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A LOW COST REFRESHABLE BRAILLE DISPLAY; A NOVEL APPROACH FOR THE PRIMARY EDUCATION OF BLIND IN INDIA

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ABSTRACT

The increased access to books afforded to blind people via e-publishing has given them long-sought independence for both recreational and educational reading. In most cases, blind readers access materials using speech output. For some content such as highly technical texts, music, and graphics, speech is not an appropriate access modality as it does not promote deep understanding. Therefore blind braille readers often prefer electronic braille displays. But these are prohibitively expensive. The search is on, therefore, for a low-cost refreshable display that would go beyond current technologies and deliver graphical content as well as text. And many solutions have been proposed, some of which reduce costs by restricting the number of characters that can be displayed, even down to a single braille cell. In this project, we demonstrate a low cost refreshable braille display consisting of solenoids which can be controlled over a Wi-Fi network. This facilitates a mode of primary education for the blind population and thus helps in the upliftment of the literacy rate of the blind.

Keywords*: *Braille, Blind, Particle Photon, Powerboost, Solenoid, Text to Speech Module

I. INTRODUCTION

"Living life easy with eyes closed". It is obvious that this thought which has paved the way for a scrutiny of various technologies that can provide ways of reading for the blind which is often enough for them to visualize things. Of the 37 million people across the globe who are totally blind,over 15 million are from India, a situation that has left us crestfallen[1].According to this statistics the visually impaired people cannot be ignored and remain stolid as they form a major part of our population. Anyway there is no doubt that most of them are self-sufficient enough and Visual impairments have not imparted much restrictions in their path of learning as we have people like HelenKeller standing forefront in the worldly quest of success.However the increasing percentage of blind have

always left the question of how to improve their mode of accessing information. It had been revealed that Brain circuits which normally handle information from the eye can switch gears to tactile receptability in visually impaired people which further accelerated the researches behind Braille devices but the fact that braille display technology has not changed significantly for 35 years is astonishing while the interaction paradigms for personal computing is continually subjected to changes.As of this date,no company is currently manufacturing a braille display with more than one line.The major throwbacks on the road of marketing braille displays as the primary reading modality for blind are[2]:-

1) The increasing cost of braille displays.

2) The decline in support for teaching blind students and drop in their literacy rate.

3) The increasing cost of hard copy of braille textbooks.

In our paper,we present a low cost refreshable braille display which evolved out after taking the first two above mentioned causes of concern.We are aware of the fact that developing a Braille Display is no more a new technology but the widening possibilities of a braille display is still a credible factor to be explored further. Even as far back as 1916,a patent was filed for a spring-loaded refreshable braille display.Since then, a tremendous number of actuator technologies have been adapted to create refreshable braille including belt drives and tape drives[3].

The 3x2 dot array makes up a braille character.The tactile acuity is much poorer than the visual acuity and thereby the tactile field of view is much smaller than that of the visual field of view.Hence the patterns that make up the braille characters are much simpler than the globally processed word shapes followed by us which is more akin to vision. Combination of six solenoids can represent 64 braille characters in either up or down position.Previously our model was powered by the ac mains but later on the idea of portability led to the use of Lipo battery for power supply.The dots are sized to fit the space between the fingertip and flat surface of the device.Above all the device has a provision to produce the pronunciation of the word that is being depicted which makes it more advantageous as far as the students are concerned.During the path of progress of our work we had managed to develop much more features that make our device further user friendly.

Now a question naturally arises like how our product differ from the available market products or what are the new technologies provided in our product that make it more reliable.The major aspect that counts for the market value of our product is that it is cheap and affordable comparing to the existing braille displays because of its reduced manufacturing cost when it comes to bulk production.Currently,a maximum of nineteen Braille printers are available all over India.So it is obvious that with this limited infrastructure, number of braille textbooks made available for the blind people are quite less in amount and hence they are really very expensive.With the advent of our product,it would facilitate the primary education for students at a much higher pace.Thus initiating a substantial amount of public support for the educating the blind population and hence notable increment in their literacy rate can be expected in the near future.Another differentiating feature to pay attention is that our product is equipped with Wi-Fi connectivity which helps it to be controlled from anywhere from distant places.With this product getting established we even foresee a possibility of online learning courses for the blind students.

Emotionally speaking, at the end of the day the visually impaired people must be able to develop an advanced communication channel with other normal or deaf-blind people. In this paper, we further intend to discuss about the relevance, our idea of implementation and a detailed analysis of the construction of the product consisting of its hardware and software requirements.

II. RELEVANCE

Traditionally Braille is printed on paper through a specially designed impact printer[4]. However the costs of printing Braille textbooks as well as their bulkiness prove to be a major hindrance for their mass production. It so results that the blind have access to very limited resources.

An alternative to this drawback is the use of Refreshable Braille Displays, which are electromechanical devices for displaying Braille characters. They are available in various kinds with display ranging from those that display a single character to those which can display a complete sentence. Nevertheless it proves to be an expensive technology affordable to the elite sections of the blind community.

This paves the way for the need for a low costrefreshable Braille display which is cost effective for blind students. This device can display one character at a time and hence would be very useful as a teaching tool for primary school students. This product can provide an online learning process since it can be accessed from any place in the world. Apart from displaying braille characters, this equipment can also provide the pronunciation of the character which is displayed. This can make teaching more effective.

III. DESIGN

As we have discussed above, plenty of advantages are available for our low cost refreshable braille display. Among all of these, the important point is about the wireless connectivity of the device with the text sending part. Here we use Wi-Fi which is a substitution for cabled networks and also have higher data rate. Every existing similar device uses either Bluetooth or zig-bee for the transmission of information. For the first stage of our project we had selected the Bluetooth module for the wireless connectivity purpose. But later on we decided to replace it with Wi-Fi module because of its immense benefits like its operating frequency band (2.4 GHz or 5 GHz) and can support devices with a substantial power supply. Hence we can send the information from anywhere in the world. At the same time the addition of an extra Wi-Fi module is not a good idea due to rise in the overall size of the product. So we searched for a developer board with inbuilt Wi-Fi module for further advancement of our project. Finally we found a most advanced hardware development kit, Particle Photon.

Particle has combined a powerful 120 Mhz ARM Cortex M3 microcontroller with a Broadcom Wi-Fi chip in a tiny thumbnail-sized module called the PØ (P-Zero). The Photon Kit includes a Photon with headers, a shiny white mini-breadboard, a USB-micro cable, and a couple of extra features.Prototyping is easy as the Photon plugs directly into standard breadboards and perfboards. The Photon is not only powerful, but easy to use. The small form factor of this development kit is ideal for getting utilized in IoT projects with cloud-connectivity. To start quickly, Particle has

added a rock solid 3.3VDC SMPS power supply, RF and user interface components to the PØ all on a small single-sided PCB. In our product the Particle Photon makes up the major part of the wholework.

Six 5V solenoids are arranged in the form of a 3x2 matrix. The raising and lowering of these solenoids represent the Braille characters. There are 64 possible combinations (2^6) available using this matrix arrangement. This includes 26 alphabets, 10 numeric and other special characters.

Power to the photon is supplied via the on-board USB Micro B connector and the voltage is regulated between 3.6VDC and 5.5VDC. When the Photon is powered via the USB port, VIN will output a voltage of approximately 4.8VDC due to a reverse polarity protection series Schottky diode between V+ of USB and VIN. When used as an output, the max load on VIN is 1A.

We need to boost a lower voltage to a stable 5V from a 3.7V LiPo battery and charge it at the same time. Hence we use a PowerBoost 1000C. It is rechargeable and includes extra load sharing charging circuitry. Thus used Lipo battery which is 1000 mAh and has a continuous discharge rate of 25C.

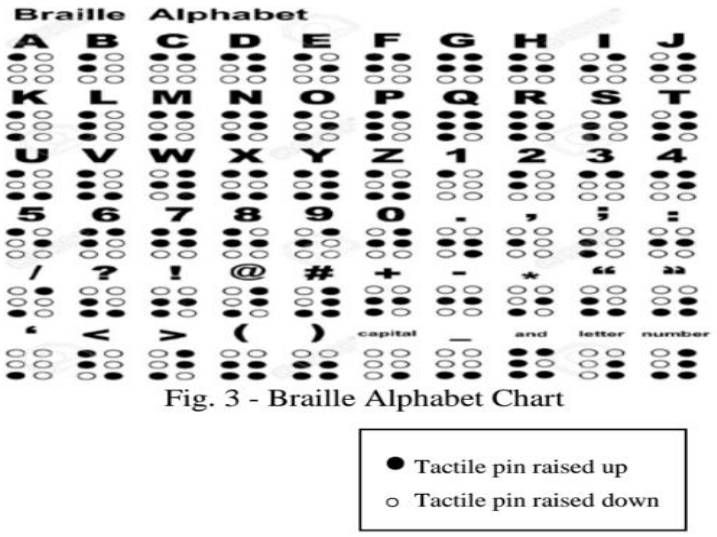

Fig. 3 - Braille Alphabet Chart

Fig.1 – Braille Alphabet Chart

Wireless charging is the other main feature of our product. It is a quite difficult task for blind people to insert a charger pin to the port for charging. This thought led us to implement a wireless charging provision. It includes a transmitter dock and a receiver. The receiver is connected to the powerboost as the part of design. The transmitter is charged up to its maximum during its charging time. Whenever the product run out of battery the blind student himself/herself can simply place the device on the dock and charge it. Students can use the device while charging since the powerboost provide the all necessities.

For 5V solenoids the output current of Particle Photon is not sufficient. Therefore we need a driver circuit. On this purpose ULN2003 stepper motor driver is used. ULN2003 is a high voltage and high current Darlington array IC. The inputs and outputs are provided opposite to each other. It contains seven open collector darlington pairs with common emitters. A darlington pair is an arrangement of two bipolar transistors. A 5VDC supply is given to the

driver IC, so the output of photon that is given to the six input pins of ULN2003 is powered up to the required amount and can take out from the six output pins.

Most advanced feature of our product is its audio output. Accordingly we use Emic-2 text to speech module. It is a multi-language voice synthesizer that converts a stream of digital text into natural sounding speech. Its simple command-based interface makes it easy to integrate with the photon.We connected the Emic-2 to a VIN power supply of photon and then send it a stream of serial text at 9600bps from the controller. There is an inbuilt headset port on the text to speech module. Therefore the blind student can hear the pronunciation using a headset. The module contains all of the smarts necessary to parse the text into phonemes and then generate natural sounding speech.

A simple webpage is developed to enter the text and send to the device.

IV. IMPLEMENTATION

In order to increase the ability to read information, people with visual impairments have expressed much interest in the development of refreshable Braille displays. As of this date, no company has currently contrived refreshable Braille displays of low cost. Also in India, only eighteen Braille printers are available. Thus the outlay of each Braille systems produced is of high cost which sequentially reduced the number of Braille systems as it is not reasonable to every blind student. So this paper outlines a low cost refreshable Braille display which is very functional for the primary education purposes.

The refreshable Braille system which is finished in the figure of a box is provided to each student in a classroom. A web page is made open in a laptop which is connected to a Wi-Fi network. The teaching process begins with the input of characters by the teachers using the web page which will be stored in the cloud. The particle photon has the cloud connectivity. Once the system is activated the particle photon will receive the characters from the cloud which is provided by the teacher. The inputs that are provided in the web page will then appear in the form of its Braille combination in the device. The six solenoids in the device will get raised up and down in a pattern corresponding to the input combination that is received. 64 Braille combinations are available in this device. Thus the blind student can utilize his/her tactile receptability to sense the solenoids and identify the desired letter.

Also a text to speech module is provided in addition to the device through which the input received in the particle photon will be converted into voice output. Externally headphones can be connected to the text to speech module. As a result, the blind student can listen to the pronunciation of the input letter while sensing the same simultaneously. Since the device is using internet for transferring the characters, the main benefit is that it can be controlled from any part of the world. The voice output can be accustomed in different versions which will provide a striking process for the primary students to swot up quickly. An adjustable knob is also fixed in the device in order to adjust the delay between the characters. This stipulation aids the user to calibrate his/her reading speed. A switch is also provided to facilitate the users to view the previous displayed characters as per their convenience.

Since this is a wireless device it is highly user friendly. The power boost kept in the device provides charge to the battery which in turn supplies power to the solenoids to lift up. Also cooling methods are provided to avoid

overheating of the device. Fans and tills are provided in the device to propel the hot air. Thus there won't be any perplexity in managing with the device in the primary students.

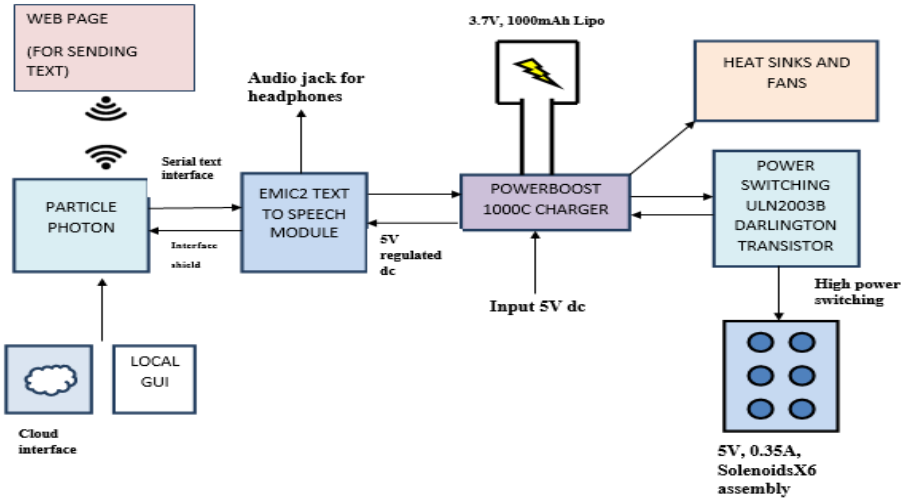

Fig. 2- Block Diagram

V. CONCLUSION

There are only eighteen Braille printers available in India till now and scarcity in the number of textbooks had become a major issue confronted by the blind people. Moreover, updating the textbooks has become yet another tedious work with this limited infrastructure. This prevailing situation became the predominant reason behind the development of new technology for the upliftment of education system for blind students. This led to the emergence of Low Cost Refreshable Braille Display which mainly intends to provide primary education for Blind students with ease of teaching.

This device can be implemented in a classroom at low cost which requires very little space and it is a portable device due to its compact nature. This device can be provided to a number of students and teacher requires only an android device with an app installed in it which is quite common in order to transfer the data to thestudents. The device has additional provision forproducing audio output of the text transmitted for which it is equipped with a headset port. Moreover, this helps in providing the students with appropriate word emphasis that is inevitable during the initial learning process.

The solenoids which represent the six dots in the device ultimately give the sensation of the desired Braille character and are capable of getting refreshed between the occurrences of each character. In addition to all these, this device has additional advantages like adjustment of the speed of occurrences of characters and to view the previous character and so on. This technology can be utilized to provide primary education for a huge number of students at a time and it is quite user friendly. This highly advanced version of the refreshable Braille display will create an immense progression in the development of the society for the blind individuals.

REFERENCE

[1] Ashwini S. Bagane, Prof. S.R. Jagtap, A Low Cost Portable Refreshable Paperless Braille for Blind People, International Conference on Computing, Communication and Energy System (ICCCES-16)

[2] Abhinav Kulkarni, KishorBhurchandi, Low Cost e-book Reading Device for Blind People, 2015 International Conference on Computing, Communication, Control and Automation.

[3] Alexander Russomanno, Brent Gillespie, Matthew Rodger, Refreshing Refreshable Braille Display, Submitted on IEEE Transactions on Haptic.

[4] Hyun- Cheol Cho, Byeong-Sang Kim, Jung-Jun Park, Jae-Bok Song, Development of a Braille Display using Piezoelectric Linear Motors, SICE-ICASE, International Joint Conference 2006, Oct 18-21, 2006 in Bexco, Busan, Korea.

[5] Yashura Matsuda, Teaching Interface of Finger Braille Teaching System using Smartphone, 2016 8th International conference on Intelligent Human- Machine System and Cybernetics