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Blind Aid: A Self-Learning Braille System for Visually Impaired

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Abstract - Braille is vital to all visually impaired individuals and it's the only system through which visually impaired children can learn to read and write, yet the rate of Braille literacy among visually impaired people belonging to developing countries including Pakistan is alarming low. Today in developing countries less than 3% of visually impaired children are learning to read Braille in school. This continues despite the fact that studies have shown that 80% of all employed visually impaired people read and write Braille fluently. Thus, Braille literacy is the key to employment and full participation in society. This research paper presents the design of a low-cost, low-power, portable, self-learning, and user friendly Braille system. The designed system serves as Braille writing and reading tutor, so visually impaired people can enhance their Braille writing and reading skills without the assistance of a Braille teacher. The designed system takes the input through Braille keyboard and produces the speech output and it also has the capability to read documents. It is believed that by implementing the designed Braille system in schools and homes, Braille literacy rate can be increased and visually impaired people can be employed and can fully participate in society.

Keywords – Braille system, visually impaired, Braille literacy, employment, Braille keyboard, Braille writing and reading tutor, speech output.

I. INTRODUCTION

According to the World Health organization (WHO), 285 million people are estimated to be visually impaired worldwide among which 90% live in developing countries [1]. Despite the fact that education plays a crucial role in everyone's life and there is a significant relationship between Braille literacy and academic success, higher income, and employment, the rate of Braille literacy in developing countries is alarming low [2]. Today in developing countries less than 3% of visually impaired children are learning to read Braille in school [3].

Braille is the only system through which children with profound or total loss of sight can learn to read and write. It's traditionally written with embossed paper. Louis Braille, a French 12-year-old, who was also blind, developed this code for the French alphabets as an improvement on night writing which was a tactile military code developed by Charles Barbier in response to Napoleon's demand for a means for soldiers to communicate silently at night and without light. Later on, the work of Louis Braille changed the world of reading and writing, forever [4].

The basic grid of a Braille alphabet character consists of six raised dots, positioned like the figure six on a die, in two parallel vertical lines of three dots each. From the six raised dots that make up the basic grid, 64 different signs can be created. At first, Braille was a one-to-one transliteration of French orthography, but soon various abbreviations, contractions, and even logograms were developed, creating a system much more like shorthand. There are three levels of Braille system encoding named as Grade 1, Grade 2, and Grade 3. Grade 1 is a letter-by-letter transcription used for basic literacy and consists of the standard alphabets of English and punctuation marks. Grade 2 consists of the standard alphabets of English, punctuation marks and contractions. Contractions are used to efficiently utilize the Braille page space and Grade 2 is used for books, public place signs, menus, and other Braille materials. Grade 3 is used in personal letters, diaries, notes, and in literature. It's a kind of shorthand, with entire words shortened to a few letters. Figure 1 shows Braille character sets.

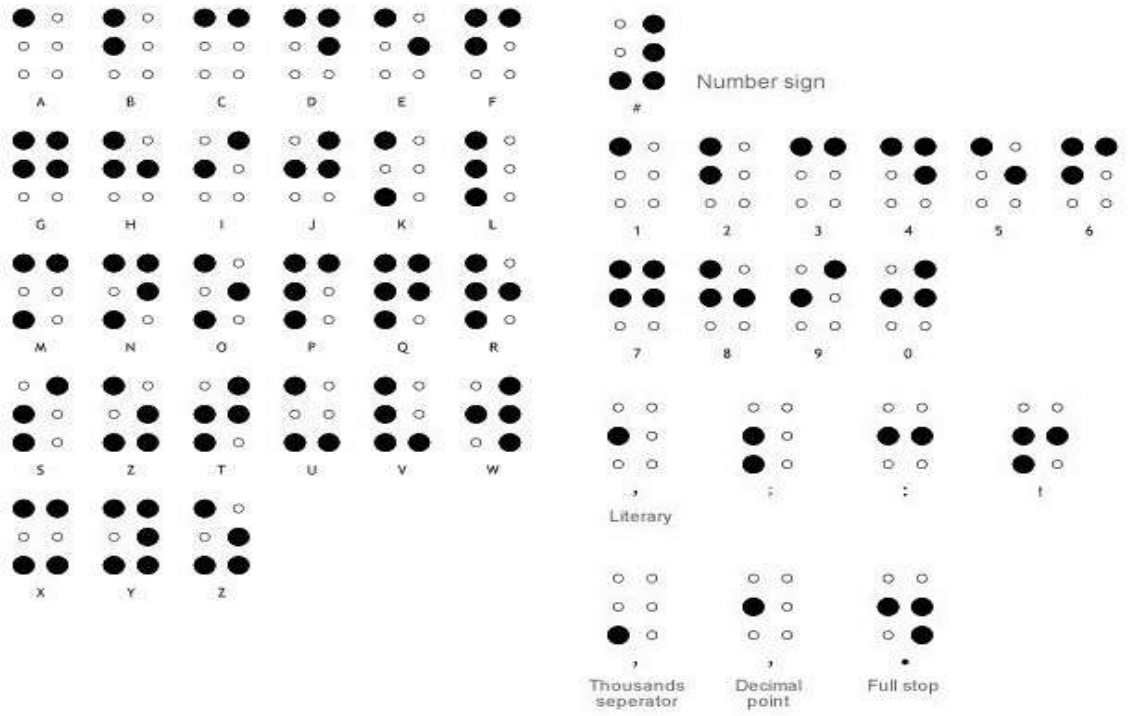

Figure 1 Braille Character Sets

Despite the fact that Braille literacy is the key to employment and full participation in society, educating visually impaired children is not given priority in developing countries including Pakistan. Most of the schools for visually impaired in Pakistan are in a very poor state, lacking basic facilities [5]. The number of educational institutes for visually impaired people and trained Braille teachers in developing countries is negligible. Most of the devices available in the market for visually impaired people are either complex to operate, or costly. Majority of the people belonging to developing countries are living on less than $1.25 per day so it's almost impossible for the parents belonging to developing countries to educate their visually impaired children [6].

Thus, in order to cope these barriers, we have designed a low-cost, low-power, portable, self-learning, and user friendly Braille system. The designed system is capable to enhance the Braille writing and reading skills of a visually impaired individual without the need of a teacher. The designed system works on the text-to-speech technology and is capable to read documents. So by implementing the designed system in schools and homes, the rate of Braille literacy can be increased and visually impaired people can be employed and can fully participate in society and the money, time, and human resources can be saved in an efficient way.

This research paper is based on 5 sections. Section II is based on literature review and reviews the existing techniques and devices for visually impaired people. Section III is based on system implementation methodologies and describes our contribution and the techniques we have used in designing the Braille system. Section IV is based on results and reflects the results obtained from carried out research work. Section V is based on conclusions and concludes the research paper with the important suggestion and factual finding from the research paper.

II. LITERATURE REVIEW

There are different devices available in the market for visually impaired people to help them in educational activities and to bridge the communication gap between visually impaired people and people with sight. The popular devices for visually impaired people are Speech Assisted Learning (SAL) which costs around $4,600, Book Sense Reader which costs around $499, Eye-Pal Reader which costs around $1,995, Eye-Pal ROL which costs around $2,195, Electronic Braille pad [7], Automated electronic pen [8], Automatic visual to tactile translation [9], Interactive 3D Sound Hyper stories for Blind Children [10], A PC-based Braille library system for the sightless [11], FPGA Based Braille to Text and Speech for Blind Persons [12]. There are also some web browsers specially designed

for visually impaired people to help them in internet surfing. The popular web browsers for visually impaired people are Audio-haptic internet browser and associated tools for blinds and visually impaired computer users [13], The Auditory browser for blind and visually impaired users [14].

According to the statistics provided by the World Health Organization (WHO), about 90% of world's visually impaired live in developing countries and majority of the people are living on less than $1.25 per day so they can't afford the devices available in the market for visually impaired individuals. Most of the devices available in the market are either Braille writing tutors, or Braille scanners, yet a low-cost Braille system is not available in the market for visually impaired individuals belonging to developing countries which can teach the Braille writing and reading skills to visually impaired people without the need of a Braille teacher.

Blind Aid: A Self-Learning Braille System for Visually Impaired is the only Braille system which is low-cost, low-power, portable, self-learning, and user friendly Braille writing and reading tutor with the capability of reading documents and works on text-to-speech technology which is the assistive technology for visually impaired individuals.

III. BRAILLE SYSTEM IMPLEMENTATION METHODOLOGY

The designed Braille system is based on text-to-speech technology which is the assistive technology for visually impaired people. The block diagram of the designed system is shown in Figure 2.

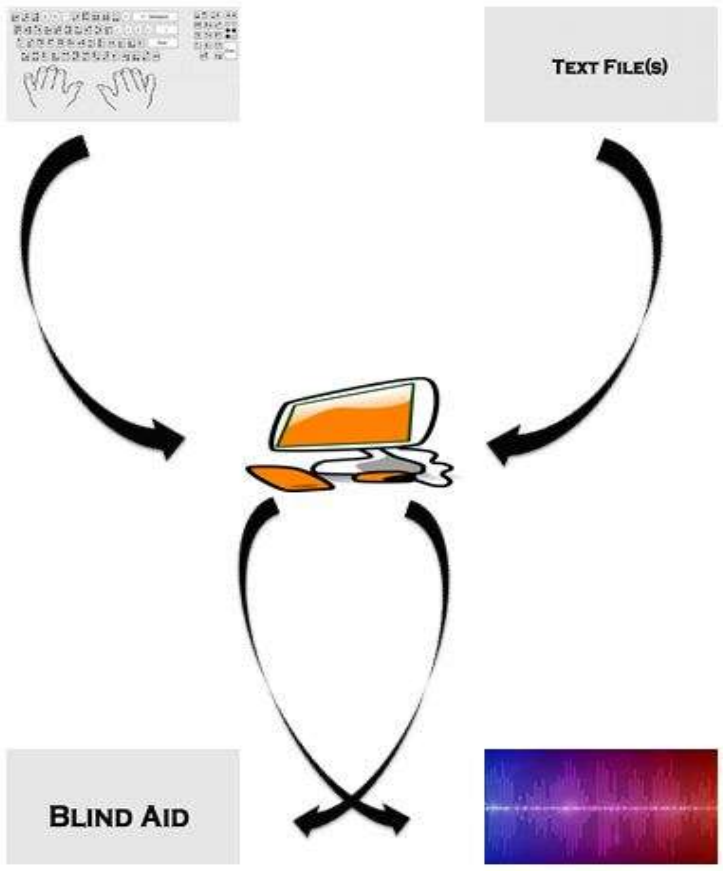

Figure 2 Block Diagram of Blind Aid

The block diagram of Blind Aid in Figure 2 shows different steps of the designed Braille system. The input can be provided by either typing through the provided Braille keyboard, or inserting text files. The designed Braille keyboard supports all levels of the Braille

system encoding so beginners as well as advanced users can use it for typing. The entered characters or words by Braille keyboard and/or inserted text files are then processed by the computer. The designed Braille system then converts the Braille character sets into the standard alphabets of English, numbers, and punctuation marks. The final output appears in the form of text on the computer screen and in the speech format by using the text-to-speech synthesis. The designed Braille system also has the capability to read documents so inserted paragraphs or complete text is processed by the system and the speech output is produced.

The designed Braille system is an intelligent system so it predicts the entered characters or words and automatically decides that whether the given input is a character, or a word and then it produces the speech output accordingly. This feature of the designed Braille system distinguishes it from the other available text-to-speech Braille systems which only produce the speech output in character form.

IV. RESULTS AND DISCUSSIONS

The simulation of the designed Braille system is done on Microsoft Visual Studio software which is an integrated development environment (IDE) from Microsoft and is used to develop computer programs for Microsoft Windows superfamily of operating systems, as well as websites, web applications and web services. A sample text typed through Braille keyboard with speaking mode is shown in Figure 3.

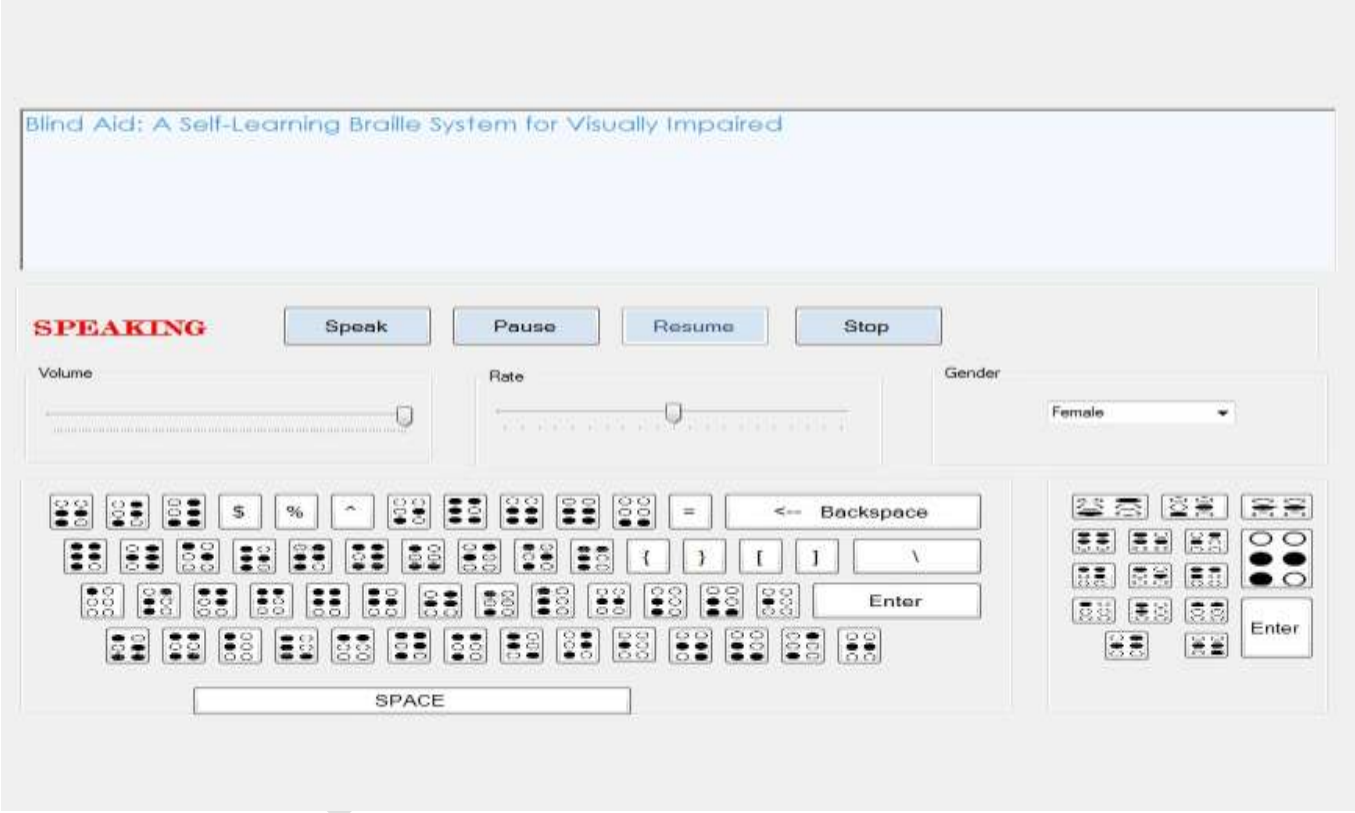

Figure 3 Speaking Mode

The designed Braille system has the capability to pause and resume the speech. When the speech output is stopped the system goes in idle mode. The volume of the designed Braille system can be adjusted to the desired level. The speech rate can also be changed and visually impaired individual can increase or decrease the speech rate to the desired level. The designed Braille system also provides the facility to change the gender so the speech output can either be produced in female voice, or male voice. The output of the designed Braille system in pause and idle mode is shown in Figure 4 and Figure 5 respectively.

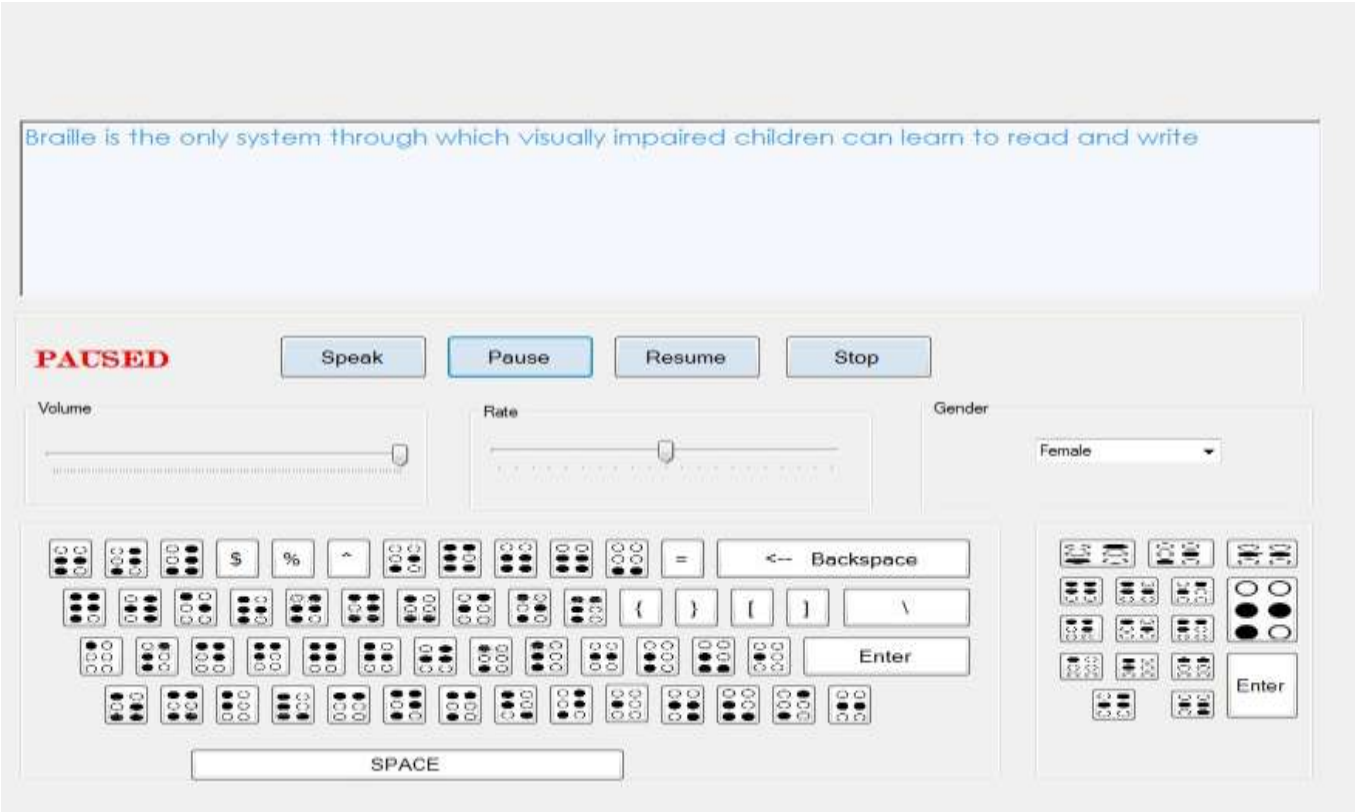

Figure 4 Pause Mode

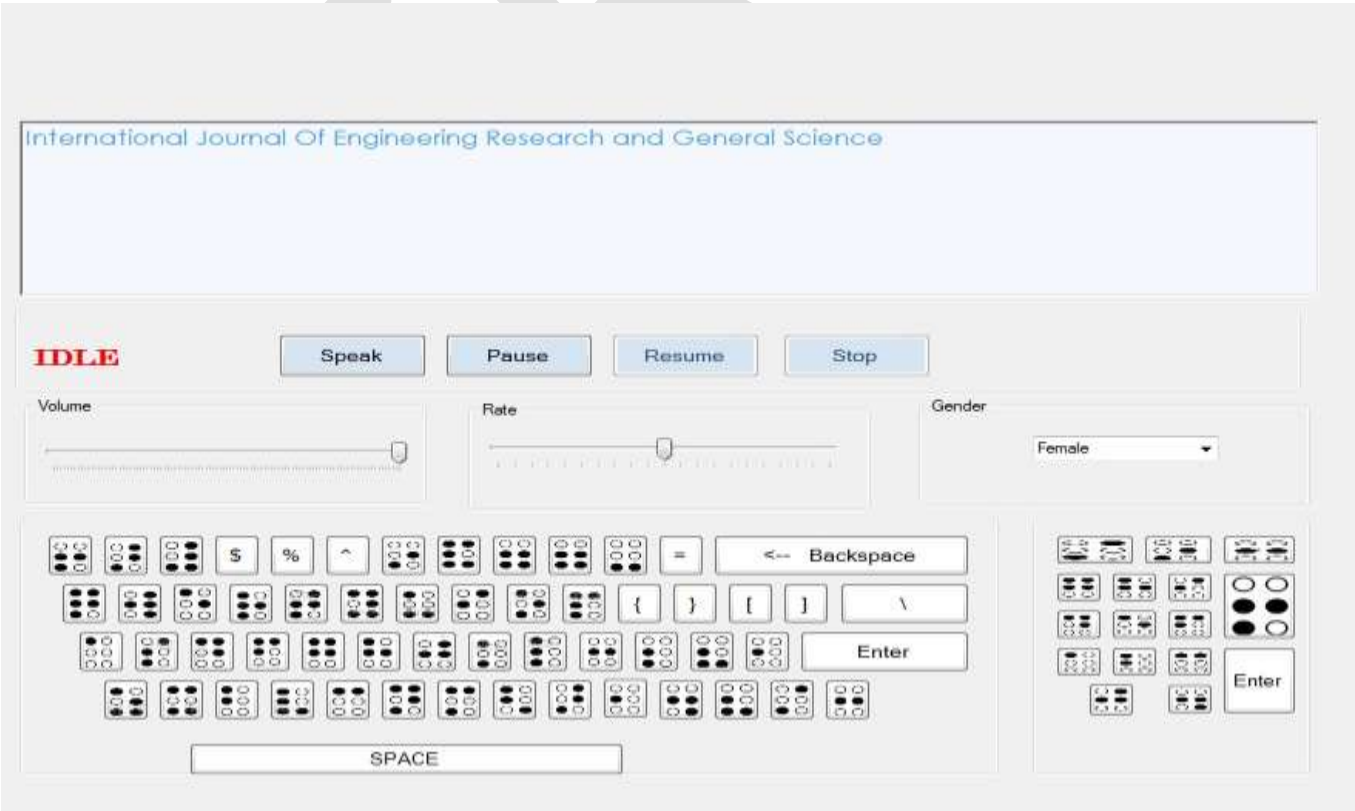

Figure 5 Idle Mode

V. CONCLUSIONS AND FUTURE RECOMMENDATIONS

The presented solution is a low-cost, low-power, portable, self-learning, and user friendly Braille system. The designed Braille system costs around $30. The presented solution is a comprehensive system for Braille writing and reading and is based on text-to-speech technology. The designed Braille system supports all levels of the Braille system encoding so beginners as well as advanced users can use it for typing. Blind Aid is a self-learning system so by implementing this Braille system in schools and homes, time, money, and human resources can be saved. It is believed that by implementing this system in developing countries, the rate of Braille literacy can be increased and visually impaired people can be employed and can fully participate in society.

In future, the designed Braille system can be used to update the visually impaired individual about date, time, temperature, etc. The designed system can also be used as a personal assistant to the visually impaired individual and can be used to schedule meetings and other important events for the visually impaired individual. In future, Blind Aid can be integrated with different sensors to monitor several health parameters of the visually impaired individual to update the visually impaired individual about his/her current health status.

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