

Comparative analysis of technologies and devices for the blind and visually impaired

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Annotation: Today, techniques, technologies, in a word, information technologies are rapidly developing. So far, the development of information technologies and achievements requires the need to inform all spheres of human life. Using the capabilities of these technologies, special devices are produced for blind and visually impaired people. The ability to see, to be able to see fully, understand and perceive this bright world and its diversity is one of the greatest gifts given to mankind.

In this paper, we present a general description of devices and technologies for the blind and visually impaired, their principles of operation, as well as a comparative analysis of the results obtained during the research.

Keywords: *gadget, neural network, blind, smartphone, Braille alphabet, device, glasses, information, software.*

Introduction. According to the World Health Organization (WHO), about 2.2 billion people in the world are either farsighted or nearsighted [1]. Unfortunately, blind people are deprived of many opportunities and amenities.

World scientists and leading technology companies are developing special devices and software systems in order to make life a little easier for the blind or visually impaired, to ensure their movement without assistance [11-13].

20-30 years ago, blind and visually impaired people used canes, guide dogs and the simplest electronic devices with voice function (clocks, landline phones). In our time, modern devices, techniques and technologies are aimed at organizing comprehensive social adaptation of blind people [8].

Participation in the process of mass communication for the blind is complicated by the inconsistency of their perceptual abilities with the established social practice, which focuses mainly on visual forms of presenting the information. Traditional methods of access to information resources based on the image of alternative materials (sound or point reliefs) for people with severe visual impairment require a lot of time and money. They cannot provide information needs corresponding to the current level of development of society in various spheres of human activity (educational, professional, etc.) [9].

It is known that people perceive information about the environment or the world mainly through the 5 senses. These are properties such as sight, hearing, touch, smell and taste. It would not be an exaggeration to say that in the modern era of the development of high technologies, smell and taste do not participate in the processes of using information services by people. Simply by seeing, hearing and touching, modern information services can provide users with information that they can perceive. So, all the signs of an information system that provide information can be divided into 3 groups: visual, audio and tactile [7].

It is undeniable that computer technology is firmly entrenched in human life. Currently, such technologies help people not only study, work, and communicate, but also solve the problems of blind or visually impaired

people, support them, and use educational, scientific, and fiction literature.

Braille alphabet. To date, the only primary means of written communication designed for the blind and visually impaired is Braille.

The Braille alphabet is a special alphabet based on raised dots, which was created by the French educator Louis Braille in 1824 to promote literacy among the blind [2].

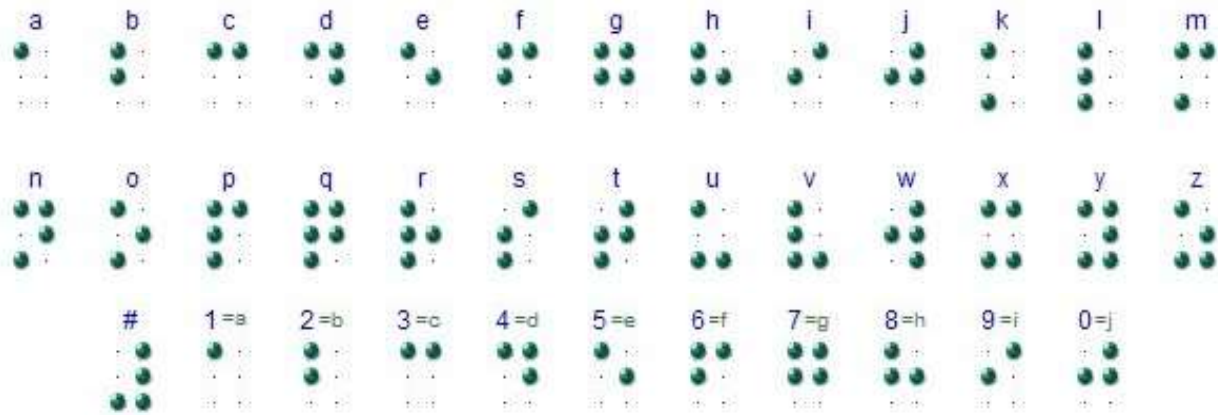


Figure 1. 6 dot based Braille

To represent letters and numbers, Louis Braille used 6 dots arranged in three rows and two columns. Two more dots were later added, creating an 8-dot extended Braille system. It is possible to express 64 different characters using traditional six-point Braille and 256 different characters using extended eight-point braille. The formation of Braille is a systematic and somewhat complex process. The most important thing to read is the structure of the letters. Blind people who have fully mastered the Braille alphabet will be able to read and write.

The use of Braille is regulated by some government standards.

“Smart glasses”. One of the devices created for the blind is smart glasses, which, with the help of a built-in special camera, warn blind people of a certain situation by making sounds about objects and obstacles around them.

Developing visual wearables for the visually impaired requires two key elements. First, an appropriate display device, and second, the development of imaging techniques that produce accurate and timely spatial information [10].

As a result of research conducted at the University of Oxford, Professor Stephen Hicks has developed a model of "smart" glasses that can perceive light and movement for blind people.



Figure 2. Special "smart" glasses for blind people [4]

These special glasses are equipped with two micro-cameras to detect nearby objects and present them to the user in a recognizable way, as well as an infrared projector that determines the distance to nearby objects. Information received by the cameras from the environment is processed using a portable pocket computer or tablet and reflected on the lens. The glasses are equipped with a compass, a gyroscope and a GPS module, so the blind can easily navigate without the help of people.

Enables visually impaired people to understand the text and identify objects with voice prompts describing things they cannot see.

Tactile device. A group of 6 engineering students from the Massachusetts Institute of Technology (MIT) has created a prototype device that converts printed text into Braille in real-time. This device is relatively inexpensive and significantly increases the possibility of using printed products for visually impaired people [5].



Figure 3. Real-time text to Braille converter

This prototype device has a special internal camera for scanning text. This camera captures printed text and converts it to digital text through optical recognition software. The scanned text is then converted to Braille, and a mechanism moves 36-pointed pins on the device's surface to create fingertip-readable characters.

Braille device Sense U2. The South Korean company HIMS has developed a special device based on the Braille alphabet for the blind [3].



Figure 4. Braille Sense U2 device

Braille Sense U2 with a 1 GHz processor and 32 GB internal memory provides fast data processing. There is also a USB interface for connecting external devices, a VGA interface for connecting to a monitor, and an Ethernet interface for connecting to the Internet.

This device in the form of a tablet for the blind can read e-books, process text, access social networks, recognize and record speech, and use e-mail in Braille.

Smartphone instead of eyes – This is a special mobile application "I can see", created for smartphones based on a neural network trained by Ukrainian programmer Sergey Stakhov.

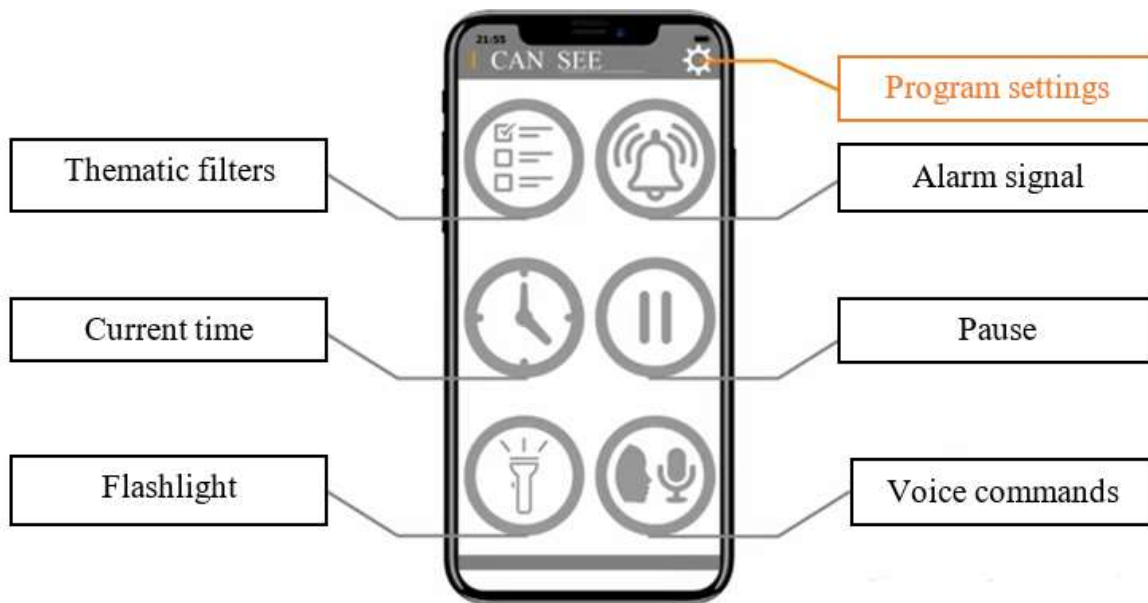


Figure 5. "I can see" mobile application [6]

This application recognizes the objects around you and pronounces them using a synthesized voice. To do this, you need to launch the application and point the camera of your tablet or smartphone to the desired point. Through the object detection function, the recognition of objects captured by the camera will start in turn and be heard by voice: food, clothing, household appliances, etc.

Also on the main screen of the application, there are 5 main buttons (dots) and they are located so that they are easy to remember. These are the "exact time", "night time" (turn on the backlight of the phone), "pause search" and "settings" buttons, which are additional conveniences for the blind or visually impaired.

The analysis showed that each technology has many advantages and features. None of the above options can be ruled out and is important for users in the world of modern technology. The table below provides a comparative analysis of technologies for the blind and visually impaired:

Table 1.

Comparison of existing smart gadgets for the blind according to the technical specifications

Name	Functionality	Hardware/Software	Sensors	Technical specifications
Smart glasses	Head-mounted device	Hardware	Micro camera, compass, gyroscope and GPS module	Connected to a computer
Tactile device	Braille reader	Hardware	Built in camera	Consists 36 pins
I can see	Mobile application	Software	Detects objects using the phone's built-in camera	Any Android smartphone
Braille Sense U2 device	Braille display	Hardware	Piezoelectric actuator	1 GHz processor and 32 GB of internal memory

Conclusion. In conclusion, it can be said that today in the world, various gadgets, devices or software tools are being created for blind or visually impaired people. The biggest problem for users is the relatively high cost of these devices. For example, the Braille Sense U2 device costs \$5,000. Currently, more than 65,000 blind citizens live in the Republic of Uzbekistan. For them, special Uzbek-language devices are not produced in our republic and are imported only from abroad. Some of these methods and technologies have been briefly reviewed and analyzed in this article. In the future, it is planned to create a "Smart gadget" based on the Uzbek alphabet for the blind and visually impaired.

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