

1.0 The Structure of the Visual System

The visual system consists of the eye and brain working together. Functionally, the visual system is an image-processing system that extracts specific aspects of the retinal image for interpretation by the brain.

1.1 The Visual Field

Humans have two eyes, mounted frontally. Figure 11 shows the approximate extent of the visual field of the two eyes in humans, measured in degrees from the point of fixation. The enclosed darker area can be seen with both eyes. The shaded area to the left is visible to the left eye only. The shaded area to the right is visible to the right eye only.

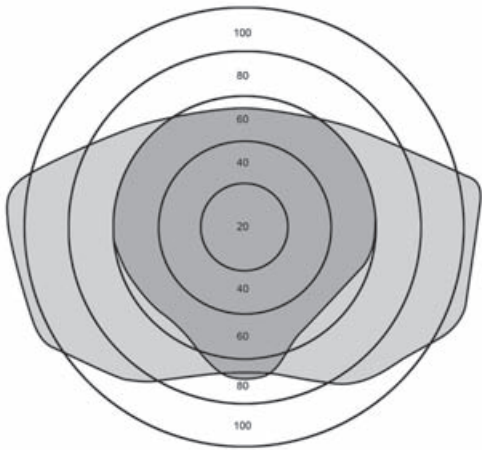


Figure 11
The binocular visual field expressed in degrees deviation from the point of fixation. The shaded areas are visible to only one eye. Given this limited field of view for a fixed position, it is necessary for the two eyes to be able to move. There are two ways this can be done; by moving the head and by moving the eyes in the head. Humans have a limited range of head movements but a wide range of eye movements.

1.2 Optics of the Eye

Figure 12 shows a section through the eye, the upper and lower halves being adjusted for focus at near and far distances, respectively. The eye is basically spherical with a diameter of about 24 mm. The sphere is formed from three concentric layers. The outermost layer, called the sclera, protects the contents of the eye and maintains its shape under pressure. Over most of the eye's surface, the sclera looks white but at the front of the eye the sclera bulges up and becomes transparent. It is through this area, called the cornea, that light enters the eye. The next layer is the vascular tunic, or choroid. This layer contains a dense network of small blood vessels that provide oxygen and nutrients to the next layer, the retina. As the choroid approaches the front of the eye it separates from the sclera and forms the ciliary body. This element produces the watery fluid that lies between the cornea and the lens, called the aqueous humor. The aqueous humor provides oxygen and nutrients to the cornea and the lens, and takes away their waste products. Elsewhere in the eye this is done by blood but on the optical pathway through the eye, a transparent medium is necessary.

As the ciliary body extends further away from the sclera, it becomes the iris. The iris forms a circular opening, called the pupil, that admits light into the eye. Pupil size varies with the amount of light reaching the retina but it is also influenced by the distance of the object from the eye, the age of the observer and by emotional factors such as fear, excitement and anger.