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Smart Reader For Blind People

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***Abstract*—We can see millions of visually impaired people overall world. According to the data on visual impairment by World Health Organization (WHO), there are 2.2 billion people are living with some kind of visual impairment while 36 million people are completely visually impaired. One of the major necessities of visually impaired people is reading. Many researchers have worked and even also working on developing a device or mechanism which will help and allow blind people to read the books, written or printed text. We proposed a system which will help the visually impaired people to read text by converting the text into voice signal based on raspberry pi. Optical Character Recognition (OCR) is a technique which can be used for detection of text from the images taken from the camera. Our proposed method is developed using raspberry pi in which we are using OCR for image to audio conversion purpose.

***Keywords*—smart reader, OCR, image processing**

Introduction:

In today's technologically advanced era, where digital solutions permeate every aspect of life, individuals with visual impairments face persistent challenges in accessing printed information. According to the World Health Organization (WHO), approximately 2.2 billion people worldwide experience vision impairment or blindness, with 1 billion of them having conditions that could have been prevented or have yet to be addressed. Among these individuals, access to written material remains a significant barrier to education, employment, and social inclusion.

Traditional methods of accessing printed content, such as Braille or audio recordings, have limitations in terms of availability, cost, and convenience. Moreover, a study by the National Federation of the Blind (NFB) revealed that less than 10% of printed materials are available in accessible formats for individuals with visual impairments. This glaring disparity underscores the urgent need for innovative solutions that bridge the gap between printed text and auditory information.

Recognizing this imperative, our engineering mega project group has embarked on the development of a "Smart Reader for Blind People" This project aims to harness the power of Raspberry pi technology to provide a transformative solution for individuals with visual impairments. By converting printed text into audible speech in real-time, the smart reader offers a practical and efficient means of accessing written content independently.

The significance of this project is underscored by the growing demand for assistive technologies worldwide. According to a report by Grand View Research, the global market for assistive devices for visually impaired individuals was valued at USD 5.2 billion in 2020 and is projected to reach USD 9.9 billion by 2027, driven by technological advancements and increasing awareness of accessibility issues.

In this context, the development of a smart reader represents a crucial step towards addressing the unmet needs of individuals with visual impairments. By leveraging Raspberry pi capabilities, optical character recognition (OCR) technology, and text-to-speech (TTS) algorithms, the device offers a user-friendly interface for accessing printed materials in real-time. Through seamless integration and intuitive design, our aim is to empower blind users to navigate and comprehend written content with greater independence and efficiency.

In this introduction, we have highlighted the pressing challenges faced by individuals with visual impairments in accessing printed text, supported by relevant facts and figures from reputable sources. We have also outlined the objectives and scope of our research, emphasizing the potential impact of developing a practical and effective solution for blind readers. Moving forward, the subsequent sections of this paper will delve into the technical aspects of the smart reader design, the implementation process, and the evaluation of its functionality and usability. Through collaborative effort and innovative thinking, we aspire to make meaningful contributions to the field of assistive technology and improve the lives of individuals with visual impairments.

Literature View:

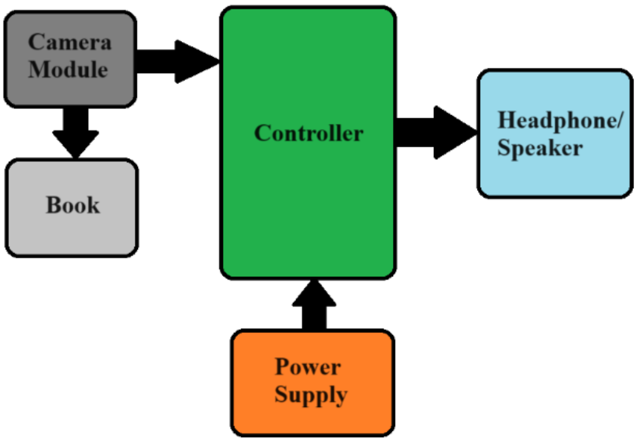
TTS systems have seen remarkable progress, with the development of neural TTS models. These models generate more natural-sounding speech. Waveform synthesis methods like WaveNet and Tacotron have improved the quality of synthesized speech by capturing prosody and intonation. Prosody modelling in TTS has been a focus, aiming to make synthetic voices more expressive and human-like. Multilingual and multi-speaker TTS models have emerged, enabling diverse applications of image-to-text-to-speech systems.[1]

The integration of OCR and TTS is often used in applications for visually impaired individuals, where text from images is converted into speech. Research on seamless transitions from image to text and then to sound, preserving context and meaning, has been explored. End-to-end deep learning approaches that combine OCR and TTS within a single model have shown promise for efficiency and accuracy.[2]

OCR technology has made significant advancements, includes various methods such as convolutional neural networks and recurrent neural networks being widely used. Deep learning approaches, like the use of convolutional and recurrent layers in models, have led to remarkable accuracy in text extraction from images. Transfer learning techniques, such as fine-tuning pre-trained models like Tesseract and OCR, have also improved OCR performance. Real-time OCR for images captured by mobile devices has gained attention due to its applications in augmented reality and accessibility.[3]

These technologies find applications in accessibility tools, document reading for the blind, language translation, and image-based information retrieval. In healthcare, image-to-text-to speech converters assist in reading medication labels and medical reports. Educational tools benefit from these systems for reading textbooks or providing audio descriptions for visually impaired students.

Block Diagram:



Block diagram includes all the components used in the project which includes Raspberry pi as controller of the device, a web camera module, power supply and speakers as output device. As shown camera will act as eye for the device which will capture the image and send it to the raspberry pi for the further process, raspberry pi will process the image and after all the operations the output which is audio will be sent to the speakers.

Methodology:

i. The working substantially consists of Image Processing and Voice processing system. The image processing system includes the image capturing and image to textbook conversion. The image processing can be done with the optic character recognition system. The optic character recognition is a system that captures or scans the images and has an capability to convert the image into readable or textbook format which can be reused further. The image captured with OCR can be of any resolution. The image processing system includes capturing of stationary image with the help of camera. The camera works as an eye for the jeer pi. The camera can be connected to the jeer- pi with the help of Cable. We've used a web camera to capture the image. After the successful connection the image can be captured with the help of tesseract OCR software. We can use tesseract OCR which is jeer pi compatible and can understand primarily English language. The teserract- ocr is library and is open source. The Tesseract- ocr is command line OCR which captures the image on the press of button. The image can be saved in. jpeg or. png format. With the help of tesseract OCR library of python, the captured image is converted to the textbook format in the jeer pi and saved with the same name as an image. The converted textbook is handed to TTS system which converts the textbook to the voice format. In this step, the inbuilt camera captures the images of the textbook. The quality of the image captured depends on the camera used. Image Preprocessing Before factual birth of textbook from image we need to preprocess the captured image first to enhance the quality of the image and also it'll be helpful to get proper birth of textbook. Image preprocessing can includes conforming the brilliance, intensity and contras of the captured image.

ii. Binarization Binarization can be called as converting image into only black and white color. Every single pixel in the image is converted to either black or white. The thing is to make clear which pixels belong to textbook and which pixels belong to the background, which speeds up the factual OCR process.

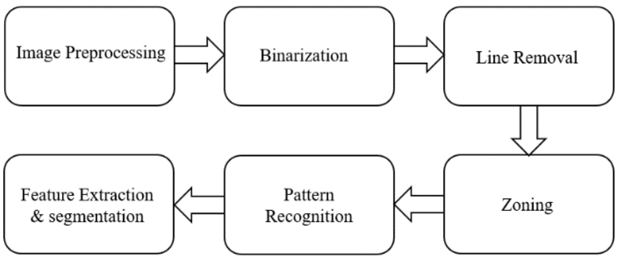
iii. Line junking It simply includes junking of gratuitous lines which aren't part of the textbook. Identifies all lines and markings that probably are n't characters, also removes them so the factual OCR process does not get confused. It's especially important when surveying documents with tables and boxes.

iv. Zoning It includes separating the image into zones. Separates the image into distinct gobbets of textbook, similar as relating columns inmulti-column documents. The image is separated into zones so that the image can be read in proper sequence.

v. Pattern Recognition In this step the identification of the factual reading pattern of the rulings is done.

vi. point birth and Segmentation This is the step in which factual textbook get uprooted from the image. Segmentation of each letter in the judgment is done and after comparing with the libraries each word is honored letter by letter and the textbook from the image is get uprooted.

1) Image Processing:



2) Voice Processing:

i. Voice Processing In this system our main end to convert attained textbook to speech with the help of rendering in jeer pi using textbook to speech(TTS) synthesizer. The textbook to speech synthesizer is installed in jeer pi. The affair can be heeded through audio speakers Text train creation After completing the all way of image processing, textbook train having extension. txt is created using tesseract OCR. This textbook is saved in the memory of the jeer pi and further it'll be given as input to the TTS machine which is formerly present in jeer pi.

ii. TTS Engine TTS machine which is formerly present in the jeer pi will take textbook train input and will convert that train into audio train by following the way given to it.

iii. Voice birth After TTS machine operation audio train is ready, now voice from audio train can be uprooted from the headphone jack of the jeer pi and we will get the final affair.

Requirements:

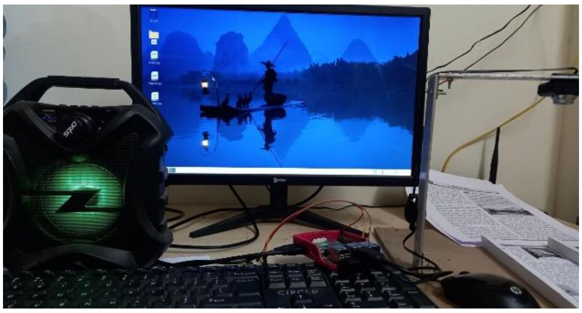
1) Raspberry Pi 4: The Raspberry Pi is the central computing unit of the project. It serves as the brain that process data, controls other components, and manages the overall functionality of the smart reader.

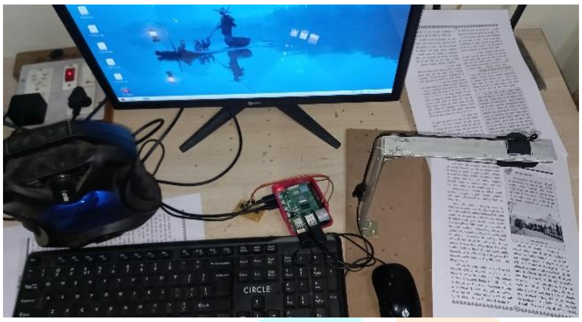
2) Camera Module: The camera module is a crucial input component. It captures image of text documents, books or other printed materials. These images are then processed for text extraction using Optical Character Recognition (OCR) software.

3) Earphones/Speakers: Speakers are the audio output component of the smart reader. They are used to convert text to audio/speech, enabling visually impaired users to hear the content read aloud.

4) Tesseract OCR software: Tesseract OCR is software that performs Optical Character Recognition. It is responsible for recognizing and converting the text present in the image captured by the camera module into machine readable text data.

Results and Model Images :





Conclusion:

In conclusion, the development of a smart reader for blind individuals represents a significant step towards enhancing accessibility and independence for the visually impaired community. Through innovative engineering and technological advancements, we have created a device that empowers users to access printed text in various formats, enabling them to engage more fully with the world around them. In this project, we have involved main to processes which are image processing and voice processing. both processings consists various procedures.

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