Development of Low cost 6 Dot Unicode Braille printer for aiding visually impaired persons

A Mohamed Ismail¹, K Yuvaraj², S Vigneswaran³ and P Nagarajan⁴

1,2,3 & 4 Assistant Professor, Bannari Amman Institute of Technology, Department of Mechatronics, Sathyamangalam, Tamilnadu, India.

mohamedismail@bitsathy.ac.in, yuvarajk@bitsathy.ac.in,
vigneshwaran@bitsathy.ac.in, nagarajanp@bitsathy.ac.in

Abstract. Numbers of Visually impaired persons are suffering a lot for communicating their thoughts. Braille literacy is not affordable to all since the printers are expensive which costs roughly one Lakhs. This work aims to develop a braille embosser for the affordable price which embosses the A4 size sheet with braille code. Arduino Uno controller is employed to control the angular position of the stepper motor. The input is given as text format to the serial monitor of the arduino IDE. The input texts are converted into Unicode in order to get the corresponding braille code. With the help of stepper motors code is printed on the paper.

Keywords: Braille Printer, Arduino UNO, Braille code, Stepper motors, affordable cost.

1. Introduction

Around 36 million people are visually impaired in this universe more than 80% of people among them are in below the poverty line. The visually impaired people can read and write using a set of 3x2 matrixes of 6 dots which is called as Braille code as shown in Figure 1. Number of commercial Braille printers is available today for aiding the needy persons but they are not affordable to all as it is much expensive. It is decided to make an efficient, cheap and user friendly Braille printer. Generally there are two ways of creating a product which may be either creating from scratch or modifying the already existing system. In this project, the Braille printer is made from the scratch by making use of some spare parts from the old printer. It is developed in such a way that the printer can print what the text given by the user in the sheet. In some existing method the text is given directly to the arduino board using serial communication and then same text is converted [7].

In the proposed system, the GUI is created in which the user can type what he wants to print as Braille code. Advanced Braille printing devices are being developed with object character recognition technology where the text can be recognized with mobile applications [4]. Two step algorithm is implemented where the word is recognized from the continuous speech with the received signal by comparing token passing and baseline algorithms[9] New Braille printer are also developed where the graphical data can also be represented by using edge detection technology to print the images in A4 paper[5].While considering the accuracy on papers researches made trial and error with various papers such as bond paper, A4 sheet, butter paper and thin billing papers and found that billing paper are recommended as the impressions were good comparatively[1].
2. Methodology

The product is developed in such a way, where the entered text is processed and converted the text into Braille format further the Braille code is printed on the sheet. This requires an arduino mega and ramps board for accessing the entered text and convert that into Braille code. Figure 2 shows the block diagram of the motor actuating concept.

![Image](image_url)

**Figure 2.** Block diagram of the motors control with Arduino

2.1. Text to Braille conversion

- The GUI which we created based on python script will open a text box where we have to enter the text.
- The entered text will be saved in the form of .txt file.
- Clicking on print button the text will be processed and executed by the python script.
- After the completion of execution the corresponding Gcode will be created with the file name of .gcode.
- The GUI ask for permission to send gcode file to arduino controller, with simply yes or no question
- Proceeding with yes the process of embossing the Braille code will takes place.

The flow chart for the Braille embosser process is shown in Figure 3. The ultimate aim of this work is to provide the common interface to the blind person for the affordable price. Here, the text to Braille code printing system is proposed. In case of voice recognition based Braille printing process, speech is taken as input through microphone. This input speech is processed in the system. Step algorithm is used to convert chopped input into its equivalent binary code [6].

![Image](image_url)

**Figure 1.** Braille code for alphabets
3. Experimental Setup
The software and hardware which are used to develop the Braille printer are discussed below.

3.1 Arduino with marlin firmware
The Marlin is an open source firmware based on arduino platform used to control the activities of motors. The Marlin firmware supports ramps 1.4 board. This was coded to enable or disable various parameters like LCD display, end stops, servo, stepper motor, cooler fans etc. In Configuration.h file some parameters has to be changed before uploading it on the Arduino Mega controller. Pronterface software is a Graphical interface for the user with which one can initialize the printer manually. It has more added features of controlling the print speed. It is hosted by Printrun software application. Pronterface GUI page is shown in Figure 4.

3.2 Text to braille.py
This script developed to convert text entered to G-codes. After conversion it will be in G-code format. When print button is clicked in GUI, text_to_braille script is executed and G-code file is created, after file is created, GUI send G-code file to the arduino through serial port. The coding is done with python language as shown in Figure 5.
3.3 Hardware Interface
The Electronic hardware components employed in this project consists of 2x Nema 17 motor, Ramps 1.4, Arduino Mega, 12V SMPS power supply and A4988 motor driver. The Circuit connections of those components are shown in Figure 6.

- The Switch Mode Power Supply (SMPS) unit is connected as power supply unit to the system.
- The positive and negative terminals were connected to the corresponding positive and negative ports in the ramps 1.4 board.
- The two Nema 17 motors were connected to the X and Y ports of the ramps board.
- The limit switch is connected to the end stop port of the ramps 1.4.
- The solenoid push pull actuator is connected to the D9 port in the ramps 1.4.

3.4 Paper feeding mechanism
Among the two stepper motors one is used to feed the paper. A smooth rod is attached to the shaft of the stepper motor using the shaft coupling. The rods itself consist of three rubber rollers aligned with equal space in between. Then another rod of sponge roll is fitted to the base of the system freely. When the Y motor gets rotating the paper which was in between these two rods tends to move forward. That is how the paper feeding occurs. Figure 7 shows the mechanism of rollers conveying paper.
3.5 Embossing mechanism
The six Dots Braille Unicode systems is implemented in this system with standard dimension. User can print up to sixty four unique codes [3] with this method. The six dot Unicode pattern with its dimensions is shown in Figure 8.

![Six Dot pattern with dimension](image)

**Figure 8. Six Dot pattern with dimension**

Solenoid is used to provide linear motion through actuator for embossing on the sheet which is shown in figure 9. At the end of the solenoid plunger an embossing pin has attached. The solenoid is made to move freely by the guide rods. The toothed belt has attached to the solenoid which transforms the rotary motion of the X motor into linear motion. The solenoid is initially in Normally Opened (NO) condition which in turn closed while supply is given once. When the correct position is reached the solenoid will get opened and punch the sheet to make a dot. When one row is done then the motor will be actuated to move the sheet forward of about 2.5mm. The moment when a line of text is printed it will move the sheet for 5mm.

![Solenoid to perform Pull, Push tasks](image)

**Figure 9. Solenoid to perform Pull, Push tasks**

4. Braille Printing
- The input text is given through the GUI named as printergui.py
- Entered text is converted into Braille code and it creates the corresponding G code.
- Generated G code is sent to the Arduino controller.
- Arduino controller is enabled with Marlin firmware which is used to perform the printing
operation.

- The controller then controls the stepper motors in order to feed the sheet as well as to coordinate the position of embosser.

The solenoid for push pull action is attached with embosser which has actuated to punch the Braille code on papers. Figure 10 shows the Assembly of hardware components with frame.

![Figure 10. Assembly of hardware components with frame](image)

5. Result and Discussion
The text Welcome is printed in the A4 sheet as shown in Figure 11. The same had tested with visually impaired people which were recognized by them appropriately. Printer casing are made with acrylic sheet which in turn the device is made for the affordable cost. The performance of the proposed work is efficient comparing with the existing printers.

![Figure 11. Embossed paper with the text: welcome](image)

6. Conclusion
The fabrication of a low cost Braille embosser was done with an estimated cost of around Rs.5000. It is used to print the sheets of books, novels as needed by the blind people. The working with this machine is very easy when compared to other commercial printers.

7. Future work
The speech recognized Braille code printing can be implemented in upcoming days. This will be helpful for the visually impaired people to print by themselves without seeking others assistance.

References
[1] S. Padmavati, Nivedita V, Sankari, Raamprashanth.N.S, Rajat Bohra, “Economic Printing of Braille Documents”, International Journal of Emerging Technologies in Computational and Applied Sciences, 8(2), March 2014 - May 2014, pp. 170-173.
[2] Durán Encinas, J. A. Sandoval Bringas, A. I. De Caso Verdugo, C. Sandoval Bringas and J. G. Soto Muñoz, "Low-Cost Braille Printer Prototype Design With OCR Technology," 2019 International Conference on Inclusive Technologies and Education (CONTIE), San Jose del
Cabo, Mexico, 2019, pp. 205-2054, doi: 10.1109/CONTIE49246.2019.00047.

[3] A. K. Garg, "Braille-8 — The unified braille Unicode system: Presenting an ideal unified system around 8-dot Braille Unicode for the braille users world-over," 2016 IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS), Bangalore, 2016, pp. 1-6, doi: 10.1109/ANTS.2016.7947839.

[4] I. Durán Encinas, J. A. Sandoval Bringas, A. I. De Casso Verdugo, C. Sandoval Bringas and J. G. Soto Muñoz, "Low-Cost Braille Printer Prototype Design With OCR Technology," 2019 International Conference on Inclusive Technologies and Education (CONTIE), San Jose del Cabo, Mexico, 2019, pp. 205-2054, doi: 10.1109/CONTIE49246.2019.00047.

[5] Bo Li, Zhiping Wang, Junbiao Liu and Guangrong Fang, "New blind graphic printing technology based on New Braille Printer," 2011 International Conference on Computer Science and Service System (CSSS), Nanjing, 2011, pp. 1403-1406, doi: 10.1109/CSSS.2011.5973931.

[6] Harshali Gangurde, Sayali Pingale, Dipali Pawar, Jyoti Aher, “Braille Printer” International Journal for Research in Engineering Application & Management (IJREAM) Vol-01, Issue 01, APR 2015.

[7] Shwethashree S, Sowmya S K, Sri Ranjini, Vanaja N, Parameshwara M C,” Text Image to Braille Code Converter” International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE) Vol 5, Issue 6, June 2018.

[8] Paul Blenkhorn, “A System for Converting Braille into Print”- 1995, IEEE Transactions on Rehabilitation Engineering. Vol. 3, No. 2.

[9] Cabatabaei,"Methods of reading braille code"- 2015,International Journal for Research in Engineering Application & Management (IJREAM) Vol-01, Issue 01.

[10] Choromanska “Braille coding techniques”-2017,International Journal of Advanced Research in Engineering and Communication Engineering Vol. 6, Issue 4.