FAER - Integra SCHOLAR PROGRAM: 2024-2025

1.	Name of the Students	: Sharath Krishna Naik
	Degree registered	: Bachelor of Engineering (B.E.)
	Branch	: Electronics and Communication Engineering (ECE)
	Year	: 4th year
	Address (residential)	: SDMIT Boys Hostel Dharmasthala Rd, near Siddhavana, Ujire.
	E-mail address	: ksharathnaik12@gmail.com
	Phone / Cell no	8660494042
	Name and Address of the College (including pin code)	: SDM Institute of Technology. Dharmasthala Rd, near Siddhavana, Ujire, Karnataka – 574240.
	Web site of the college	: https://sdmit.in/
	Phone No	8762127991
	Name of the Supervisor / Project Guide with E-mail address and mobile Number	: Dr. Prathapchandra Emailid:prathapnadoor@sdmit.in Phone no: 9964025500
	Whether the students belong to SC/ST	: No
2.	Title of the Project	: Development of Speech and to Braille Script Converter
	Area	: Health Care Technologies
	Relevance to the area of the contest	: The Speech to Braille converter technology simplifies the lives of blind individuals by enhancing accessibility, making it easier for them to read books and novels.
	Type of Project	: Product / Technology Development.

Objective of the project:

To create a user-friendly and efficient application that can accurately convert spoken language into Braille script, enabling visually impaired individuals to access and understand information through touch.

- Accuracy: Ensure high accuracy in the transcription of speech to Braille, minimizing errors and omissions.
- Accessibility: Design the application to be easily usable by individuals with varying levels of technical proficiency and visual impairments.
- Efficiency: Optimize the conversion process for speed and responsiveness, providing a seamless user experience.
- Adaptability: The application should be compatible with a wide range of devices and platforms, including smartphones, tablets, and computers.
- Language Support: Incorporate support for multiple languages and dialects to cater to diverse user needs.
- Integration: Explore potential integrations with other assistive technologies and platforms to enhance accessibility and usability.
- Continuous Improvement: Implement a feedback mechanism to gather user insights and continuously improve the application's functionality and performance.

By achieving these objectives, the speech-to-Braille script converter will empower visually impaired individuals to access information, education, and communication opportunities more independently and effectively.

Additional Features:

Core Features

- Multiple Language Support: Expand the converter to support a variety of languages, including those with different writing systems and phonetic structures.
- Dialect Recognition: Implement features to recognize different dialects or accents within a language, ensuring accurate transcriptions for diverse users.
- Contextual Understanding: Enhance the converter's ability to understand the context of spoken words, improving the accuracy of Braille translations, especially for homophones or words with multiple meanings.
- Customizable Braille Output: Allow users to choose different Braille codes or standards (e.g., Grade 1, Grade 2, UEB) to suit their specific needs or preferences.

Advanced Features

- Real-time Transcription: Enable real-time speech-to-Braille conversion, providing immediate feedback to users and facilitating communication in real-time scenarios.
- Integration with Assistive Technologies: Integrate the converter with other assistive technologies like screen readers or refreshable Braille displays for seamless user experience.
- Offline Functionality: Develop an offline mode for the converter, allowing users to use it without an internet connection, especially in areas with limited connectivity.
- Error Correction and Feedback: Implement features to help users correct errors in the transcribed Braille output and provide feedback to improve the converter's accuracy over time.
- Voice Synthesis: Add a voice synthesis feature to read the transcribed Braille text aloud, providing an alternative method for users to access the information.
- Educational Resources: Include educational resources or tutorials to help users learn Braille and understand the concepts behind the conversion process.

Implementation Plan from: January 2025 to April 30, 2025

- January 2024: Design and implement speech recognition module.
- February 2024: Develop speech-to-Braille conversion algorithm.
- March 2024: Integrate the speech module with Braille output hardware.
- April 2024: Test the complete speech-to-Braille system, optimize performance, and finalize documentation.

Existing Approaches:

1. ASR to Braille Translation: Speech is converted to text using Automatic Speech Recognition (ASR), which is then transcribed into Braille using translation software. This can be outputted on refreshable Braille displays or Braille printers.
2. Mobile & Wearable Solutions: Mobile apps and wearable devices capture speech, convert it to Braille in real-time, and display it on a touchscreen or connected Braille display, offering flexibility and on-the-go accessibility.
3. Real-Time Transcription Services: Live transcription platforms integrate with Braille displays to provide real-time speech-to-Braille translation, making them ideal for events, meetings, or lectures.

References (Literature):

[1] S. Swathi, G. Shreya, P. Payal Jain, Sushma, and M. G. Ravi Kumar, “Speech to Braille Convertor for Visually Impaired using Python,” International Journal of Advance Science and Technology, vol. 29, no. 10S, pp. 3916, 2020.

[2] S. Ramachandran, N. Rajan, K. N. Pallavi, J. Subashree, S. Suchithra, and B. Sonal, “Communication Device for the Visual and Hearing Impaired Persons to Convert Braille Characters to English Text,” 2021 International Conference on Emerging Smart Computing and Informatics (ESCI), Pune, India, 2021, pp. 587-592.

[3] R. Sudhir Rao, H. Sushma, G. Varsha Bhat, S. Suman, and M. K. Bhaskar, “Novel Methodology for Kannada Braille to Speech Translation using Image Processing on FPGA,” In 2014 International Conference on Advances in Electrical Engineering (ICAEE), 2014, pp. 1-6.

[4] K. Parnesh, R. Sahana, P. Sheetal, and K. Niranjana, “Conversion of Hindi Braille to Speech using Image and Speech Processing,” In 2020 IEEE International Conference on Electrical, Electronics and Computer Engineering, 2020, pp. 284.

What is new in the project:

1. Real-time Transcription and Conversion: The converter should be able to accurately recognize and transcribe spoken language in real time, allowing for seamless communication.
2. Multiple Braille Output Methods: The system should support various Braille output methods, such as Braille displays, printers, and embossers, to cater to different user preferences.
3. Language Support: The converter should support multiple languages and dialects to ensure accessibility for a wider range of users.
4. Integration with Other Technologies: The system should be compatible with other assistive technologies and devices to provide a comprehensive solution for visually impaired individuals.

How is this proposal different from existing approaches based on

- Real-time transcription: Convert spoken words into Braille instantly.
- Accurate speech recognition: Understand speech in various accents and noisy environments.
- Multiple Braille output: tactile Braille display, printers, or embossers.
- Language flexibility: Support multiple languages and dialects.
- Integration with other devices: Work with screen readers, mobile apps, and more.
- Easy-to-use interface: Designed for everyone, regardless of tech experience.

Reasons Why This Proposal Should Be Considered for Selection:

The Speech-to-Braille converter project enhances accessibility for visually impaired individuals by directly translating spoken language into Braille, fostering greater independence and inclusion. It fills a technological gap by combining speech recognition with Braille output, which can be beneficial in educational and communication contexts. This project advances assistive technology, providing a unique tool for real-time, tactile access to spoken information. Ultimately, it empowers users to interact with their surroundings more fully.

Approach to solving the problem:

1. Problem Identification

The project focuses on addressing communication barriers faced by blind and deaf people, especially those in developing countries where resources are scarce. These individuals struggle with effective communication, reading, and writing, and the project aims to develop an assistive tool to bridge that gap.

2. Proposed Solution

The core of the solution involves converting speech and text into Braille using a Raspberry Pi Zero. This device processes inputs and outputs Braille codes, enabling visually and hearing-impaired individuals to communicate and access information.

3. Key Components

- Raspberry Pi Zero: Acts as the main processing unit for handling all conversion tasks.
- NodeMCU 12E: This module has an in-built Wi-Fi module and is used for connectivity and communication with the web server.
- Braille input/output: Both speech-to-Braille and Braille-to-text conversions are supported. Users can enter Braille via push buttons or images, and the system processes them to produce text or voice outputs.

4. Workflow

The system processes speech or text inputs and converts them into Braille in four main steps:

- Text to Braille: Users can input text through a webpage interface. The system converts the text into ASCII values, maps them to the corresponding Braille codes, and displays the Braille output.
- Braille to Text: Users can enter Braille via a 4x4 keypad, where each button corresponds to Braille letters.

The input is then processed and converted into text.

- Image to Text: Users can upload an image of Braille text, which is processed using image recognition techniques (e.g., black-and-white conversion, edge detection) to extract the Braille code and convert it into readable text.
- Voice to Braille/Voice: Speech input is converted into text using a Python voice recognition package, which is then mapped to Braille. This allows blind and deaf people to communicate effectively using spoken language that is converted to Braille.

5. Hardware and Software Integration

The approach uses hardware like the LED Matrix tactile Braille display for Braille output and various software techniques such as Flask (a Python web framework) to build an interactive webpage interface. Speech recognition and image processing algorithms are integrated into the Python code to carry out the text and speech conversions.

6. Innovative Features

- The use of a web-based interface (built using Flask) allows users to interact with the system easily, choosing different conversion options (e.g., text-to-Braille).
- The project aims for cost-effectiveness by utilizing affordable and widely available components such as the Raspberry Pi and NODEMCU.

Budget estimates:

Component	Cost (INR)
Raspberry Pi Zero/4	7000
Microphone (Input Device)	200
Speech Recognition Module	2500
Braille Translation Software	Free
Refreshable Braille Display (tactile display)	5000
Battery (Rechargeable)	900
Other Components (wires, PCB, etc.)	800
Total	16400

1. Declaration:

We will take up this project if selected, for FAER Scholar Project only and will not submit this to any other contest. we will comply with FAER s requests on submission of action plans, summary, monthly progress reports. we will regularly discuss with mentors and follow his advice. Mentors are there to help us.

Signature of Students | Signature of Project Advisor / Project Guide

Date:09/10/2024 | Signature of Principal

DECLARATION / UNDERTAKING

This is to certify that Ms. Sharath Krishna Naik, Pratham H P, Rohan Kumar M S is a Bonafide student of 4th year in the degree program of our college. If the proposal is selected by FAER, we will provide the requisite laboratory / computer support in our college.

Date: 09/10/2024

Signature of Principal
Seal of the institution

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