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Human Eye as a Device

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Why can't you just point the camera at what you see and shoot it? This question seems to be simple. However, it is very difficult to answer, and it will require studying not only how the camera records light, but also how our eyes work and why they work the way they do.

An interesting question appears, when we ask ourselves, how many frames per second processes our eye and which camera characteristics are suitable for eye. Modern cinema is often based on a frame rate of 24 frames per second – at such a rate most viewers do not get discomfort, but most still see a difference between a 'real' picture and a 'cinematic' one. Human vision is not frame-based. Therefore, even at low frequencies of a few frames per second, a person is able to perceive the change of frames as movement. The human eye automatically adjusts to the illuminance of an object. This is called adaptation. In a camera, the light is adjusted either manually or automatically by means of a lens. Human vision is not a discrete system whose capabilities can be described in simple numbers. You could say that about a camera: it records video at 3240x2160 pixels, at 60 frames per second. But the human eye only sees frames when it is looking at a developed film or a digital video storyboard in an editor.

The visual system understands an image as a whole, noticing only its changes. If a picture does not change – it makes no difference whether it changes by 5 frames per second, 25 or 250. The faster it moves, the sharper these

movements are, the higher the frequency limit. When you see the difference between 30, 60 and 100 FPS, you can clearly see that the human eye sees far more than 24 frames per second, so myth about 25th frame is easy to disprove.

When the frame is displayed for a short time (1 millisecond shows - 10 ms does not show) the sensitivity of the eyes is even higher. Even if a person does not see the frame change and the picture is smooth, sharp color flashes, alternating with a black background (the frame is not shown), are detected by the visual system. If we have a case with video, in which every frame differs from the previous, people experience much more difficulties with detecting frames, and the number of FPS is better seen. Although the focal length of the human eye is roughly 22mm, the periphery of our visual field is significantly less detailed than the center, and additionally, what we see is the combined result of two eyes.

Each eye individually has an angle of view of the order of 100-140°, depending on how strictly the objects are defined as 'observable'. Accordingly, the overlap between the two eyes is on the order of 120° - almost as wide as a fisheye lens. Incredible and unbelievable for the first sight fact: people can see color only in 40-60° - it’s our central angle of view. Held by us experiment has proved that information. The person, who took part in it, sees movement at an angle about 100° and colors at an angle about 60°. Make the angle of view too wide and the difference in size of objects will be too big, while a too thin angle of view makes the relative sizes of objects almost the same, and you lose sense of depth. Extra wide angles also result in objects being extended out at the edges of the frame.

Most modern digital cameras have 5-20 megapixels, which is often presented as a complete failure if we compare it to our own eyesight. This is based on the fact that with perfect vision the human eye is equivalent in resolution to a 52 megapixel camera (assuming a 60° angle of view). However,

these calculations are misleading. Only our central vision can be perfect. As we move further away from the center our visual abilities drop dramatically - so much so that at only 20° from the center our eyes see just a tenth of the original detail. At the periphery we only detect large-scale contrast and a minimum of color. Taking this into account, it could be argued that our eyes can only see detail comparable to 5-15 megapixels of a camera.

Cameras require a different standard: they are needed to create realistic-looking prints. The printed image doesn't know what objects the eye will focus on, so every part of the frame needs to be extremely detailed.

In general, most of the advantages of our visual system get from the fact that our mind is able to intelligently interpret the information collected by our eyes, whereas in the case of a camera, all we have is the result of the sensor. Even so, modern digital cameras are developing, and in some visual characteristics even outperform our eyes.

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