International Journal of Academic Health and Medical Research (IJAHMR)
ISSN: 2643-9824
Vol. 5 Issue 4, April - 2021, Pages: 17-21

Classification of Alzheimer's Disease Using Traditional Classifiers with Pre-Trained CNN

Husam R. Almadhoun and Samy S. Abu-Naser

Department of Information Technology,
Faculty of Engineering and Infromation Technology,
Al-Azhar University, Gaza, Palestine

Abstract*: Alzheimer's disease (AD) is one of the most common types of dementia. Symptoms appear gradually and end with severe brain damage. People with Alzheimer's disease lose the abilities of knowledge, memory, language and learning. Recently, the classification and diagnosis of diseases using deep learning has emerged as an active topic covering a wide range of applications. This paper proposes examining abnormalities in brain structures and detecting cases of Alzheimer's disease especially in the early stages, using features derived from medical images. The entire brain image was passed on through the transmission of Xception learning architectures. The Convolutional Neural Network (CNN) was constructed with the help of separable convolution layers that It can automatically learn general features from imaging data for classification.*

Keywords: Alzheimer's disease; Dementia disease; super-resolution; Deep learning.

I. INTRODUCTION

Alzheimer's disease is one of the most common types of dementia. Symptoms appear gradually and end with severe brain damage as a result of nerve cell death. persons with Alzheimer's disease loses the abilities of knowledge, memory, language and learning.

Alzheimer's symptoms increase over months, or years. If it develops within hours or days, a person may need medical attention, as this could indicate a stroke.

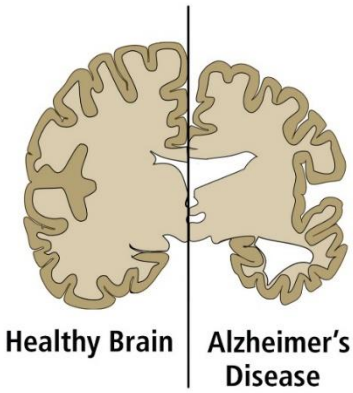

Figure 1: healthy brain vs alzheimer's disease

Contributing Factors

- Age symptoms first appear after the age of 60.
- Family history : Genetics play a role in an individual's risk of developing the disease.
- Head trauma: There is a relationship between the disease and repeated trauma or loss of consciousness.
- Heart health : The risk of developing vascular dementia increases with heart diseases such as high blood pressure, high cholesterol and diabetes.

Symptoms of Alzheimer's disease include:

- Memory loss.
- Cognitive deficits.
- Problems with recognition.
- Problems with spatial awareness.
- Problems with speaking, reading, or writing.

- Personality or behavior changes.

Stages of Alzheimer's Disease :

Each stage of the disease reduces the patient's cognitive function, and the stages may overlap with each other, and the condition may worsen.

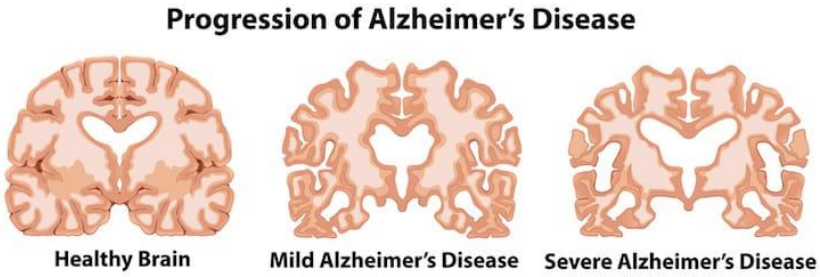

Figure 2: The Stages of Alzheimer's

Stage 1: Normal Adult

There is no apparent impairment of memory.

Stage 2: Normal Older Adult

A person feels a decline in consciousness, and becomes more forgetful of people's names and personal items such as keys and a wallet.

Stage 3: Early Alzheimer's Disease

The person at this stage has difficulty concentrating and retaining information, confusion, and may falter in speech.

Stage 4: Mild Alzheimer's Disease

In addition to the previous symptoms, the patient's condition develops with Alzheimer's disease, and others notice the patient's condition, such as the inability to perform common tasks, eat dinner, pay bills, and manage finances.

Stage 5: Moderate Alzheimer's Disease

The patient's condition deteriorates to the point that he cannot work alone, such as not being able to choose the right clothes.

Stage 6: Moderately Severe Alzheimer's Disease

The condition of the Alzheimer's patient deteriorates dramatically, as a person may not be able to distinguish familiar people.

Stage 7: Severe Alzheimer's Disease

In the final stage of Alzheimer's disease, a person with Alzheimer's disease experiences a gradual loss of basic physical abilities, the ability to communicate verbally, muscles become stiff due to lack of use. There is a disturbance in a person's circadian rhythm, which can disturb sleep patterns and contribute to confusion and fatigue.

Deep learning architecture and convolutional neural networks have become a major trend in computer-aided medical image analysis. The aim of this paper is to use pre-trained CNNs to classify histopathology images. For four cases of Alzheimer's disease, Moderate, Very naughty, Not imbecile.

The pre-trained model contains a large dataset with weights and biases that represent features of a trained dataset. These acquired features are transferable to various data.

Pre-trained CNNs were trained on Xception to extract features from MRI images. And use it by machine learning methods.

2. LITERATURE REVIEW

Deep learning has gained a reputation for solving problems [1-57] in various agricultural, industrial and medical fields including medical image analysis.

Diagnosing Alzheimer's disease is very difficult and requires highly differentiated representation of the classification due to similar brain patterns and pixel density.

III. MATERIAL AND METODS

The pre-trained model contains a large dataset with weights and biases that represent features of a trained dataset. These acquired features are transferable to various data.

Pre-trained CNNs were trained on Xception to extract features from MRI images. And use it by machine learning methods.

The Xception model is a deep learning neural network model that takes its inspiration from Inception.[9] With a modified depth wise separable convolution layers. The Xception architecture consists of 36 convolutional layers forming the feature extraction base of the network and each of them is organized into 14 modules, all containing residual linear connections about them, except for the first and last units, which make up the feature extraction rule for the network.

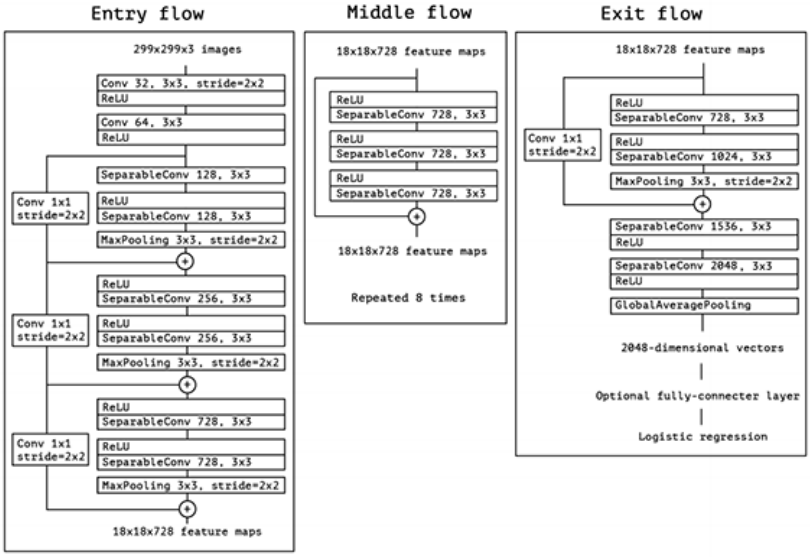

Figure 3: The arcitecture of Xception model

V. EXPERIMENTS AND RESULTS

A. Dataset

MRI files dataset, the data contains four categories of images in a total of 5,000 images divided into four categories (Mild Demented, Very Mild Demented, Non Demented, Moderate Demeneted) both in the training and in the test set.

The images in the dataset have been pre-processed in size of 200 (W) * 200 (H) * 3 (color channel).

B. Evaluation of proposed solution

The training model is used to find out the accuracy and loss after 20 epochs, and it has 5,000 steps per epoch for the 5000 images for zheimer's disease Classification dataset data set.

For the evaluation of results on datase, we computed the following performance metrics F1-score.

$$F_1\text{-score} = \frac{2TP}{2TP+FP+FN}$$

F1 score is the harmonic mean of accuracy and sensitivity. The ideal value for this scale is 1, which is the goal in studying this model. We define true positivity (TP) as the score for which the model correctly predicted the subject category for Alzheimer's disease.

A false positive (FP) also called a type 1 error occurs when The model incorrectly predicts an instance of a non-Alzheimer's class to be an equivalent class of Alzheimer's disease. A false negative (FN) error, also called a type 2 error, occurs when the model incorrectly predicts an instance of Alzheimer's class to be an equivalent of a class other than Alzheimer's. Finally, the true negative (TN) occurs when the model predicts an instance of a class not properly afflicted with Alzheimer's disease.

Here are the results we have got after doing 20 epochs (as shown in table1 and figures 4 and 5):

Model	F1-Accuracy		F1-Loss	
Name	Training	Validation	Training	Validation
Xception	99.98%	99.83%	0.0109	0.0130

Table1: Training and validation Accuracy and Loss

From this figure 4 and 5, the results training and validation is very high.

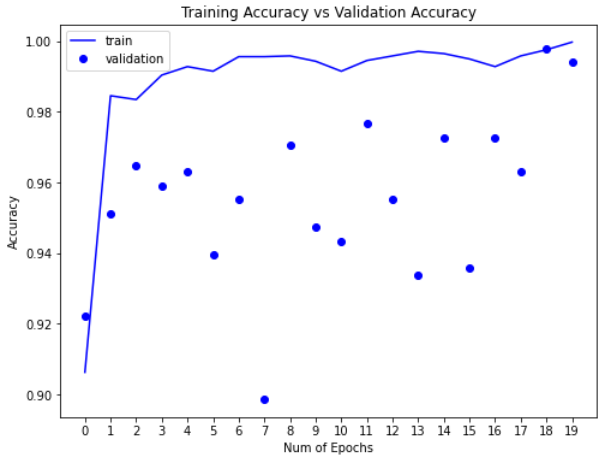

Figure 4 : Training and validation accuracy

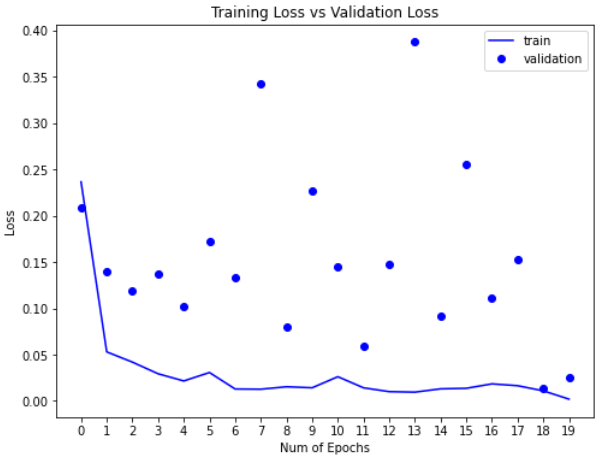

Figure 5: Training and validation loss

C. Performance of the model:

We tested our proposed model using the un-seen dataset (test dataset). We had 1279 images kept aside for testing (i.e. the proposed model did not see the images during trading and validation) our proposed model. The F-1 measure accuracy we achieved as in table 2.

Table2: Accuracy of testing the proposed model

Model	Testing Accuracy
Xception	97.74%

V. CONCLUSION

In this work, we proposed CNN model built with separable convolutional layers with transfer learning architectures Xception that are pretrained using the imagenet dataset.

The proposed technique results in a predictive accuracy of 97.74 %, which is a marked increase in accuracy compared to previous studies and clearly reveals the effectiveness of the proposed method.

References

1. Health Line Website https://www.healthline.com/nutrition/foods/bell-peppers#nutrition, date visited December 25, 2020.
2. The spruce eats Website https://www.thespruceeats.com/types-of-sweet-peppers-4067589, date visited December 25, 2020.
3. Investopedia Website https://www.investopedia.com/terms/d/deep-learning.asp, date visited December 25, 2020.
4. Abu Nada, A. M., et al. (2020). "Age and Gender Prediction and Validation Through Single User Images Using CNN." International Journal of Academic Engineering Research (IJAER) 4(8): 21-24.
5. Abu Nada, A. M., et al. (2020). "Arabic Text Summarization Using AraBERT Model Using Extractive Text Summarization Approach." International Journal of Academic Information Systems Research (IJAISR) 4(8): 6-9.
6. Abu-Saqer, M. M., et al. (2020). "Type of Grapefruit Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 4(1): 1-5.
7. Afana, M., et al. (2018). "Artificial Neural Network for Forecasting Car Mileage per Gallon in the City." International Journal of Advanced Science and Technology 124: 51-59.
8. Al Barsh, Y. I., et al. (2020). "MPG Prediction Using Artificial Neural Network." International Journal of Academic Information Systems Research (IJAISR) 4(11): 7-16.
9. Chollet, F.: Xception: Deep Learning With Depthwise Separable Convolutions. In: CVPR. pp. 1251–1258 (2017), http://openaccess.thecvf.com/content_cvpr_2017/html/Chollet_Xception_Deep_Learning_CVPR_2017_paper.html 4
10. Al Barsh, Y. I., et al. (2020). "MPG Prediction Using Artificial Neural Network." International Journal of Academic Information Systems Research (IJAISR) 4(11): 7-16.
11. Alajrami, E., et al. (2019). "Blood Donation Prediction using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(10): 1-7.
12. Alajrami, E., et al. (2020). "Handwritten Signature Verification using Deep Learning." International Journal of Academic Multidisciplinary Research (IJAMR) 3(12): 39-44.
13. Al-Araj, R. S. A., et al. (2020). "Classification of Animal Species Using Neural Network." International Journal of Academic Engineering Research (IJAER) 4(10): 23-31.
14. Al-Atrash, Y. E., et al. (2020). "Modeling Cognitive Development of the Balance Scale Task Using ANN." International Journal of Academic Information Systems Research (IJAISR) 4(9): 74-81.
15. Alghoul, A., et al. (2018). "Email Classification Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 2(11): 8-14.
16. Al-Kahlout, M. M., et al. (2020). "Neural Network Approach to Predict Forest Fires using Meteorological Data." International Journal of Academic Engineering Research (IJAER) 4(9): 68-72.
17. Alkronz, E. S., et al. (2019). "Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network." International Journal of Academic and Applied Research (IJAAR) 3(2): 1-8.
18. Al-Madhoun, O. S. E.-D., et al. (2020). "Low Birth Weight Prediction Using JNN." International Journal of Academic Health and Medical Research (IJAHMR) 4(11): 8-14.
19. Al-Massri, R., et al. (2018). "Classification Prediction of SBRCTs Cancers Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 2(11): 1-7.
20. Al-Mobayed, A. A., et al. (2020). "Artificial Neural Network for Predicting Car Performance Using JNN." International Journal of Engineering and Information Systems (IJEAIS) 4(9): 139-145.
21. Al-Mubayyed, O. M., et al. (2019). "Predicting Overall Car Performance Using Artificial Neural Network." International Journal of Academic and Applied Research (IJAAR) 3(1): 1-5.
22. Alshawwa, I. A., et al. (2020). "Analyzing Types of Cherry Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 4(1): 1-5.
23. Al-Shawwa, M., et al. (2018). "Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(9): 1-6.
24. Ashqar, B. A., et al. (2019). "Plant Seedlings Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 3(1): 7-14.
25. Bakr, M. A. H. A., et al. (2020). "Breast Cancer Prediction using JNN." International Journal of Academic Information Systems Research (IJAISR) 4(10): 1-8.
26. Barhoom, A. M., et al. (2019). "Predicting Titanic Survivors using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(9): 8-12.
27. Belbeisi, H. Z., et al. (2020). "Effect of Oxygen Consumption of Thylakoid Membranes (Chloroplasts) From Spinach after Inhibition Using JNN." International Journal of Academic Health and Medical Research (IJAHMR) 4(11): 1-7.
28. Dalffa, M. A., et al. (2019). "Tic-Tac-Toe Learning Using Artificial Neural Networks." International Journal of Engineering and Information Systems (IJEAIS) 3(2): 9-19.
29. Dawood, K. J., et al. (2020). "Artificial Neural Network for Mushroom Prediction." International Journal of Academic Information Systems Research (IJAISR) 4(10): 9-17.
30. Dheir, I. M., et al. (2020). "Classifying Nuts Types Using Convolutional Neural Network." International Journal of Academic Information Systems Research (IJAISR) 3(12): 12-18.
31. El-Khatib, M. J., et al. (2019). "Glass Classification Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 3(2): 25-31.
32. El-Mahelawi, J. K., et al. (2020). "Tumor Classification Using Artificial Neural Networks." International Journal of Academic Engineering Research (IJAER) 4(11): 8-15.
33. El-Mashharawi, H. Q., et al. (2020). "Grape Type Classification Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 3(12): 41-45.
34. Elzamly, A., et al. (2015). "Classification of Software Risks with Discriminant Analysis Techniques in Software planning Development Process." International Journal of Advanced Science and Technology 81: 35-48.
35. Elzamly, A., et al. (2015). "Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis: Statistical Methods." Int. J. Adv. Inf. Sci. Technol 38(38): 108-115.
36. Elzamly, A., et al. (2017). "Predicting Critical Cloud Computing Security Issues using Artificial Neural Network (ANNs) Algorithms in Banking Organizations." International Journal of Information Technology and Electrical Engineering 6(2): 40-45.
37. Habib, N. S., et al. (2020). "Presence of Amphibian Species Prediction Using Features Obtained from GIS and Satellite Images." International Journal of Academic and Applied Research (IJAAR) 4(11): 13-22.
38. Harz, H. H., et al. (2020). "Artificial Neural Network for Predicting Diabetes Using JNN." International Journal of Academic Engineering Research (IJAER) 4(10): 14-22.
39. Hassanein, R. A. A., et al. (2020). "Artificial Neural Network for Predicting Workplace Absenteeism." International Journal of Academic Engineering Research (IJAER) 4(9): 62-67.
40. Heriz, H. H., et al. (2018). "English Alphabet Prediction Using Artificial Neural Networks." International Journal of Academic Pedagogical Research (IJAPR) 2(11): 8-14.
41. Jaber, A. S., et al. (2020). "Evolving Efficient Classification Patterns in Lymphography Using EasyNN." International Journal of Academic Information Systems Research (IJAISR) 4(9): 66-73.
42. Kashf, D. W. A., et al. (2018). "Predicting DNA Lung Cancer using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(10): 6-13.
43. Khalil, A. J., et al. (2019). "Energy Efficiency Predicting using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 3(9): 1-8.
44. Kweik, O. M. A., et al. (2020). "Artificial Neural Network for Lung Cancer Detection." International Journal of Academic Engineering Research (IJAER) 4(11): 1-7.
45. Maghari, A. M., et al. (2020). "Books' Rating Prediction Using Just Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 4(10): 17-22.
46. Mettleq, A. S. A., et al. (2020). "Mango Classification Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 3(12): 22-29.
47. Metwally, N. F., et al. (2018). "Diagnosis of Hepatitis Virus Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(11): 1-7.
48. Mohammed, G. R., et al. (2020). "Predicting the Age of Abalone from Physical Measurements Using Artificial Neural Network." International Journal of Academic and Applied Research (IJAAR) 4(11): 7-12.
49. Musleh, M. M., et al. (2019). "Predicting Liver Patients using Artificial Neural Network." International Journal of Academic Information Systems Research (IJAISR) 3(10): 1-11.
50. Oriban, A. J. A., et al. (2020). "Antibiotic Susceptibility Prediction Using JNN." International Journal of Academic Information Systems Research (IJAISR) 4(11): 1-6.
51. Qwaider, S. R., et al. (2020). "Artificial Neural Network Prediction of the Academic Warning of Students in the Faculty of Engineering and Information Technology in Al-Azhar University-Gaza." International Journal of Academic Information Systems Research (IJAISR) 4(8): 16-22.
52. Sadek, R. M., et al. (2019). "Parkinson's Disease Prediction Using Artificial Neural Network."International Journal of Academic Health and Medical Research (IJAHMR) 3(1): 1-8.
53. Salah, M., et al. (2018). "Predicting Medical Expenses Using Artificial Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 2(20): 11-17. 54. Salman, F. M., et al. (2020). "COVID-19 Detection using Artificial Intelligence." International Journal of Academic Engineering Research (IJAER) 4(3): 18-25.
54. Samra, M. N. A., et al. (2020). "ANN Model for Predicting Protein Localization Sites in Cells." International Journal of Academic and Applied Research (IJAAR) 4(9): 43-50.
55. Shawarib, M. Z. A., et al. (2020). "Breast Cancer Diagnosis and Survival Prediction Using JNN."International Journal of Engineering and Information Systems (IJEAIS) 4(10): 23-30.
56. Zaqout, I., et al. (2015). "Predicting Student Performance Using Artificial Neural Network: in the Faculty of Engineering and Information Technology." International Journal of Hybrid Information Technology 8(2): 221-228