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Analyze the Performance of Breast Cancer Detection using Neural Network Techniques

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Abstract:- *In the human body, there are several types of tissues formed by a plurality of cells. The inharmonious and vertiginous growth of these cells can cause a tumor, being able to be benign or malignant thus originating the cancer. Breast cancer is the type of cancer that affects women more; however, there is a small possibility of occurring in men, even in a very unusual way, since according to statistics, for every 1 man diagnosed with cancer 100 women present the disease. Breast cancer accounts for more than 1 in 10 new cancer diagnosis each year and is the leading cause of cancer death in women. For early and efficient diagnosis of breast cancer more and more techniques are being developed. The feed forward back propagation neural network is one of famous approaches in neural network. In this work we present the feed forward neural network classifier for the breast cancer detection and improved the accuracy rate over the previous approach.*

Keywords: Diseases diagnosis, Classification, Machine learning, Image segmentation, CAD.

Introduction

One in eight deaths worldwide is due to cancer. Cancer is the second leading cause of death in developed countries and the third leading cause of death in developing countries. In 2009, over the years, the incidences of breast cancer in India have steadily increased and as many as 100,000 new patients are being detected every year. In the United States, cancer is the second most leading cause of death, and accounts for nearly 1 of every four deaths [1].

Cancer results from a series of molecular events that fundamentally alter the normal properties of cells. In cancer cells the normal control systems that prevent cell overgrowth and the invasion of other tissues are disabled. These altered cells divide and grow in the presence of signals that normally inhibit cell growth; therefore, they no longer require special signals to induce cell growth and division. As these cells grow they develop new characteristics, including changes in cell structure, decreased cell adhesion and production of new enzymes. These heritable changes allow the cell and its progeny to divide and grow, even in the presence of normal cells that typically inhibit the growth of nearby cells. Such changes allow the cancer cells to spread and invade other tissues [2]. The abnormalities in cancer cells usually result from mutations in protein-encoding genes that regulate cell division. Over time more genes become mutated. This is often because the genes that make the proteins that normally repair DNA damage are themselves not functioning normally because they are also mutated. Consequently, mutations begin to

increase in the cell, causing further abnormalities in that cell and the daughter cells. Some of these mutated cells die, but other alterations may give the abnormal cell a selective advantage that allows it to multiply much more rapidly than the normal cells. This enhanced growth describes most cancer cells, which have gained functions repressed in the normal, healthy cells. As long as these cells remain in their original location, they are considered benign; if they become invasive, they are considered malignant. Cancer cells in malignant tumors can often metastasize, sending cancer cells to distant sites in the body where new tumors may form. Cancer is a disease that begins in the cells of the body [3]. Under normal conditions, the cells grow and divide depending on the requirement of the body. This orderly process is disturbed when new cells are formed which is not needed by the body and old cells don't die when they should. These extra cells lump together to form a growth called tumor. There are two types of cancer, benign and malignant.

Breast cancer can be separated into different types based on the way the cancer cells look under the microscope. Most breast cancer is carcinomas, a type of cancer that starts in the cells that line organs and tissues like the breast. In fact, breast cancers are often a type of carcinoma called adenocarcinoma, which starts in glandular tissue. No effective way to prevent the occurrence of breast cancer exists. Therefore, early detection is the first crucial step towards treating breast cancer. It plays a key role in breast cancer diagnosis and treatment. Data from breast cancer facts and figures tells us about estimated new female cases and deaths by age

Global cancer statistics show that breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death among females, accounting for 23 percent of total cancer cases and 14 percent of cancer deaths. Breast cancer is now also the leading cause of cancer death among females in economically developing countries. Each year about 700 women are diagnosed with this cancer. American statistics classify this cancer as the second leading cause of death among women with an age between 40 and 55 years. Early detection is the key to improving breast cancer prognosis [4]. Consequently many counties have established screening programs. These programs yield large volumes of mammograms. Cancer that originates from the breast tissue is called as breast cancer. The ability to improve diagnostic information from medical images can be further enhanced by designing computer processing algorithm, applications and software intelligently.

The rest of this paper is organized as follows, section II discuss the computer aided detection and their role in health care sector, in section III we present the feature selection and it's process, section IV present the proposed work for the breast cancer detection and screening with block diagram and flow graph, in section V we present the experimental work in the form of graph and figure, also present the comparative result analysis for the previous and proposed work, finally in section VI we conclude our work and also suggest some future scope work and direction.

II. Computer Aided Detection

A Computer Aided Detection (CAD) system can be described as the use of computers to evaluate the medical images in an automatic or semi-automatic manner. In the field of breast imaging, availability of accurate CAD methods can make a real impact in improving the current breast screening procedures. Reading and understanding breast images requires a well trained and experienced radiologist, and the CAD systems can be effectively used as the "second opinion" and assist radiologists in screening programs [8]. CAD employs computer vision techniques and/or artificial intelligence to deal with radiological and pathology images. In recent years, with the advancement in technology there has been an increase in the use of different imaging modalities for detection and diagnosis of cancers/tumours. Reading and understanding the images from these

different modalities require highly experienced and well-trained doctors/radiologists. Moreover, even with well trained experts, there exists high possibilities of intra- and intervariabilities between the readers. This motivated the use of computers to support radiologists to make accurate diagnosis [6]. The advantage of using a CAD systems is that it can reduce the diagnostic time, reduce inter-observer variations, and can act as a supplementary tool for the radiologists. In recent years, with the advancements in computer technology and data sciences, there has been a lot of interest in exploring deep learning methods for various tasks. In this regard, deep learning methods based on Convolutional Neural Network (CNN) have also gained importance in the field of medical image analysis and the efforts are laid to develop modern CAD systems based on the these newly developed CNN algorithms. This thesis is also a effort in this direction, exploring recent advancements in CNN to facilitate the development of an automated CAD system to assist radiologist in fast and accurate detection of lesions during breast cancer screening.

III. Feature Selection

Feature selection is a commonly used data preprocessing procedure in data classification. It is mainly used for reducing and eliminating irrelevant and redundant attributes from any dataset. Additionally, it plays a significant role in enhancing data comprehensibility, data visualization as well as reducing the time to train a classification model, and improves the prediction results [9]. Feature selection is the process of obtaining a subset of the original feature set, according to a certain criterion, which selects the most relevant features for classification. Feature selection plays a very important role in data compression and allows pre-processing of machine learning algorithms, in order to improve learning accuracy, reduce learning time and simplify results of learning. Feature selection can be classified into three methods: filter, wrapper and embedded. The filter method aims to the selection of features based on a performance measure (e.g., correlation, Chi-square and Fisher score) in order to find the best subset of features [15]. The wrapper method exploits the feature space to score subsets of resources according to their predictive power, optimizing the subsequent induction algorithm that uses the respective subset for classification. This method requires more computation time than the filter method, but it achieves more accurate results. The embedded method selects the features in the training process, without splitting data into training and testing, aiming to reduce the computation time. Feature selection has been a research topic used in many fields, such as image recognition, image recovery, text mining, intrusion detection, bioinformatics data analysis and fault diagnosis [10].

There exist numerous applications of relevant feature identification techniques in healthcare sector. Filter methods, wrapper methods, ensemble methods and embedded methods are some of the popularly used techniques used for variable selection. In research, the ultimate goal of performing the feature selection process is not limited to obtaining the highest classification accuracy [11]. However, it is also related to the detection of the most clinically significant features as this optimal set of features can help the specialist objectively focus on these features during a routine manual diagnosis process.

Both SFS (sequential forward selection) and SBS (sequential backward feature) are iterative methods. The SFS starts with an empty set and in each iteration a new unseen feature is added. For each added feature, performance is evaluated using the induction algorithm. Only the feature producing the highest increase of performance is added to new feature subset. Then a new iteration is started with the new generated subset. On the other hand, the SBS starts with full feature set and at each iteration one feature is removed. In both methods the searching process stops when there is no further improvement is detected by the induction algorithm [12, 13].

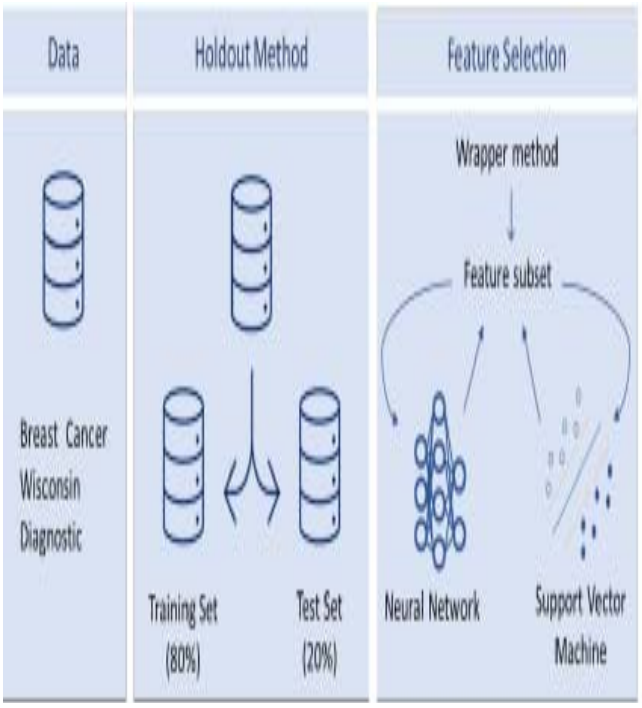

Fig. 1: Steps to achieve the proposed aims.

IV. Proposed Work

Neural networks (NN) have been increasingly used to solve artificial intelligence problems. The diagnosis of breast cancer is an example where NN have been widely used. Neural networks are machine learning techniques that simulate the learning mechanism in biological organisms and are networks of interconnected artificial neurons. The main advantage of neural networks is that they are data-driven and do not require restrictive assumptions about the shape of the basic model. In addition to this advantage, NN allow detecting complex nonlinear relationships between independent and dependent variables and to identify all possible interactions between predictor variables, having the ability to store information on the network (memory capacity). In addition, NN can work with incomplete knowledge and in parallel processing [16]. However, NN also have disadvantages, such as hardware dependency, the lack of determination of the appropriate network structure, more computational resources requirements and limited ability to identify possible casual relationships [14]. In this research, the ANN is used to classify the breast cancer samples in the WBCD into either benign or malignant. ANN was used intensively in the diagnosis and classification of many medical conditions such as leukemia, prostate cancer, lung cancer, liver cancer and many others. There are various ANN architectures. However, one of the most widely used is the multilayer feed-forward neural network (FFNN) with a back-propagation learning algorithm.

In FFNN, there are a number of parameters need to be tuned in order to obtain the best classification performance. These parameters include the number of hidden layers, the activation function, the number of neurons, the learning rate, and the epochs. The number of hidden layer is set to one as usually single hidden layer is sufficient for various kinds of classification problem. Regarding the activation function, in fact, there are many options available. Hence, for this experiment, the sigmoid activation function is chosen. The rest of the FFNN hyper-parameters is tuned with the grid search optimization using 10-fold cross validation. The grid search algorithm traverses a given combination of parameters [17]. Later, the parameters resulted in the best performance can be used to train the final model and tested using the test set. In grid search the performance of the model is verified using a statistical method called cross validation (CV). The cross validation divides the dataset into two parts, namely, training and validation. On each hyper-parameter combi-nation, the FFNN is trained and the accuracy is verified. Eventually, the model which produced the highest performance is used for the final classification test.

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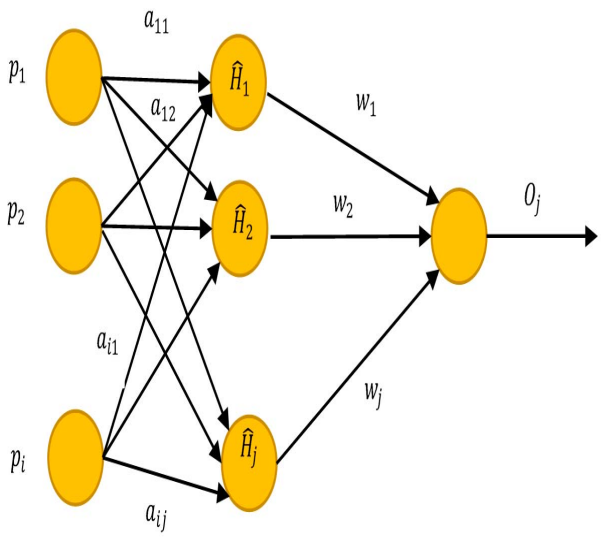

Fig. 2: Feed forward neural network.

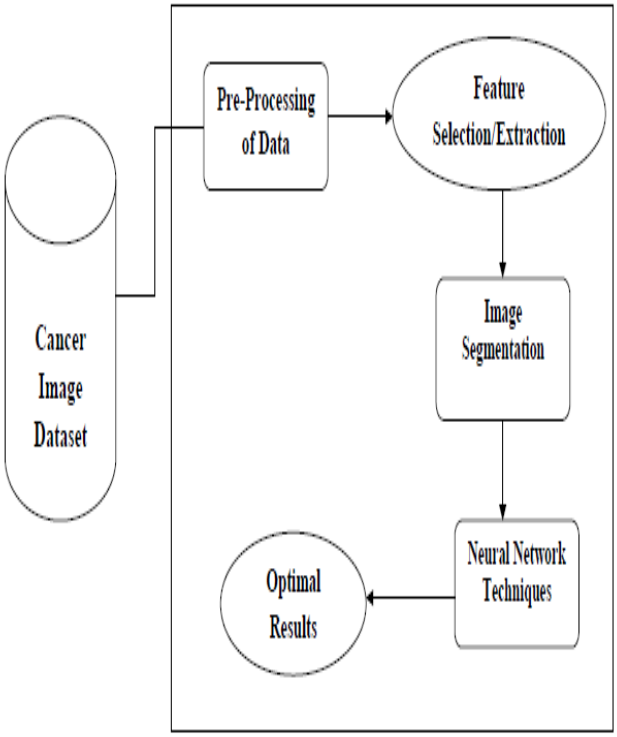

Fig. 3: The above image shows the proposed work simulation block diagram.

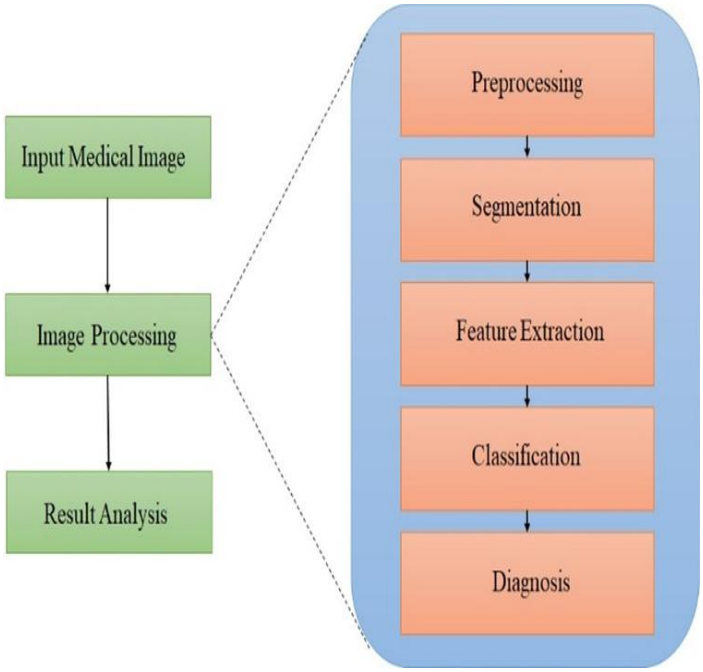

Fig 4: The above image shows the proposed work flow graph.

ALGORITHM:

Begin
Initialize all weights and biases
Set acquisition of knowledge rate Ω ε [0-1]
For each input pattern E_k do
Compute difference of output from actual output
For i=1 to k do
For layers = 1 to L' -1 do
Compute the error based on the i-1 module i
End for
End for
After the update weights of the output for i=k to 1 do
for i=1 to L do
if module i is not a layer
then
update the weights and biases of the module i
end if
update the threshold of the module I for segments
end for
end for
End

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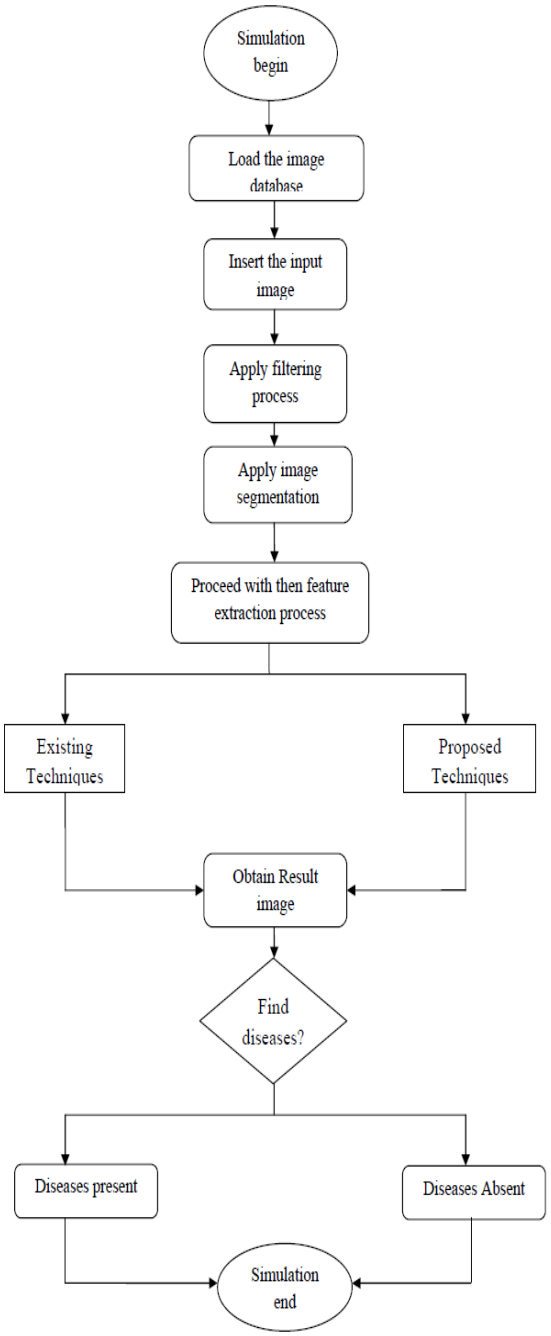

Fig 5: The above image shows the comparative experimental process between existing and proposed work.

V. Result Analysis

In this section, experimental process of we show that the comparative result analysis study for the detection of breast cancer using classification techniques. The mining of healthcare database is very critical issue. The healthcare data stored the information about medical diseases and patient's information.

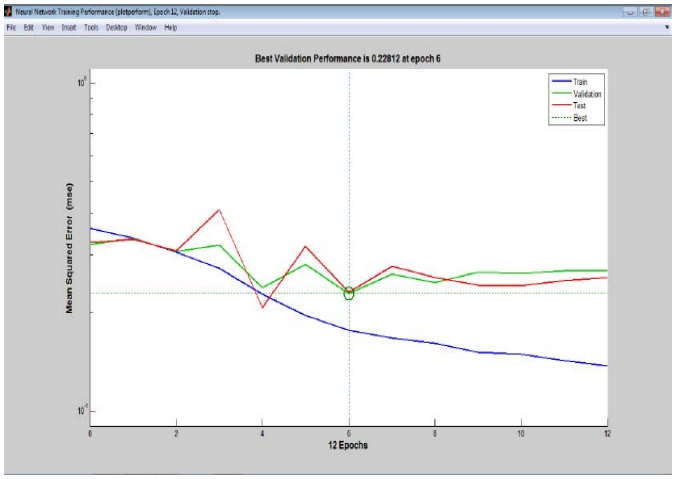

Fig. 6: This picture represent validation performance for the experimental work using the feed forward neural network.

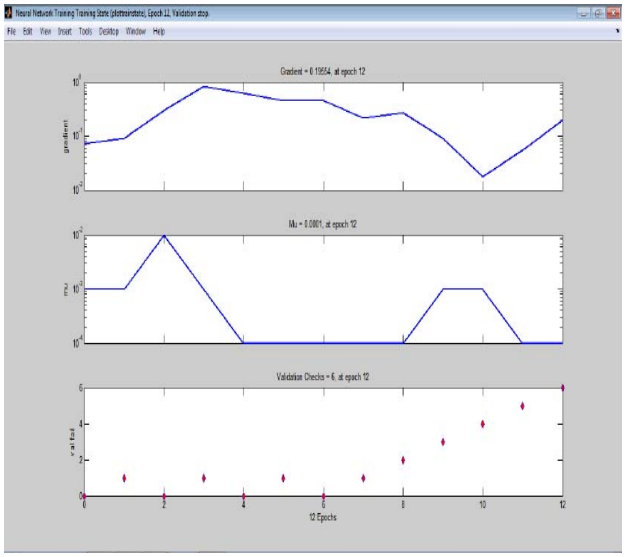

Fig. 7: This picture represent epoch window for the experimental work using the feed forward neural network.

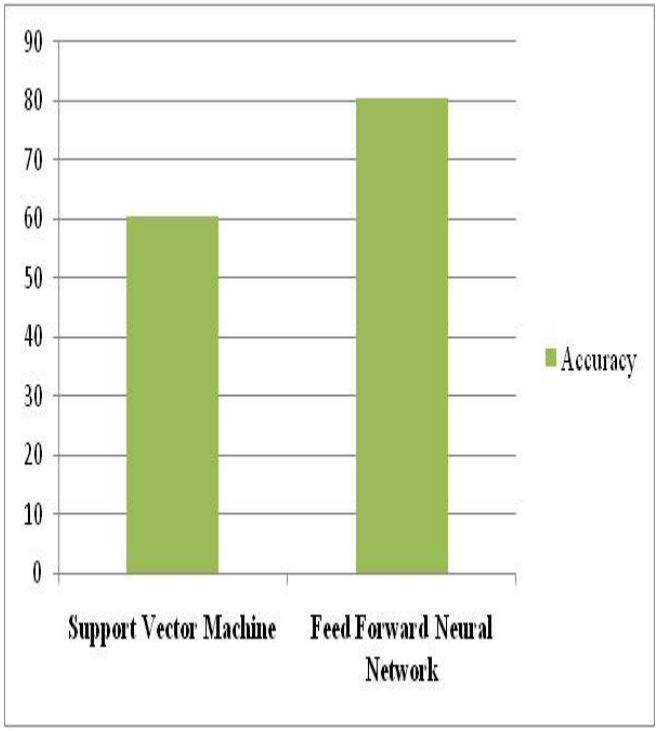

Fig. 8: This picture represent accuracy for the breast cancer detection using the existing and present method.

VI. Conclusion

Cancer is a term used for a group of disorders associated with abnormal cell growth. The abnormal cells have the potential to spread to other parts of the body (metastasis). Cancer can develop in any part of the body; the most common types are prostate, lung and bronchus, breast and colorectal. Cancer is staged according to its extent at the time of diagnosis. Breast cancer is the second leading cause of death for women, so accurate early detection can help decrease breast cancer mortality rates. Neural networks are used in computer aided diagnosis to perform image classification tasks. This study analyzed the performance of two commonly used feed forward neural networks for classification of histopathology images of breast tissue. The aim of this paper is to develop a feed forward neural network based model that can classify breast cancer images in a normal and abnormal form. In future work we may also used some evolutionary approach for feature reduction and focus for the complexity and calculation time.

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