Machine Learning Approaches In Medical Image Analysis Using PSO Clustering: From Detection to Diagnosis

Christina Baby
Associate Professor, CSE, MZCET

Teena Joseph
Associate Professor, CSE , MBC CET

ABSTRACT

With the growth of technology, a lot of computer aided system has been developed for detecting the presence of disease with a significant emphasis on systems accuracy. The paper brings out different steps in computer-aided medical diagnosis with soft computing skills. This work concentrates on image classification task through the use of image spectral components. The spectral components within the image for each class are used for categorization. Particle swarm optimization (PSO) is applied to trim the fuzzy rules generated by a trained Hyper-Rectangular Composite Neural Networks to improve the recognition performance Case-Based Reasoning (CBR) process is also explored here and it is an approach for developing knowledge-based medical decision support system. This is the process of solving new problems based on the solutions of similar past problems.

Keywords

Machine learning, Classification, Computer aided diagnosis, Transfer learning, Point-based registration, Registration error, Accuracy

I.   INTRODUCTION

In the computer aided medical diagnostic system, the result obtained from the computer is used as the second opinion by the radiologists. In automated computerized medical diagnosis, the performance level of the system of equipment requires being very high and the result obtained from this system is used for further treatment. In case of automated system, the sensitivity and specificity of the automated system should be very high. The main difference between automated computer diagnosis and CAD lies in the quantitative evaluation. CAD gives a performance similar to that of a physician while automated system gives the performance akin to that of a computer. If specificity and sensitivity of a computer are low, then many false positives will be found, and the automated system becomes a failure. Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. When performing analysis of complex data, one of the major problems stems from the number of variables is involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy. Feature selection is the technique of selecting a subset of relevant features for building robust learning models by removing most irrelevant and redundant features from the data,

Feature selection helps improve the performance of learning models by:

- Alleviating the effect of the curse of dimensionality.
- Enhancing generalization capability.
- Speeding up learning process.
- Improving model interpretability.

The typical geometric problems can be identified by contour data points which connect a proper surface. Segmenting the medical images is considered as a

basic of analysing and understanding the images in medical field [8]. The images are segmented and the features are extracted by Gabor feature extraction method and these extracted features are selected by using PSO-ANN method. The experiments were conducted on MATLAB and the performance of the method was evaluated by metrics such as Accuracy (Acc), Sensitivity (Sen) and Specificity (Spec).

II. PROBLEM DEFINITION

The automated system is developed for diagnosis of the diseases by using ultrasonic systems in recent years. During imaging, the system allows the extraction of vast data and good quality of information to detect the diseases. The evaluation of global conditions can be made by the process of feature extraction, analysis of images and classify the images by pattern recognition techniques. But no technique had yet improved the accuracy of the system or proved to be best in accuracy for classifying the kidney diseases. Therefore, the classification accuracy will be improved with the help of improving the existing pre-processing as well as classification model. This above mentioned limitations and the lack of solutions motivated this research work.

III. PROPOSED METHODOLOGY

In this work, the accuracy of the classification results can be improved by implementing the computer-aided system for classifying the normal and abnormal US infected images according to extraction of features and classification methods. The proposed method involves extracting the features based on multi-scale wavelet and classifying the images with the help of ANN in which the parameters are optimally chosen through PSO. In first step, the multi-scale wavelet features are extracted from ROI of each image. The ANN is used for classification of kidney images through extracted features and provides the better classification by combined with PSO algorithm

IV. ARCHITECTURE

The major components of our system are Database, Normalization, Feature selection, Feature extraction and Classification. Image segmentation is important in the fields of medical diagnosis. The purpose of image segmentation is to partition an image into meaningful regions concerning a particular application. Segmentation methods have been used to found the location, size, area, perimeter, diameter, etc. of tumor and severity. Computer aided diagnosis can be utilized as a second opinion for disease classification. In this thesis, effective devised methods are used for finding the abnormality in kidney images. CAD technology aims in developing an image segmentation tool to automatically detect cyst and incorporate this feature in a knowledge based artificial intelligent decision support system.
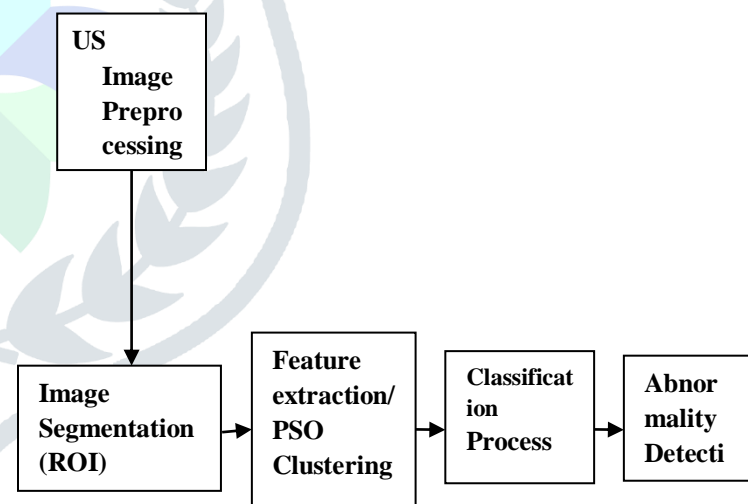
Figure 4.1 CAD technology architecture in PSO

. Also, telemedicine allows the use of modern telecommunications and information technologies for the provision of clinical care to individuals at remote areas and the transmission of information to provide that care.

In the computer aided medical diagnostic system, the result obtained from the computer is used as the second opinion by the radiologists.

In automated computerized medical diagnosis, the performance level of the system of equipment requires being very high and the result obtained from this system is used for further treatment. In case of automated system, the sensitivity and specificity of the automated system should be very high. The main difference between automated computer diagnosis and CAD lies in the quantitative evaluation. CAD gives a performance similar to that of a physician while automated system gives the performance akin to that of a computer. If specificity and sensitivity of a computer are low, then many false positives will be found, and the automated system becomes a failure.

V. Artificial Immune Recognition System (AIRS)

Artificial immune systems (AIS) are digital intelligent systems which are based on the principles and processes of the vertebrate immune system introduced in the mid of 1980 by Farmer. The learning of AIS algorithms typically helps to find out the immune system's characteristics and memory to solve a problem. The processes involved in AIRS are. Normalization of data and its initialization.

- Identification of memory cell, Artificial Recognition Balls generation and competition for resources in the creation of a candidate memory cell.
- Introduction of the potential candidate memory cell into the set of established memory cells.

VI. OPTIMIZATION TECHNIQUES USING SWARM INTELLIGENCE

Swarm intelligence (SI) is a self-organized and shared behavioural system. It was firstly introduced in the context of cellular robotic systems by Glen L et al., in the year of 2014. SI is an intelligent optimization technique inspired by the collective behavior of birds, fishes, and colonies of insects while searching for food. There is no centralized controller but they exhibit complex global behaviour, and all individuals follow simple rules to interact with neighbours. The general rules of birds flocking are 1) Collision Avoidance 2) Velocity Matching 3) Flock Centring. The optimization potential of collective behaviors of insects has been studied in many types of research.

An insect may have only a few hundreds of brain cells but insect colonies are capable of elaborating communication systems, to develop terrific resistance to the threats, to develop complex social relationships and creation of intellectual skills. The similar behaviors are also observed in birds flocking and fish schooling. SI methods are part of the meta-heuristic family of algorithms. Artificial Neural Networks is one of the soft computing techniques used for data classification where SI plays a vital role in improving the results.
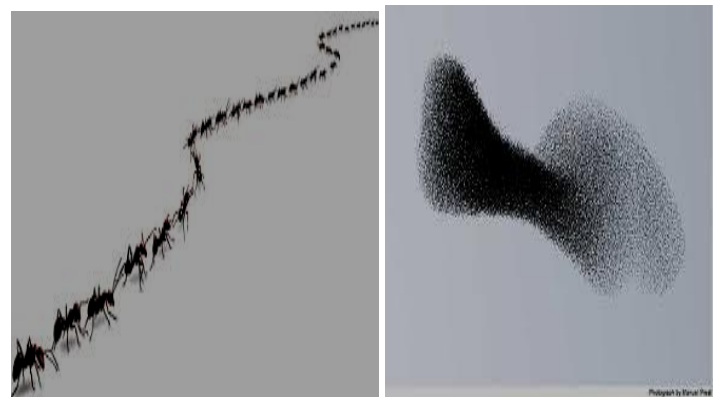

Figure 6.1 Ant Colonies and Swarm of bees

Procedure of PSO

```
Generate random population of N solutions
(particles);
For(i=0;i< Swarm_Size;i++)
    Evaluate fitness f(x_i)
    Initialize the value of weight factor ω;
while (termination condition is not true)

    {
        for(i=0;i< Swarm_Size;i++)
          {
                  if(f(x_i)>pbest_i) pbest_i=x_i;
                  if(pbest_i>gbest_i)
          gbest_i=pbest_i;
                  Update(Position          x_i,
Velocity v_i);
              Evaluate f(x_i);
          }
    }
```
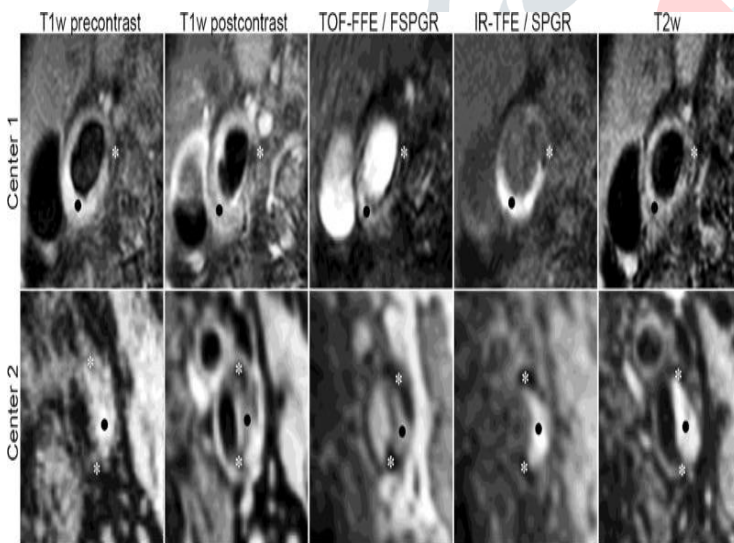

Figure 6.2 Multi-center MRI images with high resolution

VII. CONCLUSIONS

This work has reviewed methods and algorithms of kidney diagnosis using ultrasound imaging system. The image denoising using NSCT and edge enhancement has provided better results in image preprocessing stage. Algorithm for detection and segmentation of kidney cyst proposed has given the high percentage of accuracy and is very useful in assisting kidney diagnosis.

The Swarm Intelligence techniques have been used extensively with various types of Artificial Neural Networks (ANN) for improving the performance. Artificial Neural Networks is one of the soft computing techniques used for data classification where SI plays a vital role in improving the results. Swarm intelligence algorithms have proved to be very efficient in solving real-world optimization problems. The Swarm Intelligence based approaches are applied in Military Applications, Robotics Navigation and Space Research. SI algorithms include Particle Swarm Optimization (PSO), Ant Colony Optimization, Stochastic Diffusion Search, and Bacteria Foraging, etc. The accuracy obtained with our proposed system was 98% because of PSO clustering which is superior to any other method proposed in the literature.

VIII. FUTURE SCOPE

Further research directions may include development of techniques for faster indexing and search mechanisms which efficient image retrieval and inferences. It can be extended to support General Packet Radio Service (GPRS), which is a new non-voice value added service that allows mobile phones to be used for sending and receiving data over an Internet Protocol (IP)- based networks.

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