NASA TECH BRIEF

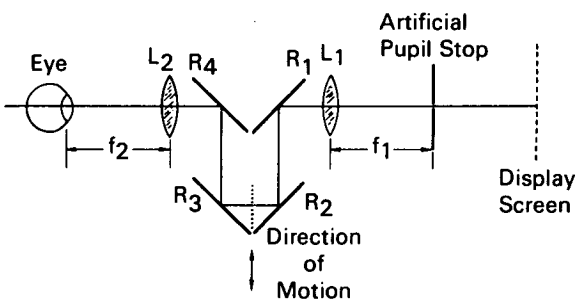
Visual Focus Stimulator Aids in Study of the Eye's Focusing Action

The problem:

To design an apparatus (Visual Focus Stimulator) for study of the eye's focusing action by providing a display that can be made to vary in apparent optical distance without change in apparent size, brightness, or color.

The solution:

An optical apparatus that varies the apparent distance of a target image from the eye by means of reflectors that are moved orthogonally to the optical axis between fixed lenses. The apparatus can be pointed at any object, test pattern, or other visual display.



How it's done:

Light from a visual display passes through the artifical pupil stop and then through lens L_1 which is at its focal distance from the stop. The light is then reflected by R_1, R_2, R_3, and R_4 through lens L_2 which is at its focal distance from the natural pupil of the subject's eye; thus, an image of the artificial pupil aperture is formed in the plane of the pupil of the eye. Lens L_1 also forms a real image of the display somewhere in the optical path between L_1 and L_2. If the system is adjusted so that lens L_1 forms an image of the target in the plane of the dotted line which is at the focal distance from lens L_2, the target would appear to the eye to be at infinity, requiring focus at infinity. If the image were formed closer to lens L_2, the eye would have to focus at a distance nearer than infinity in order to bring the target into sharp focus.

Reflectors R_2 and R_3 are the internal surfaces of a 90-degree prism that is mounted on a carriage driven by a servomotor programmed to provide a desired schedule of optical distance variations; R_1 and R_4 are the mirrored external surfaces of a 90-degree prism. As R_2 and R_3 are moved, the optical distance between the image of the display screen and lens L_1 does not change, but the distance between the image and lens L_2 does. For example, if reflectors R_2 and R_3 are driven closer to R_1 and R_4, the image of the target approaches closer to lens L_2; and the subject's eye must provide increased refractive strength in order to maintain the target in focus on the retina.

The artificial pupil is at the focal distance from lens L_1; hence, rays orginating in the plane of the artificial pupil will be collimated in the path between L_1 and L_2, and the image of the artificial pupil will not move when reflectors R_2 and R_3 are moved. Since the nodal point of the eye is very close to the plane of the natural pupil, and therefore close to the focal distance from lens L_2, the angular size of the retinal image of the target will not change when the two reflectors are moved. As long as the artificial pupil is centered on the optical axis of the system, the retinal image of the target will undergo no translation when the reflectors are moved.

Notes:

1. A related instrument is described in NASA Tech Brief 70-10401.

(continued overleaf)

2. Requests for further information may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: TSP70-10568

Patent status:

No patent action is contemplated by NASA.

Source: H. D. Crane and T. N. Cornsweet of
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