A REVIEW ON DISEASES MANIFESTATION BY OCULAR DISEASES USING COMPUTER AIDED DIAGNOSIS (CAD)

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Abstract—**The use of eye for diagnosis for detecting the disease has been used long time ago. However, for conventional medical practitioners this procedure are used to detect diseases that cause vision problems. This method is widely used by practitioners of alternative medicine that uses the eyes to detect the presence of disease, such as iridology practitioners. In this paper we study the method adopted by the researchers based on conventional and alternative medical practitioners to detect the presence of disease using a computer-aided diagnosis (CAD) or automatically**

Keyword-Ocular Diseases, Computer Aided Diagnosis (CAD), Automatic Diagnosis System

I. INTRODUCTION

The use of eye for biometric has been widely used as the biometric identification because the eye has a very unique and complex iris pattern. The iris pattern is not the same for every man [1], therefore it is suitable for use as a biometric identification [2]. In addition there are research studies conducted showed the potential to use eye as parameter for health monitoring such as alcohol addiction problems [3] and smoking [4], hypertension [3], diabetes [5] and obesity [3][6]. Normally analysis conducted for vision problems related cases such as retinopathy, glaucoma and cataracts. This paper will look at the use of the eye through CAD method for determining the presence of diseases that are correlated with the signs and markings on the eyes.

II. IMAGING MODALITIES

In this section we look at the types of imaging modality used to detect the disease and also the types of diseases that can be detected by ocular manifestation. Generally there are two categories of diseases discussed in this paper, the first category is related eye diseases and the second category is that the disease manifest by ocular signs. The medical imaging standard used in eye examinations such as optical coherence tomography (OCT) [7] , slit lamp [8], RetCam [9], fundus retinal and Heidelberg Retina Tomography (HRT) [10]. For the first category of diseases associated with eye problems such as age-related macular degeneration (AMD) [10], myopia [11], cataracts [12] , glaucoma [13] and retinopathy [14]. While for the second category of diseases that can be detected through the eye such as cardio heart diseases (CHD), diabetes, leukemia, cancer and tumor. Table 1 lists the type of diseases which reported able to identify the diseases through eye diagnosis.

There are various types of medical imaging device that has been developed as a diagnostic tool for detecting ocular problems related to signs of pathology. There are also cases where these signs are present have been associated with health problems such as cancer. Hence this paper see the review study conducted by researchers on the use of CAD in diagnostic to identify the diseases which associated to eye problems.

III. OCULAR DISEASES

Ocular diseases often become serious if early signs are ignored. In this section we discuss several types of diseases that are usually examined by ophthalmologists regarding eye problems and CAD methods used to inspect and determine the cause of this ocular problem such as vision blur and impairment.

Table 1 Types of diseases which can be diagnosed through eye.

Authors	Iris Diagnose /Ocular sign	Method	Type / condition diseases	Finding/Conclusion
Pomerantz [15]	AS	Statistical analysis	CHD	AS with age below 56 frequency related to coronary, statistically significant 5%.
Urbano [16]	AS, CA	Review paper	CAD, hyperlipidemia	Patient with this sign should be screened for hyperlipidemia.
Crispin [17]	OLD	Comparative method	hyperlipoproteinemia	Investigate early ocular changes in the presence of hyperlipoproteinemia.
Navoyan [18]	AS	A case-control study and questionnaire	CHD	Include cornea examination as part of their routine examination.
Wibawa et.al. [5]	Iris texture	Pancreas's position in iris (iridology)	pancreas, diabetes	Comparison result with the insulin normality test
Antonio Fern´andez et.al [19]	CA	Review paper	CHD	CA represents physical evidence of early lipid deposition
Moosavi et.al.[20]	Senile corneal arcus	Cross sectional study	AMI	CA is associated with age and hypercholesterolemia.
Forbes et.al [21]	retinal detachment	Case report	AML	Patients with leukemia should have an ophthalmologic examination.
Sivasankar et al. [22]	Iris texture	CHT, FCM and Gray level analysis	Pulmonary Diseases and Tissue imbalance	The efficiency of the proposed system support iridologist claim.
Hussein, et.al [23]	Iris texture	Wavelet analysis and ANFIS	kidney	Need extensive studies to certify iridology as a valid scientific technique.
Norini et.al.[24]	Iris texture	PCA and SVM-RBF	pelvis, vagina	Development of diagnostic system to monitor the human health.
Hareva et al.[25]	Iris texture	Developed iridology application.	heart, lung, spleen and liver	Analyze only four type of disease, not to include all kinds of diseases
Yuan et.al [26]	Iris texture	Adaptive Canny operator's	gastrointestinal	Detection method can extract different types of the iris intestinal loop region.

AMI=Acute myocardial infarction
AML=Acute Myeloid Leukemia
CHT= Circular Hough Transform
FCM=Fuzzy C-Means
ANFIS=Adaptive Neuro Fuzzy Inference System
PCA=Principal Component Analysis
SVM-RBF= Support Vector Machine with Radial Basis Function kernel

A. *Diabetic Retinopathy (DR)*

The DR is a condition caused by severe diabetes, this condition will cause an aneurysm Micro (MAs) which will lead to complications such as blurred vision problems and blindness [27]. There are studies such as [28] using an automated method for detecting MAs using local contrast normalization (LCN) and local vessel detection (LVD) to produce a brightness image contrast to distinguish between MAs and other particles in the retina . Another study using an automatic method for detecting MAs in the retina image, as presented by [29], using the naïve Bayes (NB) as a classifier. Others studies using CAD to identify the DR such as done by [31]– [36].

B. *Cataract*

Cataract is a condition of the eye lens become blur such as shows in Figure 1 (d), it will lead to lower quality of vision and cause deterioration of vision [30]. There are research studies conducted to evaluate and identify this problem by using CAD, such as Huiqing Li et al. [31] have proposed the use of modified active shape model (ASM) to detect problems at the image through the lens contour from slit lamp images. While Hualei

Shen et al. [32] have proposed the use of k-nearest classifier for the classification level of the hardness degree of cataract lens from microscope images during phacoemulsification procedures. Xinting Gao et al. [33], proposed the enhanced texture analysis (TA) method. While researchers [34] develop cataracts detector automatically based on the classification of the retina using a back propagation neural network (BPNN). Liye Guo et al. [12] have developed an automation cataract classification and grading system based on fundus images and classify the condition to mild, moderate and severe. They had used wavelet transform for cataract classification.
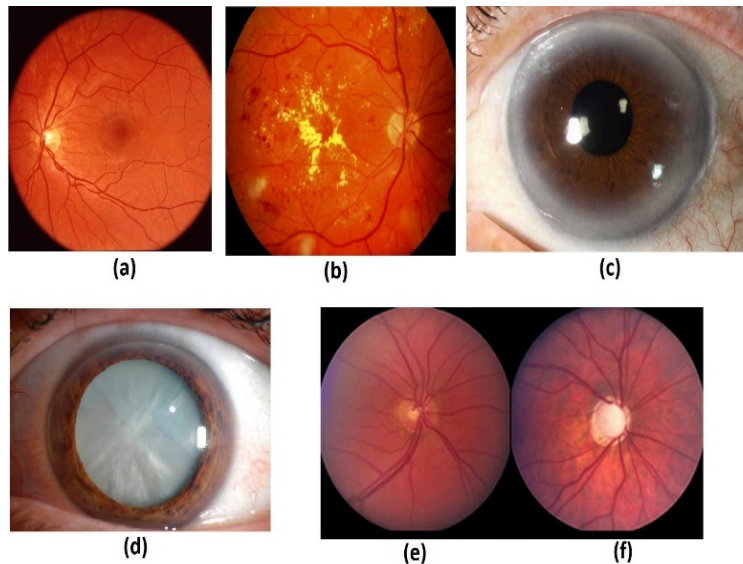

Figure 1: Various type of ocular diseases

C. *Pathological Myopia (PM)*

Myopia is a condition in which the eyes have vision problems resulting from retinal tissue degradation, the condition is known as pathological atrophy (PA). For this problem there are researchers [35] using an automated system to detect PA with pathological myopia detection system through peripapillary atrophy (PAMELA) in passing the analysis of gray level and texture. Authors [36] had used a minimum redundancy maximum relevancy (mRMR) as a classifier and were tested on 800 subjects. While [37] Yanwu et al., proposes a bag-of-feature and sparse learning in their automatic system for detecting PM.

D. *Arcus Senilis (AS)*

AS is a situation where the loop like white ring on the cornea at the limbus approximately 0.3-1mm thick [16], [38] as shown in Figure 1(c). This phenomenon is caused by abnormal lipids in human blood (hyperlipidaemia). There are research studies that support the opinion that these situations concerned with CAD, especially those aged between 30 and 60 years [39]. Among the researchers who conducted the study researchers on this situation as by [3], [4], [39], [15], [18], [19], [40]–[42] who do medical research and surveys. There are also researchers who propose an automatic method for detecting the presence of such US [43] using RBF classifier, while [63] had used Artificial Neural Network (ANN), Fuzzy classifier and Neuro-Fuzzy classifier for this purpose. Researchers [64] using iris image processing such as segmentation and normalization for the purpose of separation of parts of ROI and using Otsu method to identify the presence of the US.

IV. DISEASES MANIFESTATIONS BY OCULAR SIGNS

The eye is a precious in human body, to enable people to see. In order to ensure this eye in good condition should make regular eye examinations. Eye examination is also said to be beneficial for the early detection of health problems such as rheumatoid arthritis [44]. In this section discusses the relevant diseases manifestations by ocular signs and identify the diseases using CAD method.

A. *Diabetes*

Diabetes is a condition in which blood sugar levels are at abnormal levels which can lead to a state of acute diabetes if left untreated. As a result of these complications can cause deterioration of the quality of vision and even worse cause blindness [45]–[47]. Most studies were conducted to identify and classify diabetes performed using image PDF. Wibawa et al. [5][48] in their study using a different approach, in which they used the method of iridology in identifying the presence of diabetes through the eyes using eye image processing methods. Chaska et al. [49], conducted a study to detect diabetes through iris image analysis using PCA and ANN to 480 iris images. The results of their study showed that ANN can identify the classification of diabetes with an

accuracy of 90%. While [50] using SVM and 2-D wavelet tree for classification of diabetes, they also adopt the principle of iridology in their study.

B. Kidney

For kidney disease we have found a study done by [23], in which they use the method of wavelet analysis and neural network (NN) to classify subjects with kidney disease (168) and normal (172) subjects. The results of their studies do indicate, for normal subjects classification accuracy was 93 %, while subjects with kidney problems 82 %. Murli et al. [51], in their study suggest that ophthalmologists during screening patients undergoing treatment for eye should see if there is any abnormal condition of the eye patients because they think kidney cancer can spread to the eye.

C. Gastrointestinal or colon problem

For gastrointestinal problems and colon problems, investigations carried out in connection with ocular diagnosis by means of CAD, is like a study by Yuan et al. [26], where they perform extraction and analysis of iris texture to see the connection with intestinal and gastrointestinal problems. While [52] studied the characteristics of changes in the geometry of the iris associated with gastrointestinal problems based on the views of iridology . They use the PCA for classification of iris image for these gastrointestinal problems.

D. Pelvis and vagina

There are studies that discuss the problem of pelvic and vagina disease based on correlation with eyes as suggested by Noraini et al. [24]. Where they use the PCM and SVM for classification purposes to the problem pelvis and vaginal disease. Based on their results they have obtained the correct classification for the vagina 80% and correct classification for the pelvis is 70 %.

E. Lung

Base on ocular manifestation signs, to identify lung disease problems using CAD has been discussed by [53], where they have been reviewed regarding autonomic nervous wreath (ANW) based methods available on iridology chart for this they have used methods such as Hough transform image processing, segmentation and normalization for study the iris of the eye. While the authors [54], discuss clinical cases, 72-year-old female patient with cancer of lung squamous cell where he was found to have pain and blurred vision in his left eye, also found a number of malignant cells in the eye. Researchers [25] have developed a smart device for the purpose of health care services. For the purposes of image processing, they use canny edge detection and ANN are utilized for the purpose of classification and analysis for the detection of disease characteristics. Sivasankae et al. [22] have been proposed to identify disease-related Pulmonary they use CHT processing technique, Fuzzy C-Means clustering and gray level analysis. Where the results of the techniques they use are; 75%, sub-acute 80%, chronic 85.71% and degenerative 80%.

F. Leukaemia

Pavithran et al. [21] reported that ocular manifestations are common in patients with acute leukaemia , they have reported a case of a 65-year -old man who suffered a loss of vision in both eyes. These patients were also found to suffer from vitreous hemorrhage, glaucoma and hyphaema in the right eye. In another experimental Mateo et al. [55] have studied the relevant association with ocular manifestations of acute lymphoblastic leukaemia. They discussed the ocular manifestations that occur on the eyelids, conjunctiva, cornea, anterior chamber, retina, choroid and optic nerve. According to the authors in [21] and [55], ocular manifestations can be used as an indicator to identify the disease.

CONCLUSION

This review presents a detailed study conducted methods for detecting diseases associated with ocular diseases and diseases that can be detected through the signs contained in ocular automatically using computer aided known as CAD. The use of CAD is very useful and benefits, where it can reduce the workload of tasks to doctor or ophthalmologist in making health screening and examination of the patient. Tasks such as grading, classify and make interpretation of potential problems associated with ocular problems sometime very challenging. Where to diagnose the eye there are several steps that need to be done such as, identify eye's anatomy, segmentation, localization and normalization on ROI. There are also processes such as extraction, classification and grading using a variety of methods and algorithms. To perform an analysis of disease associated with ocular problems most researchers using OCT images, slit lamp, RetCam, and retinal fundus. While for diseases identified by signs found on the ocular, most researchers use iris image in their analysis

From research studies that have been conducted by researchers, it can be concluded here ocular provide clues to potential health problems. Thus, we propose that the doctor and specialist ophthalmologist using observations during screening examinations of patients, if there are signs of abnormalities in the eyes of patients, so that more detail medical studies can be performed to identify the problem. Use of ocular diagnosis automatically in CAD extremely beneficial and potentially to be studied in greater depth. Therefore further research needs to be done

to ensure that the usage of the eye as one of the parameters used in screening for health problems have firm foundation of medical terms.

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