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USE OF ARTIFICIAL NEURAL NETWORK TO IDENTIFY CARCINOMA CELL

Miss. Kuralkar Samruddhi S. *, Dr. Deshmukh P.R. *

Department of computer science and engineering Sipna college of engineering and technology Amaravati , India

***Abstract** -Artificial neural networks have featured in a wide range of medical fields, often with promising results. This paper reports on a review benefit of artificial neural networks (ANNs) as decision making tools in the field of cancer. Artificial neural network are used to find relationship between input and output or recognized pattern in data. Here we have to recognized cancer cell pattern. This addresses the system which achieves cell characterization for finding percentage of cancer cells in the given image with high accuracy. Harris corner detection Algorithm itself scans the whole image and performs the classification of cancer cell. Artificial neural networks are used to aggregate the analyzed data from these images to produce a diagnosis prediction with high accuracy instantaneously where digital images serve as tool for input data. Hence in the process of surgery these automated systems help the surgeon to identify the infected parts or cells in case of cancerous growth of cells to be removed with high accuracy hence by increasing the probability of survival of a patient. In this proposal one of such an automated system for cancer cell classification which helps as a tool assisting surgeon to differentiate cancerous cells from those normal cells i.e. percentage of carcinoma cells, instantaneously during the surgery. Here the pathological images serve as input data. Finally, algorithm was applied to selected pathological images for classification. This design can be extended to estimate the number of carcinoma cells per unit area.*

Index Terms— Grey scale images, Harris corner detector, Artificial Neural Network(ANN), Artificial Neuron, Synapses.

I.INTRODUCTION

For many years cancer diagnosis has been a learning problem. Various learning algorithms has been widely used. The problem is basically nontrivial and not easy to solve because the data set is relatively small and noisy. For such problem technique which are used mainly rely on a large training data set would not work well. In developed countries, cancer has become a major cause of death among people. To reduce cancer deaths the most effective way is to detect it earlier. However earlier treatment requires the ability to detect cancer in early stages. Early diagnosis requires correct and reliable diagnosis procedure that will allows physicians to distinguish benign carcinoma cell from normal cell . The most important is automatic diagnosis of cancer and it is real-world medical problem. So, to find an accurate and effective diagnosis method is very important. Knowledge of cancer cell growth is important in the planning and evaluation of screening programs, clinical trials and epidemiological studies. The successful treatment of most critical illnesses is based on early and accurate detection. The use of technology in medicine has changed the face of medical practice completely. But most of this technology is based on detecting the problem only after it has occurred. Even with the availability of superior computing and imaging capabilities, the concept of “prevention is better than cure” has not caught in medical practice. The human body is made up of many cells. Normally, the cells grow and die in a controlled manner. However, sometimes, cells will keep dividing in an uncontrolled manner, forming cancer. Most cancer cell do not invade surrounding tissues and are non-life threatening. They are deemed benign cancer cell. If the cancer cell does invade and destroy nearby tissues, it is classified as cancer and might threaten the person's life.

The occurrence of cancer cell is preceded by gradual change in cell density in the neighborhood. If these signs are detected then it is possible to prognosticate the severe conditions that are likely to occur. In this case the cancer can be predicted well before it actually appears and appropriate counter measures can be taken at an earlier stage with a higher degree of success. The effectiveness of such a system is gauged by how early the changes are detected and the accuracy of the predictions. In the field of automated diagnostic systems plays an important and vital role Image processing are one such field where numerous systems are proposed and still many more under conceptual design due explosive growth of the technology .artificial neural networks are used to aggregate the analyzed data from these images to produce a diagnosis prediction with high accuracy instantaneously where digital images serve as tool for input data. Hence in the process of surgery these automated systems help the surgeon to identify the infected parts in case of cancerous growth of cells to be removed with high accuracy hence by increasing the probability of survival of a patient. In this proposal one of such an automated system for cancer cell classification which helps as a tool assisting surgeon to differentiate cancerous cells from those normal cells i.e. percentage of carcinoma cells, instantaneously during the surgery. Here the pathological images serve as input data. ***Harris corner detection Method*** [1] itself scans the whole image and performs the classification of cancer cell. Since the neural networks are used as classifiers in this design which takes only numerical data as input rather than any kind of data as input by using feature Extraction, the input image data has to be converted to numerical form.

This paper describes neural network approaches to cancer diagnosis. Neural networks have been widely used for cancer diagnosis. However, most of these applications assumed a predefined network architecture and used a training algorithm. Supervised feed-forward back-propagation neural network ensemble used as a classifier tool. As discussed , neural network differs in various ways from traditional classifiers . One of the main differences is linearity of data. Traditional classifiers requires linear data to work correctly. But neural network works as well for nonlinear data because it is simulated on the observation of biological neurons and network of neurons. Wide range of input data for training makes neural network to work with higher accuracy, in other words a small set of data or large set of similar data makes system to be biased . Thus neural network classifier requires a large set of data for training and also long time to train to reach the stable state.

II. LITERATURE REVIEW

The number of research works conducted in the area on cancer detection, classification, scoring and grading. Many university centers, research centers and commercial institutions are focused on this issue because of the fact that cancer is becoming the most common disease in today's population.

A systematic literature search was conducted for entries during the period 1994–2003 with the keywords 'neural networks'. The search was limited to clinical trials and randomized controlled trials .The search was repeated using the keywords (neural networks) and (cancer) from 1994 to the current date. Cervical cancer applications concentrated mainly on the benefits. one of very few ANNs systems use for clinical use. The system uses ANNs to extract abnormal cell appearance from affected side and describe them in histological terms . The alternative more conventional way is to rescreen the slides under the microscope. Mango and Valente have shown that the PAPNET[2] system uncovered a higher proportion of false negatives than conventional microscopic re-screening as confirmed by cytologists an interesting feature of neural network decision support in medicine is the routine without listing supportive clinical trials. The Wisconsin cancer database using a hybrid symbolic- connectionist system was provided by Ismail Tahe and Joydeep Ghosh [4]at university of texas, Austin. This paper introduces a new rule ordering and evaluation algorithm that orders extracted rules based on three performance measures so they can be used by any generic interface engine. Moreover, it introduces an algorithm to inspect the network's output as well as that derived rule base subsystem and provides a final decision, along with an associated confidence measure.

The Cancer detection and Classification using Neural Network was provided by Shekhar Singh and Dr. P.R. Gupta[5] at International journal of advance engineering science and technologies . This paper proposes a method for automatic cancer detection, classification, scoring and grading to assist pathologists by providing second opinions and reducing their workload. A computer-aided cancer detection, classification, scoring and grading system for tissue cell nuclei in histological image is introduced and validated as part of the Biopsy Analysis System. Cancer cell nuclei are selectively stained with monoclonal antibodies, such as the ant estrogen receptor antibodies, which are widely used as part of assessing patient prognosis in cancer. Next Parallel Approach for Diagnosis of Cancer using Neural Network Technique was provided by Dr. K. Usha Rani [2] at International Journal of Computer Applications. In this paper a parallel approach by using neural network technique is proposed to help in the diagnosis of cancer. The neural network is trained with cancer database by using feed forward neural network model and back propagation learning algorithm with momentum and variable learning rate. The performance of the network is evaluated. The experimental result shows that by applying parallel approach in neural network model yields efficient result.

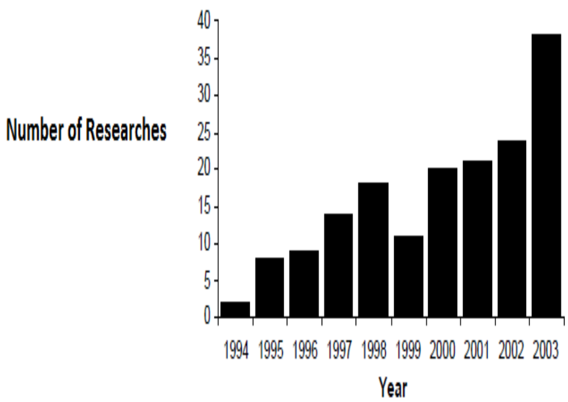

Fig 1:Number of researches involving the use of ANNs in the last decade.

III. PROPOSED WORK

The analysis of these pathological images is directly based on four steps:

i) Image filtering or enhancement,
ii) Segmentation,
iii) Feature extraction, and
iv) Analysis of extracted features by pattern recognition system or classifier .

Since neural network ensembles are used as decision makers in Intelligent Systems even though network takes more time to adapt behavior, once it is trained it classifies almost instantaneously due to electrical signal communication of nodes in the network.

- ***System Architecture***

The ANN architecture is shown in below figure . It comprises of five distinct components, as show below. Each component is described briefly in subsequent sections.

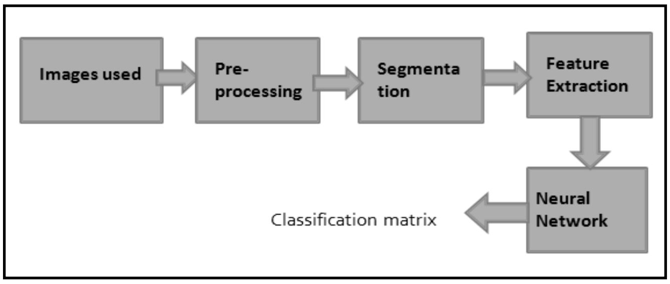

Fig 2 : ANN system architecture

- *Images used*

This system is designed and verified to take grey scale pathological images as input. Grey scale pathological images help to identify affected cells makes these images for analysis of cancerous growth of cells.

- *Pre-processing*

Grey scale pathological imaging process may be dirtied by various noises. Perform an image pre processing task to remove noise in a pathological image first.

- *Segmentation*

Segmentation includes two phases. First phase deals with corner point detection and the later one with similar region identification. For corner point detection various methods like harris corner detectors[1] can be used. Since this design mainly deals with multiple objects (cells) in an input image, Harris corner detectors are used to find corner point . In second phase, points detected by corners serve as seed point for segmentation.

- *Feature Extraction*

Neural network classifiers are those differ from traditional classifiers in various aspects from type of input data to output representation. Since the neural networks are used as classifiers in this design which takes only numerical data as input rather than any kind of data as input. the input image data has to be converted to numerical form. This conversion is done by extracting texture features.

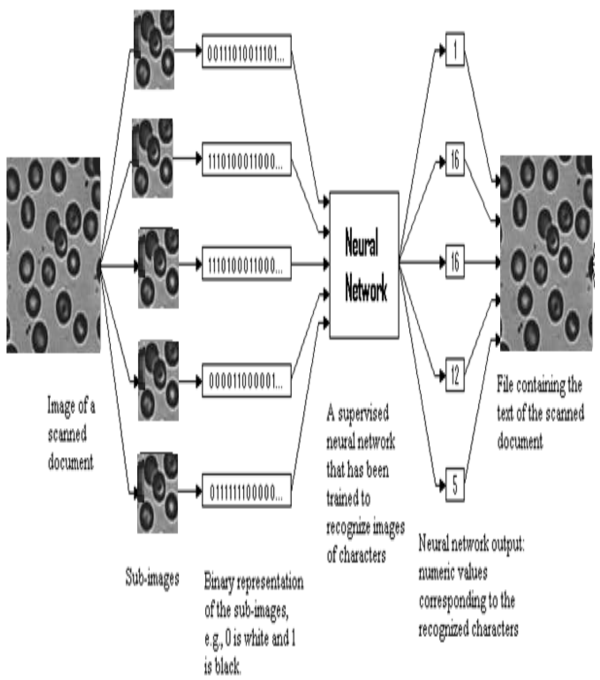

Fig 3: conversion of input image in numerical for

- *Neural Network*

Supervised feed-forward back-propagation neural network ensemble used as a classifier tool. As discussed previously, neural network differs in various ways from

traditional classifiers like Bayesian and k – nearest neighbor classifiers. One of the main differences is linearity of data. Traditional classifiers requires linear data to work correctly. But neural network works as well for non linear data because it is simulated on the observation of biological neurons and network of neurons Wide range of input data for training makes neural network to work with higher accuracy, in other words a small set of data or large set of similar data makes system to be biased Thus neural network classifier requires a large set of data for training and also long time to train to reach the stable state. But once the work is trained it works as fast as biological neural networks by propagating signals as fast as electrical signals.

IV.TECHNIQUE USE TO DETECT CANCER CELL

- ***Harris corner detector***

A corner can be defined as the intersection of two edges. A corner can also be defined as points for which there are two dominant and different edge directions in a local neighborhood of the point. An interest point is a point in an image which has a well-defined position and can be robustly detected. This means that an interest point can be a corner , for example, an isolated point of local intensity maximum or minimum, line endings, or a point on a curve where the curvature is locally maximal.

In practice, most so-called corner detection methods detect interest points in general, rather than corners in particular. As a consequence, if only corners are to be detected it is necessary to do a local analysis of detected interest points to determine which of these real corners are. A simple approach to corner detection in images is using correlation, but this gets very computationally expensive and suboptimal. Harris corner detector[1] is one such corner detector, which uses differential of the corner score with respect to direction directly, instead of using shifted patches. This corner score is often referred to as autocorrelation. The algorithm of haris corner detector as follows:

Without loss of generality, we will assume a grayscale 2-dimensional image is used. Let this image be given by *I*. Consider taking an image patch over the area (*u*,*v*) and shifting it by (*x*,*y*). The weighted sum of squared differences (SSD) between these two patches, denoted *S*, is given by.

$$S(x,y) = \sum_u \sum_v w(u,v)\,(I(u+x,v+y) - I(u,v))^2 \qquad (1)$$

I(*u* + *x*,*v*+ *y*) can be approximated by a Taylor expansion . Let *Ix* and *Iy*be the partial derivatives of *I*, such that

$$I(u+x,v+y) \approx I(u,v) - I_x(u,v)x + I_y(u,v)y \qquad (2)$$

This produces the approximation

$$S(x,y) \approx \sum_u \sum_v w(u,v)(I_x(u,v)x + I_y(u,v)y)^2 \qquad (3)$$

This can be written in matrix form:

$$S(x,y) \approx (x\ y)A\begin{pmatrix} x \\ y \end{pmatrix} \qquad (4)$$

Where *A* is the structure tensor,

$$A = \sum_u \sum_v w(u,v)\begin{bmatrix} I_x^2 & I_xI_y \\ I_xI_y & I_y^2 \end{bmatrix} = \begin{bmatrix} \langle I_x^2 \rangle & \langle I_xI_y \rangle \\ \langle I_xI_y \rangle & \langle I_y^2 \rangle \end{bmatrix} \qquad (5)$$

This matrix (5) is a Harris matrix, and angle brackets denote averaging (i.e. summation over (*u*,*v*)). If a circular window is used, then the response will be isotropic. A corner (or in general an interest point) is characterized by a large variation of *S* in all directions of the vector (x,y). By analyzing the eigen values of *A*, this characterization can be expressed in the following way:

A should have two "large" eigen values for an interest point. Based on the magnitudes of the eigen values, the following inferences can be made based on this argument:

If $\lambda 1 \approx 0$ and $\lambda 2 \approx 0$ then this pixel (*x* ,*y*) has no features of interest.

If $\lambda 1 \approx 0$ and $\lambda 2$ has some large positive value, then an edge is found.

If $\lambda 1$ and $\lambda 2$ have large positive values, then a corner is found.

below fig shows corner points of infected area

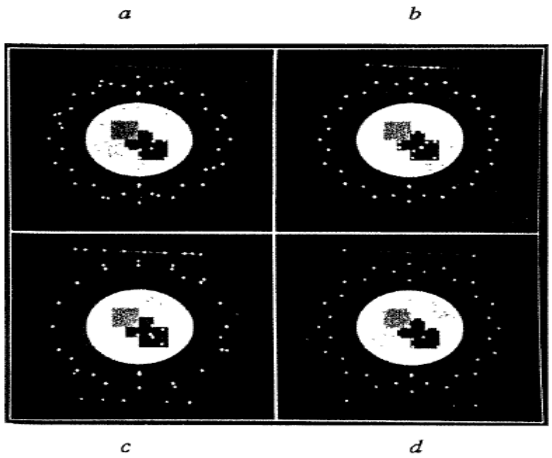

Fig 3. Corner detection of image

By applying harries corner detection method with the help of above procedure we can find out corners of infected area.

- *Analysis of extracted features*

Texture features corresponding to human perception and these features examined by 6 different constituent features .Six features are:

- Coarseness – Coarseness is the numerical value describing whether texture is coarse or fine.
- Contrast – Contrast defines whether texture contrast is high or low.
- Directionality – Directionality defines whether texture pallets are oriented in single direction or not i.e .directional or non-directional.
- Line-likeness – Line-likeness correspond to pattern elements i.e. whether texture formed by lines i.e. line like or blob-like.
- Regularity – Regularity defines the interval in which patterns repeated. If

patterns are repeated in regular interval then the texture is regular else it is said to be Irregular.

- Roughness – Roughness defines the whether the surface is rough or smooth.

In these six features, Coarseness, Contrast and Directionality correspond to strong human perception and these features are calculated pixel-wise by creating histogram of these features.

V. ARTIFICIAL NEURAL NETWORK

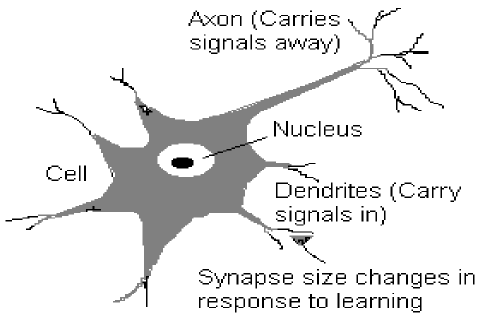

Fig 5. Neuron Schema

Many tasks involving pattern recognition are extremely difficult to automate. The neural network is part of its nervous system, containing a large number of interconnected neurons (nerve cells). Artificial neural networks are computing systems whose central theme is borrowed from the analogy of biological neural networks. A neural network is a massively parallel distributed processor that has a natural propensity for storing experiential knowledge and making it available for use. It resembles the brain in two respects:

1. Knowledge is acquired by the network through a learning process.
2. Interneuron connection strengths known as synaptic weights are used to store the knowledge.

Artificial neural networks are also referred to as neural nets artificial neural systems parallel distributed processing systems and connectionist systems. For computing systems to be called by these names, it is necessary for the system to have a labeled directed graph structure where nodes perform some simple computations. From elementary graph theory we recall that a directed graph consists of a set of ,nodes' (vertices) a nd a set of ,connections connecting pairs of nodes. A graph is a labeled graph if each connection is associated with a label to identify some property of the connection. In a neural network, each node performs some simple computations, each connection conveys a signal from one node to another, labeled by a number .

Benefits of neural network

- Nonlinearity.
- Input-output mapping.
- Adaptivity.
- Contextual information.
- Fault tolerance.
- Uniformity of analysis and design.
- Neurobiological analogy.
- Model of a neuron

VI. DETECTION OF CANCER CELL

In below figure we can see how cancer cell is detected.

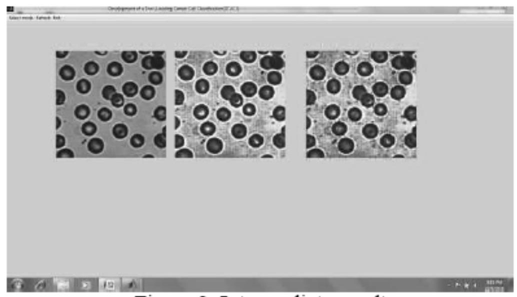

Fig 6:Cancer Cell Detection

Figure shows the intermediate result after corner detection. First image in figure is the input image, 2nd image displayed is histogram equalized image by removing noise in the image. After removing noise from image by using harries corner detection we can detect cancer cell as shown in 3rd image .detected cancer cell is marked with red marks as shown in image.

VII. FUTURE SCOPE

In this proposal there is one of such system for cancer cell classification which helps as a tool assisting surgeon to differentiate cancerous cells from the normal cells. In future we will try to implement such a system which will help for detecting cancer cell of specific type. Means we will implement such system which detects specific type of cancer cell whether it is lung cancer or liver cancer or blood cancer, etc. In this we take grey scale pathological images as input. In future this can extended to take color image as input with more feature added to feature vector to increase the accuracy of the output.

VIII. CONCLUSION

A review of listed publications involving clinical trials of neural network systems identified trends in areas of clinical promise, specifically in the diagnosis, prognosis and therapeutic guidance for cancer, but also the need for more extensive application of rigorous methodologies. . In this proposal one of such an automated system for cancer cell classification which helps as a tool assisting surgeon to differentiate cancerous cells from those normal cells i.e. percentage of carcinoma cells. Here by using Haris corner detector algorithm we detect the four corners of infected area. Haris corner detector is one such corner detector, which uses differential of the corner score with respect to direction directly.

Algorithm was applied to selected pathological images for classification. This design can be extended to estimate the number of carcinoma cells per unit area. So we can use Harris corner detection method to detect infected area by cancer.

IX. REFERENCES

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