

## VISUAL FIELD TESTING VIA TELEMEDICINE

### CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part patent application of U.S. patent application Ser. No. 09/179,112, filed on Oct. 26, 1998, and entitled "Automated Visual Function Testing Via Telemedicine" which is a continuation-in-part of prior application Ser. No. 08/864,331, filed on May 28, 1997, U.S. Pat. No. 5,898,474, which is a continuation of prior application Ser. No. 08/700,754, filed on Jul. 31, 1996, U.S. Pat. No. 5,864,384. This application also claims the benefit of earlier filed U.S. Provisional Application Ser. No. 60/067,521, filed on Dec. 4, 1997, and entitled "Automated Visual Function Testing in Virtual Reality"; U.S. Provisional Application Ser. No. 60/089,817, filed on Jun. 19, 1998, and entitled "Telemedicine for Autointerpretation of Visual Field Testing"; and U.S. Provisional Application Ser. No. 60/090,214, filed on Jun. 22, 1998, and entitled "Telemedicine for In-Home Visual Field Screening".

### STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

"Not Applicable"

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

This invention is in the field of visual field screening.

#### 2. Background Information

On a world-wide basis, glaucoma is one of the leading causes of blindness. Unlike cataract blindness, which is correctable with modern surgical techniques, blindness from glaucoma is permanent. The target organ of glaucoma is the optic nerve, which transmits signals of light from the retina to the brain. No known method is available for repairing, or transplanting, an injured optic nerve. Millions upon millions of patients throughout the world have glaucoma and are completely unaware of this. The particularly sad aspect of glaucoma blindness is that it is generally preventable with proper diagnosis and treatment.

A major diagnostic problem is that, in many areas of the world, medical resources are scarce to the point of being virtually nonexistent. Therefore, many diseases which are readily treatable, sadly, go about their devastating business completely unchecked. Glaucoma, which causes absolute, total blindness when untreated, is no exception.

A second major diagnostic problem is that visual loss from glaucoma is, almost without exception, painless. The patient is unaware of the ravages of glaucoma until it is too late. With the use of an instrument called a "tonometer" to measure the intraocular pressure, the diagnosis can be made whenever the pressure within the eye is significantly elevated. However, tonometry is not available in many parts of the world; and many patients have the "low-tension" form of glaucoma in which the intraocular pressure is completely normal. Therefore, reliance upon tonometry, in areas of the world where this is available, frequently leads to a blatantly false sense of security. The patient is told that glaucoma is not present, when, in reality, the disease is insidiously attacking the patient's optic nerve, causing irreversible neurological damage to the visual system.

Because of the limitations associated with tonometry, most eye physicians attest that visual field testing is mandatory for glaucoma diagnosis and treatment. In fact, visual

field testing is currently considered to be the gold standard for measuring the function of the optic nerve and the presence, or absence, of glaucoma. Visual field testing is generally an expensive proposition, however, with significant fees being charged for each test. Often, there is a physician or optometric examination charge in addition to the fee for the visual field test itself. Another major hurdle is that the patient must make an appointment for an eye examination, which is sometimes difficult. Additionally, since glaucoma is generally painless and totally devoid of symptoms until late stages of the disease, for the vast majority of people, no concrete motivation is present to seek professional help when nothing hurts. The upshot of this is that the diagnosis of glaucoma is all too frequently never made until it is too late.

Furthermore, in countries which are economically disadvantaged, visual field testing machines are prohibitively expensive.

### BRIEF SUMMARY OF THE INVENTION

Utilizing the patient's home computer, or some other video display system, and telemedicine, such as the Internet and other telemetric modalities, the present invention provides an extremely inexpensive vehicle for addressing the serious problem of glaucoma blindness throughout the world.

Screening software programs can be accessed by the patient's personal computer (or by any computer available to the patient, such as that of a friend or of a local clinic) from the Internet or other telemetric vehicle. Alternatively, a computer monitor, a television screen, or some other local video display system may be used, with the software programs being operated entirely on a remote computer to generate the desired stimuli on the local video display system. Therefore, the entire testing process can be performed via long-distance transmission vehicles, such as, but not limited to, the Internet, or an optical fiber network, thus providing, telemetrically, not only essentially instantaneous autointerpretation, but also telemetric monitoring of the patient's performance of the test in real time.

At least gross telemetric monitoring is available by monitoring the speed of the patient's responses, as well as the response itself and whether it makes rational sense, based upon nomograms of typical patient visual behavior. Computers or systems available to the patient with audio capability, such as an audio card, can provide audio feedback stimuli, such as voice, or a tone or series of tones, to monitor the test performance in real-time and provide interactive feedback to the patient. A patient can receive a "grade" correlated with demonstrated responsiveness and concentration ability, thus indicating whether the patient's performance is satisfactory for meaningful autointerpretation.

A central world-wide monitoring and data collection station, or a series of stations in different geographic areas, can link the system and provide multiweb-like integration. As international long-distance communication becomes more and more accessible and affordable, it is preferable that one station have global capability. The Internet provides virtually instantaneous, extremely affordable, world-wide access. The present telemedicine system is "intelligent," in that ongoing data accumulation and analyses thereof improve the computational model and provide, over time, increasingly more accurate identification of more subtle disease processes.

The novel features of this invention, as well as the invention itself, will be best understood from the attached