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Feature Based Analysis of MSVM on Brain MRI Images

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Abstract
Multiclass Support Vector Machine (MSVM) is a multi-class classifier is used to solve real life health problems of human beings mostly in Alzheimer's disease (AD) diagnosis. MSVM able to deal efficiently multi class classification problems in Medical diagnosis. MSVM are successfully applied in the fields of Text categorization, Handwriting Recognition, Protein Structure Prediction, etc.Various Magnetic Resonance Image (MRI) features are used to get accurate diagnosis of AD as it is safe, reliable and noninvasive. Biomarkers are quantifiable indicatorsforspecific disease state or anotherphysicalstate of an organism. At early stage of AD diagnosis biomarkers are usedand they are also used to get objective and reliable measures of disease diagnosis. A few biomarkers can be used to diagnose AD like MRI scan, PET Scan, SPECT Scan, etc., Among these, two biomarkers namely Morphometric features and Texture features are chosen for this study.To perform quantitativeassessments and to identify the important changes in the brainmorphometric analysis is consider as a primary tool. Hippocampus is one among the key biomarkers to know about the state and progression in AD.Texture analysis is a model that permits mathematical identification of changes in MRI there byquantitative and reproducible strategy for extracting image features. Two feature based models are proposed using MSVM to classify the MRI Images. The performance of proposed models is analyze and the best model is evaluated.

Keywords: *Multi-class Support Vector Machine, Biomarker, Hippocampus, Morphometric feature, Texture Feature*

I. INTRODUCTION

Various Magnetic Resonance Image (MRI) features are used to get accurate diagnosis of AD as it is safe, reliable and noninvasive. Biomarkers are used to evaluate the biological changes carried due to Alzheimer's disease [1,2,3]. In the diagnosis of Alzheimer's biomarkers plays a vital role. The functions of biomarkers are listed as drug target identification, disease prevention, disease modification significant to the disease diagnosis [4]. Biomarkers like amyloid, tau, neurodegeneration focus mainly on brain imaging in research framework.Several biomarkers can be used to diagnose AD like MRI scan, PET Scan, SPECT Scan, etc., In developing a computer technology to diagnose the brain disease with neuro images basically, also with MRI will enable Artificial Intelligence, machine learning and pattern analysis [5].

Various features are often removed from the brain mages, like greymatter volumes [6], cortical thickness [7], morphometric [8], and texture features [9]. Among these, two biomarkers namely Morphometric features and Texture features are chosen for this study. For accomplishing quantitative measures and to sort outstructural changesin the brain Morphometric analysis is a tool[10]. The most effected part within the brain in

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response to AD is thatthe hippocampus region. Hippocampus is a key biomarker to know about the state and progress in AD [11]. For measuring the texture of image, Texture analysis is effectively applied in many fields such as resonance imaging as a computer based tool [12] for the diagnosis and in medical structuring incorporate analysis and grouping of tissues and sores. Here, the OASIS database which is publicly available is considered for Brain MRI image classification. The MRI images of Brain are preprocessed and the Texture features of MRI images are extracted. The main objective of this examine is two feature based models are proposed using MSVM to classify the MRI Images. The performance of proposed models is analyze and the best model is evaluated.

This paper is described as follows. The associated works are shown in second section. In third section, the methods and materials are presented along with the proposed method implementation. In fourth section, the experiment results are described. The paper is concluded in section five.

II. LITERATURE SURVEY

Minguez CA et.al [4] has presented an overview of Biomarkers on Alzheimer's Disease diagnosis and other types of dementia, clinical needs, limitations and future aspects.

D. Zhang et.al[5] has presented the role of biomarkers in AD diagnosis and Predicting Future Clinical Changes of MCI Patients Using Longitudinal and Multimodal Biomarkers.

Ashburner J et.al[10] has presented overview on importance of Voxel based morphomety analysis in Alzheimer's disease diagnosis by considering various voxel features of MRI image.

R.M.Mallikaet.al[11] has proposed a methodology to diagnose the Alzheimer's is fuzzy based expert system. Hippocampus volume of three projections of images from OASIS database are considered in this study. Fuzzy Inference System is developed for classifying the MRI images to multiple classes. The effectiveness of proposed fuzzy-based expert system is analyzed.

Andrés Larrozaet.al [12] has presented the review on texture analysis on magnetic resonance imaging and highlights the importance of texture features in the diagnosis of disease.

YashimaAhujaet.al [16] has presented the classification of AD diagnosis using of Gabor Texture Features of Hippocampus region in brain.

By the motivation from above studies Multi-Class SVM is considered forexperimentation in this study to diagnose the Alzheimer's.

III. PROPOSED METHODOLOGY

In our proposed system, Alzheimer's data is classified using Multi class Support Vector Machine, by using Morphometric and texture parameters of the brain MRI. Two feature based models are proposed in this study. Proposed Methodology includes three stages: Preprocessing, Feature Extraction and Classification. The work flow of the proposed methodology is presented in figure 1. In the first stage the noise in the input MRI Images are eliminated and enhanced by highlighting the edges. Texture features and morphometric featureare are removed in the second stage. The extracted two feature datasets are trained by MSVM and finally the data is classified into multiple classes in the third stage.

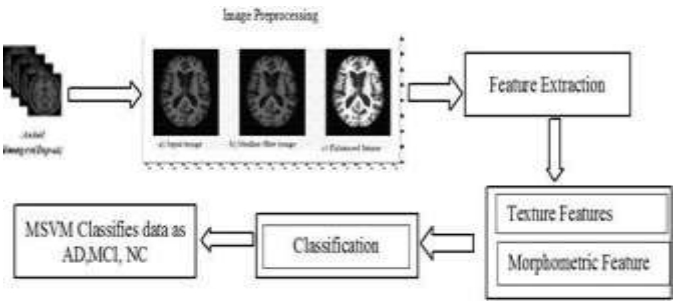

Fig 1. Schematic Structure ofProposed Methodology

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Feature Extraction

To remove the irrelevant features and to minimize the vastness of feature space [15] from the text documents feature extraction techniques are used. Different kinds of feature extraction techniques like ICA, PCA, LDA, clustering methods etc. During this phase the features associated with MRI images is obtained. By using gray level co-occurrence matrixthe texture features associated to Brain MRI images are extracted within this phase. The second order statistical texture features are extracted using GLCM method [16]. Here, 17 texture features are extracted from MRI Images of Brain like mean, standard deviation, contrast, correlation, energy etc.,

In this study, two models are proposed for the experimentation by using MSVM classifier. In first experiment Morphometric feature i.e., Hippocampus feature is analyzed with MSVM on MRI images data. In Second Experiment Texture features are analyzed with MSVM on MRI Images data.

Texture Feature based MSVM Model

Texture analysis is a model which enables to find out the mathematical changes in resonance imaging there by providing computable and progressive approach for removing the features from images. In this study, One-vs-One decomposition strategy is considered for the experimentation with total 17 texture features of MRI Image of Brain. One-vs-One approach is considered for texture feature classification with the help of MSVM. It is one binary SVM model for each two classes will be trained.

Therefore totally c(c-1)/2 models will be trained for c classes. The classification will be done based on the voting strategy. c(c-1)/2 binary classifiers are applied to an unknown sample and that sample will be classified as a specific class that contain highest votes [17]. This method is suitable for one classifier consistent with couple of classes. It does not provide better results when the sample size increases.

Morphometric Feature based MSVM Model

For accomplishing quantifiable assessments and to identify basic changes in the brain morphometric analysis is the only tool. Hippocampus is one among the morphometric features of MRI images of brain. The volume of hippocampus is extracted from the images of brain which are segmented. It is a significant biomarker used to identify the sick condition in progress of Alzheimer's. The region of hippocampus is chosen manually to determine the hippocampus area. The thickness of images are 1.2 mm. Hence, similar thickness is utilized to assess the volume of hippocampus.

IV. RESULTS AND ANALYSIS

In this study MSVM is experimented separately with two proposed models like "MSVM with Texture features" and "MSVM with Morphometric feature". MSVM classifies the data into three classes such as AD, MCI and NC using the above said proposed models.

Table 1. Comparison of MSVM performance with Morphometric feature and Texture features

Method	Accuracy (%)	Recall (%)	Precision (%)
MSVMwith Morphometric Feature	**55.4**	**59.7**	66.7
MSVM with Texture Features	**66.7**	**75**	**34.4**

MSVM classifier with texture features are classified the data with 66.7% of accuracy, 75% of recall (sensitivity) and 45% of precision. Whereas MSVM classifier with morphometric feature i.e with Hippocampus classified the data with 55.4% of accuracy, 59.7% sensitivity and 66.7% Precision. From the results it is observed that MSVM with texture features classified the data with higher accuracy than with morphometric feature. Recall value is also high for MSVM with Texture features model than Morphometric feature based model. But precision value of morphometric feature based MSVM model is more than MSVM with texture feature based model. The comparison of MSVM classification measures is represented diagrammatically in figure 3.

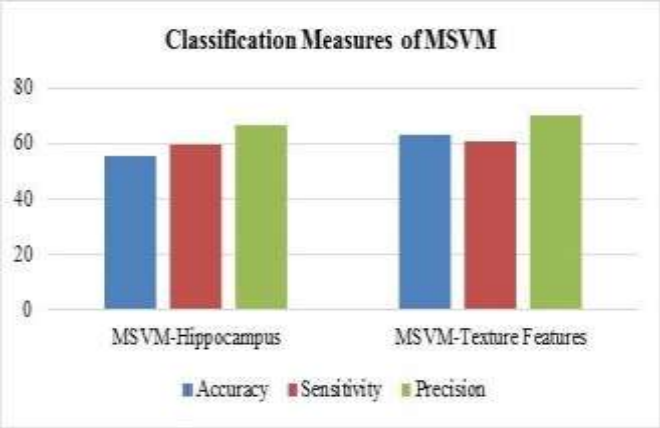

Fig 3. Comparison of Performance of MSVM with Texture features and MSVM with Morphometric feature.

V. CONCLUSION

MSVM is able to handle Multi-Class classification problem efficiently. Problems related to Medical field are almost multiclass classification problems. Hence, the multi-class classification of Brain MRI images into multiple classes are considered in this work. Multi Support Vector Machine (MSVM), a significant Multi-class classifier with two proposed models MSVM with Morphometric feature approach and MSVM with texture feature approach are used for the experimentation. The MRI Images of Brain are preprocessed and the significant features are extracted. The extracted features dataset is used for the classification. MSVM with Morphometric feature based and MSVM with texture based models are experimented. The classification performance of MSVM with the above said approaches are evaluated using the classification measures such as Accuracy, Recall and Precision. MSVM with Texture feature analysis performed better than MSVM with morphometric analysis. The performance of MSVM classification could be enhanced using the Feature Selection Techniques in future.

REFERENCES

[1] Sprott RL. Biomarkers of aging and disease: introduction and definitions. ExpGerontol. 2010;45(1):2-4.
[2] Minguez C A, Winblad B, Biomarkers of Alzheimer's disease and other forms of dementia: clinical needs, limitations and future aspects, ExpGerontol 2010;45(1): 5-14.
[3] Ho L, Fivecoat H, Wang J, et al. Alzheimer's Biomarker discovery in symptomatic and asymptomatic patients: Experimental approaches and future clinical applications, ExpGerontol. 2010;45(1):15-22.
[4] The Role of Biomarkers in Alzheimer's Disease Drug Development Jeffrey Cummings Springer Nature Switzerland AG 2019 29 P. C. Guest (ed.), Reviews on Biomarker Studies in Psychiatric and Neurodegenerative Disorders, Advances in Experimental Medicine and Biology 1118, https://doi.org/10.1007/978-3-030-05542-4_2.
[5] D. Zhang and D. Shen, "Predicting future clinical changes of MCI patients using longitudinal and multimodal biomarkers," PLoSONE, vol.7, no.3, ArticleIDe33182,2012.
[6] E.Janousova, M.Vounou, R.Wolz,K.R.Gray, D.Rueckert,G. Montanaetal., Biomarker discovery for sparse classification of brain images in Alzheimer'sdisease,2012.
[7] S.F.Eskildsen, P.Coup´e, "Prediction of Alzheimer's in subjects with mild cognitive impairment from the ADNI cohortusing patterns of cortical thinning,"Neuro Image,vol.65, pp.511–521,2013.
[8] Wen.Ying.Wang, Lan Tan and J.T.Yu, "Voxel- based meta analysis of grey matter changes in Alzheimer's,"Translational Neuro degeneration, vol.4, no.1, 6pages, 2015.
[9] Y.T.Jing and H.T.Yong "One- dimensional grey level co-occurrence matrices for texture classification," in Proceedings of the MMU International Symposium on Information andCommunicationsTechnologies,pp.197-202, 2008.
[10] Ashburner J, Friston, "Voxel-based morphometric Analysis should be used Neuro Image"2001,14, 1238–1243. https://doi.org/10.1006/nimg.2001.0961 PMID: 11707080
[11] Mallika R.M., Usha Rani K., Hemalatha K "A Fuzzy-Based Expert System to Diagnose Alzheimer's disease", Internet of Things and Personalized Healthcare Systems. SpringerBriefsin Applied Scinces and Technology. Springer, Singapore(2019).
[12] Texture Analysis in Magnetic Resonance Imaging: Review and Considerations for future applications by Andrés Larroza, Vicente Bodí and David Moratal.
[13] https://en.wikipedia.org/wiki/Multiclass_classification
[14] YashimaAhuja, Sumit Kumar Yadav, "Multiclass Classification and Support Vector Machine", Global Journal of Computer Science and Technology, Vol XII, issue XI, 2012.

May – June 2020
ISSN: 0193-4120 Page No. 5748-5752

[15] Yashima Ahuja, Sumit Kumar Yadav, "Multiclass Classification and Support Vector Machine", Global Journal of Computer Science and Technology, Vol XII, issue XI, 2012.

[16] P.Keserwani et al., Classifcation of Alzheimer disease using Gabor texture feature of Hippocampus region. I.J.Image, Graph. Signal Proc. 6, 13–20, Published Online June 2016 in MECS.

[17] Chih-Wei Hsu and Chih-Jen Lin, "A Comparison of Methods for Multiclass Support Vector Machines", IEEE Transactions on Neural Networks, Vol. 13, No. 2, March 2002.