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Analysis of Various Methods for Diagnosing Alzheimer Disease and their Performances

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ABSTRACT

Alzheimer disease in humans leads to reduce the mental ability in regular life and finally causes memory loss. This disease will affect the recalling power of past incidents of memory, particularly the recently happened or learned information, and the capacity to think about a problem to find the solution and the behavior of the affected person. Initially, this disease will develop slowly, but it will become worse over the time. It will disturb the person totally from involving in daily life after several years. It reduces the cognitive skills of the person. The complications of Alzheimer disease increase mostly in older ages above 65 and they are like trouble in having the discussions with others and responding to the circumstances. It is the major disease nowadays causing death all over the world. After diagnosing the disease, the possibility of survival rate of the diseases is 5 to 8 years mostly. It is the disease which cannot be cured and the research is on the way still. This paper focuses on the various past researches on analyzing the Alzheimer Disease (AD) and to propose an effective novel technique for handling the same.

Key words: *Alzheimer Disease, Optical Coherence Tomography, Axis Method, Color Fundus, prediction and diagnosis.*

1. INTRODUCTION

As like the other parts of the human body, the brain will also degrade its performance due to aging. Degradation in the thinking ability, recalling ability and severe memory loss are the symptoms of the disease. By means of Alzheimer's progression in the brain causes bafflement, temperament and activity variations, increased misperception on the happenings and misperception on the time and location, unsubstantiated doubts on the peoples like relatives, neighbors and colleagues, etc., finally, it results in very complicated loss of memory and so that there will be difficulties in interacting with others, eating, drinking and walking also. But the diseased cannot recognize their own problems. Diagnosing Alzheimer disease in the early stages may help with increased treatment options, but not hundred percent till date. The brain consists of billions of nerve cells called neurons.

These neurons are in communication with other parts of the human body for nor functioning. The neurons were grouped into several groups for performing some special tasks like cognitive thinking, recalling and learning new things, etc., It also helps to see and recognize the objects or others, hear, taste, feel and smell in our daily life.

The neurons work as like the small industrial unit. They obtain input, produce energy, supplies to other parts of the body and get rid of waste. To do their work, brain cells work like tiny jobs. They receive the input, generate potency, and construct equipment. Then it sends out the waste. These neurons will calculate, store the information for further communication with further clusters of neurons. All these processes need very huge volume of fluid and oxygen. All these regular activities are prevented by the Alzheimer disease. A problem in the functioning of one group of brain cells will disturb other groups of brain cells from functioning. These spreads more and brings the changes in the brain, which are highly irreversible causing the death of neurons. The exact root cause of this not yet diagnosed and the researchers believe that the blocks in communication among the neurons may cause this situation.

2. NEED FOR EARLY DIAGNOSIS OF ALZHEIMER DISEASE

At present, AD is treated as the leading life threatening disease and the researchers in biomedical industry are focusing much on the analysis and prediction of AD. Many researchers are concentrating on finding the root causes and factors influencing the AD. Better understanding of the disease and its factors only can provide the way for good and useful treatments in future. Many methodologies were considered for analysis and a deep investigation is going on worldwide. This paper aims to bring the contributions of the many researchers in the field to propose a new methodology for effective diagnosis and preventions of the AD in the early stages along with the root causes.

3. REVIEW OF LITERATURE

Applied the spectral-domain coherence tomography (OCT) for analyzing the outer retinal constraints of the patients having many neurodegenerative problems [1]. The author has considered around 132 cases for evaluation and analysis having neurologic and Neuropsychology. The patients considered for evaluation were aged above 50 years, having AD and other related complications. All the patients

undergone a macular cube scan for their eyes by using the Cirrus 4000 HD-OCT. The images obtained with good quality were considered for further investigation. The parameters like ellipsoid zone mapping and outer nuclear layer metrics were examined with the support of a new software. Out of 132 considerations, 124 participants has been tested and diagnosed with the following diseases as tabulated in Table 1.

Table 1: Number of Participant's and outcome.

S. No	Disease	Number of eyes tested
1	AD dementia	**24**
2	Amnestic MCI	**22**
3	Non-Alzheimer Disease dementia	**20**
4	Parkinson's disease	**22**
5	Age and sex matched controls	**36**
Total Participant's for testing		**124**

Eight eyes were not considered because of the occurrence of macular disease and the low quality of the obtained OCT images. The average age of the participants was 65 to 68 years. The author concluded that there is not statistical significance in between the groups while examining the outer retinal thickness.

It has been presented a methodology for diagnosing the AD [2] with the help of magnetic resonance images using the spatial-component (SC) approach. First, the complete brain images are broken into smaller regions and fed as input to the Bayesian network to identify the dependencies between the affected parts of the AD. The organization of relationships among affected regions permits to perceive neurodegeneration by the probable performance of 88%. It is obtained by considering the 400 subjects and predictneurodegeneration by 80% accuracy. The author has concluded that the dependencies between the components increases the recognition of diverse patterns of brain degeneration in AD.

It is used to optical coherence tomography (OCT) among Alzheimer's disease to describe Retinal ganglion cell degeneration. In this study 21 Alzheimer's disease patients [3] with mild to moderate levels were considered. All the members undergone OCT assessment to examine peripapillary retinal nerve fiber layer (RNFL) thickness, macular volume and thickness. The further study with huge population by the author concluded that, for early diagnosis of AD, OCT has to be in clinical implementation. Bearing in mind the retinal variations in AD, the author has considered the eye as a window to the brain. Using OCT for clinical diagnosis will be in biomarker in the future. As the results obtained from the implementations belongs to the huge diversity, the further studies considering huge populations are required and a normative database for elderly population should be required for immediate assessment.

It has compared the retinal nerve fiber layer (RNFL) with the macula volume and thickness in the eyes. This assessment was carried out the elderly people having mild cognitive impairment (MCI) or AD [4]. The author has considered ninety eyes for this analysis. This contains 3 groups and they are (i) 30 normal eyes, (ii) 30 patients eyes with MCI and finally (iii) 30 AD Patient's eyes. All the eyes undergone the following tests and they are (i) ophthalmologic and cognitive inspections, and measurements of the RNFL thickness as well as macular volume and thickness with the help of OCT for all the patients. The author concluded that the RNFL thickness upon OCT was meaningfully thinner in the AD group of eyes than in the MCI group of eyes. It is found that the thickness of the RNFL in the inferior, nasal and temporal quadrants has no significant difference. But, there is a difference in the RNFL thickness among the mentioned three groups. This recommends that a variation in average RNFL thickness could be a expressive index for diagnosing the AD in the early stages.

It has examined the Choroidal thinning and its relation with AD[5]. The connection between the retina and its vasculature has been discussed by many authors, but none of them has examined the choroid in vivo. The choroidal thickness of the patients with AD is assessed by the Spectral domain optical coherence tomography (SD-OCT) and enhanced depth imaging (EDI) technique. It is also used to choose the peripapillary retinal nerve fiber layer (RNFL) and central retinal width. The author has used 42 eyes from 21 patients with the average age range of 73 having mild to moderate AD. It is found that there is a meaningful reduction in choroidal thickness when compared with the normal subjects. Choroidal thinning can be used to represent and diagnose the AD diseases which can be treated as the biomarker.

4. ANALYSIS OF VARIOUS IMAGING METHODS

4.1 Retina and its Image for Analyzing AD

For better understanding of the AD, it is necessary to visualize the complete structure of the retina and also its functions of the retina. This is been developed well with the development of the latest imaging methods. The new imaging methods are supporting the medical professionals and their researchers for the early detection and analysis of the AD. Some of those techniques were analyzed in this review.

4.2 Retinal Photography (RP)

It is described the standard imaging method called Retinal Photography for analyzing the retina and its structure [6]. It is usually carried out in eye clinics. It is used to identify the three kinds of retinal vascular symptoms and they are (a) retinal reteriolar symptoms, (b) variations in retinal vascular caliber and variations in internal patterns of the retina.

4.3 Optical Coherence Tomography (OCT)

SD-OCT techniques are 50 fifty to 100 times faster than the traditional systems. It can analyze the essential amount of tissues for OCT from a single eye within eight minutes. The drawbacks are reduction in sensitivity and the quality of the image if the penetration depth is above 2 millimeter. In these situations, these techniques would yield the images not suitable across the depth of the eye. It can also be used to generate the mirror image at the zero delay position [7]. It is a noninvasive method yielding very high quality images of retina. The light with low-coherence is used to capture the high quality resolution images in 2D or 3D forms. It is mostly used for capturing medical images and industrial

nondestructive testing. It is also used to examine the structural changes in the retina like peripapillary RNFL and macular width.

4.4CONFOCAL SCANNING LASER Ophthalmoscopy (cSLO)

It is an imaging method which permits the reconstruction of 3 dimensional structures with improved resolution and contrast [8]. It leads to major decrease in the RNFL, neuro-retinal border, and increased vertical cup-to-disk in Alzheimer disease patients.

4.5 Retinal Oximetry

Retinal oximetry is a spectrophotometric fundus imaging system used to estimate the O_2 level in the plasma vessels of retina in a no offensive way. It is a fast and safe method. Even there are many similar systems available, they are differ slightly with each other in the way of construction. It consists of a fundus camera which is attached to the image splitter. The splitter consists of mirrors which splits the beam emerging from camera into smaller ones based on the light wavelength and also filters the beam for further process. [10].

4.6 Doppler OCT

Doppler Oct is a type of OCT enhancement. It focuses mainly on shows and countable the flow of plasma in vivo [9]. Major decrease in the flow rate of the retinal plasma and thinning of the blood vessel of retina have been diagnosed using the Doppler OCT from the AD patients.

4.7 Detection of Apoptotic Retinal Cells (DARC)

Identification of apoptotic cells in retinal is a new imaging method which can be used ot observe RGC apoptosis [11]. Even RGCs cannot be visualized in real time without a marker, it has been verified that DARC is a very helpful tool to recognize the RGC apoptosis in vivo.

5. CONCLUSION

Errors After analyzing the different techniques for handling AD, this paper proposes an effective technique for diagnosing and predicting the AD. Out of the discussed methods, the Spectral-Domain Optical Coherence Tomography (SD-OCT) can be used for diagnosing and treatment of the AD. This method can be used to analyze the inner layer in the images of the retina. This method can be applied to extract retinal layer segments from color retina images using chromatography processes. The other technique that has to be enhanced is modeling of color fundus images into axis to determine the progress of neurological degradations. This approach segments the retinal images for grading, monitoring and diagnosing Alzheimer’s disease. These methods are highly useful in detecting the symptoms and also can support for the evaluation of treatments and its outcome. It is concluded that the further researchers can be extended on applying the Spectral-Domain Optical Coherence Tomography (SD-OCT) and modeling of color fundus images into axis for the deeper understanding, diagnosing and prediction of the AD.

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