International Journal of Engineering & Technology, 7 (3.1) (2018) 82-85

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Prototype to Help Visually Impaired Person in Reading Printed Learning Materials using Raspberry PI

Jaichandran R[1]*, Somasundaram K[2] , Bhagyashree Basfore[3] , Menaka I.S[4], Uma S[5]

[1,2,3,4,5]Centre of Excellence for IoT, Department of CSE, Aarupadai Veedu Institute of Technology, Vinayaka Mission's Research Foundation (Deemed to be University), Kanchipuram District,Tamil Nadu 603104, India
**Corresponding author E-mail:rjaichandran@gmail.com*

Abstract

This paper presents a prototype to help visually impaired persons in reading printed learning materials using Raspberry PI. Tesseract an open source optical character recognition technique is used extract texts in printed images and converted to audio output using text-to-speech conversion software. Prototype is experimented using printed text pages with various font sizes and line spacing as test cases. Results show that the prototype is better in converting printed texts to speech. However quality of image, font size, and line space affects performance of prototype in converting printed texts to speech..

Keywords: Optical Character Recognition*; Raspberry PI; Text-to-speech Conversion; Visually Impaired.*

1. Introduction

Reading is a part of every human life. Every single day, we read books, magazines, newspapers, etc to update ourselves and to know the developments happens around us [6]. Human eye is an important organ that helps us in this process. But unfortunately visually impaired persons cannot read and update their knowledge as a normal person does. They depend on touching and feeling sense and hearing sense for reading and learning. They need special methods like Braille or Audi lectures for this purpose.

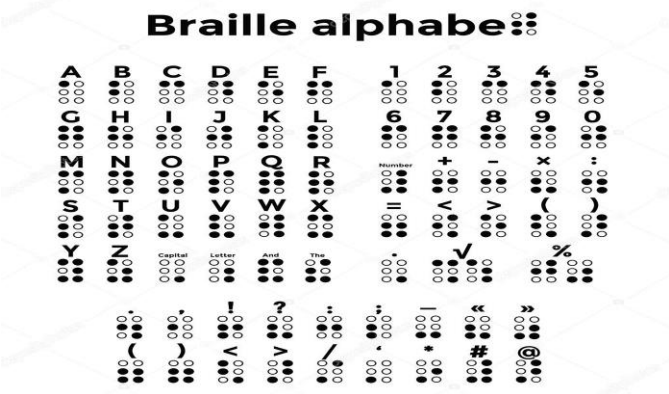

Fig. 1: Braille Alphabets

Braille is the systems of dots used to represent alphabets, numbers, and symbols. Figure 1 illustrates Braille dots for each alphabets, numeric's and symbols. Visually impaired peoples learn by touching and feeling the system of dots. This method is commonly used for teaching visually impaired students. Braille method can be suitable for learning fundamentals at the initial stage of education. But for getting more knowledge; particularly for higher education visually impaired people need to update themselves by learning new things from different sources like books, magazines, newspapers, etc. But unfortunately not everything is printed in Braille. Braille method may not be suitable for quick learning because it supports reading by touching and feeling and requires more time and effort [8]. This makes visually impaired peoples as slow learners.

To overcome the above limitation, it is necessary to develop a prototype to that support visually impaired persons in reading printed learning materials..

2. Literature Review

To the best of our knowledge, only very few works are carried out in developing prototypes to help visually impaired peoples in reading printed learning materials. Some of them are discussed below.

Ashwini V. Mhaske et al., (2016) proposed, "Portable Camera Based Assistive Text Reading from Hand Held Objects for Blind Person". The proposed system assists visually impaired peoples in reading printed texts on hand held objects. A text localization algorithm is proposed using Optical character Recognition (OCR) to perform text recognition on the coverage region and then recognized text codes are transformed to speech.

Aaron James S et al (2016) proposed "OCR based automatic book reader for the visually impaired using Raspberry PI". In this wok Tesseract algorithm is used for OCR. Texts in scanned images are detected and converted to ASCII codes using Tessact library and open source computer vision library. ASCII codes are converted to audio using filter library and pronounced through earphone using Flite library. Authors discussed about two types of OCR: offline OCR and online OCR. Printed text, handwritten text are used in offline OCR and magnetic ink character recognition are used in online OCR. Prototype is experimented using offline OCR and online OCR need to be explored further. Similar work has

been reported by velmurugan D et al (2016) and Mallapa D Gurav eta al., (2017).

Ajantha Devi V et al., (2014) proposed "Embedded Optical Character Recognition on Tamil Text Image using Raspberry Pi". In this work open source computer vision libraries is used recognize tamil text characters and was converted into machine encoded text using OCR. Text-to-speech (TTS) software in raspberry pi converts encoded text in to audio. Authors experimented prototype with Thirukkural text with font size of 10. The challenge in this work is tamil letters has 247 characters out of which 18 are consonants, 216 are compound characters, and 12 vowels.

Chucai Yi et al., (2011) proposed "Assistive Text Reading from Complex Background for Blind Persons". In the proposed system authors proposed a camera-based assistive system for visually impaired persons to read text from printed learning materials. The system is able to read text from complex backgrounds and then communicate this information aurally. Performance of the proposed system is evaluated using Robust Reading Dataset and experimental results gives promising solution in reading out texts in printed learning materials.

Heba Saleous et al., (2016) proposed "Read2Me: A Cloud-based Reading Aid for the Visually Impaired". Authors proposed two platforms such as raspberry pi platform and android application platform to help visually impaired people in reading printed text. In raspberry Pi platform text image captured by camera is uploaded by a python web application program in to ABBYY cloud. OCR software in ABBYY cloud extracts texts in image and sends it back to raspberry pi for further processing. TTS software in raspberry pi converts received text in to audio. A web application program in python is used for communication between raspberry pi and ABBYY cloud. In android application platform text image captured by mobile phone camera is uploaded by a mobile phone app to ABBYY cloud. Texts in image are extracted using OCR techniques in ABBY cloud and send back to mobile phone. Texts are converted into audio using TTS engine in android phones. Experiments are conducted using text images with various fond sizes and better results are produced for the fond size of 16 and above.

3. Methodology

Figure 2 illustrate proposed prototype and the primary component in the prototype includes Raspberry PI, web camera, hear phone or a speaker. Methodology of the prototype is described using following steps.

Step1: Mount the web camera on a stand in such a position that if a printed learning material is placed in between the area marked by angular braces (focus area), it captures full view of the material into the system.

Step 2: Place the printed learning material in the focus area of the web camera and ensure sufficient lighting condition for taking good quality snapshots.

Step 3: Power on Raspberry PI and Web camera.

Step 4: Let the Snapshot of printed learning material is processed using Tesseract algorithm in Raspberry PI. Tesseract algorithm is an open source OCR technique involves following stages in converting printed text to speech: scanning, pre-processing, segmentation, feature extraction, classification, Unicode mapping, and text recognition.

.

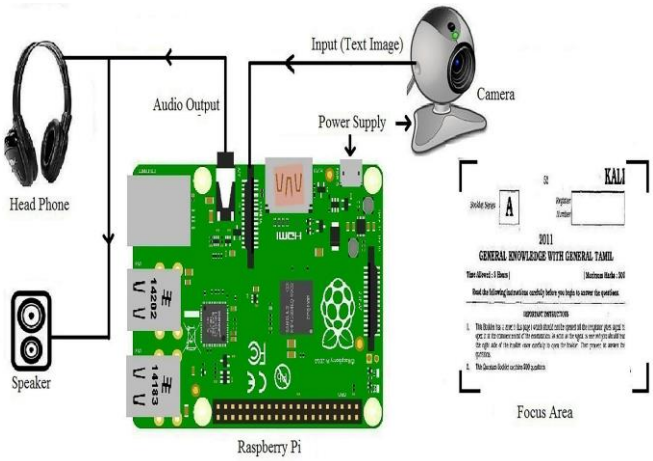

Fig. 2: Methodology

In preprocessing stage noises in the scanned images are removed. In segmentation stage texts in image are classified into paragraphs, lines, words, and characters. During feature extraction stage height and width of the characters are identified. In classification stage support vector machine recognizes the texts in image.

Step 5: Recognized texts are converted to speech using text-to-speech conversion software

Step 6: Hear phone or speaker can be connected to audio output of Raspberry PI. Visually impaired people can able to hear and understand contents that are printed in learning materials.

4. Implementation

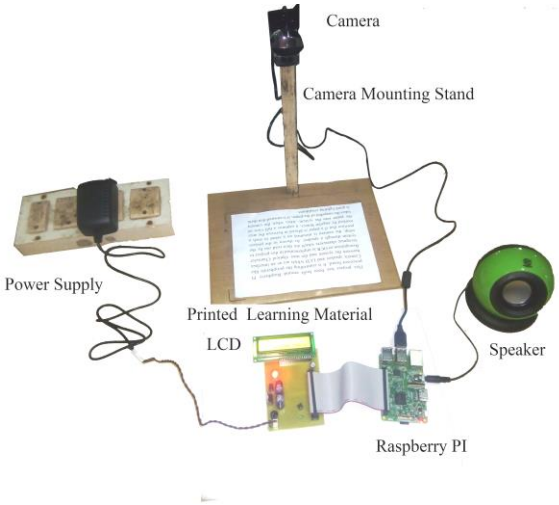

Fig. 3: Implementation of Prototype

Figure 3 illustrates implementation of proposed prototype. Primary components used includes Raspberry PI model B with 32 bit ARM processor with 900MHz clock speed and 1GB RAM, Camera, Camera mounting stand, speaker or ear phone, and LCD Display. Latest version of Raspbian-jessie operating system is downloaded from official website and unzipped to get disc image file.Win32DiscImager is used to write Raspbian-jesse disc image to SD card. Maximum size of SD card is 32 GB. SD card with Raspbian-jessie disc image is inserted into SD card slot of Raspberry PI model B and the system is powered on using 5V micro USB connector. Digital TV can be connected using HDMI pin for visualizing output. Camera and USB audio outputs are enabled using respective commands. Image captured by camera are processed using open source computer vision library functions. Tesseract OCR engine extracts text from image and the extracted text are convert to audio using TTS software.

5. Experiments and Results

Prototype is experimented using printed text pages in times new roman with different font sizes and line spacing as test cases.
Case 1: Printed text with font size 12 and single line spacing.
Case 2: Printed text in with font size 12 and 1.5 line spacing.
Case 3: Printed text in with font size 12 and double line spacing.
Case 4: Printed text in with font size 14 and single line spacing.
Case 5: Printed text in with font size 14 and 1.5 line spacing.
Case 6: Printed text in with font size 14 and double line spacing.
Case 7: Printed text in with font size 20 and single line spacing.
Case 8: Printed text in with font size 20 and 1.5 line spacing.
Case 9: Printed text in with font size 20 and double line spacing.
Case 10: Printed text in with font size 24 and double line spacing.
Case 11: Printed text in with font size 28 and double line spacing.
Case 12: Printed text in with font size 32 and double line spacing.

Table 1: Test Cases and Results

Cases	Font size	Line Spacing	Number of Text Converted to speech	Number of Text Not Converted to speech
1	12	Single	0	116
2		1.5	0	116
3		Double	0	116
4	14	Single	0	116
5		1.5	5	111
6		Double	15	101
7	20	Single	10	106
8		1.5	25	91
9		Double	80	36
10	24	Double	116	0
11	28	Double	116	0
12	32	Double	116	0

Printed text pages used as test cases include 116 words. Let us consider each word in printed page as text. Prototype converts texts in to speech. Table 1 shows text to speech conversion ratio under each test case. Figure 4 to figure 10 are based on the results in table 1. Figure 4 shows the results of case 1 to case 3, results shows for font size 12 the number of texts converted to speech is 0%. Similar results are reported for font size less than 12. Figure 4, figure 5 and figure 6 shows results of case 4, case 5 and case 6, results shows for font size 14 and line spacing single, 1.5 and double the number of texts converted to speech is 0%, 4% and 13%. Figure 7, figure 8 and figure 9 shows results of case 7, case 8 and case 9, results shows for font size 20 and line spacing single, 1.5 and double the number of texts converted to speech is 9%, 32% and 69%.This shows increase in font size and line spacing produces better output. Figure 10 shows results of case 10 , case 11 and case 12, results shows for font size 24, 28, 32 and line spacing double the number of texts converted to speech is 100%.This shows increase in font size and line spacing produces better output. Results show that the prototype is better in converting text to audio in case 10, case 11 and case 12 compared to other test cases. This is because font size, line spacing and quality of image affect OCR software in recognition of text in printed materials.

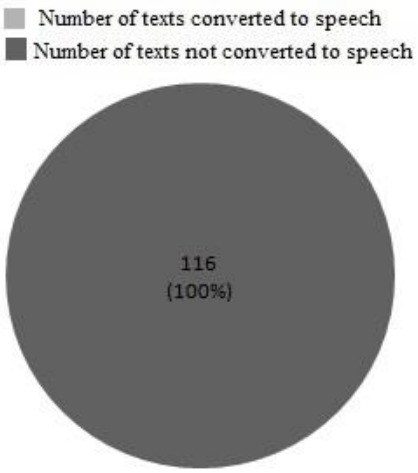

Fig 4: Results of case 1 to case 4

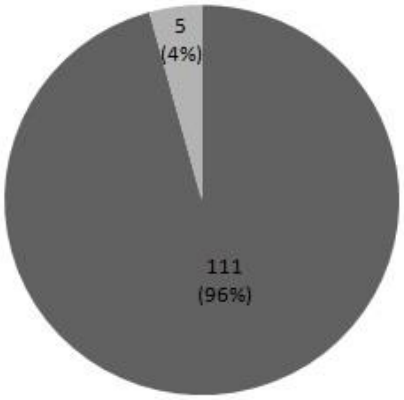

Fig 5: Result of case 5

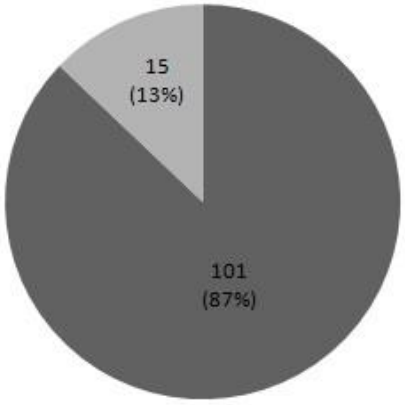

Fig 6: Result of case 6

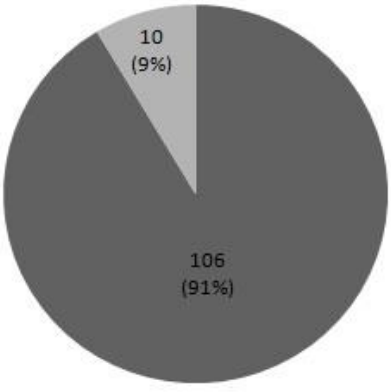

Fig 7: Result of case 7

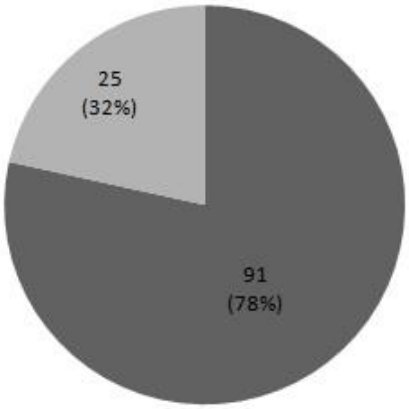

Fig 8: Result of case 8

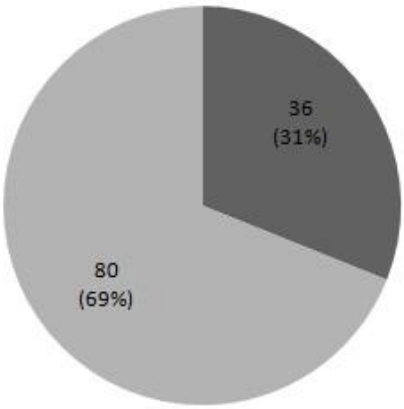

Fig 9: Result of case 9

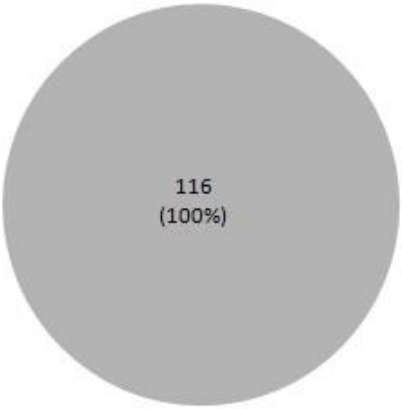

Fig 10: Results of case 10 to 12

6. Conclusion

Prototype for helping visually impaired person in reading printed learning materials is developed using Rasperry PI. Tesseract an open source OCR engine is used to convert printed text to machine encoded text. Text-to-speech conversion software is used to covert machine encoded text to audio. Experiments are conducted to evaluate the prototype using printed text of various font size and line spacing. Results show proposed prototype gives promising solution in converting printed text to audio and helps visually impaired persons in reading printed learning materials.

References

[1] Ashwini V. Mhaske and Mahesh S. Sadavarte "Portable Camera Based Assistive Text Reading from Hand Held Objects for Blind Person", *International Journal of Advanced Research in Computer and Communication Engineering*, Vol. 5, Issue 6, pp. 625-628, 2016.

[2] Aaron James S, Sanjana S, Monisha M, " CR based automatic book reader for the visually impaired using Raspberry PI", *International Journal of Innovative Research in Computer and Communication Engineering*, Vol. 4,Issue 7, pp. 1111-1118, 2016.

[3] Ajantha Devi V, Santhosh Baboo S, "Embedded Optical Character Recognition on Tamil Text Image using Raspberry PI", *International Journal of Computer Science Trends and Technology (IJCST)*, vol. 2, issue 4, pp. 127-131,2014.

[4] Chucai Yi, and Yingli Tian, "Assistive Text Reading from Complex Background for Blind Persons", *International Workshop on Camera-Based Document Analysis and Recognition*, LNCS 7139, pp. 15–28, 2012.

[5] H. Saleous, A. Shaikh, R. Gupta and Sagahyroon, A, "Read2Me: A cloud-based reading aid for the visually impaired," *2016 International Conference on Industrial Informatics and Computer Systems (CIICS), Sharjah*, pp. 1-6, 2016.

[6] Komala Mohan Kalbhor, and Kale, S.D, " A Survey on Portable Camera-Based Assistive Text and Product Label Reading From Hand-Held Objects for Blind Persons", *International Research Journal of Engineering and Technology*, vol. 4, issue 03, pp. 53-57, 2017.

[7] Mallapa D Gurav, Shruti S Salimath, Shruti B Hatti, Vijayalaxmi, I. Byakod, and Shivaleela Kanade," B-LIGHT: A Reading aid for the Blind People using OCR and OpenCV", *International Journal of Scientific Research Engineering & Technology*, vol. 6, issue 5, 2017, pp. 546-548.

[8] Michael J Tobin, and Eileen W Hill, "Is literacy for blind people under threat? Does braille have a future," *British Journal of Visual Impairment*, vol. 33, issue 3, pp. 239-250, 2015.

[9] Velmurugan D, Sonam M.S, Umamaheswari S, Parthasarathy S, Arun K.R, "A Smart Reader for Visually Impaired People Using Raspberry PI", *International Journal of Engineering Science and Computing*, vol. 6, Issue 3, pp. 2997-3001, 2016.

[10] G. Ramprabu, S. Nagarajan, "Design and Analysis of Novel Modified Cross Layer Controller for WMSN", Indian Journal of Science and Technology, Vol 8(5), March 2015, pp.438-444.

.