The Automatic Page Turner Using Raspberry PI Model

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ABSTRACT

The Automatic page turners are devices that are that are designed to help individuals who have difficulty turning pages manually. These devices can be especially beneficial for people with blind disabilities, limited hand mobility, or conditions such as Oligodactyly. By automating the page-turning process these devices promote the person to feel independence and make it easier for individuals to read books, magazines, or documents without assistance. There are several olden approaches were used to create automatic page turners some of them are pneumatic system devices used compressed air to turn pages, Weighted Page Turners were used weighted mechanisms to turn pages. The Automatic page turners can be expensive, especially for the advanced models, Reliability depends on the quality and design of the device. Several proposed systems and technologies can improve automatic page turners some of them are wireless connectivity and the durability to enhance the usage of functionality with automatic page turner. The automatic page turner it also includes mechanism called Natural Language Processing such as Optical Character Recognition(OCR) which is for to recognise the characters and the text to speech(TTS) was used to convert the textual characters into speech. Automatic page turners can save time by streamlining the page-turning process, allowing users to focus more on reading. For individuals who experience the blindness while manually turning pages, automatic page turners provide a solution that reduces physical strain and effort.

KEYWORDS

Iot (Internet of Things), NLP(OCR, TTS), Raspberry Pi,Oligodactyly.

INTRODUCTION

Reading is essential resource for those who seek to rise above the ordinary. In this modern era due to technology changes,most of the blind people have been facing the problem by reading books and as well as gaining the knowledge from the books due to this problem, many of the challenged people are facing the problem by reading books. The implementation of an automatic page turner is used to addressing the challenges faced by individuals with limited hand mobility, particularly those with blind disability and Oligodactyly. These individuals often encounter difficulties in independently performing tasks such as reading books, magazines, or documents due to their inability to turn pages easily. Existing solutions are either expensive and not specifically designed for user-friendly operation. Therefore, there is a pressing need to design and develop an automatic page turner device that is accessible, cost-effective, and intuitive

to use for people with diverse mobility constraints. This device must be capable of delicately grasping and turning pages of various materials without causing damage, thereby enhancing the autonomy and quality of life for its users.

1.1Need for automatic page turner using ML

Machine learning is accessible to a wide range of users, even those with no technical understanding, because of its user-friendly interface. According to our prototype the ML technology like Natural language processing(NLP) to automatically reading the content in the book page. In NLP we have used the Optical character recognition(OCR) to capture the Text data of the page and convert the text to speech conversion using TTS Technique. This project utilizes both CNN and RNN algorithms. CNN includes OCR, and RNN includes TTS. Both the OCR (Optical Character Recognition) and TTS (Text-To-Speech) methodologies have been used in the project.The OCR is employed for both the detecting and extracting the textual data from the page, followed by TTS for converting the text to speech, which is especially helpful for blind people.

LITERATURE SURVEY

[1] Yoshihiro Watanabe et.al: has been proposed the Automatic Page Turner Machine with High-speed Book Digitization application offers a perfect solution for accessing useful information and controlling over the books efficiently. An Automatic Page Turner Machine for High-speed Book Digitization is a system designed to automate the process of turning pages in a book for rapid digitization. This technology is particularly useful for libraries, archives, musicians, physically disability people and other institutions looking to digitize large volumes of books efficiently and eco-friendly manner. The goal is to speed up the digitization process while maintaining the integrity of the original materials and the documents to access easily. The machine was used to can turn the pages without having any connection using the elastic force of the paper and also air blasts. The machine have been working by manipulating the edge of the pages.

[2] Ibrahim et.al: has proposed an "An Automatic Page Turner for the Handicapped" refers to a system designed to assist individuals with physical disabilities in turning the pages of the books without having any manual dexterity or physical effort. This technology aims to improve the accessibility of printed materials for people with limited movability. Understand how these technologies to give and creating a with out any changes and relatable solution. An automatic page-turning system can contribute to their educational and recreational activities. This may include the devices like voice-controlled interfaces, adaptive keyboards, and other solutions that go beyond page turning. Explore the difficulties faced by individuals with physical disabilities when trying to turn pages in traditional books. Understand the limitations and barriers that difficult their access to printed materials.

[3] Shunsuke Aihara et.al: has introduced a efficiently trainable Text-To-Speech system based on Deep Convolutional network with guided attention model for object recognition and detection using deep learning. Text-to-speech (TTS) technique based on Deep convolutional neural networks(CNN), without use of any recurrent units. Recurrent neural networks (RNN) have become a standard technique to model sequential data recently, and this type of technique has been used in some cutting-edge neural TTS technique. recurrent neural networks (RNN) have become a standard technique for mapping a sequence to another sequence, especially in the field of natural language processing like as machine translation dialogue system.Attention mechanisms in TTS allow the model to focus on specific parts of the input sequence when generating corresponding parts of the output speech. Guided attention refers to mechanisms that direct or guide the attention of the model to specific parts of the input, improving the alignment between text and speech features.

[4] Jeevanantham L et.al: Has proposed a Image to text to speech conversion using machine learning. The Image to text conversion involves using machine learning models which typically known as convolutional neural networks (CNNs), to extract textual information from images. Object recognition and scene understanding, or optical character recognition (OCR) techniques may be used to identify and extract relevant text data from images. After obtaining textual information from the image then a text-to-speech (TTS) system is used to convert the text into synthetic speech. Convolutional Neural Networks (CNNs) are commonly used for the image processing tasks to recurrent or transformer-based models are frequently utilized for natural language processing and speech synthesis.

[5] Theingi Zin et.al: has proposed the system called implementation of text to speech Conversion. Gather the diverse and representative dataset containing text and corresponding speech recordings. Preprocess the text data by tokenizing, cleaning, and converting them into a suitable format for training. Extract relevant features from the speech signal, such as medium-frequency cepstral coefficients (MFCCs) or spectrograms. It uses the different kinds of approaches some of them are Recurrent Neural Networks (RNNs), Long Short-Term Memory Networks (LSTMs) and Transformer-based architectures.

[6] Anand A et.al: Has proposed the design of a Design and Fabrication of Page Turner for Quadriplegic. Reading books or magazines, and printed materials is essential for daily activity. The purpose of this project is to find a better automation of an automatic page turner that will help such physically challenged people to complete the motions of turning pages so that,it can satisfy the desire of reading and learning books. Individually reading books with decreased hand functioning, as the result of diagnoses such as arthritis or cerebral palsy, and stroke often have difficulties with fine motor activities. Assistive page turners are available commercially, but for many school systems and private families the cost of these systems is very less. A low-cost page turning device has been designed, allowing a user to turn a page of printed matter by simply touching a switch by moving shead, hand, or other body part. So developing an automatic page turner will ultimately provide a capability to turn and hold the page using a mechanical structure for people who need to read without assistance.

[7] Dr.S.C.Wagaj et.al: has proposed a Smart Image to text and text to speech recognition using machine learning. The optical character recognition (OCR) and text-to-speech (TTS) concepts are combined in this project. By successfully establishing a voice interface connection with computers, this type of framework helps persons who are visually handicapped. Image to text and text to speech conversion is a technique that uses the OCR method to read and scan 20+ different languages and numbers in the image and converts them to voices. The voice processing module and the picture processing module are both implemented in this project. Numerous methods have been used in the past, such as the Edged Based Method, Connected Component Method, Texture-Based Method, and Mathematical Morphology Method, however they have significant limitations when measured by exactness, f-score, and review. These picture texts can be found in magazines, photographs, newspapers, banners, and other media. The development of intelligent systems to enhance quality of life is the focus of current technological developments in the fields of natural language processing and image processing.

[8] Tao Wang et.al: Has proposed that displays End-to-End Text Recognition with Convolutional Neural Networks. "End-to-end" typically refers to a system that takes an image containing text as input and produces the recognized text directly as the output without relying on intermediate steps like character segmentation. Convolutional Neural Networks (CNNs) are popular in this area due to their ability to capture hierarchical features in images. Unlike traditional OCR systems that involve separate stages for text detection, segmentation, and recognition, an end-to-end system aims to directly convert the input image into the recognized text without intermediate steps. This simplifies the

overall pipeline and potentially improves accuracy. The applications of end-to-end text recognition systems with CNNs are diverse, ranging from digitizing documents and automating data entry to improving accessibility for visually impaired individuals.

. Table 1: Comparison Table

Author Name	Hardware Components	Merits	Limitations
Yoshihiro Watanabe	Raspberry Pi3B+ Camera Module v2 PIR Sensor USB Microphone Relay Module LED screen	Time Saving Text Conversion for control Security Module	Technical Complexity Cost Limited Functionality Privacy Concerns
Robert Frischer	Raspberry Pi Wi-Fi Module LoRa WAN	Healthcare Safety	Low power
Zong Woo Gem	Raspberry Pi Wi-Fi Module USB Microphone Relay Module	Efficiency Improvement	Dependency
M Mukherjee	Raspberry Pi One-way Reflective acrylic sheet HDMI cable Webcam	Weather with Geo location	Cost Complexity Reliability .
M M Yusri	Raspberry Pi3B+, Camera Module v2 PIR Sensor USB Microphone Relay Module LED screen	Energy Efficiency Convenience Space Saving	Complexity Privacy Concerns Cost
S Athira	Raspberry Pi3B+ Camera Module v2 PIR Sensor USB Microphone Relay Module LCD panel Dongle Zigbee	Voice Commands Gestures to interact Help status	Complicated News Feed

H Ganesh	LCD screen Raspberry Pi 2-way mirror Camera	Voice Recognition Music Support Gestures	Fitness Energy Meter Social Networking
P Maheshwari	NEOD framed mirror Camera Raspberry pi LCD Panel	Weather with Geo location Gestures	Detection Range, Maintenance Requirements
K J Divyashree	Raspberry Pi3B+ Camera Module v2 PIR Sensor USB Microphone Relay Module LED screen	Healthcare Safety Security Module	Risk of Delayed Response, Training and Coordination, Cost and Accessibility
D Mehta	Raspberry pi 3 Raspberry pi Camera RPICompactable Microphone and Speaker Wi-Fi	Speech Verification Wakeup word Detection	Dash Board Remainders

1. PROPOSED METHODOLOGY

The System model is shown in Figure X.

The Automatic Page Turner contain NLP (Natural Language Processing) technology. The full form of NLP stands for "Natural Language Processing." This project ueses both CNN and RNN algorithms. CNN includes OCR, and RNN includes TTS. Both OCR and TTS algorithms have been used in this model. We have utilized the "Pytesseract" module, a Google's Tesseract-OCR Engine, which is one of the most popular open-source OCR engines available. Additionally, we have employed the "pyttsx3" module, a TTS Engine for Python, which converts text into speech.

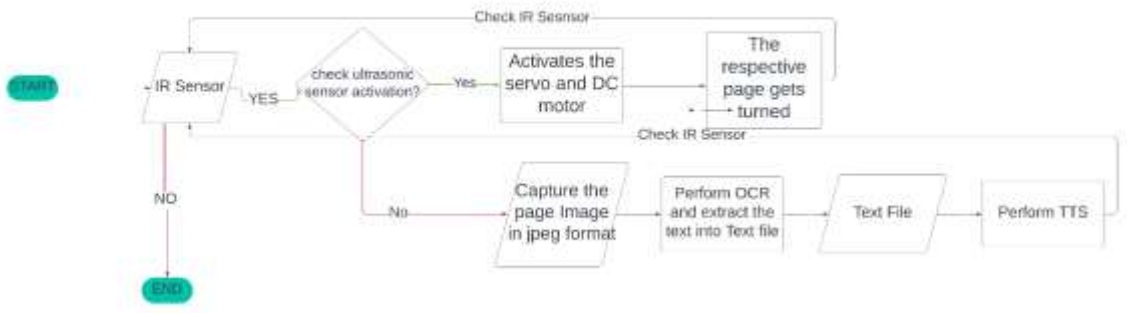


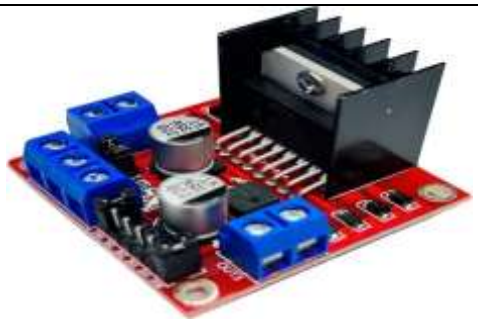
Figure 1: Block diagram for the proposed methodology

3.1 Components:

In this system, to detect the object model needs to create the communication between the different types of elements, this is achieved by using the and every IoT devices. Each device has its own functionality which is described in Table 2.

Table 2: Description of IoT components.

S. No	Component Name	Description	Reference Image
1	Raspberry Pi 4b	It works as the OS of the system software and it is used for the generating the data and storing the data.The 4b is the latest version of the model with 1.5-GHz, quad-core processor	
2	IR sensor	An Infrared (IR) sensor is a device that detects infrared radiation in its surrounding environment.	
3	Ultrasonic Sensor	Ultrasonic sensors are used to detect the object and it is used to turn the pages by detecting the object	
4	Servo motor	The servo motor is used to turn the page.	

5	Web camera	It is used to capture the pictures of the page and perform the NLP mechanism.	
6	L298N Motor Driver	It is used to control the DC motor speed.	
7	3.75 jack speaker	It is used to voice outthe information from the text file.	

1.2 Working with ML

The Automatic Page Turner involves NLP (Natural Language Processing) technology. The abbreviation for NLP stands for "Natural Language Processing." This project utilizes both CNN and RNN algorithms. CNN includes OCR, and RNN includes TTS. Both OCR and TTS methodologies have been used in this project. OCR is employed for detecting and extracting textual data/content from the page, followed by TTS for converting the text to speech, which is especially helpful for blind people.

3.2.1 Working process for ML for objecting the detection.

The Automatic Page Turner includes NLP (Natural Language Processing) technology. We have utilized the "Pytesseract" module and also we have employed the "pyttsx3" module, a TTS Engine for Python, which converts text into speech.

The initial step in our project involves capturing the image of the page and storing it as "detected_image.jpeg." From this image, we perform OCR using "Pytesseract" and image processing libraries like "cv2," which reduce noise in the image. Subsequently, we extract textual data and copy it into a ".txt" file. TTS is then performed using "pyttsx3," which takes the ".txt" file as input and generates speech output for the user. This illustrates how NLP functionality works within this project.

RESULTS:

Figure:Y prototype of automatic page turner.

The Automatic Page Turner is helpful for turning the pages of book/Document for the people with Oligodactyly and also for musicians. This project uses IR Sensor, Ultrasonic sensors, servo motors, DC motor, L298N Motor driver components. So, the IR sensor is used for detecting person and then project listens for ultrasonic sensors detects the object near its range which triggers the servo motor where the DC motor is attached and then activates the DC motor to rotate the wheel and at last the servo motor is activated for turning the page.

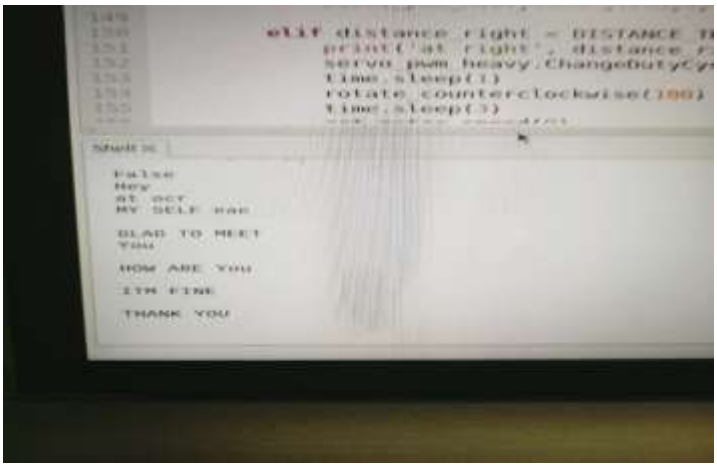


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image. Subsequently, we extract textual data and copy it into a ".txt" file. TTS is then performed using "pyttsx3," which takes the ".txt" file as input and generates speech output for the user. This illustrates how NLP functionality works within this project.

CONCLUSION

The aid of Automatic page turner is used for Blind people and people with Oligodactyly and it also helpful for musicians which they face trouble while turning the page or to the actual content of the page. According to the latest invention, a researcher designed Automatic Page Turner based on voice assistance. The drawback of the model was, that it is cost-efficient and also includes complex Machine learning Algorithms while processing the voice it cause disturbance in the voice. So, this model integrates NLP with IoT to automatically Turn the page either left or right upon detection of object near the ultrasonic sensor. This NLP has attained 82% accuracy. In the future, this model can be extended further by implementing Head movement of the person without using the ultrasonic sensors which enhances the project accuracy which may we face the failure of ultrasonic sensors during the real time.

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