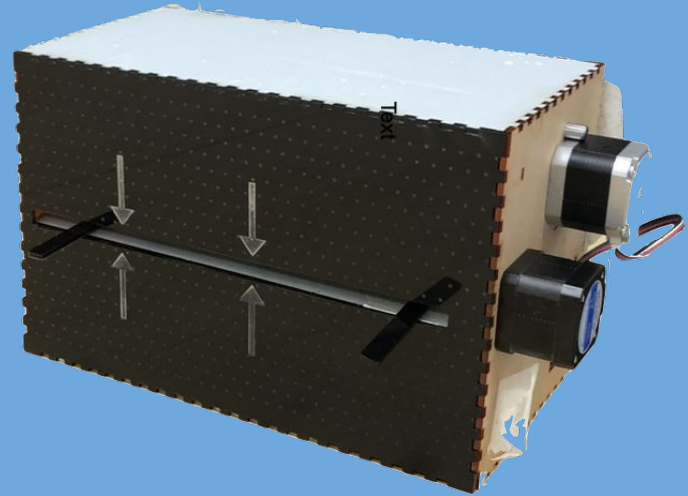


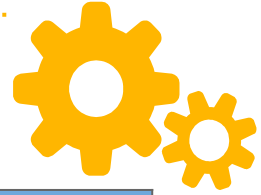
DigiBraille

Team A4

Becky Button, Joshna Iyengar, Zeynep Ozkaya

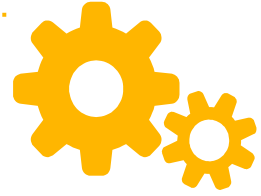


Use Case Requirements

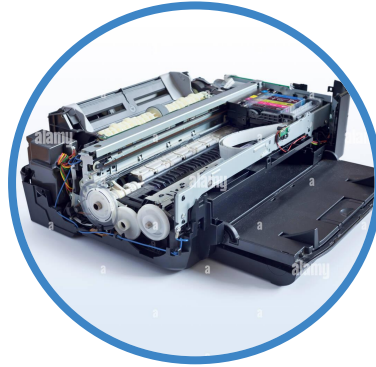


User Requirement	Design Requirement
Speed	<ul style="list-style-type: none">• Embossing an 8.5" x 11" sheet of braille should take <10 mins• Solenoids actuate <.5 sec, motor rotates 15-300 MMS• 1 second latency
Accessibility	<ul style="list-style-type: none">• User should learn to use device in <10 min• Weigh < 2.5 kg
Accuracy	<ul style="list-style-type: none">• Embossed braille should be readable by 99% of users• 100% accuracy of translation
Completeness	<ul style="list-style-type: none">• Web-scraping must produce result 95% of the time.• Web-scraping should produce results in <.5 sec

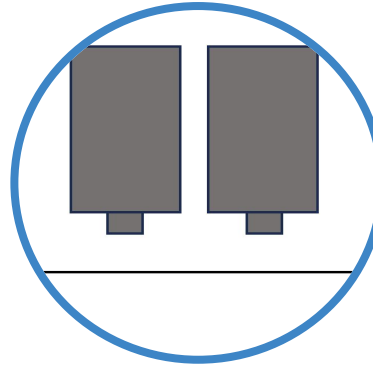
Solution Approach



Web Interface
accessible from
a phone



gantry system with
rollers to move paper



Braille cells will be
embossed using
solenoids



An embossing system
designed with
accessibility and long
term use in mind.

<https://tetralogical.com/blog/2021/10/05/browsing-with-a-mobile-screen-reader/> <https://www.alamy.com/what-is-inside-a-desktop-printer-image15154428.html> <https://www.news18.com/news/education-career/colleges-universities-to-create-resources-for-blind-students-468882.html>

Changes from Proposal

Circuitry

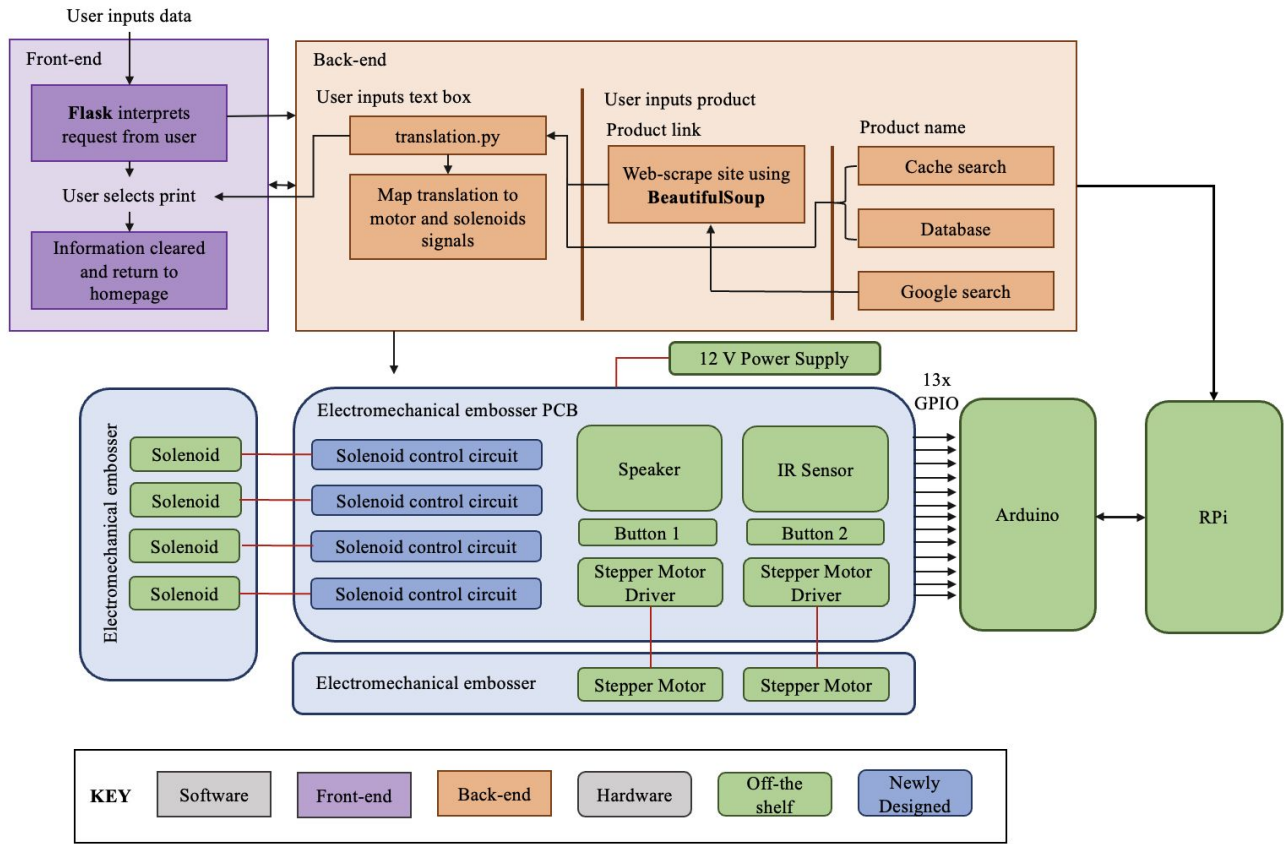
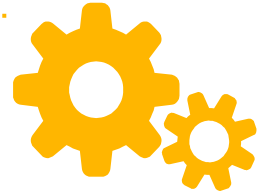
- Using Arduino for hardware control
- Module-Based Circuit Redesign
 - Use of L298N
 - Rethink Power Management

Mechanical

- 2 solenoids vs 4 solenoid
- Change of rigid surface

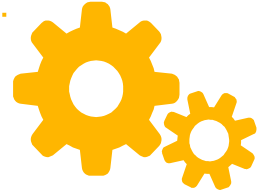
Software

- Query for product result instead of database
- Communicate to hardware via UART



System Block Diagram

Complete Solution

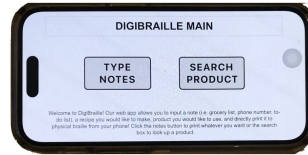


Accessible web-app

DIGIBRAILLE MAIN MENU

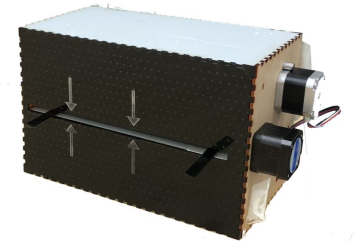
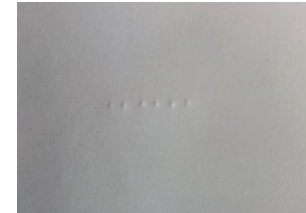
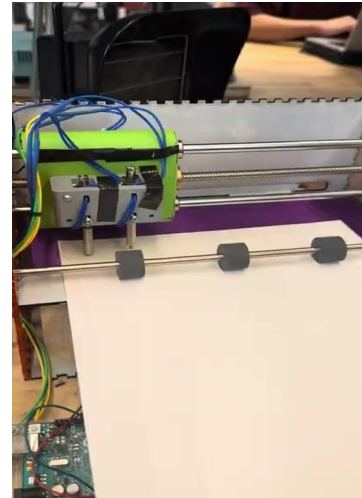
TYPE NOTES

SEARCH PRODUCT

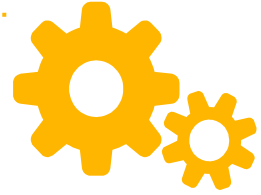


Welcome to DigiBraille! Our web app allows you to input a note, a recipe you would like to make, or a product you would like to use, and directly print it to physical braille from your phone! Click the notes button (top of the page) to print whatever you want or the search box (middle of page) to look up a product.

Braille Embosser



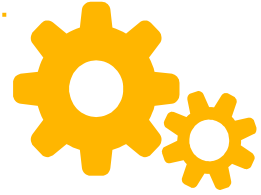
Testing - Speed



Feature Tested	Quantitative Methodology	Result
<10 min. to emboss 768 braille cells	<ul style="list-style-type: none">• Time how long it take arduino code to run for given set of inputs• Time how long it takes one line to emboss	<ul style="list-style-type: none">• 45 min• 30 seconds
<1 sec product search time	<ul style="list-style-type: none">• Time database set up time• Time database search time• Time average query time	<ul style="list-style-type: none">• Average Database Initial Setup: 36.7 s• Average Database Search Time: 0.136s• Average Query Time: 5.32s

Future test: Time how long it takes full embosser system to print full sheet of braille

Testing - Accessibility

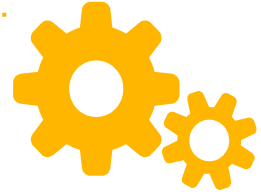


Feature Tested	Quantitative Methodology	Result
Ease of use of web-app using accessibility tools	<ul style="list-style-type: none">Satisfactory experience on survey questions with (1-5) ratings	<ul style="list-style-type: none">Average 4.55 feedback
Ease of use of embosser device based on tactile cues User should learn to use device in <10 min	<ul style="list-style-type: none">Satisfactory experience on survey questions with (1-5) ratingsTiming user learning time	<ul style="list-style-type: none">Average 4.67 feedbackAverage 4 min

Future tests: Test quality of braille output; Test combined web-app and embosser user experience

"I liked it. It's a handy tool. It would be nice to have a more affordable and portable braille printer"

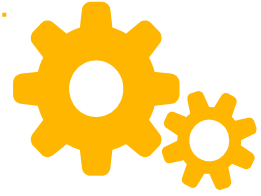
Testing - Accuracy and Completeness



Feature Tested	Quantitative Methodology	Result
95% accuracy of North American English to braille (grade 1 and 2) translation	<ul style="list-style-type: none">Compare output of text to braille conversion on 100+ randomly generated scripts of text with output from Braille Blaster App (standard library used with other products)	<ul style="list-style-type: none">100% accuracy
Result Relevance	<ul style="list-style-type: none">Compare results for 100+ most popular products with expected results	<ul style="list-style-type: none">100% expected results
Web-scraping must produce result 95% of the time.	<ul style="list-style-type: none">Test web-scraping algorithm on 100+ most popular products with websites	<ul style="list-style-type: none">Produces results 100% of the time with Google backupProduces non-google responses 97% of the time

Future tests: User testing for accuracy of embossed braille

Design Trade-Offs



Design Choice	Trade-Off
2 solenoids	Precision vs speed
Querying websites	Query vs database
Using Arduino + RPi	Speed vs Cost
Minimal use of mechanical components (rely mostly on laser cut parts)	Cost & Reparability & Ease of manufacturing vs Mechanical Robustness
Decoupled X & Y	More precise control vs. ease of mechanical design

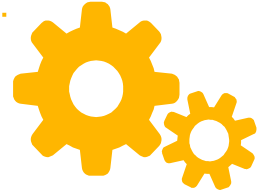
Ethics

Welfare: Informed by discussions with members of LAMP, consideration of tools for blind individuals, and consistent feedback from multiple blind users

Economic : Consideration of economic realities of end user, designed device considerably cheaper than most accessible devices on the market

Health & Safety: Designed device with tactile cues, IR sensor, and meticulous wire management to ensure health and safety of user

Project Management



Week	1	2	3	4	5	6	7	8	9	10	11	12	13
Background research	Yellow	Yellow	Yellow										
Build basic framework for website			Blue	Blue	Green	Green							
Design solenoid+motor system				Green	Green	Green							
Design x/y gantry				Purple	Purple	Purple							
Develop algorithm for translation						Blue	Blue	Blue					
Test solenoid+motor system						Green							
Design and fab PCBs/enclosure						Purple	Purple	Purple					
Develop frontend							Green	Green	Green	Green			
Integrate hardware and software components									Yellow	Yellow	Yellow	Yellow	Yellow

Becky Zeynep Joshna All

Remaining work

- RPi integration
- Refining braille