# Brain Tumor Classification Using PNN And Clustering

P.Sangeetha

Department of Electronics and communication engineering, Nehru institute of Technology, Coimbatore, Tamilnadu, India.

**ABSTRACT –** Probabilistic Neural Network (PNN) also termed to be a learning machine is preliminarily used with an extension of various image classifications based on Training networks and Testing networks. To efficiently detect Brain Tumor cells, clustering method based on FCM can also be implemented. The Probabilistic Neural Network (PNN) will be employed to classify the various stages of Tumor cut levels such as Benign, Malignant or Normal. Probabilistic Neural Network with Radial Basis Function will be applied to implement tumor cells segmentation and classification. Decision should be made to classify the input image as normal or abnormal cells. This can be performed in two stages: Gray-Level Co-occurrence Matrix and the classification using Neural Network based function. The schematic method for Computerized Tomography based tumor cells detection is done using human inspection method. Probabilistic Neural Network with Discrete Cosine Transform has been imparted for Brain Tumor Classification. Prediction of malignant cells or non-tumor cells can be executed using two variants: i) Feature extraction using the Discrete Cosine Transform and ii) classification using Probabilistic Neural Network (PNN).

**KEYWORDS:** Radial Basis Function based PNN, DCT, Preprocessing and GLCM

## I.INTRODUCTION

A brain tumor is an intracranial solid neoplasm or abnormal growth of cells within the brain or the central spinal canal. Brain tumor is one of the most Common and deadly diseases in the world. Detection of the brain tumor in its early stage is the key of its cure. There are many different types of brain tumors that make the decision very complicated. So classification of brain tumor is very important, in order to classify which type of brain tumor really suffered by patient. A good classification process leads to the right decision and provide good and right treatment. Treatments of various types of brain tumor are mostly depending on types of brain tumor.

Treatment may different for each type, and usually determined by:

- Age, overall health, and medical history
- Type, location, and size of the tumor
- Extent of the condition
- Tolerance for specific medications, procedures, or therapies
- Expectations for the course of the condition.
- Opinion and preferences

Classification of tumor is to identify what type of tumor it is. The conventional methods, which are present in diagnosis, are Biopsy, Human inspection, Expert opinion and etc.

The biopsy method takes around ten to fifteen days of time to give a result about tumor. The human prediction is not always correct, sometimes it becomes wrong but a computer cannot. The expert, himself cannot take the decision rather he refers to another expert to give his opinion, this process continues for long time.

## II.LITERATURE SURVEY

In general, early stage brain tumor diagnose mainly includes Computed Tomography (CT) scan, Magnetic Resonance Imaging (MRI) scan [1]-[5], Nerve test, Biopsy etc. At present with the rapid growth of the Artificial Intelligence (AI) development in Biomedicine, computer-aided diagnosis attracts more and more attention. In this paper, based on the power of Probabilistic Neural Network (PNN) [1], a computer-aided brain tumor classification method is proposed. It utilized the feed-forward neural network to identify which type of brain tumor suffered by patient regarding to the image of brain tumor from the Magnetic Resonance Imaging (MRI) [2] and Computed Tomography (CT) scan as inputs for the network.

## III.EXISTING SYSTEM

In detecting the brain tumor type of each patient, doctor usually refer MRI image and make the report about the MRI analysis of the patient. This method will help doctor in diagnosing brain tumor patients. With the existence of proposed system, doctor can train the system with some known data and then, use this system to generate the MRI report of the patient after testing the data. The intensity is varied from one MRI [1]-[5] signal to the other and also even with a single signal [1].

Much more regularization techniques have been developed. An algorithm could decrease the contrast level between cells and brain tissue by thinking the en-hancement of contrast level. Few approaches came in applying Discrete Cosine Transform (DCT) [2] to decrease redundancy gradually in images. To use the information for classification DCT [4] can also be employed. The system first computes its discrete constituents (coefficients of the many images) [2]-[5]. Selecting a fixed number for DCT elements are to be done before representing them as inputs to the step of classification [2].

Feature selection plays an important role in classifying systems such as neural networks (NNs) [3]. A set of attributes that are nearer, dissimilar or surplus from dealing a set of data which is large in count; decreases the number of attributes by giving only the relevant images as desirable output. In doing so, two feature selection algorithms can be achieved [3]. 6 stages are involved which are commencing from the image input to output. Generally, in image processing system, image enhancement paves the way [5] to enhance the color or contrast of the particular image.

## IV.PROPOSED SYSTEM

Out proposed system will be having various parts as:

- Input Image
- Discrete Wavelet Decomposition (DWT)
- GLCM Feature Extraction
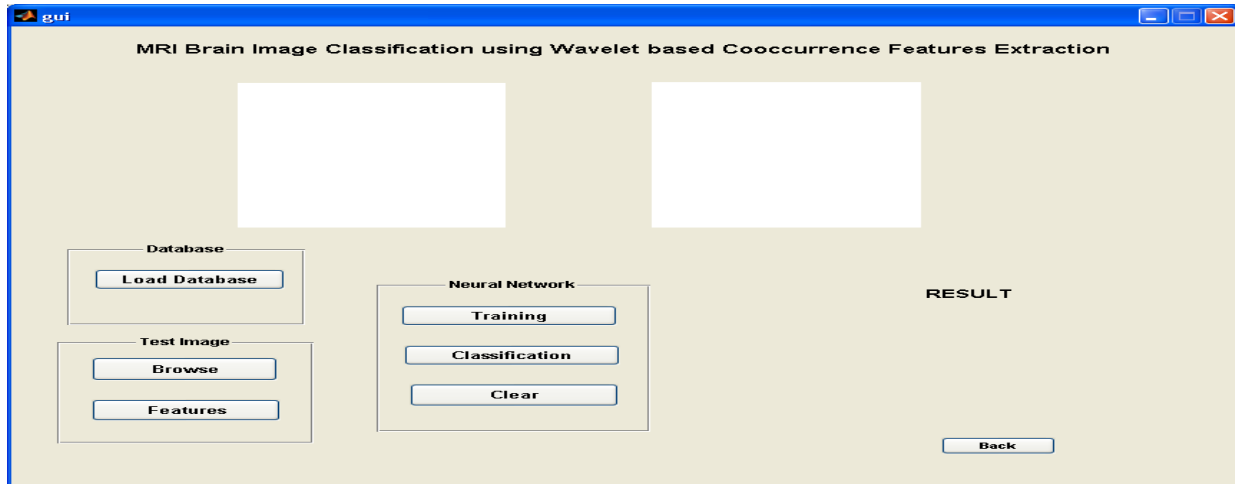- PNN-RBF Training & Classification

Fig 1: Matlab GUI representation of our Proposed Algorithm

## V. INPUT IMAGE

In imaging, or imaging sciences, image processing is nothing but any form of signals can be processed for which the input is an image, such as a pictorial representation or PICture Element, i.e., PIX-EL or a video frame

Multi level Wavelet Decomposition with Level-4

Wavelet filter of order four is used and identified to get back good results in classification and segmentation of tumor from the brain CT images. By applying 2D DWT, two level wavelet decomposition of Region of Interest (ROI) is done which results in four sub bands. In 2D level decomposition the image is displayed as an approximation and three detail images, representing the low and high frequency contents image correspondingly. LL1, LL2 represent the wavelet approximations at 1st and 2nd level respectively, and are low frequency part of the images. LH1, HL1, HH1, LH2, HL2, HH2 represent the details of horizontal, vertical and diagonal directions at 1st and 2nd level correspondingly and are high frequency part of the images. This DWT can be implemented in many ways such as to compress an image file, to transform the data based on: low level, mid level, high level, etc.

Fig 2: Wavelet Decomposition Level - 4
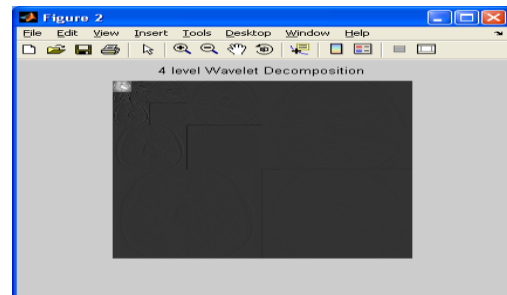


## VI. GLCM EXTRACTION FEATURE

Gray-level co-occurrence matrix (GLCM) is the statistical method of examining the textures that considers the spatial relationship of the pixels. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship that present in an image, forms GLCM. This forms the extraction of statistical measures from this matrix.

The gray-co-matrix function in MATLAB creates a gray-level co occurrence matrix (GLCM) by calculating how often a pixel with the intensity (gray-level) value (for instance) row occurs in a specific spatial relationship to a pixel with the value by row and column. The relationship is defined as the picture elements with respect to the features present and the pixel to adjacent

sides, but the specification will be on other spatial relationships between the two pixels.

Each element (i, j) in the final outcome of GLCM which is simply the sum of the number of times that the elements of image with value I occurred in the specified spatial relationship to a pixel with value j in the input image. A GLCM is a matrix where the number of

rows and columns is equal to the number of gray levels, G, in the image. Various features are extracted from GLCM.

$$p_x(i) = \sum_{j=0}^{G-1} P(i,j) \text{ and } P_y(j) = \sum_{i=0}^{G-1} P(i,j)$$
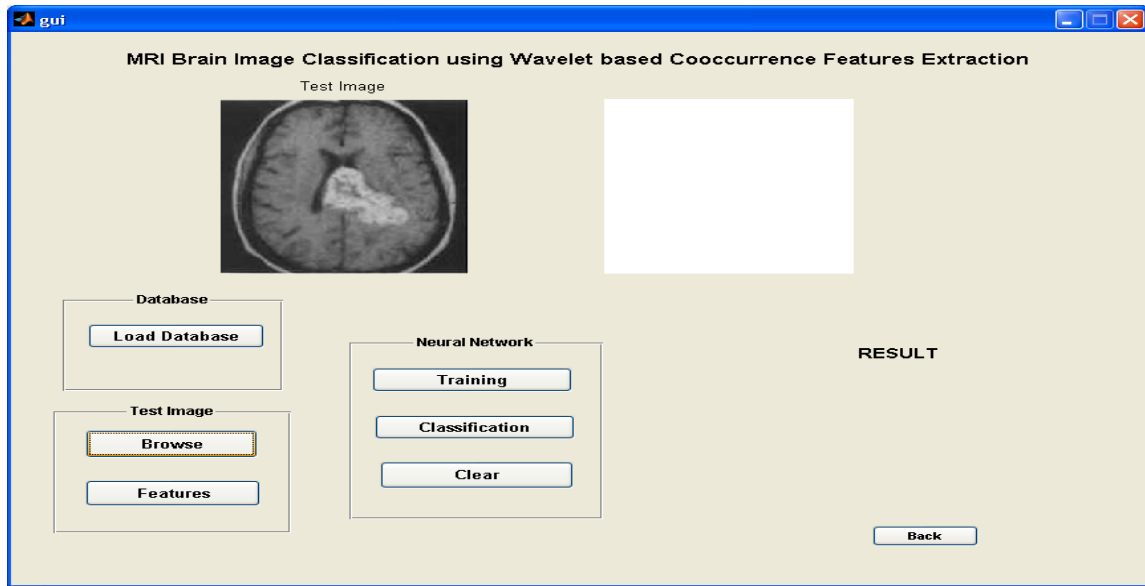
.. (1)



*Fig 3: Representation of Input Image and Training the Database*

**VII.PNN -RBF TRAINING AND CLASSIFICATION**

Probabilistic Neural Network is a classification of Radial Basis Function (RBF) network. The fundamental architecture of this Neural Network is having various layers, Input Weights Layer, a Rule Layer, and an exhibiting layer called Output Layer. The Rule layer or the Pattern Layer constitutes a neural implementation of a classifier and their performances. The class dependent Probability Density Functions (POF) is approximated using an estimator called the Parzen estimator. It determines the Probability Density Functions by reducing the awaited danger in classifying the training set incorrectly. Using the Parzen estimator, the classification gets closer

to the true underlying class density functions as the number of training samples increases, the pattern layer consists of a processing element corresponding to each input vector in the training set. All the output parameters in the pattern layer is tested and trained based on the Neural Network once. An element is trained to return a high output value when an input vector matches the training vector. To obtain more generalization a factor is included to smooth the signals while training the network. The pattern layer classifies the input vectors based on ranking level, where only the highest smoothing vector to an input vector wins and generates an output.
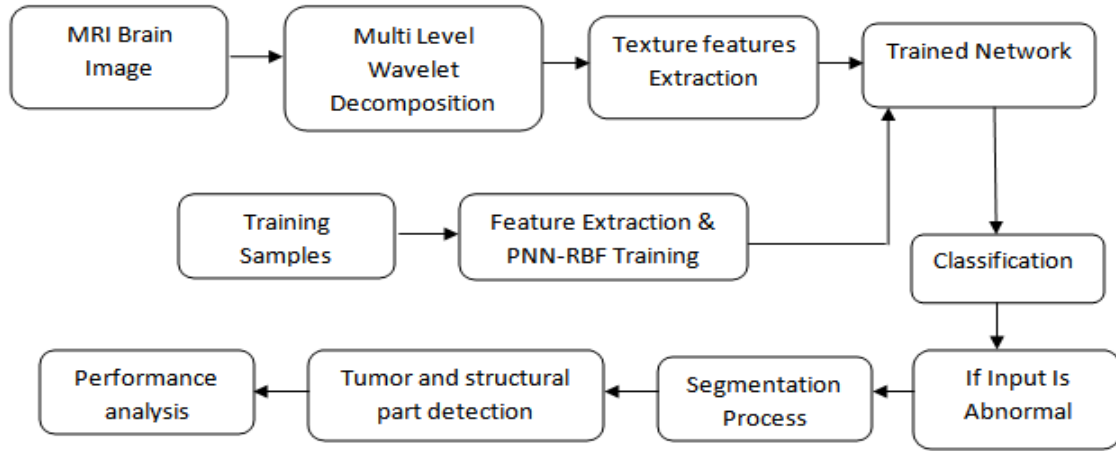
Fig 4: Block Diagram representation of our overall view

Hence only one classification category is generated for any given input vector. If there is no relation between input patterns and the patterns programmed into the pattern layer, then no output is generated. The Probabilistic networks classify on the basis of Bayesian theory, it is essential to classify the input vectors into one of the two classes in a Bayesian optimal manner. This theory provides a cost function to comprise the fact that it may be worse to misclassify a vector that is actually a member of class A than it is to misclassify a vector that belongs to class B. The Bayes rule classifies an input vector belonging to class A as:
... (2)

$$P_A\, C_A f_A(x) \; > \; P_B\, C_B f_B(x)$$

where,
PA - Priori probability of occurrence of patterns in class A
CA - Cost associated with classifying vectors

JA(x) - Probability density function of class A

The PDF estimated using the Bayesian theory should be positive and integral over all x and the result must be 1. The probabilistic neural net uses the following equation to estimate the probability density function given by,

$$f_A(x) = \frac{1}{(2\,\Pi\,)^{n/2}\,\sigma^{\,n}}\frac{1}{m_n}$$
$$\sum_{i=1}^{m_A} \exp\left[ -2\,\frac{(x - x_A)^Y (x - x_{Ai})}{\sigma^{\,2}} \right]$$
.... (3)

Where
XAi – I th training pattern from class A
n - Dimension of the input vectors
σ - Smoothing parameter (corresponds to standard deviations of Gaussian distribution)
The function JA (x) acts as an estimator as long as the parent density is smooth and continuous.
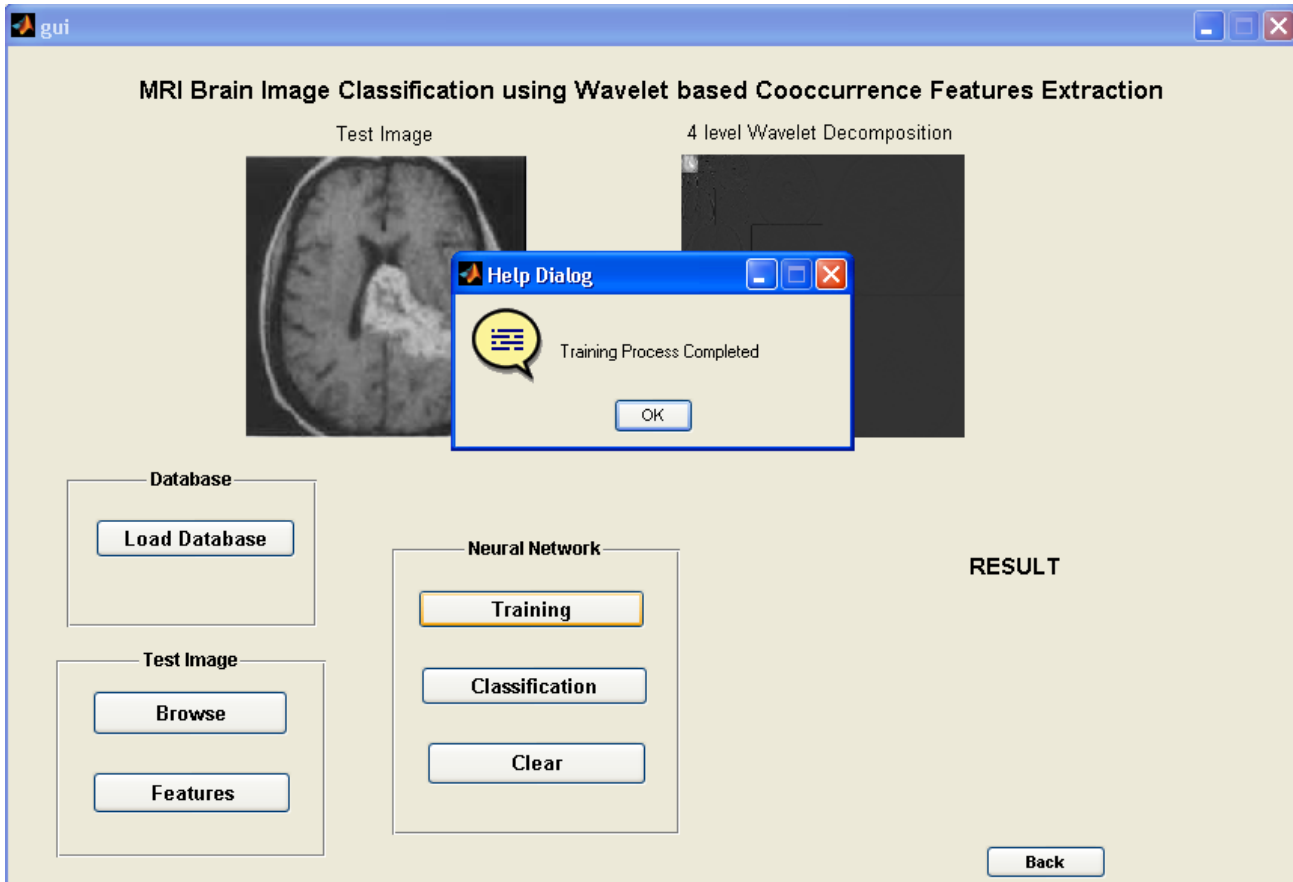
Fig 5: Training Process between Training & Testing Networks

After the training process is being completed, the abnormal level brain tumor cells are to be identified and classified altogether with the help of Neural Network and also with the use of Clustering means. Such that, various clusters are identified and training is given based on the test and training network.
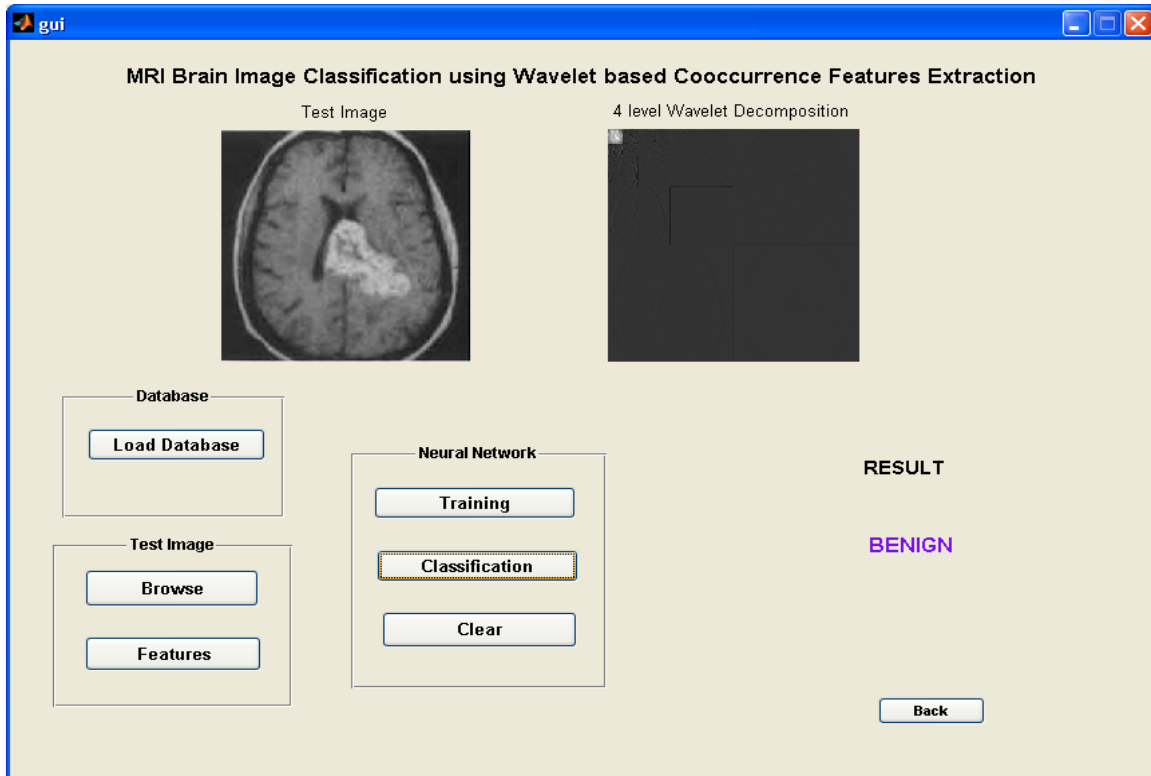
Fig 6: Classified Image type based on Normal/Benign/Malignant Levels

## VIII.CONCLUSION:

A novel algorithm for Brain Tumor Classification is presented. This new method is a combination of Discrete Wavelet Transform and Probabilistic Neural Network along with the implementation of GLCM. By using these algorithms an efficient Brain Tumor Classification method was constructed with maximum recognition rate Simulation results using Brain Tumor database demonstrated the ability of the proposed method for optimal feature extraction and efficient Brain Tumor classification. The ability of our proposed Brain Tumor Classification method is demonstrated on the basis of obtained results on Brain Tumor image database. On other Brain Tumor image databases the other combinations are there for training and test samples. In the proposed method only 5 classes of Brain tumors are considered, with respect to an example of 20 test images for instance but this method can be extended to more classes of Brain tumors.
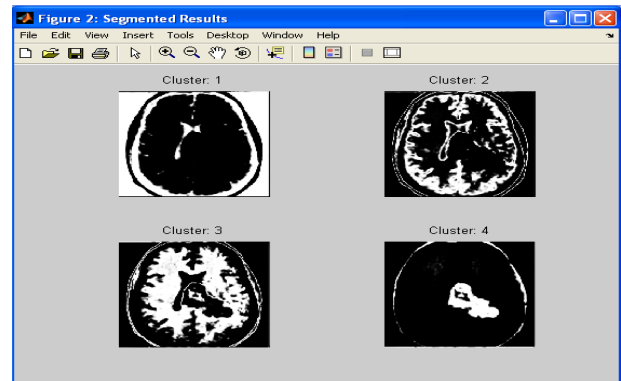


Fig 7: Final Clusters for Abnormal cells

## REFERENCES:

[1] Graph-based Detection, Segmentation & Characterization of Brain Tumors by Sarah Parisot, Hugues Duffau, St´ephane Chemouny, Nikos Paragios.

[2] Image Redundancy Reduction for Neural Network Classification using Discrete Cosine Transforms by Zhengjun Alistair G. Rust'l2, and Hamid Bolouri

[3] Input Feature Selection for Classification Problems by Nojun Kwak and Chong-Ho Choi, *Member, IEEE*

*[4]* Probabalistic Neural Networks for Classification, Mapping, or Associative Memory by Donald F. Specht

[5] Probabilistic Neural Network for Brain Tumor Classification by Mohd Fauzi Othman and Mohd Ariffanan, Mohd Basri.

[6] AK. Jain, R.P. W. Duin, J. Mao, Statistical pattern recognition: a review, IEEE Trans. Pattern Anal. Mach.Iintell. 22 (2000) 4 - 37.

[7] K. Fukunaga, Introduction to Statistical pattern recognition, 11 and Edition. Academic Press, New York, 1990.

[8] N. Kwak, and C.H. Choi, "*Input Feature Selection for classification problem*", IEEE Transactions on Neural Networks, 13(1), 143-159,2002.

[9] D.F. Specht, "*Probabilistic Neural Networks for classification, mapping, or associative memory*": Proceedings of IEEE International Conference on Neural Networks, Vol. I, IEEE Press, New York, pp. 525-532, June 1988.