



# SURVEY ON "HOW AI CAN HELP VISUALLY CHALLENGED PEOPLE IN READING"

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## ABSTRACT

There are millions of individuals throughout the globe who struggle with their vision. The World Health Organization (WHO) has published data on visual impairment, which show that 36 million people worldwide are completely blind and that 1.3 billion people worldwide have some kind of visual impairment. For those who are visually impaired, reading is one of the most crucial abilities to possess. Many experts have focused a great deal of their research on how blind people may recognise barriers, read labels or specific currencies, and analyse information that has been written, typed, or printed. Using optical character recognition (OCR) and smart technology in combination with artificial intelligence and deep learning, we investigated different methods for assisting visually impaired people who want to read. These methods are discussed in detail in the article.

**Keywords:** Visually Impaired, Artificial Intelligence, Smart System, OCR, Voice Assistant

**DOI Number:** 10.48047/NQ.2023.21.2.NQ23034

**Neuroquantology 2023; 21(2):297-307**

## 1 Introduction

People suffering from vision loss seek support to do everyday tasks like moving around and navigating surroundings successfully. Though others could provide assistance with this but that is not possible every time. The World Health Organization's most current statistics [1] show that over 253 million people worldwide have some kind of vision impairment. 36 million of these people are completely blind, while 217 million have some degree of vision impairment. This problem is becoming worse since the number of individuals who are blind or visually impaired is increasing by 2 million every ten years[2]. According to one prediction, the number of persons who are blind might potentially treble in upcoming years. Blindness is a disease that refers to a lack of discernment and is caused by an imbalance in either the physiological or neurological components of the body.

Blindness is still a significant problem despite the many advances that have been made in technology[3]. Researchers have been concentrating their efforts on this topic in order to provide helpful tools or aides for those who are visually impaired[4].

There are lot of challenges that are faced by those with visual impairment. A person who is blind will never know what it's like to see and experience the world like those who does not have this problem. The problem of visibility is a "black dot" that affects billions of people worldwide[5].Using artificial intelligence and machine learning, our goal is to get rid of this black dot.

The problems faced by an individual with vision impairment are:

- i) The routine tasks
- (ii) Verbal, written, and nonverbal communication
- iii) A projected depiction of the area's size and displacement
- iv) It takes a lot of concentration and



endurance to watch an activity for an extended amount of time. Currently existing technology reads e-books aloud to blind or visually impaired people using a mobile application using speech synthesis. In addition, the technology turns the printed or digital versions of the books into audible texts using Text-to-Speech and natural language. The system's incompatibility with other languages and limited functionality in English are its greatest flaws. Thus, it requires an internet connection in order to offer feedback or a response, and it is unable to operate without one[7].

## 2 Related Work

[8]A mobile application that has a clear focus on voice assistant, image recognition, money identification, etc. makes the research idea of the authors concrete. The application may also assist users by identifying objects in everyday life using voice commands and by doing text analysis on hard copy documents to identify text. For those who are blind or visually handicapped, using technology to interact with the outside world and use its possibilities will be a fruitful strategy.

[9] The author addressed the notion that voice assistant, image recognition, currency recognition, e-books, chat bots, and other features would be included into Android mobile apps. In addition to using text analysis to assist you in reading text in a hard copy document, the programme may utilise voice commands to assist you in identifying adjacent objects. It may be an effective way for blind people to interact with others and may encourage their independence.

[10] On the second possible choice, the author provided an outline. The suggested solution's goal is to provide a programme for visually impaired people that can take voice and text commands from the user and perform the necessary tasks. The JAVA programming language is used to construct the application, which is then built on the open-source Android Studio platform.

[11]The author described how images can include crucial textual information that the user would want to change or keep digitally. Tesseract OCR Engine's Optical Character Recognition may be used for this. Artificial

intelligence technology called OCR is used in applications to extract text from scanned documents or photos. To enable persons who are blindhear the information they need to know, the detected text may also be converted to audio format.

[12] The finger-worn Chinese Finger Reader allows people with visual impairments to read traditional Chinese characters that are stored on a tiny internet of things (IoT) processor. The device is portable and easy to use, and it may be worn on the index finger. The Chinese Finger Reader on the index finger features buttons and a small camera. The small camera calculates the distance between the user's index finger and the text before taking a photo. Blind persons may request photographs by clicking the buttons, and a voice prompt will play the audio output of the appropriate Chinese character. To discriminate between Chinese characters, English letters, and numerals, a robust Chinese optical character recognition (OCR) system was developed utilising the training approach of an improved convolution neural network algorithm.

## 3 Use of Artificial intelligence

Blind people have several challenges in everyday life, such as difficulty reading and crossing the street. Although they have a variety of tools at their disposal to assist people with their difficulties, they are not enough. The most fundamental human ability is vision, and whether or not someone can see has a significant impact on their existence. Even for regular everyday tasks, a person who is vision impaired needs assistance[13].

Moving about without adequate aid or guidance from others is very difficult for those who are suffering from vision problems. So it's obligatory to provide a convenient tool to help them. An effective method, such as an advanced system, is recommended as a remedy for these folks. Image classification is a method for obtaining the data input required by machine learning algorithms. Cameras are used to take pictures of the things in the proximity that surrounds a blind person's immediate area. When set to a certain distance, it may pinpoint the location of any and all objects within that range. The

data is turned into an audible signal so that visually impaired person may use it easily. Machine Learning has gained attention since the introduction of high computing machines and the availability of huge amount of data also known as big data. Today, machine learning is used in many types of industries from medical image processing to autonomous car. Recent advances in this field have allowed computers to not only recognise things in a picture, but also to construct bounding boxes around those items. Computer vision is another name for this. It suggests that one can use machine learning techniques for computer vision with the goal of assisting the visually handicapped and the blind. The article further describes the process of training a convolutional neural network using the ImageNet dataset to perform object detection and narration for the visually

#### System [A]

- Using cloud vision API

impaired. Camera-equipped gadgets including desktops, laptops, tablets, and smartphones are all compatible with this setup.

One of the biggest difficulties of object detection is that an object viewed from different angles may look completely different. Accuracy, illumination, numerous hardware configurations for visually impaired and the surroundings, lengthy processing time, complicated outputs, poor performance, high cost, etc., are all issues that plague the current systems. Blind person also has restrictions when it comes to moving around. There is a high risk of injuries. These people further suffer from cognitive disabilities and poor mental health.

Different Systems that are developed to assist blind people in reading are discussed in the upcoming section.

#### Modules

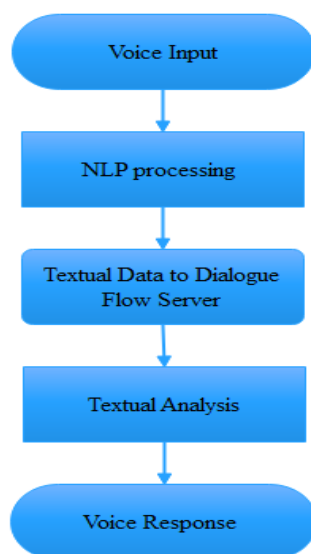


Figure 1 Flowchart of Chat Bot

Everyone is aware of how crucial good eyesight is. If a person is unable to see, they have a sense of being incomplete within them. Also, life in modern society has a significant number of obstacles for them to overcome[15]. Artificial intelligence and machine learning have been used by researchers in an attempt to identify answers to some of the problems faced by people with visual impairments. Users of the Dialog-Flow platform may create interactions that are

both natural and conversation-rich[16]. As seen in "Fig. 1," a chat-bot with a Google-like assistant will make it easier for consumers to communicate with the bot and get the right answers. A chat-bot is an interface that may take voice or text input from the user and then respond with the appropriate response. If a person wants to visit a certain area, they may ask the chatbot to guide them with a map utilising voice assistance or ask the chatbot to provide them with speech or text



directions. This can be done by the person. The chat-bot has been trained to communicate with people via the usage of the Dialog-Flow platform, which was employed in the training process. It then compares the

user-supplied keywords with the trained data before returning a response to the user. The user is responsible for providing the keywords[17].

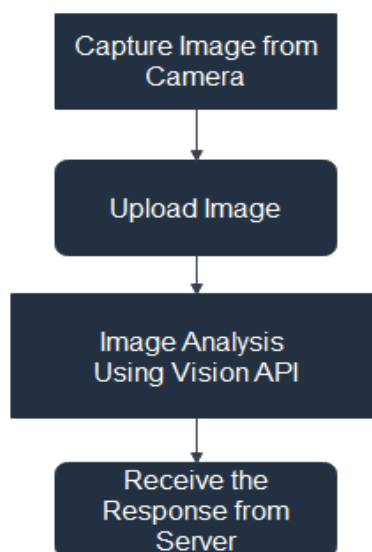


Figure 2 Working flowchart for the Vision API

The REST API is used to analyse the image provided by the Cloud Vision API, which has strong machine learning capabilities, to evaluate the gathered image. It quickly sorts pictures into several groups (such "Taj Mahal," "Deer," and "Footwear"), discovers and reads written words that are hidden in pictures, and recognises lone objects and people (as seen in "Fig. 2"). They now make a distinction between photos shot on cellphones and others. After looking at the photograph, the observations about it are addressed. In a manner similar to this, if someone snapped a photo of the Taj Mahal, the Google Vision API would analyse the image and respond by providing the information that was required, either orally or in text. The obtained images may be divided into many categories using the Google Vision API. These categories include document text detection, landmark detection, label detection, explicit content detection, image characteristics, and logo identification[18].

Using a neural network and an efficient model, one may easily interact with an application programming interface (API). The designer has the ability to convert voice input into text by using the Cloud Speech API. More than 100 different versions and dialects of the application programming interface (API) are

available for the convenience of users located all over the globe. They can read documents and comprehend the content of customers who are addressed to an application's microphone, active summon, and voice command, among many other potential uses. The aforementioned method uses the Google Cloud Speech API to translate the client's voice input into text before sending the text to WhatsApp, Message, and other related Android apps that support notifications[19].

#### Algorithm

The algorithm used to create the AI chat bot bases its response on the user's question key phrases, which are then utilized to search the training dataset and provide the appropriate result as a sound format. As part of Dialog-Flow, the algorithm is used to decide how to respond to a client's voice summon and classify that response depending on the entry component in a phrase. After that, a decision tree technique is used to search the training dataset for the key elements.

#### System [B]

- **AI Reader System**

A SMART READER is a device that, when a book is inserted, reads aloud the text with the aid of Python programmes that assist in taking



a picture of the page using a camera and turning it into text (the images on the page are automatically ignored) before turning the text into an audio file and playing it through speakers or headphones. A variety of options are available to the user, including DICTIONARY, MECHANISM, PAUSE, PLAY, RESUME, STOP, and others. User requests are taken into account while delivering the activity. As a result, the system is more interactive than self-sufficient.

The system may be stopped and started with the push of a button by the user. The system may be stopped and another button can be pressed if the user is unsure about the meaning of a word. It hears the word when the user speaks into the microphone when the button is pushed. After converting this voice to text, it looks for the definition of the

term in the question online. This string is placed in a written document after the meaning has been taken from the internet. The user may then choose to hear this material and it can be read out on a speaker or via headphones, depending on their preference. The user chooses the technique to turn the page properly and advance to the next page. As a consequence, the system gives the user the impression that they are reading a book alone, while also enabling interactive sessions that include page turning and dictionary searches.

### Block Diagram

The block diagram of the above method is given in the picture below. Raspberry Pi serves as the framework. The block diagram is made up mostly of three parts.

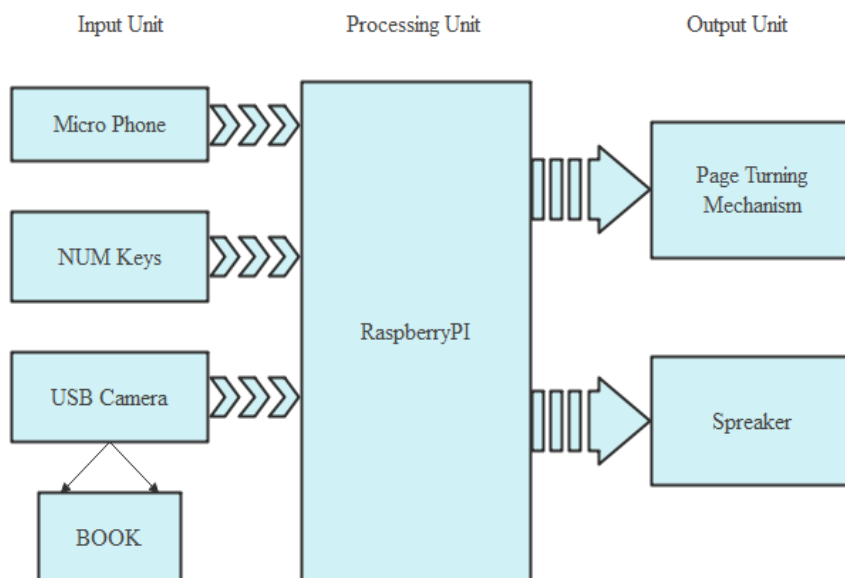


Figure 3 Block diagram of system

#### • Input unit:

A USB camera, a microphone, and interrupt buttons/NUM Keys make up the system's input device.

The main source of high-quality photos for the processing unit is a **USB camera**. It is a plug-and-play USB device that can be managed by Python's OpenCV module. It supports the USB 2.0 protocol and features a small USB connection. It often comes in cameras with resolutions of 2MP, 5MP, 8MP, 13MP, and 25MP. The converted text is more exact the better the MP, and the greater the image

quality, the more accurate the speech. It is set up at a specified height right above the page using a host stand and a clip to attach the camera to.

Using a **microphone**, an audio input device, you can convert sound impulses from speakers into electrical signals. It fulfils this transducing function using a variety of technologies, including condenser, dynamic, piezoelectric, fiber-optic, laser, MEMS, etc. It can be wireless or wired. A condenser-type analog 3.5mm jack-supported microphone

with wired connection is installed for this design.

A mechanical switch known as an **interrupt button or push button** operates by closing the switch when pushed and opening it when released. The logic for reading input is represented by this opening and closing operation. Push buttons are most often used as interrupt buttons in robotics and embedded system applications. Push button interface for the Raspberry Pi's input pin. These NUM Keys/Buttons, such as Play, Pause, Resume, and Stop, are necessary for the actions/instructions.

- **Processing unit:**

The processing unit is the brain and the soul of the task at hand. The processing platform most suited to our proposal is the Raspberry Pi 3 Model B board, which performs the roles of both a processor and a controller. It has the look and feel of a little pocket computer since it is Debian-based. It may also be used as a microcontroller because to its programmable GPIOs and other peripherals, which include SPI, I2C, UART, USB, and an SD card slot. The Raspberry Pi 3 Model B is a capable single board computer that is the size of a credit card and is appropriate for a variety of projects and applications. Compared to the first-generation Raspberry Pi, it offers 10 times quicker computing and more potent processing. It also offers wireless LAN connection, which makes it the perfect choice for robust linked designs.

A display monitor with an HDMI or VGA connector is attached to the Pi 3. If the

monitor's HDMI input port is not supported, an HDMI to VGA converter may be used to fix the issue. Plugging in the micro USB connection turns on the Pi, which then begins to boot up automatically. Once the BIOS start-up processes are finished, the pi is ready to display its GUI monitor. Additionally, we have access to its command window, which allows us to download and install all of the apps and modules. All of the Python modules, packages, etc., are very easily installed with the use of shell scripts. The Raspberry Pi supports the installation of all software modules, Python modules, image processing engines, etc.

- **Output unit:**

The Speaker/Headphone and Page turning mechanism make up the Output unit.

An electromechanical device called a **page-turning mechanism** flips a book page when the user requests it. The Roller wheel, Lifter arm, and Turner arm make up the majority of it. These make it possible for the page-turning mechanism to work properly.

A **headphone or speaker** is an output device. Electrical impulses are transformed into sound signals by it. Speaking output is heard via a speaker.

### **System Overview**

Any kind of text document may be read aloud using the smart reader for the visually impaired that is described in the approach that has been presented. The system flow and architecture are shown in the following image.



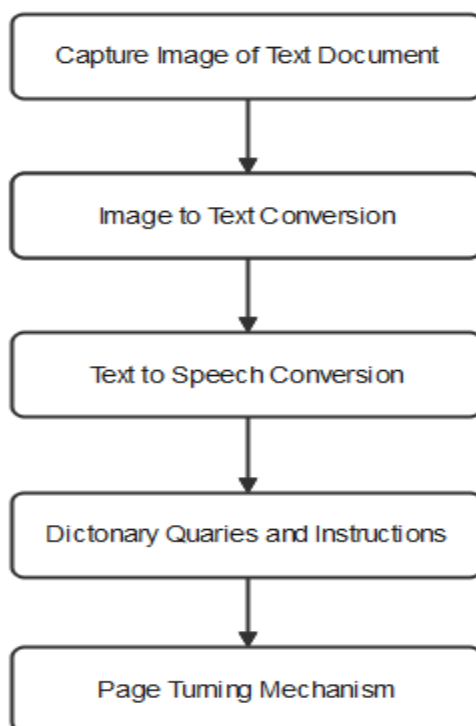


Figure 4 System Flow

The first thing that happens when you use Smart Reader is that it takes a picture of the text document. OpenCV is used to take a picture of the page of the book and then apply its built-in functions for pre-processing, such as de-skewing, noise removal, binarizing, etc., to the picture. This ensures that the picture will be of the highest possible quality when the OCR module converts the picture to text. Image Processing is going to be a theme that runs throughout this which is explained below.

#### System [C]

##### • Smart Reader System

The author has explained a Smart Reader, system that makes written material accessible to those who are blind or visually impaired by combining text-to-speech (TTS) with optical character recognition (OCR) technology. Smart Reader digitises printed documents and turns the pictures into text using a camera and OCR software. A TTS system is then used to transform the text to speech. The Smart Reader system also has a user interface for managing the device and giving updates on how the recognition process is going. The system is designed to be user-friendly and easy to use. The results of the system indicate that it is capable of providing access to printed materials with a high degree of

accuracy. The Smart Reader system has the potential to significantly improve the lives of visually impaired people by providing them with access to printed material.

##### A. Optical Character Recognition(OCR)

The technique of Optical Character Recognition (OCR) allows computers to read and interpret printed or handwritten characters. It is used for a number of purposes, including the digitization of documents, the automation of data input, and the recognition and interpretation of handwriting. OCR technology is based on computers' capacity to recognise patterns in visual data. OCR technology operates by comparing data from an input source to a database of recognised characters. For instance, a computer may compare a scanned paper to a database of all the English alphabets. After identifying characters, the computer can understand them and transform them to digital text. The quality of the input source affects optical character recognition's accuracy. The OCR method is likely to work if the input source's characters are distinct and readable. The OCR system may, however, be unable to efficiently decode the characters if they are illegible or malformed[20].



Depending on the kind of input source, optical character recognition (OCR) might be more or less accurate. For instance, the identification process could be more precise when the input source is a scanned document rather than a handwritten one. In addition, the technique may be more accurate for some sorts of characters, such as those in the Latin alphabet. OCR technology may also be used to identify photos and other information in addition to text. OCR technology may be used, for instance, to decode barcodes, which are extensively employed in retail businesses. Signatures, which are essential for financial transactions, may also be interpreted using OCR technology[21].

The OCR technique has several uses. Numerous businesses, including finance, healthcare, and law enforcement, use it. OCR technology is used in the banking sector to identify and interpret checks and other

financial documents. It is also used in healthcare to identify medical records and other patient information and by law enforcement to identify licence plates. OCR technology is also used in several educational and recreational settings. In educational applications, such as handwriting recognition for youngsters, for instance, it is utilised to identify handwriting. Additionally, OCR technology is used to decipher puzzles such as Sudoku and Crosswords.

Overall, OCR technology is a potent computer tool for recognising and interpreting printed and handwritten characters. It has several uses, including banking, healthcare, and law enforcement. Additionally, it has several educational and recreational purposes. With its extensive variety of applications, OCR technology will continue to increase in significance in the future.

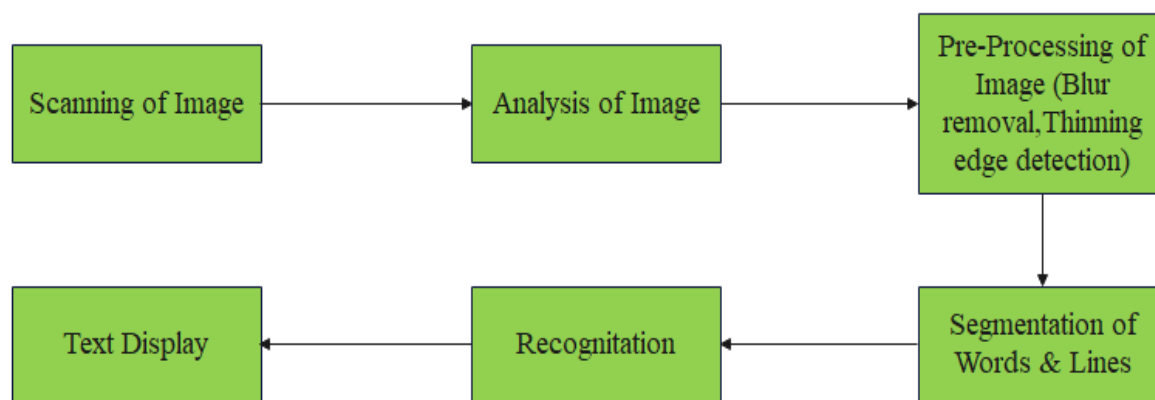


Figure 5 flow of image to display

### B. Text-to-Speech:

A technique known as text-to-voice (TTS) transforms written text into speech that sounds natural. It is used to improve the user experience of a variety of digital goods, including as virtual and augmented reality (VR/AR) apps, gaming, and web surfing. Using text-to-speech (TTS), users may listen to content without having to read it by having text spoken aloud to them. People who read in a foreign language or who have visual

problems may find this to be very beneficial. Natural language processing, speech synthesis, and audio production are used to make TTS work. Natural language processing is used to extract phonemes, syllables, and words from the text. A synthesiser may then read the text aloud after being converted into that format. Last but not least, audio production techniques are used to create a voice that sounds authentic.



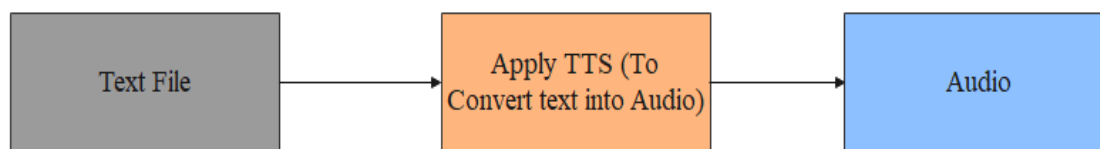


Figure 6 flow of text to audio

TTS is gaining more and more popularity, and now even tech giants like Google, Apple, and Amazon are providing their own versions of the service. These services enable the creation of podcasts, audiobooks, and even interactive voice assistants. TTS is also used to enhance the customer experience for consumers with visual impairments and to make websites and apps more accessible to persons with disabilities. TTS is used to provide a more natural and engaging experience for users, in addition to enhancing the user experience. Many businesses, for instance, use TTS to develop interactive customer support experiences. Using TTS, a chatbot for customer care, for instance, may give clients with an engaging and customised experience. TTS is a robust and adaptable technology that is revolutionising the way we engage with digital goods. It may be utilised to provide an accessible user experience as well as more engaging and personalized user experiences. TTS is rapidly becoming a need for all digital products.

#### 4 Conclusion

The majority of quickly emerging technologies are those using artificial intelligence and machine learning. These technological advancements are crucial to progress. They made an attempt to employ this technology for blind individuals so that they might live regular, autonomous lives. Friendly conversation with the bot that can identify surroundings and items, recognise different currencies to facilitate payments and can perform text identification and analysis. If the suggested system is finished, it will provide a better aid to visually impaired persons.

AI Reader for Blind People on the other hand involves the creation and implementation of a functional model. It offers an autonomous page turning mechanism and interactive dictionary querying functions. This will ultimately give them a sense of comfort. After being installed and configured, it is possible

for the system to function as the user's ideal personal device. Even on a smaller scale, the technology has uses in places like schools and libraries, among other places.

The Smart Reader is a device that uses optical character recognition (OCR) and text-to-speech (TTS) technology to make printed material accessible to those with visual impairments. Smart Reader takes pictures of printed materials using a camera and then turns the pictures into text using an OCR technology. A TTS system is then used to transform the text to speech. The Smart Reader system also has a user interface for managing the device and giving updates on how the recognition process is going. The system is designed to be simple to use and user-friendly. The findings show that it can accurately and efficiently provide access to printed content. The Smart Reader gadget has the potential to significantly improve the lives of persons who are blind or visually impaired by providing access to printed documents.

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