AI BASED OFFLINE BRAILLE BOOK AUDIO NARRATOR

Project Reference No.: 49S_BE_2025

College : G.S.S.S. Institute of Engineering and Technology for Women, Mysuru
Branch : Department of Computer Science & Engineering
Guide(s) : Mrs. Nischitha B S
Student(s) : Ms. Anagha
Ms. Anam Irfan
Ms. Arena Zumur
Ms. K S Namratha

Keywords:
Braille Recognition, Offline TTS, Assistive Technology, Image Processing, Accessibility, Machine Learning.

Introduction:

Braille is essential for visually impaired individuals, but access to Braille materials is limited and costly. Traditional Braille books require specialized printing, making them less available in many regions. This creates a gap in education and access to information for visually impaired users. Existing digital tools mainly support visual text and offer limited support for Braille. Conventional OCR systems cannot effectively recognize embossed Braille patterns. Text-to-speech systems are advanced but depend on readable digital text input. There is a need for a system that can directly interpret Braille content. An offline solution is important for areas with limited or no internet access. Recent advancements in image processing enable detection of fine Braille dot patterns. Computer vision techniques can accurately segment and recognize Braille cells. These technologies make automated Braille recognition more feasible. The proposed system converts Braille images or PDFs into readable text. The recognized text is then transformed into speech using offline TTS. This ensures accessibility without relying on cloud services. The system is designed to be lightweight and efficient on standard hardware. It also supports multiple languages to improve usability. Such a solution promotes inclusive education and independent learning. Overall, it bridges the gap between tactile reading and digital accessibility.

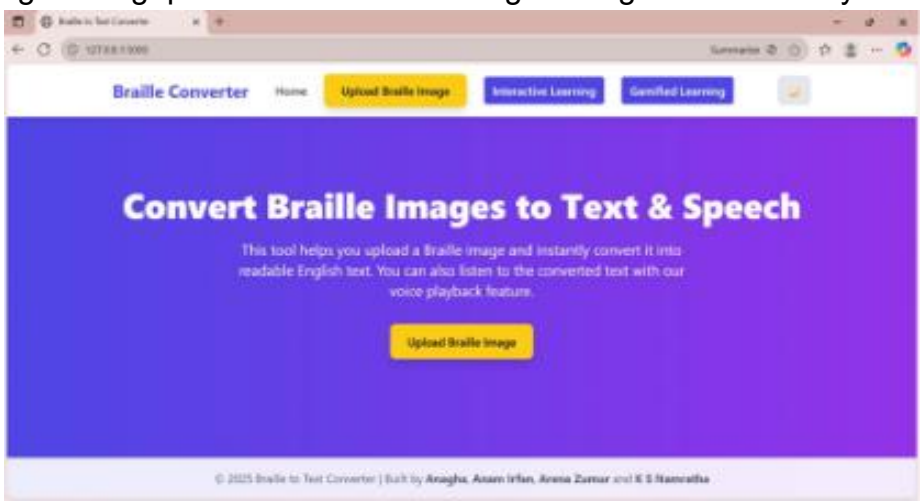

Figure 1: Braille-to-Speech Software Prototype
Converts Braille images into audible speech using CNN recognition and offline TTS integration

Objectives:

1. Enable Offline Accessibility: Ensure Braille-to-audio conversion works without an internet connection.
2. Enhance Reading Efficiency: Provide clear and accurate speech output for Braille text.
3. Support Multi-Language Narration: Enable conversion of Braille text into multiple languages.
4. Optimize Real-Time Processing: Minimize delay in text recognition and audio generation.

Methodology:

- The project “AI-Based Offline Braille Book Audio Narrator” follows a systematic approach to convert Braille text into audible speech using artificial intelligence techniques.
- The first phase involves data collection, where images of Braille characters and full Braille pages are gathered from reliable sources or captured using a camera. These images from the base dataset for training the model.
- Next, image preprocessing is performed to enhance data quality. This includes converting images to grayscale, removing noise, improving contrast, and resizing images to a standard format suitable for model input.
- After preprocessing, the Braille patterns are carefully labeled with their corresponding textual characters to create a structured dataset for supervised learning.
- In the model development phase, a machine learning or deep learning model, typically a Convolutional Neural Network (CNN), is designed to recognize Braille patterns from images.
- The model is trained using the prepared dataset, allowing it to learn the mapping between Braille dot patterns and their corresponding alphabets, numbers, and symbols.
- Model performance is evaluated using test data, and accuracy metrics are analysed. Based on results, the model architecture and parameters are refined to improve performance.
- Once trained, the model is used for Braille-to-text conversion, where predicted characters are combined to form meaningful words and sentences.
- Additional logic is implemented to handle multi-cell Braille, including spacing, punctuation, and line breaks for proper text interpretation.
- In the next phase, Text-to-Speech (TTS) integration is carried out using offline engines such as pyttsx3 or eSpeak to convert the generated text into speech.
- The system ensures that the audio output is clear, natural, and understandable for users.
- Finally, the entire system is deployed as an offline application, integrating the trained model and TTS engine into a single platform.
- The solution is optimized for real-time performance and designed to function efficiently on systems with minimal hardware requirements, ensuring accessibility and usability without the need for internet connectivity.

Result and Conclusion:

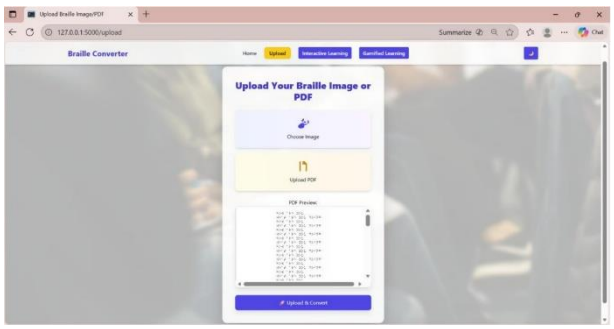

Figure 2: Upload Interface
Allows users to submit Braille images for processing.

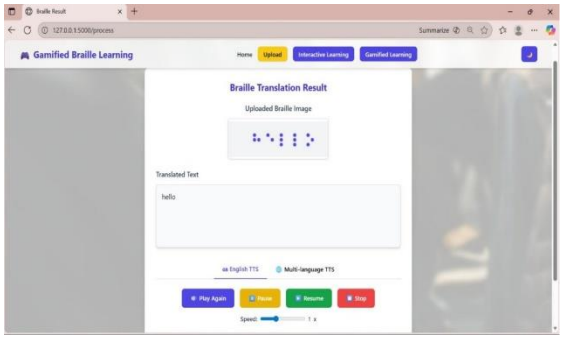

Figure 3: Translated Braille Output
Displays recognized Braille text converted into readable characters.

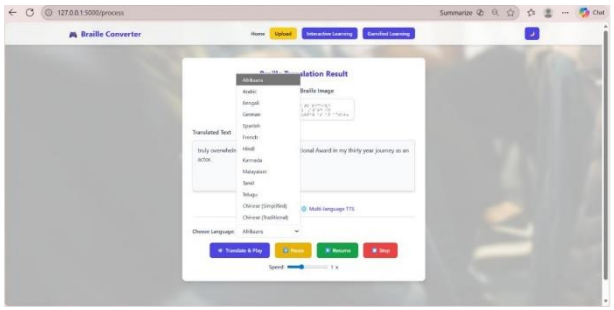

Figure 4: Multi-Language Selection
Provides options to narrate Braille text in different languages.

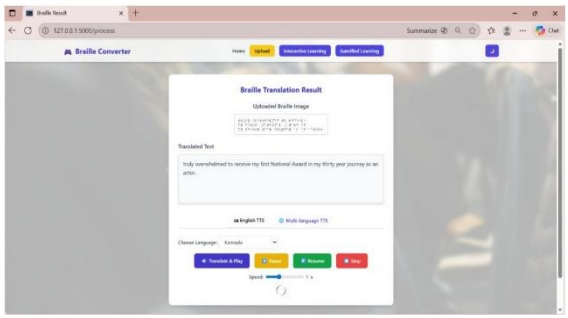

Figure 5: Audio Playback
Plays the converted text aloud using offline TTS integration.

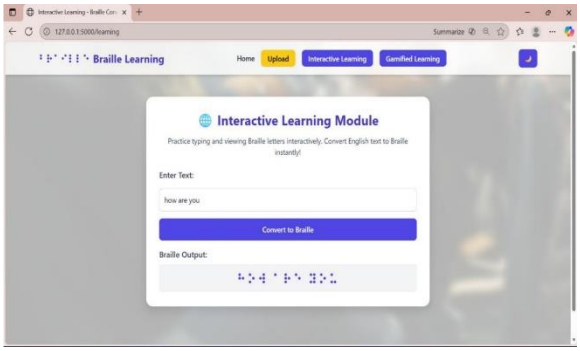

Figure 6: Interactive Learning Tool.
Supports practice and engagement with Braille recognition.

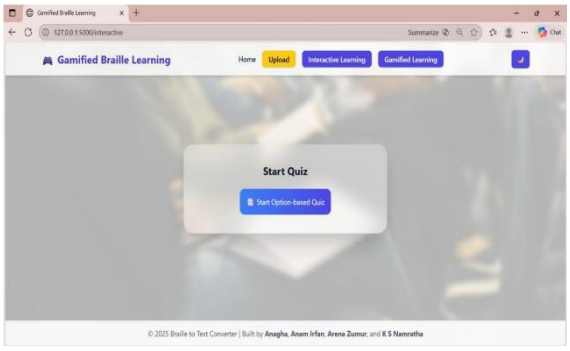

Figure 7: Quiz Module
Tests user knowledge through Braille-related questions

Project Outcome & Industry Relevance:

- The project resulted in the successful development of a prototype AI-based offline Braille book audio narrator capable of converting Braille text into speech with good accuracy.
- It demonstrated the practical implementation of computer vision and deep learning techniques for real-world accessibility applications.
- The system achieved seamless offline functionality, ensuring usability in low-connectivity or remote environments.

- The integration of multilingual support and Text-to-Speech enhanced its versatility and user accessibility.
- From an industry perspective, the project is highly relevant in the field of assistive technology, which is rapidly growing due to increasing focus on inclusivity and accessibility.
- It aligns with advancements in artificial intelligence, particularly in image recognition and natural language processing.
- The solution can be adopted in educational institutions, libraries, and organizations supporting visually impaired individuals.
- It also has potential applications in digital publishing and accessibility services, where automated Braille translation is required.
- The project reflects industry trends toward offline-capable AI systems that ensure data privacy and independence from cloud services.
- Additionally, it highlights the importance of user-centric design in developing inclusive technology solutions.
- Overall, the project demonstrates how AI can be leveraged to solve socially impactful problems and improve quality of life for differently abled individuals.

Working Model

- Fully functional prototype that converts Braille images to speech.
- Use image preprocessing and CNN model for accurate recognition.
- Converts recognized text into audio using offline TTS.
- Works completely without internet (offline system).
- Provides real-time output with minimal delay.
- Integrated system (image → text → speech in one flow).
- Usable by visually impaired users in real-world scenarios.

Project Outcomes and Learnings:

- Developed a working prototype of an AI-based offline Braille-to-audio system.
- Achieved accurate Braille character recognition using a CNN model.
- Successfully convert Braille text into clear speech output.
- Implemented complete offline functionality without internet dependency.
- Enable real-time processing with minimal delay.
- Added multilingual support for better accessibility.
- Designed a user-friendly interface for visually impaired users.

References:

[1] T. Bharti et al., “Next-Gen Assistive Technology: AI Applications for Deaf-Mute and Blind Communities,” 2025.
[2] Chen et al., “AI-Powered Speech-to-Text System for Hearing-Impaired Individuals,” 2024.
[3] V. P. Campos, “Machine Generation of Audio Description for Blind and Visually Impaired People,” 2023.

[4] S. Yadav and P. Singh, “A Deep Neural Network Framework for Translating Braille to Natural Language,” Journal of Intelligent & Fuzzy Systems, 2022.
[5] Gupta et al., “Smart Braille Reading Assistant for Visually Impaired,” 2022.

Future Scope:

The future scope of this project includes:

- Improve Braille recognition using advanced deep learning to handle unclear, damaged, and complex patterns including Grade-2 Braille.
- Enhance speech output with more natural voices and add features like language options and personalized user settings.
- Develop a mobile app for on-the-go use and expand the system for wider real-world applications.