

Electronic Progressive Braille Learning Kit for Blind (Low Cost, All Languages and Multiline Braille Screen)

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ABSTRACT

Learning the Braille script is not an easy task for Visually Impaired students. Visually Impaired students have to memorize/remember various patterns of keys of Braille matrix assigned for different letters/words/symbols in Braille script to read and write effectively. The electronic Braille kit is for helping them out with the more difficult stages of learning Braille to expand their knowledge and assistance in orientation and mobility. Braille Keypad, which can be used to help users learn Braille by tactile signals, and also hearing it read out to them. The keypad allows visually impaired users to enter Braille characters into the system easily for different use and works.

The integration of physical activity and hearing can facilitate easy learning of Braille Script (all languages). It consists of a keypad same as Braille Cell which is based on the Braille matrix (3*2 matrixes) with two extra control keys. The user first listens to the instructions and gets the training from the kit, then enters the combination of keys in compliance with internationally accepted Braille matrix/script, the device in turn pronounces corresponding output of letter/word/symbols/contractions (flexible for all languages). Our project is an attempt to utilize technology to educate the visually impaired students.

Keywords

Braille Matrix, Tactile, Portable, Multi-lingual, Learning aid, Teacher independent, Hand held, Multi-line Braille Screen.

MOTIVATION

Self-reliance is a word that gives a value to any person by generating self-esteem in her/him. It is imperative for physically challenged to be self-reliant. To enable these people, it is our responsibility to provide them special care without affecting their self-esteem. So, the first step in this regard is to give them the quality education. In this era of technology, one must utilize the technical knowledge to increase the quality of education to enable physically challenged people in the society in order to avoid inferiority complex which is the major curse on just society.

Being engineering students, we have thought it would be better to do the project which has humanitarian approach, particularly which addresses the problem of physically challenged people. Among physically challenged people, visually impaired are the most vulnerable, because they

cannot differentiate the colors and see dimensions of any object. So we have decided to provide them with the learning kit and full-fledged device which can reduce their labor and infuses excitement to learn basic letters in Braille to fully fledged use for visually impaired.

1. INTRODUCTION

In India it is true that computers have not reached even normal schools in the rural and remote areas, getting the visually handicapped children to learn to use them, seems certainly far-fetched. For many children in India, a visual handicap almost invariably leads to virtual isolation from the community. These children struggle to come up in life, often sacrificing their education for a job that can at the best allow them a daily allowance.

The spontaneous response of the engineer community towards extending the ideas and concepts behind "Assistive Technologies" has been overwhelming. In the developed world, special facilities are extended to help the disabled move around, work in buildings without having to heavily rely on the support from people around. Technical advances, especially in the fields of precision manufacture and electronics have resulted in products which go a long way in helping the disabled cope with their specific disabilities.

The situation observed in India is said to be different for two basic reasons.

1. Technology is not affordable by majority of the citizens specifically those who live in rural/ remote areas.
2. Lack of knowledge or little knowledge of Braille Script for English or any other languages, which is required to be in pace with ever running technologies.

We have come up with a solution to strengthen the education for the visually impaired students at their early stages . In the initial stage of schooling, teaching the Braille script to the visually impaired students is elementary. So, the Electronic Progressive Braille Learning Kit would be fully-fledged device which will facilitate the learning of Braille and meets the objective in a cost effective manner.

2. BRAILLE SCRIPT

Braille is writing system which enables the blind and partially sighted people to read and write through tactile sense. It was

The paper has no cited reference papers because the work is 100% original and does not drawn from any past works.

invented by Louis Braille (1809-1852), who was blind and became a teacher of the blind. It consists of patterns of raised dots arranged in cells of up to six dots in a 3 x 2 matrix (see figure 1). Each cell represents a letter, numeral or punctuation mark. Some frequently used words and letter combinations also have their own single cell patterns.



Figure 1: Braille Cell with Standard dot positions (3*2)

English Braille has got three levels of encoding and are explained below [1] :

2.1 Grade 1

Grade 1 consists of 26 standard letters of the alphabet and punctuations. It is only used by those people who are new to read the Braille Script. (See Figure 2) [2]

2.2 Grade 2

Grade 2 consists of 26 standard letters of the alphabet, punctuations and contractions. The contractions are employed to save space because a Braille page cannot fit as much text as a standard printed page. Books, signs in public places, menus, and most other Braille materials are written in Grade 2 Braille.

2.3 Grade 3

Grade 3 is used mainly in personal letters, diaries, and notes and also in literature to some extent. It is a kind of short-hand, with entire words shortened to a few letters. Braille has been adapted to write many regional languages. Indian Braille is based on Devanagari Script which forms the root for all other languages.

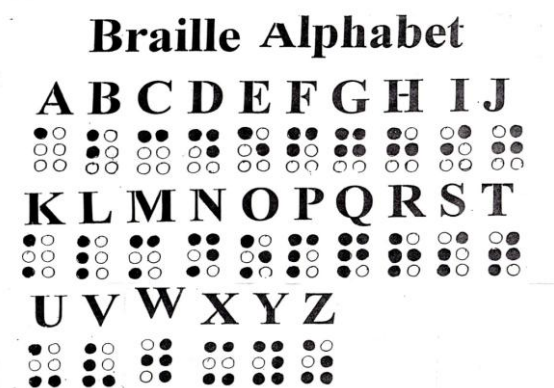


Figure 2: Braille combinations for letters of English Alphabet in International Braille script

Following are the real problems with Visually Impaired students:

1. Lack of teachers with firm hold on Braille Script.

2. Learning Braille script involves sensing Braille Dots because of small size of the dots, sensing and recognizing the dots becomes very difficult for them.
3. Students need constant guidance and monitoring from a teacher to recognize and practice the pattern of each letter of the alphabet.

Students have to memorize various patterns of keys of Braille matrix assigned for different letters/words/symbols in Braille Script. It becomes extremely challenging for Visually Impaired students to learn and expand their knowledge base in Braille Script.

In India, it is true that computers have not reached all schools in the rural and remote areas, getting the visually handicapped children to learn to use them without strong base knowledge of Braille Script, seems certainly farfetched and this would make visual handicap virtually isolated from the peer group. These children struggle to come up in life, often sacrificing their education for a job that can at best allow them a daily allowance.

3. PROBLEM STATEMENT

To design and implement an electronic kit at very low cost that would facilitate easy learning of the Braille Script in all languages by giving tactile feedback using Braille Display.

Strong basic education for the Visually Impaired students through a hand-held, application friendly teaching aid in order to assist students to gain expertise over Braille Script in cost effective manner.

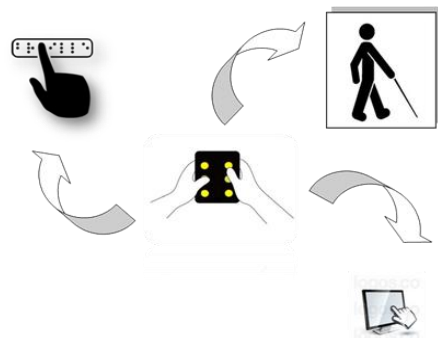


Figure 3: Applications

4. LITERATURE SURVEY AND INDIAN SCENERIO

Following are the points explaining the gravity of visual impairment and blindness in India [3]:

- 1) 15 million people are blind.
- 2) 11.75 million Blind live in the rural and backward areas.
- 3) One out of every three blind people in the world lives in India.
- 4) 9.4 million have cataract related blindness.
- 5) 6 million people become blind and low vision every year.
- 6) 3.2 million children are blind under the age of 16 years, only 5% of them receive any education.

अ	आ	इ	ई	उ	ऊ	ए	ऐ	ओ	औ
क	ख	ग	घ	ङ	च	छ	ज	झ	ञ
ट	ठ	ड	ढ	ण	त	थ	द	ध	न
प	फ	ब	भ	म	य	र	ल	व	ळ
श	ष	स	ह	क्ष	ज्ञ	झ	ड़	ढ़	
अं	अः	औं	ँ	ऑ	एँ	ऽ	।		

ಅ	ಆ	ಇ	ಀ	ಁ	ಂ	ಃ	಄	ಅ	ಆ
ಕ	ಖ	ಗ	ಘ	ಙ	ಚ	ಛ	ಜ	ಝ	ಞ
ಟ	ಠ	ಡ	ಢ	ಣ	ತ	ಥ	ದ	ಧ	ನ
ಪ	ಫ	ಬ	ಭ	ಮ	ಯ	ರ	ಲ	ವ	ಳ
ಶ	ಷ	ಸ	ಹ	ಕ್ಷ	ಞ್	ಝ	ಞ್		
ಅಂ	ಅಃ	ಃ	ಁ	ಂ	ಃ	಄	ಅ	ಆ	ಇ

Figure 4: Combinations for letters of Hindi and Kannada Alphabet in International Braille Script

5. OUTCOME

5.1 Hand-held and Portable

A small rechargeable device/kit similar to mobile which can be carried all around.

5.2 Reusable

The kit is useful for initial learners, primary school students, high school students and for any level of education. Visually impaired person can use the kit as per his requirements in which ever language of his comfort and respective applications can be installed into the kit that can be downloaded through internet or through backups in the form of CDs or any other secondary memory. Very similar to how normal students change their books once they go for higher studies. Kit can be considered as the friend for lifetime. The Braille Script in the Hindi and Kannada languages are shown in the Figure 4 [4] [5].

5.3 Typing

The Visually impaired student needs a normal person's assistance while writing exam/letter/mail/ any important document. So, the problem can be overcome by using the kit in a way that, the Visually impaired student/person can write the exam/letter/mail, etc. using the Braille keypad by interfacing the kit with computer through an application, the user writes in Braille language through Braille Keypad and it appears on computer in normal language and further more it can be read by another Visually impaired person by taking printouts in Braille Script.

6. DESIGN AND METHODOLOGY

The design of the system is done keeping the requirements of the end user in mind. We analyzed the problem and divided the working of the device into four important modes – Instruction Mode, Audio Mode, Tactile Mode and Advanced Mode.

1. Instruction Mode: Instructs the user on the application installed into the kit in the form of audio.
2. Audio Mode: This mode enables the user to know various combinations of Braille Dots of letters/words through audio output.
3. Tactile Mode: This mode enables the user to enter the combination of various dots allowing user to practice the things that are learnt in Audio Mode.
4. Advanced Mode: Multi Line Braille Display [6] to get tactile feedback. See Figure 5.

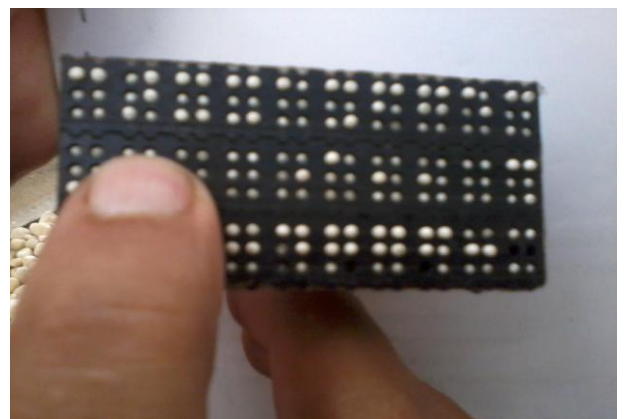


Figure 5: Typical Multi-Line Braille Display – Paul G D'Souza

Similarly any number of modes/lessons/applications can be created as per the requirements of visually impaired.

6.1 Technical challenges encountered during the system design.

We had to find a way to store various voice recordings corresponding to different letters of English alphabet. Later we found SD card as the way, but we did not know how to interface the SD Card to the controller. And with the help of a senior we could find the solution. When it came to processing the data retrieved from SD card, we were not getting the voice signals rightly and later we found that it was the issue with difference of endianness between the way the controller handling multiple bytes and the way multiple bytes stored in the SD Card.

6.2 Block Diagram Description

- 1) Input block consists of a keypad based on priority encoder and a microphone with speech recognition module. (See Figure 6).
- 2) ARM7 based LPC2148 microcontroller as processing unit.
- 3) Secure Digital (SD) card as external memory.
- 4) A speaker driven by the output of Digital-to-Analog converter (DAC).

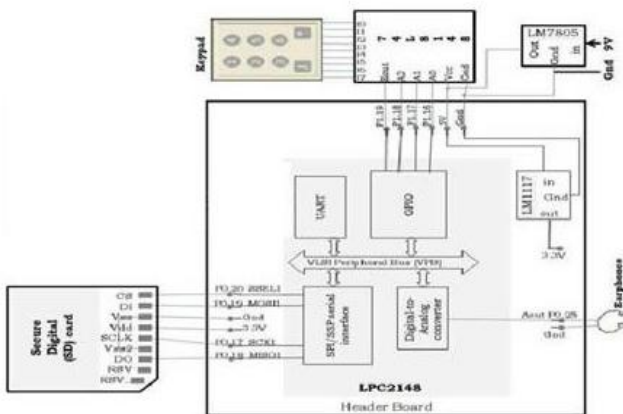
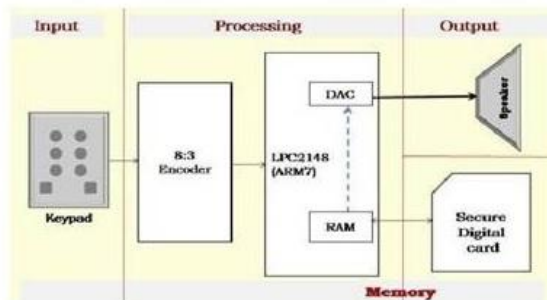


Figure 6: Architecture and Design.

7. UNIQUE FEATURES

- 1) Application software can be installed into the Kit as per the requirements of user.
- 2) Multi Line Braille Display – Paul G D’Souza.
- 3) Flexible towards any language.
- 4) The easy learning of Braille with audio output and instructions.
- 5) Lifelong friend for learning and communication.
- 6) Ability to create customized applications for each user requirement.

- 7) Document writer/editor and reader by interfacing the Kit with computer and Braille Display.

8. SOFTWARE AND HARDWARE REQUIREMENTS

- 1) Hardware: ARM 7 micro-controllers, here; we have used LPC2148 micro-controller, Memory Device (SD Card).
- 2) Software: Flash Magic, Keil μ Vision 3, GoldWave, WinHex and HyperTerminal.
- 3) Platform: Embedded.
- 4) Language: C.

9. RESULTS

- 1) The Braille keypad: The positioning of 6 keys is done in compliance with standard Braille matrix. (See Figure 7).

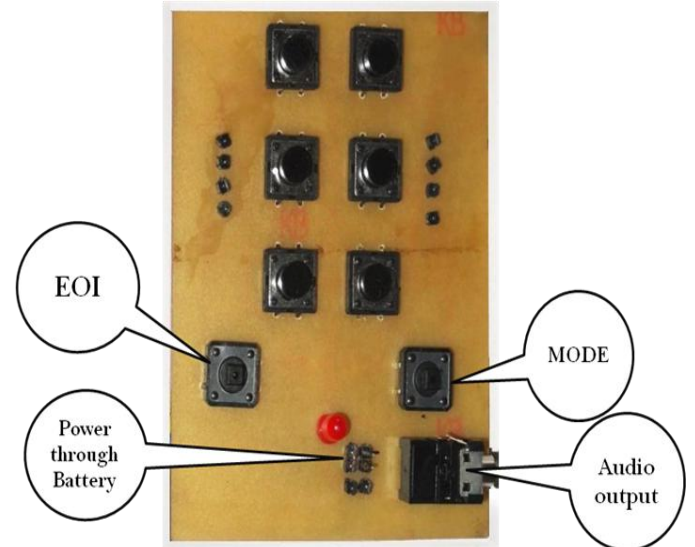


Figure 7: Braille Keypad

- 2) LPC2148 - The brain of the device is available on the header board with 68 pins for external connections. We use the UART provided on the board for flashing the μ Controller and display the sample output. (See Figure 8).

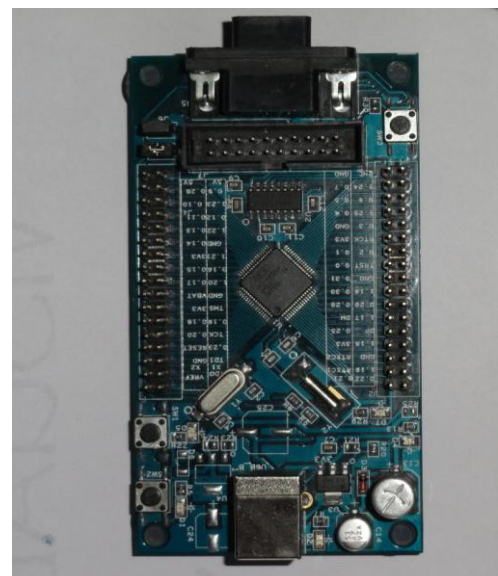


Figure 8: Header Board- ARM7 based LPC2148 Microcontroller

- 3) The first step in achieving audio output is recording the sounds and storing them digitally, in the form of wave files. The default sampling frequency, resolution and the bit rate of the audio are 44100 Hz, 16 bit, 1411 kbps respectively. We process the audio data in GoldWave software to obtain the desired properties, i.e. a single channel audio with sampling rate of 8000Hz, Resolution of 8 bits/sample, and bit rate of 64kbps. (See Figure 9).



Figure 9: Creating the Audio Files using GoldWave Software

- 4) After the creation of audio files, they are stored in the SD card. WinHex software is used to get the exact location (in terms of starting and ending sector number) of stored files in the SD card. A look-up table containing the file lengths and starting sector is created in the micro-controller. (See Figure 10 and Figure 11).

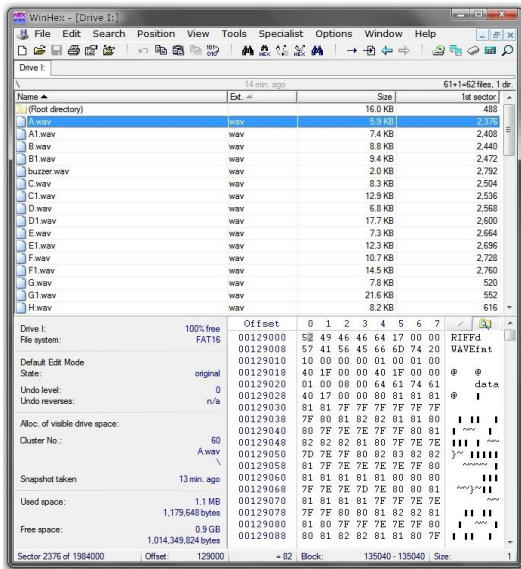


Figure 10: Accessing sectors in the SD card of Audio Files using WINHEX software

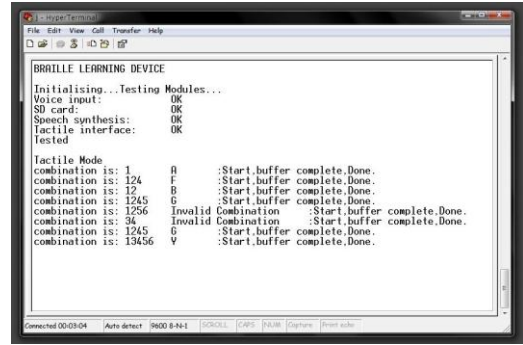


Figure 11: Document writing using Braille Keypad

10. FUTURE SCOPE

The product can be enhanced with addition of extra features like Note Taker, interface electronic kit with Braille Screen for full-fledged use, assisting visually impaired while walking by informing about the directions.

11. CONCLUSION

Electronic Progressive Braille Learning Kit enables the Visually Impaired Students to expand their knowledge in a self-paced easy manner and it also makes their life easier to gain the expertise over Braille script. The kit enables the Visually Impaired Students to be independent without the need of constant guidance and monitoring from the teacher to recognize and practice the patterns of Braille script.

12. ACKNOWLEDGMENTS

We are thankful to Paul G D'Souza for giving us outstanding support in the project.

We would also like to thank the teachers of the school for Visually Impaired Children at Siddarud Math, Hubli, Karnataka for helping us to conceive the idea of learning device on Braille Script.

We also extend our gratitude to

1. School for Visually Impaired, Navanagar, Hubli,
2. National Association for Blind, Bengaluru.
3. LEAD Programme (LEaders Accelerating Development) of Deshpande foundation, NGO from Hubli, Karnataka.

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