Enriched Neutrosophic Clustering With Knowledge Of Chaotic Crow Search Algorithm For Alzheimer Detection In Diverse Multidomain Environment

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Abstract: The persons with alzheimer disease are severely impaired with their daily activities. Elderly peoples with mild cognitive impairment also have such issue but in a mild range. Alzheimer is a kind of dementia which results in chronic illness related with progressive memory loss, abstract thinking and lessen the intellectual abilities and cognitive loss. But detection of Alzheimer's at earlier stages may stop further progression and automated detection and classification models are pretty challenging task. This paper focuses on developing an nature inspired unsupervised learning model whose objective is to handle the indeterminacy and ambiguity while clustering the dataset for alzheimer disease detection. This work uses two different heterogenous Multidomain datasets for prediction of alzheimer, CASAS dataset comprised of Activities of Daily living of the smart home residents and OASIS dataset consist of Clinical Dataset. This work proposed a neutrosophic clustering enabled with the intelligence of chaotic crow search algorithm. The neutrosophic clustering handles the indeterminacy by introducing three degrees of membership truthiness, falsity and indeterminacy. The centroids are optimized by applying chaotic crow search algorithm based on the inspiration of crow's memory of food stored location and its searching strategy. The issue of local optima in conventional crow search algorithm is overwhelmed by applying chaos mapping which offers the ability of global optima to produce best solution in selecting most prominent cluster centroids. The performance results proved the efficacy of the proposed work in treating presence of noisy data and indeterminacy for better alzheimer disease detection.

Index Terms: Alzheimer, neutrosophic clustering, chaos map, crow search algorithm, smart home, unsupervised learning, indeterminacy

1 INTRODUCTION

Aging people often suffers from dementia, where age is the primary risk aspect for cognitive impairment [1]. The most common reason of dementia is Alzheimer Disease (AD), which is a condition where the brain neurons stop functioning, lose their connection with other neurons and expire. It is also because of irreversible and progressive decline in cognition. This common cause of dementia leads to loss of brain functioning which unfavorably impact thinking, language, memory, judgment and behavior which rules out other possible cause of dementia. The important manifestation of dementia is its progressive inability which is proportional to the disease severity and these victim's loss the independence to perform their activities of daily living. Thus, Dementia people need more assistance from their caregivers and their contribution need increases while the disease gets progressed. Alzheimer's cannot be cured, but detection of such symptomsin earlier stages, may avoid further worst conditions. Assistive Methodologies with the technological advancement like smart homes greatly constitute a significant solution to detect the people with cognitive impairments at their earlier stages very effectively [2]. The smart home sensor offers the aid to elderly residents, particularly for those who are suffering from caregivers and Mild Cognitive Impairments (MCI).These intelligent smart homes contain technologies devices which captures the actions of the persons and to analyze their Activities of Daily Living (ADL). Daily functioning of a person is considered as a key clinical feature to identify presence of Alzheimer. Activities of daily living of a person in a community setting during normal days like food preparation, telephone, laundry, housekeeping, etc.

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Mild cognitive impairment is commonly considered as a primary and foremost symptom of Alzheimer and other dementia forms. Using smart homes, the daily activities as well as the behaviour patterns of the people can be observed through sensors embedded within different places within the home. The primary objective of this paper is to use smart home collected information to decrease this cost by avoiding few responsibilities on caregivers, lessen the medical emergencies and detect any cognitive impairments at the earlier stages. As there is an exponential growth in the field of pattern recognition using machine learning paradigms, medical applications also receive the attention of using machine learning.

2 PROBLEM DEFINITION

Using various approaches in machine learning, clinical dataset of a patient or daily activity of the elderly persons can be analyzed from the sensor installed in smart homes, to determine the anomalous behavior which might be predictive of the beginning stage of dementia. These qualities can be used to describe anomalous behavior between residents. With the methods of anomaly detection daily activities of residents can be examined to determine whether they are experiencing decline in their cognitive capabilities. This research work uses inference models with machine learning concept to determine and predict whether a resident may be in risk of cognitive disabilities by discovering abnormal patterns in their daily activities.

Contribution

With the increasing population of elderly persons, research towards elderly person well-being and living has been intended towards medical investigation and supporting independent living of elderly persons. Most researchers work on detection of cognitive disabilities used analyzing behaviour of the residents within the sensor-based atmosphere. They used many intelligent approaches to evaluate behavior varies from wearable sensors to sensors installed with a resident'scommunity. But handling

ambiguity and vagueness in detection of alzheimer's with the traits of activities of daily living is the toughest challenge to detect the earlier symptoms of dementia. This paper aims to overcome such issues by developing neutrosophic logic-based clustering approach with Forward variable neighborhood searching metaheuristic algorithm optimizes the process of alzheimer detection at its earlier stages.

3 RELATED WORK

In this section some of the existing methodologies are discussed to detect alzheimer's in various dimension Aversen et al [3] examined a physical MRI data, which adaptstwo models of Support vector machine which identifies AD in MRI images using Alzheimer's DiseaseNeuroimaging Ingenuity (ADNI) catalogue. Brosch et al. [4]devised a deep learning model using belief networks which manifold the learning process for AD detection in MRI images. Gray et al [5] designed a random forest classifier which acts as a multimodal classification system to detect AD form PET and MRI data. Gupta et al [6] in their work introduced a sparse encoder model to detect mild cognitive impairments, AD, healthy control by using ADNI dataset. Hosseiniet al [7] proposed a 3D CNN model to diagnose the presence of AD at earlier stages, with the stack of RBM and the feature vectors and kernel filters are involved with fully connected deep neural network which work on AD diagnostics. Kloppel et al [8] to detect AD they used various testing methodologies on T1 weighted MRI scan of brain and the classifier used for determining the presence of cognitive impairment is done by linear support vector machine. Liu et al[9] designed a deep neural network with the ADNI subcategory of data which classifies the patients as AD or MCI depending on the features extracted and the region of interest considered for investigation. Liu et al [10] devised an auto-encoder multimodal stack network which used zero masking scheme. Their goal is to avert the information loss of image.SVM classifier for classifying the neuroimaging structures on MRI/PET images. Magninet al [11] used an anatomical label brain model to discover the region of interest and concluded that it will be more helpful for the process of AD detection. Morra et al. [12] performed a comparative analysis of different models in detection of AD and the algorithms used for investigation are SVM, AdaBoost hierarchical and automated feature of SVM. Tao et al [13] devised a deep learning paradigm was developed for removing the features with no information load by deploying sparse multi task learning in a hierarchical manner. FirouzehRazavi et al [14] developed a two-stage model for AD detection in Brain images, initially they used scattered filtering and network uses two layers to learn the features of raw input data. Second phase use regression of softmax to detect health status. Sivaranjaniand Senthil [15] developed a secure energy aware protocol for health monitoring through networks very effectively. Rathiand Senthil[16] presented a nature inspired algorithm with and fuzzy classifierto authenticate the process using pattern of key stroke.Illango[17] introduced a developed a novel optimization process for prominent routing in MANET. Dhanusha and Senthil Kumar [26] in their work applied a elephant search metaheuristic algorithm in the field of alzheimer detection using the daily activities collected from smart home and clinical dataset.

4 PREAMBLE OF NEUTROSOPHIC LOGIC

To overcome the limitations of traditional fuzzy theory and to enhance the ability of processing and representing uncertain information of data, Smarandache [19] introduce the Neutrosophic theory which is a multi-value approach which is an extension of other non-classical theories like fuzzy, intuitionistic fuzzy, multivalued logic and paraconsistent logic. This neutrosophic logic not only handles indeterministic problems in a precise manner, but also produce better result on problems which are unsolvable by fuzzy theory. In neutrosophic logic each instance is represented by its truth value in terms of grade of truthiness, indeterminacy and falsity []. Neutrosophic theory sustains reliability with classical and non-classical theory in a distinct term of when the value of truthiness, falsity and indeterminacy is summed its value will be equal to 1 i.e T+F+I = 1. The logic referred as intuitionistic fuzzy when the value of T+F+I < 1 in case of treating incomplete data. It can also act as a paraconsistent logic when the value of T+F+I > 1 [20]. Henceforth, the advantage of Neutrosophic Logic (NL) with the characteristics of non-standard analysis discriminates absolute falsehood signified by –0 and relative falsehood signified by 0. Similarly, absolute truth is denoted as 1+and relative truth is denoted as 1 respectively [21].

5 CROW SEARCH ALGORITHM

There are many metaheuristic natures inspired algorithm which simulate the behaviors of living beings. Commonly, real life issues are nonlinear by nature. While using optimization techniques it tries to discover the optimal solution from a feasible set of solutions. In clustering problems. Objective functions have to be minimized is the major constraint in this subject. The problem with clustering is that they often fall into local optima so that the goal of this optimization algorithm is to identify global optima. In this work crow search algorithm [22] was adopted by examining the crows behaviour. Crows are very intelligent birds which can memorize faces and places where the food they stored. A flock of crows shows some resemblances in their behavior pattern. To acquire food sources, they follow each other. The crows search which is known as search space for a feasible solution and its global solution is best food source. Here, the food source quality is considered as the fitness function for this Crow Search Algorithm. This algorithm is characterized by two major factors they are diversification and intensification. Diversification means the unexplored regions which must be visited in the search space. Intensification signifies the regions that are completely searched so as to discover better solutions. Awareness probability is the parameter which controls these two factors for achieving a balance among them. Mode I: In this mode if a crow τ is ignorant of being followed by crow λ, crow λ will alter its location to crow's location τ as mention below []:

$y\lambda,iter+1 = y\lambda,iter + \gamma\tau * fl n\lambda,iter * (mem\lambda,iter-y\lambda,iter)$ (1)

where $\gamma\tau$ represented as a random value deployed by the standard uniform distribution and $fl n\tau$,itersignifies the flying length of crow τ at iteration (iter) Mode II: if the crow τ is conscious of being followed by the crow λ, it will fool crow λ by arbitrarily moving to a search space position. The modes I and II can be computed as formulated []:

$$y^{\lambda,\text{iter}+1} = \begin{cases} y^{\lambda,\text{iter}} + \gamma_\tau * \text{fln}^{\lambda,\text{iter}} * (\text{mem}^{\lambda,\text{iter}} - y^{\lambda,\text{iter}}), \gamma_\tau \geq AP \\ rand\ loc, \qquad\qquad\qquad\qquad \gamma_\tau < AP \end{cases}$$

(2)

Where $\gamma_\tau$as a random value deployed by the standard uniform distribution and AP refers to awareness probability of crow τ at an iteration (iter)

6 METHODOLOGY- NEUTROSOPHIC CLUSTERING WITH KNOWLEDGE OF BINARY CHAOTIC CROW SEARCH ALGORITHM FOR ALZHEIMER DETECTION IN DIVERSE MULTIDOMAIN ENVIRONMENT

In this paper to perform early detection of alzheimer two different heterogenous datasets are used for performing this process. The first dataset is gathered from the repository Centre of Advanced System in Adaptive Systems (CASAS) [24] encompassed of Activities of Daily living (ADL) of aged peoples with the assistance of smart home testbeds. Second dataset is collected from Open Access Series of Imaging Studies (OASIS) [25] source stores the details of MRI data to identify persons with dementia which ranges between mild to server cognitive impairments. The similar patterns in the dataset are recognized by applying multivalued clustering model which is known as neutrosophic C-Means clustering.

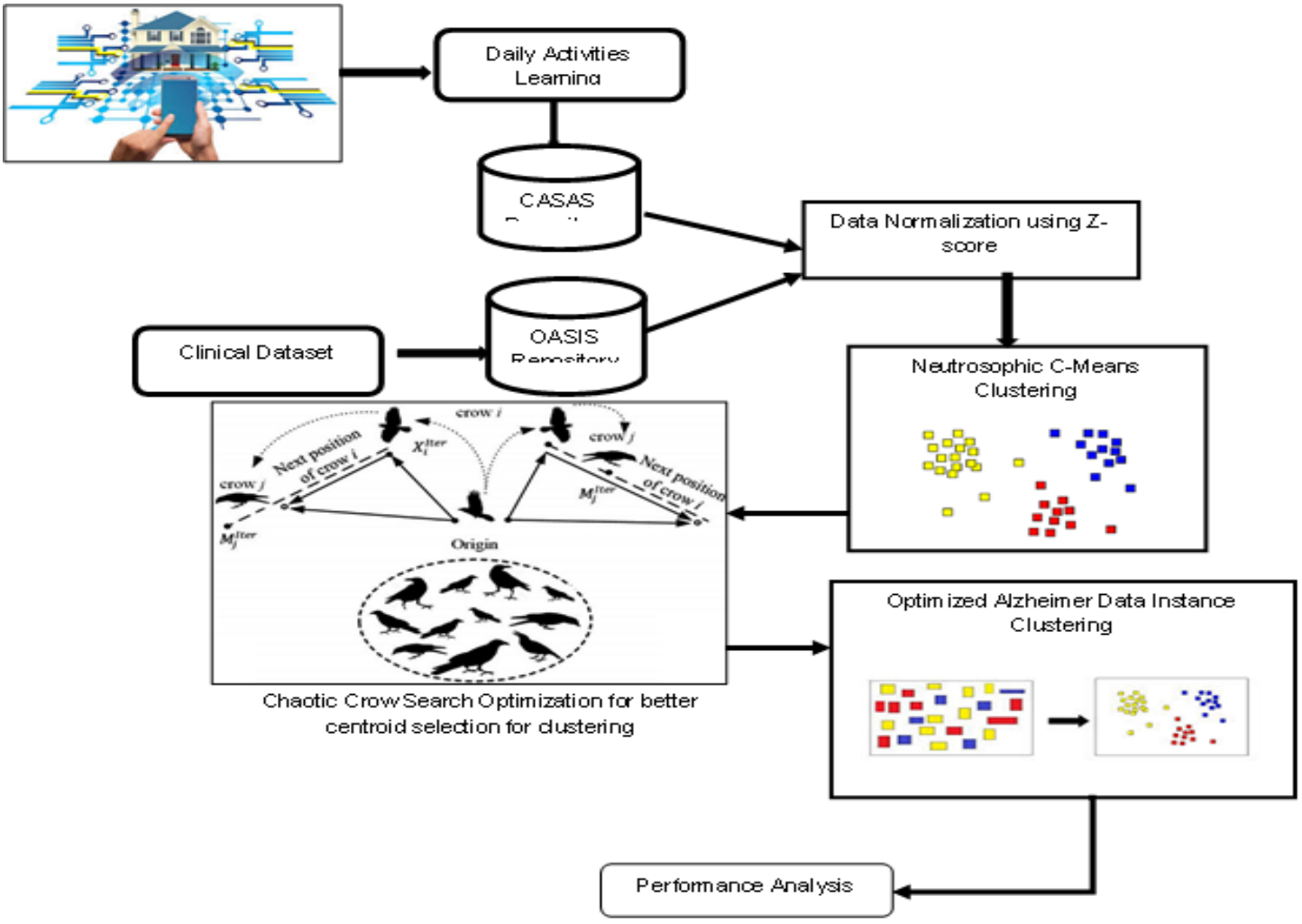

Fig Overall Architecture of Neutrosophic clustering with knowledge of Binary Chaotic Crow Search Algorithm for Alzheimer Detection in Diverse Multidomain Environment

This proposed work used unsupervised learning model to determine the similar patterns and cluster them accordingly. In addition, this work enriches the clustering process done by neutrosophic clustering, chaotic crow search algorithm is used for selecting the optimized centroids. The detailed description of each process in explained in the following subsections:

6.1 CASAS dataset Description

This work uses CASAS dataset [24] information is gathered with the aid of middleware techniques which has the ability to record the Activities of daily living of early persons who are living in a smart home, and their activities are recorded deprived of allocating their daily works. This proposed work uses the dataset of single resident apartments, which

consist of minimum one bedroom, a kitchen, a dining area and a bathroom. All rooms are fortified with motion, temperature, light, water and door sensors. The information is recorded in a continuous manner and it is kept in server. Figure 2 illustrates a simple smart home test beds with sensor key. In OASIS dataset the MRI information of the patients are collected which consist of 373 records with 12 attributes are the patient MRI information, 2 attributes are patients record identifiers and one is the class label, totally 15 attributes are in this dataset [25].

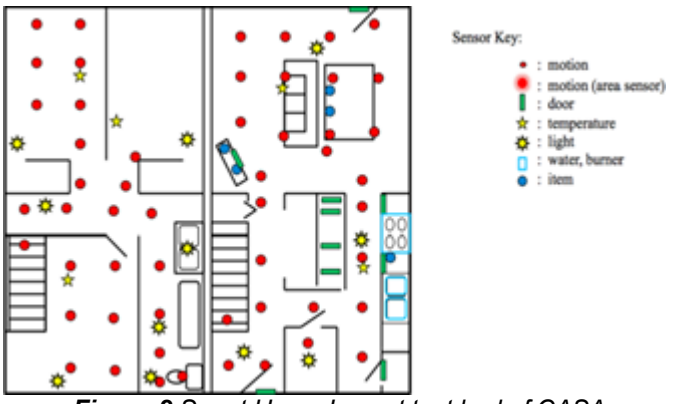

***Figure 2** Smart Home Layout test bed of CASA*

OASIS Dataset

***Table 1**: Description of OASIS Dataset*

1. Patient id	7. Bare Nuclei
2. Clump Thickness	8. Bland Chromatin
3. Uniformity of Cell Size	9. Normal Nucleoli
4. Uniformity of Cell Shape	10. Mitoses
5. Marginal Adhesion	11. Class: (benign, malignant)
6. Single Epithelial Cell Size	

6.2 Dataset Preprocessing

The dataset values are in raw format to perform further processing, the dataset is normalized using Z-score Normalization. It is a strategy of data normalization which avoids this outlier problem.

$$Z = \frac{x-\mu}{\sigma} \quad (3)$$

Where x is to be normalized, μ is the concern attributes mean value and σ is the standard deviation of that attribute. If the x value is exactly equivalent to the mean of all values of attributes, then its value will be assigned to 0. If the x value is below the mean value then it is a negative number, if its value is larger than the mean value will be positive number. Standard deviation is used for determining size of negative and positive numbers of the original attributes. If the unnormalized attribute had large standard deviation means then the normalized values will be always nearer to 0. The both datasets used in this work is normalized as mentioned in the above procedure to treat all the attributes in a same range.

6.3 Neutrosophic C-means Clustering

In standard clustering approaches, each instance exactly falls into any one of the clusters. And the similarity among other instances are determined and instances with minimum distance, falls under same cluster. But in reality, some of the instances are considered to be outliers or they may be ambiguous on two different clusters, which are not well handled by the conventional clustering models. To exemplify in detail, consider that D is a Alzheimer dataset which comprised of N number of records represented as {Di, i=1,2,3,…N},Di indicates a solitary records. To classifybetween dataset categoriesinto hard and non-classical grouping methods [12]. Hard clustering allocates instance to a precise cluster, which will not be confined insidefurther clusters. But in distinction,non-classical clustering allocates each instance that may fit to more than one clusters with diverse membership grades. In this research work Neutrosophic Clustering is done to determine similarity of each Alzheimer dataset instance's by discovering degree near determinacy cluster and indeterministic clusters. In neutrosophic T (μ) characterizes degree of determinant clusters and membership Falsity F (ν)and Indeterminacy I (π) defines two diverse kinds of indeterministic clusters specifically outlier and vagueness cluster for each individual data instance correspondingly. While instances are actual far from cluster centroids then it is contained within in the outlier cluster which permitsrefusingthosecases. The vagueness cluster allows to deliberate instances that are lying near the borders of the clusters. During the process of iterative clustering, these two clusters are used but not involved in decision making. This is due to the reason that outlier and ambiguity class of instances are obvious and their value are informative during clustering. Thus, by applying three grades of neutrosophic components it can immune the system of detection against noisy data and thus the inability of both fuzzy C means and Intuitionistic Fuzzy C Means handling unusual data instances and uncertainty can be solved positively by NCM. In this, each data instance is defined with their uncertainty using euclidean distance from its neighbors which is depicted in the formulas (4 -6)

$$Ind(i) = \begin{cases} 1 - \frac{NQ(i)}{\frac{N}{NMC}}, & if\ NQ(i) < NQ_{tsh} \\ \alpha, & otherwise \end{cases} \quad (4)$$

$$tmp[k] = \begin{cases} 1, & if\ dst[i,k] < eps, k = 1,2,3,\dots,N \\ 0, & otherwise \end{cases} \quad (5)$$

$$NQ(i) = \sum_{k=1}^{N} tmp[k] \quad (6)$$

Where Ind signifies an indeterminacy value and Dataset size is denoted by N, the number of clusters in represented by NMC, and NQ_{tsh} referred as a threshold value which is a constant number. For indeterminacy assessment, the value of NQ_{iis} compared with NQ_{tsh}. While NQ is smaller than NQ_{tsh}, then the value is considered as noisy data and should have a bigger indeterminacy. Otherwise, eps is considered as indeterminacy, the distance among two points i and k is determined by applying euclidean distance. It is well specified that this idea allocates indeterminacy nearer to 0 for data points inside the main clusters and for noisy data points is assigns near to 1. In this work a unique set U is assumed as a union of deterministic and indeterministic clusters. Let U= $DC_i \cup IDC$; I = 1,2,3,..n where DC_i refers to membership grade for deterministic main cluster i and indeterministic noisy cluster is denoted by IDC. ∪ characterizes the union operation. With t3he presence of indeterminacy in clustering, the objective function is formulated as:

$NF(T,F,C)=\sum_{i=1}^{n}\sum_{j=1}^{m}(wt_1,\pi_i\mu_{i,j})^m\left\|Y_i-DC_j\right\|^2+\sum_{j=1}^{n}(wt_2(1-\pi_i)\vartheta_i)^m\,(n-\left\|Y_i-DC_j\right\|^2)$ (7)

Where n refers to number of clusters, $\mu_{i,j}$definesmembership grade of data instance i to the main cluster j and ϑ_i is the membership grade of noisy cluster for the data instance i. Based on the constraint in Neutrosophic Theory, the values of membership grades are always lie between the interval of $0<\mu_{i,j},\vartheta_i<1$. For each instance, the sum of $\mu_{i,j}\ and\ \vartheta_i$should be 1 which is fulfilled as formulated:

$$\sum_{j=1}^{n}\mu_{i,j}+\vartheta_i=1 \quad (8)$$

Here two conditions are considered for data instance I to hold the highest membership grade to cluster n, they are:

- An instance i must have minimum distance from the cluster centre n rather than other clusters
- Data instance I must have a small amount of indeterminacy

The maximum variance among any two instances is 1 since all the sets have been normalized using Z-score whose values lie between the interval of [0,1]. Thus, the maximum quantity for $\sum_{j=1}^{n}\left\|Y_i-DC_j\right\|^2$is n.

6.4 Chaos map-based Crow Search Algorithm

As conventional Crow Search Algorithm often falls into local optima it fails to produce better results because of earlier convergence. To overcome this local optimum issue and to achieve better results in alzheimer disease detection at its earlier stages, a well dispersion characteristic which is more essential for improving the performance of crow search algorithm which produce best solution is used in this work which is known as chaotic maps [23]. This work used non-invertible maps to produce chaotic maps. Two keymechanisms of metaheuristic systems are intensification and diversification, where intensification work toward local search and diversification concentrates on global search which allows crow search process to work effectively in the search space. In this work, crow search uses exploration and exploitation are significantly controlled by the awareness probability parameter. Hence, using small values of AP, increases intensification and vice versa. The main idea of using chaos in metaheuristic algorithm is when there is a random values or probabilities are used, this chaos maps are switched by probabilities and random values to offer chaotic behaviour for crow search algorithm. In standard Crow Search Algorithm (CSA), crows transport form one place to another place and seek for better storage locations of nourishment. The crows store in their memory with their best knowledge of food location. There are two different modes are involved in discovering the best location of concealment food conferring to the awareness probability of crow [22]. This work uses chaotic maps to be substituted for random location and awareness probability values as formulated:

6.4.1 Procedure for Chaotic Crow search algorithm

Arbitrarily set the initial location of flock of NC crows in alzheimer dataset search space
Calculate the locations of each crows
Prepareindividualcrowsmemory
While iter<itermax
for λ = 1:NC
Arbitrarily select one of the crows τ to be followed
State an awareness probability
If $\gamma_\tau \geq CHM^{\tau,iter}$ then

$$y^{\lambda,\mathrm{iter}+1}=y^{\lambda,\mathrm{iter}}+\gamma_\tau*\mathrm{fln}^{\lambda,\mathrm{iter}}*(\mathrm{mem}^{\lambda,\mathrm{iter}}-\mathrm{y}^{\lambda,\mathrm{iter}})$$

Else

$$y^{\lambda,\mathrm{iter}+1}=CHM^{\tau,iter}$$

End if
End for
Likelihood for new location is checked
Compute the new-fangled location of the crows
crow's memory is updated
End of While

Where CHM refers to chaotic map. In conventional crow search algorithm awareness probability of crow will be used whose value will be 0.1 to discover best solution. In this proposed work instead of using awareness probability of crow its chaotic sequences is used and for finding the best location of crow, instead of using random value as in standard crow search algorithm here chaotic maps is used.

6.4.2 Neutrosophic C-Means Clustering with chaotic crow search algorithm for Alzheimer detection in its earlier stages

1. Load Alzheimer Dataset //CASA and OASIS
2. Determine number of attributes in the dataset
3. Initializeμ, ν
4. Initialize parameters DC, $\mathrm{wt}_1,\mathrm{wt}_2,EPS,n\ and\ m$
5. Compute Indeterminacy (π) for each data instance using the equation
6. Set K = 0
7. Compute Center's of each cluster's DCi using CCSA (call procedure for CCSA algorithm) at iteration k
8. Update μij, νi and DCi
9. Check the stop condition if $|\mu(k)-\mu(k-1)|<\in$then terminate the process, otherwise go to step 8
10. Assig each data point into boundary cluster if the first two membership grades μij and μik are between t and (1-t), otherwise assign it to a cluster which data instance in has the maximum membership grade of it
11. end

Output: Clustered Alzheimer dataset

7 EXPERIMENTAL RESULTS AND DISCUSSIONS

The proposed Neutrosophic clustering with knowledge of Chaotic Crow Search Algorithm (NC-CCSA) is simulated using Matlab software. To assess the concert of this proposed clustering archetypal two different dataset are used they are CASA [24] and OASIS [25]. The proposed NC-CCSA is applied on these datasets and compared with three different clustering models namely k-means clustering, Density based clustering and fuzzy c means clustering [18].

7.1 Evaluation Metrics

In this work to assessthe proposed model efficacy NC-CCSA to predict the presence or absence of alzheimer are evaluated using the following metrics.

Precision-Metric

Precision is defined as a division of correct number of records which was correctly clustered as it is truly belonging to the relevant class.

Pef_Prec(Classr, ClSi) = Numri/Numi

Where class Clsr, whose size Nri ,clusterClSiof its size is Numi, Numri data instance in ClSi from the class Classr

Recall-Metric

Recall is evaluated by finding the ratio of actual instance which was discovered by the clustering algorithm

Pef-Rcll(Classr, ClSi) = Numri/Numr

F-Measure:

It uses the values of both precision and recall to generate its metric value

$$\text{Pef-FM}(\text{Class}_r, \text{ClSi}) = \frac{2*\text{Recall}(\text{Classr},\text{ClSi})*\text{Precision}\ (\text{Classr},\text{ClSi})}{\text{Recall}(\text{Classr},\text{ClSi})*\text{Precision}\ (\text{Classr},\text{ClSi})}$$

***Table 2**: Performance Analysis of four Clustering Models to Detect Alzheimer*

Clustering Approaches	Correctly Clustered Instances	Incorrectly Clustered Instances
KMC	75.1	24.9
DBSCAN	80.25	19.75
FCM	86.64	14.73
NC-CCSA	98.72	1.28

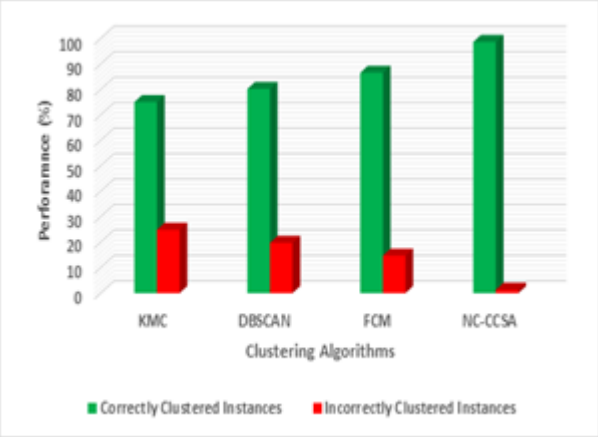

***Figure 2:** Performance Analysis of four Clustering Models to Detect Alzheimer*

From the table 2 and figure 2 explores results of four different clustering models in the process of clustering similar pattern of patients to predict the signs of Alzheimer in their earlier stages. The results revealed that the performance of the proposed Neutrosophic clustering with chaotic crow search algorithm (NC-CCSA) cropsimproved result while comparing with the other clustering approaches. This is because in Alzheimer disease detection, the case of indeterminacy is very high, which are often considered as noisy records and they are eliminated by the standard k-means clustering, dbscan clustering and fuzzy clustering. The issue of determining each instance has some membership grade of indeterminacy is considered in the neutrosophic clustering and their centroid selection is enriched with the knowledge of the chaotic crow search optimization algorithm. Thus, the anticipated modelNC-CCSA produces higher accuracy rate of clustering with the 98.72%.

***Table 3**: Performance Evaluation based on Precision , Recall and F-measure*

Clustering Approaches	Precision	Recall	F-measure
KMC	78.2	74.2	76.1
DBSCAN	80.1	82.7	81.4
FCM	86.9	89.2	88.0
NC-CCSA	96.4	98.6	97.5

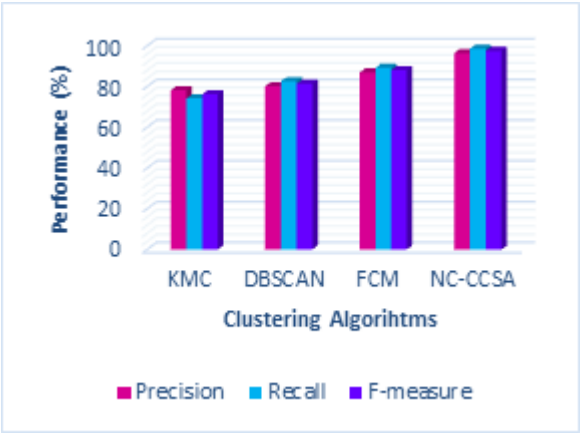

***Figure 3**: Performance Evaluation based on Precision, Recall and F-measure*

The Table3 and the figure 3, illustrates that the proposed work NC-CCSA is compared with three standard clustering models kcm, DBSCAN and FCM. In FCM only the degree of membership of each instance toward the presence and absence of Alzheimer is considered. In K-Means and DBSCAN they avoid the noisy data while clustering or assigns them in any one of the clusters with assumptions. But NC-CCSA uses its ability of handlingindeterminacy where it maintains the clusters with deterministic groups and noise groups. Each instance is considered to have some degree of indeterminacy, based on the maximum degree of determinacy the data instances are considered to belong to that cluster. Additionally, in this work centroid are optimized by using chaotic crow explorationprocess, which improves standard crow search process by adapting chaos maps instead of probability and randomness to determine best solution. Thus, the proposed NC-CCSAproduces the best results in terms of evaluation measures with existing three standard clustering models.

8 CONCLUSION

While giving treatment to dementia, it is very essential to measure the severity of disease, its progression, response of symptom, behavioral and cognition disturbance while

assessing the effect of disease at earlier their earlier stages. The ultimate motivation of this research work is to predict the presence or degree of alzheimer's in terms of mild to moderate cognitive impairments without distributing their daily activities and without their knowledge. This work used both sensors collected daily activities in smart home residents and clinical dataset of persons with dementia or alzheimer. This paper introduced a concept of handing indeterminacy in clustering noisy data using multivalued non-classical logic, neutrosophic clustering, its performance is enriched by adapting chaotic crow food search strategy to choose the best centroid during each iteration and re-clustering. The metaheuristic Crow search process itself is enhanced by applying the chaos mapping to search the best solution to cluster the dataset in a accurate and efficient manner. By Examining the performance of the presented NC-CCSA clustering approach accomplishes best result by handling the indeterminacy in detection of Alzheimer disease.

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