Image processing for early detection of Alzheimer’s disease using Iridology

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ABSTRACT

Alzheimer’s disease is caused by genetics, personal lifestyle and other environmental factors. It is an irreversible disease that slowly destroys the brain memory cells. There are no specific methods for the detection of Alzheimer’s disease. The primary symptoms of Alzheimer’s disease are memory loss, difficulty in thinking, a problem in writing and speaking and others. Iridology is alternative research that has gained more popularity in recent years, which studies the alterations of the iris in correspondence with the organs of the human body. The combination of digital image processing with Iridology gives an excellent opportunity to explore and learn about different neuronal diseases, specifically Alzheimer’s disease. In this work, MATLAB software is applied to determine the colour, pattern and other factors that show the existence of Alzheimer’s disease. The noise in the iris image is removed by the Gaussian filter, followed by histogram analyses and cropping. The Hough circle transform is used to identify the region of interest and to convert the circular iris image into rectangle form. In the training methods, the SVM and CNN classifiers are used to classify whether the person has Alzheimer’s disease. Finally, the results are compared with the real-time images.

INTRODUCTION

Iridology is an elective research that has increased greater prevalence in recent years. It studies the alterations of the iris in correspondence with the organs of the human body (Pergad and More, 2015). Alzheimer’s disease can’t be identified in the beginning period until the individual show’s symptoms like memory loss, problem in writing and learning, difficulty in thinking and other symptoms (Thakare and Pawar, 2016). This appears when the disease has grown. So, it is hard to identify the disease in the beginning time. The combination of digital image processing with Iridology gives a great opportunity to study and learn about different neuronal diseases, specifically Alzheimer’s disease (Escudero et al., 2013). In this paper, we will be discussing the condition of the brain region through the iris. The iris picture of the patient is utilized as an input for detecting the condition of the brain region. This study allows us to analyze and observe several characteristics like color, texture, pupil range of the iris image. Using this data with MATLAB we are going to conclude whether the patient has Alzheimer’s. This whole process is performed as graphical user interface in MATLAB for easy operation. The sample steps used in graphical user interface are shown in Figure 7. The region of interest (brain region) is taken from the iridology chart as shown in Figure 1.

Methodology

Alzheimer’s can be detected in an early stage by processing iris images in MATLAB. This procedure
incorporates different steps. The iris image taken from the patient is used as an input image in MATLAB (Trokielwicz et al., 2015). Image preprocessing, image segmentation and normalization is performed on the iris image from this ROI (Region of interest) is obtained. Feature extraction is performed on the ROI and classification is done using an SVM (Support Vector Machine) and CNN (Convolutional Neural Network) classifier. The output of the classification is mean, entropy and standard deviation of the pixel values in the iris image. By comparing these values with a healthy patient, we can detect Alzheimer’s disease.

**Input Image**

The image that is used as the input system comes from the eye clinic database or real-time images of the patient. The input image is the primary procedure to recognize the brain region on the iris image (Ramlee and Ranjit, 2009). The real-time images should be photographed within highly compelled, capturing surroundings so that the iris is visible (Trokielwicz et al., 2014). The iris image can be captured with the help of the iris scanner or a high definition camera (Sarika and Madhuri, 2016). The iris scanner is a movable opening (gap), which controls the measure of light getting through the lens.
that is exposure (McGropy et al., 2017). The captured images are stored in the database along with both the normal and abnormal images of an iris. The sample image used for the process is shown in Figure 2.

**Preprocessing of Image**

In preprocessing of an image, the image is subjected to two changes that are the noise in the image is removed and image enhancement is performed. The noise is removed by using the Gaussian filter and the image enhancement is performed to improve the visibility or highlight any portion or feature of the image. These processes improve the details of the image. Histogram analyses are also performed on the iris image. This process improves the complexity of an image to acquire a uniform histogram intensity levels overall the image. The graphical user interface of image preprocessing is shown in Figure 3.

**Segmentation of Image**

Segmentation is performed to eliminate the unwanted surrounding around the iris region. So that the image is clearer and easier to understand and analyze. There are two types of segmentation required. 1. Iris segmentation 2. Pupil segmentation. The output of the segmentation is only the circular part of the eye that is the iris and the pupil (Kashani et al., 2015). The iris and pupil segmentation of sample image is shown in Figures 4 and 5.

**Normalization of Image**

Normalization converts the circular shape iris image into a rectangular shape (Xing et al., 2015). This is performed so that various sizes of irises of every patient can be changed over into standard size and shape (Shree and Sheshadri, 2014).

**Extraction of ROI**

The iris image is converted into a standard rectangle shape to identify the region of interest. The region
of interest is the brain region. The region of interest for Alzheimer's is shown in Figure 6.

 Extraction of Feature

The features and characteristics of the iris image are different for the normal iris image and abnormal iris image. So, feature extraction is performed to extract the features like mean and entropy. The graphical user interface of feature extraction is shown in Figure 8. The mean and entropy values of Alzheimer's and Non-Alzheimer's iris images are given in Table 1.

| Image | Entropy  | Mean  |
|-------|----------|-------|
| NA*   | 0.998174 | 0.102259 |
| NA*   | 0.904701 | 0.856764 |
| NA*   | 0.995424 | 0.25674 |
| A**   | 0.99611  | 0.217861 |

*Non-Alzheimer’s. **Alzheimer’s.

Classification

The classification is the last step to detect Alzheimer’s disease (Umesh et al., 2016). There are different types of classifiers available (Hernández et al., 2018). All these classifiers are appropriate for classification. We need to choose a suitable classifier among them based upon our requirement.

CONCLUSIONS

This paper provides a clinical feature analysis for the detection of Alzheimer’s disease. In this project, the abnormal image is stored in the database along with the normal iris image. The image is filtered using the Gaussian filter, the iris pattern from eye image is normalized and increased that iris pattern and extracted some characteristics like mean, variance, entropy. By comparing these values with the normal iris image values, we can conclude the presence of Alzheimer’s disease.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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