Department of Computer Science and Engineering
Bangladesh University of Business and Technology (BUBT)

CSE 498: Literature Review Records

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Capstone Project Title	Single Deep CNN Features to Detect Neurodegenerative Diseases and Context Behind the Detection: Alzheimer's, Parkinson's, Dementia
Supervisor Name & Designation	Milon Biswas, Assistant Professor, Dept. of CSE, BUBT
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Aspects	Paper # 1
Title / Question (What is problem statement?)	Application of deep learning in detecting neurological disorders from magnetic resonance images: a survey on the detection of Alzheimer's disease, Parkinson's disease, and schizophrenia.
Objectives / Goal (What is looking for?)	The main objective of the proposed model are - 1. To detect these disorders at the earliest stage possible so that their progress can be slowed down, if not fully stopped. 2. To critically examine and compares performances of the existing deep learning (DL)-based methods to detect neurological disorders—focusing on Alzheimer's disease, Parkinson's disease, and schizophrenia—from MRI data.
Methodology/Theory (How to find the solution	In this article, Recurrent Neural Network (RNN) and Long–Short Term Memory (LSTM), Deep Neural Network (DNN), and Autoencoder (AE) method were proposed.
Software Tools (What program/software is used for design, coding and simulation?)	DL algorithms in computer vision.

Test / Experiment How to test and characterize the design/prototype?	DL methods in detecting neurological disorders from MRI datasets.
Simulation/Test Data (What parameters are determined?)	Free parameters are being used in this article.
Result / Conclusion (What was the final result?)	The highest accuracy 98.09 of schizophrenia detection has been observed which has employed 3D-CNN-based classification. By using 3D-CNN achieved 100% accuracy on the validation and test sets for PD diagnosis. At the same time, the study in discriminated PD from typical parkinsonian syndromes had 85.7% test accuracy.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	DL algorithms present impact and accurate solutions for large datasets. However, high-dimensional CNN such as 2D-CNN and 3D-CNN will provide high accuracy for the large and multimodal neuroimages. On the other hand, Generative Adversarial Networks (GAN) can generate synthetic neuroimages which may also be used along with CNN. Adversarial noise can add to the neuroimages and may reduce the classification accuracy. Thus, the cancellation of adversarial errors is a challenge.
Terminology (List the common basic words frequently used in this research field)	Machine learning, Alzheimer's disease, Parkinson's disease, Schizophrenia, Neuroimaging.
Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	In this article, it is shown that using 3D-CNN 100% accuracy can be achieved easily for PD diagnosis.
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	I am going to prepare a new methodology which is single deep CNN. I am going to use it to detect the disease.

Aspects	Paper # 2
Title / Question (What is problem statement?)	A review of Parkinson's disease.
Objectives / Goal (What is looking for?)	Collect the basic information on Parkinson's disease.
Methodology/Theory (How to find the solution?)	Although there is no cure, there are several management options for the early treatment of PD. As the disease progresses, further treatment options are available; however, the management of late-stage motor complications and non-motor symptoms remains particularly challenging and will benefit from further clinical research.
Software Tools (What program/software is used for design, coding and simulation?)	No software tools are being used.
Test / Experiment How to test and characterize the design/prototype?	
Simulation/Test Data (What parameters are determined?)	
Result / Conclusion (What was the final result?)	A large number of agents together with surgical interventions are now available to treat early and late complications of PD. Increasing attention is being given to the diagnosis and treatment of non-motor complications in PD
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	It's a review paper of previous papers which were related to Parkinson's disease. So no challenges came up.
Terminology (List the common basic words frequently used in this research field)	Parkinson's, disease, review, clinical diagnosis.
Review Judgment	

(Briefly compare the objectives and results of all the articles you reviewed)	
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	

Aspects	Paper # 3
Title / Question (What is problem statement?)	A Survey on Deep Learning for Neuroimaging-Based Brain Disorder Analysis
Objectives / Goal (What is looking for?)	This paper, reviews computer-aided analysis of four typical brain disorders, including Alzheimer's disease, Parkinson's disease, Autism spectrum disorder, Schizophrenia, and importantly, the limitations of existing studies and present possible future directions discussed.
Methodology/Theory (How to find the solution?)	Deep learning methods using structural magnetic resonance imaging (MRI), functional MRI, and positron emission tomography (PET)
Software Tools (What program/software is used for design, coding, and simulation?)	Platform - Linux, Windows, Android, Javascript. Language - C, C++, JAVA, Python, MATLAB. Caffe, Deeplearning4j, TensorFlow, Pytorch as open-source toolkits being used.
Test / Experiment How to test and characterize the design/prototype?	Through analyzing and discussion using deep learning they do their work.
Simulation/Test Data (What parameters are determined?)	Hyper-parameter optimization methods, including manual (e.g., grid search and random search) and automatic (e.g., Bayesian Optimization), are proposed

Result / Conclusion (What was the final result?)	This paper is reviewed the most recent studies on the subject of applying deep learning techniques in neuroimaging-based brain disorder analysis and focused on four typical disorders.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	It is difficult to trust these predictions based on features you cannot understand. The lack of sufficient training data in neuroimage analysis has been repeatedly mentioned as a challenge to apply deep learning algorithms. To address this challenge, a data augmentation strategy has been proposed, and it is widely used to enlarge the number of training samples. An effective fusion of multimodal data has always been a challenge in the field.
Terminology (List the common basic words frequently used in this research field)	Neuroimaging, Parkinson's, Alzheimer's, Deep CNN, MRI, PPMI.
Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	Through this approach we able to know understand the importance of deep learning over machine learning.
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	This paper provides, a comprehensive overview of deep learning techniques and popular network architectures by introducing various types of deep neural networks and recent developments. however, using deep learning for implementation was best choice to get their desirable result.

Aspects	Paper # 4
Title / Question (What is problem statement?)	Deep Learning-Based Binary Classification for Alzheimer's Disease Detection using Brain MRI Images
Objectives / Goal (What is looking for?)	The proposed method classifies diseases like Alzheimer's disease (AD), mild cognitive impairment (MCI), and normal control (NC).
Methodology/Theory (How to find the solution	This paper methodology includes two steps preprocessing and network training.
Software Tools (What program/software is used for design, coding and simulation?)	Tensorflow
Test / Experiment How to test and characterize the design/prototype?	In this paper, the ADNI dataset is being used.
Simulation/Test Data (What parameters are determined?)	Hyper Parameters.
Result / Conclusion (What was the final result?)	98.57% accuracy on the dataset without using any handcrafted features for training the network. Validation accuracy achieved is 87.72%.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	To achieve the highest accuracy.
Terminology (List the common basic words frequently used in this research field)	Alzheimer's disease · Convolutional neural network · Deep learning · MRI · Neurological disorder
Review Judgment	Here, they were able to achieve the highest accuracy than other existing proposed systems.

(Briefly compare the objectives and results of all the articles you reviewed)	
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	after reviewing their result we are inspired and decided that we will prepare a new methodology which is a single deep CNN to detect the disease.

Aspects	Paper # 5
Title / Question (What is problem statement?)	Automatic Alzheimer's Disease Recognition from MRI Data Using Deep Learning Method.
Objectives / Goal (What is looking for?)	1. To get the highest accuracy. 2. Resulting in an accurate recognition.
Methodology/Theory (How to find the solution?)	convolutional neural network (CNN) with deep learning
Software Tools (What program/software is used for design, coding and simulation?)	Tensorflow, google collab etc.
Test / Experiment How to test and characterize the design/prototype?	Testing CNN is being proposed to extract seven middle cross-sections as patches. Since not all patches are abnormal in AD cases, only when all seven patches were classified as NC, here, considered the data as NC.
Simulation/Test Data (What parameters are determined?)	The MRI data acquired from Alzheimer's Disease Neuroimaging Initiative (ADNI) database

Result / Conclusion (What was the final result?)	This paper achieved sensitivity at a patch level is 0.69 and specificity is 0.98. When using the AD detection rule which was mentioned in the testing section, the case level sensitivity is 1 and specificity is 0.93.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the articlayer.	In the structure, every one of the three groups is made up of three layers, including a convolutional layer, a pooling layer, and a normalization layer which was really challengeable.
Terminology (List the common basic words frequently used in this research field)	Alzheimer's Disease, AD, Recognition, Magnetic Resource Imaging, MRI, Deep Learning, Convolutional Neural Network, CNN
Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	This paper specifically defined each segment which is really important. The proposed system is built and tested with the MRI data acquired from Alzheimer's Disease Neuroimaging Initiative (ADNI) database
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	This paper describes an automatic AD recognition algorithm that is based on deep learning on 3D brain MRI. From this work, we got an overview of how to gain the utmost accuracy.

Aspects	Paper # 6
Title / Question (What is problem statement?)	Early Detection of Parkinson's Disease Using Deep Learning and Machine Learning
Objectives / Goal (What is looking for?)	Aims to contribute to the PD diagnosis process by using a convolutional neural network, a type of deep neural network architecture, to differentiate between healthy controls and PD patients. This paper focused on discovering deviations in patients' movements with the use of drawing tasks.
Methodology/Theory (How to find the solution?)	CNN model is being used in this paper.
Software Tools (What program/software is used for design, coding and simulation?)	
Test / Experiment How to test and characterize the design/prototype?	
Simulation/Test Data (What parameters are determined?)	
Result / Conclusion (What was the final result?)	With 93.5% accuracy, a convolutional classifier, trained with images of the pentagon drawing task and augmentation techniques, can be used as an objective method to discriminate PD from healthy controls. The compact model has the potential to be developed into an offline real-time automated single-task diagnostic tool, which can be easily deployed within a clinical setting.
Obstacles/Challenges (List the methodological obstacles if authors mentioned in the article)	Although the accuracy of the model is competitive against other approaches to get the highest accuracy was a hard challenge for the authors. The limitations of this study include (1) its proof-of-concept nature; (2) the interpretability of the results typical of using a black-box optimization approach; (3) the relatively small size of the dataset and its imbalanced nature.

Terminology (List the common basic words frequently used in this research field)	
Review Judgment (Briefly compare the objectives and results of all the articles you reviewed)	
Review Outcome (Make a decision how to use/refer the obtained knowledge to prepare a separate and new methodology for your own research project)	