

Exploring Clinically-relevant Image Retrieval for Diabetic Retinopathy Diagnosis

Principal Investigator:	Li, Baoxin, Ph.D., M.S.
Organization:	Arizona State University-Tempe Campus
Mechanism:	PAR: HS08-269: Exploratory and Developmental Grant to Improve Health Care Quality through Health Information Technology (IT) (R21)
Grant Number:	R21 HS 019792
Project Period:	August 2011 - July 2013
AHRQ Funding Amount:	\$299,999

Summary: Diabetic retinopathy (DR) is the leading cause of new blindness in adults aged 20-74. Among diabetics, the prevalence of DR is 28.5 percent. Despite advances in diabetes care, visual impairment is still a devastating complication. Studies show that timely DR diagnosis and treatment can significantly reduce the risk of severe vision loss. Although digital retinal imaging has quickly become an alternative to traditional face-to-face evaluation, it is laborious and prone to error or reviewer fatigue. For this reason, researchers are exploring automated detection and evaluation of diabetic retinal lesions. Potential benefits of automated DR diagnosis include improved consistency and speed over human reviewers. However, clinicians remain superior in detecting and assessing the severity of DR over computer-based systems, which fail to incorporate the experience and variables that clinicians apply to their assessments. Therefore, more effort is required to improve the performance of such systems.

This research project explores an innovative method to retrieve clinically-relevant images for facilitating timely and accurate evaluation of DR. Images are considered clinically relevant if they contain the same types of lesions with similar severity levels. Dr. Baoxin Li and his team have extensive experience in acquisition and deployment of computer-assisted evaluation of DR. Building on their experience, the team will design machine learning-based algorithms for retrieving images of clinical relevance to contribute to building automated DR detection and evaluation systems. Additionally, the team plans to develop a prototypical DR image management system to improve reviewers' diagnostic performance. A direct outcome of the proposed research is a system that can provide a reviewer with instant reference to annotated images from a database. Maximizing the efficiency and accuracy of assessing DR could help prevent vision disabilities and their resulting high cost to the health care system.

Specific Aims:

- Develop a content-based retrieval system for referencing diabetic retinal images to improve diagnosis. (**Ongoing**)
- Develop a prototypical DR image management system to improve reviewers' diagnostic performance. (**Upcoming**)

2011 Activities: The initial focus of the project was to collect a sufficient number of DR images to support the development of the machine learning algorithm, which requires large amounts of data to diagnose different stages of DR. These stages include non-proliferative retinopathy (mild, moderate, and severe) characterized by microaneurysms, and proliferative retinopathy, characterized

by neovascularization. Initially, Dr. Li planned to use images from a researcher with a large database of images at the University of Wisconsin, but the researcher retired. As a result, Dr. Li contacted alternative potential collaborators around the country. To date, he has amassed approximately 500 images. While this is a large number of images, more will eventually be required to validate the algorithm.

Dr. Li began work on the algorithm using the available images. Currently there are five well-known algorithms to process DR Images. These existing algorithms do not sufficiently distinguish between shades of red, the dominant color in DR images. Dr. Li's team plans to focus on color contrast when developing their algorithm to address this weakness. To do this, the existing algorithms are being applied to each of the images in Dr. Li's collection. The algorithms work by extracting several hundred data points from each image and analyzing them. These results will serve as the benchmark for the newly-developed algorithm.

As last self-reported in the AHRQ Research Reporting System, project progress and activities are on track and project spending is on target.

Preliminary Impact and Findings: There are no findings to date.

Target Population: Other Conditions: Diabetic retinopathy

Strategic Goal: Develop and disseminate health IT evidence and evidence-based tools to improve health care decisionmaking through the use of integrated data and knowledge management.

Business Goal: Knowledge and Creation
