



# AUTOMATIC READER FOR BLIND PEOPLE USING RASPBERRY PI

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**Abstract:** Visually impaired people often find it difficult to read everyday printed materials like books, newspapers, or documents. To address this problem, we built a simple and affordable automatic reading system using a Raspberry Pi 3 Model B, a 5MP camera, basic speakers with a 3.5 mm jack, and a standard 5V power supply. The entire setup is compact and easy to carry, making it practical for daily use.

The way it works is quite straightforward. The camera captures an image of the printed text, and then Optical Character Recognition (OCR) is used to extract the words from that image. Before running OCR, we apply a few basic image processing steps such as noise reduction, converting the image to grayscale, and thresholding. These steps help improve accuracy, especially when the text is clear and the lighting is good.

Once the text is recognized, it is passed to a Text-to-Speech (TTS) engine, which converts it into audio. The output is then played through the speakers, allowing users to hear the content almost instantly.

Our main goal was to keep the system low-cost, portable, and easy to use. It doesn't require any technical expertise—users simply need to point the camera at the text and let the system do the rest. During testing, the device performed well under good lighting conditions with clear and properly aligned text. However, we noticed that performance drops when the lighting is poor or when the text is blurry or curved, which is something we plan to improve in the future.

Overall, this project shows that by combining affordable hardware with simple image processing and speech technologies, it's possible to create practical reading aids for visually impaired individuals. Such solutions can help improve independence and make access to information much easier in everyday life.

**Keywords:** Raspberry Pi 3, Smart Reader, Optical Character Recognition (OCR), Text-to-Speech (TTS), Assistive Technology, Pi Camera, USB Speakers, Image Processing, Visually Impaired.

## I. INTRODUCTION

Assistive technology is becoming increasingly important in helping people with visual impairments lead more independent and fulfilling lives, especially when it comes to accessing printed text, which remains largely designed for sighted users in the form of books, newspapers, official documents, and study materials.

While Braille has long served as a useful solution, it has notable limitations, including limited availability of materials and the time and effort required to learn it, and relying on others to read aloud can feel inconvenient, reduce privacy, and limit independence. With advancements in embedded systems, image processing, and artificial intelligence, more practical and accessible solutions are now possible, such as an automatic reader system that can scan printed text and convert it into speech. Affordable devices like the Raspberry Pi 3 Model B make it feasible to develop such systems at a low cost, thanks to their compact size, low power consumption, and sufficient processing capabilities for real-time applications. The system operates by capturing an image of the text using a camera, enhancing it for clarity, extracting the text through Optical Character Recognition (OCR), and then converting it into audio using a Text-to-Speech (TTS) engine, allowing users to listen instead of read. Because this process occurs quickly, the device is easy and natural to use, and its portability and affordability make it particularly beneficial for students and professionals with visual impairments, especially in developing countries where advanced assistive technologies may be too expensive. This project focuses on designing and implementing such a system using a Raspberry Pi 3 Model B, along with a 5MP camera, speakers, and a reliable power source, with the aim of delivering an accurate, efficient, and user-friendly solution for converting printed text into speech, ultimately empowering visually impaired individuals with greater independence, improved access to information, and increased inclusion in education, work, and everyday life.

## LITERATURE REVIEW

Over the years, many researchers have worked on developing technologies that help visually impaired people read printed materials more easily. One of the most common and effective approaches is combining a Raspberry Pi with Optical Character Recognition (OCR) and Text-to-Speech (TTS). This setup allows printed text to be captured, converted into digital form, and then read out loud.

One of the earlier works in this area was done by Thiagarajan et al. (2018). They built a system using a Raspberry Pi and a camera to capture images of printed text. The image was then processed using OCR to extract the text, which was finally converted into speech using a TTS engine. Their work showed that such systems can be very useful, especially for reading materials that are not available in Braille or digital formats.

In a similar direction, George et al. (2019) developed a reading device using Raspberry Pi along with Tesseract OCR and OpenCV. They focused on improving image quality before text recognition, and their results showed that better image processing leads to more accurate text extraction. The system was able to convert the recognized text into clear speech, providing real-time support to users.

Around the same time, Patil et al. (2019) introduced an IoT-based assistive device built on Raspberry Pi. Their system combined OCR and TTS with image processing using Python and OpenCV. They mainly focused on making the device portable and easy to use in everyday situations, which is important for practical use.

In recent years, research has moved beyond basic functionality and started focusing more on usability and advanced features. For example, the AI-WEAR system (2023) introduced a wearable device that not only reads text but also includes voice assistance and communication features. This made the system more interactive and especially helpful for students.

In 2024, Dahiphale et al. worked on improving the accuracy of such systems by using better image preprocessing techniques. Their Raspberry Pi-based model showed that enhancing the image properly before OCR can significantly improve the final results.

Another study in 2024 took this further by using adaptive or dynamic preprocessing methods. Their system achieved over 88% accuracy, showing that adjusting image processing based on conditions like lighting and alignment can make a big difference in real-world use.

More recently, in 2025, researchers have started integrating modern AI techniques into these systems. These newer models are not limited to reading text—they can also recognize objects and describe surroundings. This adds an extra layer of assistance and helps users better understand their environment, not just read documents.

## METHODOLOGY

### 3.1 Image Acquisition:

The process begins by capturing an image of the printed document. The user just needs to point the camera at the text and press a button. For the system to work well, the text should be clearly visible, properly aligned, and in good lighting. Lighting really matters here—if it's too dark or uneven, the image can turn out blurry or unclear, which affects everything that comes after.

### 3.2 Image Preprocessing:

After the image is captured, it's cleaned up to make the text easier to read. First, the image is converted to grayscale so that unnecessary color information is removed. Then, noise reduction is applied to get rid of small unwanted spots or distortions. Finally, thresholding is used to make the text stand out more clearly from the background. These steps help make the characters sharper and easier for the system to recognize.

### 3.3 Optical Character Recognition (OCR):

Next, the processed image is sent to the OCR module. This is the most important part of the system. Here, the software looks at the shapes of the letters and words and converts them into digital text. The accuracy of this step depends a lot on how clean the image is—better preprocessing usually means better results.

### 3.4 Text-to-Speech Conversion (TTS):

Once the text is extracted, it is passed to a Text-to-Speech engine. This part converts the written text into spoken words. The voice output is generally clear and natural, making it easy for the user to understand without much effort.

### 3.5 Audio Output:

Finally, the audio is played through speakers or earphones. The user can listen to the content almost immediately, which makes the system very useful in daily situations—whether at home, in class, or while traveling. The sound is kept clear and loud enough for comfortable listening.

## SYSTEM ARCHITECTURE

The automatic reader system is designed to help visually impaired people read printed text by converting it into speech. The idea is simple — instead of trying to read with their eyes, users can just listen to the content. The whole setup uses basic hardware and software, but together they get the job done quite effectively.

At its core, the system is made up of four main parts: capturing the image, processing it, recognizing the text, and finally converting that text into speech. All these steps happen one after another. First, the user takes a picture of the printed page using a camera. Then the image is processed so that the text becomes clearer, and OCR is used to extract the words. After that, the extracted text is turned into speech and played through speakers or earphones.

The entire system runs on a Raspberry Pi 3 Model B, which acts like the brain of the device. It's a good fit for this kind of project because it's affordable, small in size, and doesn't consume much power. That makes the system easy to carry around and use anywhere.

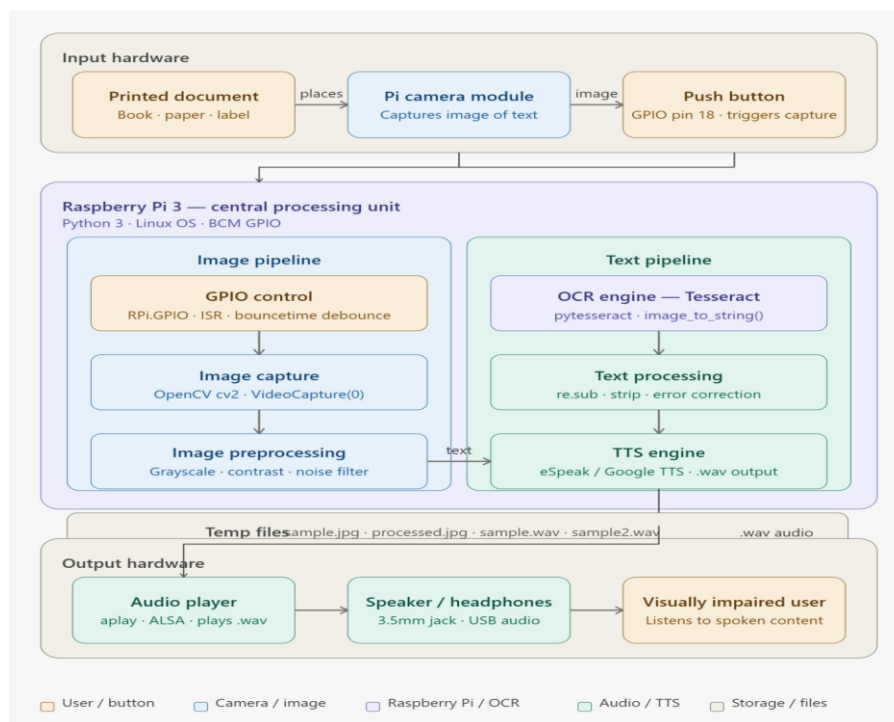


Fig.1. System Architecture

In real use, the process is very straightforward. The user just points the camera at the document and captures an image. Of course, things like proper lighting and a steady hand really help. If the image is too dark or blurry, it can affect how accurately the text is recognized later.

Once the image is taken, the Raspberry Pi processes it by converting it to grayscale, reducing noise, and improving the contrast so the text stands out more clearly. After that, the OCR software analyzes the image and identifies the letters and words, converting them into digital text.

The next step is converting that text into speech. This is done using a Text-to-Speech module, which produces a clear and natural-sounding voice. It doesn't sound too robotic, so it's comfortable to listen to, even for longer text.

Finally, the audio is played through speakers or headphones, allowing the user to hear the content almost immediately. This makes the system very practical for everyday tasks like reading books, documents, or even product labels while on the go.

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## IMPLEMENTATION

The implementation of the automatic reader system for visually impaired users is carried out by combining both hardware and software components in a simple and practical manner. In this project, the Raspberry Pi 3 Model B is used as the main controller because it is low-cost and easy to handle. A 5MP camera module is connected to the Raspberry Pi to capture images of printed text. For the output, basic speakers are connected through a 3.5 mm audio jack so that the system can read the text aloud. The entire setup works with a 5V power supply, which makes it portable and convenient for regular use.

On the software side, the Raspberry Pi runs on a Linux-based operating system, generally Raspbian. Python is used for coding since it is simple and has support for many libraries. When the system is turned on, either automatically or by pressing a button, the camera captures an image of the document placed in front of it. This image is then processed using OpenCV. Some basic steps like converting the image into grayscale,

reducing noise, and applying thresholding are done to make the text clearer. These steps are important because they help in getting better results from the OCR, especially if the image is not very clear.

After this, the processed image is given to the Tesseract OCR engine, which extracts the text from it. The extracted text is then converted into speech using a text-to-speech engine such as eSpeak or Google Text-to-Speech. Finally, the audio is played through the speakers so that the user can hear the content easily.

The system is designed to be simple and easy to use, so it does not require much effort from the user. A small push button can also be added to start the process, which makes it more helpful for visually impaired users. Overall, the system is affordable and useful in real-life situations. However, it may still face some problems, especially in low lighting conditions or when the text is complex and not clearly printed.

## RESULT AND DISCUSSION

The system was tested using different types of printed materials such as books, newspapers, and typed documents, and under various lighting conditions to see how it performs in real-life situations. This helped us understand not just how accurate it is, but also how reliable it can be for everyday use.

When the conditions were good—like when the image was clear, properly aligned, and taken under decent lighting—the OCR worked very well. It was able to recognize most of the text correctly, with only a few minor errors. But when the lighting was poor or uneven, or if the image was a bit blurry, the accuracy dropped. This was expected because OCR depends a lot on how clear the text appears in the image. Even then, the system still managed to pick up a fair amount of readable text, which shows that it can still function reasonably well in less-than-ideal conditions.

One thing that really helped improve the results was the preprocessing step. Simple methods like converting the image to grayscale, reducing noise, and applying thresholding made a noticeable difference. These steps made the text stand out more clearly, which helped the OCR perform better. We also realized that holding the camera steady and making sure the image is in focus can make a big difference in accuracy.

The Text-to-Speech part worked surprisingly well. The audio output was clear and easy to understand, and it didn't sound robotic or distorted. Even when reading longer text, the voice remained smooth and consistent, which makes it comfortable to listen to for longer periods.

Another positive point was how fast the system responded. The time between taking the picture and hearing the output was very short, so it felt quick and practical to use. There's no long waiting time, which makes the whole experience much better for the user.

Using a Raspberry Pi turned out to be a good decision. It keeps the system affordable while also making it compact and portable. Since it doesn't consume much power, it can be used for longer durations without needing frequent charging.

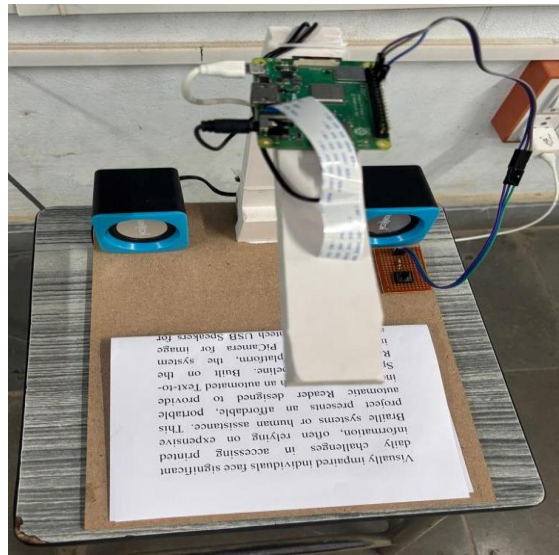


Fig.2. Automatic reader for blind People using raspberry pi

## FUTURE SCOPE

The automatic reader system developed in this project creates a strong starting point for further improvements. While it already performs its basic function effectively, there is still plenty of scope to make it more accurate, efficient, and user-friendly. One of the key areas for future development is improving the OCR capability using advanced AI techniques. By applying deep learning methods, the system can better handle unclear or tilted images and recognize text even in difficult backgrounds. This would make the device more reliable in everyday situations where lighting and image quality are not always perfect.

Another important improvement would be adding support for multiple languages. Right now, many systems are limited to a few languages, which can be a drawback in multilingual environments. Expanding this feature would allow users from different regions to use the system comfortably and make it more widely applicable.

Adding voice control is also a practical enhancement. Instead of pressing buttons or giving manual input, users could operate the system using simple voice commands. This would make the device more convenient, especially for visually impaired users who rely more on audio interaction.

Linking the system to a mobile application can further increase its usefulness. Through a mobile app, users could store scanned text, adjust settings, or even translate the content when needed. Cloud connectivity could also be included so that data can be saved and accessed anytime, adding more flexibility.

Other possible improvements include better performance in low-light conditions, the ability to read text from live video, and designing the hardware to be smaller and easier to carry. Overall, these enhancements would make the system more practical and adaptable, helping it serve users more effectively in real-life situations.

## CONCLUSION

The automatic reader developed using a Raspberry Pi provides a simple and cost-effective way to help visually impaired individuals read printed text. It works by combining image processing, Optical Character Recognition (OCR), and text-to-speech technology to turn printed words into spoken output. With components like the Raspberry Pi 3 Model B, a 5MP camera, speakers, and a reliable power supply, the system is designed to be compact, portable, and easy to handle in everyday situations.

A major benefit of this system is that it is both affordable and easy to use. Many existing assistive devices are expensive and complicated, which limits their use. In contrast, this system uses commonly available components, making it more accessible to a wider range of users. When the lighting is good and the text is

clear, the system performs well by recognizing the text accurately and producing understandable speech. This allows users to read books, documents, and other printed materials independently, which can greatly improve their confidence and daily life.

At the same time, the system has a few limitations. Its performance can drop in poor lighting or when the image quality is not clear. It may also struggle with unusual fonts or poorly printed text. However, these issues are not major barriers and can be improved with better image processing and software updates.

In the future, the system can be made more advanced by using AI-based OCR for better accuracy. Adding support for multiple languages and voice commands would make it even easier to use. It could also be connected to mobile applications for added convenience and features. Overall, this project is a useful step toward making technology more inclusive and helpful for visually impaired individuals.

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