Chapter 6
A Study of Cloud Computing for Retinal Image Processing through MATLAB

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ABSTRACT

With the ability of MATLAB to run in the cloud environment the authors analyse a retinal image efficiently. A quick and on-the-fly image processing is the cause for leveraging the ability of Cloud with the classic computing power of MATLAB. This cloud-based image processing has significantly saved on the cost of procuring resources and it has processed an image in a few seconds. This revolutionary change in computing power has not only eased the life of engineering community but has demonstrated an inertia to help the common man through its language of computing. The objective of this particular piece of work is to leverage the ubiquitous cloud features to process the images taken from retina portion through a hi-fidelity algorithm. The reflection of the computing ability of complex mathematical equations, SaaS (Soft as a Service) architecture of cloud and tools developed in Windows Azure platform has come out as research findings such as the spatial modelling of a diseased portion of a retina. The portion diagnosed with a difficulty undergoes a series of steps based on the algorithm developed by authors and ultimately the original image is transformed into a form with information on the status of the disease in the retina.

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INTRODUCTION

With the ability of MATLAB (http://mathworks.com) to run in the Cloud environment we have attempted to do a complex computation of analyzing a retinal image pretty efficiently. This cloud-based image processing has significantly saved a good amount of cost of procuring expensive resources and it has processed an image in a few seconds. The speed and the accuracy involved in executing this task has come from the cloud based set-ups and a few tools we have developed. The objective of this paper is to demonstrate how ubiquitous cloud services and features have been leveraged to process the images taken from retina portion through a hi-fidelity algorithm. The interest to carry out this research has been derived from medical image processing (Bankman, 2000). It is the confluence of two sciences that behave in completely different ways. While medicine is a science where experience plays a majors role and where the practical use is evident, image processing—as a derivative of applied mathematics—is a more theoretical discipline. Hence, the conditions of this confluence need to be analyzed sophisticatedly. It is known that diabetic retinopathy (American Academy of Opthalmology, n.d.) is a severe and widespread eye disease. In fact, it is the leading cause of legal blindness for the working age population (between 20 and 64) in many places in the globe. Diabetic retinopathy is a complication of *diabetes mellitus* and its prevalence increases with the duration of the disease. After 15 years of diabetes, the prevalence lies near 98%, so nearly all diabetic patients are affected by this disease after some time. Although not all the forms of the disease coincide with vision alteration, about 2% of the diabetic patients are blind and 10% suffer from vision loss after 15 years of diabetes.

The above reasons have generated lot of interest to develop a fast and accurate method based in cloud so that the processing could be done from anywhere if we have the image is available. The algorithm, the flow of computation and processing of a particular image is carried out using MATLAB through a cloud based user interface.

Why MATLAB Based Image Processing?

Though MATLAB based image processing offers lot of advantages we emphasize on certain salient points that have encouraged us to go for it and enhance its already existing computing power by introducing cloud's presence to make it available everywhere and at anytime. Some features of MATLAB are image enhancement, mass screening and monitoring.

We know that automated extraction of blood vessels in retinal images is a significant step in computer aided diagnosis. This is also true in the treatment of diabetic retinopathy, hypertension, glaucoma, obesity, arteriosclerosis and retinal artery occlusion, etc. (Jelinek & Cree, 2009). As per our literature study done during this project it is understood that vessel extraction is basically a kind of line detection problem, and many methods have been proposed by many researchers. One of the popular approaches to vessel segmentation is a filtering-based method which works by maximizing the response to vessel-like structures. Another type of approach is mathematical morphology. Some of the other important methods are trace-based methods, machine-learning methods.

In our study we have understood and attempted to enhance one retinal vessel extraction method through the cloud computing architecture. That is the matched filter (MF) with first-order derivative of the Gaussian (MF-FDOG) which is an extension and generalization of the MF. As per the literature study we know that by applying the MF-FDOG filters to the retinal image, two response maps, H (by the MF) and D (by the FDOG) can be obtained. The vessel map is then detected by applying a threshold T *to* H, while the threshold T is adjusted by D so as to remove the non-vessel edges and ex-