



Smart Assistance for Blind People Using Bonic Eye Using Raspberry Pi

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Abstract:

Speech and text is the main medium for human communication. A person needs vision to access the information in a text. However those who have poor vision can gather information from voice. This paper proposes a camera based assistive text reading to help visually impaired person in reading the text present on the captured image. The faces can also be detected when a person enter into the frame by the mode control. The proposed idea involves text extraction from scanned image using Tesseract Optical Character Recognition (OCR) and converting the text to speech by eSpeak tool, a process which makes visually impaired persons to read the text. This is a prototype for blind people to recognize the products in real world by extracting the text on image and converting it into speech. Computer vision is one of the emerging technologies that can be used to aid visually impaired people for navigation (both indoor and outdoor), accessing printed material, etc. This paper describes an approach to extract and recognize text from scene images effectively using computer vision technology and to convert recognized text into speech so that it can be incorporated with hardware to develop Electronic travel aid for visually impaired people in future.

Keywords: Raspberry pi, webcam, text to speech conversion

I.INTRODUCTION:

Visually impaired people report numerous difficulties with accessing printed text using existing technology, including problems with alignment, focus, accuracy, mobility and efficiency. We present a smart device that assists the visually impaired which effectively and efficiently reads paper-printed text. The proposed project uses the methodology of a camera based assistive device that can be used by people to read Text document. The framework is on implementing image capturing technique in an embedded system based on Raspberry Pi board. The design is motivated by preliminary studies with visually impaired people, and it is small-scale and mobile, which enables a more manageable operation with little setup. In this project we have proposed a text read out system for the visually challenged. The proposed fully integrated system has a camera as an input device to feed the printed text document for digitization and the scanned document is processed by a software module the OCR (optical character recognition engine). A methodology is implemented to recognition sequence of characters and the line of reading. Optical character recognition (OCR) is the translation of captured images of printed text into machine-encoded text. OCR is a process which associates a symbolic meaning with objects (letters, symbols an number) with the image of a character. It is defined as the process of converting scanned images of machine printed into a computer process able format. Optical Character recognition is also useful for visually impaired people who cannot read Text document, but need to access the content of the Text documents. Optical Character recognition is used to digitize and reproduce texts that have been produced with non-computerized system. Digitizing texts also helps reduce storage space.

II.SYSTEM ARCHITECTURE:

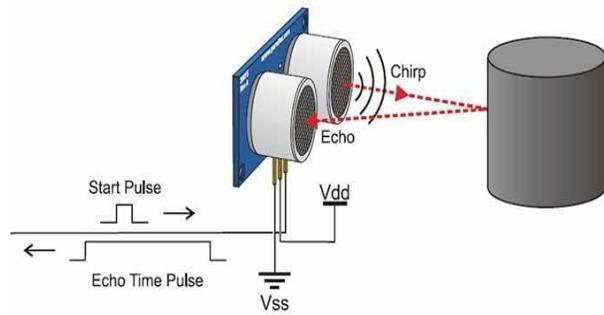
The design part consists of mainly two sections,

- Hardware architecture
- Software architecture

A.HARDWARE ARCHITECTURE

The **Raspberry Pi** or **Raspi** for friends – it's a small computer. It has everything you could want: a 700MHz ARM processor, RAM, USB, Ethernet, but especially a comb (see Fig.3) is welded on the electronics board and it is directly connected to the processor. This comb allows us with digital inputs / outputs (freely configurable) controlled directly by the operating system. There are two versions of the Raspi, the model A and B. The difference lies in the hardware, the model B, [1]compared to its little brother, has in addition an Ethernet connector, two USB ports instead of one, and bigger RAM (512MB against 256Mb of the model A). Obviously, the price is different: at present, the B model can be purchased for € 37, while model A costs only € 28. **Model A** is **lighter** and therefore it is ideal for embedded applications (dedicated) where weight is an issue and where the extra features of model B are superfluous. On the other hand, **model B** is much more **versatile**: it can be connected to the computer network and it can handle more applications and processes than model A. All models feature a Broadcom system a chip (SoC), which includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit (GPU, a VideoCore IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM.

Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or MicroSDHC sizes. Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. The B-models have an 8P8C Ethernet port and the Pi 3 and Pi Zero W have on board Wi-Fi 802.11n and Bluetooth.



CONNECTING THE DISPLAY/MONITOR

Connect the TV screen or monitor to Raspberry Pi board using a composite video cable (AV cable) or HDMI cable, insert the SD card into the SD card slot[2] and switch-on the power supply. The TV screen/monitor even on the right AV channel may refuse to come up the first time. When that happens, remove the power-supply cord of Raspberry Pi board once (keeping the monitor's power supply on) and then re-plug it. Now, the monitor should come on live, if the SD card is not removed.

HDMI TO VGA CONVERTER:

There are devices that just adapt the physical connection and also devices that convert the type of signal from one format to another. **NOTE: in most cases a simple cable or physical adapter will not be all that is needed.** Let me explain what some of the most common devices are.

So what are the different types of converters?

Most HDMI converters are devices that connect a non-HDMI source to an HDMI display. This means we're going from another signal type to HDMI. Some people get that backwards, but think of the signal as being something flowing from one location to another [4]. For example, the HDMI signal flows out of your DVD player and into your TV. Some converters go the opposite direction and go from an HDMI source to a DVI or VGA display. Below are the most sought-after connections to convert to HDMI.

Select connection to convert to HDMI



What do these converters do for me?

To put it simply, each of these converters make it so you can have two devices interact that use two different signal types. It gets slightly more complicated depending on which two signals we're dealing with. I'll go through each of the types mentioned above and try and give you a basic explanation of what each accomplishes.

VGA to HDMI

VGA to HDMI converters are most commonly used to go from a computer to a TV that has an HDMI input. VGA is an analog signal so the converter has [6]to convert the signal from analog to digital. Many VGA to HDMI converters also take an audio input and add that to the HDMI signal since HDMI does both audio and video, while VGA only does video. See more detailed information on making a VGA to HDMI conversion here:

USB to HDMI

A USB to HDMI adapter connects to the USB port on a computer and essentially adds an HDMI output to the computer. This allows you to connect your computer to your HDMI enabled display, like a TV or computer monitor. This also allows you to add multiple extra displays to your computer making for much more powerful monitor set ups. The Minideck 3.0 is a great way to transmit HD video and audio from your computer to your HDTV.

DVI TO HDMI

DVI is a digital signal in the same format as the video portion of HDMI. The difference is that DVI doesn't carry the audio signal like HDMI does. This means that if you are only using the video signal you can use a simple DVI to HDMI plug adapter that changes the physical connections. If you want to go from a DVI source with audio, you'll need an active converter to combine the video signal from the DVI source and the audio into the HDMI signal.

WEB CAMERA INTERFACING WITH RASPBERRI PI

Raspberry PI persists in its pride stage due to its relevance in performing image processing applications. Real time image processing schemes can be developed using a Raspberry Pi, as it supports the webcam interface, and thereby we can process the algorithms for detection, recognition, segmentation, surveillance etc.

Once the Raspberry Pi starts booting up, it will prompt you for login name and password. The login for Wheezy linux is pi and the password is raspberry. Once entered, Raspberry Pi will open the text screen. Enter Startx command at the prompt to start the beautiful GUI desktop screen [7]. The first time when I saw the image on my television screen, I was mesmerized.

To make Raspberry Pi open the GUI screen every time it boots up, all you have to do is to make a change in the raspi-config page. Select SudoRaspi-config and bring the cursor down on Automatic GUI Boot Up. Select → Finish → Reboot. And, it's done.

B.SOFTWARE REQUIREMENTS:

The Raspberry Pi has quickly become very popular among hobbyists, both for the low price and for its great versatility. This is especially true if you think back to when the production of this board was announced and you had to put on waiting lists for expecting even six months before you can get a board. The **ARM** processor supports many operating systems (mostly **Linux-based**), and this allows everyone to work in his preferred environment. No, Windows is not compatible with ARM and even if it were, would you use it on really such a thing? Imagine how many blue screens ... it would always be locked. And no, not even OSX is going to run on ARM! After the first Raspi was delivered around the world, many developers vied to recompile the kernel of the most popular Linux distributions specifically for the hardware of this board, and in fact, we now have a substantial amount of operating systems adapted to give the best performance on the Raspberry Pi board. Among the most famous operating systems adapted to work with Raspberry, there are:

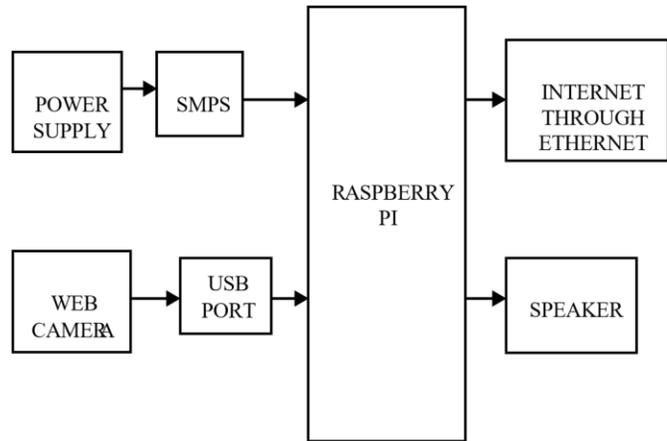
- Raspbian(a lighter version of Debian),
- Pidrorra(daughter of the most famous Fedora),
- Arch Linux ARM (review of ArchLinux).

Then there are operating systems that run natively, such as **Android 4.0,GoogleChromium OS**, some UNIX distributions such as **Free BSD**and many others (for the complete list see here). The site RaspberryPi.org has its own official list of supported operating systems that you can find here. The **Raspberrypi.org** site has its own official list of supported operating systems that you can find here. In this article we will see how to install and configure **Raspbian**. I chose this distribution because Debian (the mother of Raspbian) is very famous and is well documented, so it is easier to find solutions and support in case of problems during use. With this operating system you can easily achieve interesting applications such as a media center, a web server, a mail server, torrent, databases, ftp ... and all this is shareable with all the electronics you want. Today, however, you will do only the first step, you will learn to control the outputs and read the inputs of the GPIO using the python language and a few lines of code.

III. BLOCK DIAGRAM OF PRPOSESD METHOD

The framework of the proposed project is the raspberry pi board. The raspberry pi B+ is a single board computer which has 4 USB ports, an Ethernet port for internet connection, 40 GPIO pins for input/ output, CSI camera interface, HDMI port, DSI display interface, SOC (system on a chip), LAN controller,

SD card slot, audio jack, and RCA video socket and 5V micro USB connector.



PRE-PROCESSING:

Pre-processing stage consists of three steps: Skew Correction, Linearization and Noise removal. The captured image is checked for skewing. There are possibilities of image getting skewed with either left or right orientation. Here the image is first brightened and binarized.

The function for skew detection checks for an angle of orientation between ± 15 degrees and if detected then a simple image rotation is carried out till the lines match with the true horizontal axis, which produces a skew corrected image. The noise introduced during capturing or due to poor quality of the page has to be cleared before further processing

SEGMENTATION

After pre-processing, the noise free image is passed to the segmentation phase. It is an operation that seeks to decompose an image of sequence of characters into subimage of individual symbol (characters). The binarized image is checked for inter line spaces. If inter line spaces are detected then the image is segmented into sets of paragraphs across the interline gap. The lines in the paragraphs are scanned for horizontal space intersection with respect to the background. Histogram of the image is used to detect the width of the horizontal lines. Then the lines are scanned vertically for vertical space intersection. Here histograms are used to detect the width of the words. Then the words are decomposed into characters using character width computation

FEATURE EXTRACTION

Feature extraction is the individual image glyph is considered and extracted for features. First a character glyph is defined by the following attributes:

- (1) Height of the character;
- (2) Width of the character;
- (3) Numbers of horizontal lines present—short and long;
- (4) Numbers of vertical lines present—short and long;
- (5) Numbers of circles present;
- (6) Numbers of horizontally oriented arcs;
- (7) Numbers of vertically oriented arcs;
- (8) Centroid of the image;
- (9) Position of the various features;
- (10) Pixels in the various regions.

IMAGE TO TEXT CONVERTER

The ASCII values of the recognized characters are processed by Raspberry Pi board. Here each of the characters is matched with its corresponding template and saved as normalized text transcription. This transcription is further delivered to audio output.

TEXT TO SPEECH

The scope of this module is initiated with the conclusion of the preceding module of Character Recognition.

The module performs the task of conversion of the transformed Tamil text to audible form.

The Raspberry Pi[5] has an on-board audio jack, the on-board audio is generated by a PWM output and is minimally filtered. A USB audio card can greatly improve the sound quality and volume. Two options of attaching a microphone into Raspberry Pi. One is to have USB mic, another to have an external USB sound card.

SIMULATION ENVIRONMENT

The image to text and text to speech conversion is done by the OCR software installed in raspberry pi. The conversion which is done in OCR can be simulated in MATLAB. The conversion process in MATLAB includes the following processes.

1. Binary image conversion.
2. Complementation.
3. Segmentation and labeling.
4. Isolating the skeleton of character.

SAMPLE IMAGE

The following image which is captured by the webcam contains the following word. This image is in the jpeg format which has to be converted into text.



BINARY CONVERSION

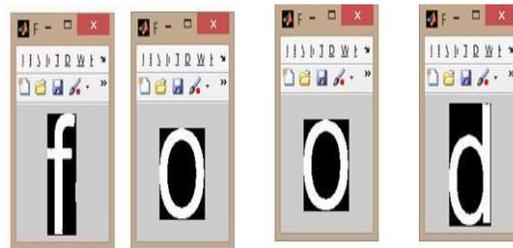
In this section sample image is converted into binary format. The image which was a 3D image initially is converted to 2D image. Binary 0 represents black color of the characters. Binary 1 represents white color of the characters.

BOUNDARY MARKING

The area of the text is bordered and the boundary for each character is isolated. The boundary for each character is programmed and it can vary from 0 to 255 bits of characters occupying memory in the database.

Segmentation and labelling

The isolated blocks of characters are segmented and are automatically labelled for identity. Image segmentation is the process of partitioning a digital image[8] into multiple segments (sets of pixels, also known as super pixels).



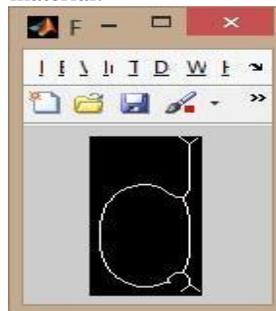
Segmentation and labelling

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics.

Connected-component labelling is used in vision to detect connected regions in digital images, although color images and data with higher dimensionality can also be processed. When integrated into an image recognition system or human-computer interaction interface, connected component labelling can operate on a variety of information. Blob extraction is generally performed on the resulting binary image from a thresholding step. Blobs may be counted, filtered, and tracked.

FORMING CHARACTER SKELETON

Skeletonization is a process for reducing foreground regions in a binary image to a skeletal remnant that largely preserves the extent and connectivity of the original region while throwing away most of the original foreground pixels. To see how this works, imagine that the foreground regions in the input binary image are made of some uniform slow burning material.

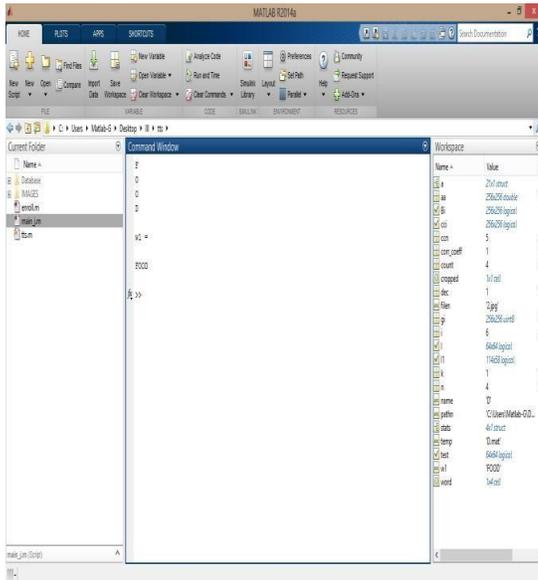


Character Skeleton

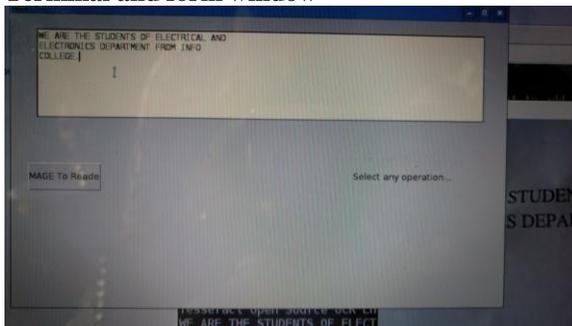
Light fires simultaneously at all points along the boundary of this region and watch the fire move into the interior. At points where the fire travelling from two different boundaries[9] meets itself, the fire will extinguish itself and the points at which this happens form the so called 'quench line'

AUDIO OUTPUT

The programming codes are run in MATLAB and corresponding output is generated. The output is in the form of audio. The audio is heard using headphone or speaker connected to the system. Each character of the word is spelled out first and then the entire word is read out.

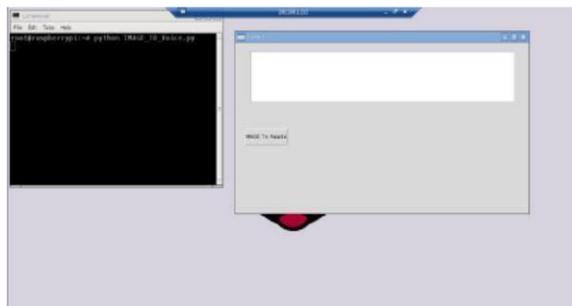


Terminal and form window



The text document which has to be read out has to be placed at a considerable distance from the webcam so that the image is clear enough with proper illumination. In the terminal window the command for image to text conversion has to be given. Immediately a form window opens. In the form window, a dialog box is seen named 'image to read'. That option has to be clicked to enable the webcam. The webcam auto focuses the image and it is captured. The displayed image is read out by the text to speech engine ESPEAK.

IV. RESULTS



V. CONCLUSION

We have implemented an image to speech conversion technique using raspberry pi. The simulation results have been successfully verified and the hardware output has

been tested using different samples. Our algorithm successfully processes the image and reads it out clearly. This is an economical as well as efficient device for the visually impaired people. We have applied our algorithm on many images and found that it successfully does its conversion. The device is compact and helpful to the society.

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