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E-Braille: A Study Aid for Visual Impaired

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***Abstract*: In ancient times, Braille system was developed to eradicate the darkness of visual impaired people and make them to gain knowledge for proper interaction with the world. Learning Braille script involves sensing of Braille dots. The size of the dots is too small. Therefore, sensing the dots and recognizing the letters is a difficult task. Visually Impaired students have to memorize/remember various patterns of keys of Braille matrix assigned for different letters / symbols in Braille script to read and write effectively. Different types of Braille devices are available in the market such as refreshable Braille display, rotatable Braille display and panda Braille display. The cost of them is too high. In a developing country like India, people can't afford. From the literature it is known that, in India it is true that computers have not reached even normal schools in the rural and remote areas. Therefore, providing computers for visually handicapped children to learn and use them seems certainly farfetched. Therefore, we got an idea to design and develop user friendly cost effective learning aid for visually handicapped children. The project aims to design a learning aid for visual impaired in English language which infuse a sense of playing while learning. The proposed idea is implemented on Arduino Microcontroller interfaced with Speaker, LCD and Braille Cell as output devices. The proposed model is develops a character followed by number on Braille cell sequentially hence aids the visual impaired to learn the language.**

***Keywords*: Visually Impaired, Braille language, Braille keypad, Arduino.**

1. Introduction

In an information-oriented society, all members of the Society have the right to obtain and use the information. Therefore, it is necessary to develop various devices, which can provide information to anyone easily. Globally more than 44 million people are visually impaired. Physically challenged people like visually impaired or deaf-blind people are facing lots of problem while communicating or interacting with other people. To provide a helping hand towards the visually impaired, recent technological growth has been developing different skilled methods to enhance their communication procedures. Illiteracy among this group is very high, much of which is attributed due to the lack of reading material in accessible format. For reading and writing visually impaired people always use Braille representation of different alphabets, symbols (as shown in Fig. 1) and digits (as shown in Fig. 2) etc. Braille is the language used by the blind to read and write. It is vital for communication and educational purposes.

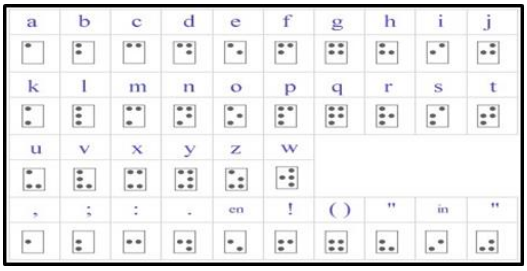

Fig. 1. Standard Braille alphabets of English language

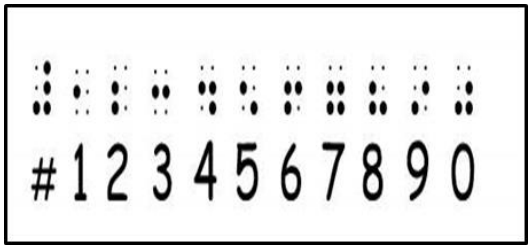

Fig. 2. Standard Braille alphabets of English language

The Braille is a tactile writing system used by the blind and the visually impaired. It is traditionally written with embossed paper. They can write Braille with the original slate and stylus or type it on a Braille writer, such as a portable Braille note-taker, or on a computer that prints with a Braille embosser. Braille is named after its creator, Frenchman Louis Braille, as shown in fig 3 who lost his eyesight due to accident in childhood. In 1824, at the age of 15, Braille developed his code for the French alphabet as an improvement on night writing.


Fig. 3. Image of Louis Braille

He published his system, which subsequently included musical notation, in 1829 the second revision, published in 1837, was the first binary form of writing developed in the modern era.

A. International standards of braille

Braille is a series of raised dots that can be read with the fingers by people who are blind, visually impaired, or deaf blind. Teachers, parents and others who are not visually impaired ordinarily read Braille with their eyes. Braille is not a language. It is a code by which all languages may be written and read. Braille is now used in almost every country in the world and has been adapted to almost every known language, from Albanian to Zulu. Braille codes have also been developed to represent the many symbols used in advanced mathematical and technical material, musical notation, and shorthand.

B. Braille code

Braille codes are formed within units of space known as Braille cells. A full Braille cell consists of six raised dots arranged in two parallel vertical rows, each having three dots as shown in fig 1.4. The dot positions are identified by numbers one through six. Sixty-three combinations are possible using one or more of these six dots as shown in fig 4. Cells can be used to represent a letter of the alphabet, number, punctuation mark or even a whole word.

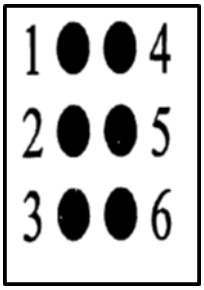

Fig. 4. Braille cell

The presence or absence of dots gives the coding for the symbol. Dot height is approximately 0.02 inches (0.5 mm); the horizontal and vertical spacing between dot centers within a Braille cell is approximately 0.1 inches (2.5 mm); the blank space between dots on adjacent cells is approximately 0.15 inches (4 mm) horizontally and 0.2 inches (5.0 mm) vertically. A standard Braille page is 11 inches by 11.5 inches and typically has a maximum of 40 to 43 Braille cells per line and 25 lines.

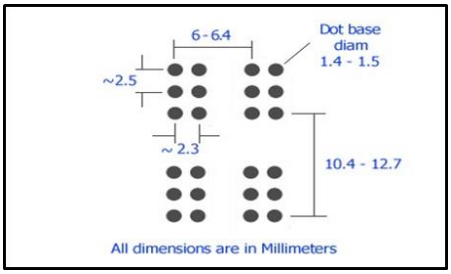

Fig. 5. Dimensions of Braille cell

There are a number of different versions of Braille, Grade 1, which consists of 26 standard letters of the alphabet and punctuation. It is only used by people who are first starting to read in Braille. Grade 2, which consist of the 26 standard letters of the alphabet, punctuation 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. Grade 3, which is used mainly in personal letters, diaries and notes, and also in literature to some extent. It is a kind of shorthand, 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.

2. 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 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 color and see dimensions of any object. So we have decided to provide them with the learning kit which can reduce their labor and infuses excitation to learn basic letters in Braille.

3. Literature survey

Braille is a language which is used by the visually impaired. The paper which is used for printing Braille letters is known as Braille paper. Braille-users can read words by touching the Braille printed on paper. Braille got its name from its inventor Louis Braille who lost his vision due to an accident which he met when he was barely 15.Thus to overcome his difficulties he started working on the code to develop the language which can be understood by the visually impaired. His first paper was published in 1829.Braille language consists of dots arranged in columnar fashion known as cells. They are nothing but elevation on the other side of the paper. A full Braille letter consists of six cells having two columns and three rows. The cells are denoted by simple numbers such as one, two, and three and so on. Total of sixty four combinations are possible. When Braille language was first introduced to other languages there was immense confusion as that time there was no alphabet W in French. So the English alphabet W was assigned to X and X was assigned to Y and so on. In Canada the notes have raised dots which help the visually impaired to distinguish between different currency. The Braille which is used on these notes is different than the actual Braille and is implemented with mutual

consent of the visually impaired Canadians. In India the parliament acts are published in Braille. In United Kingdom it is necessary for the medicine manufactures to have the medicine name in Braille. B Dange and A Brahmane [1] found Braille Printer to be of a very great help for visually challenged people. They are different type of printers which are used to print Braille. They make use of Braille embossed paper for this purpose. They are noisy and very costly. As these printers are costly hence developing them in India is difficult as the ones developing them are finding issues when it comes to funds. Project DRISHTI is a solution which helps the visually challenged person to use simple facilities offered by a computer. Padmavati S and Nivedta V [2] focus on the process of printing Braille documents using a dot matrix printer. Without Braille language there is no other source of communication for the visually impaired. Therefore this project was developed to help such people. The documents were printed in Braille using a dot matrix printer keeping into consideration all the standard sizes and accuracy of the mark made on paper. Trial and error method was used to choose the best possible outcome. Using Paul Blenkhorn [3] paper we get a detailed description of a method for converting Braille, as it is stored as "characters" in a computer, into print. The system has been designed in such a way that we can get a wide range of languages and character sets. It makes use of a table driven method to achieve the required result.

4. Problem statement

The major problem with the existing refreshable Braille devices is the cost. Current costs of Braille display technology (currently upwards of Rs. 2,58,560/- for a 40-line display) preclude the development of Braille literacy for educational and employment opportunities. In a developing country like India, people can't afford such a huge cost. Another problem with the existing system is that the input given to the device is not real time. Normally they are previously stored data which are sent to the tactile device and then displayed. The existing Braille devices are heavy, and maintenance cost also too high.

5. Objective

To provide quality education for the visually impaired students by designing and developing a learning aid which offers self-learning environment, which infuse a sense of playing while learning to gain expertise in Braille script in a very cost effective manner.

6. Methodology

The Fig. 6 represents block diagram of the project carried out. The regulated power supply of +15V is required for the operation of the system. The outputs equipment's are LCD, Braille cell and speaker. The system is so designed such that once the Arduino is powered up, sequentially the braille characters starts appearing on the braille cell. The braille cell is constructed with the help of vibrating motors whose speed of vibration is controlled using PWM technique in Arduino. The character represented on the braille cell is pronounced by the speaker for better realization of the character and same is displayed on LCD for visual assistance for a guide to understand the braille characters.

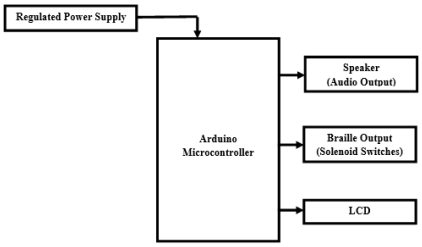

Fig. 6. Block diagram of the proposed concept

7. Hardware implementation

The hardware design of the overall system has been implemented in the same form as it was designed. The subsystems implemented are illustrated in a sequence.

A. LCD interfaced with Arduino

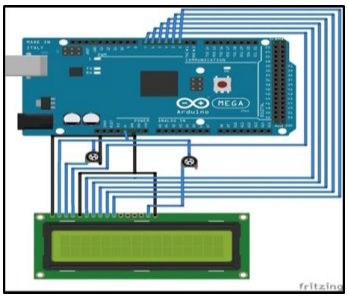

Fig. 7. Hardware implementation of LCD

The Fig. 7, represents circuit of LCD (20x4) interfaced with Arduino MEGA. The two potentiometer are used in order to control the contrast and brightness of the LCD. The LCD is used to display alphanumeric character. Four bit of data transmission is used to interface between the Arduino and LCD. Only write operation is used by sending a low signal to read/write terminal of the LCD.

B. Vibration motor interfaced with Arduino

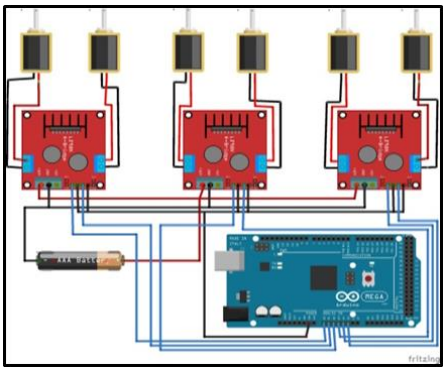

Fig. 8. Hardware implementation of solenoid

The Fig. 8, represents circuit of vibration motor interfaced with Arduino MEGA. This circuit is built upon TI's 16-pin L293D motor driver IC. The IC provides the Vcc supply at the output when the corresponding input is high. It has dual input and output pins. In total, three IC's drive six solenoid actuators of the Braille cell. To avoid damage to the IC from heat dissipation, heat sink fins have been cut and applied on the backside of the integrated circuit.

C. DF Player interfaced with Arduino

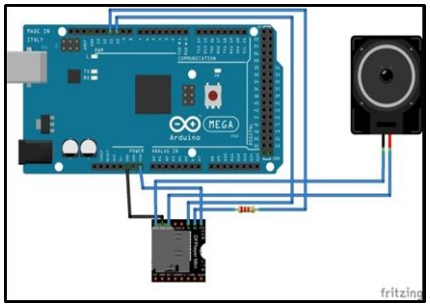

Fig. 9. Hardware implementation of DF Player

The Fig. 9 represents circuit of DF Player interfaced with Arduino MEGA. The DF Player Mini is a small and low cost MP3 module player with a simplified output directly to the speaker. The module is used as a standalone module with attached battery, speaker and with an Arduino. The DF Player perfectly integrates hard decoding module, which supports common audio formats such as MP3, WAV and WMA. Besides, it also supports TF card with FAT16, FAT32 file system.

8. Experimental setup

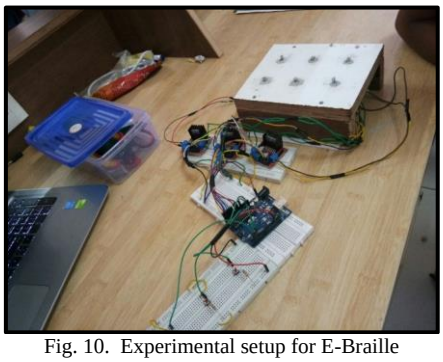

Fig. 10. Experimental setup for E-Braille

Fig. 11. Realization of Braille characters

9. Software implementation

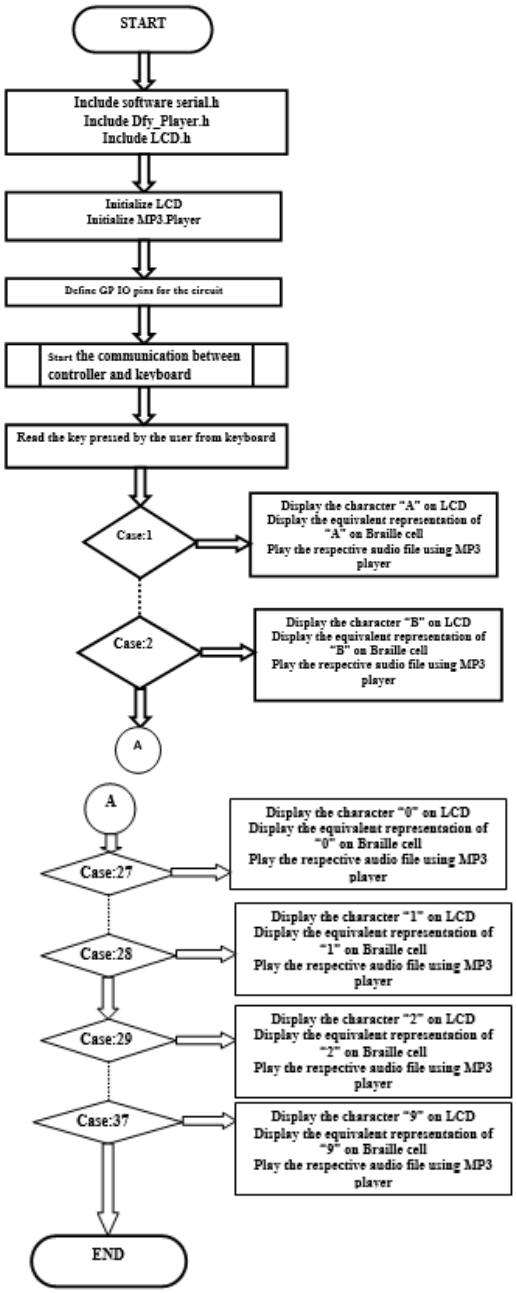

Fig. 12. Hardware implementation of solenoid

10. Results

The results of the designed embedded system clearly describe the operational accuracy and effectiveness in making Braille learning an easy and comfortable option. The results of the system provide consecutive Braille pattern and concurrent voice feedback from audio output.

11. Conclusion

The problem of Braille literacy is creating a major hurdle in enabling the visually disabled people in achieving a rightful place in the society. The use of Braille system is inevitable for

such people. Our project emphasizes on the use of Braille system in an independent, user friendly, portable and cost effective manner. It can affect the learning ability of visually challenged people in a comfortable and interactive way. The software processing that is performed in project is developed independently and does not rely on internet connectivity. This device can be used effectively to simplify the learning of Braille. It can prove to be a small but effective step in enhancing the literacy rate for visually challenged people.

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