Iridology Based Alzheimer's disease Detection

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Abstract– Alzheimer's disease is an illness of brain which affects the memory, thinking and behavior of person. It is named after Alois Alzheimer, the German doctor who has described it in 1907.The brain cells eventually die and this means that information cannot be remembered. As Alzheimer's disease affects each area of the brain that causes a slow decline in memory, thinking and reasoning skills. As there is no cure system available for this disease, but early effective detection of disease can slow down the progression of disease. Several techniques are available like MRI scan, CT scans, PET scans; these can help to detect the Alzheimer's. A new innovative technique based on iridology is proposed in this paper. This paper presents a specific pattern which will be used to determine existence of Alzheimer's disease. The adaptive pattern recognition technique can lead to achieve better than 75% accuracy; which was last milestone. A good resolution image can give better results while blur; ambiguous image can degrade performance of pattern recognition of technique.

Keywords- Alzheimer's disease, Alois, Brain cells, MRI scan, CT scan, PET scan and Iridology.

I. INTRODUCTION

Alzheimer's disease is a progressive disease that destroys memory and other important brain related functions. At early stage, someone with Alzheimer's disease may notice mild confusion and difficulty remembering the things. Even the people with this disease may forget important people in their lives and undergo dramatic personality changes. In Alzheimer's disease brain cells eventually die and this means that information cannot be remembered. Alzheimer's gets worse over time. The effect of Alzheimer's disease on different age categories of India is as shown below. As there is no cure system available for this disease, early detection can slow down effect of this disease. Images of brain and iris can be used to detect the effect of this disease.

Fig 1: Alzheimer's disease on different age [17]

Magnetic resonance imaging (MRI) uses radio waves and a strong magnetic field so as to produce brain image details. MRIs are used to diagnose different parts of body, it shows blood vessel damages. In addition, they may be used to diagnose diseases of central nervous system and the MRI is safe and painless test. Computerized tomography (CT) produces cross-sectional images (slices) of your brain and combines a series of X-ray images taken from different angles. It is currently used chiefly to diagnose joint problems, bone fractures tumors, strokes and head injuries.

In the PET scan, you will be injected in a vein with a low-level radioactive tracer. The tracer may be a special form of glucose (sugar) that shows overall activity in various brain regions that will show you how your tissues and organs are functioning. New PET techniques are able to detect your brain level of plaques and tangles, the two hallmark abnormalities linked to Alzheimer's. These new PET techniques are generally found in research which shows brain images testing in clinical trials. Cerebrospinal fluid is special circumstances such as rapidly progressive dementia or very young onset dementia, a cerebrospinal fluid examination may be performed. The spinal fluid can be tested for biomarkers that indicate the likelihood of Alzheimer's disease [18]. A new iridology technique can add better accuracy over existing systems. In this system alterations of the iris in correspondence with the organs of the human body will be analyzed to detect impact of Alzheimer's disease. For the detection or impact of Alzheimer's disease the iris images must be processed as follows.

- The Fourier Transform to normalize the image

- The Hough Transform to locate circles in an image.

Multilayer classifiers are used like ZeroR, Naïve Bayes and Multi-layer Perceptron to detect impact of disease [2].

II. PROBLEM STATEMENT

To develop Iridology based early Alzheimer's disease detection and prediction. Implementation of Fourier transform and Hough transform led to better accuracy towards detection of Alzheimer's disease.

III. LITERATURE REVIEW

R. Suji Pramila, A. Shajin Nargunam [3] proposed Bluetooth enabled in-home patient monitoring system. It enabled in-home patient monitoring system which facilitates early detection of Alzheimer's disease. With the help of short-range Bluetooth communications, the location and movement pattern of a patient can be tracked and recorded in a local database. Thus a medical practitioner is able to perform remote diagnosis via the internet. This system is not suitable for long-range outdoor environments. The e-healthcare solution has a number of issues like security and privacy that are hard to accomplish in an effective way. The e-healthcare solution can be enhanced for long range outdoor environments with location tracking technology like GPS. Data security issues can be considered with two important aspects like secure and dependable distributed data storage and fine-grained distributed data access control for sensitive and private patient medical data. Different methods are analyzed to improve the security and efficiency of data sharing. This work facilitates better medical treatments, improve the quality of treatments and reduce health care costs.

R.Anitha, Mr.Prakash [4] proposed a mechanism for detection of Alzheimer's disease. It is a neurological disorder in which the death of brain cells causes memory loss and cognitive decline. A neurodegenerative type of dementia, the disease starts mild and gets progressively worse. An important area under medical research is Brain image analysis, results to detect brain diseases. The main cause for Alzheimer's diseases is Low brain activity and blood flow. In general Segmentation technique is using for the medical images .One of the important component of the brain is Hippocampus. The normal behavior of human beings is depends on the functionality of Hippocampus. Manual Segmentation by a specialist on the Hippocampus takes many hours. In image processing there are various techniques available for segmentation process. Modified approach based on the watershed algorithm is used for segmenting the hippocampus region. The brain images converted into binary form using two approaches. The first approach is block mean, mask and Labeling concepts and in the second approach top hat, mask and Labeling concepts. However it is found that some part of the image contains holes which interrupt the segmentation process. To overcome this problem image hole filling techniques are implemented and related components are grouped into connected components. The shape analysis of hippocampus structure will result in classifying the Alzheimer's disease.

Atul Bansal, Ravinder Agarwal [5] proposed mechanism in which authentication of persons are performed using machines Biometric systems for authentication based on human characteristics such as face, finger, voice and iris is becoming the prominent research area. Iris recognition among these is considered the most accurate and reliable biometric identification system. Iris recognition system finds application in the various security systems including at airports, confidential sections at laboratories and offices, A number ATM machines etc. researchers have proposed various algorithms based on different feature extraction techniques. In this paper, various algorithms in the different stages of iris recognition along with feature extractions have been reviewed. A template matching technique namely supporting vector machine is also analyzed for iris recognition.

Najmeh dashti nejad [6] proposed a research in which main objective is to evaluate the disease diagnosis through iridology by neural network that uses eye structure and a mechanism to diagnose accurately the iris position and matching with iridology pattern evaluating the accurate positions. So, the offered software evaluates accurately iris tissue through edge detection and then analyses the intended area according to the disease type and finally by the neural network, evaluates learning and prediction in health area. The risks of a lack of accurate and rapid disease detection with a high cost of diagnosis are considered as one of the problems of medical society.

Paul et al [7] has proposed an automatic segmentation algorithm using the circular Hough transform to identify the Iris pupil boundary and linear Hough transform for detecting the occluding eyelids. To remove the eyelashes and reflections thresholding is employed. The segmented region is normalized using the Daughman's rubber sheet model. The normalized Iris image is convolved with the 1D Log-Gabor wavelets and the resulting phase data is used to extract the feature from the Iris image. And finally for the template matching Hamming distance is employed. This recognition rate achieved a FAR of 0.005% and FRR of 0.238 % for CSISA images

Yuan et al [8] has proposed feature extraction method which is invariant to illumination. The pre-processing of image is performed by using Hough transform to localize Iris and Daugman rubber sheet model to normalize the Iris image. The annular region containing eyelid and eyelashes are

discarded (45° to 135° and 225° to 325°) and the rest annular region is normalized and converted to 64 X 256 rectangles. Phase congruency depends on overall magnitude of signal making it invariant to illumination changes. In the process of feature extraction, the normalized image is convolved with the bank of 2D log-Gabor filters with different orientation and scales. Euclidean distance of feature vectors is calculated during matching. It is reported that the matching rate is about 98%.

IV. METHODOLOGY

The various stages of processing involved in the design of Iris recognition system are:

A. Eye Image Acquisition
B. Pre-Processing
C. Segmentation
D. Normalization
E. ROI Extraction
F. Feature Extraction
G. SVM Classification

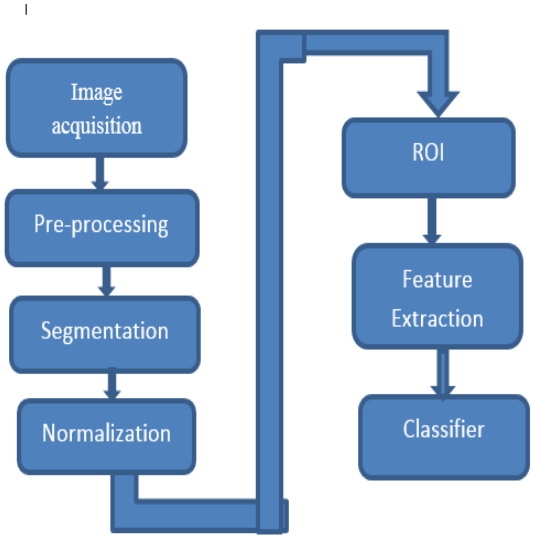

Fig. 2: Proposed System Diagram

A. Eye Image Acquisition: Images will be captured within highly constrained capturing environment, which conditioned the characteristics of the resultant images. Initially the eye image is captured with the help of certain cameras, and stored in the database which contains normal as well as abnormal results of iris [9].

B. Pre-processing: pre-processing is done in order to reduce the presence of noise in the iris image and to enhance image. Due to pre-processing step the obtained result is more suitable than the original image. Here adaptive median Filter is used here for removing the pepper & salt noise present in image, this will make the hidden features of an image more visible for us. Enhancement is done for improving the details of an image [10].

C. Segmentation: Segmentation (localization) process is done to search the centre coordinates of the pupil and the iris along with their radius [1]. Segmentation is done to find inner and outer boundaries of the iris which will be found by subtracting pupil from sclera from this the iris part of an eye [4] can be obtained. Once we will find the segmented iris region from an eye, the next step is to transform the iris region into fixed dimensions. After subtraction, we will get the iris pattern into circular shape [10].

D. Normalization: Normalization is done to convert circular iris pattern into rectangular shape.

E. ROI extraction: After normalization process the next step which comes into picture is ROI extraction that is Region of Interest. ROI extraction is nothing but cropping some portion of normalized iris image so as to find particular area [1].

F. Feature extraction: Feature extraction is defined as a function of one or more measurements, each of which specifies some quantifiable property of an object, and is computed such that it quantifies some significant characteristics of the object or image [11]. Texture on its own does not have the capability of finding similar images, but it can be used to classify textured images from non-textured ones and then this is combined with another visual attribute like color to make the retrieval more strong and effective. Texture is used to classify and recognize objects and it is used in finding similarities between two images in multimedia databases [12].

G. SVM classification: SVM classification is the important part of the approach because the overall process depends upon the classification done through this algorithm. Support Vector Machine (SVM) is relatively a new method of classification and it expands very quickly, the SVM used in different areas of medicines.

V.DESIGN AND IMPLEMENTATION

The designing process has following steps:

A. Iris Image Database
B. Pupil and eyelid boundary detection
C. Integro-Differential operator
D. ROI Extraction
E. DWT Based Feature Extraction
F. SVM Classification

A. Iris Image Database: Varieties of Iris databases are available in the research and educational domains that will help to validate the performance and issues in biometric Iris

recognition systems. Many publicly available databases such as CASIA, UPOL, Bath, MMU, and UBIRIS are freely available for research and education. Indian dataset from IIT Delhi (IITD) is also available for research purpose .This dataset is having total 1120 iris images from 224 persons. It is made up of low resolution images captured using JIRIS, JPC1000, and a digital CMOS camera.

B. Pupil and eyelid boundary detection, using edge detection Method: In order to effectively extract the pupil boundary, it is essential to define the contour characteristics that the system aims to capture. Generally a pupil boundary is a closed continuous and smooth curve, which is nearly equal to circular shape. In order to achieve a better performance in iris recognition system, it is essential to capture the images with respect to a proper center point and a proper angular resolution. The continuity criterion of the contour has been chosen based on the angular resolution rather than the distance between the vertices which is common in general active contour models [15].

The resolution is chosen based on the average radius of pupils in the eye images of CASIA database [16]. By considering the average radius of 45 pixels, the perimeter of a circle obtained nearly around 285 pixels. A resolution of 400 angles has been chosen in order to obtain contours that are pixel wise continuous. Following important steps are involved in iris segmentation methods.

a. Finding the pupillary boundary of the iris
b. Finding the limbic boundary
c. Specular reflection removal, if any
d. Detecting and removing any superimposed occlusions of eyelashes, shadows or reflections.

Most of the failure in iris recognition system occurs due to inaccurate iris segmentation. Even an effective feature extraction method would not be able to obtain useful information from an iris image if it is not segmented accurately. So for the better performance of the iris recognition system correct segmentation method plays vital role. The iris segmentation can be implemented by using Integro Differential Operator and Hough transform.

C. Integro-Differential operator: John Daugman developed the fundamental iris algorithm for recognition system. The best known and thoroughly examined iris segmentation method is Daugman *et.al*. Method using Integro-differential operators, which are a variant of the Hough Transform, act as circular edge detectors and have been used to determine the inner and the outer boundaries of the iris. It is also used to determine the elliptical boundaries of the lower and the upper eyelids. It is obvious that the results are inner and outer boundaries of iris. First, the inner boundary is localized, due to the significant contrast between iris and pupil regions. Then, outer boundary is detected; using the same operator with different radius and parameters. The eyelids can be detected in a similar fashion by performing the integration over an elliptical boundary rather than a circular one. [11]

D. Hough Transform: The Hough transform is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects, such as lines and circles, present in an image. The circular Hough transform can be employed to deduce the radius and center coordinates of the pupil and iris regions. Firstly, an edge map is generated by calculating the first derivatives of intensity values in an eye image and then thresholding the result. From the edge map, votes are cast in Hough space for the parameters of circles passing through each edge point. The range of radius values to look for is set manually, based on the database used. For the CASIA database, values of the iris radius range from 90 to 150 pixels, while the pupil radius ranges from 28 to 75 pixels. For more efficient and accurate circle detection process the Hough transform for iris/sclera is used, then the Hough transform for the iris/pupil boundary was performed within the iris region, instead of the whole eye region, as the pupil is always inside the iris region After the completion of this procedure, six parameters; the radius, and x and y center coordinates for both circles are saved. Canny edge detection is used to create an edge map, and only horizontal gradient information is used.

F. Naive Bayesian classifier: The Naive Bayesian classifier is based on Bayes' theorem with independent assumptions between the predictors. A Naive Bayesian model is easy to build, with no complicated iterative parameter estimation which makes it particularly useful for very large datasets. Despite its simplicity, the Naive Bayesian classifier often does surprisingly well and is widely used because it often outperforms more sophisticated classification methods. Bayes theorem provides gives a way of calculating the posterior probability P(c | x) from P(c), P(x), and P(x|c).

Naive Bayes classifier assumes that the effect of the value of a predictor (x) on a given class (c) is independent of the values of other predictors also. This assumption is called class conditional independence.

$$P(c/x) = \frac{P(x/c)\,P(c)}{P(x)}$$

- P(c|x) is the posterior probability of class (target) given predictor (attribute).
- P(c) is the prior probability of class.
- P(x|c) is the likelihood which is the probability of predictor given class.
- P(x) is the prior probability of predictor

VI. RESULT

MATLAB software is used for detection and prediction of Alzheimer's disease. The below MATLAB images results shows the pupil and eye lid boundary detection using threshold edge detection method.

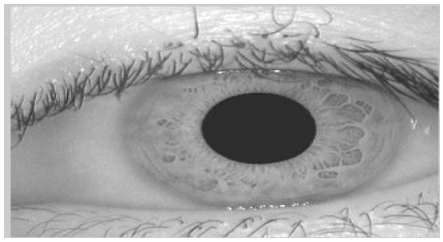

Fig. 3: Greyscale image

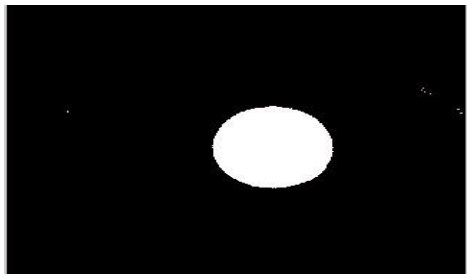

Fig.4: Black &White image

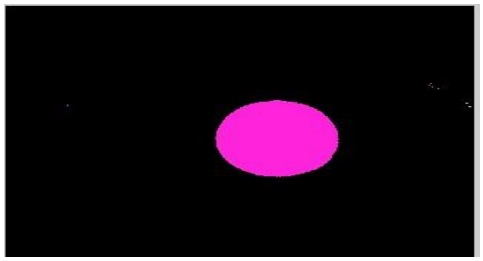

Fig.5: RGB color image

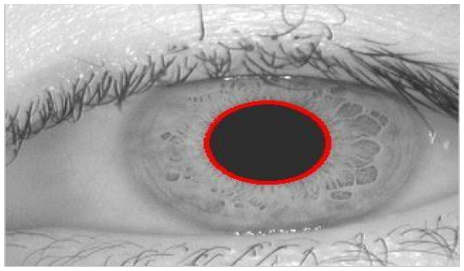

Fig.6: Pupil Boundary detection

VI. CONCLUSION

This paper provides a review on Alzheimer's disease detection through iridology. The processing of iris database and brain analysis is used to detect and predict Alzheimer's disease. Furthermore, the implementation of Fourier transform and Hough transform can increase accuracy of detection and we can detect the Alzheimer's disease at early stage.

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