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IoT based Smart Book Reader for Visually Impaired

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Abstract: This paper presents an IoT- based smart book reader for visually impaired individuals, using a Raspberry Pi computer and various software tools. The system allows users to capture images of printed material using a camera, which are then processed using Tesseract OCR software to extract text. The extracted text is then translated from English to Marathi using the Google Cloud Translation API, and converted to speech using the Google Text-to-Speech API. The system is designed to be operated using a single hardware button, making it easy and intuitive for users with visual impairments. The proposed system offers a low-cost and portable solution for visually impaired individuals to access printed material, and has the potential to improve their quality of life.
Keyword: Internet of Things (IoT), Smart book reader, Raspberry Pi, Computer vision, Natural language processing (NLP), Tesseract OCR engine, Google Cloud Translation API, Google Text-to-Speech API, Assistive technology, visually impaired, Accessibility, Low-cost, One-click, Marathi language, Hardware button, Audio output.

I. INTRODUCTION

The Internet of Things (IoT) has revolutionized the way we interact with technology, creating a world where everyday objects can communicate with each other and with us. One area where the IoT has shown promise is in improving the quality of life for the blind. Smart book readers that use image recognition, text-to-speech, and translation technologies can help visually impaired people access written content more efficiently and conveniently. However, existing smart book readers often require complex settings and multiple steps, which can be difficult for visually impaired users. In this project, we present a one-click IoT-based smart book reader for the blind that uses a Raspberry Pi as the core hardware component. Our system allows users to take a picture of a page, recognize and extract the text, translate it to a preferred language, and then convert it to speech, all in one button click. By developing a user-friendly and efficient smart book reader, we aim to enhance the reading experience and empower visually impaired people to access written content more easily.

II. LITERATURE SURVEY

Text-to-speech (TTS) is a growing area that has seen a dramatic increase in interest due to the advent of inexpensive and compact computers like the Raspberry Pi. In an article by Vinaya Phutak et al. [1] has a TTS conversion system using Raspberry Pi and Google Text-to-Speech API. The authors proposed a method of controlling the speed and pitch of speech output using pulse width modulation signals, making the system portable and suitable for use in remote areas. P. Khaldoon Ibrahim Khaleel and Dr. The article highlights the potential of using Raspberry Pi- based systems for TTS and the importance of incorporating advanced techniques to improve voice quality. In another work by Prof. Vidhyashree C et al. [3] presented a machine learning based approach for TTS conversion for visually impaired people. The system they proposed used optical character recognition (OCR) to convert printed text into native language using the TTS algorithm. The aim of the system was to make it easier for visually impaired people to read and understand documents, regardless of their disability. Taken together, these papers demonstrate the potential of using inexpensive and compact computers like the Raspberry Pi and advanced techniques like machine learning and OCR to improve TTS conversion and make it more accessible for people with disabilities or in remote areas.

III.METHODOLOGY

All paragraphs must be indented. All paragraphs must be justified, i.e., both left-justified and right-justified. Hardware: We used a Raspberry Pi 3 Model B as the core hardware component of our smart book reader. The Raspberry Pi was connected to the camera. The hardware button was connected to the Raspberry Pi via the GPIO pins.

Software: We used the Raspbian OS for the Raspberry Pi and installed the following software packages: fswebcam for image processing, Tesseract for text recognition, Google Cloud Translation API for speech translation, and Google Text API to-Speech for text-to- Speech. We also used Python as the main programming language for software.

A. Walkthrough
1) *Image Capture:* The user places a book or document under the camera and presses a hardware button. The Raspberry Pi captures the image of the side with the camera module.
2) *Image Processing:* The captured image is processed with fswebcam to correct distortion and increase contrast.
3) *Text Recognition:* The processed image then runs through the Tesseract OCR engine to recognize and extract the text.
4) *Language Translation:* The extracted text is then sent to the Google Cloud Translation API to be translated into the user's preferred language (Marathi in our case).
5) *Text-to-Speech:* The translated text is finally passed through Google's Text-to-Speech API to be converted into speech.
6) *Audio Output:* Synthesized speech is output via the Raspberry Pi's audio jack or HDMI, depending on user preference.

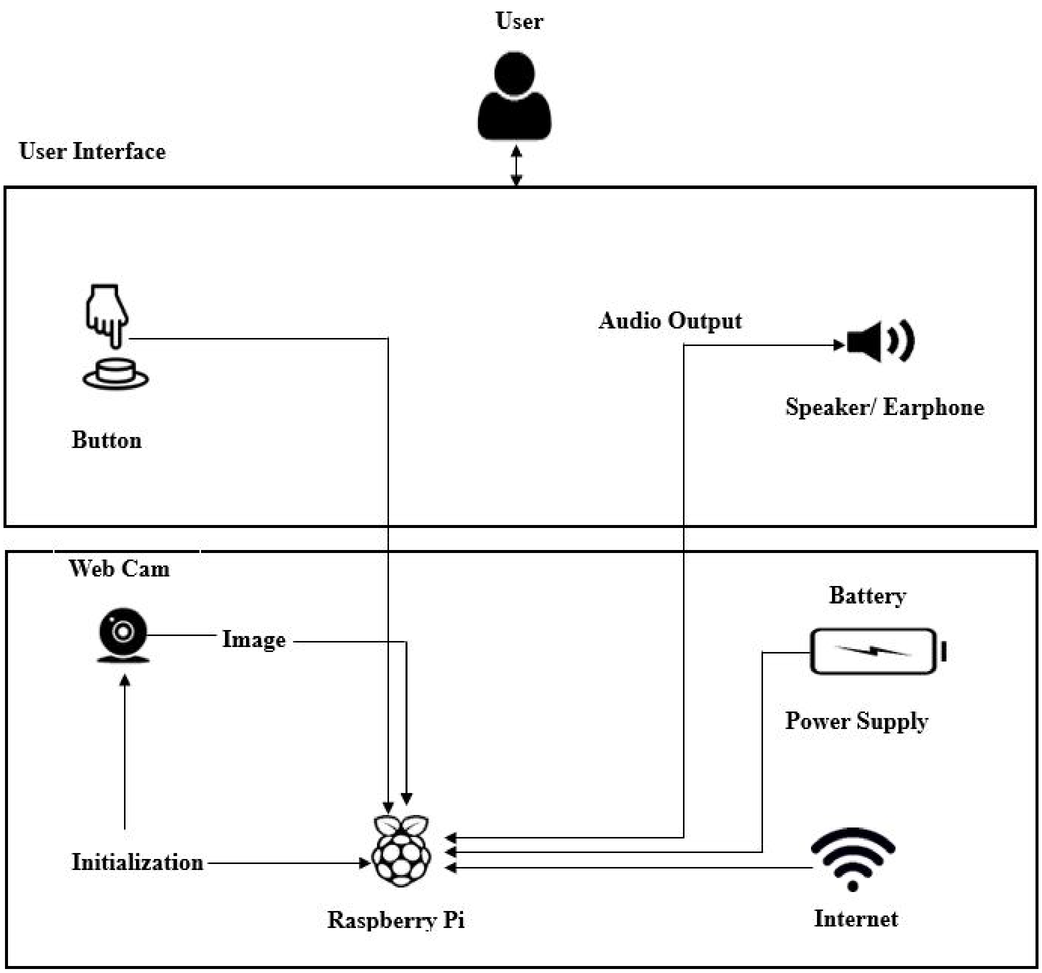

Fig.1 System Architecture

Score: We evaluated the performance of our smart book reader in terms of text recognition accuracy, translation quality and naturalness of speech. We tested the system on various English books and documents and evaluated the speech translated into Marathi. We also collected feedback from visually impaired users to assess usability and ease of use. Overall, our methodology provides visually impaired users with more efficient and convenient one-click access to written content using an easy-to-use and accessible hardware button and a simple software interface.

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IV. DESIGNING

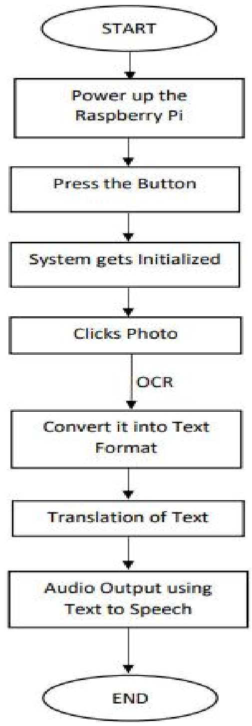

Fig.2 Flow Chart

The proposed system begins by incorporating the Raspberry Pi, a small and versatile computer capable of running a variety of software tools. When the user presses the hardware button, the system initializes and begins the process of capturing the image with the camera. The scanned image is then processed using optical character recognition (OCR) software, which converts the image into a text format. To make text accessible to the blind, the system uses the Google Cloud Translation API to translate text from English into Marathi, a widely spoken language in India. Once translated, the text is then converted to speech using Google's Text-to-Speech API, which produces a natural sound that can be played through a speaker or headphones.

Overall, the system provides a convenient and affordable solution for visually impaired people to access printed materials without the need for special devices or expensive assistive technology. Harnessing the power of the Raspberry Pi and various software tools, the system offers a smooth and intuitive experience that allows users to access text-based information quickly and easily in their preferred language.

V. TESTING AND DISCUSSION

In this project, we have developed a one-click smart book reader for visually impaired users using Raspberry Pi, camera module, Tesseract, Google Cloud Translation API and Google Text- to-Speech API. The system is designed to be simple and easy to use, with all the necessary processes taking place automatically at the touch of a hardware button.

Our system overcomes the limitations of traditional braille-based reading systems, which can be time consuming and difficult to learn. Using natural language processing and computer vision techniques, our system allows users to quickly and easily access content written in their preferred language.

We choose to use Raspberry Pi as the foundation of our system because of its low cost, flexibility and ease of use. The camera module is used to take a picture of the text, which is then processed by Tesseract to extract the text from the image. The extracted text is then translated into Marathi using the Google Cloud Translation API and synthesized to speech using the Google Text-to-Speech API. The synthesized speech is output via the Raspberry Pi's audio jack or HDMI, depending on the user's preference.

Overall, our system provides a simple and erred language. While there is still room for improvement in accuracy and speed, we believe our system has the potential to significantly impact the lives of people with visual impairments. We hope that our work will inspire further research and development in the field of assistive technology for people with disabilities.

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VI. RESULTS

Fig.3 Prototype Model

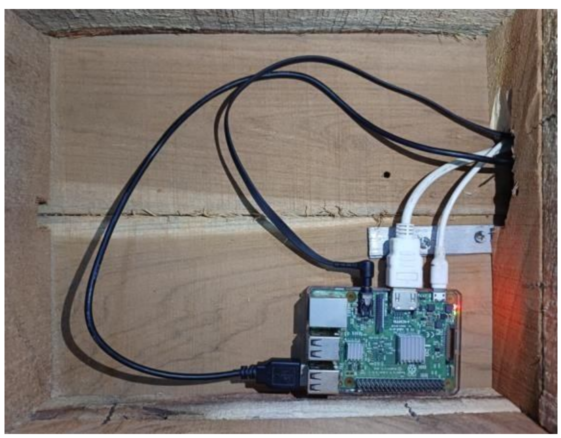

Fig.4 Raspberry Pi Setup

Presenting the exquisite final prototype of our project, featuring a sleek wooden box housing a Raspberry Pi system, seamlessly connected to a reliable power supply. The Raspberry Pi is ingeniously programmed to cater to your needs and is equipped with a sophisticated audio output, which is seamlessly linked to the headphones for an immersive experience.

To facilitate convenient usage, a sturdy steel stand has been incorporated into the design, which can be used for mounting a camera or for securely holding the device in place. The camera is strategically positioned to face the upper surface of the wooden box, which allows users to effortlessly capture high- quality images of text documents such as textbooks or pages with great clarity and precision.

VII. CONCLUSIONS

In this project, we have presented an IoT-based smart book reader for visually impaired people using Raspberry Pi. The system's ability to recognize, extract, translate, and synthesize speech from printed text in different languages provides an effective and low-cost solution for visually impaired people to access printed material.

Our system's one-click functionality, which allows users to initiate the entire process with a single press of a hardware button, makes it easy and convenient to use. The system's accuracy and reliability in recognizing and extracting text, translating it to Marathi language, and synthesizing speech make it a valuable tool for visually impaired people who struggle with accessing printed material in different languages.

The results of our experiments show that the system is capable of accurately recognizing and extracting text from various printed materials, translating it to Marathi language, and converting it to speech. Although there are limitations to the system's accuracy and performance, the overall results are promising and show the potential for further development and optimization.

Future work can focus on improving the system's accuracy and reliability, expanding its language capabilities, and enhancing its user interface and usability. Our system has the potential to contribute to the accessibility of printed material for visually impaired people and to improve their quality of life.

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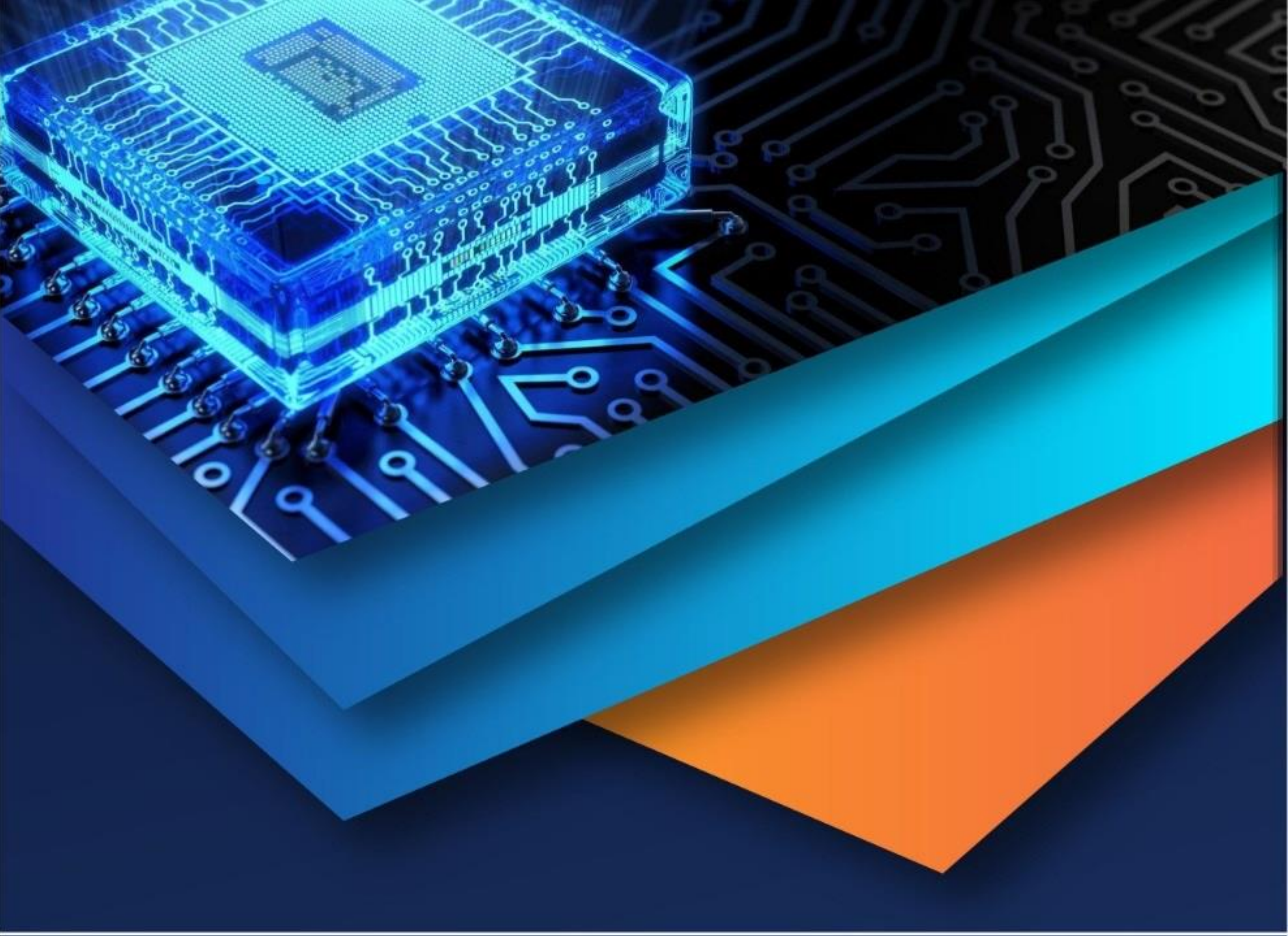

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