

MPC Corporation

Annual Progress Report: 2006 Formula Grant

Reporting Period

July 1, 2010 – December 31, 2010

Formula Grant Overview

The MPC Corporation received \$160,944 in formula funds for the grant award period January 1, 2007 through December 31, 2010. Accomplishments for the reporting period are described below.

Research Project 1: Project Title and Purpose

Interactive Search-Assisted Diagnosis of Pigmented Skin Lesions - The ability to diagnose pigmented skin lesions, and in particular melanocytic neoplasms, with greater precision and accuracy, is a high health care priority. In addition to current methods of health care provider education, computer-aided diagnosis of the lesions has already been applied in radiology. The Jukic group has developed and used this approach for the analysis of dermatopathologic and pathologic images in the past and now intends to apply the approach to both dermatopathologic and dermatoscopic images of pigmented skin lesions. This approach is unique in that it will assist both the clinician and the pathologist, and in that the resulting database will consist only of those lesions with clinicopathologic correlation.

Duration of Project

7/1/2007 - 12/31/2010

Project Overview

The researchers will investigate and develop a new approach to dermatologic and dermatopathologic diagnosis called interactive search-assisted diagnosis (ISAD) for evaluation of pigmented cutaneous lesions depicted on dermatoscopic and dermatopathologic images. The software support for this new search capability is embodied in an open-source software prototype called Diamond, which has been created previously through a collaboration with Intel Research and Carnegie Mellon University. It is hypothesized that clinical decision making will be improved if the clinician is able to search a database of images with known diagnoses to find images that are similar in order to evaluate a lesion of unknown diagnosis.

Not only has this approach not been tried previously, but there is currently no concept regarding the appropriate prototype for the graphic user interface (GUI) for image comparison in dermatopathology and dermatology. To use any software successfully, one needs to develop an acceptable GUI to ensure the success of the software application.

Specific Aims:

1. To build a database of at least 300, although ideally more, annotated dermatoscopic and dermatopathologic images of pigmented lesions paired with diagnosis.
2. To test the Diamond software's ability to process terabytes of data in the guise of dermatopathologic virtual slide images (aka whole slide images) that range in size from 50 MB to 10 GB.
3. To develop an interactive image-matching and pattern recognition scheme for dermatoscopic and dermatopathologic images based on Diamond and work toward the development of an ideal GUI for image comparison in dermatopathology and dermatology.

Principal Investigator

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Other Participating Researchers

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Expected Research Outcomes and Benefits

The goal of this project is to deliver an information technology (IT) tool that will allow for the screening of pigmented lesions with greater precision in both dermatology and dermatopathology and be useful across the board for primary care physicians, general pathologists, dermatologists, and dermatopathologists. The medical community will benefit several-fold from this project. The outcome of the first specific aim, to build a database of pigmented and melanocytic lesions, will benefit the biomedical community as a whole. Even if one does not use Diamond or any software-assisted or guided diagnosis, there is no image database in the world that features dermatoscopic images of pigmented lesions paired with either still or whole-slide dermatopathologic images. From the software perspective, this will be the first orchestrated attempt for Diamond to compare processing of still images and virtual slide images. Thus, the investigators will develop and optimize the algorithm for the processing of whole slide images. Once the scheme for interactive matching of pigmented lesion images is actually developed, the creation of a graphic user interface (GUI), with input from both a dermatologist and a dermatopathologist, will ensure ease of implementation of this product in the clinical setting. The researchers believe that the Diamond-based approach will be used in the future for applications in dermatoscopy that will span clinical trials, therapeutic decision-making, and further analysis of dermatopathology images via whole slide images (WSI). The methodology developed in this study will be useful for other investigators who will adopt interactive search-assisted diagnosis (ISAD) or similar image-matching projects in other areas of medicine, including regular

radiology, ultrasound imaging, CT scans, echocardiography, and other areas of pathologic imaging. At the end of the project, the research team hopes to have both a database and a software product that will help in diagnosing pigmented lesions.

Summary of Research Completed

As reported previously we purchased a 40 x microscope objective with 0.95 numeric aperture (NA) for our Zeiss/Mirax robotic scanner. We have created 132 new scans that comprised around 300 GB of data. Objectively, the scans that were taking 6 minutes at 20 x were now taking ~ 24 – 30 minutes at 40 x.

Therefore, if one compares the same slide scanned at 20 x that generates 140 MB of data, this will generate the 1.5 GB of data if scanned at 40 x. This raises additional questions and technical hurdles – for instance, how easy is to transfer 1.5 GB data via the current networks? Timing now becomes an issue as well as the processing power of a computer needed to evaluate such scans, as well as the demands on the software used for processing (such as Diamond).

In response to this, the team is in the process of creating an on-line repository code-named Algom with new server and support for additional software. The new server has considerably better specifications, 8 CPU cores, 8GB of memory, and 1TB of available disk space, plus several empty drivebays to add extra disks as needed.

It is now possible to upload a zip archive file containing slide data in any format that is supported by OpenSlide (Trestle, Hamamatsu, Mirax, Aperio and generic TIFF formats). After upload you can double-click on the slide thumbnail to start an embedded OpenSeadragon viewer to pan and zoom over the full slide. We hope to fully test the abilities of this machine and OpenSlide in next few months, and continue working as a part of CTSi at University of Pittsburgh, and expand our efforts to University of South Florida and some other Universities in the country.

Research Project 2: Project Title and Purpose

Predicting Three-Dimensional Protein Structures - Automated structural prediction of tertiary and quaternary protein folding as well as finding corresponding coding motifs in the DNA sequence are crucially important in computational molecular biology. The research team had already made major inroads in precursor research, especially with respect to the computational mechanisms. The purpose of this project is to develop computational algorithms to predict the quaternary structure of multimeric protein strands.

Duration of Project

7/1/2007 – 6/30/2010

Summary of Research Completed

This project ended during a prior state fiscal year. For additional information, please refer to the Commonwealth Universal Research Enhancement C.U.R.E. Annual Reports on the Department's Tobacco Settlement/Act 77 web page at <http://www.health.state.pa.us/cure>.

Research Project 3: Project Title and Purpose

Attentional Bias, Craving, and Smoking Related Cues: An fMRI Investigation - The purpose of this study is to further understand the mechanisms underlying self-regulation in people who smoke. The study will focus on the degree to which smoking-related items, or “cues,” draw and capture attention. This effect, termed attentional bias, is thought to play a critical role in generating and maintaining drug craving and, importantly, is correlated with smoking relapse. This project will contribute to the understanding of (1) the cognitive and brain-based underpinnings of attentional bias for smoking-related cues, and (2) the relationship between attentional bias, craving, and subsequent smoking behavior. The research findings will be applicable to many other conditions in which attentional biases are a factor (e.g., general drug addiction, mood disorders, and eating disorders).

Duration of Project

7/1/2007 - 6/30/2009

Summary of Research Completed

This project ended during a prior state fiscal year. For additional information, please refer to the Commonwealth Universal Research Enhancement C.U.R.E. Annual Reports on the Department's Tobacco Settlement/Act 77 web page at <http://www.health.state.pa.us/cure>.

Research Project 4: Project Title and Purpose

The Life Events Assessment Profile (LEAP): A Preliminary Psychometric Analysis - This pilot project will be conducted in partnership with the Pittsburgh Mind-Body Center, a National Institutes of Health-funded center jointly operated by the University of Pittsburgh and Carnegie Mellon University. The project will systematically assess external environmental stressors (i.e., chronic burdens and resources) thought to result in adverse mental and physical health outcomes. Life stress has been posited as a key mechanism in the etiology and course of both psychological and physical health outcomes (e.g., depression and cardiovascular disease); however, research has been hampered by the limitations of available assessment methods. The purpose of this project is to test a newly developed instrument for assessing life stress, the Life Events Assessment Profile (LEAP).

Anticipated Duration of Project

7/1/2007 – 12/31/2009

Summary of Research Completed

This project ended during a prior state fiscal year. For additional information, please refer to the Commonwealth Universal Research Enhancement C.U.R.E. Annual Reports on the Department's Tobacco Settlement/Act 77 web page at <http://www.health.state.pa.us/cure>.

Research Project 5: Project Title and Purpose

The Effect of Sleep Deprivation on Acute Stress and Emotional Reactivity - Sleep deprivation and stress are both associated with negative health outcomes and negative emotional responses. Few studies, however, have examined the incremental effect of stress under sleep-deprived conditions. The purpose of this project is to investigate the synergistic effect of stress and sleep deprivation by examining stress reactivity and emotional reactivity in healthy adults under both normal sleep and sleep-deprived conditions. The project also will examine the associations between stress reactivity and emotional reactivity. The ultimate goal of this research is to develop therapeutic and preventive strategies to reduce the psychiatric and physical consequences of sleep loss.

Anticipated Duration of Project

7/1/2007 - 12/31/2009

Summary of Research Completed

This project ended during a prior state fiscal year. For additional information, please refer to the Commonwealth Universal Research Enhancement C.U.R.E. Annual Reports on the Department's Tobacco Settlement/Act 77 web page at <http://www.health.state.pa.us/cure>.