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CUCKOO SEARCH ALGORITHM – ARTIFICIAL NEURAL NETWORKS FOR KIDNEY STONE DETECTION

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Abstract - *Computed Tomography (CT) Scan imaging is used to provide the structural abnormalities like stones, infections and cysts for kidney disease and also produces information about the kidney. The goal of this work is to classify the kidney images using CT according to the process of feature extraction. The images of a kidney are classified as abnormal images by algorithms and preprocessing techniques (i.e. grey-scale conversion), generate ROI, using of sobel filtering and edge detection method for extracting the features and Cuckoo Search (CS) for optimization and Artificial Neural Network (ANN).This techniques are used for detection of kidney stones through different steps of image processing. The first step is the image pre-processing using filters in which image gets smoothed as well as the noise is removed from the image. Image enhancement is a part of preprocessing which is used to enhance the image. CT has low noise compared to other images such as x-ray and ultrasound. The CS-ANN method is performing on the platform of MATLAB. By comparing it with the existing methods, the CS-ANN has the 0% of false-acceptance rate.*

***Key Words*: Kidney Stone, Preprocessing, Cuckoo search, Artificial Neural Network.**

1. INTRODUCTION

Kidney-Urine-Belly computed tomography (KUB CT) analysis is an imaging modality that has the potential to enhance kidney stone screening and diagnosis proposed by Saman Ebrahimi and Vladimir Y. Mariano et.al., This study explored the development of a semi-automated program that used image processing techniques and geometry principles to define the boundary, and segmentation of the kidney area, and to enhance the kidney stone detection. The detected kidney stones and provided an output that detected the size and location of the kidney based on pixel count. The program was tested on standard KUB CT scan slides from 39 patients at Imam Reza Hospital in Iran who were divided into two groups based on the presence and absence of kidney stones in their hospital records. The program generated six inconsistent results which were attributed to the poor quality of the original of CT scans. Results of the program has 94.61 percent accuracy, which suggests the program's potential in diagnostic efficiency for kidney stone detection.

2. OVERVIEW

Kidney stone imaging is an important diagnostic tool and initial step in deciding which therapeutic options to use for the management of kidney stones. Guidelines are provided by the American College of Radiology, American Urological Association, and European Association of Urology differ regarding the optimal initial imaging modality to use to evaluate patients with suspected obstructive nephrolithiasis. Non contrast CT of the abdomen and pelvis are provides the most accurate diagnosis but also the exposes of the patients. The ultrasonography has a lower sensitivity and specificity than CT, but doesn't require the use of radiations. However, when these imaging modifications were compared in controlled trial that they were found to have equivalent diagnostic accuracy of the emergency department. Both have advantages and disadvantages. Kidney, ureter, bladder (KUB) plain film radiography is most helpful in evaluating for the interval of stone growth in patients with known stone disease, and is less useful in the setting of stones. MRI provides the possibility of 3D imaging without exposure to radiation, but it is costly and the stones are difficult to visualize.

3. ARTIFICIAL NEURAL NETWORKS

ANNs are considered as robust machine learning approaches capable of approximating the complex patterns. Interconnected computational neurons are arranged for the math metrical mapping during the process, which requires of weight values adjustment. In order to detect the kidney disease, the two phases are followed, i) the training phase that used for the training dataset to adjust the NN weights, ii) the evaluation of (test) phase that used to test dataset to evaluate the final solution for confirming the actual predictive power of the network.

The main idea of the NN lies in the artificial neuron that receives inputs, and then using the input signal (x) and the corresponding weights (w) to form 'net' input (net_j). The $net_j = \sum w_{ij}x_i$ is passed through i=1 a linear threshold (bias 'θ_j') filter. The signal output y is passes to another neuron and represented by:

$$y = e^{-\text{net}\, j + \theta\, j}$$

The initial weights, for the finite iterations, it is required to accomplish optimal weights using the perceptron learning [12]. The several constructions can be proposed to enhance the performance of NN. Two -layer perceptron FF- NN has been proved to be optimal for the classification step in the work. MCS optimization procedure is used to support the MLP-FFN optimal weight determination.

4. CUCKOO SEARCH ALGORITHM

Cuckoo search is considered as the most efficient meta-heuristic optimization procedure, which driven by obligates brood parasitism nature of cuckoo birds. In the current study the CS procedure using Levy flights is engaged to optimize the NN weights for further use in the prediction process. Cuckoos lay their eggs in the nest of other birds. These eggs are either being accepted or can be thrown (if they are detected as unknown). For the host bird's eggs, the cuckoo eggs are highly likely to be similar that reduces the probability of the cuckoo eggs from being detected. Afterwards, the algorithm uses the random walk by way of Levy flight behavior. Each egg in the CS refers to a new solution that can replace the weak in the nests. Three descriptive CS algorithm rules are as follows:

- One egg is laid by each cuckoo at a time with deposits it in an arbitrary nest.
- The superior nests containing a high quality solutions (eggs) will remain to the next iteration.
- The accessible fixed number of host nests is assumed. A $P_a \in = 0, 1$ probability is used to realize a foreign egg host, which can be estimated a fraction P_a of the ψ nests to be interchanged by fresh nests.

5. METHODOLOGY

The kidney malfunctioning can be life full of fear. So, the early detection of kidney stone is very important. Identification of kidney stone is vital in order ensuring the surgical operations as success. The ultrasound images of kidney comprise speckle noise and are of low contrast which makes the identification of kidney abnormalities are very difficulties. As a result, the doctors may find the identification of small stones is difficult and challenging for identify the stones. An automated system is developed for the diagnosis of kidney diseases by using ultrasonic systems. The system allows the extraction of data and good quality of information to detect the stone.

The global conditions can be made by the process of feature extraction, analysis of images and classify the images by pattern recognition techniques. But still, no techniques are improved the accuracy of the system or proved to be best in accuracy for classifying the kidney stone disease.

6. IMPLEMENTATION

The proposed system developed an image-driven method for the automatic segmentation of the images from CT scans. The methodology relies on image processing techniques such as, multi-thresholding, image filtering, but it also exploits the available of the kidney disease. The development of such a segmentation system has two major tasks initial step is, a pre-processing stage in which the region of interest (ROI) is delimited and the statistical parameters are computed and next step is, the segmentation procedure itself, which makes use of the data can get during the previous stage. To introduce the step of feature extraction and find out the best features and optimize by using of cuckoo search algorithm and artificial neural networks for classification of kidney images as normal as well as the abnormal images and then results of the stone detection.

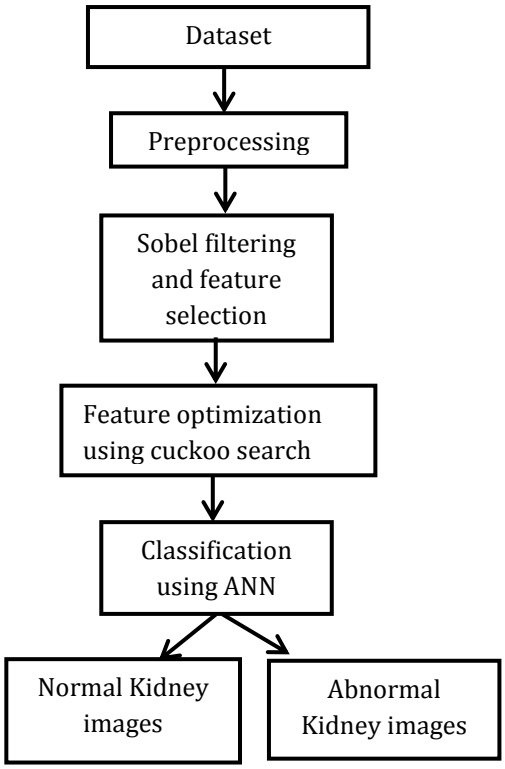

Fig.-1: System Architecture

A. Image Acquisition

The image can we get from the hospital is in the form of DICOM to perform the image processing it needs to convert as jpg. This can be done the way of Micro DICOM converter. The image is in Matlab using 'misread' command. Syntax: imread ('filename.jpg') .The image can be converted to grayscale image. To perform this 'rgb2gray' function is used.

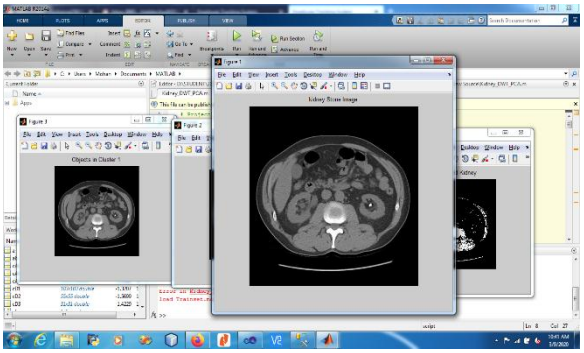

Fig -2: Kidney Stone Image

B. Image Preprocessing

There are various filters such as average filter, weighted average filter, Sobel and Gaussian filter but the sobel filter is the best way to remove the noise in the image. After filtering the image gets smoothed. The filtering is also done to smooth the image. Image enhancement is a technique is help to modify the intensities of the image. The image enhancing is used to improve the quality of the image. The best way to do is through using of histogram equalization. In this, each pixel intensity is modified and so if the image is towards the darker side then it gets stretched towards more white side and then the image is enhanced.

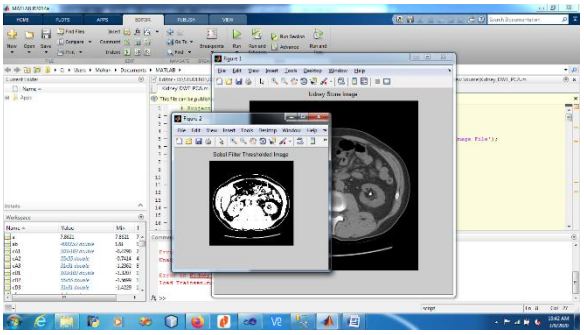

Fig-3: Sobel Threshold Image

C. Image Segmentation

The image segmentation means partitioning the image into different regions to extract the desired features. There are several ways of doing segmentation along with different algorithms, here, Sobel thresholding technique is used to segment the image. In this technique, threshold value based on the intensity of the pixel is selected and intensities below this value will become zero. Thresholding is done on the preprocessed image.

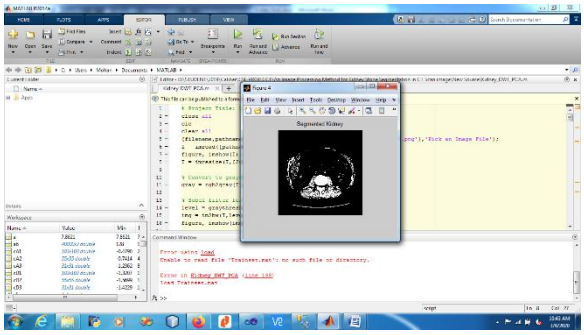

Fig.-4: Segmented Image

Finally gets the output of the kidney stone using the cuckoo search algorithm and artificial neural network.

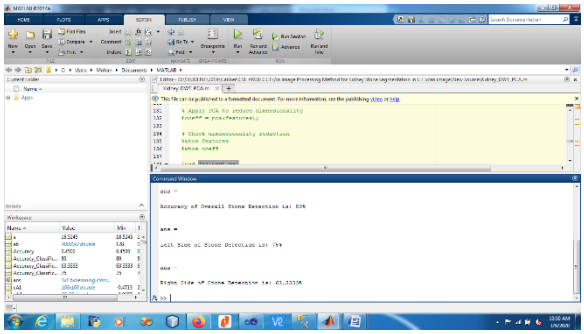

Fig- 5: Stone Detection Output

7. CONCLUSIONS

In future work, the proposed methodology will be designed for the real time implementation by interfacing it with the scanning machines. The captured kidney image will be subjected to the proposed algorithm to identify the affected region and for accurate classification of kidney stone.

REFERENCES

[1] Alkhammash, E., Mohamed, W. S., Ashour, A. S., & Dey, N. Designing Ontology for Association between Water Quality and Kidney Diseases for Medical Decision Support System. Conference: VI International Conference Industrial Engineering and Environmental Protection 2016 (IIZS 2016), At Zrenjanin, Serbia.

[2] Vijayarani S, Dhayanand S. Data mining classification algorithms for kidney disease prediction. International Journal on Cybernetics and Informatics. 2015.

[3] Yang XS, Deb S. Engineering Optimisation by Cuckoo Search.J. International Journal of Mathematical Modelling and Numerical Optimisation, 2010; 1(4): 330--343.

[4] Chatterjee S, Chakraborty R, Hore S, Dey N. A Quality Prediction method of Weight Lifting Activity. Proceedings of the Michael Faraday IET International Summit - 2015 (MFIIS-2015), an IET International Conference On September 12 - 13, 2015, India.

[5] Chatterjee S, Chakraborty R, et al. Particle swarm optimization trained neural network for structural failure prediction of multistoried RC buildings. Neural Computing and Applications, 2016; 1-12.

[6] Chatterjee, Sankhadeep, Forest Type Classification, A Hybrid PSO-NN Model Based Approach. Information Systems Design and Intelligent Applications, 2016.

[7] Chatterjee S, Hore S, Dey N, Chakraborty S, Ashour AS. Dengue Fever Classification using Gene Expression Data: A PSO based Artificial Neural Network Approach. 5th International Conference on Frontiers in Intelligent Computing: Theory and Applications; Springer, June 2016.

[8] Chatterjee S, Paladhi S, Chakraborty R. A Comparative Study on "The Performance Characteristics of Sudoku Solving Algorithms". IOSR Journals (IOSR Journal of Computer Engineering), 1(16): 69-77.

[9] Chatterjee S, Dey N, Ashour AS, Drugarin CVA. Electrical Energy Output prediction using Cuckoo Search supported Artificial Neural Network. World Conference on Smart Trends in Systems, Security and Sustainability (WS4 2017) at London, Volume: Springer LNNS series, February 2017.

[10] Chatterjee S, Nag R, Dey N, Ashour AS. Efficient Economic Profit Maximization: Genetic Algorithm based Approach. World Conference on Smart Trends in Systems, Security and Sustainability (WS4 2017) At London, UK, Volume: Springer LNNS series, February 2017.

[11] Lichman M (2013). UCI Machine Learning Repository [http://archive.ics.uci.edu/ml]. Irvine, CA: University of California, School of Information and Computer Science.