EquiBraille

Motive

"Education is the passport to the future, for tomorrow belongs to those who prepare for it today" - Nelson Mandela

The strive towards digital Equity fortunately acts as an enabler to ensure everyone has their right to education.

Unfortunately, the visually impaired students are hampered in their efforts to achieve equal education.

Situation 

According to a survey conducted by APH (a 150-year organization which supports blind students) , there were 56K blind students who are eligible to to receive funds under Federal Quota.

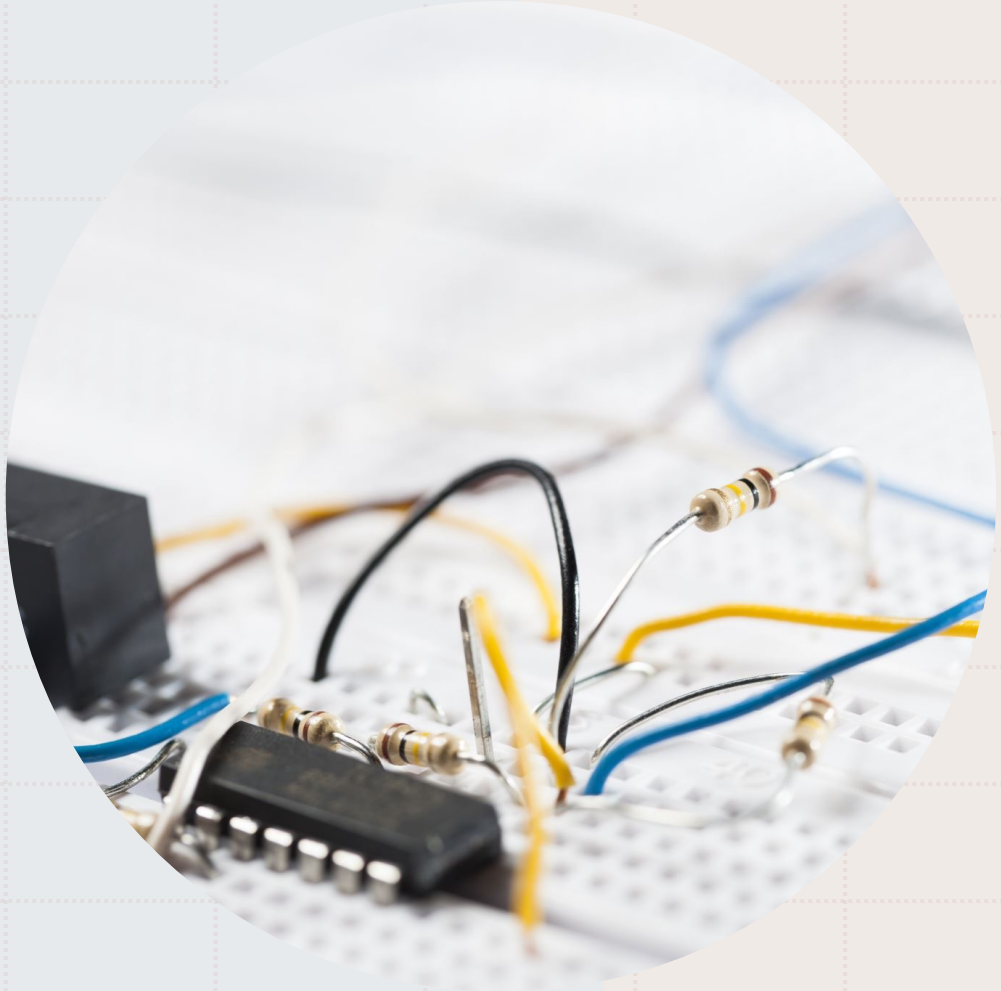
The total number of blind students would be even greater, and exponentially greater in the world , making our scope extremely massive.

But most of them , go to Specially Disabled Schools etc which might be comforting now, but makes it difficult to face the real world later on.

We hope our solution would provide them the opportunity and strength for equal learning.

Problem statement ?

- Our educational system continues to shift towards a visual-centric system of learning in a digital world surrounded by devices connected to the internet. And visually impaired students have a difficult time navigating this visual-centric educational model. Existing systems [1],[2] focus on accuracy and not the latency of transcribing. Using IoT technology, such as Multi Access edge computing and AWS Wavelength, we aim to develop a ultra low latency for transcribing and translation system to aid the visually impaired pupils.



Review of existing technology

Refreshable Braille Displays

- Brallient, Braille Note
- Expensive

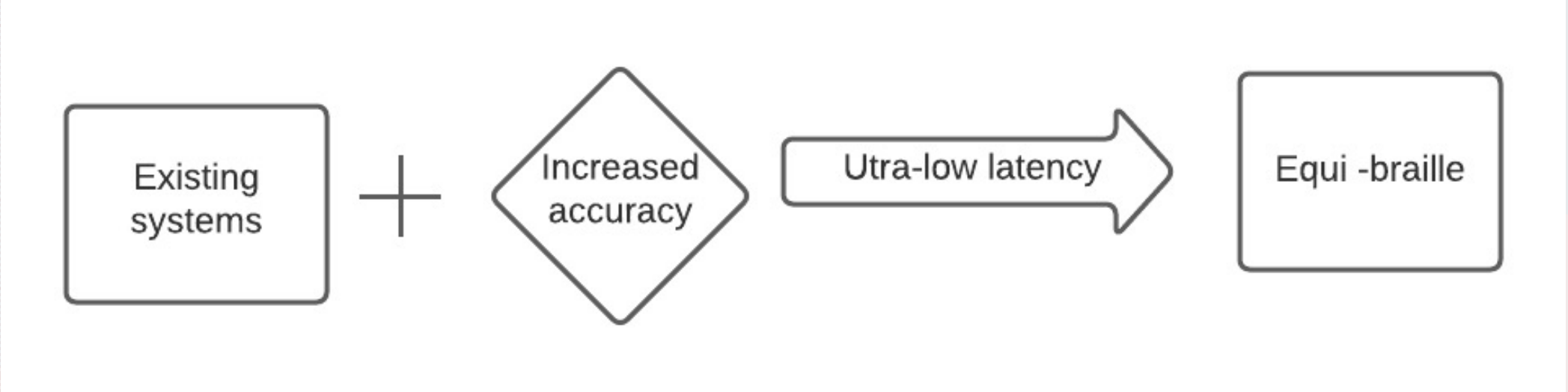
OCRs

- Chinese optical character recognition(OCR) - 95%
- Google OCR APIs - 65%

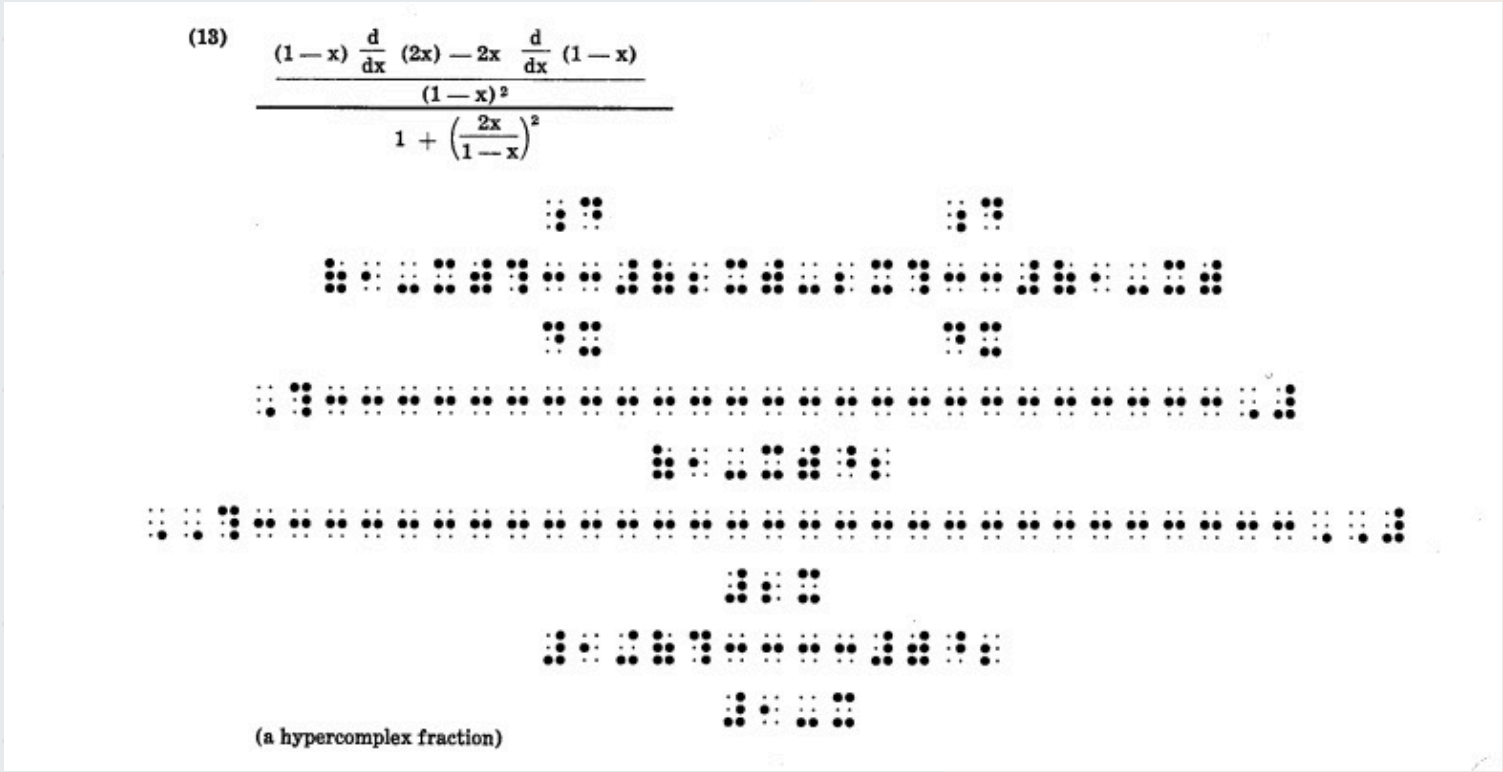
Innovation

- Our solution consists of two main components :

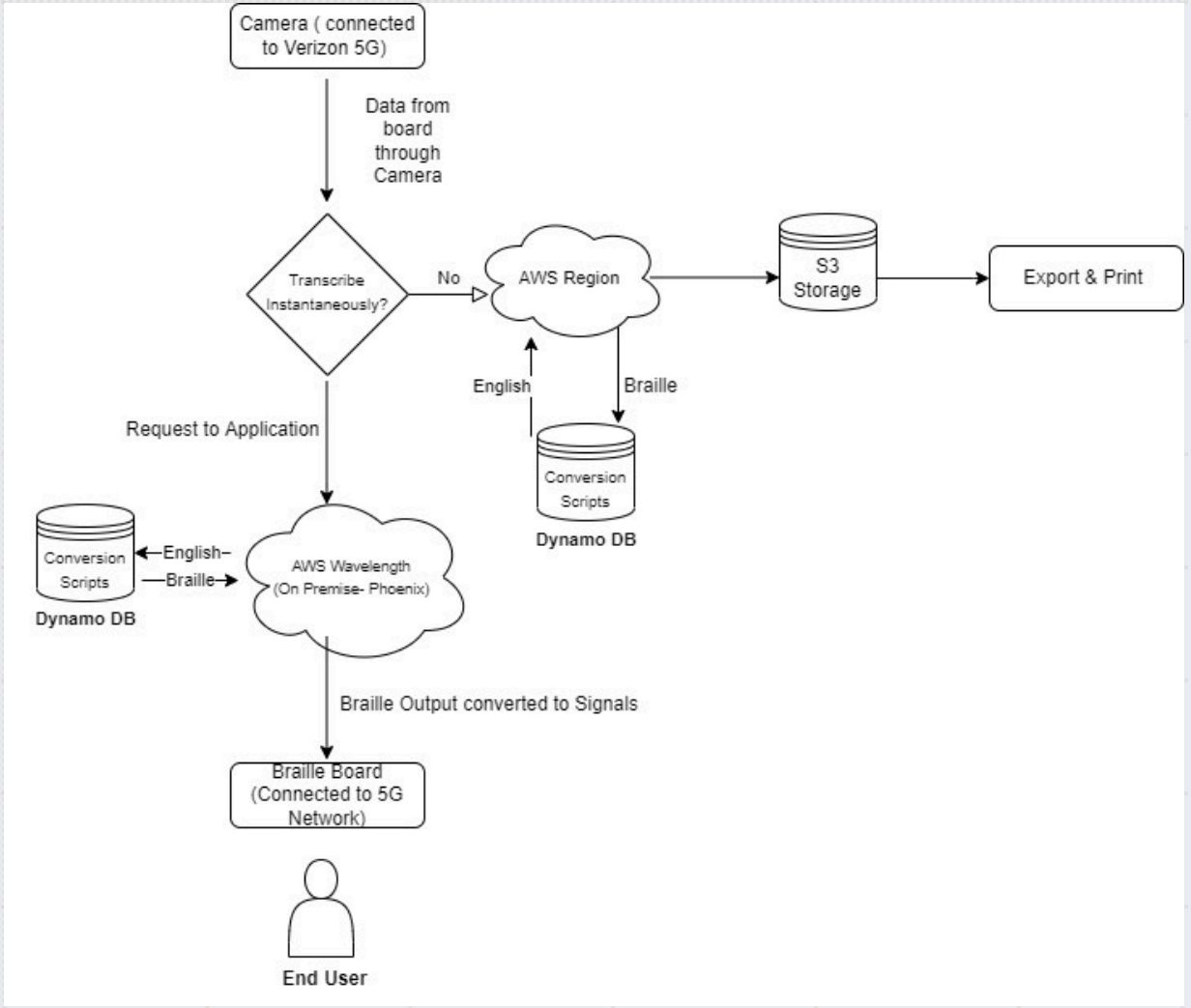
1. Text/handwritten to braille
2. Braille board



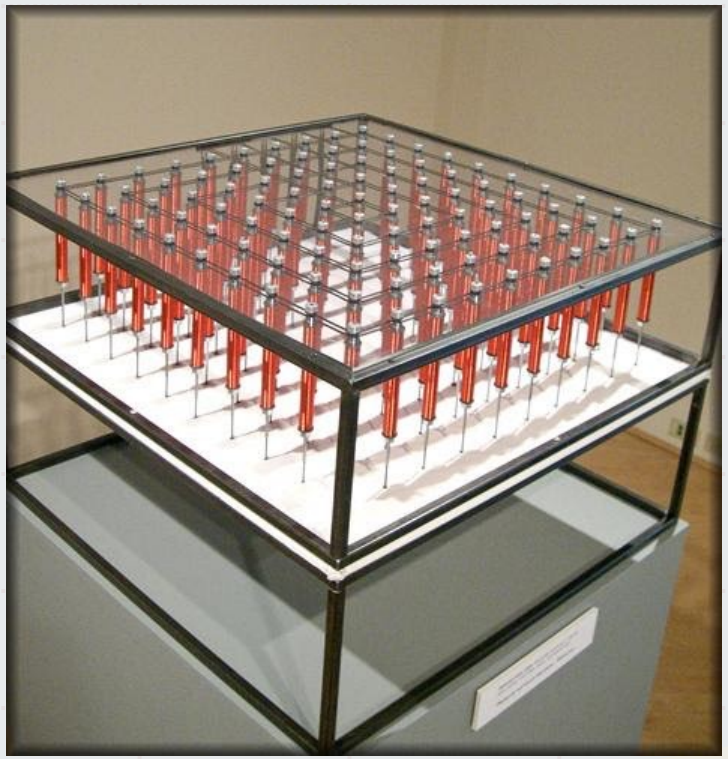
Braille


(13)
$$\frac{(1-x)\frac{d}{dx}(2x) - 2x\frac{d}{dx}(1-x)}{(1-x)^2}$$
$$1 + \left(\frac{2x}{1-x}\right)^2$$
(a hypercomplex fraction)

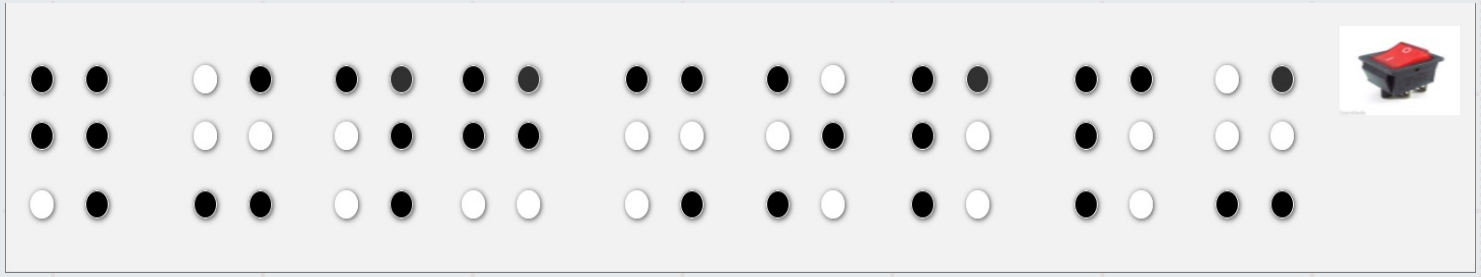
Diagram

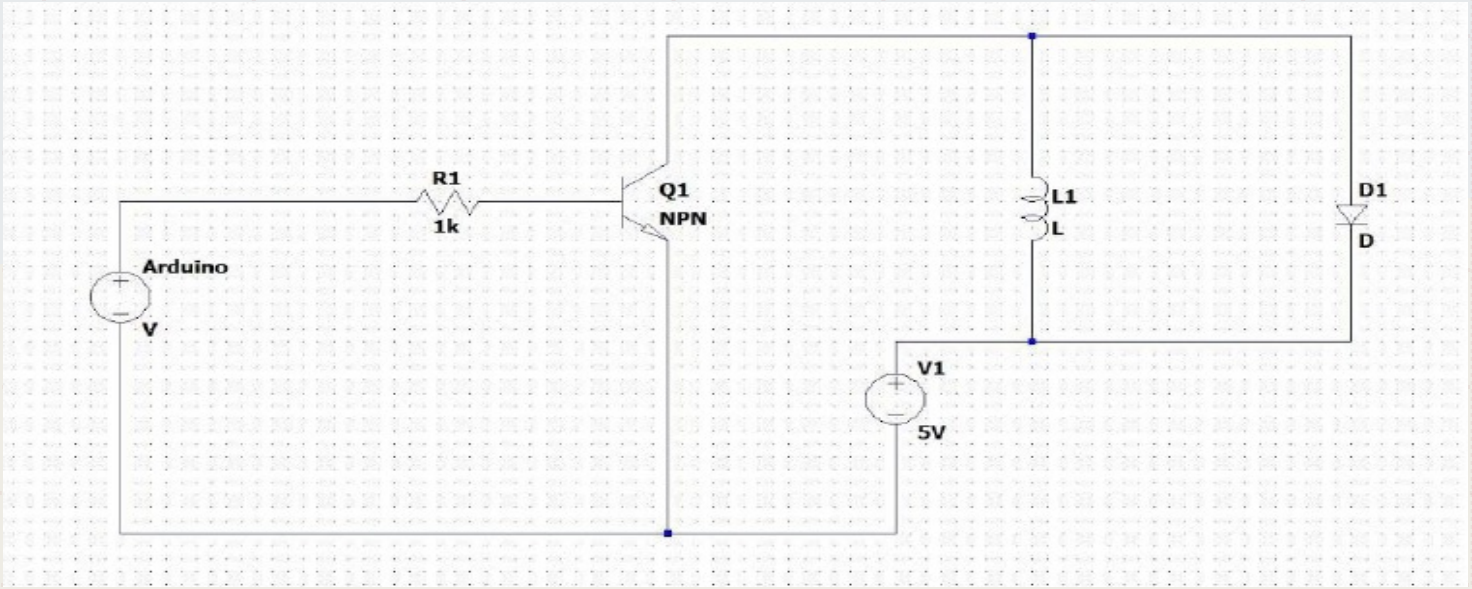

Camera (connected to Verizon 5G)
Data from board through Camera
Transcribe Instantaneously?
No
AWS Region
S3 Storage
Export & Print
English
Braille
Request to Application
Conversion Scripts
Dynamo DB
Conversion Scripts
Dynamo DB
English
Braille
AWS Wavelength (On Premise- Phoenix)
Braille Output converted to Signals
Braille Board (Connected to 5G Network)
End User

Braille board



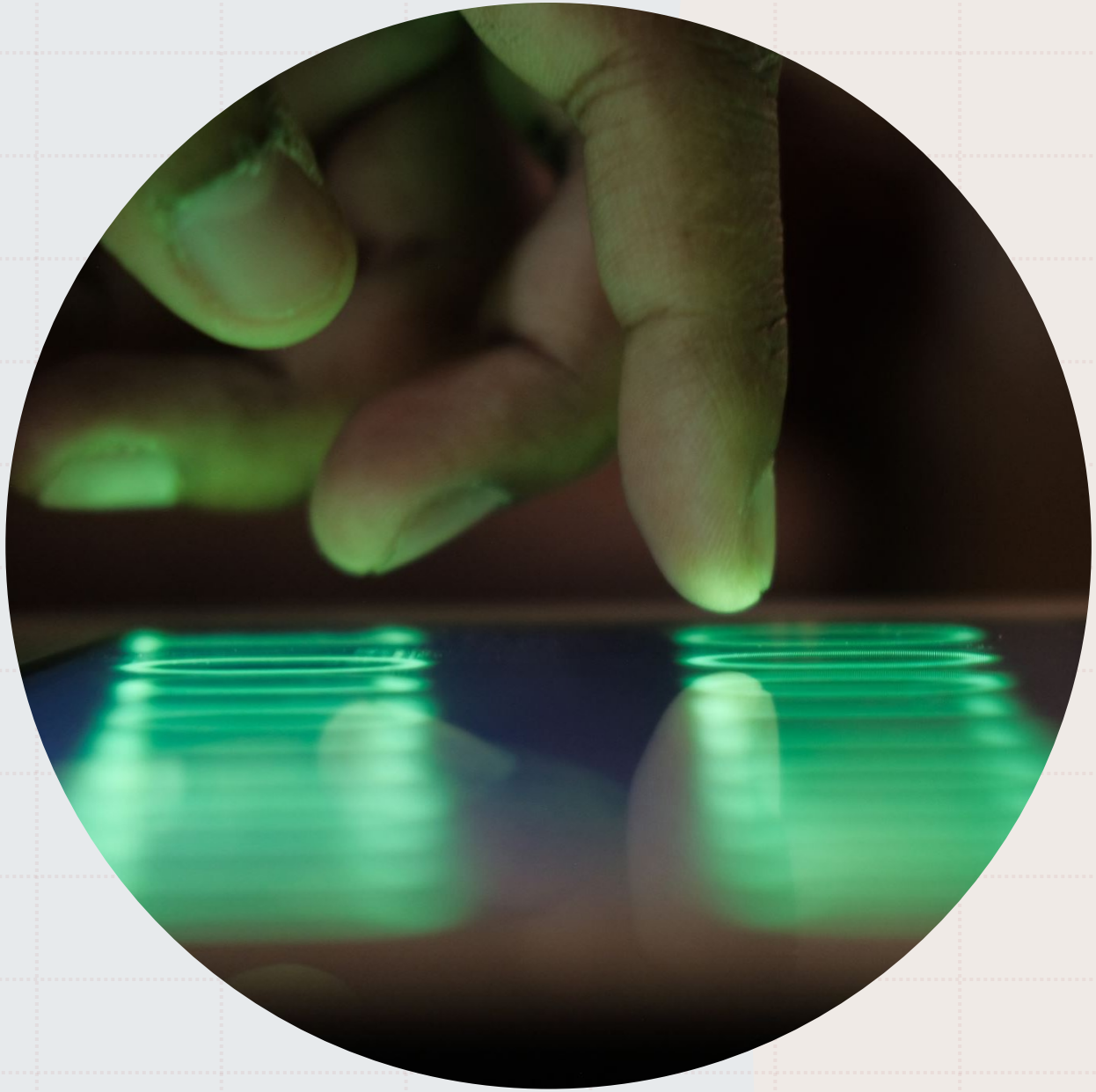
- Solenoid push-pull motors
- Arduino-uno that controls individual motors





Impact

- First device using MEC and AWS Wavelength to provide ultra-low latent and accurate text/handwritten text to braille
- Portable and easy to use
- A step towards to a larger system of devices that can be built for the visually impaired



Cost

Componenets	Costs
Ics and Circuitry	$20
PCB Assembly / Labor Cost (JLCPCB and Express PCD)	$10
Micro-pin Mechanism	$250
5G Modem Chips	$50 - $70
AWS Services Cost (AWS Rekognition, S3 Bucket)	$200

Scalability ⚖

- Production of a affordable board- $300
- AWS Service Cost = $200
- Test with ASU's Student Accessibility and Inclusive Learning Services
- Produce the device for around the 1000 students at ASU

Timeline ⏱


1
Project start
(Feb, 2022)
2
AWS wavelength & MEC
(End of Feb 2022,)
3
Board production
(March 2022)
4
Testing
(April, 2022)

Future scope - IoT

Other devices that can benefit from ultra-low latency :

Equi-stick: a cane that detects objects and helps in navigation

Equi-glasses : a device that can process sensory and image data to render artificial image

Equi-glove: A glove that can sense and relay information about the objects a person is about to touch or in their proximity

Future Scope 

Right now , our model would be present in US, UK, Germany, Korea as these are the countries in which Verizon Wavelength zones are present.

Not only students, but working professionals in corporates can benefit from this, as lot of corporates are trying to be more inclusive in their hiring.

Works cited

- 1.Dennis A. Martillano Malayan Colleges Laguna, et al. “Pindots: An Assistive Six-Dot Braille Cell Keying Device on Basic Notation Writing for Visually Impaired Students with IOT Technology.” *PINDOTS | Proceedings of the 2018 2nd International Conference on Education and E-Learning*, 1 Nov. 2018, https://dl.acm.org/doi/abs/10.1145/3291078.3291106.

- 2.SU, YU-SHENG. “A Finger-Worn Device for Exploring Chinese Printed Text with Using CNN Algorithm on a Micro IOT Processor.” *IEEE Xplore*, https://ieeexplore.ieee.org/abstract/document/8805080.