Study on Alzheimer's disease using Image Processing

Alina Nibu Mathew, Jeena Mariya Kuriakose , Sethulakshmi Haridas, Sani John
ECE Department
Viswajyothi College of Engineering and Technology Vazhakkulam
Muvattupuzha, Kerala, India
alinanibu30@gmail.com, jeenakuriakosev@gmail.com , sethu2910@gmail.com, sanijohn111@gmail.com

***Abstract*— In this study we describe how to detect the presence of Alzheimer's disease with the help of image processing . The data used are iridology images which are collected from subjects with and without Alzheimer's disease, that studies the alterations of the iris in correspondence with the organs of the human body. This is done with the help of certain mathematical models based on specialized software called Matlab. For this we have: i)The Fourier Transform to normalize the image; ii) The Hough Transform to locate circles in an image. Which helps to determine the characteristics of the iris establishing criteria or patterns to determine the existence or non existence of Alzheimer's disease (AD).**

Keywords—Alzheimer's, Iridology, Image processing

I. INTRODUCTION

Alzheimer's disease (AD) is the most common form of dementia, affecting over 8 lakh of people in the UK and without efficient treatment. Diagnosis of AD is very difficult, as many neurodegenerative conditions present with a similar picture .

Variations in the brain that causes Alzheimer's disease are believed to start decades before cognitive symptoms emerge. If early stages of AD could be identified, it would contribute to a precise estimation of an individual's risk of developing disease and enable the monitoring of high-risk (presymptomatic) persons as well as providing the means for assessing the efficacy of new interventions.

People with AD can have difficulties with vision and perception which results in misinterpreting the world. The process of vision is complicated and there are many possibilities which come apart at seams. Disruptions in vision and perception leads to behavioral abnormalities and even safety risks.

The retina links to the visual perception and cognitive centers of the brain . Along with that it is also an extension of the brain sharing embryological origins as well as a blood supply and nerve tissue[1]. Therefore has huge potential as a site for AD investigation through easy, nonintrusive imaging and computational image analysis to disclose valuable information about microvascular health, deposition, and neurodegenerative damage. Encapsulating reliable longitudinal data concerning to the onset of Alzheimer's disease is a key target, but a high degree of standardization. Standardization is highly required if the potential of the retina is to be fully realized. Our goal is to provide guidelines on how to execute robust iris imaging and analysis for neuroretinal AD discovery and to highlight advantages and limitations of the techniques.

Iridology which is also known as irido-diagnosis or iri-diagnosis is a possible medical technique in which various properties of iris along with many other characteristics like circumference patterns, colors etc can be examined to determine therapeutic data about a patient's systemic health. Practitioners match their observations to iris charts ,which divide the iris into different zones that corresponds to specific parts of the human body. Iridologists see the eyes as "windows" into the body's health status. It is claimed that we can use the charts to distinguish between healthy systems and organs in the body and those that are overactive, inflamed, or distressed.[1] Iridologists claim this information demonstrates a patient's susceptibility towards

This work was done as a part of B. Tech project at Viswajyothi College of Engineering and Technology

certain illnesses, reflects past pharmaceutical problems, or predicts later health problems.

A major benefit of the iris is that it is difficult to forge, that is the importance in the biometric identification. Thus, iris identification became a research topic. In addition, the use of advanced camera systems in association with computer-assisted image processing methods enables the determination of important objective characteristics of the iris with greater accuracy and reliability .[2]On the other hand, iridology is used as an alternative means for the diagnosis of this disease, based on the comparative and modeling of patterns, making decisions at a minimum cost, and a high efficiency in the results. For this, a neural network can be used and for the diagnosis and validate the present investigation. Thus, the specific objective of the diagnosis is to gather information stored in the eyes (Fig.1).

II. MATERIALS AND METHODS

Iridology is a diagnostic method that examines the patterns and changes in the iris of the eye, and has been documented since the early 17th century. In order to know the characteristics that appear in a person's iris, a cross-validation was performed with real data which collaborated with personnel for the collection of samples. Whenever there is a state of alteration in any organ of the body it manifests in the iris, because it suffers an alteration that corresponds to the affected area or where that alteration is located. Figure 1 illustrates a map of iridology, where each sector after the pupil, is a region that details the entire structure of the brain, in this area are located the anomalies that cause Alzheimer's.

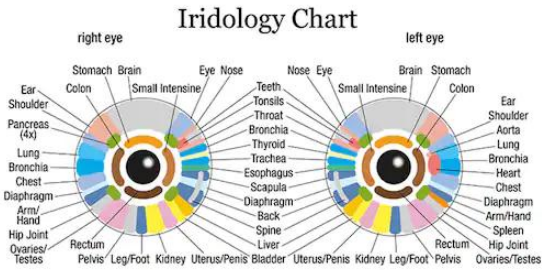

Figure 1: Iridology chart

After detecting the color changes in the brain area (Figure 1) and extracting six parameters, which are relevant for the recognition of the pathology; the system must learn to generate an automatic diagnosis, this is obtained through supervised and automatic learning applying concepts related to MATLAB, describes the general process by establishing a diagnosis.

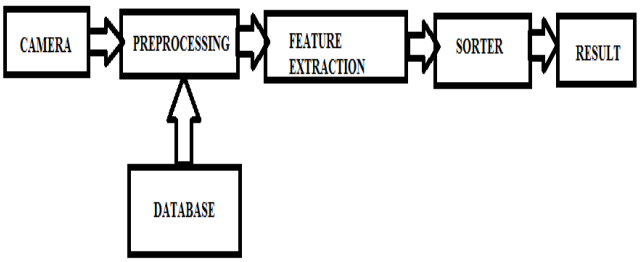

Figure 2:Proposed process for the detection and diagnosis of Alzheimer's Disease

A. Process Description

The system will take an image of the iris, which can be obtained by means of a camera or an existing Database(Iriso),for the present work we used the data of the images obtained in the Foundation, as well as being a JPG format.

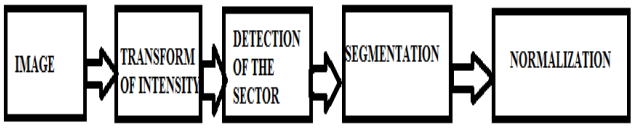

Figure 3:Algorithm of image pre-processing

Step 1: Detection of perfect circumferences of negative images were carried out. For these images, both the inner edge - Pupil and outer edge -Iris, by Hough transform were carried out(Figure 4).

Step 2: In addition to this, the image is segmented (Figure 5), to locate the affected brain area. For this, a logarithmic intensity transformation is used to clarify the affected areas with the help of Circle Hough Transform. The Circle Hough Transform (CHT) is a basic technique used in Digital Image Processing, for detecting circular objects in a digital image. The Circle Hough Transform (CHT) is a feature extraction technique for detecting circles. It is a specialization of Hough Transform. The purpose of the technique is to find circles in imperfect image inputs. The circle candidates are produced by "voting" in the Hough parameter space and then select the local maxima in a so-called accumulator matrix.

This work was done as a part of B. Tech project at Viswajyothi College of Engineering and Technology

Figure 4. Hough transform for detection of pupil and iris

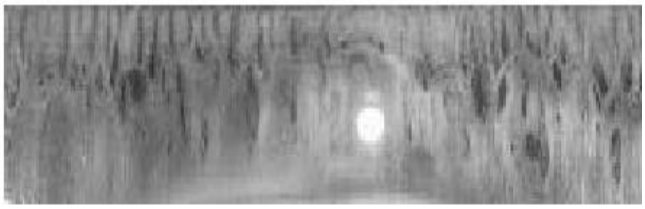

Figure 5. Process of segmentation of the imag

Step 3: Feature extraction, for feature extraction we go for GLCM. GLCM is a method to examine textures of spatial relationship of pixels is the Gray-Level Co-occurrence Matrix (GLCM), so known as gray-level spatial dependence matrix.

These steps are done on both positive and negative images, then comparison is done based on average intensity, average contrast of standard medium, mildness, third moment, uniformity of histogram and entropy. Where Average intensity, is the average feature in a bitmap of an image, while Average contrast of standard deviation, is known as the average variant in a bitmap, on the texture of the same under a given criteria which is not proportional to the smoothness of the bitmap. Mildness, which shows the inverse of the average contrast of the standard deviation. The Third moment is the lack of symmetry of histogram proportional to the uniformity of the previous specimen. Uniformity of the histogram is a data trend to know if the curve is flattened or elongated and entropy shows the average information that contains the image of the segmented iris, this is done in order to identify the quantity of useful data needed to be analyzed.

With the experimentation of digital processing algorithms, an innumerable number of parameters can be determined that can be used to detect different diseases. Here,color characteristics were taken, spectra for the determination of the characteristics are required for compliance with this research.

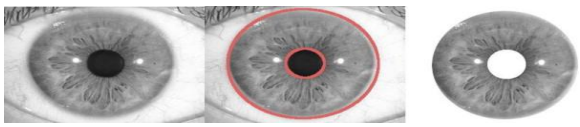

Figure 6: First phase output of study

B. Sorter

In second phase we uses supervised learning techniques, such as SVM(Support Vector Machines) that are agile, simple and to evaluate the previously proposed six criterias which are taken in order to compare their performance, and thus make a correct classification of the characteristics and detection thresholds. We uses Support vector machine (SVM) whenever our data has exactly two classes. An SVM classifies data by finding the best hyperplane that separates all the points of datas of one class from that of the other class. By using this algorithm, we classifies the images such that we train the images to be in 2 classes;0 for negative images and 1for positive images

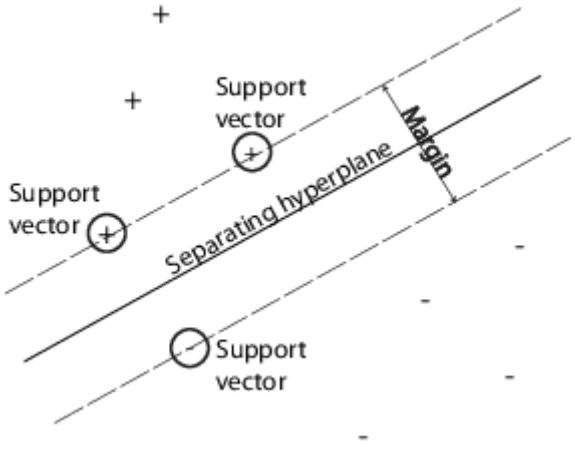

Figure 7 : SVM

Here we uses Naïve Bayes Model which is a probabilistic classifier to find the strong independence assumptions between features or different properties. All Naive Bayes classifiers

This work was done as a part of B. Tech project at Viswajyothi College of Engineering and Technology

works on the assumption that the value of a particular feature is independent of the value of any other feature, given the class variable.

EVALUATION

For evaluation tests to be done for the diagnosis, an image is selected, then the necessary digital processing techniques are made on it and in this way the required characteristics for the analysis of the basis are acquired. To scrutinize the results , obtain an automatic recognition, based on machine learning, for this Naïve Bayes classifiers are used. So first a Graphical Used Interfaced dialogue box appears as the front end of analysis. On uploading the image(positive/negative),check for the analysis. The image is initially converted into a binary image and then edge detection is done. Once the edges are detected circular Hough transform is performed to obtain the radius of the iris and crop the upper portion which connects with brain. Later extraction of the features are done and by using classifier algorithm they are trained to produce the results.

RESULTS

Results of Phase 1 includes the extraction of features of iridology images such as average intensity, average contrast ,mildness etc. by using GLCM. Depending upon the values shown by the model our system predicts whether the image is AD positive or AD negative

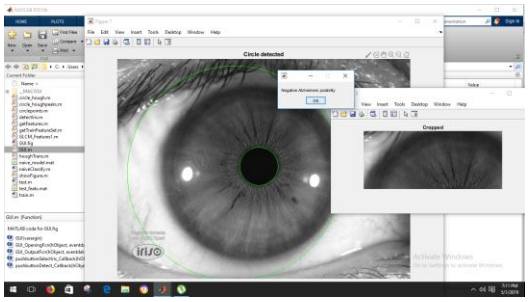

Figure 8: Positive image detection

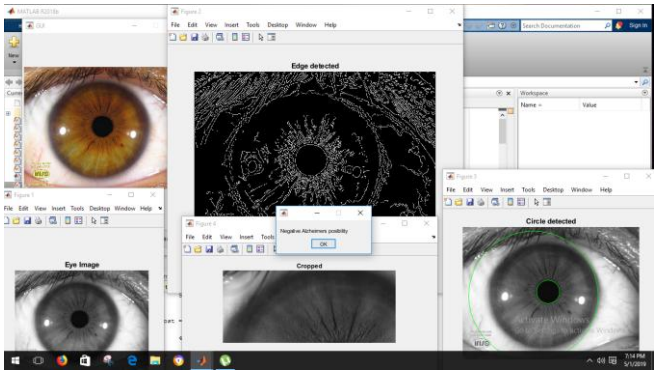

Figure 9: Negative image detection

The results of the evaluation are presented in terms of accuracy, sensitivity, specificity and predictive capacity.

$$Accuracy = \frac{(\mathrm{VP} + \mathrm{VN})}{\mathrm{VP} + \mathrm{VN} + \mathrm{FP} + \mathrm{FN}} * 100$$

Sensitivity refers to the capacity of the system to identify true positive:

$$Sensitivity = \frac{VP}{VP|FN} *100$$

i) VP – true positive; ii) VN – true negative; iii) FP – false positive; and, iv) FN – false positive.

CONCLUSION

Inorder to carry out detection tests on the diagnosis, an iridology image is taken, then the digital processing analysis is done on it and in this way the required characteristics for the analysis of the specifications are obtained**.** In this paper, we presented how images analysis can be used to detect the presence of AD at the early stage in short time and cost efficient manner. The relations between imaging and AD were captured using SVM base learner. Our future extention includes the proposed model can be widely used to detect other neurological diseases.

As a part of future work it is planned to focus on the methods to recognize the stage of the corresponding patient so that we can diagnose the disease in a better fashion.

This work was done as a part of B. Tech project at Viswajyothi College of Engineering and Technology

REFERENCES

[1] Fernando Hernández; Roberto Vega; Freddy Tapia; Derlin Morocho; Walter FuertesUniversidad de las Fuerzas Armadas ESPE,Early Detection of Alzheimer's using digital imageprocessing through Iridology, an Alternative method, Published in**:** 2018 13th Iberian Conference on Information Systems and Technologies (CISTI)
DOI**:** 10.23919/CISTI.2018.8399151

[2] Musab Sahrim and Mark S. Nixon,Roxana O. Carare, Blood Vessel Feature Description for Detection ofAlzheimers Disease, Published in**:** 2014 13th International Conference on Control Automation Robotics & Vision (ICARCV), DOI**:** 10.1109/ICARCV.2014.7064325

[3] Audrey Demmitt, RN and VisionAware Peer Advisor https://www.visionaware.org/info/for-seniors/health-and-aging/vision-loss-and-the-challenges-of-aging/alzheimer%27s-disease/how-alzheimer%E2%80%99s-disease-affects-vision-and perception/12345

[4]omMacGillivray,SarahMcGrory ,TomPearson ,James Cameron,Retinal imaging in Early Alzheimer's detectionRainer A. Leitgeb , 2017, Springer Protocols

[3] to me

This work was done as a part of B. Tech project at Viswajyothi College of Engineering and Technology