Middle-East Journal of Scientific Research 24 (S1): 96-100, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.S1.22

A Refreshable Braille Display for the Interaction with Deafblind People

P.G. Anuradha

Student, Embedded System Technologies, Department of Electronics and Communication Sri Sairam Engineering College Chennai, India

Abstract: This project proposes to design and implement an assistive communication device for the Deafblind. Deafblindness is an impairment involving varying degrees of loss in hearing and vision. The main objective of this project is to design a low cost communication device that is affordable by the common man. To do this, an inexpensive Refreshable Braille display is designed using servo mechanism. Two way communications both face to face and long distance communication, between a Deafblind person and a non-disabled person is possible. An additional feature involves the integration of a camera used by the Deafblind to capture an image, e-mail it and gain information about the image.

Key words: Deafblindness · Refreshable Braille display · Communication device

INTRODUCTION

According to a survey conducted by Sense India there are around 444, 000 people who suffer from Deafblindness. Deafblindness is the condition where a person has varying degrees of hearing and vision loss. Hence for such a person communication is very difficult. A deafblind person has to use other senses such as tactile sense to be able to interact with the world. A person being born with Deafblindness, called congenital Deafblindness will find it very difficult to learn any form of interaction as they would not understand any language. Hence such a person can easily be misunderstood as to have autism or be mentally retarded. A person who begins to lose their sense of hearing and vision overtime, called acquired Deafblindness has a number of options to communicate such as sign language, Braille or moon since they already know some language of communication[1]. The most common form of communication with the Deafblind has been through Braille.

The braille system invented by louis braille is used by the blind to read and write. Each alphabet, number and punctuation is represented in braille by the use of a 3x2 matrix of raised dots as shown in figure 1. The six raised dots together form a braille cell. The blind person feels the pattern of the raised dots with a finger to read the corresponding text. There are two grades of braille. In grade i each letter is represented by its own braille code. Grade i is easy to learn and can be used to have a conversation. In grade ii braille, contractions are used. Grade ii is used when the content of text is large such as a book. The use of contractions makes grade ii braille difficult to read and needs special education. The art of writing braille is accomplished using many ways such as a slate and stylus, a braille embosser connected to a computer or a perkins brailler.

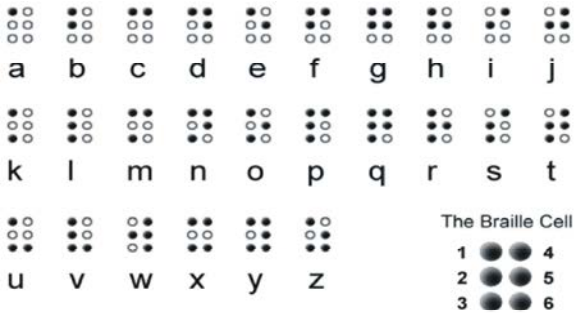


Fig. 1: The Braille Alphabet

As technology grows, assistive devices for the Deafblind keep evolving. Over the years, many devices based on wearable technology have been developed, both to learn Braille and to communicate with it, such as the approaches proposed by Germagnoli *et al.*, 1993 [2] and Rastogi *et al.*, 2015. Another approach that enables the deafblind to communicate over Skype has been proposed by Ohtsuka *et al.*, 2012 [3]. Computers have played an important role in converting any form of input

Corresponding Author: P.G. Anuradha, Student, Embedded System Technologies, Department of Electronics and Communication Sri Sairam Engineering College, Chennai, India.

such as speech, text or images into Braille as applied in approaches proposed by Chung *et al.*, 2002 [4] and Sarkar *et al.*, 2013 [5]. Stand alone devices such as the one proposed by Su *et al.*, 2001 [6] has brought portability into the picture by use of RF transmitters. A communication device proposed by Ramirez-Garibay *et al.*, 2014 [7] uses the current technologies but are very expensive due to the use of refreshable Braille displays that cost between ?1lakh – ?2lakhs. A simpler and less expensive Braille display has been proposed by Wang *et al.*, 2012 [8] to be used as an eBook reader. The objective of this project is to provide the Deafblind people with a communication device that is easy to use and affordable by the common man. The proposed system consists of two units. The Normal unit consists of a QWERTY keyboard used by the non-disabled person to enter text, a 16x2 LCD used to display the text entered by a deafblind person, which can be read by the nondisabled person and a loudspeaker which relays the text converted into speech to a larger audience. The Braille unit consists of a Braille keypad consisting of 6 keys to enter the Braille characters. Additional keys have been provided to serve as a spacebar, Enter key and camera capture. A Braille display is designed using servo motors to raise the dots. This arrangement ensures that the cost of the device is minimum. A camera module is provided so that the deaflblind person can capture an image of the surroundings and transmit it to a remote person, who in turn can provide a description of the image back to the deafblind person. This makes the deafblind person be aware of the surroundings and also gain information about anything of interest.

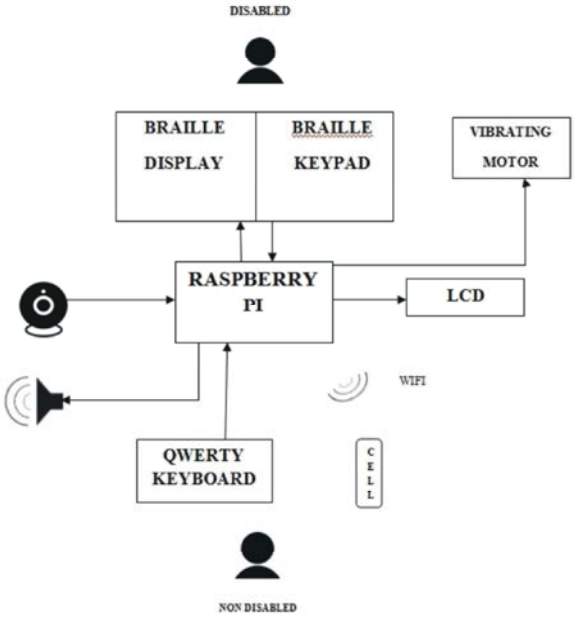


Fig. 2: Block Diagram

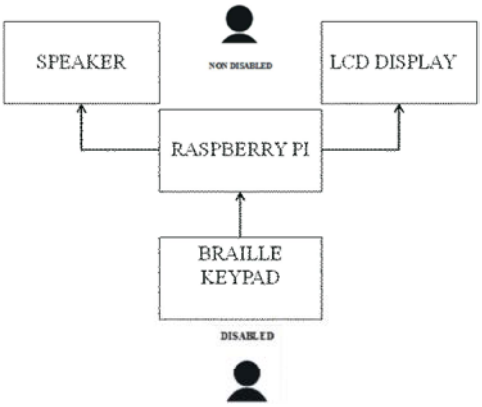


Fig. 3: Deafblind to Non-disabled communication

MATERIALS AND METHODS

Work Flow: The proposed system aims to provide the Deafblind with a communication device that is affordable and easy to use. The block diagram is depicted in Figure 2.

Communication from a Deafblind person to a non-disabled person is shown in Figure 3. A Bluetooth QWERTY keyboard is used to enter a message by a non disabled person. This text is converted into Braille characters and displayed on a Braille display.A 16x2 LCD is used to display the text entered by a deafblind person on a Braille keypad, which can be read by the nondisabled person.A loudspeaker is used which relays the text converted into speech to a larger audience.

Communication from a Non-disabled person to a Deafblind person is shown in Figure 4.A Braille keypad which consists of 6 keys is used to enter the Braille characters to convey a message by a deafblind person. A Braille display is designed using servo motors, which is used by the Deafblind to read the text received. This arrangement ensures that the cost of the device is kept low.

Communication via E-mail is depicted in Figure 5. A camera module is provided so that the deafblind person can capture an image of the surroundings and transmit it to a remote person via email. An image is captured and automatically emailed to previously specified email IDs by the click of just one key. Corresponding Flowchart is given in Figure 6(a). The text entered on the Braille keypad

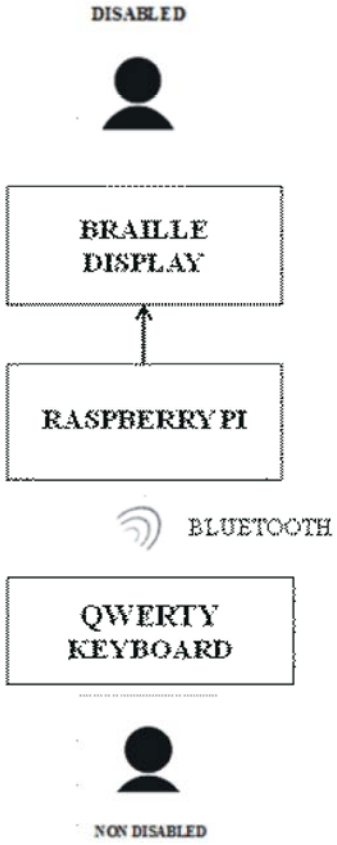


Fig. 4: Non-disabled Deafblind to communication

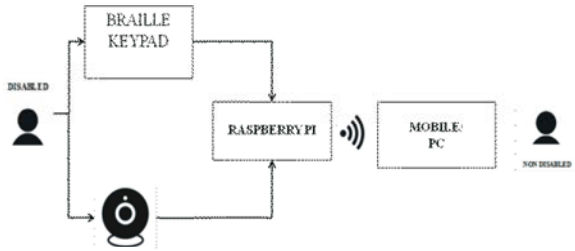


Fig. 5: Communication via E-mail

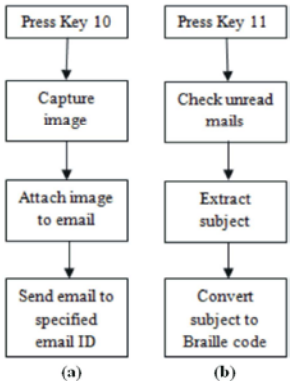


Fig. 6: (a)Flow chart to capture and send email (b)Flow chart to check mail

is attached to the E-mail as the subject. The non-disabled person on receiving the email can provide a suitable reply back to the deafblind person via email. The contents of this email are read by the Deafblind person on the Braille display. Corresponding Flowchart is given in Figure 6(b). This makes the deafblind person be aware of the surroundings and also gain information about anything of interest.

Hardware Components

Processor: To meet the power, cost and portability requirements of the communication device, the Raspberry pi 2 a mini computer sporting a Broadcom BCM2836 SOC which includes an ARM Cortex-A7 processor is chosen. With inbuilt USB port, AV jack and several other interfaces, the addition of more applications is easily possible. The raspberry pi board is shown in Figure 7.

Fig. 7: The Raspberry Pi2

Braille Display: The Braille display consists of a single Braille cell driven by servo motors. The display was designed keeping in mind to reduce the cost of the system as most of the store-bought refreshable Braille displays are very expensive. The use of a single Braille cell is advantages as the text can be read without moving the finger, which can cause errors in reading the Braille cells.

Braille Keypad: The Braille keypad has a layout similar to a Braille cell, instead of a Perkins keyboard layout used in the previous approaches. Use of this layout removes the need to remember the combinations of all the characters to type a word. Having the Braille display and the Braille keyboard layout similar will be easier and faster to operate.

Camera: The raspberry pi camera module is a custom add-on camera to the raspberry pi2. The camera with dimensions of 25mmx20mmx9mm, weighing 3g is capable of taking still photographs and videos of 5Megapixels resolution. The camera module is attached to the CSI interface using a ribbon cable.

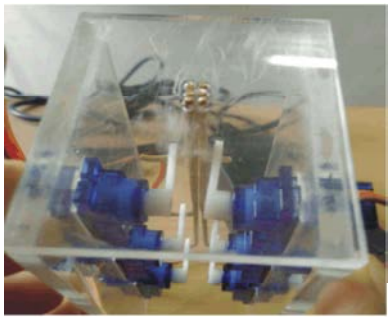
Speaker: A speaker is connected to the AV jack of the raspberry pi2. The text entered by the deafblind person is converted into speech using a text to speech synthesizer. The speaker gets the attention of the non-disabled person if they are far away. It is also useful for addressing a large audience.

LCD Display: A 16x2 Liquid Crystal Display is used to display the text entered by the deafblind person. The LCD is an economical display and is also easy to program. Since the text being displayed is from an ongoing conversation, the Sentences will be short and can easily be read from a 16x2 LCD.

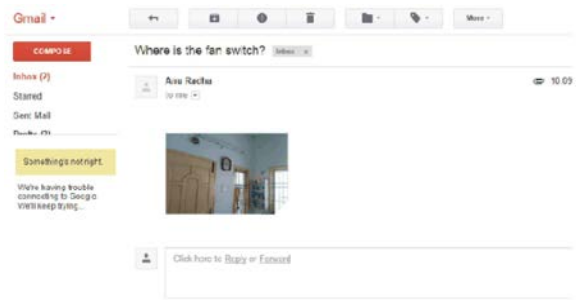
RESULTS AND DISCUSSION

The design proposed above has been implemented and yielded the following results. The words entered on the Braille keypad are displayed on an LCD and heard through the speaker shown in Figure 8(a). The words entered on a QWERTY keyboard are converted into Braille code read by the Deafblind person on the Refreshable Braille display as shown in Figure 8(b). By pressing the Sendmail key on the Braille keypad a photo is taken and sent by E-mail to a pre-specified E-mail address along with a subject. An E-mail containing an attached image, sent from the device is shown in Figure 8(c). By pressing the Checkmail key on the Braille keypad, the Gmail inbox is checked for new E-mails and the subject of the E-mail is extracted and converted into Braille. The extracted subject is shown in Figure 8(d).

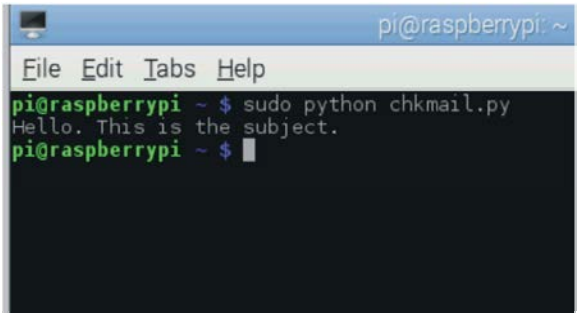
(a)



(b)



(c)



(d)

Fig. 8: (a) Braille keypad (b) Braille display (c) E-mail sent with Image attached (d) Extracted subject of the received E-mail

CONCLUSION

Even though the population of Deafblind people is low, it should not be forgotten that they are also a part of our society. This device uses popular technologies to help the physically challenged to involve themselves more in the society and not feel ostracized from it. The deafblind community who are always at a disadvantage can communicate with the world more effectively using this device. Special education schools can use this device to educate the young deafblind children thus enabling them to be a more integral part of

the society. The deafblind person can also address a gathering using the loudspeaker. The deafblind person can become aware of his surroundings by using the camera to capture images of his surroundings and ask questions about it. The cost of the device is comparatively much cheaper than the existing devices, making the device affordable to the common man.

REFERENCES

1. Germagnoi, F. and G. Magenes, 1993. University of Pavia, (1993) " A computerized system for helping blind people to learn Braille code", Engineering in Medicine and Biology Society, 1993. Proceedings of the 15th Annual International Conference of the IEEE, pp: 1318-1319.
2. Rohit Rastogi, Shashank Mittal and Sajan Agarwal, 2015. "A novel approach for communication among Blind, Deaf and Dumb people", Computing for Sustainable Global Development (INDIACom), 2015 2nd International Conference, pp: 605-610.
3. Ramirez-Garibay, F., C. Millan Olivarria, A.F. Eufracio Aguilera and J.C. Huegel, 2014. "MyVox—Device for the communication between people: blind, deaf, deaf-blind and unimpaired.", IEEE Global Humanitarian Technology Conference, pp: 506-509.
4. Ohtsuka, S., S. Hasegawa, N. Sasaki and T. Harakawa, 2001. "Helen Keller Phone-a communication system for deaf-blind people using Body-Braille and Skype." in 2012 IEEE consumer communications and networking conference(CCNC). IEEE, pp: 30-31.
5. Jong-Moon Chung., K. Ramasamy, V. Kotikalapudi and Z. Mulla, 2002. " Virtual laboratory education for persons with vision disabilities", Circuits and Systems, 2002. MWSCAS-2002. The 2002 45th Midwest Symposium, pp: II-617 - II-620 vol.2 http://www.lagardecommunication.com/Deafblind/screenbraillecommunicator_en.html.
6. Mu-Chun Su, Chia-Yi Chen, Shi-Yong Su, Chien-Hsing Chou, Hsiang-Feng Hsiu and Yu-Chine Wang, 2001. "A Portable Communication Aid for Deaf-Blind People", Computing and Control Engineering Journal, 12(1): 37-43.
7. Mingjie Wang, Rajarshi Roy, 2012. "Portable refreshable Braille display", Research Gate Publications6] Mu-Chun Su, Chia-Yi Chen, Shi-Yong Su, Chien-Hsing Chou, Hsiang-Feng Hsiu and Yu-Chine Wang, (2001) "A Portable Communication Aid for Deaf-Blind People", Computing and Control Engineering Journal, 12(1): 37-43.
8. Ruman Sarkar, Smita Das and Sharmistha Roy, 2013. "SPARSHA: A Low Cost Refreshable Braille for Deaf-Blind People for Communication with Deaf-Blind and Non-disabled Persons.", 9th International Conference, ICDCIT 2013, Bhubaneswar, India.