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EARLIER DETECTION OF ALZHEIMER'S DISEASE USING IMAGE PROCESSING AND MACHINE LEARNING ALGORITHMS WITH GRAPH THEORY

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Abstract— Alzheimer's disease is one of the brain disease which is irreversible, progressive brain disorder that slowly destroys memory and thinking skills and, eventually, the ability to carry out the simplest tasks. There is no cure for Alzheimer's disease but we prevent it's by early detection. In existing work, limited with Alzheimer's are irreversible, effect on daily activities, high memory loss and reducing the size of brain, etc. previous works focused on 2D and 3D formats now we considering 4D images. In proposed work, this work aims to present an automated method that assists in the diagnosis of Alzheimer's disease supports the monitoring of the progression of the disease. The study of brain network based on resting-state functional Magnetic Resonance Imaging (fMRI) has provided promising results to investigate changes in connectivity among different brain regions because of diseases. Graph theory can efficiently characterize various aspects of the brain network by calculating measures the accuracy of different machine learning methods and different features to classify Cognitively Normal (C.N) individuals from Alzheimer's Disease (A.D) and to predict longitudinal outcomes in participants with Mild Cognitive Impairment (MCI).
Keywords— Alzheimer's Disease (A.D), Cognitively Normal (C.N), functional Magnetic Resonance Imaging (fMRI), NeuroImaging Informatics Technology Initiative(N.I.F.T.I), Digital Imaging and Communications in Medicine (D.I.C.O.M).

I. Introduction

Alzheimer's disease is one of more advanced stage of death rate disease in india and it is an irreversible, progressive neurological brain disorder which can be multifaceted disease that slowly break downs the brain cells, which may causes memory loss and thinking capability skill losses, and even though simply tasks might not be possible to remember. This is known as dementia. This disease grows progressively worse in situation neurodegenerative type of dementia which can't be diagnose this type of disease in medical assessment medical assessment and which contains patient history MMSE and physical and neurobiological examination needed. To exam The MRI table and scanning of both structural and hippocampus and cerebral context and enlargement of different stages of disease can be identified.

II. RELATED WORK

A. Alzheimer's Disease Detection using CNN

In this paper, CNN is trained using 2,850 images, with 2 varieties like Alzheimer's and cognitively having 2 classes. Different types of models were trained, of which the best model provided 95.53% accuracy in correct identification. CNN was used to train 54306 images of 2 types, with Alzheimer's diseases and healthy samples. The success rate of 95.35% reduced to 31.4% when tested on another dataset collected from real life scenario. In the problem of disease severity and the reason for it being more challenging than disease classification is discussed.

B. Alzheimer's Disease Detection using CNN

Convolutional neural network classifier is used on a dataset of 2,850 fMRI images, diseased and healthy brain images. The classifier is transfer learning based using CovNet. Training the above architecture an accuracy of 91.23% is achieved but it can only predict whether plant is diseased or not. the authors collected 500 images of 2 different diseases. They developed an architecture inspired by Le-Net and CovNet and achieved 95.48% on the test set.

C. Alzheimer's Disease Detection using CNN

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III. BRAIN IMAGING TECHNIQUES FOR ALZHEIMER'S DISEASE (AD)

Brain imaging techniques are used to non-invasively visualize the structure, function, or pharmacology of the brains. The imaging techniques are divided into two categories: structural imaging and functional imaging. Structural imaging provides details about the brain's structure, including neurons, synapses, glial cells, etc. Functional imaging provides information about the activities

DATA TYPES

There are different types of formats the fMRI data is acquired. One is a D.I.C.O.M. format which is used for a long time. Later a new initiative was taken to create a 4D image dataset where D.I.C.O.M. is 3D format this format is known as N.I.F.T.I. format.

N.I.F.T.I.: N.I.F.T.I. (Neuro Imaging Informatics Technology Initiative) is a tool designed to perform quantitative analysis and visualization of neurofunctional

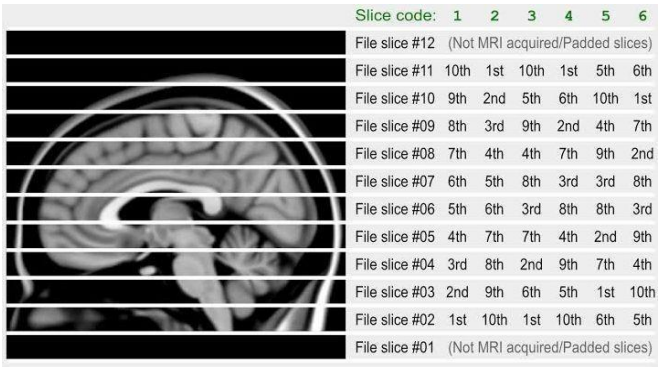

Fig 2: Nifti Format

Magnetic resonance image (fMRI) data sets. .I.F.T.I.'N.I.F.T.I.'s development will offer a robust and flexible system of essential functions integrated into an interactive, graphically- oriented program, allowing neuroscientists how to process, visualize, and interpret their data. Anisotropic diffusion routines can be used to increase the signal-to-noise-ratio of these images.

D.I.C.O.M.: Digital Imaging and Communications in Medicine is a standard of medical images, and it usually severs to the output file format of A.M.I. scanners.

D.I.C.O.M. generally stores each slice as a separate file, these files are conventionally named using numbers reflecting the slice number. Instead of separating raw image and metadata into two files, D.I.C.O.M. format keeps them together in one file, and the extraction of header information is possible by special software.

PRE-PROCESSING:

Pre-processing is a data mining technique that transformation of raw data into an understandable and workable format. It includes removal of unnecessary components and alterations in the image.

WHY PREPROCESSING?

Pre-processing of functional resonance imaging (fMRI) data is vital to get rid of unwanted artifacts and transform the info into standard format. Many neuroimaging data processing tools are widely used, such as S.P.M, A.F.N.I, F.S.L and FreeSurfer. Image pre-processing and have extraction techniques are mandatory for any image classification based applications. The importance of such approaches is highlighted in the context of Magnetic Resonance (M.R.) brain image classification and segmentation. Pre-processing techniques are developed to remove the skull portion surrounding the brain tissues like hair and skin.

B.E.T

Brain Extract Tool used a deformable a model for the input data, which fit the brain's surface by the application of a set of locally adaptive model force. In B.E.T method is used for extracting brain data.

FEAT

FEAT is a software tool for high quality model based fMRI data analysis, with an easy-to-use graphical user interface (G.U.I). FEAT is part of F.S.L. FEAT automates process as many of the analysis decision as possible.

MCFLIRT

MCFLIRT is an intra modal motion correction tool designed to be used on fMRI statistic and supported optimization and registration techniques utilized in FLIRT, a totally automated robust and accurate tool for linear inter and inter-modal brain image registration.

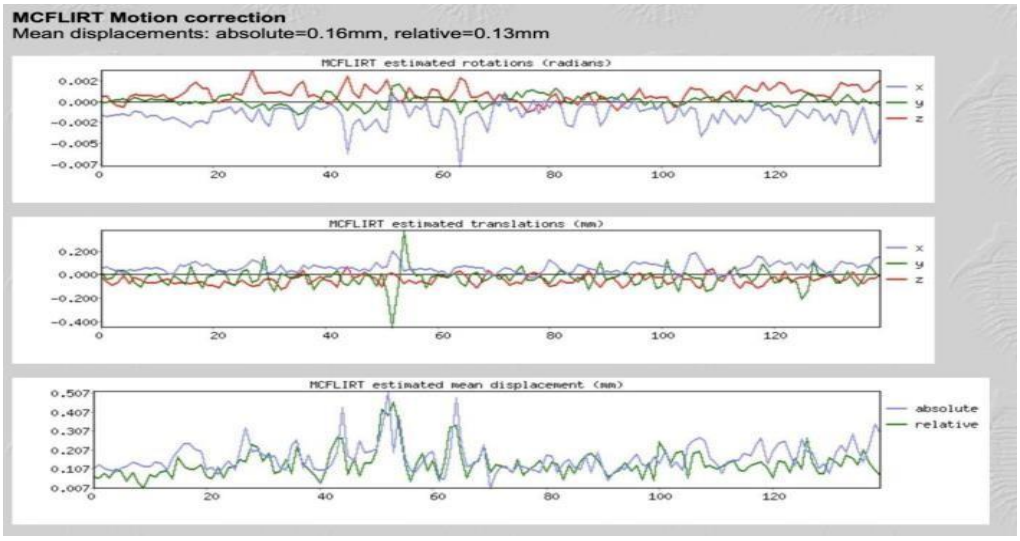

Fig 3: MCFLIRT Analysis

IV. IMPLEMENTATION

A. Experimental Setup

The experiment was performed on a Linux PC equipped with GPU card P4000, 64-bit Operating System. The CNN-based model was implemented within the Keras 2.2.4 deep learning framework with TensorFlow 1.13.1 backend and python 3.7.2.

B. Image Acquisition

The images are collected from the ADNI and LONI Datacenters, these images are categories into 2 types Alzheimer's Disease (A.D) and Cognitively Normal (C.N) images.

C. CNN Model Training

The image dataset is loaded for training and testing. The class labels and therefore the corresponding images are stored in respective arrays for training. 70 percent of data is used for training and 30 percent of data is used for testing using the train test split function. The 70 percent data is further split and 20% of it is used for validation. The class labels are encoded as integers then , one-hot encoding is performed on these labels making each label represented as a vector instead of an integer. Next, the CovNet model is loaded from Keras, and the last fully connected layers are removed. The remaining layers are made non-trainable. We have flattened the output of the feature extractor part, followed by a fully connected layer and an output layer with softmax. Then we have compiled our model using the Adam optimizer with categorical cross-entropy as the loss function for classification. We have stopped at 25 epochs after this the results were stable.

D. Justification for the Chosen Model

Transfer learning refers to things where what has been learned in one setting is exploited to enhance generalization in another setting. Transfer learning has the advantage of decreasing the training time for a neural network model and thus is extremely useful since most real-world problems typically don't have millions of labeled data points to coach such complex models. Usually, a lot of data is required to train a neural network from the scratch but access to that data is not always available. With transfer learning, a solid machine learning model are often built comparatively, but training little data are going to be easy because the model is already pre-trained. Hence we have used the pre-trained CovNet and fined tuned it to classify using our own small dataset.

V. RESULTS

Various technologies like Python, Jupyter Notebook, FSL, FSL Eye viewer. We went through various preprocessing methods and studied documentations of various tools for preprocessing and accomplished it. Our work helps in early detection of Alzheimer's disease on an early onset which has no cure but can inculcate the delay of progression of disease as long as possible. Our solution is using deep learning and brain connectomes in the later part helps in automation of the working model. Finally a working model or prototype will be produced by which we classify Alzheimer's disease with more accuracy. Automation is also a part of a project in order to reduce human intervention by refactoring the Project using python programming and its relevant ML modules. There is a lot of future scope in order to upgrade or improve the Project in further endeavors.

VI.CONCLUSION

We conclude that our Project is on "EARLIER DETECTION OF ALZHEIMER'S DISEASE USING IMAGE PROCESSING AND MACHINE LEARNING ALGORITHMS WITH GRAPHTHEORY". We have read Journals to learn about our Project and got some Technical Skills and Ideas to do our Project by using

REFERENCES

[1]. eJain, R., Jain, N., Aggarwal, A., & Hemanth, D. J. (2019).Convolutional neural network based Alzheimer's disease classification from magnetic resonance brain images. Cognitive Systems Research, 57,147159.https://doi.org/10.1016/j.cogsys.2018.12.0 15

[2]. Tripoliti, E. E., Fotiadis, D. I., Argyropoulou, M., & Manis, G. (2010). A six stage approach for the diagnosis of the Alzheimer's disease based on fMRI data. Journal of Biomedical Informatics, 43(2), 307– 320. https://doi.org/10.1016/j.jbi.2009.10.004

[3]. Yadav, R., Gautam, A., & Mishra, R. B. (2018). Classification of Alzheimer Using fMRI Data and Brain Network. 109–119. https://doi.org/10.5121/csit.2018.80609

[4]. Khazaee, A., Ebrahimzadeh, A., & Babajani-Feremi,(2015). Identifying patients with Alzheimer's disease using resting-state fMRI and graph theory. Clinical Neurophysiology, 126(11), 2132–2141. https://doi.org/10.1016/j.clinph.2015.02.060

[5]. Jo, T., Nho, K., & Saykin, A. J. (2019). Deep Learning in Alzheimer's Disease: Diagnostic Classification and Prognostic Prediction Using Neuroimaging Data. Frontiers in Aging Neuroscience, 11(August). https://doi.org/10.3389/fnagi.2019.00220

[6]. Omatu, S., Malluhi, Q. M., González, S. R., Bocewicz, G., Bucciarelli, E., Giulioni, G., & Iqbal, F. (2015). Distributed computing and artificial intelligence, 12th international conference. Advances in Intelligent Systems and Computing, 373, 303–310. https://doi.org/10.1007/978-3-319-19638-1

[7]. Maresova, P., Tomsone, S., Lameski, P., Madureira, J., Mendes, A., Zdravevski, E., … Rodile, K. (2018). Technological Solutions for Older People with Alzheimer's Disease: Review. Current Alzheimer Research, 15(10), 975–983.https://doi.org/10.2174/1567205015666180427124547

[8]. Abraham, A., Pedregosa, F., Eickenberg, M., Gervais, P., Mueller, A., Kossaifi, J., … Varoquaux, G. (2014). Machine learning for neuroimaging with scikit-learn. Frontiers in Neuroinformatics, 8(FEB), 1–10. https://doi.org/10.3389/fninf.201.4.00014

