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# Deep Learning Neural Network for Alzheimer's Disease Predictions

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**Abstract**

Alzheimer's disease is a dangerous and progressive disease that affects the nervous system and brain of people. An important and effective approach to treating Alzheimer's disease is to diagnose the disease early so that more effective treatments can be offered. One practical way to diagnose Alzheimer's disease is to use magnetic resonance imaging to detect plaque and affected areas. In this paper, a new method based on the Harris Hawks optimization method is presented for Alzheimer's disease diagnosis. This method uses the best features that obtain from the MRI images and uses it in deep learning to classify the healthy and non-healthy images.

*Keywords:* Deep Learning, Harris Hawks, Neural Network, Alzheimer's Disease Predictions.

## 1. Introduction

Although CT scans are still used regularly for diagnostic assessments and to study the relationship between the brain and behavior, they are mainly used when MRI is prohibited; Because MRI is currently the method of choice for evaluating neurodegenerative diseases. Patients with cognitive impairment can be detected up to 3 years before the onset of clinical symptoms, compared with controls. In patients with Alzheimer's, hippocampal atrophy (reduction of 10-50% (amygdala), reduction of up to 40% (and Para hippocampus) to 40% (compared to the control group in terms of age, homogenization was reported. There is convincing evidence that atrophy of the internal structures of the temporal lobe, especially the hippocampus and entorhinal cortex, early in the course of the disease and even before the onset of symptoms It occurs clinically (Soininen et al., 1982)(Tartaglia et al., 2011). In structural MRI, entorhinal cortical atrophy is now seen in MCI. By the time the mild symptoms of the disease appear, the volume of the hippocampus may have decreased by more than 25%. Hippocampal volume is associated with the severity of clinical signs and symptoms of memory loss, the patient's score on cognitive evaluation tests and pathological findings (Soininen et al., 1982). However, another group believes that there is no clear association between lesions in the course of dementia, including lesions of hyperexcitability of white matter on MRI, and the severity of symptoms of cognitive impairment after adjustment for age.

## 2. Literature review

According to the figure 1, it can be seen that there are damaged areas and plaques of Alzheimer's disease in the end areas of nerve cells, which interfere with the transmission of messages between cells.

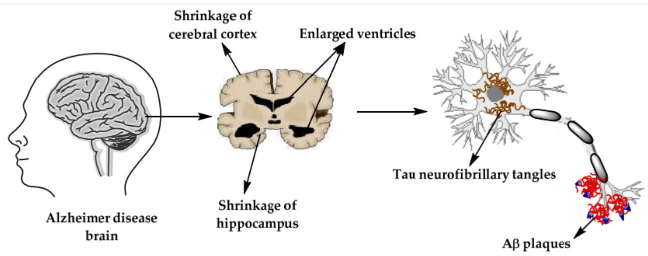


**Fig. 1.** The structure of the brain and nerve cells of an Alzheimer's patient (Breijyeh & Karaman, 2020)

One of the most important methods in diagnosing Alzheimer's disease is the use of brain imaging techniques. One of the most important methods in brain tissue analysis is the use of magnetic resonance imaging of the brain, which uses a magnetic field to image brain tissue. In this method, the effect

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of the magnetic field of the brain and the external magnetic field is investigated and based on the intensification of protons in the tissues of the tissues, images of brain tissues can be created.

In figure 1, the damaged areas of brain tissue due to diseases such as Alzheimer's are shown in magnetic resonance imaging of the brain and are distinguished by an axial area with yellow lines. One way to diagnose diseases such as Alzheimer's and Alzheimer's disease plaques with magnetic resonance imaging of the brain is to use methods such as image processing and methods such as machine learning and deep learning. In order to be able to identify plaques of Alzheimer's patients in magnetic resonance imaging of the brain, zoning methods are needed in the images. Zoning methods are an attempt to separate different types of brain tissue and try to isolate damaged areas of brain tissue from healthy areas. According to the figure 1, it is observed that first the magnetic resonance images of the brain are considered as input and then the images are pre-processed such as normalization. In the third phase, the image zoning is done normally and finally the important features of the image are extracted. So far, several methods have been proposed to diagnose Alzheimer's disease using image processing and data analysis methods, and most studies have been performed using in-depth learning because these methods have high accuracy in data analysis. Some sources, such as (Day et al., 2022), use data collected over a period of time to diagnose Alzheimer's disease in patients, but these methods are prone because they use most statistical and non-visual data. On the other hand, the statistical population of these methods is limited and Alzheimer's disease can be misdiagnosed with other diseases. In some studies, such as research (Salehi et al., 2020), a combined method based on deep learning and machine learning has been used to diagnose Alzheimer's disease.

Experiments, on the other hand, show that Kapoor entropy is more accurate for the multi-level threshold of the color image. In the study (Shanker & Bhattacharya, 2020) in 2020, they introduced a computer-aided automation system for classifying MR images using texture features and gravitational search algorithms. Nowadays, segmenting and classifying magnetic resonance imaging images of the brain is an important and challenging task for radiologists, and conventional methods for analyzing brain images are time-consuming and inaccurate in decision making. Therefore, to overcome these limitations, a computer-aided automation detection system has been proposed for accurate classification of normal and abnormal brain MR images. The proposed system has the ability to assist radiologists in detecting abnormalities in brain MR images in the early stages of the abnormality. In this study, to improve the quality of images before segmentation, histogram adjustment with limited contrast has been used. The division of the region of interest is obtained using the Otsu multi-level threshold algorithm. In addition, the proposed system selects the most important and relevant features from the contextual and multimedia features. Multi-solution properties are extracted using discrete wavelet transform, fixed wavelet transform and fast discrete curve conversion. In addition, a binary and local pattern is used to extract texture properties from images. These features are used to classify brain MR images using a nutritional neural network classifier in which various meta-heuristic optimization algorithms such as genetic algorithm, particle optimization, gravitational search algorithm and gravitational search algorithm are improved. Error reduction used.

## 3. Methodology

In this paper, a new method based on Harris hawk's optimization method is used to feature the selection of the Alzheimer's MRI image. This algorithm is inspired by nature and it uses the behavior of this bird. There are some behaviors of this bird that use to find the best-optimized value. In slow siege behavior, the fast jumps of each eagle slowly fly around the prey and move towards the prey at a suitable opportunity. It moves slowly towards the prey. In eagle optimization algorithms, each eagle can make decisions according to the gathering center of other eagles and determine their center of gravity. The desired behavior for moving an eagle with the help of the mean point can be seen in Figure 2, in which each eagle uses the average population position and its optimal position to approach the prey:

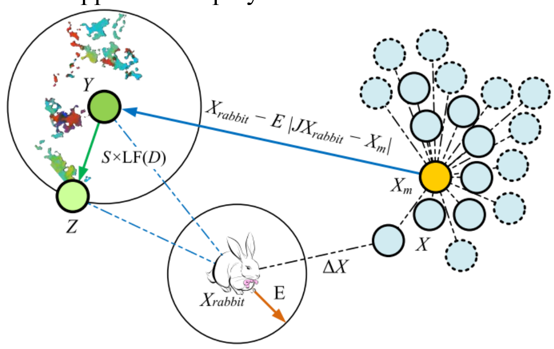


Figure 2: Fast dive behavior with the help of a spot point in the Eagle optimization algorithm

By repeating the eagle optimization algorithm consecutively, the position of the eagles and the rabbit or the current optimal answer is constantly updated, and finally, in the last iteration, the prey position is extracted as the optimal answer. Studies and experiments show that their proposed algorithm is more accurate than genetic algorithm, particle optimization algorithm, glow worm algorithm, bat algorithm, biogeography algorithm, cuckoo search and differential evolution.

An example of the inputs considered in this study is the following data shown in Figure 3 and Figure 4 in the DICOM VIEWER environment.


Figure 3. Data selection in the DICOM VIEWER environment

Figure 4. View of data in DICOM VIEWER environment

The simulation will be performed in MATLAB version 2021b and will be performed in a system with 7-core processor specifications with 6 MB of cache and 3.6 MHz and 8 GB of memory in Windows 10. When the simulation is performed, all OASIS-3 data are trained and tested using the proposed method. For visualization, a sample of images is shown to examine the results of the proposed approach step by step. First, an input image like Figure 5 is given to the system.

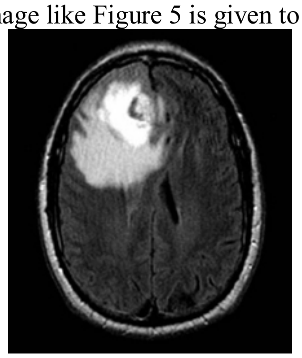

Figure 5. Input image

It is necessary to first make an initial noise reduction in all OASIS-3 data images, using a middle filter in which the image is read in rows, columns and diagonally without any repetition to reduce noise. The schematic of this output is shown in Figure 6.

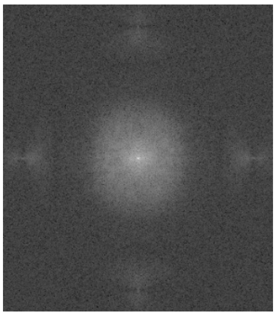

Figure 6. Application of noise reduction algorithm with middle filter in linear, columnar and diagonal without repetition

## 4. Conclusion

The main issue of this research is how to use magnetic resonance imaging to accurately identify the affected areas of Alzheimer's disease. The issue can be considered from two aspects. The first aspect of the problem is the nature of the classification and it must be determined which image has the symptoms of Alzheimer's disease and which image does not have the symptoms of Alzheimer's disease.

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