Tripler Tele-Ophthalmic Deployment

Background

The gold standard for the assessment and diagnosis of diseases of the retina is the dilated slit lamp biomicroscopy examination performed by an ophthalmologist. Tele-ophthalmology involves the diagnostic evaluation of digital fundus images captured from portable non-mydriatic fundus cameras, and holds promise as a low-cost methodology for remotely screening patients for diseases of the retina. Published data suggests that single focal point digital images of the retina allow diagnosis of retina disease at a sensitivity of only 89%. This finding suggests that current portable non-mydriatic fundus cameras do not provide adequate diagnostic quality digital images.

Interviews with retina surgeons indicate that they generally vary the focal point of the slit lamp during examination, providing depth of field information not available on the single focal point analog and digital images used in prior studies. The need to vary the focal point may explain why single focal point, two-dimensional 35mm slides do not achieve the same level of diagnostic sensitivity as the dilated ophthalmologic exam of the retina. This deficiency suggests two possible solutions: imaging with a lens having a depth of focus at least as great as the range an examiner might use, or creating a series of digital images at multiple, periodic focal points within the retina to allows for software emulation of the manual varying of the retina focal point.

Organization

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Brian K. Martin, M.D.- Martin Information Systems, Limited.—Clinical project manager and software architect
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Mission Statement

To develop cost-effective, clinically valid tele-ophthalmology technologies.

Goals and Objectives

Goal

To develop cost-effective tele-ophthalmology technologies with diagnostic sensitivity comparable to a face-to-face dilated slit lamp biomicroscopy examination.

Objectives

1. To develop an image quality standard, defined by a minimum anatomic resolution, for diagnostic-quality digital images of the retina.

2. To evaluate and recommend commercially available portable digital retina image capture devices for integration with COTS CPR software running on the COTS workstations.
3. To develop, evaluate, validate and deliver a COTS tele-ophthalmology workstation to support the remote assessment and diagnosis of disorders of the retina. The workstation will include the digital retina imaging device, a PC workstation, COTS CPR software, and software and hardware that integrates the digital retina imaging device with the CPR software and PC workstation

Current Status

Primary Accomplishments

- Completed literature review
- Revised research design based on review of the pertinent medical literature
- Completed a statistical power analysis
- Contract signed between Akemika and MISL
- Contract signed between Southern California College of Optometry (SCCO) and MISL
- Contract signed between Oak Tree Systems and MISL
- Delivery orders transmitted to SCCO
- Delivery orders transmitted to Oak Tree Systems
- Delivery orders signed by Oak Tree Systems
- COTS PC workstations acquired
- CPR software installed and validated on the PC workstations

Project Hurdles

- Delivery orders *not signed* by SCCO; SCCO has requested changes to the scope of the delivery orders and additional funds commitment prior to signing delivery orders. Oak Tree has been unable to proceed with their tasks, which are dependent upon SCCO's completion of SCCO's tasks.

Project Timelines

May 1998	Complete contracting
Sep 1998	Complete initial negotiations with SCCO Put in place contracts with SCCO and Oaktree All partners sign off on the research design
Oct 1998	Acquire COTS workstations Install and validate CPR software on COTS workstations
Jan 1999	Revised technology specification to select IEEE 1394 (FireWire) as the interface between the digital acquisition device and the COTS workstation. Revised the acquisition specification to use DV source as replacement for FrameGrabber A/D board originally specified by SCCO for NTCS video sources.
Mar 1999	Install prototype COTS teleophthalmology workstation at HAFB, TAMC for usability studies with ophthalmology staff
Apr 1999	Begin trade study/evaluation of digital retina imaging devices Begin development of software interface between fundus camera and CPR software Begin development of variable focal point image capture software Install COTS workstations and retina image bank at TAMC, HAFB and SCCO Begin image quality study using multi-resolution image bank retinal images
Apr 1999	Evaluate results of image bank-based image quality study

May 1999 Complete development of software
Complete development of COTS teleophthalmology workstation
Install completed COTS teleophthalmology workstation at HAFB, TAMC, Molokai NHHCS or DOD Location
Jun 1999 Start clinical trial of COTS teleophthalmology workstation
Aug 1999 Complete clinical trial of COTS teleophthalmology workstation
Sep 1999 Evaluate clinical trial of COTS teleophthalmology workstation
Deliver report on clinical trial of COTS teleophthalmology workstation

Strategic Direction

- Evaluate the clinical utility and sensitivity of the digital retina images captured from non-mydriatic fundus cameras
- Investigate the clinical utility and sensitivity of psuedo-3D multi-focal point images as an alternative to single two-dimensional images. If successful, investigate methods for emulating in software the ophthalmologist's manipulation of the focus controls during the slit lamp exam.
- Investigate the feasibility of incorporating adaptive optics as a method for increasing the resolution of the optics of the non-mydriatic fundus cameras. Adaptive optics is a potential technology transfer/spin-off research area of the strategic defense initiative.
- Standardize on IEEE 1394 as the high-speed serial interface between the image capture device and the workstation
- Standardize on DV as the video acquisition format for video sources

Budget/Financial Status and Information

Business Associations

Corporate Partnerships
Martin Information Systems, Limited (MISL)
Oaktree Systems Development
Government Partnerships
Department of Clinical Investigation (DCI)
Information Management Division (IMD)
Other Partnerships - (Academic)
Southern California College of Optometry (SCCO)
TAMC IMD
Network assistance, software assistance, hardware assistance

Project Security

System Security -
Standards compliance measures -

Summary

We will develop a method for creating and playing back a 3-D media object comprised of multiple retina images taken at different focal points. Software controls would enable the ophthalmologist to emulate in software the focus control of the slit lamp. This approach more closely models the actual use of the slit lamp by the ophthalmologist, and should achieve superior diagnostic quality when compared to a 35mm slide.