

UJWALITHA: An Electronic Digital Support Device for Visually Impaired-A Review

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Abstract— Braille is the composition of dots representing the various alphabets which will enable the visually impaired to read. People with visual impairments cannot read or visualize in their daily lives, they deal with several issues, including dependency, communication, transportation, and societal stigma. The goal is to create a digital assistance tool that can transform sign language into text and speech, facilitating communication between the public and groups of people who are blind. Using the latest technology and the availability of an Embedded board with a built-in advanced feature that allows real-time computation of the images and application of AI, the proposed approach will convert the text in the images into braille to help the blind to read the information in real-time the information is transformed into textual content and sent to the braille device. The Braille documents can be printed on a reusable screen or a refreshable screen, this reduces the paper cost and allows more files to be available to disabled people stimulating learning. This research presents a method where the normal text and sign board can be scanned, and it will be processed to generate the braille equivalent file. These files are used by the digital supporting device to generate braille literature on a refreshable screen of Braille embossed dots segmentation for Braille document images.

Index Terms— Braille, digital support device, computer vision, AI

I. INTRODUCTION

A recent survey has predicted that about 15-20% of the world population and About 35 million Indians are visually impaired people[1] with blind disability face major issues while reading and communicating because of which they are deprived of leisure's experienced by majority of population in order to get the community in main stream it is important to make people read and understand which will lead them to be aware of current scenario and act accordingly. So it is necessary to create a platform that will make them to read on their own ability. Even though braille script is available for deaf and dumb the documents that are in braille script are very limited which hinders the learning abilities of deaf and dumb. To overcome these constraints we need a gadget which will generate a braille document taking normal document as a reference.

The proposed digital support system will generate the engraved braille script on the surface of the gadget

corresponding to the text image or the digital document provided as the input image. The input image is de-noised using a suitable filtering technique. The characters in the text are individually extracted and compared with the text in the braille database and a braille equivalent script for the said character is generated. The process is continued to generate the braille script. This braille script is loaded into a digital device which will engrave the braille script on the surface of the user interface which will enable the deaf and dumb to feel and understand text documents.

II. LITERATURE REVIEW

In this paper, authors have developed a handheld volatile device named finger eye for reading the text. The system consists of a camera placed on the tip of a finger and an interface electrode of a braille display. The device is placed on the finger of a blind person to capture and process the images using the OCR method. The device on the fingertip of a blind person generates the braille to audio which is audible to the blind through the device; he can understand the content in the book or related material. This device will overcome the limitations of mechanical devices. The main aim of study is to help the blind to translate and text to braille in location, enabling the blind to move freely [2]. The paper presents the automatic device that is developed to convert any form of digital text to braille. The device is developed using a microcontroller that is interfaced to a customized device that will enable blind people to read the content. The system uses a microcontroller connected to a special device that can be read by blind persons. Software is developed to implement the device using FSM [3]. Globally, the number of people suffering from visual disorder is increasing continuously. These visually challenged people depend on the audio devices or tactile devices to identify and recognize the objects surrounding them. However, the infrastructure that is built to facilitate blind people is limited to certain areas globally, restricting the blind from smooth movement. The author has proposed an assistance device with the integration of various image processing algorithms and braille conversion. The device consists of a device that captures the image; the shape of the image is felt by the user using a braille display pad that is built with 100 objects that are frequently overcome by the people in their regular commute. The evaluation of the device proved that the assistance device has the accuracy of 85% with 6.6 sec of conversion latency [4]. The paper identified the requirement of a braille tab that will make the visually challenged people independent and help them in reading the text document, enable them to use social media and chat on the online platforms and also performing various other activities online. The tab should also help the blind to read the books and interact with digital devices through some modes of interfacing with the mobile phones or tablets [5]. In this paper, the author proposes a device that will replace the physical text book of braille text. The device is a refreshable display which will reduce the burden of printing the braille text book. The paper will discuss about the design of a system that will help the visually impaired to read the normal text book without having any inconvenience. In the proposed system, the e-books available in the internet are converted into braille text using some solenoid valves interfaced to the Node MCU which provides internet access to interact with web resources [6].

Braille literature is mainly categorized into two types as uncontracted (grade 2) and the contracted (grade 1), to understand the grade 2 braille script one must be thorough with the contracted braille literature. The reading abilities of contracted braille and uncontracted braille students was not of much difference; however, the uncontracted braille is preferred for better early reading skills [7]. A hardware-software approach stimulates the usage of braille script blended with modern technology, retaining the values of traditional braille script that helps in improvement of braille literacy. The braille-based tools will provide motivation for blind to acquire better fingertip reading skills [8]. The system helps anyone without the knowledge of braille to communicate with blind people. Braille recognition is carried out with two steps, identifying the cell and translation to natural language. The cell recognition is carried out using image processing techniques like image acquisition, pre-processing images, segmentation of cells, identification of dots. The images are obtained from scanners, pre-processing involves grey scale image generation; De-noising, binary data for dot identification is used. In translation block, it converts the segmented dots into equivalent natural language; the grids with six parts are formed from the dots based on its presence. Experiments are carried out on numerous scripting language with images obtained from the scanners, however, no work is carried out on images from digital cameras as source as well as usage of artificial intelligence techniques in image processing is limited [9].

The blind people will be able to read the digital inputs produced by the computer through a braille display made up of the solenoids that enable the dots in the braille display based on input character produced by the computer. The solenoids actuate the linear movement as per the instructions produced by the Arduino uno. The device with 6 solenoids generates a single braille character that is physically felt and identified by blind. The devices are cost effective and used to educate the visually challenged people thereby helping blind to get educated and make them independent in the society [10]. In this paper, the author has stated 7 different types of braille character entry procedure

based on contact and gesture. The different techniques were evaluated for its quickness and precision. Quickness is measured based on number of characters entered per second and precision is measured based on the input errors. Author after study concludes that there no single technique for braille character entry that will provide higher speed and higher precision simultaneously rather there is trade-off between each of parameters opening scope for future area of research [11]

The image in the form of braille is converted into corresponding character so the normal people can understand the braille [12]

A single character display is developed that is refreshable and cost effective and flexible to use communicated through IOT technology. This device helps the blind to read the braille text and train them remotely [13]

The author in the paper has discussed about the various ways through which the visually impaired can provide their input and generate the braille equivalent information with respect to usability and access. Author has discussed about some input devices which has limitations in identifying the characters with different styles or fonts affecting the usability of the device. However author has compared the braille touch, Edge and Enter for its efficiency, user convenience and its accuracy concluded suggesting for requirement of a robust device that will reduce the burden on visually impaired people [14]

This paper proposes an refreshable display for braille literature for blind and deaf. This makes the device handy and affordable reducing the size of the device and helping blind to read any type of document. The device is portable device that can be carried anywhere during the commute. The device will help blind to recognise the sign board and obstacles during the commute by determining the distance between the obstacles. [15].

Author here has discussed and reviewed about the gestures that are used by the visually impaired to use the smartphone. Author also suggests the limitation in number of existing gestures and improvement required in gestures to make the usability of mobile phones hassle free for blind people. Author also recommends increasing the different modes of input to the smartphone apps so that usability of smartphones by blind can be increased.[16]

III. METHODOLOGY

Input image: The document in the form of image that must be converted to braille script can be sourced from textbook, PDF documents or any other forms of digital document or images that can captured in real time these input images will be the input for the system that can be converted into braille equivalent.

De-noising: The filter is chosen such a way that the original properties of the document remain intact. In The very first step in the process is to clean up the given input sample by proper filtering process this proposed project we use median filter to extract the de-noised image.

Feature extraction and database creation: an image comprises of both useful feature as well as unwanted empty spaces. To limit the size of data only useful features are extracted from the input image and processed to obtain required features such as characters, numbers, empty spaces etc. From the image the extracted feature are then compared with normal to braille script database to convert the text in the image to braille script

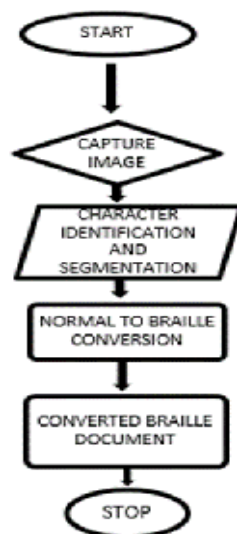


Figure1: Process flow of image to braille

Text to braille conversion: The figure 1 shows the process flow of converting a text file to braille script the process consists of capture image block which takes the given input in the form of image, filters it for the noise and provides feature extracted de-noised image. The segmentations block allows us to focus on the characters and number by eliminating the unwanted areas such as empty spaces, commas, etc. The segmented image is fed into the character identification block where the character in the image are captured and compared with the database and it is mapped to the corresponding braille equivalent of a character in the process braille equivalent of a sentence is generated. In the binarization block of figure 2 the braille script generated will be converted into specific binary values in the process it generates a valid braille script without noise. The output block is the major section of the proposed work it consists of coordinate extraction unit which will generate X, Y coordinates for each of the digital values 1/0 during binarization that must be represented in the form of braille script in the digital support device in the digital support device is a handheld device which will interpret the character or numbers in the image to braille script

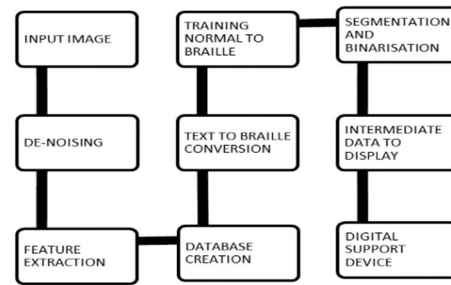


Figure 2: Block diagram representing image to engraved braille script generation.

Digital support device

The proposed Digital support device is the refreshable device that generates the braille equivalent of the braille script generated in the binarization block. The digital support device consists of movable X and Y axis controlled by the stepper motors based on input received from the controller as in figure 3. The digital support device is designed using numerical CNC with arduino that controls the coordinates. Braille printer head is placed on top of movable rotor. The printer head identifies character at time and imprints the character on display unit pushing specific dots up which will be felt by the visually impaired persons. Printer head continuously imprints the character on the slate enabling the blind to read the text continuously. The device increases the speed of readability of the blind. One the entire sentence is read he erase the entire sentence and continue reading other sentence that are printed thereby making the gadget affordable and user friendly.

The control unit controls the operation of engraving the braille script on the display. The control unit sends the control signal specifically the x,y coordinate data to the stepper motor to manage the printing in specific area. Meanwhile printer head control consists of magnetic pins to that generates the braille character according to the input data and engraves on the refreshable screen. The refreshable screen is made of mechanical push pull pins with the dimension of the braille character. The pins in the printer head mechanically pushes the pins so that character is engraved which are felt and identified by the blind speed of the device is decided by the printer head.

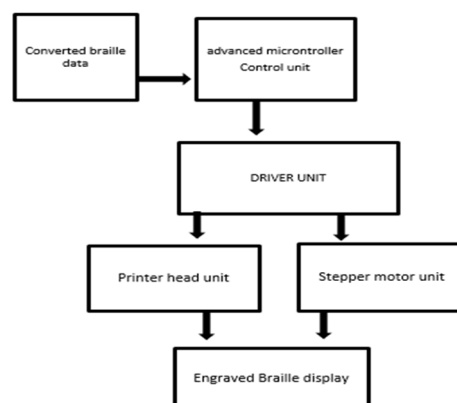


Figure 3: Block diagram representing generation of engraved braille script

IV. CONCLUSION

The goal is to provide a solution to the visually community to enable them to read scripts from a textbook or any other digital document. It is intended to generate a braille script for documents that are available in normal form. The entire proposed projects main motive is to bring the visually impaired students to mainstream of the society by educating them in all aspects. The proposed digital device will be tested with target people and its efficiency will be evaluated and same product can be patented as well as technology can be provided to mass manufacture the device and distribute to the dumb and deaf students.

The purpose of this project is to design a digital support device to help the blind community to communicate effectively with the rest of the world. Despite their inability to read and communicate, people who are visually impaired can pursue an education.

REFERENCES

- [1] National Programme for Control of Blindness and Visual Impairment, National Blindness & Visual Impairment Survey India 2015-2019-A Summary Report. Available from: <https://npcbvi.gov.in/writeReadData/mainlinkFile/File341.pdf>.
- [2] Z. Liu, Y. Luo, J. Cordero, N. Zhao and Y. Shen, "Finger-eye: A wearable text reading assistive system for the blind and visually impaired," 2016 IEEE International Conference on Real-time Computing and Robotics (RCAR), Angkor Wat, Cambodia, 2016, pp. 123-128, doi: 10.1109/RCAR.2016.7784012.
- [3] Moise, Adrian & Bucur, Gabriela & Popescu, Cristina. (2017). Automatic system for text to Braille conversion. 1-6. 10.1109/ECAI.2017.8166391.
- [4] Lee D, Cho J. Automatic Object Detection Algorithm-Based Braille Image Generation System for the Recognition of Real-Life Obstacles for Visually Impaired People. *Sensors*. 2022; 22(4):1601. <https://doi.org/10.3390/s22041601>
- [5] A. Gote, T. Kulkarni, S. Jha and S. Gupta, "A Review of Literature on Braille Tab and the Underlying Technology," 2020 5th International Conference on Devices, Circuits and Systems (ICDCS), Coimbatore, India, 2020, pp. 333-335, doi: 10.1109/ICDCS48716.2020.243611.
- [6] Rao Krishna Virinchi; Paulson K Antony; Shreyaa Saravanan; V Dhakshain Balaji; Vaishnavi Suresh Titled "Design And Analysis Of A System To Read Braille With Remote Cloud Architecture"
- [7] The Impact of Early Exposure to Uncontracted Braille Reading on Students with Visual Impairments by Sunggye Hong and Jane N. Erin
- [8] The Today and Tomorrow of Braille Learning J. Guerreiro1 , D. Gonçalves1 , D. Marques2 , T. Guerreiro2 , H. Nicolau3 , K. Montague3 1 INESC-ID, 2 LaSIGE , 3University of Dundee joao.p.guerreiro@ist.utl.pt, daniel.goncalves@inesc-id.pt, {dmarques, tjvg}@di.fc.ul.pt, {hugonicolau, kylemontague}@computing.dundee.ac.uk
- [9] A Review of Optical Braille Recognition, Samer Isayed and Radwan Tahboub Deanship of Scientific Research Master of Informatics Palestine Polytechnic University Hebron, Palestine {samers, radwant} @ppu.edu
- [10] A Cost Effective Electronic Braille for Visually Impaired Individuals Md. Ehtesham Adnan, Noor Muhammad Dastagir, Jafrina Jabin, Ahmed Masud Chowdhury, Mohammad Rezaul Islam Department of Electrical and Computer Engineering, North South University, Dhaka, Bangladesh 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC) 21 - 23 Dec 2017, Dhaka, Bangladesh
- [11] Braille Text Entry on Smartphones: A Systematic Review of the Literature Joyce Siqueira, Fabrizzio Alphonsus Alves de Melo Nunes Soares, Deller James Ferreira, Cleyton Rafael Gomes Silva, Luciana de Oliveira Berretta, Cristiane Bastos Rocha Ferreira, Igor Moreira Félix, Anderson da Silva Soares, Ronaldo Martins da Costa and Mateus Machado Luna Instituto de Informática Universidade Federal de Goiás Goiânia - Goiás - Brasil Email: {joyces, fabrizzio, deller, cleytonrafael, luciana, cristiane, igorfelix01, anderson, ronaldocosta}@inf.ufg.br and mateus.m.luna@gmail.com 2016 IEEE 40th Annual Computer Software and Applications Conference
- [12] Braille Image Recognition for Beginners Shafaf Ibrahim, Nor Azrin Tarmizi, Nurbaiti Sabri, Nur Farahin Mohd Johari, Ahmad Firdaus Ahmad Fadzil Faculty of Computer and Mathematical Sciences Universiti Teknologi MARA (UiTM) Melaka, Kampus Jasin 77300 Merlimau, Melaka, Malaysia 2018 9th IEEE Control and System Graduate Research Colloquium (ICSGRC 2018), 3 - 4 August 2018, Shah Alam, Malaysia
- [13] An IoT Braille Display towards Assisting Visually Impaired Students in Mexico † Oscar I. Ramos-García 1 , Anuar A. Vuelas-Alvarado 1 , Néstor A. Osorio-Pérez 1 , Miguel Á. Ruiz-Torres 1 , Fermín Estrada-González 1 , Laura S. Gaytan-Lugo 2 , Silvia B. Fajardo-Flores 1 and Pedro C. Santana-Mancilla 1,
- [14] Sana Shokat, Rabia Riaz, Sanam Shahla Rizvi, Khalil Khan, Farina Riaz, Se Jin Kwon, "Analysis and Evaluation of Braille to Text Conversion Methods", *Mobile Information Systems*, vol. 2020, Article ID 3461651, 14 pages, 2020. <https://doi.org/10.1155/2020/3461651>
- [15] "BLIND ASSISTANCE SYSTEM USING REFRESHABLE BRAILLE DISPLAY", *International Journal of Emerging Technologies and Innovative Research (www.jetir.org)*, ISSN:2349-5162, Vol.6, Issue 5, page no.253-255, May-2019, Available :<http://www.jetir.org/papers/JETIRBV06054.pdf>
- [16] International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-8 June, 2019 Gesture Design for Visually Impaired People on Mobile Platforms: A Systematic Literature Review Nor Azman Ismail, Yohgamalar N. G, Md. Sah Salam