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# Analysis of Alzheimer Condition in T1-Weighted MR Images using Texture Features and SVM Classifier

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***ABSTRACT--****Alzheimer's is the most common neurodegenerative disease, which affect memory, thinking, behavior and emotion. The imaging modality is Magnetic resonance imaging (MRI), whichis non-invasive technique and describes the pathology of the three-dimensional brain structure for finding the Alzheimer's disease (AD). Texture features were extracted by utilizing SF, SGLDM, GLDS, NGTDM, SFM, Laws TEM, Fourier, Fractal and Shape based feature techniques. To identify the Alzheimer's disease three classifiers k nearest neighbor, support vector machine was used. SVM Classifier Accuracy, Sensitivity and Specificity respectively increased when compare with KNN classifier.*

***Index Terms–-****Alzheimer's disease (AD),MRI, Texture Feature Extraction,k-NN and SVM*

## I. INTRODUCTION

Dementia is a condition which manifests due to several disease conditions in the elderly population, although in a small number of cases, it is genetic and young-onset. In Dementia Alzheimer's is the most common disease. There are about 5.12 million people by dementia living in India, out of which only 10% ever gets any diagnosis, treatment or care [1], over this there are several obstacles to delivering dementia care and providing adequate support to the person by dementia and their caregivers.

There is inadequate awareness of dementia in society leading to stigmatization which eventually effects the care and quality of life of people living by dementia. Cognitive Impairment leading to. 58% of people by dementia worldwide lived in LMIC with this proportion expected to increase to 63% in 2030 and 71% by 2050 [2].

It is observed that in Lower middle-income countries (LMIC) there is poor awareness of dementia, lack of understanding of dementia symptoms and considering the changes as normal ageing behavior contributing to misconceptions and stigmatization which further hinders care and quality of life of the person by dementia. India lacks dementia-oriented services and reports suggests that there are less 200 dedicated dementia services in the whole country [3]. There is inadequate awareness of dementia in society leading to stigmatization which eventually affects the care and quality of life of people living by dementia [4]. For effective dementia care, there is a need to empower healthcare professionals and caregivers in screening and care management of the disease.

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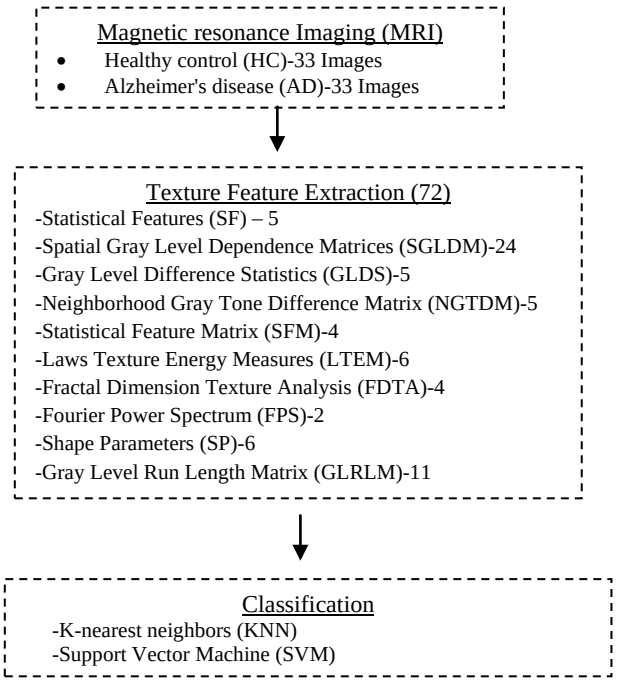
There is a need to develop an effective health care model for delivery of services for dementia care keeping in mind socio-cultural beliefs [5]. MRI with T1 Weighted used for the Classification of Alzheimer's Disease by using a Novel Texture Extraction Technique [6].

CAD model implemented to diagnosis brain abnormalities using texture analysis of MRI images [7]. 3D CNN was used to classify of conduct disorder with structural MRI [8]. Single MRI Sequence was used for the Classification of Subcortical Vascular Cognitive Impairment by Using and Deep Learning Convolutional Neural Networks (CNN) [9].Several works to classify AD/HC by using KNN, non-parametric classifiers and eigen value descriptors [10]-[12].

In this paper Section2 describes the proposed methodology and Section 3 describes results and discussion on proposed methodology.

## II. METHODOLOGY

The proposed algorithm was consisting texture feature extraction from the brain MRI T1 weighted images, and classification is finished by k- nearest neighbor (k-NN) classifier and Support Vector Machine (SVM). Figure 1 shows that the analysis of texture feature extraction for different classifiers with KNN and SVM. Here totally 72 features were used. Out of these 72 features, 5 features from SF, 24 features from SGLDM, 5 features from GLDS, 5 features from NGTDM, 4 features from SFM, 6 features from LTEM,4 features from FDTA, 2 features from FPS, 6 features from SP and 11 features from GLRLM3. The feature set is 66x72 which is given as the input to KNN and SVM classifiers.Finally, each classifier's performance was calculated in terms of accuracy, sensitivity and specificity.

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## III. RESULTS AND DISCUSSION

In this paper, brain MRIImages of Healthy control and AD images. The images were taken from OASIS which is Open Access Series of Imaging Studies.Here brain MRI image consists of axialview and T1 weightedas shown in figure 2 and 3.

The training set consists of 66samples and the test sample is classified based on the trained data with10-fold Cross-Validation.The texture features wereSF, SGLDM, GLDS, NGTDM, SFM, Laws TEM, Fourier, Fractal and Shape based were extracted from the Normal and AD images. These features were given as input to k-NN and SVMclassifiers to check the performance. This classifier is significantly honest in nature and makes no prior supposition of the crucial data. Being essential and reasonable in nature, it is not hard to complete.

In This paper the proposed classification algorithms tested on 66 MRI pictures of which 33 tests are observed to be Normal and 33 are AD. The feature set 60x72 was given as input to classifiers. From the Table 1 indicates texture feature values of Mean and Standard Deviation for AD and HC it is observed that the following features gives better result in classification. Spatial grey Level Dependence Matrices (SGLDM) the features are Correlation, Inverse difference moment, Sum entropy, Difference entropy, Information measures of correlation, Information measures of correlation2, Sum average and Entropy. From Gray level difference statistics (GLDS) the features are Energy, Entropy and Contrast.

**Figure 2:**Normal Image

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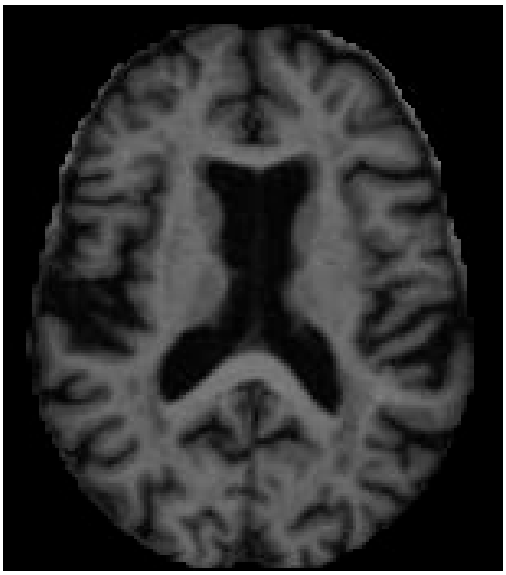

**Figure 3:**Alzheimer Image

From the Statistical feature matrix (SFM) the features are Periodicity and Roughness. From the Fractal dimension texture analysis, the features are Fractal dimensions Texture analysis-1 to 4. From the GLRLM, the features are Short Run Emphasis, Low Grey-Level runs emphasis and Short Run Low Grey-Level Emphasis. So totally out of 72 features 20 features were useful to get good classification results.

In this paper SVM classifier was used for Two classes for AD and HC. Hence in architecture softmax value is designed for 2 classes (AD/HC).

**TABLE 1 :**TEXTURE FEATURE EXTRACTION WITH DFFERENT METHOD

| S.No | AD | | HC | | S.No | AD | | HC | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D | Mean | S.D | | Mean | S.D | Mean | S.D |
| 1 | 34.69642685 | 3.6207908 | 41.246562 | 5.60234136 | 37 | 0.507607 | 0.069861 | 0.597102 | 0.09747 |
| 2 | 10.84063421 | 1.52629655 | 12.108822 | 2.2227431 | 38 | 3.27E-05 | 7.12E-06 | 2.46E-05 | 5.9E-06 |
| 3 | 41.86327514 | 4.23014337 | 46.954472 | 6.09725539 | 39 | 15047.3 | 5013.14 | 16394.24 | 6520.899 |
| 4 | 0.739432397 | 0.11267637 | 0.5467116 | 0.08332028 | 40 | 489415.7 | 112532 | 543594.2 | 136137.8 |
| 5 | 1.986869741 | 0.20841921 | 1.675548 | 0.12720702 | 41 | 9.676693 | 1.34326 | 9.66967 | 1.251336 |
| 6 | 0.240901031 | 4.8301E-05 | 0.2408934 | 4.463E-05 | 42 | 13.33454 | 1.684168 | 13.40459 | 1.795262 |
| 7 | 90.32319563 | 21.9226509 | 91.453035 | 25.0327648 | 43 | 0.64097 | 0.008694 | 0.641606 | 0.009849 |
| 8 | 0.974572633 | 0.00376879 | 0.9794507 | 0.0032518 | 44 | 2.189145 | 0.015181 | 2.186981 | 0.017892 |
| 9 | 1774.679146 | 354.652602 | 2245.7507 | 596.406692 | 45 | 167166.5 | 16894.02 | 188212.5 | 24587.49 |
| 10 | 0.569331413 | 0.01025553 | 0.568147 | 0.00944442 | 46 | 1548.969 | 206.8482 | 1550.081 | 215.6914 |
| 11 | 71.94263283 | 7.29895452 | 85.146693 | 11.2934541 | 47 | 206.7151 | 28.55143 | 209.636 | 31.65064 |
| 12 | 7008.393389 | 1401.02508 | 8891.5497 | 2364.21181 | 48 | 10503.38 | 1294.511 | 10567.27 | 1351.433 |

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|---|---|---|---|---|---|---|---|---|---|
| 13 | 3.412185395 | 0.06487833 | 3.4195657 | 0.06771386 | 49 | 525.7683 | 70.14412 | 530.5294 | 77.24086 |
| 14 | 4.843856921 | 0.12203532 | 4.8521617 | 0.12108862 | 50 | 2824.102 | 354.8502 | 2829.09 | 366.4618 |
| 15 | 68.46680884 | 16.6455414 | 69.738349 | 19.390912 | 51 | 0.516299 | 0.010461 | 0.51747 | 0.012081 |
| 16 | 2.211157348 | 0.07901577 | 2.211328 | 0.07504652 | 52 | 0.467683 | 0.008883 | 0.469153 | 0.009024 |
| 17 | -0.40456369 | 0.00860262 | -0.4031429 | 0.00744818 | 53 | 0.412397 | 0.013953 | 0.416706 | 0.009684 |
| 18 | 0.955606671 | 0.00215536 | 0.955299 | 0.00253015 | 54 | 0.404999 | 0.019315 | 0.403856 | 0.016965 |
| 19 | 0.005260475 | 1.1618E-05 | 0.0052602 | 1.2232E-05 | 55 | 9905.675 | 1013.793 | 11556.11 | 1543.506 |
| 20 | 53.63591539 | 12.7247575 | 54.738619 | 14.6449267 | 56 | 3067.847 | 420.7353 | 2925.427 | 433.3207 |
| 21 | 0.015082806 | 0.00231443 | 0.0122741 | 0.00186421 | 57 | 176 | 0 | 176 | 0 |
| 22 | 3.07008457 | 0.75565908 | 2.7703655 | 0.80562936 | 58 | 208 | 0 | 208 | 0 |
| 23 | 0.027878365 | 0.00326263 | 0.0275596 | 0.00320288 | 59 | 36608 | 0 | 36608 | 0 |
| 24 | 0.398446199 | 0.04158037 | 0.4736665 | 0.06433607 | 60 | 764 | 0 | 764 | 0 |
| 25 | 42.34009479 | 10.1351014 | 44.793189 | 12.043068 | 61 | 15.94449 | 3.55E-15 | 15.94449 | 5.33E-15 |
| 26 | 0.028540535 | 0.00199199 | 0.0304416 | 0.00154925 | 62 | 0.127496 | 0.005969 | 0.119611 | 0.008506 |
| 27 | 0.176734559 | 0.00883938 | 0.1757913 | 0.00814616 | 63 | 22.56577 | 1.913857 | 24.86005 | 2.740521 |
| 28 | 39.22668448 | 9.16380249 | 40.4381 | 10.9386493 | 64 | 2047.471 | 178.8758 | 1914.957 | 220.9391 |
| 29 | 0.210743865 | 0.0109439 | 0.2093078 | 0.00982456 | 65 | 1221.358 | 57.69839 | 1225.286 | 61.57239 |
| 30 | 0.051684756 | 0.0031901 | 0.0513924 | 0.00319779 | 66 | 5.223714 | 0.178855 | 5.162744 | 0.247165 |
| 31 | 0.013628438 | 0.00100031 | 0.0136775 | 0.0010709 | 67 | 0.518305 | 0.02273 | 0.498063 | 0.02461 |
| 32 | 90.25825676 | 21.9070851 | 91.387708 | 25.0159323 | 68 | 201.189 | 8.558332 | 202.9998 | 11.63829 |
| 33 | 0.284832822 | 0.00662596 | 0.2839626 | 0.00600353 | 69 | 0.035298 | 0.003299 | 0.031116 | 0.003927 |
| 34 | 2.218095647 | 0.07911919 | 2.2182552 | 0.07507352 | 70 | 187.222 | 6.833877 | 189.057 | 9.689582 |
| 35 | 4.576499093 | 0.59757859 | 4.5612074 | 0.59856983 | 71 | 11.79733 | 1.015415 | 12.44529 | 1.51935 |
| 36 | 9.021014104 | 1.72260807 | 8.6046788 | 1.72569 | 72 | 580.0503 | 103.0619 | 705.0892 | 134.0164 |

**TABLE 2:** PERFORMANCE OF CLASSIFIERS

| | Classifiers | |
|---|---|---|
| | K-NN | **SVM** |
| TP | 24 | **28** |
| TN | 27 | **27** |
| FP | 9 | **5** |
| FN | 6 | **6** |
| Accuracy (%) | 77.27 | **83.33** |
| Sensitivity (%) | 80 | **82.35** |
| Specificity (%) | 75 | **84.37** |

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It shows that Normal33 Images and 33 Alzheimer's Images trained.From the Table 2, it is observed that SVM classifiergives outperforms than KNN classifier.

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## V. CONCLUSION

In this paper72 features were extracted and given as input for classificationto characterize the AD and HC.Here three different classifiers, KNN and SVM classifier were applied on the 66 images (33HC and 33 AD). The performance of KNN classifier, the Accuracy, Sensitivity and Specificity was respectively 77.27%, 80 % and 75 %. From The performance of SVM classifier,the Accuracy, Sensitivity and Specificity was respectively 83.33%, 82.35 % and 84.37 %. So, SVMClassifierAccuracy, Sensitivity and Specificity respectively increasedwhen compare with KNN classifier.

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