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HUMAN COMPUTER INTERFACE FOR VICTIMS USING FPGA

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***Abstract*----Visually impaired people face many challenges in the society; particularly students with visual impairments face unique challenges in the education environment. They struggle a lot to access the information, so to resolve this obstacle in reading and to allow the visually impaired students to fully access and participate in the curriculum with the greatest possible level of independence, a Braille transliteration system using VLSI is designed. Here Braille input is given to FPGA Virtex-4 kit via Braille keyboard. The Braille language is converted into English language by decoding logic in VHDL/Verilog and then the corresponding alphabet letter is converted into speech signal with the help of the algorithm. Speaker is used for the voice output. This project allows the visually impaired people to get literate also the person can get a conformation about what is being typed, every time that character is being pressed, this prevents the occurrence of mistakes.**

Keywords---- FPGA, Braille keyboard, Visually Impaired People, VHDL, Text to speech.

I. INTRODUCTION

According to the latest statistical data on the magnitude of blindness and visual impairment from World Health Organization (WHO), more than 161 million people around the world were visually impaired, of whom 124 million people had low vision and 37 million were blind. Many of them rely on Braille as a tool of learning and communication. Although Braille dots still do not resemble print letters, Braille has been adapted to almost every language in the world and remains the major medium of literacy for blind people everywhere. Since Louis Braille published his first embossed Braille book in 1829, millions of books have been published in Braille for people with visual impairment. Recently, Braille is suffering decreasing popularity due to the use of alternative technologies, like speech synthesis. However, as a form of literacy, Braille is still playing a significant role in the education of people with visual impairments. On the other hand, reading straight from the text can avoid potential errors or problems like indecipherable meanings or misspelling caused by speech synthesis.

Automatic Braille Translation is a popular topic in the AT of visual impairment and has been wildly discussed and analyzed since 1960s. Currently, there are some commercially available programs and other computer-assisted applications which specialize in Braille translation.

Some of these use personal computers to achieve translation and other functions, such as Duxbury, the most popular multi-language Braille translation software. In this case, the speed of translation tends to be strongly related to particular computers utilized in the process. This kind of software is mainly designed for users with normal eyesight, so it has low accessibility for visually impaired users and used by transcribers translating existing print texts. They have to read the computer screen by using some AT tools, such as screen-reading software or Braille displays. There are also some portable devices specially designed for blind users which can perform text-to-Braille translation, such as Mountbatten Brailler.

These devices are based on a microcontroller running a translating program. As a small computer on a chip, a microcontroller is also able to perform multi-functional tasks; however, because a microcontroller is designed for general purposes, and the operations are based on sequential executions of instructions, therefore it may not be fast enough to perform mass translations of text documents. However, the advent of FPGAs made it possible to build a faster and stable hardware-based translation system which can also be integrated into a portable device, at a more affordable cost when compared to personal computers. To do this, the translating algorithm needs to be reconfigured so that the design can be applied to a parallel architecture in FPGAs. A hardware based translation system implemented in a FPGA is able to work as a single component, supplying greater throughput, and it also can be used as a module which is integrated in a universal Braille embedded system on a chip (SOC), supplying multi-functions. All of these components of the SOC will be integrated in one FPGA.

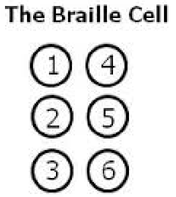


Fig.1. Braille cell

Braille was invented by Louis Braille in 1829, who is a blind Frenchman. Braille cell consists of a rectangular six dot cell up to 63combinations are using one or more of the six dots. Fig.1 shows the Braille cell in 3*2 matrix form.

Caleb Southern [1] described that the evaluation of Braille Touch, to access the keyboard for the blind users. It presents three mobile devices are Braille touch smartphone, touchscreen tablet using soft Braille keyboard and physical keys with commercial Braille keyboard. They can test with several blind persons and finally report that the braille text entry on three smartphone devices. Compared with the normal phone typing and the touch smartphone typing in words per minute.

Dhilip kanna [2] described that to the people with disabilities can communicate to the outside world by using programmable gate array and detectors. The sensor is used to sense and received the data and camera is placed at head and sensor is located at legs. The received signals are processed by gate array through the speech processing units. Camera is used to capture the information to the system and vibrators can be used to move safely.

F. Javier Toledo [3] presents the Cellular Neural Networks and augmented reality application for Visually Impaired People. The camera can acquire the image, the information can visualize by head munting display and implemented in Xilinx Virtex-II FPGA kit and information can stored in SRAM memory.

Paul Blenkhorn [4] described the method for converting Braille, character as stored in the computer, into print. Table driven method is used to configure wide range of languages and characters sets. Blenkhorn's algorithm explains the conversion of English Braille languages into print. Finally, intended to test and develop the system.

Patrick Salamin [5] developed to focus on visual learning for the visually impaired people. It describes the application and perceives 3D shapes. The test was made and concludes by results and obtained geometrical basic shapes. Based on the results and tests to build the efficient application to understand a geometrical basic 3D shape based on reduces vision. Depends on the applications, user can easily understand the contour pictures. By concluding that the system provides the efficiency and promising way for disabilities to can understand the 3D shapes.

Visually impaired people face many challenges in the society particularly students with visual impairments face unique challenges in the education environment has been developed by Prachi Rajarapollu [6]. This paper presents the Braille to text/speech converter and it can be implemented in spartan3 kit. The VHDL languages are simulated by using Xilinx Impact software and that text will be displayed in the LCD display and audio output is produced through speaker. LCD and speaker interfaced through kit. FPGA Spartan 3 IC XC3S400 is a efficient, very low power consuming and fast.

Tirthankar Dasgupta [7] proposed that forward transliteration system for Dzongkha text to Braille conversion. It provides low cost system for blind people and reduces the problem of scarcity. Based on the transliteration rule, the output can be generated. Further extended the system to an audio QWERTY editor. It allows the blind person to read and write Dzongkha texts. It develops the low cost technology to assist the blind people.

Varsha V. Gaikwad [8] described that communication SMS system for blind people. The user can send the SMS in GSM module through AT commands and converts it into braille language based on the memory stored in look up table. Blind people can send message using braille pad. And loud speaker is used for audio output.

The fast text to braille translator based on FPGA was described by Xuan Zhang [9]. Compared with the commercial methods, the translator in hardware instead of software. The translator was described using VHDL. The result shows the hardware based translator achieves as same as the software based translator. It provides better throughput compared to original blenkhorn's algorithm.

The different formats for accessible to people with less visual ability and reconfigurable PDA for visually impaired people was described by Iain murray [10]. It can design for print to braille translation system and braille keyboard controller. This can be developed by using Xilinx's FPGA and potential platform for embedded systems.

The testing system for the Braille-to-text translation is quite different from the version of text-to-Braille translation. Since Braille note takers are being widely used for the blind to take notes in Braille, and Braille-to-text translation is a typical application in these note takers, a Braille keyboard is integrated into the system and is used as an input device. Most commercial Braille note takers utilize microcontrollers with software running in them to perform multiple functions including note taking, translation, and real time speaking. When using a Braille keyboard, up to six buttons need to be pressed simultaneously. Because a simple matrix-like keyboard, shown in Fig.2, has deficiencies to deal with multiple key detections, so it is normally not referred to as an ideal solution for Braille keyboard. Instead, a popular one is to use optical detectors and a microcontroller to detect when buttons are depressed. One example of this approach reported in D. G. Evans's paper is to use infrared light source/sensor pairs and microcontrollers. When using optical detectors, if a key is depressed, it breaks the light beam between the source and sensor. Thus, the sensor generates a pulse that can be received by a microcontroller.

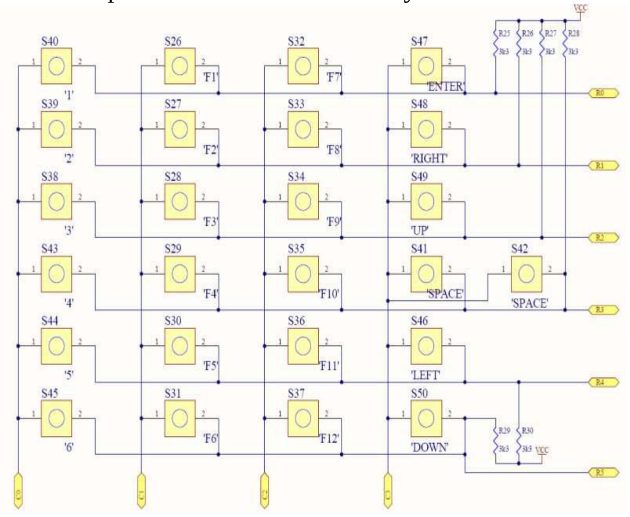


Fig.2. Schematic of Braille keyboard

A new method was developed to implement a Braille keyboard using a simple 4 x 6 push-button matrix. The buttons have been organized and positioned so as to achieve multiple key detections. A keyboard controller described in VHDL was implemented to send and receive scan codes. Fig.3 shows the layout of the proposed Braille keyboard. In line with current designs, the keyboard has function and direction keys. The arrangement of six Braille keys and space follows Perkins-style keyboard. Perkins Brailler, invented by David Abrahams, is a Braille typewriter which has been widely used by blind people. The layout of Perkins' keyboard is adopted by most of commercial Braille note taking products due to its success. To build a machine that is easy to use for the visually-impaired, the function keys can be used for selecting functions including speaking, printing, translating, embossing. Thus the direction keys can be used as "shift", "control", "capital lock" and "backspace". The layout of the schematic shows that the six Braille keys are located in the first column, twelve functions keys in the second and third columns, and enter, space and direction keys in the fourth.

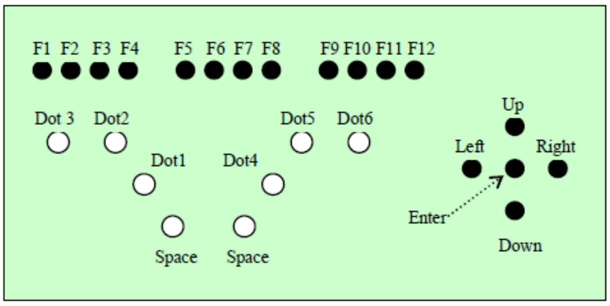


Fig.3. Layout of Braille Keyboard

The keyboard controller keeps sending 4-bit scan codes to the keyboard inputs from C0 to C3 and scans one column at a time. To do this, a circular shift register containing an initial binary value "0111" is used in the controller. For example, Fig.3 indicates a process of scanning the first column of keys for the Braille keyboard. To scan the first column, the keyboard controller sends binary code "0111" to the inputs of the keyboard C0 to C3. If key S39, S43 and S44 are pressed down, the most significant bit '0' will pass through these three keys to the output ports R1, R3 and R4. Therefore, a six-bit binary output signal "101001" has been generated and sent back to the keyboard controller. Likewise, to scan the second column, the shift register will shift right the code "0111" for one bit to generate the second scan code "1011".

In this paper, to improve the interactions between user victims and computers by making computers more usable and receptive to user needs. This paper can be implemented in Virtex kit and the program can be coded in VHDL with the help of Xilinx Software. It provides less power consumption and better portability.

I. BLOCK DIAGRAM

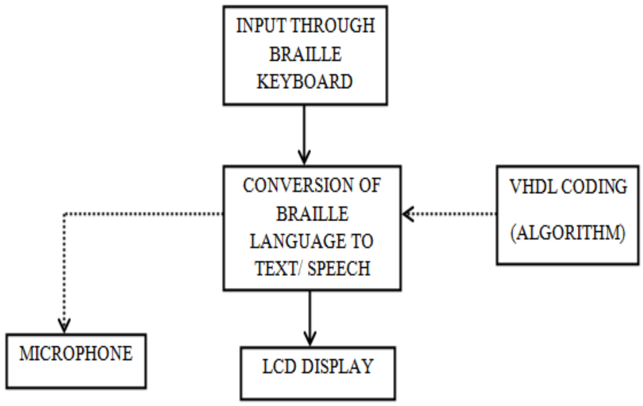


Fig.4. Block Diagram of translation

A. *Block diagram description*

The input is given through the Braille keyboard to the FPGA system. Input keyboard, LCD display and Speaker are all interfaced to the FPGA. The software will take the combination of all the six cells from the input hardware. According to the combinations, the FPGA converts the input into the text through the decoding logic in VHDL language and produce the appropriate output in the hardware. The user gives the Braille input, the conversion process takes place and it is displayed on the screen. Simultaneously, speech output to be produced the output. After accepting few characters, user will play the press button. Device has to be searching that word in look up table and produce the speech device output.

B. *Virtex-4 FPGA*

Virtex-4 has a wide variety of flexible features from the family Xilinx and it has been enhanced in programmable logic design capabilities and it makes a perfect powerful device to ASIC technology. Virtex-4 FPGA performs different platforms and multiple combinations to address the complex applications. A Virtex-4 FPGA building block enhances the popular devices such as Virtex, Virtex-E, Virtex-II, Virtex-II Pro etc.

The devices are used in the Virtex-4 piggy back board is XC4VSX25-10FF668. The number of slices used as 10,240 and logic cells is 23,040. It also contains 128 extreme DSP slices, 128 block RAM, 2304 block RAM in Kbits, 104 dedicated multiplier, 4 DCMs, 320 maximum select I/O, onboard configuration serial PROM, JTAG connector, Compatible with Xilinx ISE foundation software.

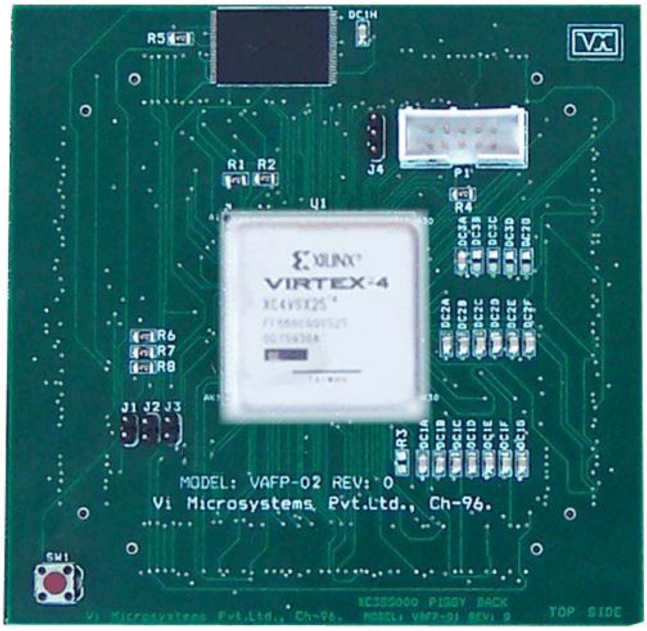


Fig.5. Virtex-4 Piggy Back Board

Virtex 4 XC4VSX25 FPGA development board is used in this design. The RS-232 serial connection is used to send the rule table to the look-up table and save the Braille codes or translation results in a text file. The system works as follows:

The rule table is sent to the translator in the FPGA through the serial receiver Rx using Hyper Terminal before the scan process starts, and then the function will be initialized as translations using a standard keyboard.

Then users can select a particular function to be performed using keys F1, F2 or F3 predefined on the Braille keyboard. If the note-taking function is selected, all Braille codes typed will be sent to a serial transmitter directly. A multiplexer MUX2 is used to select data from the translator or the keyboard controller to be outputs.

If the translation function using a standard keyboard is selected, the untranslated Braille ASCII codes will be sent through the multiplexer MUX1 to the translator.

The translator takes the Braille ASCIIs and stores them in a buffer. Characters are stored until a space or carriage return is detected. At this point the Braille to text translation process takes place. The results of the translation are sent to a serial transmitter Tx2 through MUX2 so that they can be received and stored in a text file by the computer.

If translation using the Braille is selected, the MUX1 will select data from the keyboard controller to be the untranslated codes, not those from Rx. Then the translation process happens as described before.

The system integration is able to supply users a complete design. It means it allows users to operate this translator without intervening the inside. For example, they do not need to program the FPGA and load the whole table to the FPGA for each time. What they need to know is just the particular function for each button on the Braille keyboard. Every time when the FPGA is powered on, it would perform as a Braille translator in a second. To do this, the configuration of the design must be saved somewhere on the development board. When the board is powered up, the configuration will be mapped to the FPGA. From this point, each Xilinx FPGA development board supplies at least one Xilinx Platform Flash which allows designers to store an FPGA design in nonvolatile memory. Another problem to be solved is how to pre-store the rule table before using it. In the testing systems discussed in previous sections, rule tables must be loaded to translators manually every time before further operations. However, this is not what users expect.

Fortunately, a Virtex-4 development board supplies a 4 mega-bit Flash memory. Therefore, the rule table including Braille-to-text and text-to-Braille translation can be saved in this Flash memory beforehand. Every time when the design stored in Xilinx Platform Flash is configured as a translator to the FPGA, the translator will retrieve rules from the Flash memory one by one and save them in the block RAMs. The whole process can be finished when the board is powered up. Because the same algorithm is used by Braille-to-text and text-to-Braille translators, the architectures of these two translators' are very similar. This fact makes possible the development of a translator which is capable of doing both jobs. In this case, the parallel translating schemes will be used in the text-to-Braille translation. However, creating a multi-functional translator is helpful to simplify the design. To perform both translations, a look-up table with a sufficient memory is needed to store both of the rule tables. Since two tables occupy 47 kilobytes of information, a Virtex-4 FPGA with 81 kilobytes of block RAM is capable of accommodating the rule table. A mode select input is used to switch between the two translations modes. The decision-table-check block is only for Braille-to-text translation, while left context- check is for text-to-Braille. The right-context-check block includes context information for both types of translation.

II. Results And Discussion

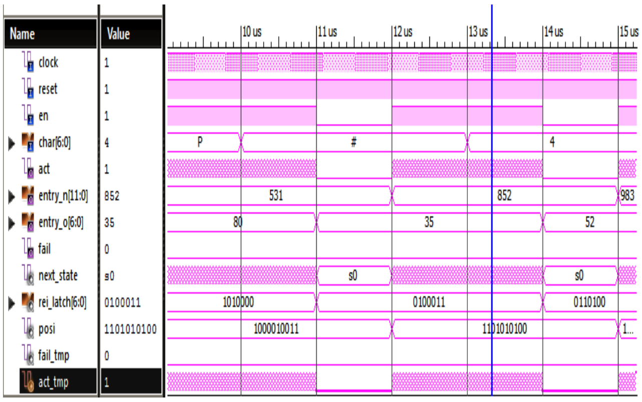
The Braille to text translation coding is written in VHDL language and it is simulated by using Xilinx Software. The program coded in Xilinx suite 12.1 Software. Then the simulation process takes place. After simulating the summary window is shown in the fig.6a. Fig.6b shows the output translation for displaying the characters, numbers and special characters. The different baud clock rate output is shown in the fig.6c. This can be implemented in Virtex-4 kit. This provides time limitation, power consumption etc.

find_rulev2 Project Status			
Project File:	find_rulev2.xise	**Parser Errors:**	No Errors
Module Name:	find_rulev2	**Implementation State:**	Fitted
Target Device:	xa95*xl-**	•**Errors:**	No Errors
Product Version:	ISE 12.1	•**Warnings:**	No Warnings
Design Goal:	Balanced	•**Routing Results:**	
Design Strategy:	Xilinx Default (unlocked)	•**Timing Constraints:**	
Environment:	System Settings	•**Final Timing Score:**	

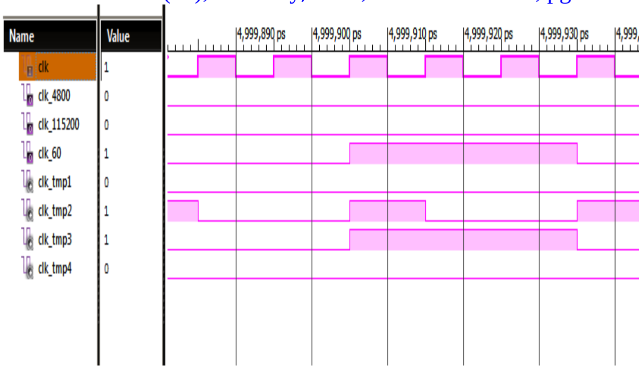
Detailed Reports					
Report Name	**Status**	**Generated**	**Errors**	**Warnings**	**Infos**
Synthesis Report	Current	Mon Nov 10 14:21:56 2014	0	0	0
Translation Report	Current	Mon Nov 10 14:22:00 2014	0	0	0
CPLD Fitter Report (Text)	Current	Mon Nov 10 14:22:12 2014	X 1 Error (0 new)	1 Warning (1 new)	0
Power Report					

Secondary Reports		
Report Name	**Status**	**Generated**
ISIM Simulator Log	Current	Mon Nov 10 14:58:44 2014
Post-Fit Simulation Model Report		

(a)Design Summary



(b) Display character, number and special character



(c) Different clock baud rate

III. Conclusion

The design of FPGA based Braille to text converter has been designed by using VHDL coding and synthesized by using Xilinx ISE design suite 12.1. This device is useful for blind people to improve the quality of their life. Using this technique, blind people can able to write, read as well as normal humans. Braille translation standards should be higher for print. In order to achieve accuracy level ASCII code should be used by Braille depends on the context.

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