The Telereader Terminal:
The High-Definition Muvie Machine

Any computer system that can run the mudoc software can present text that has been set in interactive movable type. And most of the mudocs that are consumed in the next few years will be consumed with conventional personal computers, e-book readers, and other kinds of display and projection devices that are now in use. But soon to appear will be a new kind of input/output system that will facilitate communication and interaction between the computer and the computer user. This new human/computer interface is *the telereader terminal.*

Descriptions and illustrations of the telereader are included in Chapter II of *The Mu Primer* and in the interactive movie, *The Coming Revolution in Writing and Reading.* Chapter II of *The Mu Primer* is currently being revised and *The Coming Revolution* is still in production, however, so until one or both of them is available, the verbal descriptions, references, and hyperlinks that follow are offered.

The use of retinal projectors in a screenless display system

The telereader terminal will have a visual display system that differs radically from today's personal computer monitors. There will be no CRT (cathode ray tube) or flat-panel display screens on which images are presented to the user. Indeed, **the telereader will have no screen at all**. The telereader's visual output will be projected directly onto the user's retinas using a new display technology, the virtual retinal display (VRD) technology. With VRDs, the viewer's retinas become the telereader's display screens. The VRD technology is a unique display technology being developed by the Human Interface Technology Laboratory at the University of Washington in Seattle. Products that employ VRDs are being manufactured and marketed by Microvision, Inc. in Bothell, Washington. Their websites (www.hitl.washington.edu and www.mvis.com) provide extensive information about the VRD technology.

The virtual retinal display and its advantages

Virtual retinal displays use tiny laser diodes to project images onto the user's retinas. Single red laser diodes (one for each eye) are used to project black, white, and gray images onto the user's retinas. Three laser diodes (one red, one green, and one blue) are needed to project a full-color image onto a retina. In operation, VRDs' laser diodes use only nanowatts (billionths of a watt). The pixels (*pixel* is a contraction of "picture element") in VRD images can be made much smaller than the smallest pixels found in CRT and flat-panel displays, which means that much higher resolution can be achieved with VRDs. By modulating light sources to vary the intensity of red, green, and blue light, VRDs can provide a wider range of colors than any other display technology. VRDs can provide higher levels of contrast and brightness than other display systems. VRDs can provide a wider field of view than other display systems. VRDs can present full-motion stereoscopic image-pairs and deliver the most realistic 3-D movies. VRDs can be used in either of two display modes: (1) an augmented (or see-through) mode that permits the user to superimpose a computer-generated image on a real world scene that he or she is observing, or (2) an occluded mode in which the image appears against an opaque backdrop. Because they operate at extremely low levels of intensity, VRDs pose no danger to the eye – in fact, the VRD's optics and electronics should make it the safest and most healthful visual environment provided by any computer display system.

Temporary disadvantages of VRD displays

The advantages cited above are an impressive list. At present, however, the disadvantages outweigh the advantages. The principal disadvantage is that VRDs are not yet available in significant numbers. Only prototypes and experimental and special use models are now being built and, as such, their cost per unit is high. But, the VRD technology is still in its early childhood. There are no serious developmental or manufacturing obstacles that will prevent it from realizing its full potential. As the VRD technology matures and gets refined, as high-efficiency manufacturing techniques and facilities get developed, and as VRDs come to be used in a variety of applications, mass production will bring costs down to a point where most people will be able to afford products with VRDs. This will happen within a few years – and it is likely that billions of people will be using products with VRDs within a decade or two. The telereader will be one of those products – perhaps the leading product.

Telereaders with VRD displays and the "interim" telereaders

When VRDs become readily available, highly effective, and low in cost, the telereader will realize its full promise as a "high-definition muvie machine" – as well as its promise as a high-definition movie machine. [Muvies are successive presentations of muglyphs in the same place – as movies are successive presentations of pictorial images in the same place. For more information see "Text Set in the Mu Typography" and "What the Mudoc Software Does for Readers." Also, take a look at any muvies you might have access to, such as those in *The Coming Revolution in Writing and Reading*.] As a high-definition muvie machine, the telereader will provide text images that rival the high-resolution text found in quality magazines. Because cheap VRDs in large numbers will not be available for some time, however, the first telereaders may instead use small flat-panel displays. Prototypes of these telereaders with screens – "interim telereaders" – will be developed. If the interim telereaders are effective, they may be manufactured and marketed widely – depending partly on how fast VRDs can be brought to market at affordable prices.

Corrective optical functions of telereaders

In performing its basic functions, the telereader's optics will deal with defects and deficiencies in the user's visual system. Each telereader user will use an eyepiece that is custom-made for his or her particular visual needs and capabilities. The eyepiece will contain one or more lenses for each functioning eye, lenses that will compensate for correctable defects in the user's vision, defects such as myopia, hyperopia, astigmatism, and other problems created by imperfections in the anatomy of the user's eyes. Special lenses or filters may also be used to deal with various kinds of visual deficiencies such as color blindness, amblyopia, strabismus, macular degeneration, and dyslexia.

Although telereader eyepieces will be precision instruments performing complex functions, they will be inexpensive devices. Most of the lenses, filters, frames, foam rubber cushions, and other eyepiece components will be machine-made and mass-produced. Much of the measurement and analysis that will be done to determine the configuration of components necessary to satisfy the user's particular visual needs will be done by computerized devices. (The products and services that are presently provided to those with visual limitations are costly because they tend to be labor-intensive.) Most users will be able to assemble, attach, modify, and/or repair their own eyepieces. Most users will have an extra eyepiece that they can carry with them. This will enable them to use other telereaders wherever they might be available, such as in libraries, schools, offices, information dispensaries, MuCenters, etc.

Special software and hardware for use with telereaders

Additional software and hardware will be developed (1) to facilitate the interactivity between the telereader and the telereader user, (2) to optimize the user's perceptual and cognitive capabilities, and (3) to provide the most healthful visual environment for the user. The new software and hardware will enable the user to, in effect, make design adjustments in the system to fit his or her particular needs, capabilities, and preferences. They will enable the system to do such things as (1) adjusting to users' behaviors in dealing with interactive movable type, (2) responding to a variety of user commands (using voice, hand, foot, or other signal methods), (3) providing blink cues or blink responses, (4) modifying output to compensate for changes in user's physiology or reaction time, etc. The new software and hardware will enable the user and the system to better exploit each other's capabilities and to function as a fully integrated team.

Making better use of nature's most powerful information processing system

As far as we know, the human visual system is the universe's most powerful natural information collection and processing system. Each human retina has about 125 million photoreceptors (rods and cones) and each optic nerve has about a million nerve fibers that channel the flow of data collected by the retina to the visual cortex of the brain. In a normally functioning human visual system, the neural impulses carried by the optic nerves comprise over two-thirds of all the input data processed by the brain, nature's peerless supercomputer. The telereader will help each sighted user better harness the tremendous capabilities that reside in his or her own visual and cognitive information processing system – capabilities that now lie largely untapped when processing text.

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