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Detection of Retinal Disease using Image Processing

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Abstract: ***India is one of the countries which are emerging in the field of telemedicine in recent years. We are still far away from our desired goal. To add to that the patients with eye diseases are also increasing rapidly. To provide them with a better treatment at a lower price is the main goal. The people in urban areas still manage an eye check-up but for the people in rural areas it becomes difficult. Mobile phones are reaching to every nook and corner of the country with the help of that telemedicine becomes possible. We want to come up with a solution in which this becomes possible. The ever increasing amounts of patient data in the form of medical images, imposes new challenges to clinical routine such as diagnosis, treatment and monitoring. Image mining is the process of searching and discovering valuable information and knowledge of data. It is applied on image processing and machine learning. Image processing is having significance for disease detection on medical images. These disease recognition and classification are specific to human organ and image type. With help of image processing and machine learning techniques it is possible to automate and/or assist physicians in clinical diagnosis. This project synopsis describes the application of various image processing and machine learning techniques for detection of eye diseases. Data is the future of technology. With the technological revolution the amount of data is increasing rapidly in any field. Thus using this data to distinguish between two images becomes our primary goal. The pre-processing technique leads to enhance the boundaries and feature extraction process and along with conversion of image type. and then by combining the image processing part with the machine learning part we are able to design the algorithm. For this we are using concept of Template Matching. template is nothing but a sub image which is small. The goal is to find similarities in template and input image. Due to this idea process will be done easily at faster rate***

Index Terms: MATLAB; image processing; machine learning

I. INTRODUCTION

Eyes are one of the most significant parts that used to process the world around us. It will allow us to identify faces, colors, shapes, and depth by translating the light that reflects off of these things into signals that the brain recognizes as images. The eyes occupy cone-shaped cavities in the skull called sockets and eyebrows, eyelids, eyelashes to protect the eye. The eye is composed of cornea, pupil, iris, lens, sclera, retina, vitreous humour. The eye is composed of light-sensitive cells associated with nerve fibers that allow light incoming the eye to be transformed to nerve impulses that arrive at the brain. The amount of light entering is prohibited by the iris and is then moved to the retina. The retina is a thin membranous coating at the back of the eye. It helps to focus images and convert to electrical impulses which are passed to the brain by the optic nerve. Early discovery and treatment of retinal eye diseases is critical to avoid escapable vision loss. Traditionally, retinal disease recognition techniques are based on manual interpretation. The World Health Organization or WHO finds that there are million people visually impaired in all over the world. The number of blindness cases has been extensively reduced in current years, it is estimated that 82 percentage of the cases of visual impairment are preventable or treatable. Retina is affected by several disorders which may be vision changes with aging. Many changes are common and can often be corrected. Blindness prevention is an important challenge all over the world. Cataract, glaucoma and Age related Macular Degeneration are the three major diseases to cause blindness. Vision 2020 pointed that there are about 285 million visually impaired people worldwide. So improving the eye care service especially the pre-detection is of great importance. The retina is vulnerable to micro vascular changes as a result of many retinal diseases.

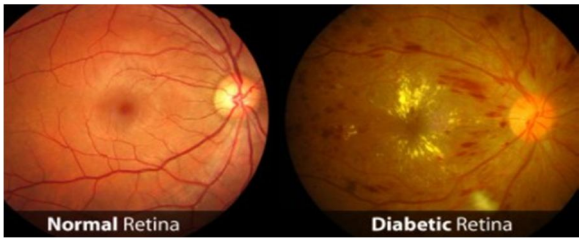

Fig 1: Comparison between healthy and diseased retinal image.

To prevent the vision impairment caused by retinal conditions, periodic eye examination is recommended for patients under high risk . Since diagnostic and investigation procedures involve a high attention of ophthalmologists, as well as regular monitoring of the condition, and the number of patients is constantly increasing, in addition to the shortage of physicians, these demands will eventually exceed the current healthcare capabilities. Due to the workload, human graders are supposed to grade images for several patients per day. Therefore, they can become easily fatigued, causing a decrease in their examination accuracy. Furthermore, despite firm grading guidelines, human graders are subjective and therefore grades for certain images can vary considerably amongst different graders . Automatic image analysis algorithms based on image processing and computer vision strategies have been gaining momentum in various medical applications and, in particular, retinal disease diagnosis. By automating the analysis process for retinal images, more patients can be screened and referred for further tests, allowing the ophthalmologists to have more time for patients who need their attention. In the literature, a large number of researchers have reported various analysis techniques for retinal images with a noticeable improvement in the performance. Nevertheless, researchers face several challenges and issues which cover different retinal image analysis aspects including localisation, segmentation and classification.

II. THEORY

A. *Image Processing*

To perform the medical image processing and disease detection, a sequence of image processing operations are required to improve quality of acquired image and to perform the detection. These processing stages are : Enhancement: Medical images are often affected by noise due to interference and other factors that affect the imaging processes. Image enhancement is the improvement of image quality to increase the perception of information in images for medical specialists. This enhancement id was achieved using the following methods which are listed below: a. Noise suppression b. Sharpening c. Contrast Enhancement d. Image Segmentation e. Feature extraction f. Statistical analysis g. Classification based on a classifier. These steps help in improving the quality of the image and algorithms used in these methods depend upon that condition or situation.

Image Processing: Various image processing techniques used in automated recent diagnosis and analysis of various eye diseases are Enhancement, Registration, Image Fusion, image Segmentation, Feature extraction, pattern matching, classification, Statistical measurements and analysis. Image Recognition: The goal of image recognition is the classification or structural description of images. Image classification involves feature detection property measurement; image description involves, in addition, segmentation and relational structure extraction . Some significant ideas in each of these areas are reviewed in the following paragraphs. Historically, the techniques used have usually been developed on heuristic grounds, but there is increasing interest in deriving optimum techniques based on models for the classes of images to be analyzed.

Following are some image processing techniques used for the detection of eye disease:

1) *Image Acquisition:* Image Acquisition Image acquisition is the very first step in the iris recognition system. The size and colour of iris of every person is different therefore it is very difficult to recognize. The acquisition process produces different results for the same persons due to the different lighting effect, different positioning and different separation of distance. The dataset from UCI Diabetic Retinopathy is used in this study[1]. Features of this dataset have been extracted from the publicly available Messidor database of 1151 fundus images of patients ; where 30percent and 70percent of the available data have been randomly selected as the testing and training data, respectively.
2) *Image Segmentation:* Image Segmentation The Image segmentation is the process of consume all the different parts of the eye like pupil diameter, eyelashes, eyelid, sclera, retina part of eye, inner and outer part of the eye and removes all irrelevant details to increase the efficiency and same time on recognition process. Inner boundary and outer boundary of typical iris can be taken as circles. The two circles are usually not to be co-centric.
3) *Image Normalization:* Normalization refers to preparing a segmentation of input image for the feature extraction process. Due to the variation of the illumination and the associated elastic deformations in the iris texture the size of pupil may change and may interface with the results of pattern matching. For the proposed system we are going to use Daugman's normalized model. In this model the process will produce the iris regions, which have the same dimension of the same captured image of iris under the different lighting effects.
4) *Feature Extraction:* The input image features are extracted by circular symmetric filter method and grabber filter method. This method describes the relationship between low frequency information and high frequency information. It improves the efficiency and correctness of the eye disease recognition system with the help of image pre-processing and feature representation. The inner and outer boundary limits of an input iris localized by filtering, edge detection and Hough transform

5) *Matching:* This will be the last step for the proposed system. In this step the encoding process will extract the feature from the iris image and use it for the matching process. The encoding process will encode the pattern of disease image into 3002 bit iris code. After the encoding process the Hamming Distance method will be used to match the process, this method gives the measure in two bit patterns that how many bits are the same. The purpose of hamming distance reduces the errors motive by false accept and false reject rate.

III. RESULT AND DISCUSSION

A. Feature Extraction

The first step in order to accomplish the task is to have the input image undergo segmentation and then further process in order to elevate the main infected part in the input image. Refer Fig 2.

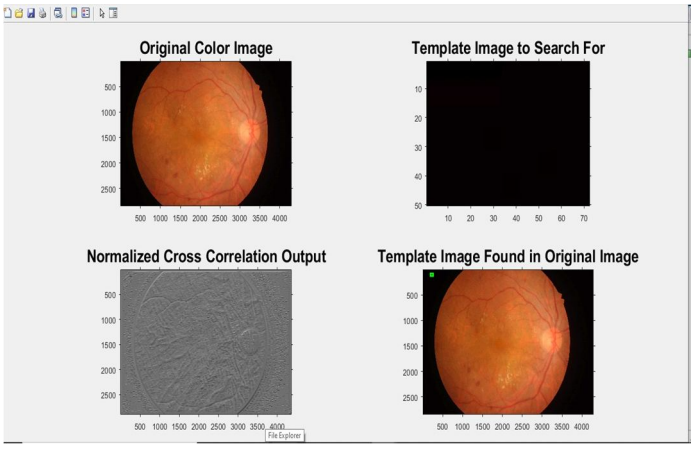

Fig 2: Screenshot of the Output Image after scaling and cross co-relation Output.

The second step is to extract the data that can be proven helpful in order detect the disease within the eye. We can zoom in and out in order to focus on the area of the infected part or to clearly envision the image. Refer Fig 3.

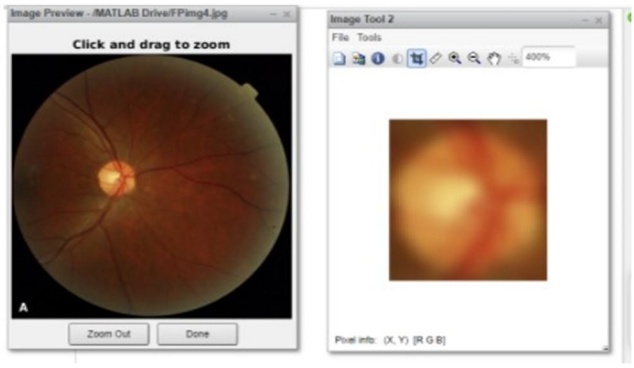

Fig 3: Zooming in to infected area.

Moving on the the biggest difference can be noted in the blood vessels of the healthy and infected person eyeball, thus these images undergo segmentation to detect blood vessels which in return provide valuable response in order to achieve a higher accuracy.Refer Fig 4.

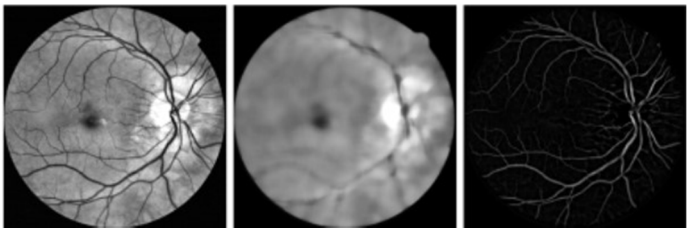

Fig 4: Extracting the retinal blood vessels.

The similar is the case with exudates. Exudates are yellow flecks made uo of lipid residues, they cause lesions. which can include to one more feature in order to establish a difference in between a healthy and infected fundus image. Refer Fig 5a and Fig 5b.

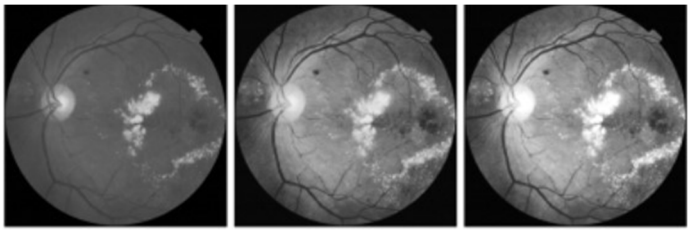

Fig 5a: Extracting Exudates.

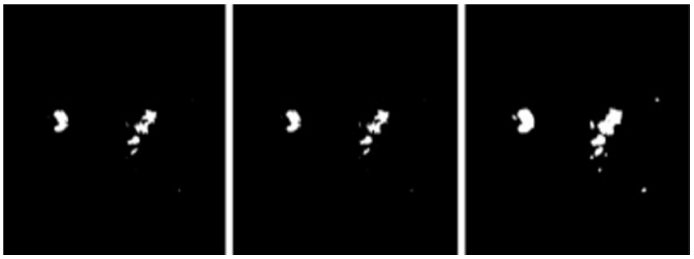

Fig 5b: Extracting Exudates.

B. Classifiers

The following classifiers were used for the scope of this project

1) *Naive Bayes::* The NB classifier has been widely and successfully applied for research on medical data. NB classifier is one of the highly effective and efficient classification algorithms, through comparison of NB with other popular classifiers such as Logistic regression, nearest neighbour, Decision Tree, Neural Network and Rule Based on medical data sets. The Classifiers are compared depending on the area under the Receiver Operating Characteristics (ROC)curve . kononenko(2001) considered NS as a benchmark algorithm that in any medical domain has to be tried before any other advanced method. Compared to other classifiers, Naive Bayes is simple, computationally efficient, requires relatively little data for training, need not to have a lot of parameters and it is naturally robust to unavailable and noisy data.
2) *KNN (K -Nearest Neighbor):* K -Nearest Neighbor is a kind of instance-based learning, where the function is only locally approximated and all computation is referred until classification. This technique is called lazy learning because it does not need any training or minimal training phase. All the training data is needed only during the testing phase and this technique uses all the training data so that if we have a large data set then we need a special method to work on part of data which is the algorithmic approach. Although classification is the primary application of KNN, we can also use it for density estimation also. The k-nearest neighbor algorithm is one of the simplest algorithms of all machine learning algorithms. KNN classification was formulated from the requirement to perform several analyses when reliable parametric estimates of probability densities are not known or difficult to determine.
3) *SVM (Support Vector Machine)::* Machine learning support vector machines (SVMs also known as Support Vector Networks) are supervised learning models with correlated learning algorithms that learns data and determines patterns, used for regression and classification analysis. Given a set of training examples, each marked as referring to one category for one of two categories, an SVM training algorithm creates a model that divides new examples into one category or the other devising it as a non-probabilistic binary linear classifier. An SVM model is a representation of the example as points in space assigned so that examples of the different categories are divided . In addition to performing linear classification, SVMs can expeditiously perform a nonlinear classification using the trick called the kernel trick, implicitly mapping their into high dimensional feature spaces.

IV. CONCLUSION

MATLAB is one of the most widely used image processing tool in order to deal with target specific user problem. It is widely used and the ease of using the language is one of the additional feature. The following table is formed based on the scope of research done in this project.

Table 1: Classification Algorithm Performance

Classifier	Optimum Parameter	Accuracy
Naive-Bayes	None	0.7283
KNN	Neighbours-44	0.7607
SVM	Polynomial(d:3) and Penalty 174.5	0.8449

From the above table it is obtained that SVM is a suitable choice as the classifier algorithm due to the yielding of higher accuracy. The accuracy in the output leads to the ultimate decision of picking the algorithm in order to solve the equation.

V. ACKNOWLEDGMENT

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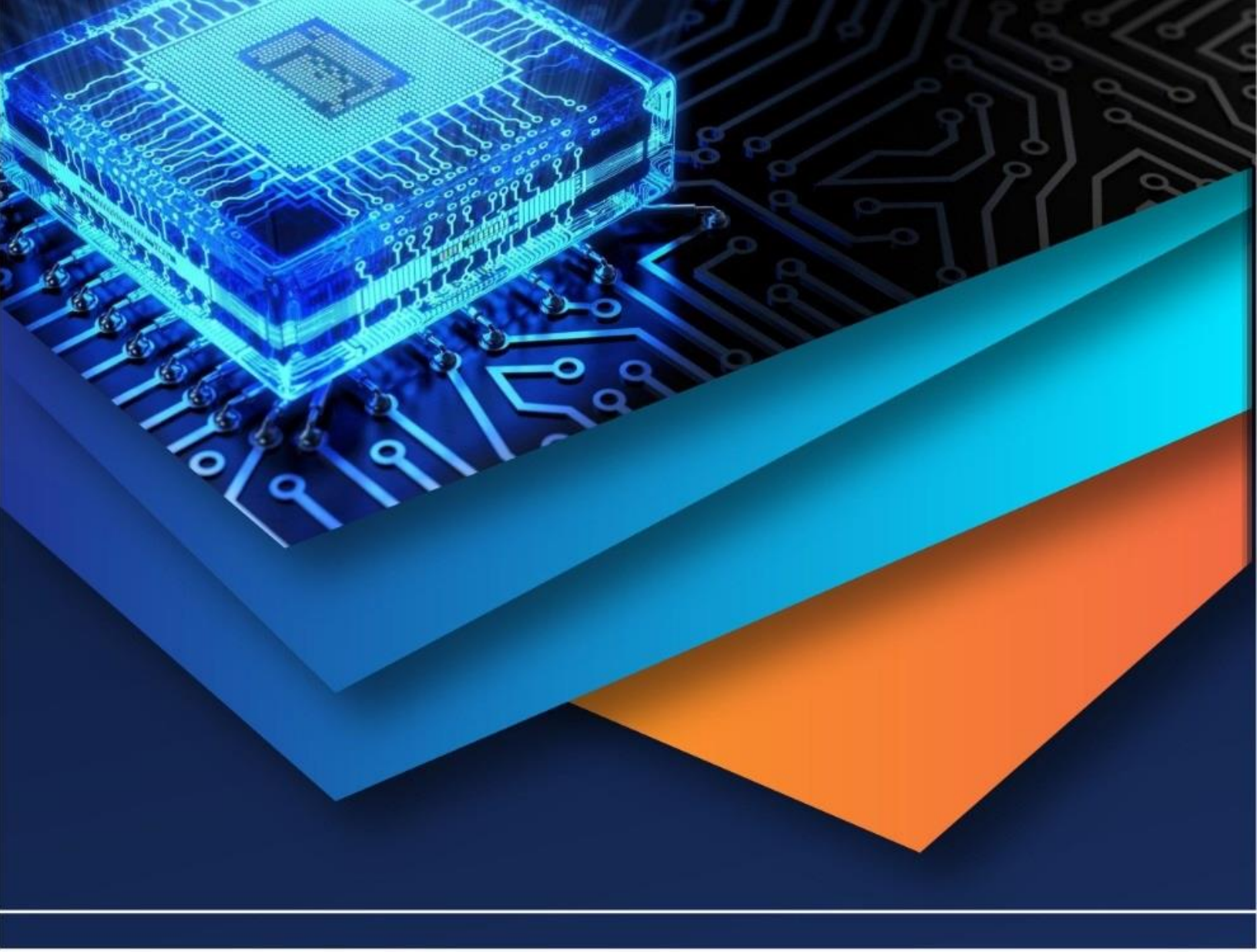

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