Braille Translators for Low-Resource Languages in ASEAN: Use case from Khmer Braille

Presented by: Ms. Mat Nab

Institute of Digital Research and Innovation (IDRI),
Cambodia Academy of Digital Technology (CADT)

Background

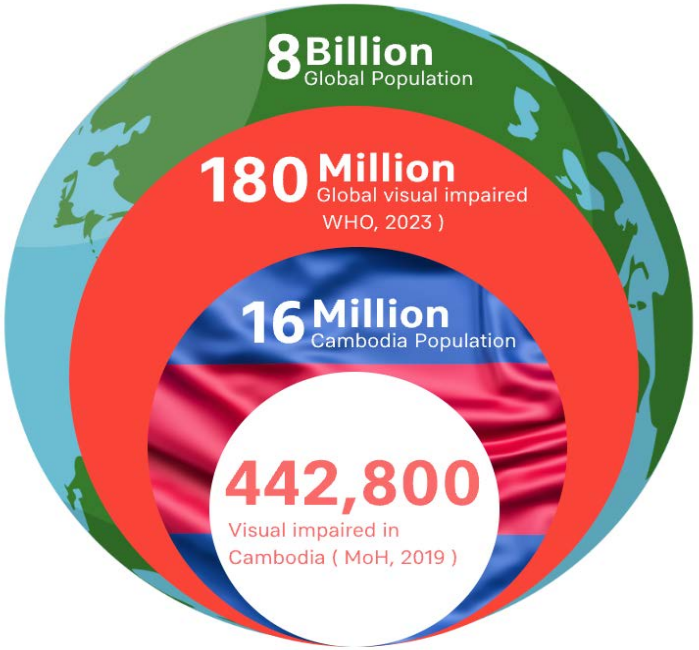
Visually impaired individuals in Cambodia face **limited access to Khmer Braille resources.**

Commercial Braille printers are **costly** and **available only at NISE**.

Existing Braille tools mainly support **high-resource languages.**

The Khmer language's **complexity** hinders effective Braille translation.

Braille is not **universal language!**



🎯 **Goal:** Bridge the gap with a knowledge-based **Khmer Braille translator** and **affordable printer.**

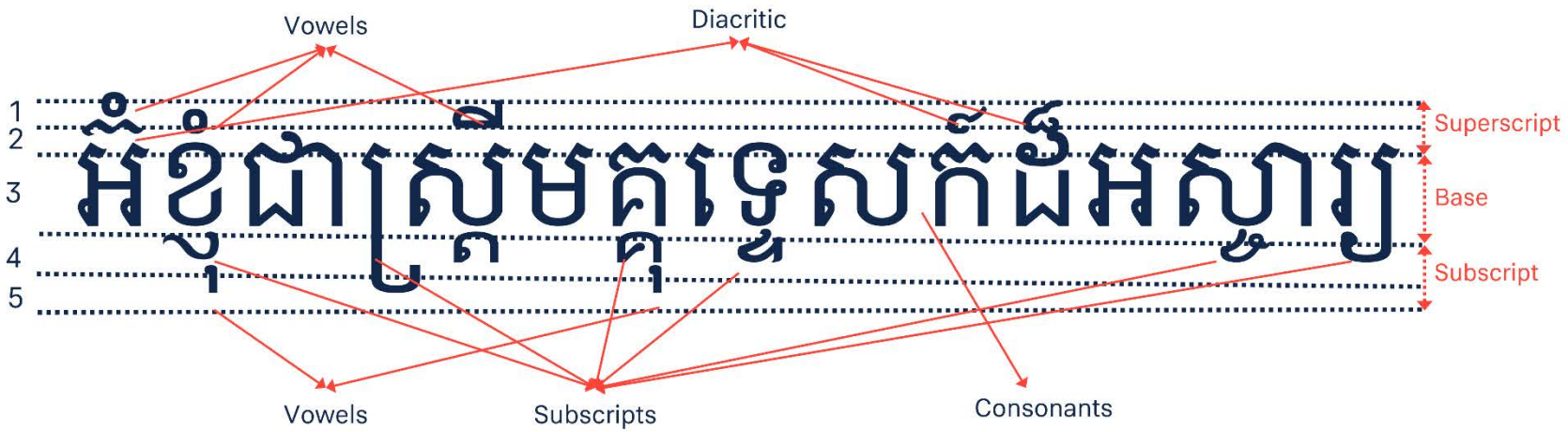
Background

Complex writing system of 5 layers

No space between Khmer words in a phrase

Khmer is a complex script language

Example: My aunt is a wonderful woman leader



Khmer complex script causes a lot of rendering errors

Targets

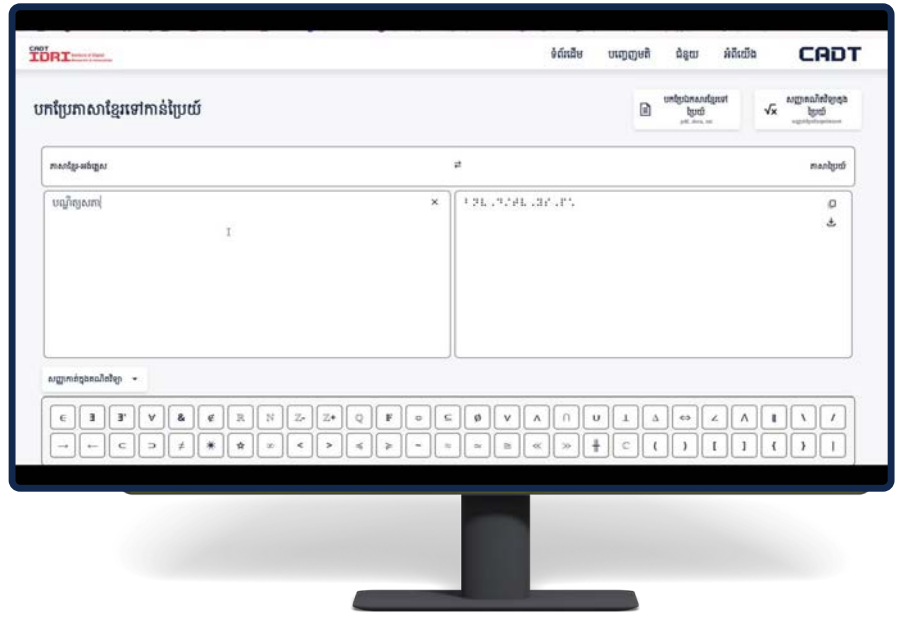
Develop: Khmer Braille translation system.

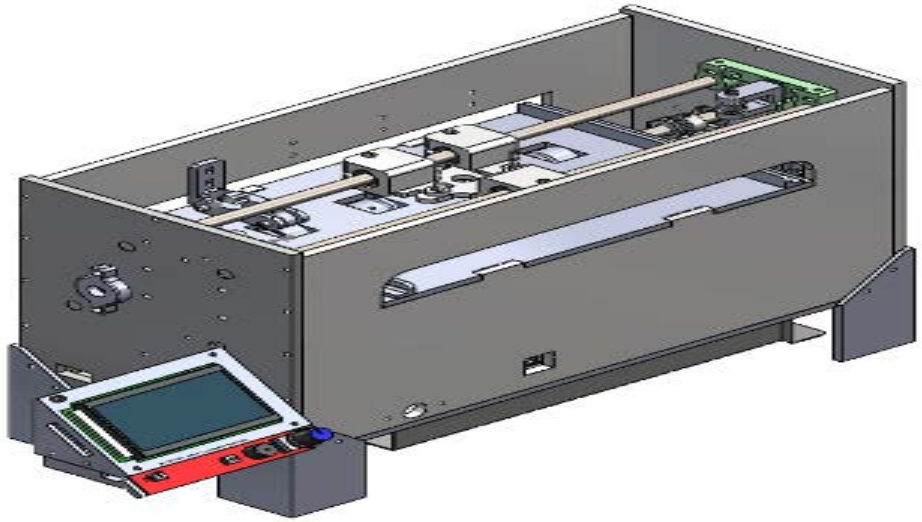
Provide: Web-based application for teachers and students.

Build: Low-cost Braille printer compatible with the system.

Promote: Digital inclusion and literacy among visually impaired people.

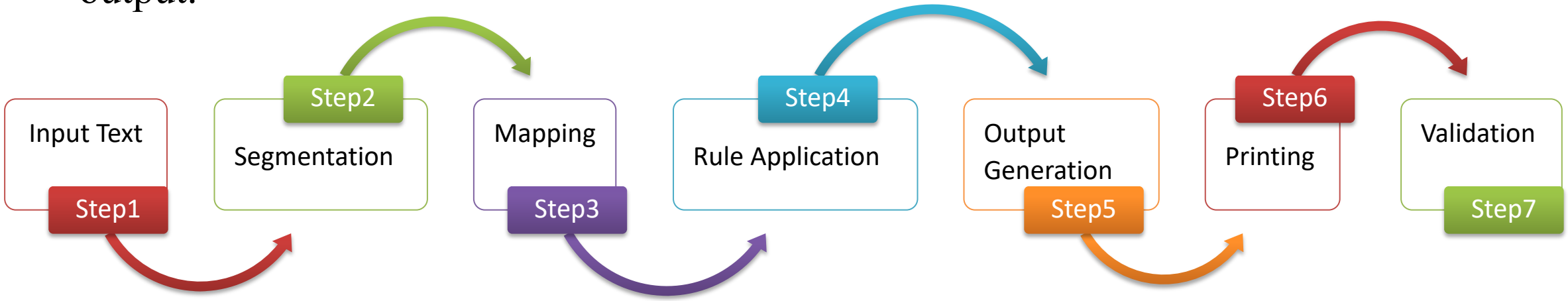
Expand: Braille translation and affordable printers to other ASEAN languages.





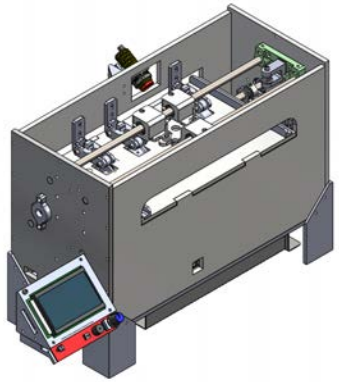
Braille Translation Methodology

A comprehensive **Khmer-to-ASCII Braille dictionary** was constructed to define character mappings. During translation**, Khmer Character Cluster (KCC)** segmentation and **rule-based processing** for **ordering, vowel combinations, and numerals** were applied to achieve accurate and linguistically consistent Braille output.



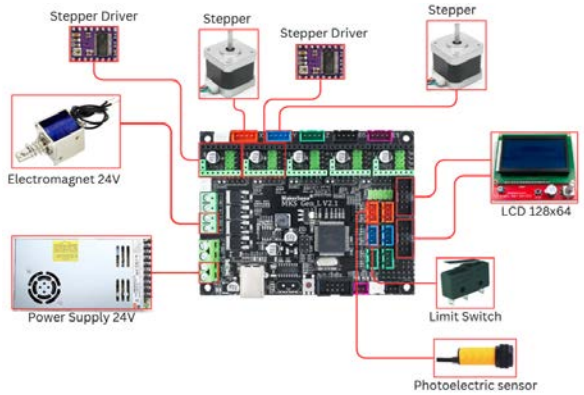
Braille Printer Development Methodology

Mechanical Design



- **Mechanical Design:** Inspired by **BrailleRap.**
- **Customization:** Added an LCD control panel for easy use, a photoelectric sensor for reliability and paper protection. We choose POM (Polyoxymethylene) for high strength low-cost to build the machine.

Electronics System



- **Actuation:** Electromagnet for dot embossing, 2 NEMA 17 stepper motors (X-axis for head, Y-axis for paper feed via roller/big roll).
- **Endstops:** Photoelectric sensor (paper detection), Limit switch (X-axis home)
- **Display:** 128×64 LCD
- **Drivers:** 2× DRV8825 (1/32 microstepping)
- **Power Supply:** DC 24V

Marlin Firmware

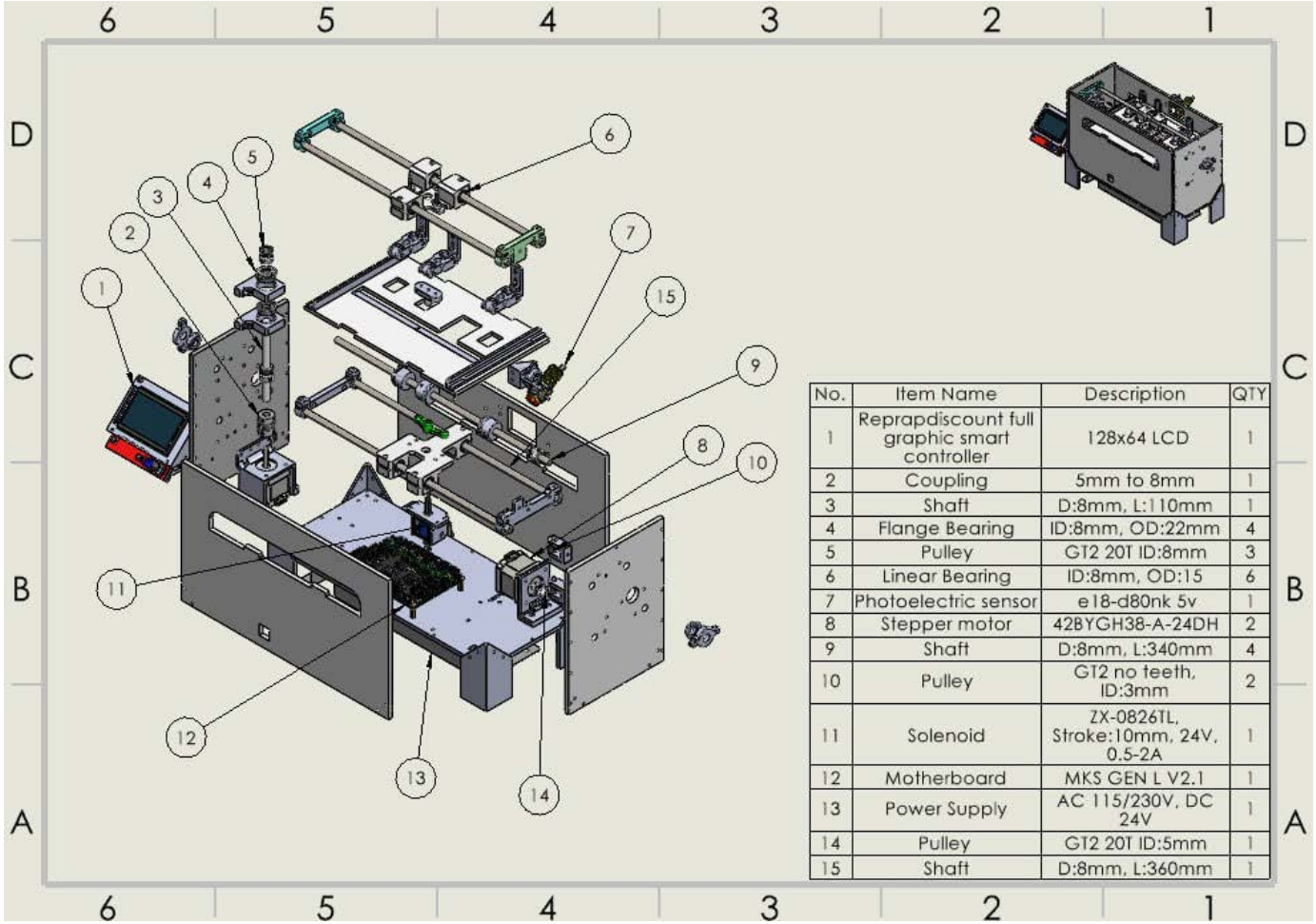
Home | Marlin Firmware

- **Firmware:** Marlin. We custom configuration for steps/mm, endstops, acceleration and enables homing to supports G-code parsing for precise X/Y moves

G-Code Converter Software

- **G-code Conversion:** Python script in VS Code.
- **Core Functionality:** Detect Braille Unicode in text file and convert it to G-code commands.

Braille Printer Development Methodology



No.	Item Name	Description	QTY
1	Reprapdiscount full graphic smart controller	128x64 LCD	1
2	Coupling	5mm to 8mm	1
3	Shaft	D:8mm, L:110mm	1
4	Flange Bearing	ID:8mm, OD:22mm	4
5	Pulley	GT2 20T ID:8mm	3
6	Linear Bearing	ID:8mm, OD:15	6
7	Photoelectric sensor	e18-d80nk 5v	1
8	Stepper motor	42BYGH38-A-24DH	2
9	Shaft	D:8mm, L:340mm	4
10	Pulley	GT2 no teeth, ID:3mm	2
11	Solenoid	ZX-0826TL, Stroke:10mm, 24V, 0.5-2A	1
12	Motherboard	MKS GEN L V2.1	1
13	Power Supply	AC 115/230V, DC 24V	1
14	Pulley	GT2 20T ID:5mm	1
15	Shaft	D:8mm, L:360mm	1

Exploded Assembly View and Component List of the Braille Printer

Impact

Scientific & Technological: Developed a rule-based Khmer Braille translation system and an affordable, locally assembled Braille printer, creating a scalable framework adaptable to other ASEAN low-resource languages.

Societal: Improved access to education and information for visually impaired people, promoting digital inclusion and narrowing the educational gap in Cambodia's special education sector.

Collaborative: Strengthened cooperation between CADT and NISE, and encouraged cross-ASEAN collaboration in developing assistive technologies and future regional Braille innovation projects.

Outcome

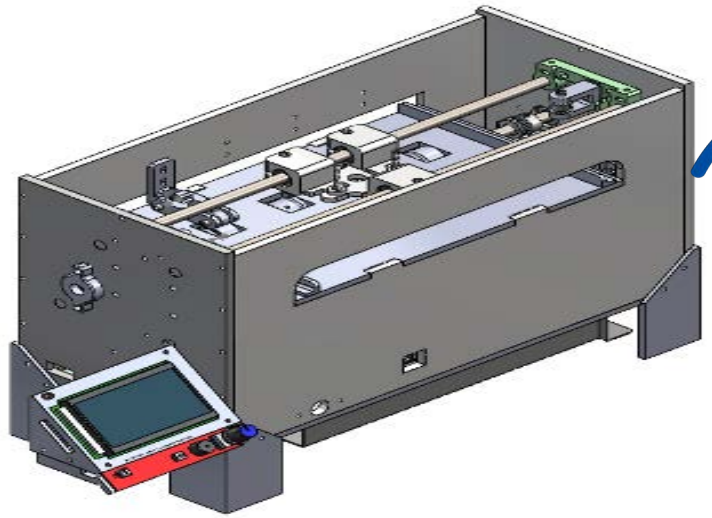
Scientific: New Khmer Braille translation model and web application.

Societal: Accessible tool for teachers and students with visual impairments.

Collaborative: Established network of Cambodian institutes and special educators.

Practical: Low-cost Braille printer

Display braille documents



Print braille document on paper

Future Work & Networking

Translation of scientific symbols (math, physics, chemistry).

Finalize and optimize our **affordable Braille printer** for wider public

Extend Braille translation and printing systems to other **low-resource ASEAN languages**, focusing on **rural and underserved communities**.

Establish ASEAN Braille Technology Network to share datasets, translation rules, and hardware designs.

Seek collaboration and partnerships through ASEAN IVO Forum to jointly develop regional Braille solutions.

Conclusion

Targets: Develop an accessible Khmer Braille translation and printing system to promote digital inclusion for visually impaired communities.

Method: Applied a knowledge-based approach using Khmer Character Clusters, dictionary mapping, and predefined rules, implemented a web-based translator and low-cost Braille printer.

Scientific & Societal Impact: Achieved high translation accuracy (≈ 99%) and improved access to educational resources, fostering digital literacy and inclusion.

Outlook: Plan to expand the system to other ASEAN languages and build a regional Braille Technology Network through ASEAN IVO collaboration.

Our Team

Dr. Rottana Ly
Director of Research and Development, CADT

Ms. Nab Mat
Lecturer Researcher, CADT

Ms. Kimhuoy Yann
Assistant Lecturer Researcher, CADT

Mr. Ponleur Veng
Assistant Lecturer Researcher, CADT

Mr. Maraviraktep Chheng
Makerspace Operation Officer

Mr. Reaksa Chhoeun
Makerspace Operation Officer

Mr. Vorn Vy
Vice President, NISE

Mr. Khemara Ly
Head of Research of IT and Library, NISE

Ms. Sokchea Meacn
Officer, NISE

Mr. Sovannara Leng
Officer, NISE

We Welcome Collaboration!

Thank you!

Institute of Digital Research and Innovation (IDRI)

Cambodia Academy of Digital Technology (CADT)

Ms. Nab Mat

Email: nab.mat@cadt.edu.kh