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Braille Script Generation Using OCR

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ABSTRACT:

Globally, there are 37 million blind individuals. Fifteen million of those come from India. These individuals are unable to view electronic media or documents that are not available in Braille. The improved Braille technology that we are using here makes it easier for blind persons to read text or content. We took a picture with a camera, processed it using image processing methods, and then used optical character recognition (OCR) to turn it into text. The Raspberry Pi will be given the recognised text, and it will recognise each character and translate it into Braille code. We are showing that Braille code on Braille with the aid of a solenoid.

Keywords: Tesseract, Raspberry Pi, Braille Display, Braille Dots, Braille Language, Character Mapping, and Optical Character Recognition.

INTRODUCTION:

For those who are blind or visually handicapped, reading and obtaining written materials present substantial problems. For some reading materials, traditional methods—like Braille books—can be time-consuming, costly, and unreliable. People who are blind or visually challenged can read by touch thanks to the Braille writing system. Nevertheless, the size and expense of Braille books limit their manufacturing and dissemination. This results in a gap in accessibility since many people who are blind or visually impaired do not have the same instant access to a large variety of printed information as people who are seeing. This issue can be resolved using refreshable Braille displays. Users can read a range of texts without the need for conventional Braille books thanks to these electronic gadgets' ability to translate digital text into Braille in real-time. Our endeavour,

What is OCR?

Optical Character Recognition (OCR) is a technology that creates editable and searchable digital text from a variety of document forms, including scanned paper documents, PDFs, and digital camera photos. A number of steps are involved in the process: obtaining the image, cleaning and adjusting it in preprocessing, segmenting and classifying the text characters to identify them, and post-processing to improve accuracy and maintain formatting. OCR is a popular tool for scanning paper documents, transforming text to speech or braille, automating data entry, and enabling text searching for the blind. It includes a variety of formats, such as conventional optical character recognition (OCR) for printed text, handwritten text recognition (ICR), and form mark detection (OMR) for forms. This innovation dramatically increases productivity by converting still photos of

What is the use of OCR in Braille script?

When Braille-adapted, OCR (Optical Character Recognition) technology greatly improves accessibility for people with vision impairments by transforming hard copy Braille materials into digital formats. Because of this adaption, people who cannot read Braille can nevertheless access Braille content by translating it into normal language. Furthermore, OCR ensures inclusivity by making it easier to create dual-format documents with both conventional text and Braille. OCR may translate handwritten or printed text into Braille for use with refreshable Braille displays in real-time applications, giving users instant access to a variety of textual content. OCR facilitates the conversion of textbooks and other educational materials into Braille, guaranteeing visually impaired students have equal access to materials. Moreover, it enables the printing and embossing of Braille from digital text, enabling accessibility for printed documents.

METHODOLOGY:

A Braille script project's approach entails a number of methodical procedures to guarantee its effective creation and execution. After defining the project's goals and consulting with stakeholders to obtain needs, a feasibility study and a review of the literature are conducted to ascertain the difficulties and technologies that are currently in use. Creating OCR algorithms specifically for Braille recognition during the system design phase entails combining image processing and pattern recognition methods. An interface that is both accessible and user-friendly is guaranteed by software development. To train and test the OCR system, a wide variety of Braille documents are acquired and annotated as part of the data collecting process. After that, the model is evaluated and trained to confirm its accuracy. After validation, the system is combined with additional parts, such as Braille displays that can be refreshed, and it is optimised according to user input and performance assessments.

A. The Braille Code

The Braille system of reading and writing was developed by French educator Louis Braille and is used by people who are blind or visually impaired worldwide. Braille is based on a fixed grid called a cell, which is made up of six or eight dots. Every single dot in the six-dot and eight-dot braille patterns is either raised or flattened, resulting in a total of 256 potential possibilities. Each letter in a six-dot composition is created in a matrix with two columns and three rows. The grid of the verso text is moved such that its dots lie in between the recto dots when the text is printed on both sides. Braille indicates less characters on a page. For example, if a page is 25 cm wide and 29 cm long,

B. Cells in Braille

For every Braille cell, a matrix consisting of two columns and three rows of dots is set up. The dots can be elevated in any one of these six locations, for a total of 64 combinations. Every location has a number where the dots are removed, for instance, from top to bottom, 1 to 3 on the left side and 4 to 6 on the right.

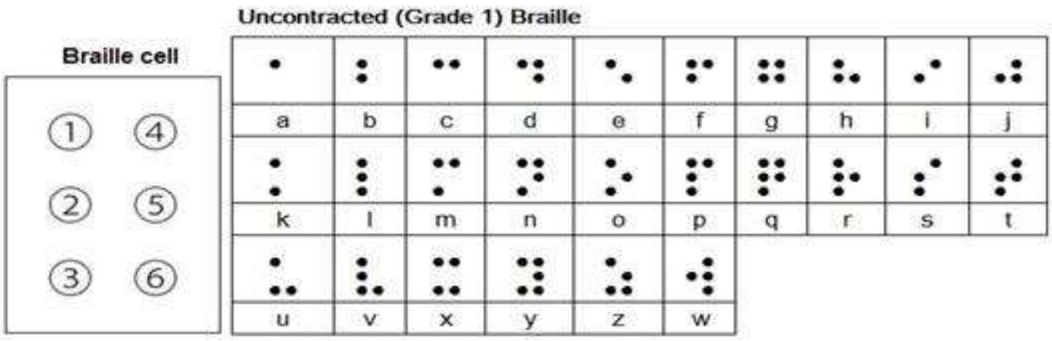

Fig.1 Braille cell

C. System Design

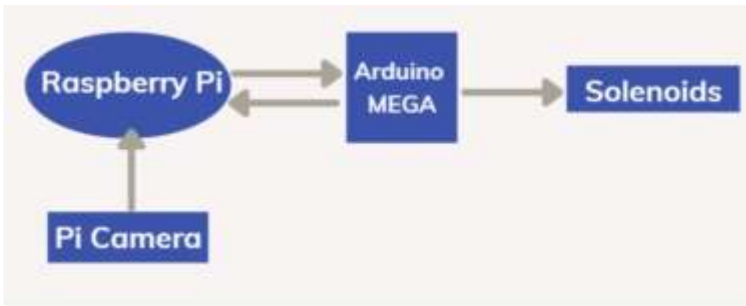

Fig.2 Block Diagram

Tesseract OCR, an open-source OCR engine renowned for its excellent text recognition accuracy, is at the heart of the system. The Raspberry Pi is used as the central processing unit for Tesseract. The Pi-cam, a camera module that attaches to the Raspberry Pi and takes high-resolution pictures of printed text, is the first step in the text recognition process. Next, OpenCV, an extensive computer programme, is used to preprocess these pictures.visionary library. It is essential to use OpenCV techniques like edge detection, noise reduction, and binarization to improve OCR accuracy and image quality.

Tesseract extracts the text, and to guarantee consistent formatting, it goes through cleaning and normalisation steps. After that, the created text is sent into a Raspberry Pi-based Braille translation process. The system uses rule-based techniques to translate the cleaned text into matching Braille patterns, taking care of contextual rules related to capitalization, punctuation, and numbers.

An Arduino MEGA microcontroller receives the translated Braille data from the Raspberry Pi and is essential in managing the hardware that produces the tactile Braille output. An array of solenoid actuators, each representing a dot in a Braille cell, is managed by the Arduino MEGA. To ensure exact and dependable dot creation, these solenoids are carefully controlled via pulse-width modulation (PWM)

allowing the Braille characters to be felt by the user

Additionally, the project includes a simple Raspberry Pi graphical user interface (GUI) that makes it simple for users to take pictures and start the OCR and Braille translation processes. To help visually challenged users navigate the system, voice assistance is an optional addition to the GUI.

Combining these methods—rapid OCR with Tesseract, OpenCV image preprocessing, rule-based Braille translation, and accurate

Real-time text-to-Braille conversion is made robust and easy to use using hardware control using solenoids and Arduino. With the help of strong error-handling algorithms, the modular architecture guarantees smooth component interaction, preserving dependability and user delight.

The architecture of the system is shown in the following diagram:

● The Pi Camera takes pictures of the printed text and transmits them to the Raspberry Pi for processing.

● The Raspberry Pi serves as the main computing unit, interacting with the Arduino MEGA and the Pi Camera.

● The text is converted into Braille patterns by the Raspberry Pi using Tesseract OCR to interpret the image.

● The Arduino MEGA receives the translated Braille data and uses it to operate the solenoids to create the tactile Braille output.

By utilising an integrated approach, the system is guaranteed to be effective, precise, and easily accessible, catering to the needs of visually impaired users who require real-time Braille text generation.

1. Image Capture: A picture of the printed text is taken by the camera module.

2. Text Extraction: OCR technology is used by the Raspberry Pi to process the image and extract the text.

3. Data Transmission: The ESP32 receives the extracted text over Bluetooth.

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4. Text-to-Braille Conversion: The text is converted into Braille using an algorithm by the ESP32. This entails assigning the appropriate Braille representation to every character.

5. Braille Dot Actuation: To activate the solenoids and produce the Braille dots on the surface, the ESP32 creates digital signals.

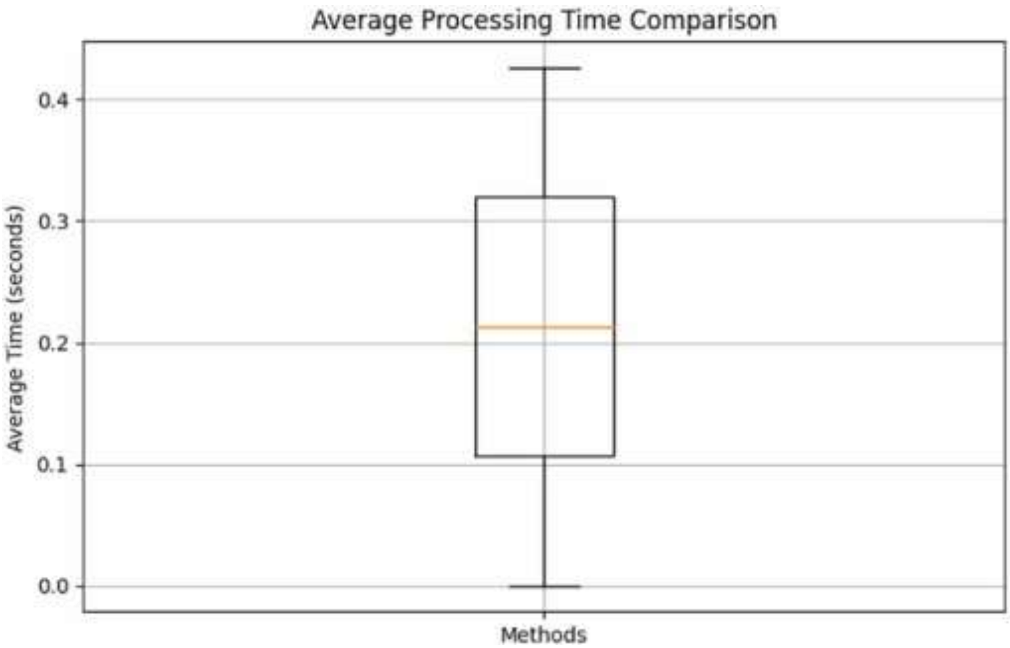

Fig.3. Refreshable OCR Braille solution.

RESULT:

When a Braille script project is finished well, visually impaired people can now access a much wider variety of texts—including printed documents that were previously inaccessible—with much greater ease. The initiative enables simpler electronic storage, administration, and exchange of Braille content by digitising hard copy Braille papers. By producing dual-format texts that are readable by sighted and visually impaired people, it also encourages inclusivity. Further improving accessibility is the capacity to convert text in real time, particularly with the use of gadgets like refreshable Braille displays. In terms of education, the project guarantees equal access to learning resources for visually impaired pupils. Because automated OCR systems eliminate the need for human transcription, text conversion procedures are sped up and efficiency is increased. The project also supports additional assistive technologies, like Braille and text-to-speech converters.

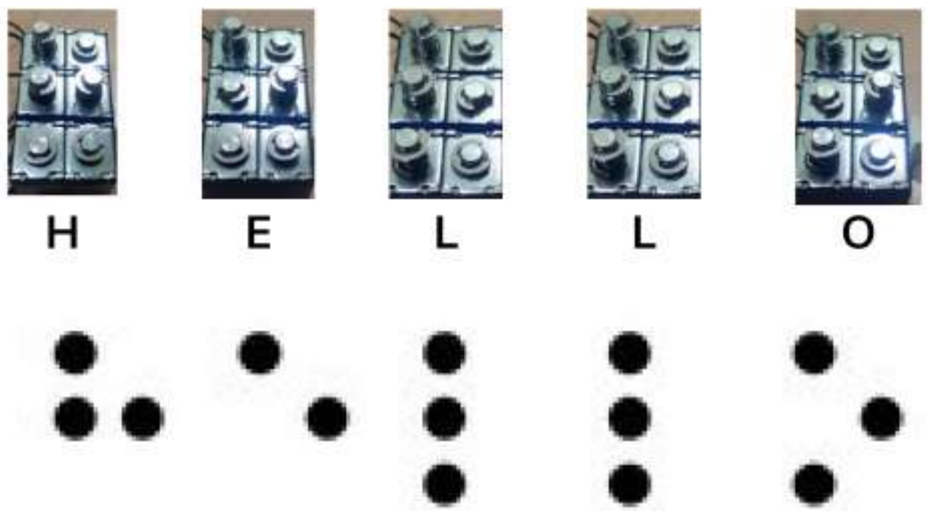

Fig.4. Actual Implementation.

CONCLUSION:

In order to meet the needs of visually impaired people, the Braille Script Generation utilising OCR (MOLBED) project has successfully demonstrated an inventive approach by offering a practical and affordable way to translate written English text into Braille script. Through the integration of multiple hardware components, such as the Pi Camera, Arduino Mega 2560, solenoid actuators, ULN 2003 driver, and Raspberry Pi Model 4, the system operates seamlessly from image capture to Braille embossing.

Text extraction and image processing have been highly accurate thanks to the use of open-source software tools like Pytesseract, OpenCV, and Tesseract OCR. These tools guarantee the system's dependable and effective operation, along with specially written Python scripts and Arduino code. The project's architecture demonstrates how realistic solutions for everyday issues can be made by utilising easily available, reasonably priced technologies.

In order to create a useful tool that satisfies a pressing need, this project highlights the value of interdisciplinary collaboration by combining components from computer vision, machine learning, and mechatronics. In addition to demonstrating the adaptability and strength of open-source technologies, the Braille Script Generation system's achievement establishes a standard for upcoming advancements in assistive technology.

By giving visually impaired people more freedom and accessibility to written material, the use of this system can greatly improve their quality of life. By enabling users to read and comprehend text without depending on visual signals, the solenoid actuators' tactile output promotes inclusivity and equitable access to information.

The project also functions as a useful teaching tool, illustrating how difficult issues can be solved creatively. It inspires other researchers and developers to keep coming up with new ideas in the vital subject of assistive technology by promoting more investigation and advancement in this area.

In summary, the Braille Script Generation using OCR (MOLBED) initiative offers evidence of the revolutionary potential of technology to advance inclusivity and accessibility.

Future Scope

A Braille script project has a wide and bright future ahead of it, full of possible breakthroughs and wider uses that might greatly improve accessibility and inclusivity for people with visual impairments. Future advancements could involve combining artificial intelligence and sophisticated machine learning to increase the precision and speed of Braille translation and recognition. Its usability can be further increased by expanding the project to accommodate many languages and complicated Braille notation. Furthermore, real-time Braille translation on-the-go could be made possible by integrating this technology into ordinary applications and mobile devices, considerably increasing the independence of visually impaired people. Partnerships with libraries and educational institutions may result in the extensive digitization of literary and educational resources, guaranteeing universal access to knowledge. Additional ongoing, feedback-driven enhancements to user interface design and user experience.

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