The active contact lens, 29 May 1991

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This is the original suggestion for the active contact lens. It used a primitive means of creating the image, (but was quite prescient in that this was the first technique used by the University of Washington to create the first prototype in 2007). A few years after this initial idea, Texas Instruments invented the micromirror, and I redesigned the active contact lens to use just 3 lasers mounted near the edge of the lens, pointing via a focusing array to the micromirror which would then raster-scan the image onto the retina. This became know and direct retinal projection. Even in 1991, its applications for 3d TV, VR and augmented reality were obvious, as even were avatars and virtual architecture overlays, showing just how old those fields are in the IT community. Here is the note where I wrote up the invention for the first time (the phone number is obsolete now, and the Network Evolution group expired a few years after this was written):

Novel User Visual Interface

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This note outlines a relatively simple visual interface based on the contact lens principle.

Application

The user would wear these lenses, perhaps all day, in the same way as conventional lenses. This interface would display any visual information required, and could replace conventional screens. Potential uses would be in monitor displacement, 3D TV, Virtual Reality Interfaces, vision enhancement, customised reality and many other forms of communication. The lenses could be used in conjunction with other interfaces, such as hearing aid-like audio interfaces.

Implementation

A potential implementation is shown in figure 1. The outer part of the lens (beyond the coverage of the pupil) acts as a power and processing base. Receivers would pick up signals from various sources, say a computer or other video transmitter. This interface could be radio or infra-red based. Processing elements here would process the signals and relay appropriate control information to the many surface emitting lasers on the central part of the lens. The power supply for these could be based on inductive receivers in the lens, or perhaps on some technique as yet unimagined (electrochemical mechanisms are another possibility).

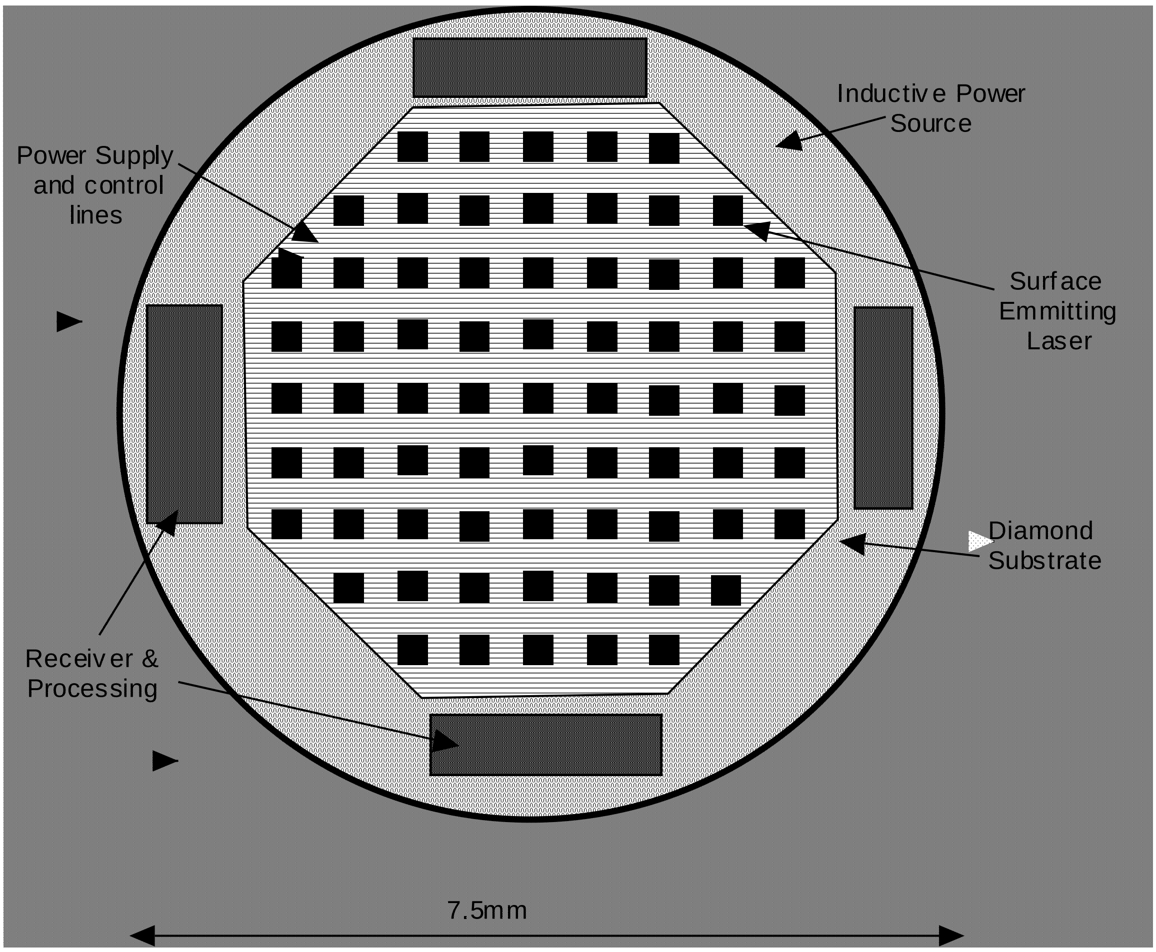

Figure 1 - Lens Layout

The light from the many lasers (there could be an array of 500 x 500 of these) would enter the eye and hit the desired part of the retina. Because the lens is actually in contact with the eye, the eye cannot focus on it and the light would be guided in the right direction by the contact lens itself. Again there are various mechanisms for achieving this, such as the use of an etched lens surface or a liquid crystal grating. If a liquid crystal grating is feasible, this could be used with a much smaller number of lasers, which could be steered using this mechanism, achieving the same result with a much reduced complexity and power requirement. This would also solve some of the problems associated with colour production, which might otherwise require coloured lasers, especially if used in conjunction with dye wavelength modifiers.

During use, external light can either be blocked (LCD film), or superimposed.

Diamond film is rapidly becoming popular in many areas. In the lens, it is useful because it is an ideal substrate for integrated circuits, being an excellent heat conductor. Its hardness and thus scratch resistance are also useful. Obviously, it is also transparent. Being largely inert, it would also enable the devices to be cleaned easily, avoiding infection.

Lens dimensions

The lens can be of the same lateral dimensions as a conventional contact lens. Since lenses are generally much bigger than the pupil, this extra size can be utilised for the power collection and processing functions. In thickness, this depends on the size of lasers. Currently, lasers can be produced smaller than 150 microns, which should allow a sandwich to be produced still within a 250 micron overall thickness, which would be acceptable. Technology improvement should see this accomplished fairly easily .

Effect on Normal Vision

Small components on the lens surface would be out of focus and thus act simply in the same way as sun-glasses in reducing light input. They should not obscure normal vision. Large components would also not affect normal vision as they would be outside of the field of view, not overlapping the pupil.

Additional Features

As well as the many potential communication uses for such devices, other possibilities exist which increase its fun potential. If a liquid crystal film is used in the device, and this is at least partially colour capable, then the lens could be used as a novelty, allowing various colour patterns to be shown to other people. This could be a very attractive fashion accessory, particularly when tuned into the music at a disco etc etc.

Vision enhancement

If the user has some form of sensor such as a TV camera, then the signal from this could be relayed into the eye to enhance the user's vision, allowing such facilities as zooming in on something, wider field of view, picture in picture etc. This potentially could allow vision in other parts of the spectrum, or even be coupled to non EM sensors such as sound receivers etc. Whole new worlds would be opened up for the user.

Customised Reality

Again, if independent sensors are available (perhaps the lens itself could be used in some way). then the visual signal could be processed to customise the user's visual environment as well as enhancing vision as desired, people could be replaced by customised characters, streets could be paved with gold, and trees could be added to landscapes. The mind boggles...

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