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A Project Work Phase-I (17CSP78)
Report on

"Breast Cancer Prediction using Deep learning Techniques"

Project Report submitted in partial fulfilment of the requirement for the award of the degree of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

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CERTIFICATE

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in partial fulfilment for VII semester B.E., Project Work in the branch of Computer Science and Engineering prescribed by **Visvesvaraya Technological University, Belagavi** during the period of September 2020 to January 2021. It is certified that all the corrections and suggestions indicated for internal assessment have been incorporated. The Project Work Phase-I Report has been approved as it satisfies the academic requirements in report of project work prescribed for the Bachelor of Engineering degree.

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Signature of the Guide	**Signature of the HOD**	**Signature of the Principal & CEO**
[Mr. Aditya Pai H]	[Dr. Rekha B. Venkatapur]	[Dr. K.V.A. Balaji]

DECLARATION

We, the undersigned students of 7th semester, Computer Science & Engineering, KSIT, declare that our Project Work Phase-I entitled "Breast Cancer Prediction using Deep learning Techniques", is a bonafied work of ours. Our project is neither a copy nor by means a modification of any other engineering project.

We also declare that this project was not entitled for submission to any other university in the past and shall remain the only submission made and will not be submitted by us to any other university in the future.

Place:
Date:

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ABSTRACT

There have been several empirical studies addressing breast cancer using deep learning and soft computing techniques. Many claim that their algorithms are faster, easier, or more accurate than others are. This study is based on machine learning algorithms that aim to construct a system to accurately differentiate between benign and malignant breast tumors.

The aim of this study was to optimize the learning algorithm. In this context, we shall apply the programming technique to select the best features and perfect parameter values of the deep learning classifiers. The performance of the proposed method is based on sensitivity, specificity, precision, accuracy. The present study proves that genetic programming can automatically find the best model by combining feature preprocessing methods and classifier algorithms.

Keywords: Deep Neural Network, Cancer Prediction, Machine Learning, Convolution Neural Network, Python, Image Processing

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Chapter 1

INTRODUCTION

1.1Overview

One of the terrible diseases in this world is cancer and especially the breast cancer in women is very dangerous. Several women expire due to this breast cancer. The detection of Breast Cancer manually consumes huge time and this was problematic to the medical doctor to classifying the disease. So, the automated detection of the cancer through various diagnostic techniques is strongly needed. World health organization (WHO) reported the breast cancer disease as the utmost danger cancer amongst Women globally.

It is also the highest ranked type of cancer the death among women in the word. In Malaysia, Breast cancer has the highest rate of cancer deaths, around 25%, and it is the commonest cancer among women. Around 5% of Malaysian women are at risk of breast cancer while Europe and the United States, it is around 12.5%. It confirms that women with breast cancer in Malaysia present at a later stage of the disease compared to women from other countries.

1.2Purpose of the project

Usually, breast cancer can be easily detected if specific symptoms appear. However, many women who are suffering from breast cancer have no signs. Hence, regular breast cancer screening is very important for early detection.

Breast cancer is uncontrolled growth of breast cells. It is not only found in breast cells but also in many parts of the body. A small number of cancers start in other tissues in the breast. There are almost 6 stages of breast cancer.

1.3 Current approach

It is always found that the detection of cancer at the first stage can cure it. A sample image is taken as an input and compared with the images already stored in database detected with cancer. Pre-processing is done on that image. If the detection is found successful then corresponding Treatment is suggested. The stage of cancer is been demonstrated and respective treatment is been advised to the patient. Stage wise treatment and medicines are given to cure that cancer. Algorithms like CNN (Convolutional Neural Network) in which the connectivity pattern between its neurons is inspired by the organization of the animal visual cortex are implemented. Using machine learning methods we can compare and detect cancer, it's stages and treatment are.

Chapter 2

LITERATURE SURVEY

According to the paper “Deep learning-based breast cancer detection and classification using fuzzy merging techniques.” The proposed method provides an automatic system for nuclei detection and classification from H&E-stained images. which includes several steps such as biomedical data preprocessing, nuclei detection, segmentation, feature extraction, and classification. [1]

According to the paper “Methods Used in Computer-Aided Diagnosis for Breast Cancer Detection Using Mammograms” The methodology used - feature extraction, feature selection, and classification methodologies. This method explains about the breast cancer detection and diagnosis using mammograms. The mammograms is limited by the low contrast between normal glandular breast tissues and malignant ones and between the cancerous lesions and the background, especially in dense breasts tissue. [2]

According to the paper “Breast cancer detection using K-nearest neighobor machine machine algorithm”- Matlab KNN Good regression value using BPNN that exceed 93% only with 240 features. Good regression value using BPNN that exceed 93% only with 240 features. [3]

According to the paper “Predicting Invasive disease Free survival for early stage breast cancer patient” using follow-up clinical data- EFS Idfs Predict the risk of recurrance and metastasis of early breast cancer patients. Significantly affect the prediction. [4]

Chapter 3

PROBLEM IDENTIFICATION

3.1 Problem statement

Breast Cancer is one of the leading cancer developed in many countries including India. Though the endurance rate is high – with early diagnosis 97% women can survive for more than 5 years. Statistically, the death toll due to this disease has increased drastically in last few decadesthe main issue pertaining to it's cure is early recognition.

3.2 Challenges

The approach for detecting the Breast cancer size and stages of the detected cancer. A seeded region growing algorithm has been used for the segmentation of Breast MR image. The algorithm performance depends on appropriate seed point selection from where the regions are started growing to nearby points on the basis of a similar criterion. After segmenting the tumor part an equation has been used to calculate the tumor area and based on this area the stage of the Breast cancer has been determined.

3.3 Motivation

Employing an efficient processing technique is considered as an essential step to improve the overall visual representation of clinical images, and as a consequence provides better diagnosis results. This paper employs an easy, fast and reliable technique to detect cancerous tissue in Breast by using different image processing techniques such as contrast enhancement, edge detection and image fusion. The experimental results show, the proposed method could obtain the smooth image with edge showing the disease affected part without the spatial and spectral noises.

Chapter 4

GOALS AND OBJECTIVES

4.1 Goals

The goal is to classify whether the breast cancer is benign or malignant. To achieve this we have used machine learning algorithm(CNN)to predict the cancer and it's stages.

Breast cancer is one of the leading cancers developed in many countries, including India. While the endurance rate is poor – with early detection, 97% of women have been able to live for more than 5 years. Statistically, the death rate due to this disease has risen significantly in the last few decades, the key problem of its cure is early detection.

4.2 Objectives

The Main objectives of the project are:

1. The Main objective of the project is detect Breast Cancer symptoms in patients using X Ray Images
2. Deploying CNN Network for classification of Cancer

Chapter 5

SYSTEM REQUIRMENT SPECIFICATION

A Software Requirement Specification (SRS) is basically an organization's understanding of a customer or potential client's system requirements and dependencies at a particular point prior to any actual design or development work. The information gathered during the analysis is translated into a document that defines a sets of requirements. It gives the brief description of the services that the system should provide and also the constraints under which, the system should operate. Generally, the SRS is a document that completely describes what the proposed software should do without describing how the software will do it. It's a two-way insurance policy that assures that both the client and the organization understand the other's requirements from that perspective at a given point in time.

The SRS document itself states in precise and explicit language those functions and capabilities a software system must provide, as well as states any required constraints by which the system must abide. The SRS also functions as a blueprint for completing a project with as little cost growth as possible. The SRS is often referred to as the "parent" document because all subsequent project management documents, such as design specifications, statements of work, software architecture specifications, testing and validation plans, and documentation plans, are related to it. Requirement is a condition or capability to which the system must conform. Requirement Management is a systematic approach towards eliciting, organizing and documenting the requirements of the system clearly along with the applicable attributes. The elusive difficulties of Requirements are not always obvious and can come from any number of sources.

5.1 Hardware Requirement Specification

- System: Pentium IV 2.4 GHz.
- Hard Disk : 40 GB.
- Monitor : 15 VGA Color.
- Mouse : Logitech.
- Ram : 512 Mb

5.2 Software Requirement Specification

- Operating system : Windows 10 / Linux
- Coding Language : Python.
- Toolbox : Anaconda Navigator
- IDE : Jupiter Notebook / Spyder

Chapter 6

METHODOLOGY

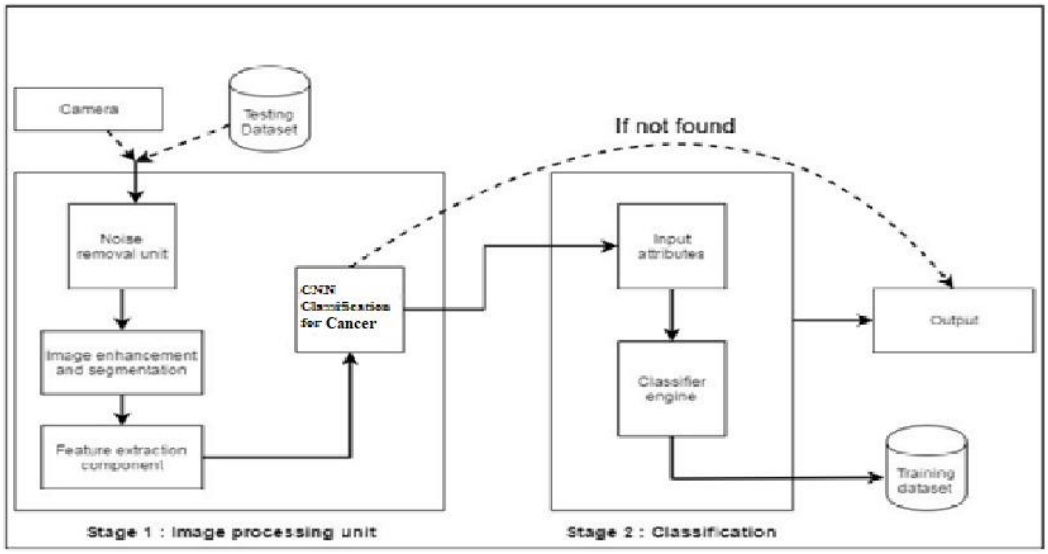

Figure 6.1: The Methodology of Breast Cancer Prediction

The framework can be comprehensively sorted into following significant stages:

1.Acquisition of image: Images are obtained either by lens or by secretly deleting them from the contraction. Whatever the source may be, it is very important that the image of the data is transparent and cautious. An incredible picture is needed for this.

2. Pre-Processing of image: In this process, the photo is standardized by clearing the commotion as it conceals hair and breast, as it may confuse the evaluation. Similarly, the image given as the information may not be of standard size as required by the figure, so it is vital that the image size needed is obtained.

3. Data storage aspect to preserve information images for testing and training: if controlled learning will occur, as is the case here, it is important to prepare data sets. The sample database is the images collected during the photo procurement process.

4. Classifier to classify the type of breast cancer: The classifier used here is the last layer of the system which gives the true probability of each experience. The project involves two major parts Image preparation unit and grouping unit. The object processing system enhances the image by removing the clatter and noisy bits. The breast and the image will then be isolated into different segments to isolate the breast from running the mill after the image features are evacuated to check whether or not the breast is contaminated.

- Noise reduction unit: removes from the photo the unwanted colors .

- Image enhancement unit and segmentation: carries the affected part to the middle by improving the area and dividing the area into different segments in order to isolate it from the normal Scanned Image.

- Feature Extraction Component: One of the notable developments in any gathering-centered issues is highlighting extraction. Looks are the cornerstone for both purposes of planning and screening. This feature contains noteworthy image information that will be used to identify the Cancer.

- Identification unit for Cancer disease: See if the cancer is considerate or hazardous.

- Input Attributes: For example, all noteworthy attributes, asymmetry, edge, concealment, distance, progression, etc. that have been expelled from the image are now provided as a dedication to Part II, which is the classifier part.

- Classifier engine: characterizes the images by grouping the calculation into one of the predefined diseases.

Block Diagram:

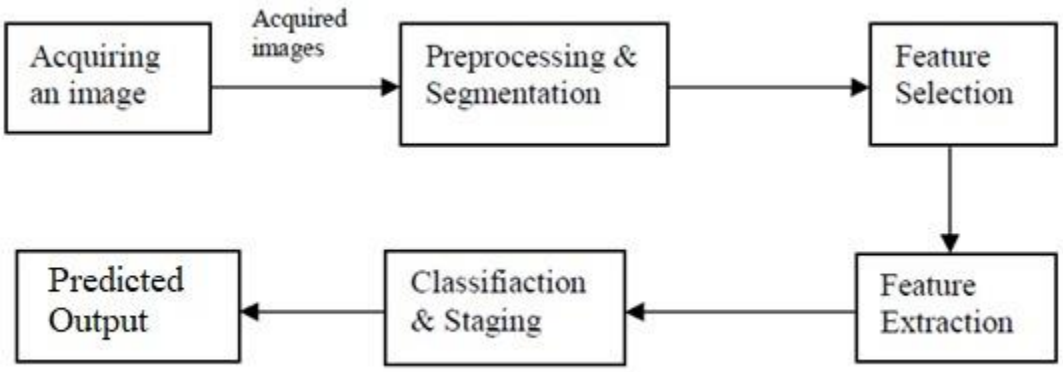

Figure 6.2: The Block Diagram of Breast Cancer Prediction

Recent developments in deep learning for image recognition in natural images have encouraged a surge of interest in applying this technique to medical images. Computer-aided diagnosis of breast cancer is potentially useful for reducing the numbers of grazes are missed by the radiologists at a reasonable cost. A convolution neural network (CNN) is used for classification of masses and normal tissue on mammograms. In a convolutional neural network, each neuron is connected with a few neurons in the previous layer, as shown in the figure below:

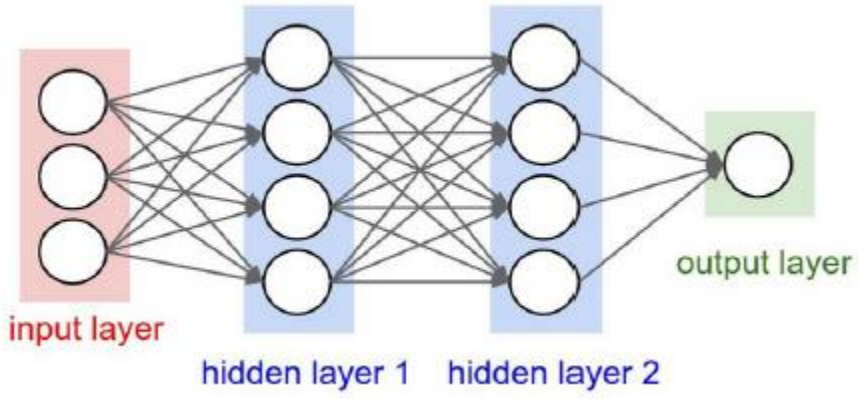

Figure 6.3: Convolution Neural Network

6.1 CNN

A Convolutional Neural Network (CNN) is made up of a number of convolutional layers (often with a subsampling step) and then followed by a number of fully connected layers as in a typical multilayer neural network. The architecture of a CNN is designed to take advantage of the 2D structure of an insight image (or other 2D input such as a speech signal). That is achieved with local connections and tied weights followed by some kind of pooling which results in translation invariant features.

6.2 DEEP LEARNING

Deep Learning is a new area of Machine Learning research, which has been introduced with the objective of moving Machine Learning closer to one of its original goals: Artificial Intelligence. Deep understanding provides the presumption these layers of facets match levels of abstraction or composition. Varying number of layers and coating styles could possibly offer different levels of abstraction.

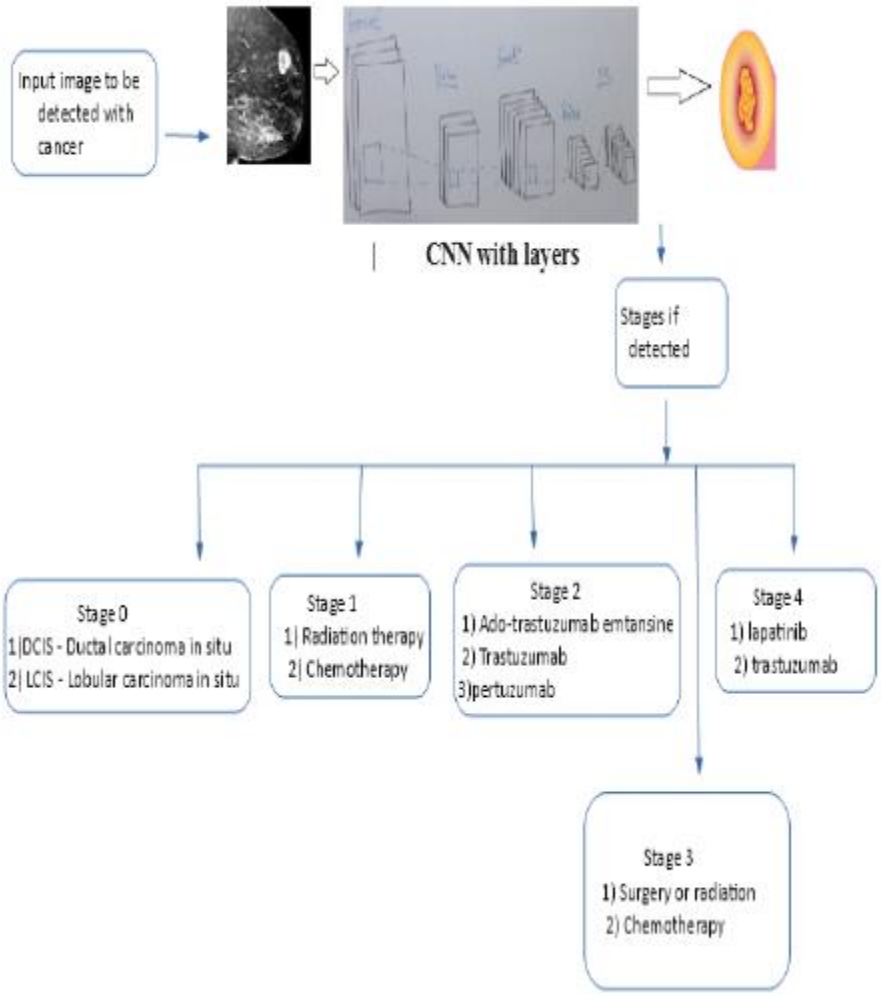

Figure 6.4 Convolution Neural Network with Layers

6.3 USE CASE DIAGRAMS

A Use Case Diagram is a lot of situations that reflect a client-frame relationship. A use case chart shows the entertainer-to-use relationship. Usage cases and on-screen characters are the two main elements of an usage case diagram. An on-screen character refers to an user or other person connected with the demonstrated process. A use case chart in figure is an out-of - the-box perspective that speaks to some activity each module will perform to complete an errand.

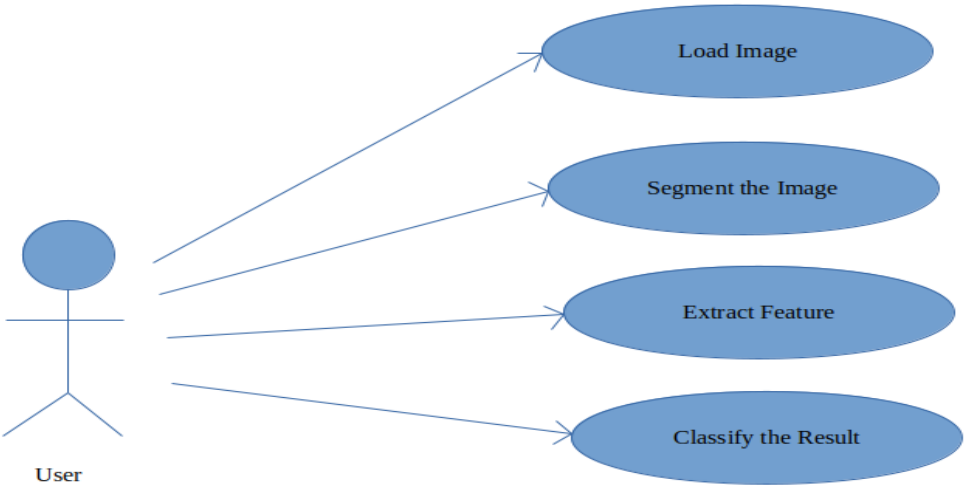

Figure 6.5 Use Case Diagram

6.4 SEQUENCE DIAGRAM

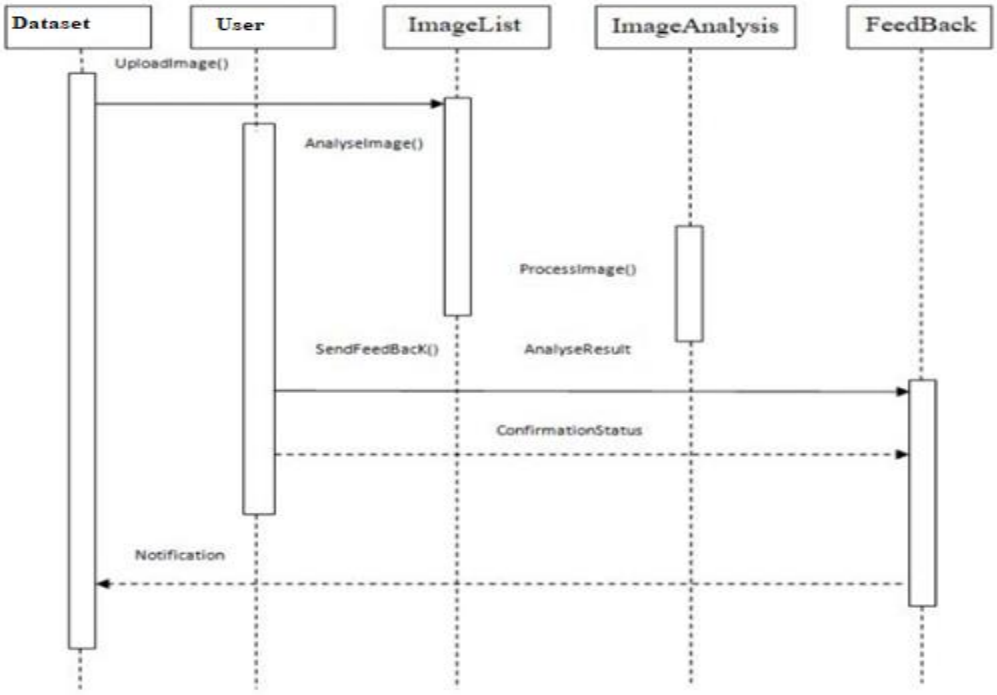

Figure 6.6 Sequence Diagram

6.5 DATA FLOW DIAGRAM

1. A data flow diagram (DFD) is graphic representation of the "flow" of data through an information system. A data flow diagram can also be used for the visualization of data processing (structured design). It is common practice for a designer to draw a context level DFD first which shows the interaction between the system and outside entities. DFD's show the flow of data from external entities into the system, how the data moves from one process to another, as well as its logical storage. There are only four symbols:
2. Squares representing external entities, which are sources and destinations of information entering and leaving the system.
3. Rounded rectangles representing processes, in other methodologies, may be called 'Activities', 'Actions', 'Procedures', 'Subsystems' etc. which take data as input, do processing to it, and output it.
4. Arrows representing the data flows, which can either, be electronic data or physical items. It is impossible for data to flow from data store to data store except via a process, and external entities are not allowed to access data stores directly.
5. The flat three-sided rectangle is representing data stores should both receive information for storing and provide it for further processing.

6.5.1 LEVEL 0 DATA FLOW DIAGRAM

The Level0 DFD shows how the system is divided into sub-systems (processes), each of which deals with one or more of the data flows to or from an external agent, and which together provide all of the functionality of the system as a whole. Figure shows the level 0 DFD. It also identifies internal data stores that must be present in order for the system to do its job, and shows the flow of data between the various parts of the system

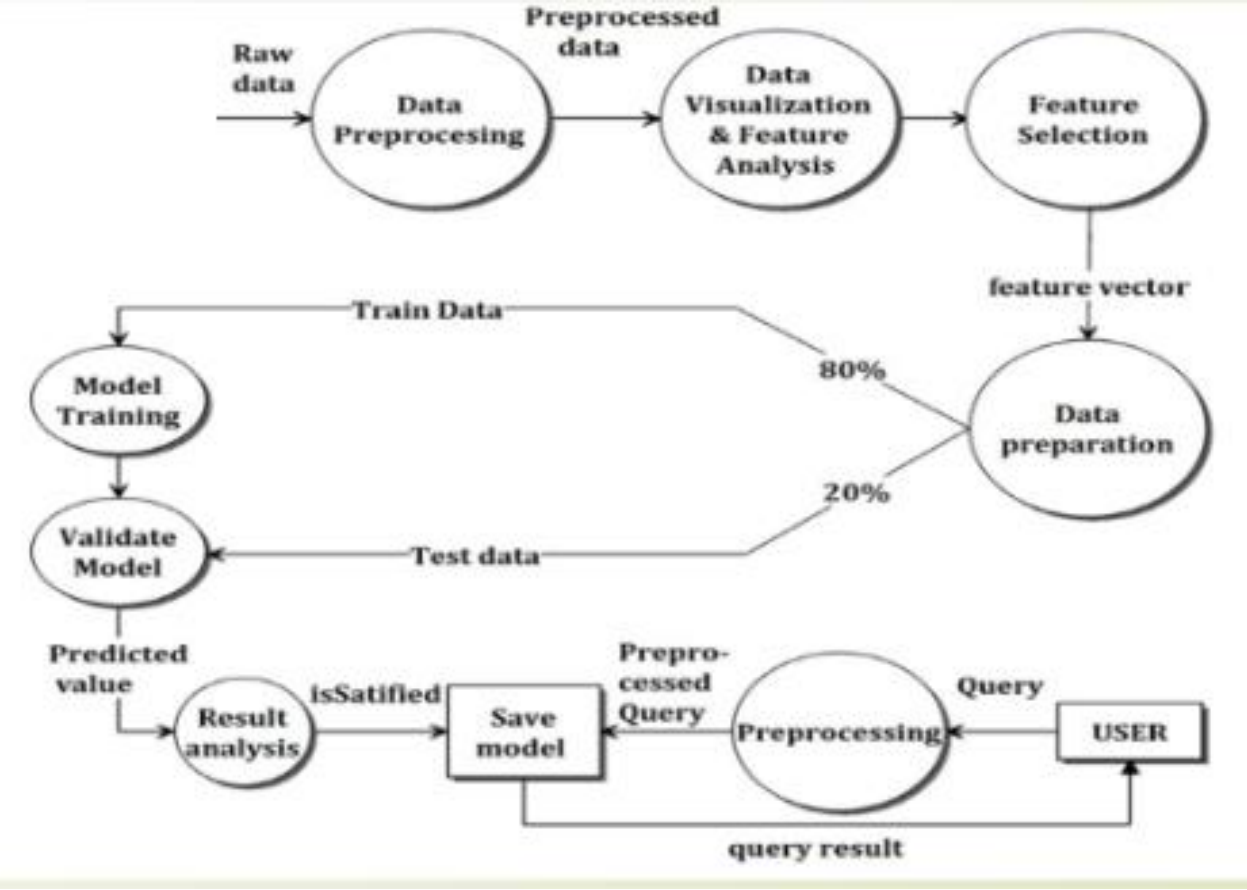

Figure 6.7 Data Flow Diagram

6.6 CANCER IDENTIFICATION USING CNN:

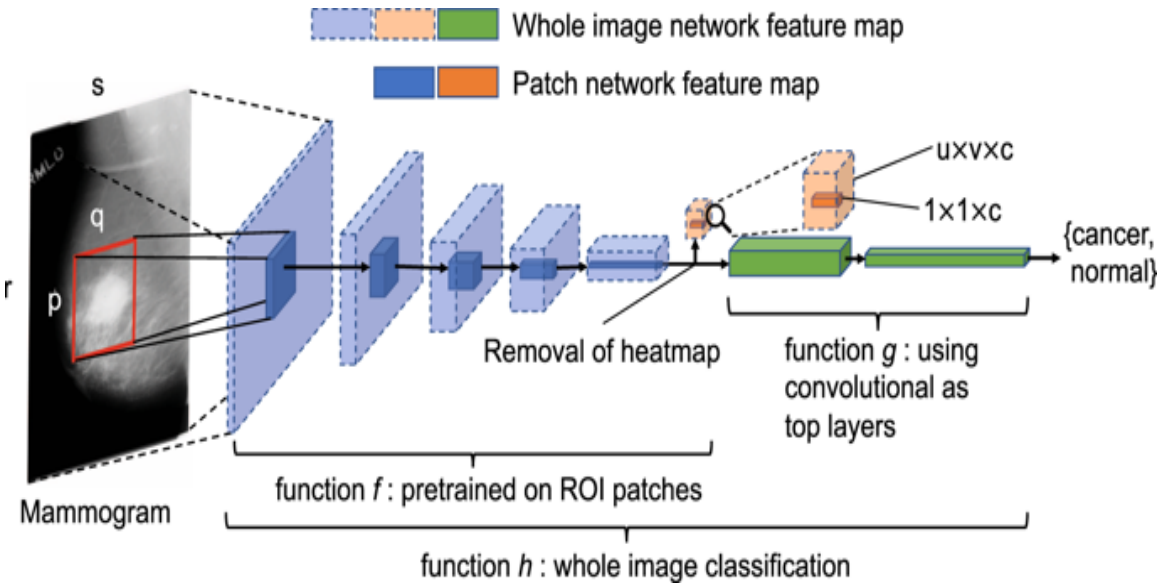

Figure 6.8 Cancer Identification Using CNN

The invention of the CNN in 1994 by Yann LeCun is what propelled the field of Artificial Intelligence and Deep learning to its former glory. The first neural network named LeNet5 had a very less validation accuracy of 42% since then we have come a long way in this field. Nowadays almost every giant technology firms rely on CNN for more efficient performance. The idea to detect diseases in mulberry leaf incorporates the use of CNN before we dive into the "functionality and working of CNN" concept, we must have a basic idea on how the human brain recognizes an object in spite of its varying attributes from one another. Our brain has a complex layer of neurons ,each layer holds some information about the object and all the features of the object are extracted by the neurons and stored in our memory, next time when we see the same object the brain matches the stored features to recognize the object, but one can easily mistake it as a simple "IF-THEN" function, yes it is to some extent but it has an extra feature that gives it an edge over other algorithms that is Self-Learning, although it cannot match a human brain but still it can give it a tough competition . Image is processed using the Basic CNN to detect the diseases in leaves.

The data training in our CNN model has to satisfy following constraints:

1) There should be no missing values in our dataset.

2) The dataset must distinctly be divided into training and testing sets, either the training or the testing set shouldn't contain any irrelevant data out of our model domain in case of an image dataset all the images must be of the same size, one uneven distribution of image size in our dataset can decrease the efficiency of our neural network.

3) The images should be converted into black and white format before feeding it into the convolution layer because reading images in RGB would involve a 3-D numPy matrix which will reduce the execution time of our model by a considerable amount.

4) Any kind of corrupted or blurred images should also be trimmed from the database before feeding it into the neural network . Now we have learned the data pre-processing rules, let us dive right into the working of the convolutional neural network.

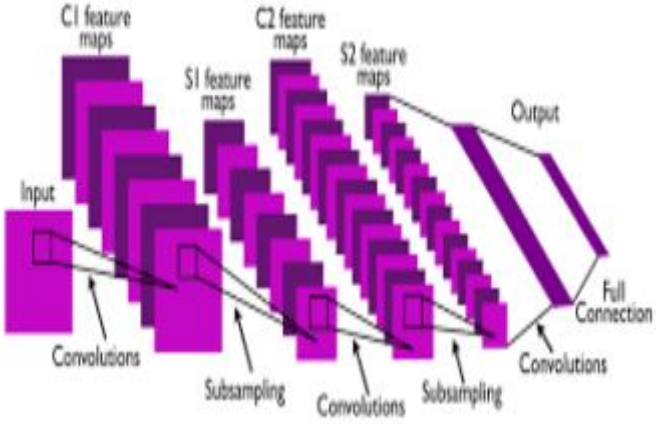

Figure 6.9 CNN Layer

A. Convolution layer

This layer involves scanning the whole image for patterns and formulating it in the form of a 3x3 matrix. This convolved feature matrix of the image is known as Kernel. Each value in the kernel is known as weight vector.

Figure 6.10 CNN Layer

B. Pooling layer

After the convolution comes to the pooling here the image matrix is broken down into the sets of 4 rectangular segments which are non-overlapping. There are two types of pooling, Max pooling and average pooling. Max pooling gives the maximum value in the relative matrix region which is taken. Average pooling gives the average value in the relative matrix region. The main advantage of the pooling layer is that it increases computer performance and decreases over-fitting chances.

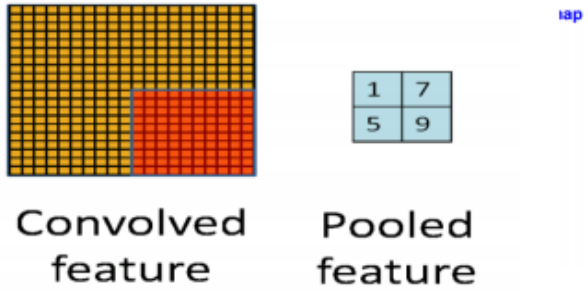

Figure 6.11 Pooling Layer

c. Activation layer

It the part of the Convolutional Neural Networks where the values are Normalized that is, they are fitted in a certain range. The used convolutional function is ReLU which allows only the positive values and then rejects the negative values. It is the function of low computational cost.

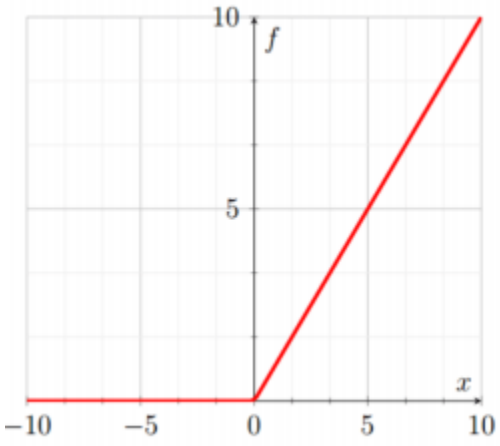

Figure 6.12 RELU Function

D. Fully connected layer

Here the features are compared with the features of the test image and associate similar features with the specified label. Generally, labels are encoded in the form of numbers for the computational ease, they will be later converted into their respective strings.

Chapter 7

APPLICATION

7.1 Application of Proposed System

- Less cost
- Least human interference
- Helpful For Doctors to diagnose Cancer in early stage
- Early Detection Leads to easy cure

Chapter 8

CONTRIBUTION TO THE SOCIETY

- In this work, different methods and solutions for automatic detection of breast cancer in histopathology images have been investigated. The aim of this work is to develop a high accuracy method that can detect cancer at early stages, define the exact type of the samples, and improve previous works results.
- The nature of cancer is often evolving, so a new dataset will not yield good results based on a collection of local features. However, due to Global Feature extraction capabilities of Deep Neural Networks, particularly CNN, have recently advanced biomedical image classification.

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Breast Cancer Detection Using Deep Learning: A Survey

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ABSTRACT

Breast cancer is one of the major causes of death for women in today's world. For the breast-image classification mission, advanced engineering of natural image classification techniques and Artificial Intelligence techniques has been used to a large extent. The inclusion of digital image classification makes a second opinion of the doctor and the physicians, and it saves time for the doctors and doctors. Despite the numerous publications on the classification of breast photos, very few review papers are available. We have placed particular focus on the breast image classification method of the Convolutionary Neural Network (CNN).

Keywords— *Convolutional Neural Network (CNN), Neural Network (NN), Random Forest (RF) algorithm, Support Vector Machines (SVM), Bayesian methods*

1. INTRODUCTION

The cell of the body maintains a cycle of regeneration processes. The balanced growth and death rate of the cells normally maintain the natural working mechanism of the body, but this is not always the case. Sometimes an abnormal situation occurs, where a few cells may start growing aberrantly. This abnormal growth of cells creates cancer, which can start from any part of the body and be distributed to any other part. In the human body, different forms of cancer may be created; among them, breast cancer creates a significant health concern.

Statistics indicate that the condition has deteriorated in the past. Figure 1 demonstrates the breast cancer situation in Australia over the last 12 years as a case study. The number of new males and females beginning to suffer from breast cancer is also seen in this statistic. The number of new breast cancer cases was 12775 in 2007, while the estimated number of new breast cancer patients will be 18235 in 2018. Statistics show that the number of new cancer patients has risen in the last
decade.

Figure 1. Number of new people facing cancer in Australia from 2007 to 2018 [5].

The number of males and females facing death due to breast cancer is shown in figure 2. About 3156 individuals are expected to face death in 2018; among them, 3128 will be women, which is almost 99.11 percent of the total deaths due to breast cancer.

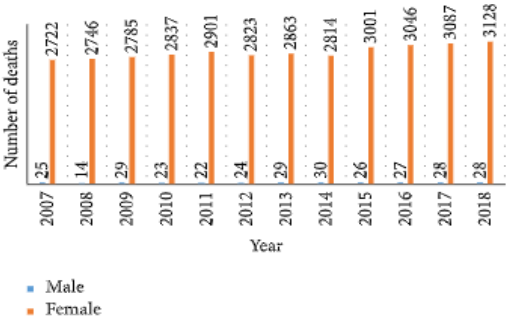


Figure 2. Number of people dying due to cancer in Australia from 2007 to 2018 [5].

Lobules, ducts, nipples, and fatty tissues make up women's breasts. Milk is formed in lobules and is carried by ducts towards the nipple. Epithelial tumors usually grow within the lobules and ducts and subsequently form cancer within the breast[1]. It also travels to other portions of the body once the cancer has begun.Breast cancer tumors can be categorized into two broad scenarios.

(i) Benign (Noncancerous). Benign cases, that is, non-life-threatening, are known as non-cancerous. Benign tumors are typically isolated from other cells by an immune system known as a sac, and can be quickly removed from the body.

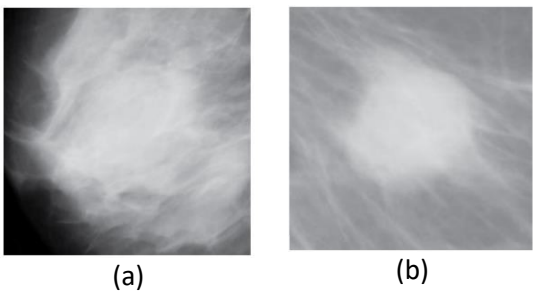
(ii) Malignant (Cancerous). Malignant cancer begins from an irregular growth of the cell and may spread or invade surrounding tissue quickly. Malignant tissue nuclei are usually much larger than normal tissue, which can be life-threatening in future stages.

Cancer is often a condition that is life-threatening. Proper cancer care saves the lives of people.With advanced modern imaging techniques, it is possible to more accurately capture the image of the targeted part of the body. Focused on the

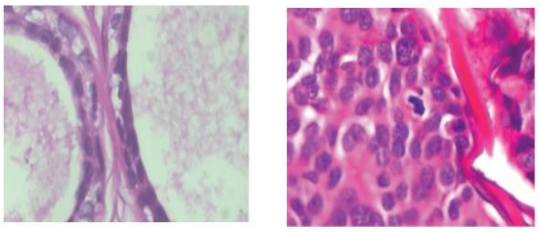
(i) Noninvasive. (a) Ultrasound: Similar to SOund Navigation And Ranging (SONAR), which works in the very high-frequency domain and records the echoes of that frequency, this photographic technique uses similar techniques developed by Karl Theodore Dussik. A Central Processing Unit (CPU), transducer, monitor unit, and a few other peripheral devices are used in the ultrasound image computer. This system is capable of both 2D and 3D images being captured. Ultrasound methods have no side effects, with certain exceptions, such as output,

(b) X-ray: X-rays use electromagnetic radiation, which was invented in 1895 by Wilhelm Conrad Roentgen. The mammogram is a particular form of X-ray (low-dose) imaging technique used to obtain a clear breast image. X-rays also increase the blood level of hydrogen peroxide, which can cause damage to cells. X-rays can change the basis of DNA sometimes. (c) Computer Assisted Tomography (CAT): CAT or short CT imaging is advanced X-ray imaging engineering, where X-ray imaging is done. The technique of CT imaging was invented in 1970 and has been used mainly for three-dimensional imaging. (d) Magnetic Resonance Imaging (MRI): MRI is a non-invasive imaging technique developed by Professor Sir Peter Marsfield that creates a 3D image of the body and uses both a magnetic field and radio waves to capture the images. In order to capture images, MRI techniques take longer, which may cause inconvenience for the user. It is important to address additional cautions to patients who ma

(ii) Invasive. (a) Histopathological images (biopsy imaging): histopathology is the microscopic investigation of a tissue. For histopathological investigation, a patient needs to go through a number of surgical steps. The photographs taken from the histopathological tissue provide histopathological images (see Figure 3).



(a) (b)



(c) (d)

Figure 3 (a, b) show mammogram benign and malignant images (examples of non-invasive image) and (c, d) show histopathological benign and malignant images (examples of invasive image).

2. BREAST IMAGE CLASSIFICATION

Researchers have used various algorithms and analysis methods to analyze breast images from different viewpoints, depending on the demand for the disease, the status of the disease and the quality of the images. Machine learning (ML) and Artificial Intelligence (AI) are highly used among the different tasks for breast image classification. The four phases of a general breast image classifier are (see Figure 4):

i. Selection of a breast database
ii. Feature extraction and selection
iii. Classifier model
iv. Performance measuring parameter
v. Classifier output.

Figure 4 shows a very basic breast image classifier model.

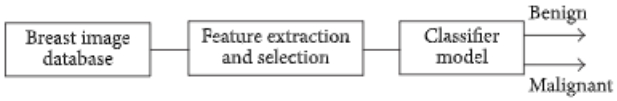


Figure 4. A very basic breast image classification model

2.1. Available Breast Image Databases

To find the present breast cancer status, doctors and doctors are heavily dependent on ultrasound, MRI, X-ray, and so on photos. However several research groups are studying how to use machines more effectively for breast cancer diagnostics in order to ease the work of doctors. Researchers often base their investigation on some well-established image database to make a reliable judgment about the cancer outcome.Various organizations have introduced sets of images databases which are available to researchers for further investigation. Table 1 gives a few of the available image databases, with some specifications.

Table 1 Shows Available Breast Image Database for Biomedical Investment

Database	Number of images	Database size (GB)	Image capture technique	Image type	Total patients
MIAS	322	2.3	Mammogram		161
DDSM			Mammogram		2620
CBIS-DDSm	4067	70.5	MG	DICOM	237
ISPY1	386,528	76.2	MR, SEG		237
Breast-MRI-NACT-Pilot	99,058	19.5	MRI		64
QIN-Breast	100835	11.286	PET/CT, MR	DICOM	67
Mouse-Mammary	23487	8.6	MRI	DICOM	32
TCGA-BRCA	230167	88.1	MR, MG	DICOM	139
QIN Breast DCE-MRI	76328	15.8	CT	DICOM	10
BREAST-DIAGNOSIS	105050	60.8	MRI/PET/CT	DICOM	88
RIDER Breast MRI	1500	.401	MR	DICOM	5
BCDR			Mammogram		1734
TCGA-BRCA		53.92 (TB)	Histopathology		1098
BreakHis	7909		Histopathology		82
Inbreast	419		Mammogram		115

The picture formats of the various databases vary. Few of the images contained JPEG images and few of the databases contained data in DICOM format. Mammogram images are found in the MIAS, DDSM, and Inbreast databases here.

2.2 Feature Extraction and Selection

Extracting the characteristics from the photographs is an important step in image classification. Features are designed locally using some unique rules and standards in the traditional image classification task. The state-of-the-art Convolutionary Neural Network (CNN) techniques, however, typically extract the features using kernels globally, and these Global Features have been used for classification of images. Texture, detector, and statistics are recognized as essential features among the local features.More precisely, the structural and dimensional details of the color as well as the strength of the image in Analytical and Mathematical Methods in Medicine are given by texture features.

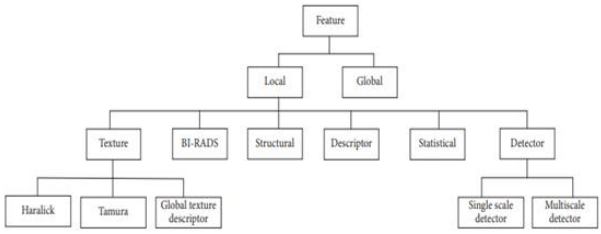


Figure 5. Classification Of Features For Breast Image Classification.

Features which are extracted for classification do not always carry the same importance. Feature set selection and prioritization can be classified into three broad categories: (i) Filter: Without testing any classifier algorithm, the filter method chooses features. (ii) Wrapper: The wrapper approach selects a feature set based on the results of a given classifier's assessment. (iii) Embedded: For classifier construction, the embedded approach takes advantage of the filter and wrapper methods.

2.3. Classifier Model:

The breast image classification strategies can be classified into the following three groups based on the learning point of view: I Supervised (ii) Unsupervised (iii) Semi-supervised. As in the table below, these three classes can be divided into Deep Neural Network (DNN) and traditional classifiers (without DNN) and some other classes.

3. PERFORMANCE OF DIFFERENT CLASSIFIER MODEL ON BREAST IMAGES DATASET

Based on Supervised, Semisupervised, and Unsupervised methods different research groups have been performed classification operation on different image database. In this section we have summarized few of the works of breast image classification.

3.1 Deep Neural Network.

The Deep Neural Network (DNN) is a state-of-the-art phenomenon where sophisticated computing has been used with traditional NN techniques. Conventional NNs have trouble solving complex problems, while DNNs are found to solve them with the utmost precision. DNNs, however, suffer from more time and computational complexity than regular NNs.

(i) Convolutional Neural Network (CNN)
(ii) Deep Belief Network (DBN)
(iii) Generative Adverbial Network (GAN)
(iv) Recurrent Neural Network (RNN)

Convolutional Neural Network. A CNN model is the combination of a few intermediate mathematical structures. This intermediate mathematical structure creates or helps to create different layers:

(i) Convolutional Layer. Among all the other layers, the convolutional layer is considered as the most important part for a CNN model and can be considered as the backbone of the model. A kernel of size $m \times n$ is scanned through the input data for the convolutional operation which ensures the local connectivity and weight sharing property.

(ii) Padding and Stride. A filter scans through the input matrices during the convolutionary process. In each process, the location of a kernel filter moving through the matrix is known as the stage. By default, the move stays at 1. The model uses extra rows and columns at the end of the matrices to solve this problem, and all 0s are contained in these added rows and columns.This adding of extra rows and columns which contain only zero value is known as zero padding.

(iii) Nonlinear Operation. The output of each of the kernel operations is passed through a rectifier function such as Rectified Linear Unit (ReLU), Leaky-ReLU, TanH, and Sigmoid.

(iv) Subsampling. subsampling. Subsampling is the method of minimizing the dimensionality of each of a particular layer's feature maps; this procedure is also known as a pooling operation. It simply decreases the sum of function data from the total data. By doing so, it decreases the model's total computational complexity. Patch units are used to do so. The two most common techniques for pooling are (a) Max-Pooling (b) Average Pooling

(v) Dropout. Regularization of the weight can reduce the outfitting problem. Randomly removing some neurons can

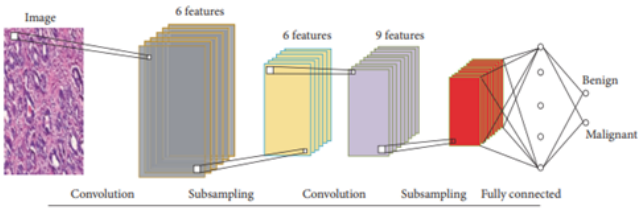


Figure 6. Work-Flow of Convolutional Neural Network (CNN)

regularize the overfilling problem. The technique of randomly removing neurons from the network is known as dropout.

(vi) Soft-Max Layer. This layer contains normalized exponential functions to calculate the loss function for the data classification.

Whichever group experiences a large loss value, the model will consider the other group as predicted class. A difficult

part of working on DNN is that it requires a specialized software package for the data analysis. Few research groups have been working on how effectively data can be analyzed by DNN from different perspectives and the demand. Table 2 summarizes some of the software which is available for DNN analysis.

Table 2: Available software for deep learning analysis.

Software	Interface and backend	Provider
Caffe [65, 66]	Python, MATLAB, C++	Berkeley Vision and Learning Centre, University of California, Berkeley
Torch [67]	C, LuaJIT	
MatConvNet [68, 69]	MATLAB, C	Visual Geometry Group, Department of Engineering, University of Oxford
Theano [70, 71]	Python	Montreal Institute for Learning Algorithms University of Montreal
TensorFlows [72]	C++, Python	Google
CNTK [73]	C++	Microsoft
Keras [74]	Theano, Tensor Flow	MIT
dl4j [75]	Java	Skymind Engineering
DeeBNET [76, 77]	MATLAB	Information Technology Department, Amirkabir University of Technology

The history of the CNN and its use for biomedical image analysis is a long one. Fukushima first introduced a CNN named “necognitron” which has the ability to recognize stimulus patterns with a few shifting variances . To the best of our knowledge, Wu et al. first classified a set of mammogram images into malignant and benign classes using a CNN model. In their proposed model they only utilized one hidden layer. After that, in 1996 Sahiner et al. utilized CNN model to classify mass and normal breast tissue and achieved ROC scores of 0.87 .

Later, directly or with some advanced modification, these DNN models have been adapted for biomedical image analysis. In 2015, Fonseca et al. [1] classified breast density using CNN techniques. CNN requires a sufficient amount of data to train the system. It is always very difficult to find a sufficient amount of medical data for training a CNN model. A pretrained CNN model with some fine tuning can be used rather than create a model from scratch .

The authors of did not perform their experiments on a breast cancer image dataset; however they have performed their experiments on three different medical datasets with layerwise training and claimed that “retrained CNN along with adequate training can provide better or at least the same amount of performance.”

Table 3: Neural Network for breast image classification.

Reference	Descriptor	Image type	Number of images	Key findings
Malik et al. [108]	(1) Speed of sound (2) Attenuation image vector (3) Reflection image vector	QTUS	—	(1) Glands, fat, skin, and connective tissue have been classified. (2) Both linear and nonlinear SVM classifier have been utilized. (3) Their experiment obtained 85.20% Accuracy.
Chang et al. [109]	(1) Textural features such as (i) Autocorrelation Coefficient (ii) Autocovariance Coefficient	Ultrasound	250	(1) Benign and malignant images have been classified. (2) Accuracy, Sensitivity, Specificity, positive predictive values, and negative predictive value are 85.60%, 95.45%, 77.86%, 77.21%, and 95.61%, respectively.
Akbay et al. [110]	(1) 52 features have been extracted	Mammogram	—	(1) Microcalcification (MC) Classification Accuracy 94.00%
Levman et al. [111]	(1) Relative Signal Intensities (2) Derivative of Signal Intensities (3) Relative Signal Intensities and their derivatives in one vector (4) (i) Maximum of signal intensity enhancement; (ii) time of maximum enhancement; (iii) time of maximum washout	MRI	76	(1) Benign and malignant lesions are investigated. (2) Linear kernel, a polynomial kernel, and a radial basis function kernel utilized along with the SVM method for the breast image classification.
de Oliveira Martins et al. [112]	(1) Ripley’s K function	Mammogram	390	(1) Benign and malignant image classification. (2) The achieved Accuracy, Sensitivity, and Specificity are 94.94%, 92.86%, and 93.33%, respectively.

Table 4: Neural Network for breast image classification.

Table 6: Neural Network for breast image classification.

Reference	Descriptor	Image type	Number of images	Key findings
Alharbi et al. [48]	(1) 49 features have been utilized.	Mammogram	1100	(1) Five feature selection methods: Fisher score, Minimum Redundancy-Maximum Relevance, Relief-f, Sequential Forward Feature Selection, and Genetic Algorithm have been used. (2) Achieved Accuracy, Sensitivity, and specificity are 94.20%, 98.36%, and 99.27%, respectively
Peng et al. [49]	(1) Haralick and Tamura features have been utilized	Mammogram	322	(1) Feature reduction has been performed by Rough-Set theory and selected 5 prioritized features. (2) The best Accuracy, Sensitivity, and Specificity achieved were 96.00%, 98.60%, and 89.30%
Jalalian et al. [50]	(1) GLCM (2) Compactness	Mammogram		(1) The obtained classifier Accuracy, Sensitivity, and Specificity are 95.20%, 92.40%, and 98.00%, respectively.
Li et al. [51]	(1) Four feature vectors have been calculated	Mammogram	322	(1) 2D contour of breast mass in mammography has been converted into 1D signature. (2) NN techniques achieved Accuracy is 99.60% when RMS slope is utilized.
Chen et al. [52]	(1) Autocorrelation features	Ultrasound	242	(1) The overall achieved Accuracy, Sensitivity, and Specificity are 95.00%, 98.00%, and 93%, respectively.
Chen et al. [53]	(1) Autocorrelation features	Ultrasound	1020	(1) The obtained ROC area is 0.9840 ± 0.0072.

3.2. Performance Based on Unsupervised Learning:

No prior knowledge of the goal is required by this learning algorithm. The main objective of unsupervised learning is to define the secret structure and relationships between the various data and to distribute the data into various clusters. Clustering is essentially a mathematical method in which a set of data points known as a cluster, is divided into a series of groups. A clustering algorithm, suggested by, is the K-means algorithm. Interestingly, it is possible to use unsupervised learning.

3.3. Performance Based on Semisupervisor: Among supervised and unsupervised learning lies the working theory of semi-supervised learning. A few input data have a related goal for semi-supervised learning and large quantities of data are not labeled. The processing of labeled data is often very difficult. It is difficult to mark little information such as speech or information scratched from the web. Semi-supervised learning to identify this type of data is very successful. However this approach has recently been used for the brat. Semisupervised learning can be classified as (i) Graph Based (GB) (ii) Semisupervised Support Vector Machine (iii) Human Semisupervised .

4. Conclusion

Breast cancer is a significant worldwide threat to women and is responsible for rising the rate of female mortality. Improving the current breast cancer situation is a major concern and can be done by proper investigation, diagnosis, and adequate patient and clinical management. Identifying breast cancer in the early stages and testing the cancer periodically will save many lives. Over time, the status of cancer changes as the cells' presence, distribution, and structural geometry change on a specific time basis due to the chemical changes that are constantly going on within the cell. Through examining biomedical images that can be collected by mammography, MRI, and so on techniques, the evolving configuration of cells can be observed. However these images are complex in nature and require expert knowledge to perfectly analyze malignancy. Due to the nontrivial nature of the images the physician sometimes makes a decision which might contradict others. However computer-aided-diagnosis techniques emphasising the machine learning can glean a significant amount of information from the images and provide a decision based on the gained information, such as cancer identification, by classifying the images.

A long tale is the contribution of machine learning techniques to image classification. The current machine learning based image classification techniques have been used for biomedical image classification, especially for breast image classification and segmentation, using some advanced engineering techniques with some modifications. There are many branches of the image classifier focused on machine learning, such as Deep Neural Network. Except for deep-learning, a machine learning-based classifier largely depends on handcrafted feature extraction techniques such as statistical and structural information that depend on various mathematical formulations and theorize where they gain object-specific information.

This research finds that most traditional classifiers rely on local feature extraction as a prerequisite. The nature of cancer is often evolving, so a new dataset will not yield good results based on a collection of local features. However, due to Global Feature extraction capabilities, the state-of-the-art Deep Neural Networks, particularly CNN, have recently advanced biomedical image classification. The kernel, which gives this model luxury, is the heart of the CNN model. This allows some exceptional results for breast cancer image classification.

For breast cancer patient care, the machine learning techniques and tools have been a tremendous success so far, and this success has gained an extra impetus with the involvement of deep-learning techniques.

. The current research is focused on the development of the light DNN model so that both the computational and timing complexities can be reduced. Another difficulty of using the DNN based cancer image classifier is that it requires a large amount of training data. However the reinforcement of learning techniques and data augmentation has been largely adapted with the current CNN model, which can provide reliable outcomes. Our research finds that the current trend of machine learning is largely towards deep-learning techniques.

Among a few other implications, the appropriate tools for designing the overall deep-learning model was the initial obligation for utilizing deep-learning based machine learning techniquesThis study finds that as a prerequisite, most conventional classifiers rely on local feature extraction. The nature of cancer is also changing, so based on a selection of local characteristics, a new dataset would not produce good results. However the state-of-the-art Deep Neural Networks, notably CNN, have recently advanced biomedical image classification due to Global Feature extraction capabilities. The heart of the CNN model is the kernel, which gives this model luxury.

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K. S. INSTITUTE OF TECHNOLOGY, BANGALORE-560109
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
PROJECT PHASE 1 + SEMINAR (17CSP78)

PROJECT ABSTRACT SUBMISSION 7TH SEM A & B SEC 2020-21 (Odd Sem)

PROJECT TITLE: Breast Cancer classification using Deep Learning techniques.

Batch No.: 2	**Guide Name: Aditya Pai**

Sl. No.	NAME	USN
1	Rakshith.R	1KS17CS063
2	Rohith.K	1KS17CS062
3	Shri Harsha Kulkarni	1KS17CS077
4		

ABSTRACT

Early diagnosis of any disease can be curable with a little amount of human effort. Most of the people fail to detect their disease before it becomes chronic. It leads to increase in death rate around the world. Breast cancer is one of the diseases that could be cured when the disease identified at earlier stages before it is spreading across all the parts of the body. The medical practitioner may diagnose the diseases mistakenly due to misinterpretation. The computer-aided diagnosis (CAD) is an automated assistance for practitioners that will produce accurate results to analyze the criticality of the diseases.CAD system can used to perform automated diagnosis for breast cancer. This method employed deep neural network (DNN) as classifier model and recursive feature elimination (RFE) for feature selection. DNN with multiple layers of processing attained higher classification rate than SVM. So, the researchers used deep learning method for hyper-spectral data classification.

This project aim is to predict Breast Cancer using Deep Neural Network.

System Requirements(H/W and S/W)

K. S. INSTITUTE OF TECHNOLOGY, BANGALORE-560109
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PROJECT PHASE 1 + SEMINAR (17CSP78)

PROJECT ABSTRACT SUBMISSION 7TH SEM A & B SEC 2020-21 (Odd Sem)

Minimum Hardware Requirements: • Pentium IV or higher, (PIV-300GHz recommended) • 256 MB RAM • 1 Gb hard free drive space

Software Requirements: • PyTorch (An open source machine learning library based on the Torch library, used for applications such as computer vision and natural language processing) • Programming language: Python • Image processing • Convolutional Neural Networks •Deep Neural Network.• Machine Learning Models • MS Word • Web Browser: Google Chrome • Operating System: Windows XP / Windows7/ Windows Vista

Base Paper Submitted: (Yes/No)

Provide Base Paper Details in the following format:

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Reason for Rejection:		
Reason for Re Submit:		

Project Coordinator **HOD**

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Department of Computer Science and Engineering

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THEME: SELF-RELIANCE AND AUTOMATION

CERTIFICATE OF PARTICIPATION

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Prof. Aditya Pai H

from ***K S Institute of Technology*** *college*

has participated and presented a paper entitled

Breast Cancer Detection Using Deep Learning: A Survey

in the domain Data Analytics, Artificial Intelligence, Machine Leaning and Software Engineering in 34th CSI Karnataka State Student Convention Jointly organized by Computer Society of India, Region V, Bangalore Chapter and Department of Computer Science and Engineering at K. S. Institute of Technology, Bangalore on 22nd and 23rd December, 2020.

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Chairperson CSI-BC	*State Student Coordinator CSI*	*Event Convener Dept. of CSE*	*Head of the Department Dept. of CSE*	*Principal/CEO K. S. I. T*

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from **K S INSTITUTE OF TECHNOLOGY** *college*
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Jointly organized by Computer Society of India, Region V,
Bangalore Chapter and Department of Computer Science and Engineering
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