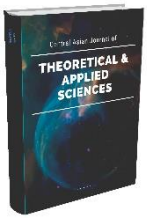


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# Design of an External USB Braille Keyboard for Computers


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***Annotation:*** *Last 20 years, billions of people around the world are widely using digital devices. In this information technology age, it is difficult to imagine our life without digital devices including computers. Computers play an important role in the lives of visually impaired people. These devices help them with electronic tasks such as writing mailing messages, and word processing tasks. Computers based on modern technologies for blind people are available worldwide. Computers have a specially designed external USB Braille keyboard with large six dots that help blind people type SMS messages easily and quickly. This paper proposes a low-cost external USB Braille keyboard for computers which is designed to help blind and visually impaired people type quick messages. This device is beneficial through its innovative concept, its simplicity, and its availability at an affordable cost.*



***Keywords:*** *Braille keyboard; blind; visually impaired.*


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**Introduction.** Recently, advanced research in communication, information and digitization is being carried out in Uzbekistan. According to the report of the World Health Organization, 284 million people are estimated to be visually impaired worldwide of which around 39 million people are blind [1]. There are more than 66,000 blind people in Uzbekistan, of whom 41,000 are members of the Blind Society of the Republic of Uzbekistan. About 2,000 of them are directly involved in production processes [2]. In Blind Society, the 6-dot Braille alphabet is widely used for educational purposes. This alphabet was

invented by the French educator and inventor Louis Braille. The Braille system is specialized a reading and writing system for use by people who are visually impaired.

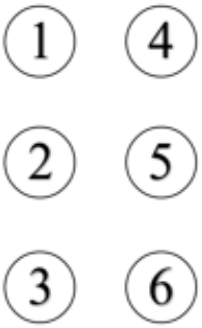


Fig. 1. 6-dot Braille pattern

Braille alphabet uses 6 dots to represent letters, numbers and various symbols, that is, 3 dots from the right side from top to bottom and 3 dots from top to bottom from the left side. The symbols generated by these 6 dots are generated as a result of pressing the main 6 buttons.

The main challenge for Blind people is the high cost of the latest commercially available Braille keyboards. Late years this problem is being solved by academic researchers and scholars around the world.

**Related work.** Technology science teachers in general secondary schools should not feel like second- rate science teachers and should be able to arouse students' interest in science while having a deep understanding of this subject. In the process of teaching, technology teachers should deeply feel the role and essence of this subject in society, the goals of the subject in education, and at the same time teach students hard work, creativity and, in some sense, entrepreneurship. "It is known that the teaching profession is a very responsible profession that requires various integrated knowledge and skills. A teacher of technology teaches students in the future, as well as forming skills related to certain professions. The teacher must have high qualifications and professional skills in preparing the given items.

In [3], it is developed a hand-held calculating unit to aid the visually impaired with voice output. The system is implemented on custom-made open source Arduino platform, making it efficient and cost-effective. In the study [3] due to the small pin count of the ATMega328, it was not possible to incorporate more functions into the calculator. In [4], it is analysed different braille devices for implementing a cost-effective and portable Braille system for visually impaired people. In [5], it is introduced a new concept of assistive virtual keyboards based on a systematic review of text entry optimization techniques. Pocket Braille keyboard – reader using braille back service is developed in [6]. In [7], it is presented OneHandBraille which is a new text entry method for visually impaired people. The method is based on gesture moves and uses only one user’s hand typing the Braille Code. It is developed a smart Braille keyboard for learning Braille literacy in blind or visually impaired people in [8]. In [9], it is presented a comparative evaluation study with totally blind participants to evaluate their performance using two braille input methods are BrailleEnter and Swift Braille keyboard. In [10], it is presented a set of new methods of Braille character recognition with the use of mobile devices such as smartphones. In the study, a set of four varying solutions was proposed which is called a simple mode, an acute angle mode, a minimum distance mode, and a scaled mode. In [11], it is developed a novel Braille pad with dual Text-to-Braille and Braille-to-Text capabilities with an integrated LCD display. In [12], it is developed a talking Braille keyboard to assist visual impaired users in text messaging. Mobile Braille touch

application for visually impaired people using double diamond approach is presented in [13]. Finally, it is developed a low cost real time braille keypad for communication in [14]. The Braille keypad implements the Braille cells as 6 switches that can be pressed simultaneously based on the actual Braille combination in order to type a particular letter and words.

To summarize, the overview of the previous contribution mentioned above on Braille keyboards for computers is more expensive and not intended for Uzbekistan. In this study, an external USB Braille keyboard for computers is designed for visually impaired individuals' lives to make it easy. Currently, available Braille keyboards for computers can only import from other countries for a high cost to Uzbekistan. This causes financial problems for blind people. To solve this problem, this study designs a low-cost external USB Braille keyboard for computers.

**Proposed Model.** The proposed external USB Braille keyboard for the computers consists of the following components and elements: Microcontroller (A); buttons (B); USB type A Male cable (C).

*A. Microcontroller*

ATmega32U4 is a low-power 8-bit RISC-based AVR family-related microcontroller by Microchip [15]-[20]. It features 32 KB self-programming Flash program memory, 2.5 KB SRAM, 1 KB EEPROM, USB 2.0 full-speed/low-speed device, 12-channel 10-bit A/D-converter, and JTAG interface for on-chip-debug. The device achieves up to 16 MIPS throughput at 16 MHz [21]. Operational voltage 2.7-5.5 V.

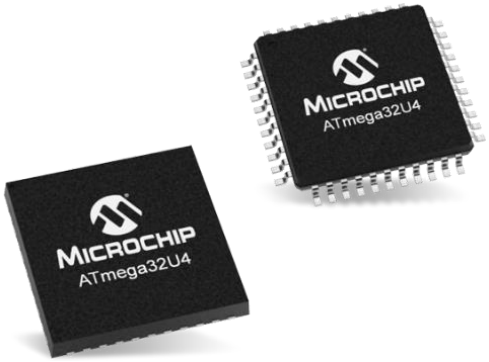


Fig. 2. ATmega32U4 microcontroller

*B. Button*

The button is also called a switch button, tactile button or momentary switch. It is one of the basic components and is widely used in many Arduino projects. In this work, 10 SMD tactile switches were used to design the proposed Braille keyboard for computers.

Fig. 3. SMD Tactile Switch

 

*C. USB type A Male cable*

USB Type-A connectors, officially called Standard-A connectors, are flat and rectangular in shape. USB Type-A connectors are supported in every USB version, including USB 3.0, USB 2.0, and USB 1.1. USB 3.0 Type-A connectors are often, but not always, the color blue. USB 2.0 Type-A and USB 1.1 Type-A connectors are often, but not always, black.

Fig. 4. USB type A Male cable

By combining all the hardware components mentioned above, one can create a prototype of a Braille keyboard for computers. 3D view of the proposed device is presented in Figure 5.

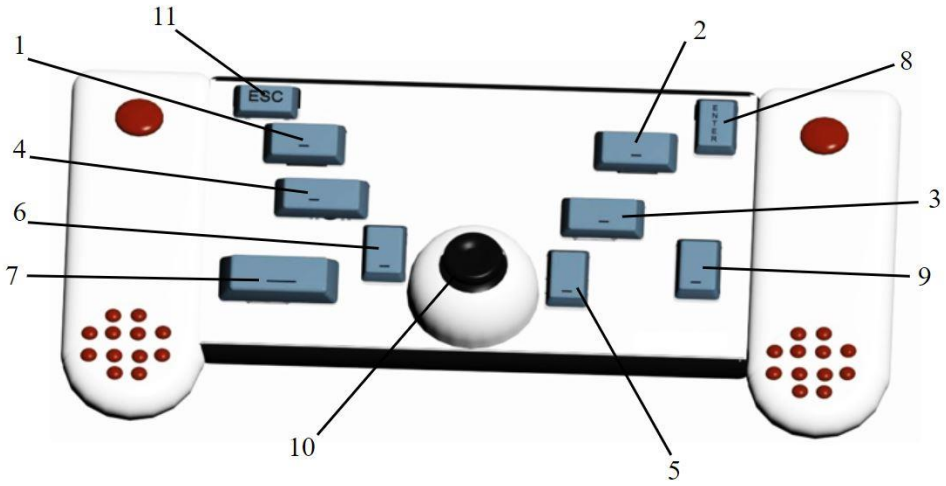


Fig.5. 3D view of the proposed braille keyboard for computers

According to the figure (see Fig. 5) shown above each number means components of the proposed braille keyboard for smartphone: 1) The first button of the 6-dot Braille-based keys and the most used function for combinations; 2) The second button of the 6-dot Braille-based keys and the function used for combinations is the BACKSPACE function; 3) The third button of the 6-dot Braille-based keys and the function used for combinations; 4) The fourth button of the 6-dot Braille-based keys and the function used for combinations; 5) The fifth button of the 6-dot Braille-based keys and the function used for combinations; 6) The sixth button of the 6-dot Braille-based keys and the function used for combinations; 7) The SPACE function of the computer keyboard was created mainly as a convenience for exchanging messages; 8) The ENTER function of the computer keyboard was created mainly as a convenience for exchanging messages; 9) Extra button for typing; 10) The joystick fulfills the task of a computer mouse; 11) ESC function of the computer keyboard.

 

**Conclusion.** Visually impaired and blind people have difficulty in realising the real environment that they are not familiar with. In this work, we have designed a prototype of an external USB Braille keyboard for computers. The Braille keyboard has been designed taking into account the need for low-cost solutions in the context of Uzbekistan. On the market, the cost of other Braille keyboards ranges between 100 USD and 1000 USD. The cost shows a great variance because the cost increases as it can be exported to foreign countries. And there are also localization problems with products. The Braille keyboard was designed in this study, the cost decreased even more. The proposed Braille keyboard will cost about 20 USD.

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