Automatic Ocular Disease Screening and Monitoring Using a Hybrid Cloud System

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Abstract:

Internet of Things (IoT) has many applications, healthcare is one of them. IoT efficiently integrates medical devices and healthcare related applications through internet. Many research has been done to improve ocular disease screening and diagnosis using advanced image and data analysis techniques. However, the developed systems are not widely used because they are usually offline and separated from medical devices. Here, we introduce a platform that connects medical devices, patients, ophthalmologists, and intelligent ocular disease analysis systems through a cloud-based system. The platform is designed in a hybrid cloud pattern to offer both easy accessibility and enhanced security. The retinal fundus images and patients' personal data can be uploaded to the public cloud tier through multiple channels including retinal fundus cameras, web portals, mobile applications and APIs. The data will be transferred to the private cloud tier where automatic analysis and assessment will be performed using advanced pattern classification algorithms. Further, the analysis report will be made available in the public tier so that patients can access their own report through mobile applications or web portals.

Keywords: Internet of Things(IoT), World Health Organization(WHO), Age-related Macular Degeneration(AMD), Computer Aided Diagnosis(CAD), Cup-to-Disc Ratio(CDR), Diabetic Retinopathy(DR), Model View Controller(MVC).

Introduction

Automatic screening and monitoring of ocular disease system enables easy and accurate detection of eye disease. The system detects the disease by performing various image processing steps on an eye image and all this process is performed without any human (expert's) interference. By storing the data on cloud, the patient records can be stored for any further study or analysis purpose.

Internet of Things (IoT): The Internet of Things is a technique where the virtual world can be connected to the physical world without any human interference. IoT forms a network where the data is effectively transferred to achieve the required task. In our project, we are using IoT to make a virtual network of patient, system and doctor to get effective result in prediction and treatment of disease.

Cloud: Now-a-days storing the data on a network of remote servers available on internet is more in practice rather than storing it on a local server or personal computer. This, makes the data accessibility easier and large amount of data can be stored and retrieved. Cloud is used in our project for storage purpose. Patient records and opthamologist details are stored on cloud.

Image Processing: Image is the input fed to our system, this image further undergoes image processing steps like feature extraction, image segmentation, etc. These image processing steps are performed to get extra information of each pixel of the image which further helps in disease prediction.

The Internet of Things (IoT) is the network of physical objects combined with electronics, software, sensors and network connectivity, so as to enable these objects to collect and exchange data. IoT enables to sense the objects and control them remotely across existing network infrastructure, thus making direct connection between the physical world and computer-based systems, and finally improving the efficiency, accuracy and economic benefit.

Internet of Things (IoT) has many applications, healthcare is one of them. IoT has can easily integrate medical devices and healthcare related applications through internet. Many research has been done to improve ocular disease screening and diagnosis using advanced image and data analysis techniques. However, the developed systems are not widely used because they are usually offline and separated from medical devices. In this project, we introduce a platform that connects medical devices, patients, ophthalmologists, and intelligent ocular disease analysis systems through a cloud-based system. The platform is designed in a hybrid cloud pattern to offer both easy accessibility and enhanced security. The retinal fundus images and patients' personal data can be uploaded to the public cloud tier through multiple channels including retinal fundus cameras, web portals, mobile applications and APIs. The data will be transferred to the private cloud tier where automatic analysis and assessment will be performed using advanced pattern classification algorithms. Further, the analysis report will be made available in the public tier so that patients can access their own report through mobile applications or web portals.

Problem Definition:

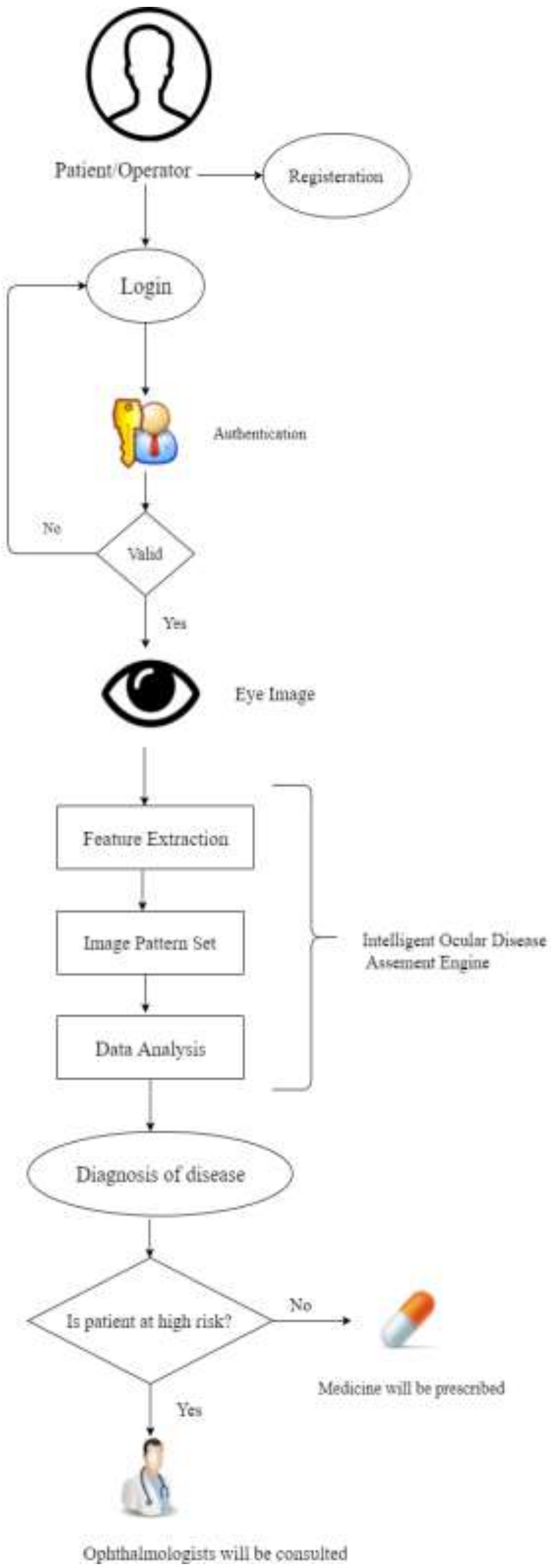
To develop a system that detects ocular diseases with more accuracy and requires less time for disease prediction. The proposed system helps to avoid further complications that occur in patients due to delay in medical assistance.

Objectives

- To connect patients, ophthalmologists through an automatic screening and monitoring of ocular disease system.
- To provide accurate and easy detection of disease.
- To provide medical assistance for the disease detected.
- To fix appointment with ophthalmologists in case the disease is severe.
- To build a web-based application for registering patient and performing its eye disease analysis if

any.

System Architecture



Above fig shows system flow. In this system user enter the personal information and enter the Username and Password. First the system search the password and find its correlation PCFG with user's personal information and if find it show notification to the user for week password, if user enter the password which not related to user's info then the system uses the distortion function and add some character to the password and shuffle the password and make them strong and send to the user and user will be successfully register. Also this system will give notification mail to the authenticate user if some fake user is trying to access their account.

Related Works

1. Automated Microaneurysm Detection Using Local Contrast Normalization and Local Vessel Detection:

Earlier screening programs using retinal photography for the detection of diabetic eye disease were introduced. Automatic grading of the images is being considered by health boards so that the human grading task is reduced. Microaneurysms (MAs) are the earliest sign of this disease and so are very important for classifying whether images show signs of retinopathy. This paper describes automatic methods for MA detection and shows how image contrast normalization can improve the ability to distinguish between MAs and other dots that occur on the retina. Various methods for contrast normalization are compared. Watershed transform method was used to derive a region that contains no vessels or other lesions. Dots within vessels were handled successfully using a local vessel detection technique. Results were presented for detection of individual MAs and for detection of images containing MAs.

Advantages:

Image contrast normalization can improve the ability to distinguish between microaneurysms (MAs) and other dots that occur on the retina.

Disadvantage:

1. The results for image classification are less clear.
2. The poor performance of method "F" requires some explanation.

2. Automatic Detection of Pathological Myopia using Variational Level Set:

Pathological myopia is a condition caused by pathological axial elongation and eyes that deviates from the normal distribution curve of axial length, resulting in impaired vision. Ocular risks associated with myopia should not be underestimated, and there is a public health need to prevent the onset or progression of myopia. Peripapillary atrophy (PPA) is one of the clinical indicators for pathological myopia. This paper introduces a method to detect pathological myopia via peripapaillary atrophy feature by means of variational level set. The proposed method has been tested on 40 images from Singapore Cohort Study Of the Risk factors for Myopia (SCORM), producing a 95% accuracy of correct assessment, and a sensitivity and specificity of 0.9 and 1 respectively. The results highlight the potential of PAMELA as a possible clinical tool for objective mass screening of pathological myopia.

Advantages:

PAMELA is an automated system for the detection of pathological myopia with more accuracy and can perform mass screening of pathological myopia.

Disadvantage:

The accuracy in the boundary location of the optic disc would be compromised.

3. Early Age-Related Macular Degeneration Detection By Focal Biologically Inspired Feature:

Age-related macular degeneration (AMD) is a leading cause of vision loss. The presence of drusen are often associated to AMD. Drusen are tiny yellowish-white extracellular buildup present around the macular region of the retina. Clinically, ophthalmologists examine the area around the macula to determine the presence and severity of drusen. However, manual identification and recognition of drusen is subjective, time consuming and expensive. To reduce manual workload and facilitate large-scale early AMD screening, it is essential to detect drusen automatically. In this paper, we propose to use biologically inspired features (BIF) for the purpose of AMD detection. The optic disc and macula are detected to determine a focal region around macula for feature extraction. The extracted features are then classified using support vector machines (SVM).

Advantages:

Easy, early and automatic detection of drusen is achieved.

Disadvantage:

Need to improve the accuracy as well as to compute the severity of the drusen.

4. Level-Set Based Automatic Cup-To-Disc Ratio Determination Using Retinal Fundus Images in Argali:

Glaucoma is a leading cause of permanent blindness. However, disease progression can be limited if detected early. The optic cup-to-disc ratio (CDR) is one of the main clinical indicators of glaucoma, and is currently determined manually, limiting its potential in mass screening. In this paper, we propose an automatic CDR determination method using a variational level-set approach to segment the optic disc and cup from retinal fundus images. The method is a core component of ARGALI, a system for automated glaucoma risk assessment. Threshold analysis is used in preprocessing to estimate the initial contour. Due to the presence of retinal vasculature traversing the disc and cup boundaries which can cause inaccuracies in the detected contours, an ellipse-fitting post-processing step is also introduced.

Advantage:

Automatic CDR determination method for optic cup-to-disc ratio (CDR).

Disadvantage:

Proposed method has an error for glaucomatous retinal images.

5. Model-based Optic Nerve Head Segmentation on Retinal Fundus Images:

The optic nerve head (optic disc) plays an important role in the diagnosis of retinal diseases. Automatic localization and segmentation of the optic disc is critical towards a good computer-aided diagnosis (CAD) system. In this paper, a method is proposed that combines edge detection, the Circular Hough Transform and a statistical deformable model to detect the optic disc from retinal fundus images.

Advantage:

Automatic localization and segmentation of the optic disc.

Disadvantage:

Results of proposed method can be much worse for discs with non-circular shapes

Design of the Study

Propose Algorithm:-

Step 1: User registration

Step 2: User login

Step 3: User uploads eye image

Step 4: CNN algorithm for feature extraction and classification

Step 5: Disease prediction

Step 6: Medicine prescription

Step 7: Doctor details

Tools Used

- JDK 1.8 or higher version
- Eclipse Mars or higher version
- MySQL 5.7 or higher version
- Tomcat 8 or higher version

Software Requirement:

- Operating System: Windows 8 and above.
- Application Server: Tomcat5.0/6.X
- Language: Java
- Front End: Java 8

- Database : MySQL

Hardware Requirement: The hardware design of the system includes designing the hardware units and the interface between those units.

- Processor: Intel i3/i5/i7
- RAM: 4 GB (min)
- Hard Disk: 50 GB

Statistical Technique Used

We have used image processing techniques such as image resizing, feature extraction in our project to extract the information from eye images. Further the classification of image is done in order to predict the disease affected.

Experiment Result:

The result of our system is, it predicts the disease of the eye image that is fed as an input to the system. The prediction time is negligible. The get the exact prediction, the system is trained by dataset of images for all the disease that are to be predicted, viz. glaucoma, diabetic retinopathy, pathological myopia and age-related macular degeneration. After training the system by these images, the test image (input eye image) is fed and then the systems give the prediction.

Future scope:

To connects medical devices, patients, ophthalmologists, and intelligent ocular disease analysis systems through a cloud-based system so as to access the data and get expert's advice online i.e. using cloud. This platform also provides easy accessibility and improved security.

Conclusion:

The system performs as an automatic ocular disease screening mechanism where the eye image is initially used to train the system so that it can predict the disease affected. The features of the image are extracted, then the prediction is done on the basis of the training performed on the system. Thus, our system efficiently predicts the ocular disease in negligible time and with more accuracy. And, as the patient record is stored on cloud, it becomes easy for the opthamologist and also the patient to refer the patient record (history) to access it whenever required.

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