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A Study of Early Prediction and Classification of Arthritis Disease using Soft Computing Techniques

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Abstract - Arthritis is the most familiar element of disability in the World. At a rate of 20 million people in the US are suffering from Arthritis. It characterizes around 200 rheumatic diseases and conditions that influence joints. The tissues surround the joint, and other connective tissue. Early disease prediction and diagnosis of Arthritis is a significant problem in Medical Field. To provide better results, we propose a framework based on soft computing techniques. First, the Arthritis data set is pre-processed by Integer Scaling Normalization. It helps to avoid redundant data and improve the processing speed. From the pre-processed data particular features are extracted by utilizing Categorical Principle Component Analysis method. The feature extraction depends on range categorization. Based on the categorization features are extracted from the input data set and then classified. Classification is performed by utilizing Neutrosophic Cognitive Maps with Genetic Algorithm. This framework provides high accuracy. From the classified data set disease can be easily predicted also it provides the detailed information about the Arthritis type. So it will help for early prediction and diagnosis of Arthritis disease.

Keywords — Arthritis, Categorical Principal Component, Soft Computing, Neutroscopic Cognitive Map.

I. INTRODUCTION

The feasibility and maintainability of a nation's economic and social development based on an effective medicinal area. A computerized medical diagnosis framework can keep up a steady economic growth without a satisfactory social insurance structure. Medical diagnosis relies upon a large degree it might take years to a doctor, especially a novel or junior one, to develop enough experiences. A few disease diagnosis models have been proposed to help doctors minimal with indicative issues. These diagnosis models deals with all necessary leadership prepare among which discoveries of the strange and unknown case from disorder clinical experience actuated by the doctor [1].

Over the years, soft computing assumes the significant part of computer aided disease diagnosis in physician choice process.The key standard of soft computing is heading of error, fluffiness, partial truth, and guesstimate accomplish traceability, quality, and low arrangement cost. A few techniques for soft computing have been proposed for application to medical related fields over a previous couple of decades. The soft computing based diagnosis framework utilizes indications for recognizable proof of the disease. Some side effects of the disease might be estimated that clinical parameters like pulse, blood glucose, filtering reports and so forth [2] [3]. Soft computing gives a computational system to address configuration, study and model issues with regard to questionable and uncertain data. Elements of soft computing like Fuzzy Logic, Neural Network, and Genetic Algorithm share a synergistic relationship as opposed to an aggressive one. These strategies have been connected in different areas like medical education, banking, business etc. [4]. Medical Decision-Support Systems (MDSS) are intended to support specialists or other social insurance experts in settling on clinical decisions. Numerous analysts have executed the strategies like Artificial Neural Network, Multilayer Perceptron, Fuzzy Cognitive Maps and Decision Tree in Medicinal Decision Support System [5] [6].

Medical diagnosis refers to the technique of figuring out a selected disease by using signs. From a biomedical informatics issue, a scientific prognosis is a type of operation incorporating a decision-making manner that is based on the accurate statistics [7]. With this component, the purpose of those systems is to minimize the possibility of physician

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blunders. The advantages of practical systems consist of extended diagnostic accuracy and a discount at the time and discover which types of disorder in arthritis [8] [9]10].

Hence, the primary goal of this paper is to predict arthritis disease accurately with a minimum quantity of attributes. In order to offer better results, we endorse a body work primarily based on soft computing techniques.First, the Arthritis facts set is pre-processed by means of Integer Scaling Normalization. It enables to avoid irrelevant facts and improve the processing velocity. From the pre-processed facts sure capabilities are extracted by using making use of Categorical Principle Component Analysis method. The feature extraction is primarily based on variety categorization. Based on the classification functions are obtained from the primary data set after which categorized. Classification is achieved by way of using Neutrosophic Cognitive Maps with Genetic Algorithm. This framework presents excellent accuracy. From the categorized data set may clear the problem of diseases also it gives the distinctive statistics for arthritis type. So it is helpful for diagnosis and early prediction of Arthritis disorder.

II. PRE-PROCESSING TECHNIQUES

Cardiovascular infection is the main reason of terribleness, and mortality in the present living style. Recognizing evidence of cardiovascular disease is a goal yet a mind-boggling task that ought to be performed minutely, capable and the correct robotization would be incredibly alluring. An automated system in practical examination would update medicinal thought, and it can similarly reduce costs. In this investigation, they have arranged a system that can capably locate the principles to anticipate the risk level of patients. The guidelines created by this framework are organized as Original Rules, Pruned Rules, Classified Rules, Sorted Rules and Rules without duplicates and Polish. The execution of this system was surveyed similar to plan exactness, and the results show that the framework has extraordinary potential in anticipating the more precise coronary disease risk level [11].

Lung cancer is the second most common cancer in both males and females within the world. The focus of this paper became to design a fuzzy rule based entirely on the medical expert machine for diagnosis of lung cancer. This framework comprises of four modules: working memory, inference engine database,and user interface. The machine takes the risk factors and symptoms of lung diseases in a -step system and stores them as facts of the problem in working memory.Also,professional domain expertise turned into collected and generated rules then saved in the rule base [16].

Automatic diagnostics of skin cancers is a standout amongst the most difficult issues in medical image processing. It helps physicians to decide whether or not a skin cancer is kind or harmful. So, determining the more green techniques of detection to reduce the rate of errors is a significant trouble amongst researchers. In this paper Pre-processing changed into the primary stage of detection to enhance the quality of images, disposing of the unnecessary noises and undesirable components inside the place of the skin images. The reason for this paper became to gather the pre-processing strategy that may be utilized in skin cancer images [21].

Congenital heart disorders (CHD) are one of the most critical reasons of neonatal mortality. CADSS was the first framework applied to diagnose the prenatal Truncus Arteriosus Congenital Coronary Heart Disorder (TACHD) from 2D US photos. The structure begins with pre-processing the medical dataset, making the utilization of Probabilistic Patch-Based Maximum Likelihood Estimation. At that point the anatomical frameworks were highlighted from the pre-processed data, using the Fuzzy Connectedness fundamentally based image segmentation technique. Then 32 diagnostic features are separated through using seven unique feature extraction models. Amongst, a subset of capability functions had been selected by way of applying Fisher discriminant ratio (FDR) analysis. Finally, Adaptive Neuro-Fuzzy Inference System (ANFIS) turned into the building with the decided on characteristic subset as classifier, to understand and show clinical effects of prenatal TACHD [22].

In have three sorts of pre-processing stages can be incorporated that are Wavelet transform and Principal component analysis utilized as a pre-processing system which can necessarily diminish the intricacy of the neural networks used in fault classification issues [26]. At first, the wavelet transform used to give the estimated results after PCA accomplishes this objective by further decreasing the dimensionality of the input space after wavelet analysis while preserving as a great part of the significant data as feasible for fault classification. Then the data normalization improves the execution of the solution. Picking legitimate wavelet capacity and wavelet coefficients is basic to the framework implementation. The absolute favorable position of preprocessing gets to be distinctly apparent when connected to more steep low-pass filter assigns all faults to one of two uncertainty class [27].

In this existing system described the preprocessing of retinal images, including Noise removal, Contrast enhancement and Shade Correction and binarization of an image using Dynamic Thresholding [28]. Thresholding procedure was utilized for discriminating foreground pixels (protest pixels) from foundation pixels. Thresholding operations employ distinction intensities of foreground and foundation for segmentation reason. By and large the intensity of foreground or object

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pixels lie in one collection and depth of organization in another. So by using a reasonable threshold grayscale image can be changed over to binary image by employing one value to foreground pixels and other value to foundation pixels. Most utilized procedures for threshold choice is observed by the histogram of images. Here the foreground pixels will be pixels of blood vessels and hemorrhages, and every other pixel are background. To binarize shade revised image the 'Dynamic Thresholding' strategy [29] [30] [31] was utilized. Dynamic Thresholding takes a shot on the way that the intensity of edges in articles remains higher than other background. So slope information can be used for obtaining fitting threshold parameter. The threshold value is figured by implementing a condition on every pixel and its neighboring pixels. As they use dynamic threshold, they don't have to take in any predefined settled threshold from the gathered database [32].

Review of Image Processing Techniques were utilized in [33]. The preprocessing of liver CT images is done to decrease the irrelevant data and to upgrade the image for further handling. Image segmentation is the way toward isolating an image into different parts. This is regularly used to recognize objects or other applicable data in digital images [34]. The primary function of segmentation (i.e.the definition of segments based on regular local image features) is data reduction without loss of 'useful' information. The purpose of these steps is basically to improve the image and image quality to get more surely and ease in segmenting the liver. It contains some steps to pre-process the image that is i) Image is converted to grayscale. ii) A 3x3 median filter is applied to liver CT image, in order to remove the noise. After performing the preprocessing the noise of the image will be eliminated. In this paper mainly focused on the segmentation for image to detect the disease [25].

In existing techniques of article [35] is focused on increase the efficiency of the classification and prediction process. So here, pre-processing stage ought to be considered to upgrade the nature of the input breast images before feature extraction and classification process. Noise in an image is inevitable. So they need to have special treatment on the noise points. In order to improve the quality of the image, in this paper using two types of algorithm such as fuzzy type-II is adopted and used to enhance the contrast of the MRI breast image. Fuzzy type-II set obtained by blurring a type-I membership function. It uses interval-based sets to construct the type-II fuzzy set by defining the upper and lower group values using some equations to develop the algorithm for preprocessing techniques [36]. But this system computation is very slow because of the algorithm depends on the equations. It is not suitable for complex medical images.

Image pre-processing is a fundamental level of identification with a specific end goal to minimize the noise and improve the quality of the original image. Skin cancers are the most widely recognized type of cancers in humans [37] [38]. It required to be applied to limit the search of abnormalities in the background influence on the result [39]. The fundamental reason for this progression is to enhance the nature of the melanoma image by expelling inconsequential and surplus parts in the background of the image for further processing. Excellent choice of preprocessing methods can extraordinarily enhance the precision of the framework. The objective of the preprocessing stage can be achieved through three process stages of image enhancement, image restoration and hair removal. Here, the paper clarifies above methods unmistakably for researchers who involves in pre-processing stages of automatic detections. Each of the steps having separate technique so it occurs the computation complexity of the process.

Preprocessing Techniques for Breast Cancer is an essential process. Mammography is exceptionally exact, yet like most medical tests, it is not great [40]. All things considered, mammography will recognize around 80–90% of the breast cancers in ladies without side effects [41] [42]. The primary goal of this preprocessing is to enhance the image quality to make it prepared for further processing by expelling or decreasing the disconnected and surplus parts out of sight of the mammogram images. Image enhancement algorithm has been used for the change of differentiation components and the suppression of noise [43] [44] [45]. Mammograms are medical images that confused to interpret. Subsequently pre-processing is basic to enhance the quality. It will prepare the mammogram for the following two-stage segmentation and feature extraction. The noise and high-frequency segments expelled by filters. In this technique using different filters for pre-processing. Mean filter or average filter, the goal of the mean filters used to improve the image quality for human viewers. In this filter, supplanted every pixel with the general estimation of the powers in the area. It privately lessened the change, and simple to carry out. [46]. It has some limitations i) Averaging operations prompt to the obscuring of an image, hiding influence features localization. ii) In the event that the averaging operations connected to an image defined by motivation noise, the drive noise lessened and diffused however not expelled. iii) A single pixel with an exceptionally unrepresentative value influenced the mean value of the considerable number of pixels in neighborhood altogether. Another is Median filtering. It is a nonlinear filter useful in evacuating salt and pepper noise median tends to keep the sharpness of image edges while expels noise. Also, some several of median filter is used such as Centre-weighted median filter, weighted median filter, Max-median filter, if the effect of the size of the window increments on median filtering, noise evacuated adequately. Another one is Adaptive

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median filter, it works on a rectangular region. It changes the measure of district during the separating operation relying upon specific conditions as recorded beneath. Every output pixel consists of the middle value in the 3x3 neighborhood around the relating pixel in the input pictures [47].The preprocessing methods utilized as a part of mammogram, introduction, name, artifact removal, upgrade and segmentations. The preprocessing required in making masks for pixels with the most intensity, to lessen resolutions and to segment the breast [48]. At last,the wiener filter tries to manufacture an ideal evaluate of the original image by implementing a least mean square error requirement between the estimate and original image. The Wiener filter is an ideal filter. The target of a wiener filter is to limit the mean square error.A wiener filter has the ability of dealing with both corruption work and also noise. So the system using different filters to handle the pre-processing. Also it using subset of steps in the filters. It is a complicated process for the preprocessing of images. Also, it computational cost is high.

Pre-processing includes three stages such as feature selection, Missing Value Imputation, Reducing Class-imbalance [49]. In Feature Selection, CHF is a complex phenomenon governed by multiple features that provide complexity and uniqueness of the domain, hospital readmission. One of their major challenges before the classification task is to determine the subset of attributes that have a significant impact on readmission of patients from the myriad of attributes present in the data set. They consider two state-of-the-art feature selection techniques like Pearson's Chi-square test and Stepwise regression. Missing value imputation is a genuine yet complicated issue went up against by machine learning and data mining [50, 51, 52, 53, 54].They observe that some of the important attributes in the dataset that have no value for individual patients. These missing qualities not just block that is genuine prediction task, but may also lead to biased results. They use a simple but effective clustering-based technique for imputing missing values. The dataset (including instances with missing values) is first divided into a set of clusters using the K-modes clustering method. Then each case with missing values is assigned to a cluster that is most similar to it. Finally,missing estimations of a case are fixed up with the plausible values generated from its respective cluster. Reducing Classimbalance is described as if the data is integrated, it is observed that the labeled dataset is highly skewed - i.e., the number of occurrences with no Readmission label significantly outnumbers the number of instances with class label Readmission. Such imbalance introduces bias in the actual predictive model. As the model with such skewed class distribution would inevitably predict the majority class far more frequently than the alternative class. To circumvent that problem, they use both over and under sampling. These techniques alter the class circulation of the training data, such that both classes are well represented. Oversampling works by re-sampling that belongs to rare class records, while under-sampling decreases the number of records belonging to the majority class by randomly eliminating tuples.

The preprocessing stage include three steps such as Feature selection, Missing value imputation, reducing class imbalance. In Feature selection is one of the real challenges before the classification task was to identify the subset of attributes that significantly impact readmission of patients from the numerous attributes present in the data set. Two state-of-the-art feature selection techniques were considered: correlation based filter approach and Pearson's chi-square test. Missing value imputation is a genuine yet challenging issue stood up to by machine learning and data mining. Missing value imputation was observed that some of the important attributes in the dataset have no value for individual patients. This paper utilized as a technique is straightforward, however powerful mean/mode attribution (MMI) procedure for imputing missing values. MMI fills in missing information with the mean for the numeric property or with the method for the ostensible quality of all cases watched. Reducing class imbalance, after data integration, in most of the cases, high skewness was observed in the labeled dataset. For this situation, it implied that the quantity of occurrences with No for Readmission class label significantly outnumbered the number of instances with Yes for Readmission class label. Such imbalance introduces biases in the actual predictive model. The reason being the model having such skewed class distribution that would indeed predict the majority class as a class label far more frequently than the minority class. To circumvent that problem, both oversampling (OS) and under-sampling (US) techniques were used which altered the class distribution of the training dataset in such a way that both classes were well represented[55][56][57][58].

Pre-Processing Technique for Brain Tumor Detection and Segmentationcontains three steps of pre-processing approaches for avoid the imperfection. Resamplingis the process which converts the original image to a new image, by projecting, to a new coordinate system or altering the pixel dimensions. By applying geometric revision and interpretation, coming about redistribution of pixels includes their spatial removals to new and more accurate relative positions. Re-sampling is usually used to create better evaluates of the intensity values of individual pixels. A evaluates of the new brightness value that is nearer to the new location is made by some mathematical re-sampling technique. Three sampling algorithms are generally utilized, for example, Nearest Neighbour technique, it changes the pixel that takes the estimation of the nearest pixel in the preshifted array. In the Bilinear Interpolation approach, the

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standard power values for the 4 pixels encompassing the changed yield pixel is utilized.The Cubic Convolution method midpoints the 16 nearest input pixels. This has a rule prompts to the keenest image. Next one is Gray Scale Contrast Enhancement. The aim of contrast upgrade is to enhance the interpretability or view of data in images for preparing the image suitable for further processing like image understanding and interpretation. Contrast enhancement process is used to make the image brighter, to improve the visual details in the image. Contrast Enhancement is mainly sorted into two groups, for example, direct techniques and indirect methods. In the case of the direct method of contrast enhancement, a difference measure is initially characterized, which is then changed by a mapping capacity to create the pixel parameter of the enhanced image. Then again, indirect strategies enhance the contrast by misusing the under-used districts of the dynamic range without characterizing the image contrast term. Indirect techniques can further be isolated into a few subgroups that is decomposing an image into high and low-frequency signal. At last, Noise Removal each imaging modality has many physical parameters that determine the visibility and sharpness of image. These are determined by spatial resolution and the clarity of boundaries. Both spatial resolution and contrast rendition are affected by noise. There are several de-noising algorithms exists for noise removal each algorithm have its own advantage and disadvantage. Linear filters like Gaussian and wiener filters are reasonably basic, yet they degrade the points of interest and the edges of the images. Therefore, the denoised image would be blurred. Markov Random Field technique is vigorous against preserves the excellent points of interest in the image, however Markov irregular field algorithm execution is complex and time-consuming. In the case of high redundancy images, using nonlocal methods they can remove the noise but it eliminate non-repeated details. Maximum likelihood estimation is another method of noise removal by adopting different hypothesis, but it does not retain the edge details [59].

III. INTEGER SCALING NORMALIZATION

As we have concentrated such a variety of research article, the specialists or researchers who are working in the region of soft computing, data mining and so forth and excluding these territories different zones like Image processing, cloud computing and so on., of the various branches or train.But the data in the form of both structured and unstructured. In order to overcome the drawback in the existing technique, we are proposing the Integer Scaling Normalization. In the existing paper the pre-processing methods using different steps of the pre-processing. That is not applicable for various types of dataset also some techniques are expensive. To solve this kind of issues we proposed the Efficient Integer Scaling Normalization.Mainly normalization takes vital part in the field of soft computing, cloud computing and so forth for control of data like scale down or scale up the scope of data before it gets to be distinctly utilized for further stage. It can be useful for the expectation or determining reason a great deal [60]. This proposed model can be appropriate for any length of data component. The below steps are considered during normalization:

- Select the range of data of any size.
- Compose a code to peruse that limit of data set container file.
- Use proposed technique to scale down range of data into between 0 and 1
- Use the newly generated scaled data into further processing as per our need.
- Then, scale up (if required).

Our normalization technique works well in each and every field of research work like soft computing, image processing and cloud computing etc. so well. It gives accurate and efficient result for next steps of feature extraction.

Table1: Comparison between pre-processing techniques

Original data	Min-Max Normalization	Integer Scaling normalization
1229	0.0976	0.229
1264	0.129	0.264
1397	0.25	0.397
1455	0.303	0.455
1483	0.3284	0.483
1523	0.385	0.523
1548	0.388	0.548
1594	0.429	0.594
1670	0.498	0.670
1680	0.5076	0.680

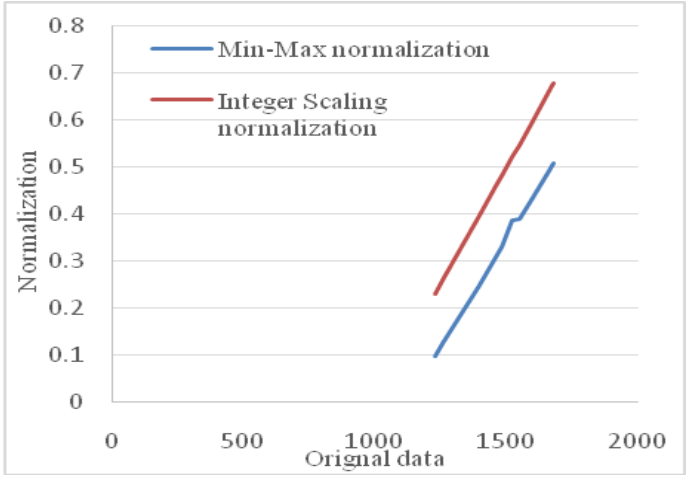

Fig1: Pre-processing comparison graph

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IV. FEATURE SELECTION TECHNIQUES

Rheumatoid arthritis is one of the diseases that its cause is unknown yet; exploring the field of medical data mining can be helpful in early diagnosis and treatment of the disease. In this study, a predictive model is suggested that diagnoses rheumatoid arthritis. The rheumatoid arthritis dataset was collected from 2,564 patients referred to rheumatology clinic. For each patient a record consists of several clinical and demographic features is saved. After data analysis and pre-processing operations, three different methods are combined to choose proper features among all the features. Various data classification algorithms were applied on these features. Among these algorithms Adaboost had the highest precision. In this paper, we proposed a new classification algorithm entitled CS-Boost that employs Cuckoo search algorithm for optimizing the performance of Adaboost algorithm. Experimental results show that the CS-Boost algorithm enhance the accuracy of Adaboost in predicting of Rheumatoid Arthritis [13].

A method for type of regular and extraordinaryarrhythmia beats the use of the continuouswavelet rework to extract features and RBF optimized by cuckoo search algorithm through Levy flight. They have optimized the RBF classifier by searching the best values of parameters. The cuckoo search through Levy flight maximizing the parameter of RBF, they have examined the offered technique on a fixed of data of 12100 beats, that carried out algorithms able to distinguishing normal and unusual beats. The experiments have been performed at the ECG statistics from the MIT-BIH arrhythmia database to classify peculiar and ordinary beats, then RBF-CS through Levy flight yielded on standard great accuracy and sensitivity [15].

An integrated BC risk assessment model employs Fuzzy Cognitive Maps (as the core decision-making methodology) in a two-level structure: the Level-1 FCM models the demographic risk profile and is trained with the nonlinear Hebbian learning algorithm to help on predicting the BC risk grade based only on the fourteen personal BC risk factors identified by domain experts, and the Level-2 FCM models the features of the screening mammogram concerning normal, benign and malignant cases. The data driven Hebbian learning algorithm is used to train the L2-FCM focused on the prediction of a new BC risk grade based solely on these mammographic image features. An overall risk grade is calculated by combining the outcomes of these two FCMs [19].

An improvement of the measurement evaluation method was introduced, which was used during the sports activity in real-time. The basis of the unconventional method turned into their formerly reported every time. The hierarchical fuzzy risk calculation version, which became capable of handle a few uncertainties, imprecision, and subjectivity within the facts and in the assessment system and can address the dynamically converting surroundings, available time, and sources. In new model the enter club features, which were tuned according to the patient traits, that are modified based on the statistics recorded in the course of previous measurements below the similar order. By this individual-dependent trait and the inevitable changing of the dynamic reactions of the human organism can also be considered and the risk stage can be extra reliably expected [23].

Artificial Bee Colony based Feature Selection for Effective Cardiovascular Disease Diagnosis. In this paper include Feature Selection process contains the accompanying techniques: subset generation, subset assessment, halting basis and result validation. Even though, the aim of this process is to remove irrelevant and redundant features, the generated subset accuracy is more important. The three common methods of feature selection utilized such as, filter technique, embedded technique and wrapper technique. The output is the optimal subset of features without redundancy or noise. Based on the selected features, the accuracy is computed with a classification algorithm. Since, this method is independent from the classification task, it is more suitable for high dimensional data. But, it has poor classification performance. The design of embedded feature selection techniques depend on a specific a learning algorithm. The selected feature subsets are verified with the help of classification algorithms features. Hence, it is possible to get different subsets based on different classification techniques. But, the computational complexity is high in comparison to embedded and filter methods. As it is simple to implement and interacts with the classification method, more work is carried using this method than filter and embedded methods [61].

Generallyfilter approach used for intrinsic properties of data justify inclusion of an attribute or a subset of attributes to the feature set [62]. Filter algorithm initiates the search with a given subset and searches through the feature space using a particular search strategy. It evaluates each variable independently with respect to the class in order to create a ranking. Variables are then ranked from the highest value to the smallest one [63]. Since the filter model applies free assessment criteria without including any classification algorithm, it doesn't acquire any predisposition of a classification algorithm [64]. In Wrapper models using Wrapper approach is similar to the Filter except that it utilizes a classification algorithm. In wrapper approach selected subset is initialized with the first variable in the ranking, and then the algorithm iteratively tries to include in selected subset, the next

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variable is ranking by evaluating the goodness of that augmented subset. Evaluation of candidate subsets is done in a wrapper way, and if a positive difference is obtained, then next variable is added to selected subset and discarded otherwise [65]. For each produced subset, it assesses its goodness by applying the classification algorithm and assessing the execution of classifier. In wrapper model include feature subset selection is controlled by classification algorithm, making it computationally costly. In this work we have adopted cross breed strategy which consolidates both, channel and wrapper models.

Early discovery plays a critical role in cancer treatment and permits better recuperation for generally patients [66]. The required restorative picture for the diagnosing procedure of breast cancer, mammogram (breast X-beam), is viewed as the most solid strategy in early location. In this paper, the elements are separated from the upgraded pictures in light of the wavelet decomposition prepare. These elements are passed to the classification arrange. There are five handling ventures in the components extraction stage, for example, Wavelet decomposition, Coefficients extraction, Normalization, Energy computation, Features reduction. Highlights, in this framework, are separated from the coefficients that were created by the wavelet analysis decomposition. At that point the each elements are pre-processed by utilizing as a part of this means. At that point the extricated elements are passed to the classification stage [67][68].

Brain Cancer Classification Using GLCM Based Feature Extraction in Artificial Neural Network. Highlight extraction is the strategy of data reduction to discover a subset of accommodating factors in view of the picture. In this work, seven textural highlights in view of the gray level co-occurrence matrix (GLCM) are removed from each picture. Co-occurrence frameworks are ascertained for four headings: 0º, 45º, 90º and 135º degrees. The seven Haralick surface descriptors are separated from every co-occurrence grids which are computed in each of four edges. The elements are Angular Second Moment /Energy, Contrast, Inverse Difference Moment/Homogeneity, Dissimilarity, Entropy, Maximum Probability, Inverse. In this elements are extricated in light of a few conditions [69][70].

V. CATEGORICAL PRINCIPAL COMPONENT ANALYSIS

Principle component analysis (PCA) is a factual methodology that uses an orthogonal transformation to change over an arrangement of perceptions of potentially corresponded factors into an arrangement of the estimations straightlythat uncorrelated factors called central components. The quantity of important components is not exactly or equivalent to the quantity of unique factors. This transformation is characterized in a manner that the primary chief component has the biggest conceivable variance and each succeeding component. So it has the most elevated variance conceivable under the imperative that it is orthogonal to the first components. The subsequent vectors are an uncorrelated orthogonal premise set. PCA is delicate to the relative scaling of the first factors.

In existing system contains several issues. To overcome that existing problem and suitable for any kind of data set, we are choosing Categorical Principal Component Analysis. Categorical principal components analysis is known by the acronym CATPCA, at the same timein this paper using time measures categorical variables while diminishing the dimensionality of the information. The objective of principal components analysis is to lessen a unique arrangement of variables into a little arrangement of uncorrelated components that speak to a large portion of the data found in the first variables. The procedure is most helpful when countless forbids compelling elucidation of the connections between items (subjects and units). By decreasing the dimensionality, translate a couple of components as opposed to countless. Standard Principal Components Analysis expect straight connections between numeric variables. Then again, the ideal scaling approach permits variables to be scaled at various levels. Categorical variables are ideally evaluated in the predefined dimensionality. Accordingly, nonlinear connections between variables can be demonstrated.

Table 2: Comparison between feature extraction techniques

	Feature extraction algorithm				
Parameter	CATPCA	Artificial Bee Colony	Filter algorithm	wavelet decom -position	GLCM
Accuracy	91%	73.57%	79.43%	78.78%	71.78%
Sensitivity	93%	65.5%	71%	71.83%	75.16%
Specificity	95%	69.73%	69.98%	63.68%	69.83%
efficiency	95%	60.60%	64.60%	62.05%	69.50%

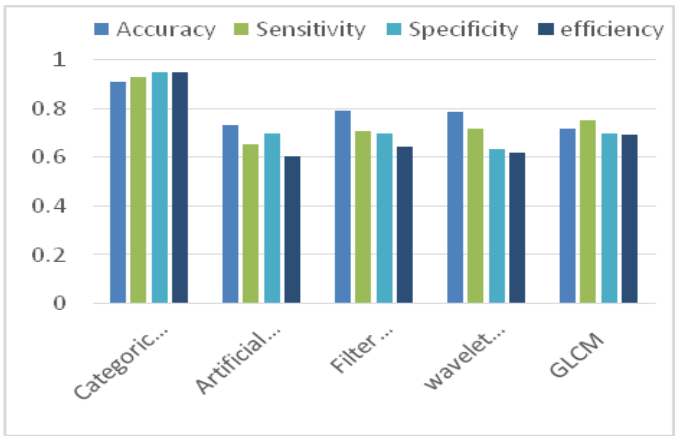

Fig 2: Feature extraction comparison graph

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VI. CLASSIFICATION METHODOLOGIES

A hybrid intelligent classification model for breast cancer diagnosis is comprises of three stages: instance selection, feature selection, and classification. In example determination, the fuzzy-rough instance selection technique in view of powerless gamma evaluator was used to reduce useless or incorrect occasions. In feature selection, the consistency-based feature selection technique was utilized as a part of conjunction with a re-ranking algorithm, attributable to its effectiveness in looking the conceivable identifications in the search space. In the classification period of the model, the Fuzzy-Rough Nearest Neighbour Algorithm was used. Since this classifier did not require the typical value for K-Neighbours and had wealthier class certainty values, this approach was used for the classification task [12].

Early prediction of treatment outcomes in RA clinical trials is critical for both patient safety and trial success. We hypothesize that an approach employing metadata of clinical trials could provide accurate classification of primary outcomes before trial implementation. We retrieved RA clinical trials metadata from ClinicalTrials.gov. Four quantitative outcome measures that are frequently used in RA trials, i.e., ACR20, DAS28, and AE/SAE, were the classification targets in the model. Classification rules were applied to make the prediction and were evaluated. The results confirmed our hypothesis. We concluded that the metadata in clinical trials could be used to make early prediction of the study outcomes with acceptable accuracy [14].

The ADABoost classifier is a very powerful tool for helping to diagnose multiple diseases. With some critical features related to the pathology, the classifier can automatically perform the subjects classification. In this way, the automatic classification is a useful aid for the doctor to make the diagnosis. In this manuscript, the authors have achieved a specific classification for fibromyalgia and rheumatoid arthritis using medico-social and psychopathological features obtained from specific questionnaires. It has obtained success rate above 89%, reaching a 97.8596% in the best case. With these results, it can avoid the innumerable and uncomfortable medical tests to diagnose the pathology, saving time and money[17].

Electrocardiogramis the standard tool for the diagnosis of cardiologic diseases. In order to help cardiologists to analyze the arrhythmias routinely, new strategies for automatic, PC aided ECG evaluation were being developed. In this work, a Modified Artificial Bee Colony set of rules for ECG coronary heart beat category was introduced. It was implemented to ECG facts set which acquired from MITBIH database and the final product of MABC changed into contrasted with seventeen different classifier's accuracy. In a classification problem, a few functions have better distinctiveness than others. In this examine, in orderto locate better specific features, a unique analysis has been performed on time area functions. By the usage of the right functions in MABC algorithm, excessivecategory price changedinto obtained. Other techniquescommonly have extreme categoryaccuracy on examined data set, but they have extraordinarily low or evenbadsensitivities for some beat types [18].

An automated support system for tumor classificationis doneby using soft computing strategies. The identification of the brain tumor was a hard problem, becauseof theframework of the tumor cells. The artificial neural network becomes used to classify the stage of brain EEG signal that if it's far the case of tumor or epilepsy or ordinary. The guided analysis of the signal was time ingesting, erroneous and requires thein-depth educated character to avoid diagnostic errors. The soft computing techniques have been hired for the class of the EEG indicators as the strategies that had been meant to version and make possible answers forreal world tribulations. The possibility of accurate classification hasbeen accelerated by the use of gentle computing strategies like Principal Component Analysis with Neural Network and Fuzzy Logic [20].

Rheumatoid joint inflammation is characterized as a perpetual incendiary issue which influences the joints by hurting body tissues. Therefore, there is an urgent need for an effective intelligent identification system for Rheumatoid arthritis especially in its early stages. This paper is to develop a new intelligent system for the identification and prediction of Rheumatoid Arthritis of the joints utilizing thermal image processing techniques and neural network. The system have some principle stages. first we load a thermal image and then select a region of hand or affected area using matlab image processing. we then read the pixels and calculate the temperature based on colour of pixel in thermal images. Due to inflammation at joints the pressure in the veins get increase which cause blood to flow rapidly with rise in temperature, on the basis of temperature on joint we are trying to predict the arthritis in early stages. The extracted features are used then as inputs for the neural network which classifies thermal joints images as normal or abnormal (arthritic) based on temperature calculation using backpropogation algorithm [24].

Rheumatic Arthritis (RA) is the most common disease found in the majority of the populations next to diabetes. RA is a chronic systemic inflammatory disease that primarily affects the synovial joints. The genes do contribute for the development of RA and it varies among individuals and between populations in different age group. It is necessary to know the gene factors that are associated with the disease for

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the better understanding of the underlying causes of the disease. Since RA is an auto-immune disease, it is important to identify the responsible SNPs of RA in order to detect and predict the disease well in advance. Prediction of RA helps in the early diagnosis of the disease and helps in improving the quality of life. This paper gives a detailed review of the existing methods that are used in the prediction of RA SNPs and also an ideology which works on the concept of Neural Network to detect and predict RA if a DNA sequence is given. The outcome of this would help doctors, genetic scientists, pharmacists in understanding the characteristic gene responsible for RA and provide proper diagnosis method and in discovering new drugs[71].

Rheumatoid joint pain (RA) is an interminable systemic provocative issue which essentially influences synovial joints [72] [73]. In this paper to appraise physical action levels in patients as they play out a mimicked protocol of run of the mill exercises of day by day living utilizing SHIMMER kinematic sensors. Physical action is characterized as any real development, created by skeletal muscles, that requires vitality consumption [74, 75].

The classification performed based on the activity level of the patients. The activity level was estimated for each signal by classifying Class A activities as 50% of the maximum recorded signal parameter and higher, Class B activities as 20-50% of the maximum recorded signal parameter and Class C as 3.3-20% of the maximum recorded signal parameter. Less than 3.3% of the maximum recorded signal parameter was considered to represent no movement. These thresholds were chosen for optimal accuracy in intensity level estimation.

They connected the nonparametric k-closest neighbour (k-NN) algorithm to actualize the VAG signal characterizations. The k-NN is a kind of instance-based learning or lazy learning approach where the capacity is just approximated locally with the end goal that the general calculation is conceded until order completed [76] [77]. The k-NN algorithm would distinguish unlabelled instances based on their similarity with each instance in the training set. In the nonparametric procedure of k-NN classification,an instance is classified by its neighbours, with the instance being allocated to the class generally normalits k nearest neighbours[78][79]. Nevertheless, due to the nature of lazy learning, the k-NN algorithm also has some disadvantages. First, the algorithm requires relatively large storage and high computational cost which make it work slowly for large-scale data sets. But the heuristic nearest neighbour searching strategy could be a solution to this weakness. Second, the performance of k-NN is sensitive to the structure of the training set and its distance function. Euclidian distance is the most commonly used to compute the nearest neighbour, but each feature is treated equally important in this metric without the discriminative ranking. Another issue is to select an appropriate integer k. A large value of$k$can yield smoother decision regions, but may destroy the locality of the estimation as well [80].

DWT Based SonoelastographyProstate Cancer Image Classification Using Back Propagation Neural Network [82]. Back Propagation Neural Network (BPNN) is a type of Artificial Neural Network, generally used for classification purpose in supervised learning based systems. In this method, the gradient of a loss function is calculated the weights associated with the values considered. This requires to know the output desired corresponding to the inputs given and hence calculates the loss function gradient which is used in optimization method to minimize the loss function. This has also several classes of algorithms that are used to achieve the learning process. Out of these we have utilized the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm here to train their data set. This is final stage in the process where the features thus extracted are feed to a back propagation neural network for supervised learning [83]. Here input to the network are the features collected and the output in terms of the Confusion Matrix and the Receiver Operating Characteristics (ROC) are generated which is given in the next section. Based on this learning process an image can be assessed as either affected or unaffected.

Another existing work described the classification structure using four layers feed forward networks i.e. one input layer, two hidden layers and one output layer. The ANN has eight input nodes, hidden nodes and one output node. Those feed forward networks were trained by Levenberg Marquardt back propagation algorithm with tansigmoid activation function[84]. The network parameters such as learning rate, momentum constant, training error and number of epochs can be considered as some default values. To evaluate the performance of the network, the entire sample was randomly divided into training and test sample. In this classification method, training process is considered to be successful when the Mean Square Error (MSE) reaches the better value.

ANFIS is a new technique utilized to predict cancer and Diabetes Diagnosis [85]. The proposed approach for diagnosis of both diabetes and cancer using ANFIS with adaptive group based KNN. ANFIS Classification used to enhance the learning process. The first order fuzzy inference system based on if then rules is used in ANFIS architecture. The rules are ANFIS incorporates the characteristics of neural networks and fuzzy systems. The algorithms such as gradient descent and back propagation are used to train the artificial neural network systems. ANFIS is used to train the neural network. The NN input nodes are constructeddepend on the input attribute. The hidden nodes are used to classify given input based on the

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training dataset with the help of AGKNN. Adaptive group based KNN is used with ANFIS to improve the efficiency.

VII. NEUTROSOPHIC COGNITIVE MAP

A cognitive map, also called a mental map, is a representation and reasoning model on causal knowledge. It is a directed, labeled and cyclic graph whose nodes represent causes or effects and whose edges represent causal relations between these nodes such as “increases”, “decreases”, “supports”, and “disadvantages”. A cognitive map represents beliefs (knowledge) which we lay out about a given domain of discourse and is useful as a means of explanation and support in decision making processes. There are several types of cognitive maps but the most used are the fuzzy cognitive maps. This last treat the cases of existence and nonexistence of relations between nodes but does not deal with the case when these relations are indeterminate. Neutrosophic cognitive maps proposed by F [81].Soft computing provides a computational framework to address design, study and model problems in the context of uncertain and imprecise information. Components of soft computing are Fuzzy Logic, Neural Network and Genetic Algorithm share a synergetic relationship rather than a competitive one. These techniques have been applied in various domains like medical [86, 87], education [85], banking [86], business etc. Previous works had some serious issues based on these diseases.In order to overcome that issues, we are using Neutrosophic Cognitive Maps with Genetic Algorithms for the classification. NCM isa Neutrosophic directed graph. It represents the causal relationship between ideas. Evaluation of every individual is done using a fitness function and a fitness value is assignedto every individual that represents the closeness of individual solution to a perfect result. The existing paper has represented the application of GA with FCM but GA-FCM model does not deal with indeterminacy, so overcome this issue we are using NCM is applied with GA to provide better results. Also, thelimitation of theGA-FCM model is it cannot handle indeterminacy in real-world data so, theGA-NCM model is proposed for thediagnosis of arthritis disease. In order to achieve early prediction and accurate diagnosis of the disease, we are using NCM with agenetic algorithm.

Table 3: Comparison between classification techniques

Classification algorithm						
parameter	Neutrosophic Cognitive map	Nearest Neighbors	Bagging	Multilayer perceptrons	Random Forest	KNN
Accuracy	90%	70.57%	76.43%	75.78%	75.78%	77.08%
Sensitivity	91%	62.5%	75%	70.83%	79.16%	79.16%
Specificity	90%	65.73%	68.88%	64.68%	67.83%	72.37%
efficiency	95%	62.60%	65.50%	64.05%	65.50%	67.53%

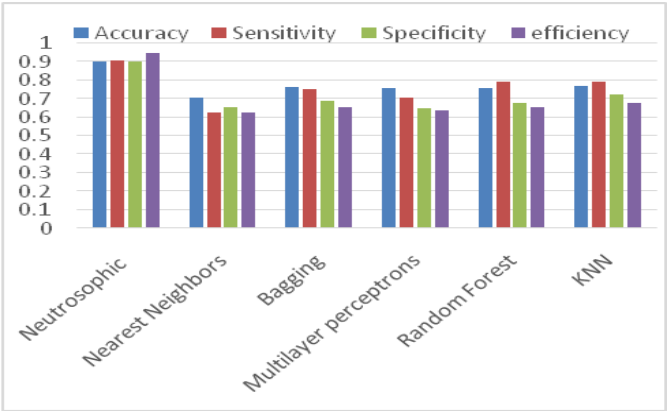

Fig 3: Classification comparison graph

VIII. CONCLUSION

A major process of this work is an early prediction and accurate diagnosis of the arthritis disease. In this study, we presented some useful techniques for early prediction and diagnosis of arthritis disease. The current work incorporated with different stages of finding the arthritis disease such as Pre-processing, Feature Extraction, and Classification. Each stage of our proposed system provides the real accomplishment compared with other techniques. In each comparison is given in the table and graphical representation. All the results reported in this paper describe the workability and the efficiency of the framework. Finally, we utilize our effective technique to predict which type of arthritis disease occurred.

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