Automatic Screening of Diabetic Maculopathy Using Image Processing:
A Survey

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ABSTRACT

Retinal imaging is a challenging screening method for detection of retinal abnormalities. Diabetic Maculopathy (DM) is a condition that can result from retinopathy. Regular screening is necessary for diabetic maculopathy in order to identify the risk of vision loss. Maculopathy is damage to macula, the key region responsible for high sharp colour vision. Diabetic Retinopathy and Diabetic Maculopathy needs regular observation in order to indicate visual impairment risk. In this article, the author first presents a brief summary of diabetic maculopathy and its causes. Then, an exhaustive literature review of different automated DM diagnosis systems offered. It is important for ophthalmologists to have an automated system which detects early symptoms of the disease and yields a high accurate result. A vital assessment of the image processing techniques used for DM feature detection is projected in this paper. Various methods have been proposed to identify and classify DM based on severity level.

KEYWORDS

1. INTRODUCTION

Present scenario the foremost challenge is controlling the evolution of diabetes. It is not possible to easily identify the side effects caused by diabetic immediately (Nishant,karthik, 2015). Diabetes is a lifelong disease which is caused by the reduced insulin production or by decreased potential to use insulin. Early diagnosis is very important in preventing health complication in diabetic patients. Without the proper treatment diabetes can lead to very high blood sugar level which can result in long term damage to various tissues and organs like heart, kidney and eyes, etc. (Shobha & Rajeshwari, 2014).

Processing and analysis of images and computer vision techniques are used generally today in every fields of medical science and specially to modernized ophthalmology, as it is heavily dependent on retinal visual alignment signs (Ashok & Sankari, 2017; Padmalal & Kennedy, 2014). Retina is a forth extension of brain and its blood vessels. Image of the retina deal about ophthalmic, retinal and systemic diseases. Although the retinal fundus photographs are accessible and suitable for screening these diseases, a huge number of observations will increase burden for ophthalmologists. Computerised

analysis of fundus images of retina can potentially reduce workload of ophthalmologists and even improve efficiency of diagnosis (Narohna & Prabakar, 2013).

1.1. Diabetic Maculopathy

Macula is a significant area responsible for sharp colour vision, it is located at central part of the retina in between inferior and superior temporal vascular arcades (Punnolil, 2013). Detection of macula is an essential module for building a computerised system to grade the DM. It is macular area of the eye which effects DM upsetting the whole central vision of eye and in severe cases it leads to total vision loss (Tariq, Akram, Shaukat et al., 2012). Maculopathy is caused when exudates occurs around the macular area. Exudates are caused by the flowing of blood from blood vessels (BV) which results in yellowish deposition of protein around the retina. The centre of macula is termed as fovea which is greatly responsible for very minute specifications in an image. DM occurs when exudates present near or on the macula effecting central eyesight (Rahim, Palade, Jayne et al., 2015). Maculopathy is classified into three different levels depending on abnormalities position present from the centre part of the macula. If the abnormality is present far away from neighbourhood of macula, then it is mild stage. If abnormalities are present at the neighbourhood of the macula it is moderate stage. Abnormalities will be present over macula in severe stage (Medi & Dandapat, 2014). Computerized methods of DM screening helps to save cost, time and eyesight of patients compared to the manual screening methods of diagnosis.

2. LITERATURE SURVEY

Grading of maculopathy is a challenging task for both computerised systems and medical doctors. A plenty of researches have been carried out to lower the time consumption and observer fatigue during digital screening of the images in order to identify maculopathy. Early detection of the diabetic maculopathy disease is possible by automated image analysis techniques which can be regarded as a manifestation of the diabetes on retina. A brief review of some recent researches is presented here.

Medi and Dandapat (2014) stated detection of fovea and Macular Neighbourhood (MN) are primary requirement for analysis of DM. The proposed method included pre-processing, detection of BV, fovea, MN, Optic Disc(OD) and then classification and assessment of DM. In the pre-processing noisy pixels are removed using 2-D median filter which is of size 3*3 is applied. Detection of BV is performed by Nick's threshold and false pixels are removed by applying binary openings to the result. Localisation of the OD is required for finding 2-OD diameter (ODD), which is needed for analysis of DM. The dark and bright lesions are isolated by separate background preparation before clustering. Fovea which is essential part, is detected by using intensity property and template matching is carried to enhance fovea identification. Spatial fuzzy clustering is used for DM analysis and to classify the severity. The proposed algorithm is applied on 694 images, detects fovea with an accuracy of 98.84% and specificity and sensitivity measured for classification of DM are obtained as 98.9% and 98.6% respectively.

Ashok and Sankari (2017) presented an approach for recognition of diabetic maculopathy adopting fuzzy C-means and cascaded neural network. The proposed algorithm starts from image acquisition, fifty digital fundus images are collected from the STARE databases. Image enhancement is carried out by green channel extraction, noise removal and histogram equalisation. The algorithm mainly aims at finding the lesions so images are segmented using FCM and blood vessels are divided from lesions. Feature extraction is carried out by GLCM. By using the extracted features, classification is carried out by Fuzzy and CNN classifiers. The proposed system performance was evaluated by using specificity, sensitivity and accuracy. Finally based on result it is concluded that CNN classifier works better than the Fuzzy classifier.

Punnolil (2013) introduced an effective computerized diagnosis system for detecting and grading severity level of maculopathy. First, the centre of the OD is identified and the localisation of fovea is

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