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IMAGE FORMATION IN AUGMENTED REALITY DEVICES

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The article presents some kind of basic technologies of image formation in augmented reality devices. The paper also has the description of these technologies and some schemes of making optical system for transmitting the picture from a display into an eye.

Introduction. Augmented reality is the result of combining perceived reality with virtual reality, supplementing information about the environment in real time. The example of augmented reality can be the trajectory of the movement of the puck in the television tournament.

In modern laparoscopic operations, the image on the endoscope is complemented by the image obtained during intraoperative angiography. This allows the surgeon to know exactly where the tumor is located inside the organ, and to minimize the loss of healthy tissue.

Modern combat aircraft and helicopters often use an indication on the windshield or on the helmet of a pilot. It allows the pilot to receive general information directly against the background of surveillance, without being distracted from the main instrument panel. It is possible to save precious seconds during a maneuverable air battle. A lot of such systems cover goals by turning the head or the movement of the eyeballs.

The augmented reality devices should be compact and ideally do not overlap the eye view with their design, and also have good brightness, clarity and contrast of the complemented image.

All devices of augmented reality can be divided into:

- near to eyes application, when the image is up to 100 mm from the eyes;
- the application, remote from the eyes, the image is at a distance of more than 100mm.

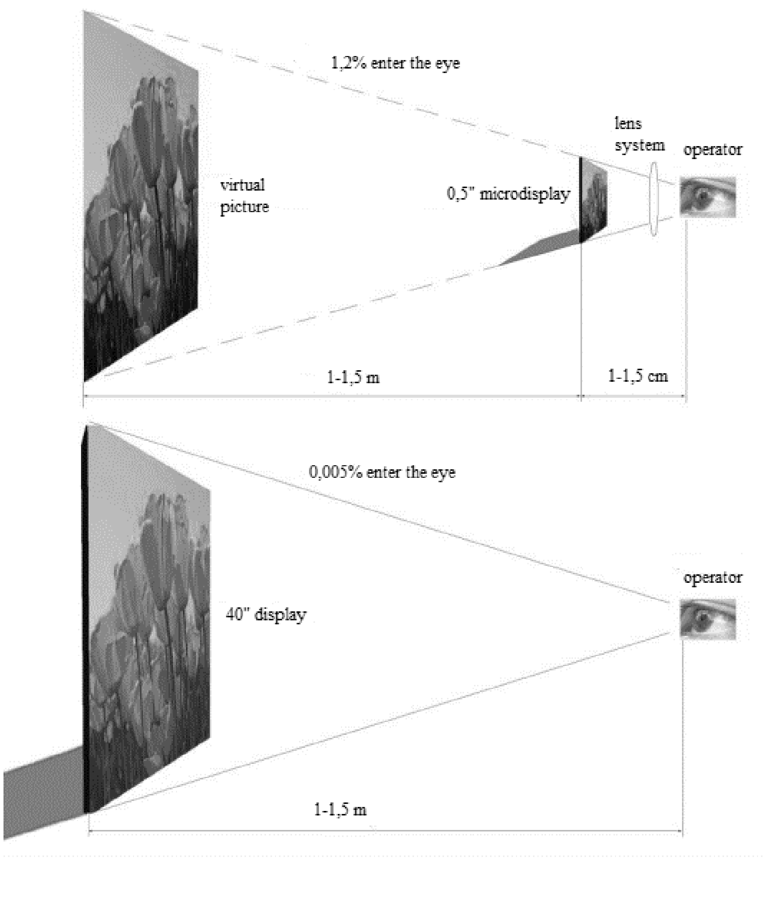

Fig. 1. Improving the efficiency of information display using micro-display technology

Examples of augmented reality of near to eye application are glasses, helmets, lenses. Examples of augmented reality that can be used for medical purposes.

From a physical point of view, the creation of near to eye is laborious, because depending on the use of microdisplays, the design becomes much more complicated and the characteristics of the supplemented image change.

For near to eyes display of the main parameter is the focal length. For a centered optical system consisting of spherical surfaces, the focal length describes the ability to collect beams into one point, provided that these rays go from infinity by a parallel beam parallel to the optical axis.

The angle of sight is also important. It determines the size, depending on the distance from the eyes. The microdisplay measuring 0.5 inches, located at a distance of 1-1.5 cm, will be perceived by the eye as a "virtual" image corresponding to the full-screen picture of a 40-inch television with an indentation of several meters - figure 1. Therefore, the closer a screen to an eye, the less the screen should be.

As can be seen in the figure, the gain in the information display efficiency is 300-500 times. [1]

Classification of indication systems. By transparency, microdisplays can be divided into:

– transparent;

– opaque.

Transparent microdisplays are not completely transparent, they have a transparency of 50%. This is determined by the number of current-carrying tracks to pixels.

The use of opaque microdisplays implies the creation of an optical system that transmits an image to the eye.

For projection systems and around-the-eye displays, various optical schemes are used. In Figure 2, 3 represent the optical circuits for the two main types of microdisplays applications. Requirements for the parameters of microdisplays intended for use in projection systems and near to eye display systems also differ (Table 1). When developing both the microdisplay and the optical circuit, various strategies should be used to optimize the output systems, in order to increase the light efficiency, economy, and price reduction.

Table 1. – Key parameters for two technologies for the use of microdisplays

Technologies	Projection	Near to eye
Key parameters	High resolution	Low consumption
	High brightness	Small weight
	High contrast	Small dimensions
	Wide colour palette	Low price

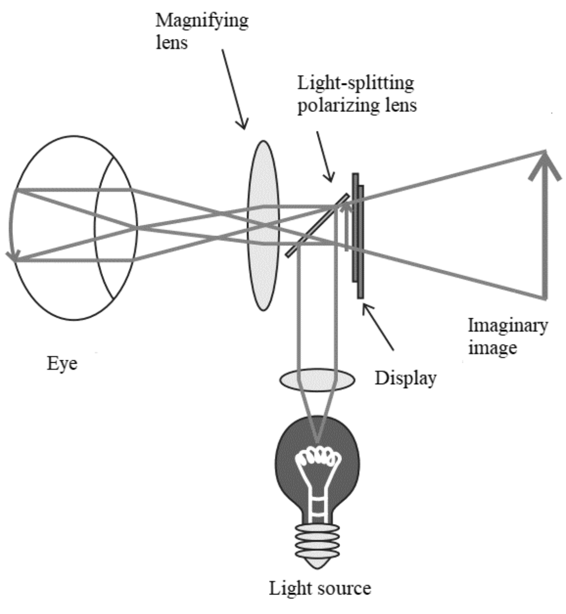

Fig. 2. Optical scheme for the use of microdisplays in near to eye displays [2]

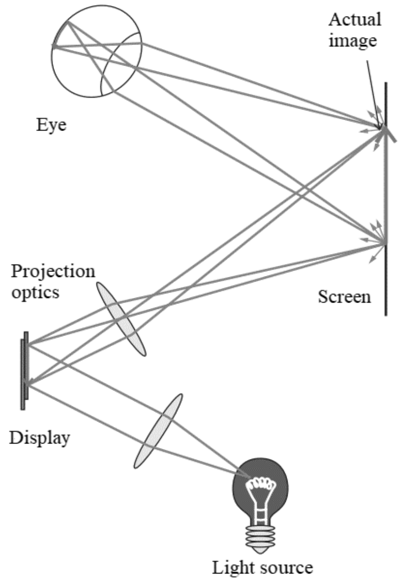

Fig. 3. Optical scheme for the use of microdisplays in projection systems [2]

Hinged display system with waveguide plate.

The helmet-based display system consists of several main blocks and two channels:

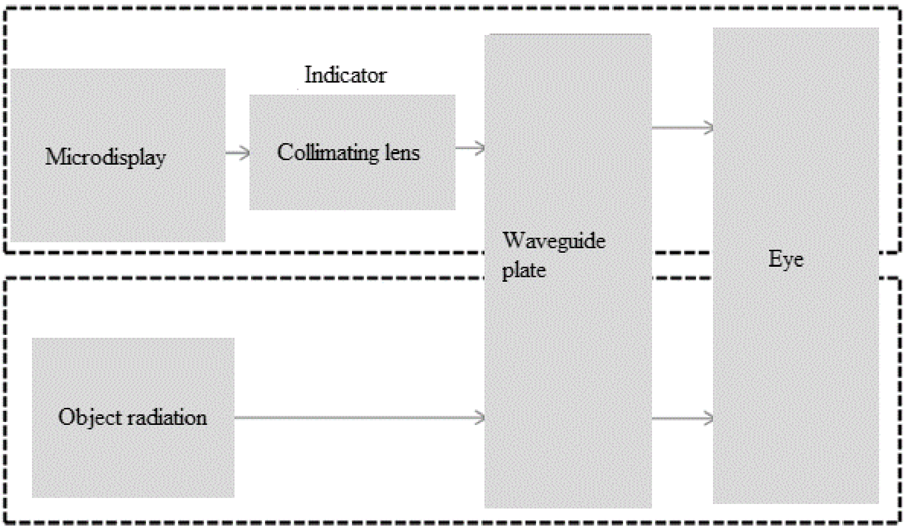

Fig. 4. Block diagram of a helmet-mounted display system with a waveguide plate

Thus, the image formed on the indicator collimates to infinity with the help of a collimating lens, then the image hits the waveguide plate, which in turn ensures the transfer of the image and its entry onto the observer's retina.

Conclusion. Technology is constantly evolving, which allows you to create more compact and functional devices. The development of technology in the future can create a favorable environment for creating augmented reality devices replacing mobile phones, televisions and computers.

REFERENCES

1. Пассивно-матричные микродисплеи светоизлучающего типа / А.С. Мохаммед [и др.] // Сборник докладов БГУИР. 2014. – № 4. – С. 29–34.
2. Самарин, А. LCoS-микродисплеи и их применение / А. Самарин // Компоненты и технологии. – 2008. – № 8. – С. 24–32.