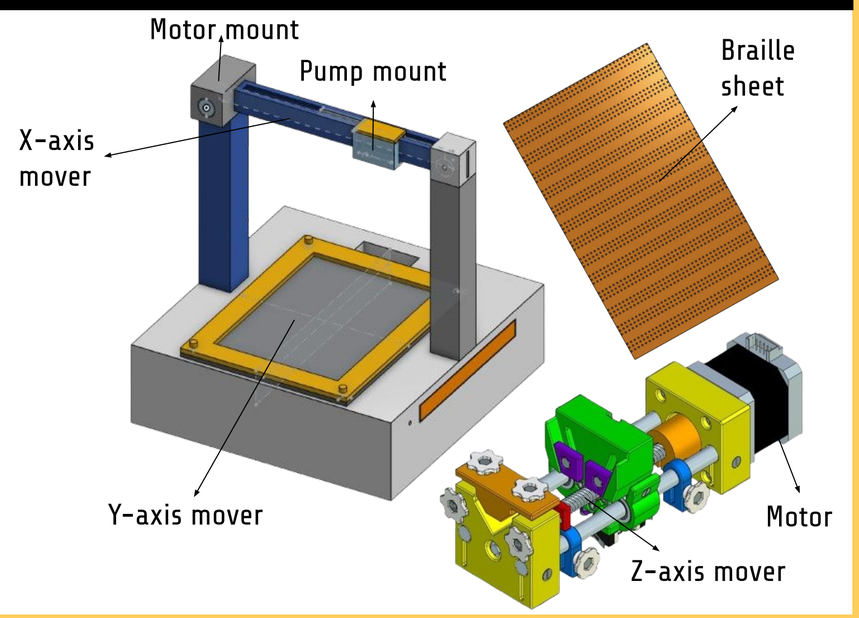
Level 1 Requirements

- Printed Braille shall follow standard Braille conventions
- Manufacturing costs shall be less than $500
- Ink shall not be damaged by water
- The dots shall not be scratched easily
- The design uses Ultraviolet Resin
- The design shall be safe to use
- The design shall use USB printing
- The design shall convert text to Braille

Our Current Design

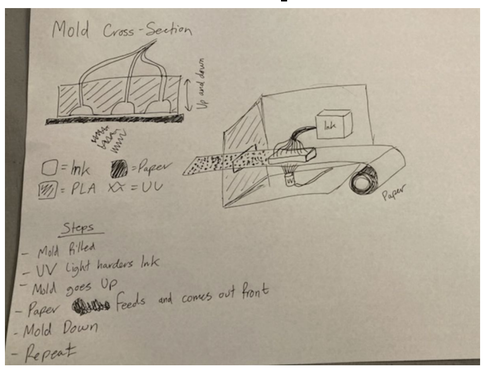
Why We Chose This Design:

- Manufacturing costs are <$500
- Dots do not get damaged by water
- Dots do not get scratched easily
- Testing individual parts of its functionality proved successful:
  - Braille Molds can be cured onto paper
  - UV light can cure through the paper



Design II

The 'Stamper'



Pros

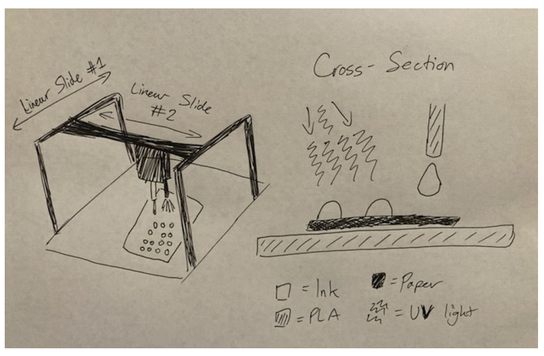
- Potential to print Braille quickly

Cons

- Inconsistent Braille Dot sizes and quality
- Requires a lot of UV ink valves

Design III

3D Printer Attachment



Pros

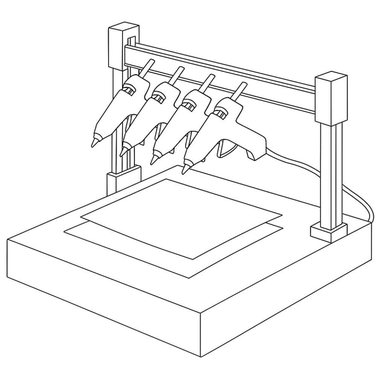
- Cheaper than other alternative designs
- Relatively easy to install

Cons

- Relies on user owning a 3D printer
- Poor braille dot quality

Design IV

Glue Gun



Pros

- Accessible
- Easy to implement and build

Cons

- Unable to adjust the size of Braille
- Size of Braille is inconsistent

Design Studies

Testing the efficacy of the braille dot sheet

Purpose: To evaluate what material or solution works best for the braille dot sheet of the "Ice Tray" method	
Test type	Result
Test 1: Evaluate the 3D-printed PLA Braille Dot Sheet	Unsuccessful. After 10 trials, the braille dots produced were illegible, and the UV resin was adhering to the sheet itself and the paper.
Test 2: Flipped the design over to evaluate if gravity was the problem	Unsuccessful. After 10 trials, the resin produced inconsistent and unsatisfactory braille dot quality similar to the first test.
Test 3: Adding lubricant before adding UV resin and curing	Unsuccessful. After 10 trials, the resin was still getting stuck to the sheet and subsequently adhering the sheet to the paper.
Conclusion: 3D printed PLA Braille was unable to perform effectively. Thus, a laser-engraved plexiglass braille dot sheet is proposed as a possible solution for the adhesion of the resin and paper. Additionally, we may reuse these tests again to evaluate their efficacy on the new sheet.	

Table 1. This table summarizes the results of our first design study, which evaluated the effectiveness of possible solutions to resolve the resin's adhesion to the braille dot sheet and paper.

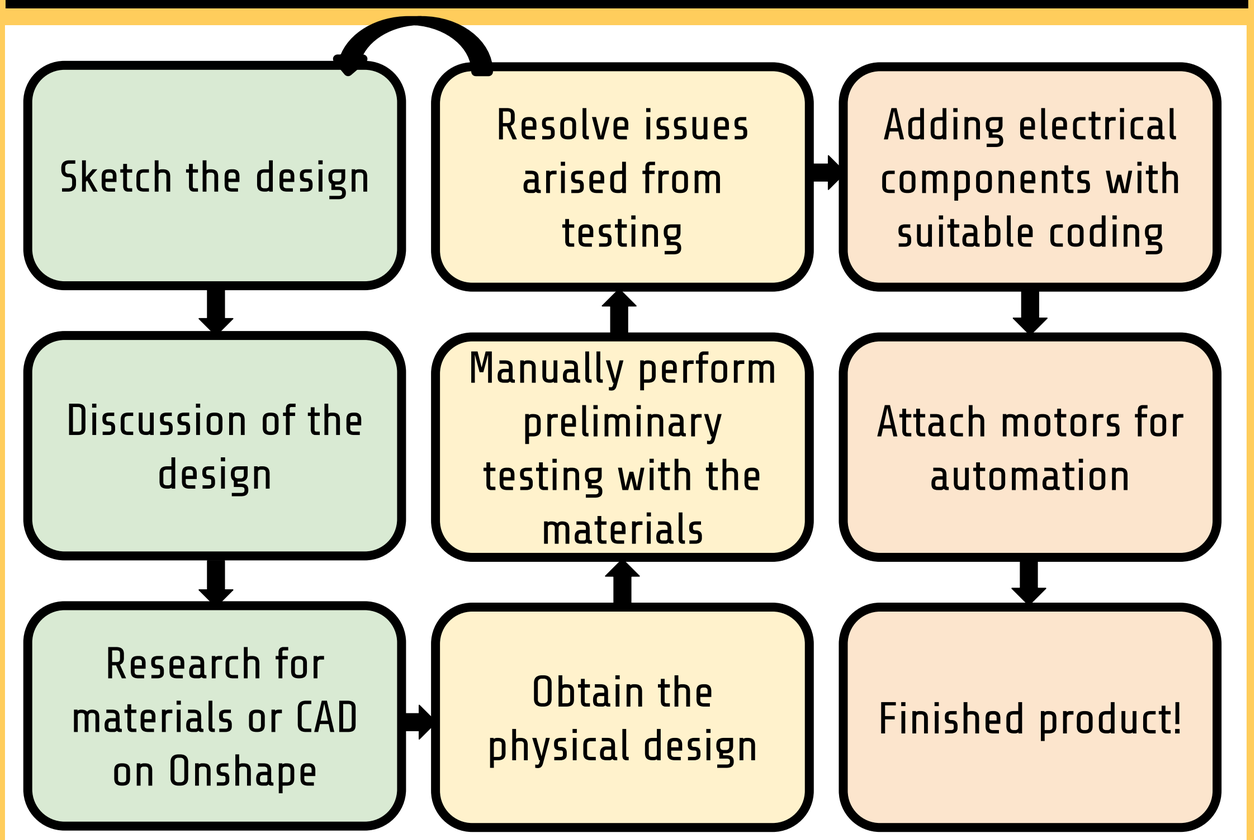
Fig 1. Paper adheres to the Braille sheet

Fig 2. Braille dots produced by the final test

Purpose: Testing the laser-engraved plexiglass braille dot sheet and using a non-adhesive spray before curing.	
Test type	Result
Test 1: Testing the laser-engraved plexiglass braille dot sheet on its own	Unsuccessful. It produced an unsatisfactory quality of braille dots and the paper adheres to the sheet after 10 trials.
Test 2: Using a non-adhesive spray before adding the UV resin and curing.	Successful. It produced a satisfactory quality for braille dots after 10 trials.
Conclusion: Using the plexiglass braille dot sheet and the non-adhesive spray together was successful in producing satisfactory braille dots. Therefore, we will move forward with the plexiglass braille dot sheet and non-adhesive spray.	

Table 2. This table summarises the results of our second design study, which evaluated the effectiveness of the plexiglass braille dot sheet and used a non-adhesive spray.

Methods



Conclusions & Future Work

- The Braille Printer allows the user to create durable Braille dots
- The Braille Printer is significantly cheaper to produce than current market options
- Incorporating the Braille sheet was difficult
- Disallow the paper to attach itself to the Braille sheet for easier removal
- Increase the speed at which the printer create Braille with a more efficient design
- Automate the entire process of the 3D printer