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Finger Reader for Visually Impaired Using IOT

Y S Ujwal, K C Chetana, Aman Singh, Mr N Raghu

U.G. Student, Department of Artificial Intelligence, Anurag University, Venkatapur, Ghatkesar, India

Assistant Professor, Department of Artificial Intelligence, Anurag University, Venkatapur, Ghatkesar, India

ABSTRACT: In this project, the Raspberry Pi CPU board has been the focal point. It is in charge of the accessories that serve as a conduit between the user and the system, such as the speaker and camera. In this experiment, optical character recognition, or OCR, is used to identify characters that the machine then reads out through a speaker. The camera is fixed on a stand so that it may record the entire view of a paper into the system if the paper is positioned between the areas indicated by angular braces. Additionally, optimal lighting conditions are guaranteed when the camera captures the photo of the paper. The paper's content should be written in English, ideally in Times New Roman, and should use a good font size—ideally 24 or larger according to Microsoft Word. The system takes a picture once all these requirements are satisfied, processes it, and notifies the speaker that the content on the paper has been properly processed if it detects the content written on the paper. Following this, the content that the system processed from the paper image to text format is displayed. A blind person can read a document on their own without the assistance of a tactile writing system or a human reader by using the Raspberry Pi Based Reader for Blind. This project showcases the Raspberry Pi-based automated message reader for individuals with visual impairments. Text to Speech (TTS) technology is mostly used to convert text files into audio or spoken word forms. The purpose of this TTS technology is to assist the blind.

The current work presents a novel, effective, and economically advantageous technique that allows users to hear text images' contents rather than having to read them. The Raspberry Pi's Text to Speech Synthesizer (TTS). Through a voice interface, this type of device facilitates successful computer interaction for those with visual impairments. The device's design, execution, and experimental findings are all covered in this publication. The text processing module and the voice processing module are the two modules that make up this gadget.

KEYWORDS: Raspberry Pi ,Optical Character Recognition (OCR), Text to Speech (TTS) technology, Visual impairments, Assistive technology, Accessibility.

I. INTRODUCTION

An embedded system is a computer system with a dedicated function within a larger, often with real-time mechanical or electrical system constraints. It is incorporated as part of a complete device that often includes hardware and mechanical parts. Integrated systems today control many commonly used devices. 92% of all microprocessors are produced as embedded system components.

When compared to their general-purpose equivalents, examples of commonly integrated computer attributes include low power consumption, small size, variable performance, and low unit cost. They are far more difficult to program and engage with because of their constrained processing power. Nonetheless, the most effective way to manage the network and unit resources is to incorporate intelligence mechanisms into the hardware itself, making use of any sensors that are already in place, and having a built-in network. For instance, clever methods can be developed to control embedded systems' energy usage.

Modern embedded systems often incorporate microcontrollers (i.e., CPUs with memory or peripheral interfaces), but common microprocessors are also commonly used (using external memory chips and peripheral circuitry interfaces), especially in more complex systems. In any case, the processor or processors can be used, ranging from general-purpose specialized in some kind of calculations, or even designed for the application. A common standard of dedicated processors is the digital signal processor (DSP).



Figure: Embedded Systems Design

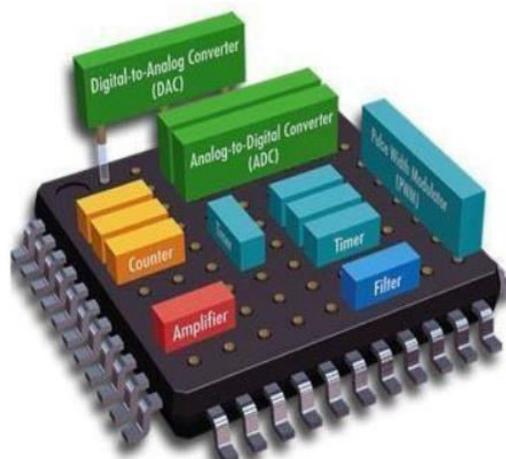


Figure: Embedded System Hardware

Integrated systems range from portable devices, such as digital clocks and MP3 players, to large stationary systems such as traffic lights, factory controllers, and large complex systems such as hybrid vehicles, magnetic resonances, and avionics. The complexity varies from low to high, with a single microcontroller chip, with the highest number of units, peripherals, and networks mounted within a large frame or enclosure.

Since these early applications in the 1960s, embedded systems have come down in price and there has been a dramatic rise in processing power and functionality. An early microprocessor, for example, the Intel 4004, was designed for calculators and other small systems but still required external memory and support chips. In 1978, the National Engineering Manufacturers Association released a "standard" for programmable microcontrollers, including almost any computer-based controllers, such as single-board computers, numerical, and event-based controllers. Charles Stark Draper of the MIT Instrumentation Laboratory created the Apollo Guidance Computer, one of the first recognizable modern embedded systems. Because it used recently created monolithic integrated circuits to decrease weight and size, the Apollo guidance computer was initially seen as the most dangerous component of the project. The Automatics D-17 guidance computer for the Minuteman missile, which was introduced in 1961, was an early example of a mass-produced embedded system. The D-17 was replaced with a new computer that was the first high-volume application of integrated circuits when the Minuteman II entered into production in 1966.

Up/down buttons or knobs read out by a microprocessor might replace pricey knob-based analog components like potentiometers and variable capacitors in consumer items when the cost of microprocessors and microcontrollers decreased. Early in the 1980s, the processor and the memory, input, and output system components were combined into a single chip to create the microcontroller. Applications for microcontrollers exist where a general-purpose computer would be prohibitively expensive. It is possible to program a relatively inexpensive microcontroller to do the same function as numerous independent components. The majority of the complexity in an embedded system is found within the microcontroller itself, even if in this particular context, embedded systems are typically more sophisticated than standard solutions. The majority of the design work is done in the program, and very few extra parts can be required. When compared to designing and building a new circuit without the use of an embedded processor, software prototyping and testing can be completed more quickly.

II. PROBLEM STATEMENT

This project's objective is to create and assess an automatic message reader for visually impaired people that runs on a Raspberry Pi and makes use of text-to-speech (TTS) synthesis and optical character recognition (OCR) technologies. The system recognizes and speaks text from paper documents aloud by merging a camera and speaker with the Raspberry Pi CPU board, allowing blind persons to independently access printed material. The study's main objectives are to maximize OCR accuracy, guarantee ideal document location and lighting, and assess the TTS interface's usefulness and efficacy. The goal of the suggested solution is to give visually impaired people an affordable and accessible way to view printed materials without having to rely on human help or tactile technologies.

III. METHODOLOGY

INSTALL RASPBIAN ON THE RASPBERRY PI:

Installing Raspbian on the Raspberry Pi is straightforward. We will be downloading Raspbian and writing the disc image to a microSD card, then booting the Raspberry Pi to that microSD card. For this project, you will need a microSD card (go with at least 8 GB), a computer with a slot for it, and, of course, a Raspberry Pi and basic peripherals (a mouse, keyboard, screen, and power source). This is not the only method for installing Raspbian (more on that in a moment), but it's a useful technique to learn because it can also be used to install so many other operating systems on the Raspberry Pi. Once you know how to write a disc image to a microSD card, you open a lot of options for fun Raspberry Pi projects.

A Word about NOOBS:

It should be noted that there are more ways to install Raspbian besides the one outlined here. Another option is to utilize NOOBS, which is an operating system installation manager that facilitates the installation of several alternative operating systems in addition to Raspbian. You can even purchase SD cards that already have NOOBS pre-installed on them if you really want to simplify things. See our guide on how to install NOOBS on the Raspberry Pi for a little more information on that.

The exciting task of installing Raspbian on your Raspberry Pi creates a plethora of opportunities for creativity, learning, and experimenting. Regardless of your level of experience with technology or curiosity, this tutorial will take you through the process of setting up Raspbian.

Step 1: Download Raspbian

Installing Raspbian on your Raspberry Pi is an exciting endeavor that opens up a world of possibilities for experimentation, learning, and creativity. Whether you're a seasoned tech enthusiast or a curious beginner, this guide will walk you through the steps to get Raspbian up and running on your device. So, let's dive in and get started.

First and foremost, ensure that you have a computer available, whether it's a Mac or a PC. Both platforms are compatible with the process of installing Raspbian. Now, let's proceed with downloading the Raspbian disk image. Head over to the Raspberry Pi Foundation's website, where you'll find the latest version of Raspbian available for download. Be patient during this step, especially if you opt for the traditional download method instead of using a torrent. Depending on your internet connection speed, downloading the disk image may take anywhere from a few minutes to half an hour or more.

Once the download is complete, you'll have a disk image file ready to be transferred onto your Raspberry Pi's SD card. But before we proceed, let's talk briefly about SD cards. Ensure that you have an SD card with sufficient storage capacity for Raspbian. A minimum of 8GB is recommended, but if you have a larger card available, that's even better. Also, make sure to back up any data on the SD card, as the installation process will erase everything on it.

Let's now get the SD card ready for Raspbian. You'll need to utilize an Etcher tool to accomplish this. Etcher is a free and open-source tool that makes creating disk images to USB devices and SD cards easier. After downloading and installing Etcher, open the program on your PC.

Place your SD card into the card reader on your PC while Etcher is active. Etcher ought to identify the SD card on its own. Next, open Etcher, select the "Select image" button, and go to the directory where the Raspbian disk image file was downloaded. After you've chosen the disk image, select your SD card from the list of possible drives by clicking on "Select drive" in Etcher.

Step 2: Unzip the File

The Raspbian disc image is compressed, so you'll need to unzip it. The file uses the ZIP64 format, so depending on how current your built-in utilities are, you need to use certain programs to unzip it. If you have any trouble, try these programs recommended by the Raspberry Pi Foundation:

Windows users, you'll want 7-Zip

Mac users, The Unarchiver are your best bet.

Linux users will use the appropriately named Unzip.

Step 3: Write the disc image to your microSD card

The disk image should then be written to your microSD card by inserting it into your computer. For this, you'll need a particular program:

- Win32 Disk Imager is the solution for Windows users.
- Mac users: you can utilize your machine's built-in disk utility.
- The Raspberry Pi Foundation suggests Etcher for Linux users, as it is compatible with both Mac and Windows operating systems.

Depending on the program you are using, the text of the image will vary slightly, but it is always self-explanatory. You will be asked to choose the disc image (the unzipped Raspbian file) and the destination (be sure you have chosen your microSD card!) in each of these tools. Select, confirm, then press the write button.

Step 4: Insert the microSD card into your Raspberry Pi and Power Up

It's time to put the microSD card into your Raspberry Pi and turn it on now that you have successfully written the Raspbian disk image to it. Simple yet essential, this step will enable you to boot up Raspbian on your Raspberry Pi. Put the Raspbian image-containing microSD card into the Raspberry Pi's slot, attach HDMI peripherals (keyboard, mouse, and monitor), turn on the device with the power adapter, and log in to the Raspbian desktop using the default credentials (username: pi, password: raspberrypi). Raspbian loads from the microSD card at bootup, launching the desktop environment. Upon entering the default credentials, users are granted access to the desktop. Users can then investigate the features, programs, and capabilities that Raspbian has to offer. This covers a variety of Internet of Things projects, games, coding, and multimedia playback. The Raspberry Pi can be used for a variety of jobs and projects thanks to the user-friendly interface of the Raspbian desktop. These instructions will help users successfully install Raspbian on their Raspberry Pi, enabling them to take full advantage of the device's potential for exploration, education, and creativity in the fields of electronics and computers.

IV. RESULT ANALYSIS

The analysis of our bus tracking application's performance revealed promising results in improving transportation efficiency and user satisfaction. Real-time tracking capabilities significantly reduced wait times for students and parents, leading to more punctual arrivals and departures. Feedback from users highlighted the intuitive interface and the effectiveness of push notifications in keeping them informed of important updates. Additionally, the integration of analytics tools provided valuable insights into usage patterns and system performance, enabling informed decision-making for future enhancements. Overall, the results demonstrate the tangible benefits of our solution in enhancing the transportation experience for educational institutions.

Here's how the output might look in the Mobile App.

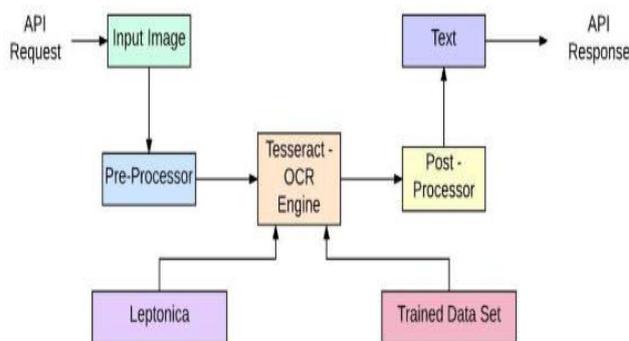


Figure: OCR Process Flow

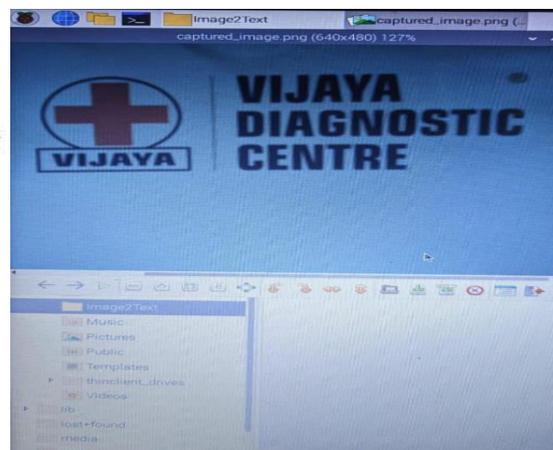


Figure: Captured Image

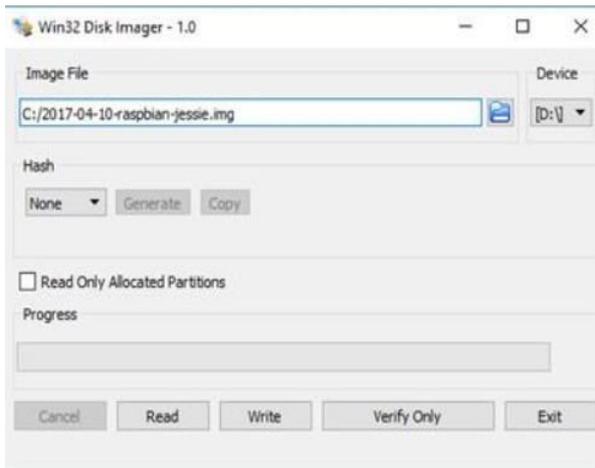


Figure: Win32 Disk Image



Figure: Command Window

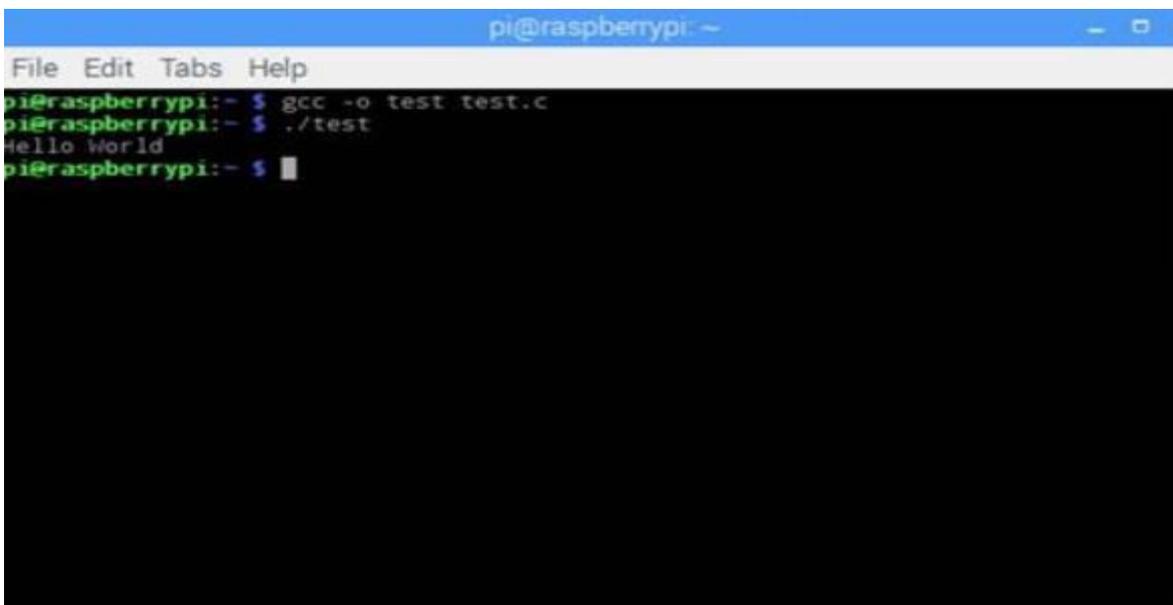


Figure: Terminal for Execution

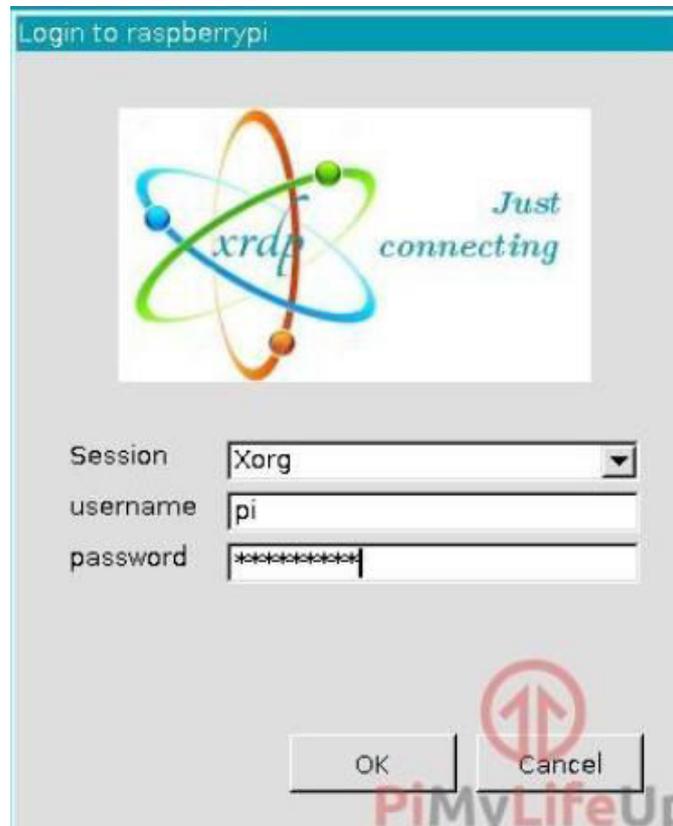


Figure: Login to raspberrypi

V. CONCLUSION

The creation of the visually impaired reader powered by a Raspberry Pi represents a significant advancement in technology accessibility and inclusivity. Through the use of contemporary computing and image processing techniques, this initiative gives visually impaired people a self-sufficient way to access printed text contents. The system efficiently converts printed text into audible speech by combining Text-to-Speech (TTS) synthesis with Optical Character Recognition (OCR) technology. This allows users to interact with written content in a natural and comfortable way. This project's use of the Raspberry Pi platform, a flexible and reasonably priced computing option that works well with embedded systems and Internet of Things applications, is one of its main advantages. With the help of peripherals like the camera and speaker, the project makes use of the Raspberry Pi board's computing power to create a small, effective design that can be used in the real world.

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