Prediction of Diseases in Retinal Fundus Images Using Image Processing

K.Keerthana[1], V.Saranya[2], C.Sushmitha[3]
[1,2,3] *Information Technology, Saranathan College of engineering, Trichy*

Abstract- **The optimal transport theory enables great flexibility in modeling problems associated with image registration, as different optimization resources successfully used because the choice of suitable matching models to align the pictures. The proposed method in this paper is an automated framework for multimodal fundus image registration using both colored and gray scaled images and graph matching schemes into a functional and easy method. Then, this method is used to predict the diseases accurately. Then this method is also used to predict whether the disease is affected or not affected by using a comparative method. These methodologies are validated by a comprehensive set of comparisons against competing and well-established image registration methods, by using real medical datasets and classic measures typically employed as a benchmark by the medical imaging community our proposed method is mostly used in medical field. It is used to easily detect the diseases. We demonstrate the accuracy and effectiveness of this framework throughout a comprehensive set of qualitative and quantitative comparisons against several influential state-of -the- art methods on various fundus image databases.**

Index terms- **Retinal image registration, optimal transport, Blood vessel detection, Image alignment**

I.INTRODUCTION

The World Health Organization (WHO) estimated that 39 million people in the world are blind, 285 million are visually impaired and 246 million have low vision degree in 2012.Considering all these disorders, glaucoma, a serious disease that affects the eyes, is considered the second leading cause of blindness worldwide. According to the American Academy of Ophthalmology, glaucoma is a complicated condition that damages the optic nerve. It occurs when a fluid (called aqueous) builds up in the front part of the eye, increasing the pressure on it. In general, the glaucoma pathology can be broadly classified into two types: the “open-angle”, and the “closed-angle” (or “angle closure”), both of them described regarding the angle delimited between the iris and cornea. The open-angle case, more drastic, appears suddenly leading to the loss of vision quickly while the closed-angle tends to advance at a slower rate progressively. As the medical diagnosis is mostly accomplished by the human inquiry for glaucoma and other eye disorders, the use of image processing algorithms became a necessity especially when ophthalmologists need to manage a large set of fundus images. Such computing apparatus has paved the way for clinicians and medical specialists to cover more patients while still seeking for greater diagnostic accuracy. However, in practice, medical inspections of retinal images are still manually performed in an attempt to carefully identify and track the evolution of eye diseases. Moreover, these visual inspections are quite time-demanding, as they depend on the physician experience in order to succeed, noticing that some pathology can require intensive examination over many years to be finally detected and treated.

In computing, digital image processing is that the use of computer algorithms to perform image processing on the digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and may avoid problems like the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing could also be modeled in the form of multidimensional systems.

Image Processing may be a technique to reinforce raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-today life for various applications. Image processing features a number of applications such as: Remote Sensing, Medical Imaging, Non-destructive Evaluation, Forensic Studies, Textiles, Material Science, Military, movie industry, Document processing, Graphic arts, Printing Industry etc.

Image processing could also be a form of signal processing that the input is an image and therefore the output of image processing may be either an image or a group of characteristics or parameters related to the image. Most image-processing techniques treat the image as a two-dimensional signal. Image processing is computer imaging where application involves a person's being within the visual loop. In other words the images are to be examined and are acted upon by people. The major topics within the sector of image processing include: Image restoration, Image enhancement, Image compression etc.

II. TYPES OF IMAGE PROCESSING

A. Analog Image Processing

Analog image processing is any image processing task conducted on two-dimensional analog signals by analog means i.e. the alteration of image through electrical means. The most common example is the television image. Analog or visual techniques of image processing are often used for the hard copies like printouts and pictures. When creating images using analog photography, the image is burned into a movie employing a reaction triggered by controlled exposure to light. It is processed in a darkroom, using special chemicals to create the actual image. This process is decreasing in popularity due to the arrival of digital photography, which needs less effort.

B. Digital Image Processing

Digital image processing is that use of computer algorithms to perform image processing on digital images. There are three major benefits to digital image processing: a consistently high quality of the image, a low cost of processing, and the ability to manipulate all aspects of the process. In digital photography, the image is stored as a file. This file is translated using photographic software to get an actual image. The colors, shading, and nuances are all captured at the time the photograph is taken, and the software translates this information into an image. The principle advantage of Digital Image Processing methods is its versatility, repeatability and therefore the preservation of original data precision.

III. STEPS IN IMAGE PROCESSING

A. Image Representation

In computing, all data is logically represented in binary. This is true of images as well as numbers and text. However, an important distinction needs to be made between how image data is displayed and how it is stored. Displaying involves bitmap representation, whereas storing as a file involves many image formats, like jpeg. An image is considered to be a function of two real variables, for example, f(x, y) with f as the amplitude (e.g. brightness) of the image at the real coordinate position (x, y). The 2D continuous image f(x, y) is divided into N rows and M columns. The intersection of a row and a column is named as pixel. The value assigned to the integer coordinates [m, n] with {m=0,1, 2,...,M-1} and {n=0,1,2,...,N-1} is f[m, n].

B. Image Pre-Processing

Is used to get rid of noise and eliminate irrelevant, visually unnecessary information. Noise is unwanted information which will result from the image acquisition process.

1. Scaling

Image scaling is that the process of resizing an image. Scaling may be a non-trivial process that involves a trade-off between efficiency, smoothness and sharpness. With bitmap graphics, because the size of an image is reduced or enlarged, the pixels that form the image become increasingly visible, making the image appear "soft" if pixels are averaged, or jagged if not. With vector graphics, the trade-off could also be in processing power for re-rendering the image, which may be noticeable as slow re-rendering with still graphics, or slower frame rate and frame skipping in computer animation.

2. Rotation

Rotation is employed in image mosaic, image registration etc. One of the techniques of rotation is 3-pass shear rotation, where rotation matrixes are often decomposed into three separable matrices. 3-pass shear rotation In 3-pass shear rotation there's no scaling i.e. no associated re-sampling degradations. Shear can be implemented very efficiently.

3. Mosaic

Mosaic may be a process of mixing two or more images to make out one large image without radiometric imbalance. If we take pictures of a planar scene, such as a large wall, or a remote scene (scene at infinity), or if we shoot pictures with the camera rotating around its center of projection, we will stitch the pictures together to make one big picture of the scene. This is called image mosaicking. Mosaic is required to urge the synoptic view of the whole area, otherwise capture as small images.

C. Image Enhancement

Sometimes images obtained from satellites and traditional and digital cameras lack in contrast and brightness because of the restrictions of imaging sub systems and illumination conditions while capturing image. Images may have different types of noise. In image enhancement, the goal is to intensify certain image features for subsequent analysis or for image display [1, 2]. Enhancement methods tend to be problem specific. For example, a way that is used to enhance satellite images might not suitable for enhancing medical images. Even enhancement and restoration are similar in their aim, (i.e.) to make an image look better. They differ in how they approach the problem. Restoration method attempts to model the distortion to the image and reverse the degradation, where enhancement methods use knowledge of the human visual systems responses to enhance an image visually.

D. Image Restoration

Image restoration refers to removal or minimization of degradations in an image. This includes de-blurring of images degraded by the restrictions of a sensor or its environment, noise filtering, and correction of geometric distortion or non-linearity due to sensors. Is the process of taking a picture with some known, or estimated degradation, and restoring it to its original appearance. Image restoration is usually utilized in the sector of photography or publishing where an image was somehow degraded but must to be improved before it are often printed.

E. Image Reconstruction

Image reconstruction encompasses the whole image formation process and provides a foundation for the next steps of image processing. The goal is to retrieve image information that has been lost within the process of image formation. Therefore, image reconstruction requires a systems approach that takes into account the entire process of image formation including the propagation of light through inhomogeneous media, the properties of the optical system, and the characteristics of the detector. In contrast to image enhancement, where the looks of an image is improved to suit some subjective criteria, image reconstruction is an objective approach to recover a degraded image based on mathematical and statistical models.

F. Image Segmentation

Image segmentation is that the process that subdivides an image into its constituent parts or objects. The level to which this subdivision is carried out depends on the problem being solved, i.e., the segmentation should stop when the objects of interest in an application have been isolated. Segmentation is one among the key problems in image processing. A popular method used for image segmentation is called thresholding. After thresholding a binary image is formed where all object pixels have one grey level and all background pixels have another - generally the object pixels are 'black' and the background is 'white'. The best threshold is that the one that selects all the things pixels and maps them to 'black'.

IV. EXISTING SYSTEM

The existing systems provide automated registration framework for aligning blood vessels at retinal fundus images. The present approach relies on the stable theory of OT (optimal Transport) in conjunction with graph-based models to precisely match retinal blood vessels. The performance of the proposed methodology are validated by a comprehensive set of comparisons against competing and well-established image registration methods, by using real medical datasets and classic measures typically employed as a benchmark by the medical imaging community. Graph representatives are constructed from the pair of the acquired images so that their nodes are viewed as a multi-valued set of features and evaluated as key points to achieve the registration. The designed optimization model allows us to establish the matching from a customized cost function that penalizes outliers as long as the matches are determined.

A. Disadvantages

- It does not provide accurate vessels extracted from fundus which leads to misidentification of eye diseases.
- It does not maintain accurate detailed information.
- Processing time is more.
- It only aligns the fundus image and not predicts the disease.

V. PROPOSED SYSTEM

This paper discuss about the prediction of eye disease by using the method image processing at retinal fundus images. Now-a-days many people are affected more by eye disease. So using that situation many doctors and hospitals are easily planning to theft more money from patients. The common peoples are mostly affected by this problem. Thus the proposed method is used to predict the disease accurately with less cost. It detects all the eye diseases easily with more efficiency. Also the prediction of eye disease can be performed at a less computation time. This proposed method is used to predict all the eye related diseases like that glaucoma, Age-related macularde generation, Diabetic retinopathy, Retinitis pimentos and so on. They are easily detected and it is used to accurately identify the diseases in less processing time.

A. Advantages

- It is used to predict disease accurately.
- It requires less processing time.
- It detects all the eye disease easily.
- Less computational cost.

VI. SYSTEM ARCHITECTURE

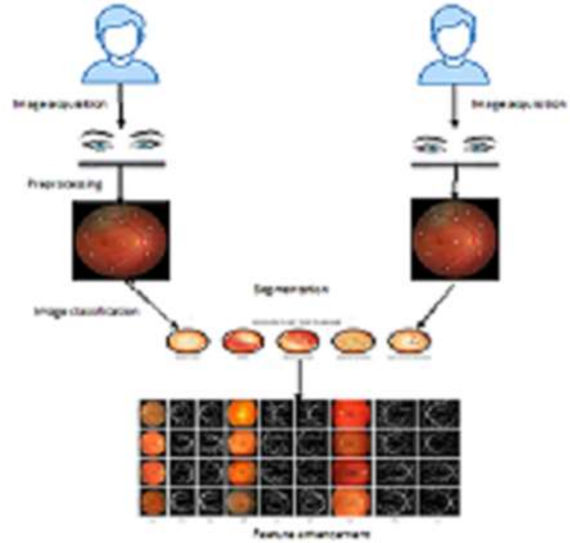

Fig 1. System Architecture

VII. MODULE DESCRIPTION

A. Data Acquisition

The disease affected image or not affected images are captured from camera. It is used to upload the pair of input images. However, it differs from conventional methods by using thermal images as inputs.

B. Preprocessing

The pair of images is preprocessed by the process of fundus image vessel optimal alignment process. The main process of the preprocessing is used to separate the meaningful features. The academic community has achieved fruitful breakthroughs in the field of fundus image in the past few decades. It is the process of extracting the graph from fundus image. The fundus image is converted into binary image. Then the binary image is used to extract the skeleton image. Given two retinal fundus images I and R, the first step of our framework consists in generating graph-based representations of I and R, more precisely, to represent the retinal veins of the images. In order to construct such reference graphs, we initially use the technique to create binary images BI and BR. These binarizations reflect into their structures vessel attributes like lines, shapes and topological groupings. From the vessel binaries BI and BR, we generate skeleton images SI and SR by applying the iterative hinning method, which shrinks large pixelated regions while still removing possible outliers.

C. Segmentation

The segmentation is the process of extracting graph from the skeleton fundus image. It is used by the fundus graph extraction. Then the process of the extracted graph is segmented it. The graph extracted fundus images are matched it to find the same points. It is used to segment the pair of input fundus images. Information carried out by look-alike nodes in GI and GR, we take the branch points of the skeleton images as key points, which are morphologically extracted from the pixels neighborhoods using MATLAB's bimorphs function, pulling out from the graphs any other internal node. These key points correspond to significant structures of the blood vessels. Next, the remaining non-branch nodes are progressively removed by a simple set of heuristic rules which relies on the neighborhoods of these nodes and the distances to the pre-specified key points.

D. Classification

The classification method is used to classify the object easily so we are detecting the object accurately. Then this method is used to classify the disease accurately and refining a background objects accurately. Because the features obtained by RoI pooling operation are more accurate in the two stage methods, the predictions for classification and localization are both refined in that stage. Then these stage methods do not have this refinement process. Moreover, the misalignment is a crucial problem when using the foreground or background as a gate for the original frame. We introduce a Background Refining stage as the second stage to complete the detection framework. In this stage, we handle the misalignment problem by pair wise non-local operations between the original frames and its backgrounds. Instead of the pixel-wise multiplication, which is sensitive to misalignments, we compute the response at a position in which the feature maps of the original frames are same as the weighted average of the features at all positions in feature maps of the background frames.

E. Feature Extraction

This method is used to predict the disease accurately. Then the useful diseases are predicted from the fundus images. We remove the average pooling layers from the pre-trained model and add auxiliary convolution layers to detect large sizes of objects. It will not be surprising for getting a better result after adding a top-down structure in FG stage, but that is beyond the scope of this paper.

F. Performance Evaluation

This method is used as a process of refine the disease accurately and. Then this method is used to predict the disease. We now provide the different types of image features employed to achieve a context-relevant cost matrix. All features are computed regarding the input retinal images and collected at the nodes or from image patches around these nodes. In our experiments, we set patches of size 21_21 pixels centered at each evaluated node. Gray-image patches are directly collected varying a predefined template over the gray-scaled version of the images. Therefore, it is a "vectored patch" with pixel intensities around node v on the gray-scaled fundus image.

VIII. IMPLEMENTATION

This project is implemented using python GUI TKinter. The two main processes are training and testing.

Fig 2. Main page

A. TRAINING PROCESS

The collected training datasets are given as input to the training process. The training datasets contains many infected retinal fundus images. These datasets undergo preprocessing phase like grayscale conversion, noise elimination and feature extraction.

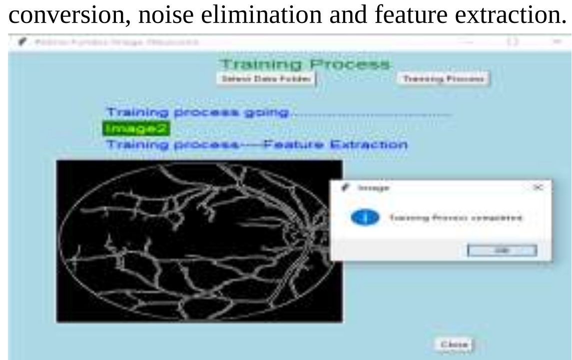

Fig 3. Training process

After successful completion of training process, this trained data is stored separately.

Fig 4. Storing trained data

B. TESTING PROCESS

In testing process, an image is selected from test dataset and given as input. The test dataset contains both infected and healthy retinal fundus images. The input image undergoes preprocessing.

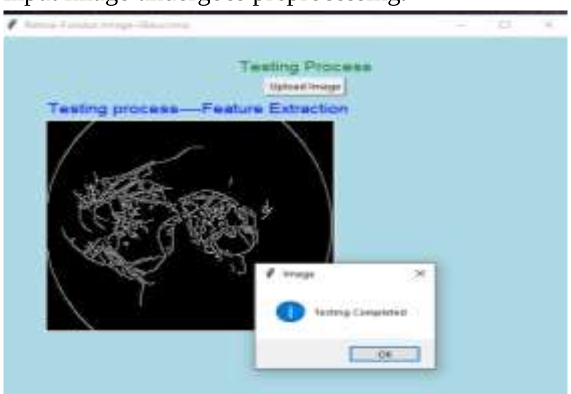

Fig 5. Testing process

After successful completion of testing process, the tested data is compared with the trained data.

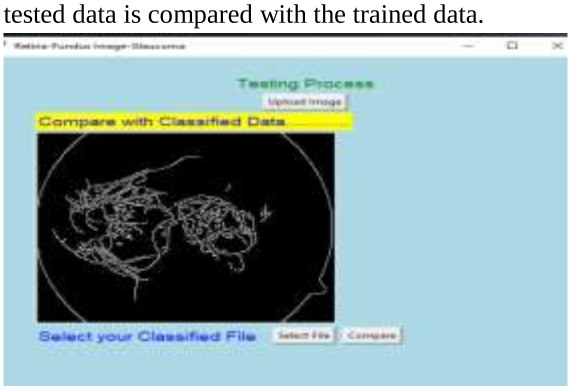

Fig 6. Comparing data

Comparison is done with the help of the extracted features and graphs. Graph matching technique is used to identify whether it is infected or not.

Fig 7. Predicting disease

IX. CONCLUSION

In conclusion, hope majority of people would find this useful since it is automated and flexible technique based on multimodal images to tackle the problem of fundus image registration. The designed framework will yield a high-accuracy registration including many cases difficult to be handled in real circumstances such as potential changes in the geometry of the vessel structures, lack of focus, and the presence of specular noise. Moreover, we also verified the effectiveness of each core modulus of multimodal images separately by analyzing them individually against existing well established approaches. As demonstrated by a comprehensive set of experiments, this system has produced highly accurate results even when compared against baseline as well as modern registration methods. It is also capable of aiding physicians and ophthalmologists under real circumstances.

REFERENCES

[1] World Health Organization (2014) Visual impairment and blindness. [Online] Available: http://www.who.int/mediacentre/factsheets/fs282/en/.

[2] H. A. Quigley and A. T. Broman, “The number of people with glaucoma worldwide in 2010 and 2020,” Brit. J. of Ophthalmol., vol. 90, no. 3,pp. 262–267, 2006.

[3] F. Laliberté, L. Gagnon, and Y. Sheng, “Registration and fusion of retinal images: an evaluation study,” IEEE Trans. Med. Imaging, vol. 22, pp.661–673, 2003.

[4] Y. Know, M. Adix, M. Zimmerman, S. Piette, E. Greenlee, W. Alward, and M. Abramoff, "Variance owing to observer, repeat imaging, and fundus camera type on cup-to-disc ratio estimates by stereo planimetry", J. Glaucoma, vol. 18, no. 4, pp. 305–310, 2009.
[5] E. Karali, P. Asvestas, K. S. Nikita, and G. K. Matsopoulos, "Comparison of different global and local automatic registration schemes: An application to retinal images," in LNCS, 2004, pp. 813–820.
[6] T. Kauppi, "Eye fundus image analysis for automatic detection of diabetic retinopathy," Ph.D. dissertation, Lappeenranta University of Technology, 2010.
[7] Z. Zhang, R. Srivastava, H. Liu, X. Chen, L. Duan, D. Kee, C. Kwoh,T. Wong, and J. Liu, "A survey on computer aided diagnosis for ocular diseases," BMC Med. Inform. Decis. Mak., vol. 14, no. 1, pp. 1–80,2014.
[8] B. N. Kumar, R. P. Chauhan, and N. Dahiya, "Detection of glaucoma using image processing techniques: A review," in MCCS 2016, 2016,pp. 1–6.
[9] D. S. Sisodia, S. Nair, and P. Khobragade, "Diabetic retinal fundus images: Preprocessing and feature extraction for early detection of diabetic retinopathy," Biomedical and Pharmacology Journal, vol. 10,no. 2, pp. 615–626, 2017.
[10] H. Liao, Z. Zhu, and Y. Peng, "Potential utility of retinal imaging for Alzheimer's disease: A review," Front. Aging Neurosci., vol. 10, pp.1–12, 2018.