BREAST TUMOR DETECTION USING DEEP LEARNING

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

The research paper titled **"Breast Tumor Detection Using Deep Learning"** which was turned in to the Department of Computer Science and Engineering at Daffodil International University by **Md. Atikuzzaman, ID No: 201-15-13595,** has been approved in terms of style and content and is considered satisfactory for partially fulfilling the requirements for the B.Sc. in Computer Science and Engineering degree. The date of this presentation is January 26, 2024.

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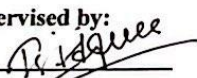Jagannath University

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DECLARATION

This declaration certifies that we, under the guidance of **Shah Md. Tanvir Siddiquee, Assistant Professor in the Department of Computer Science and Engineering,** Faculty of Science and Information Technology, Daffodil International University, conducted the study. Furthermore, I certify that no portion of my study, nor any portion of it, has ever been submitted for a degree anywhere.
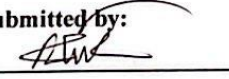
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ABSTRACT

Finding tumor areas on breast ultrasonography pictures has long been a fascinating subject. The complex architecture of breast and the presence of noise in ultrasound images sometimes make it impossible for traditional handcrafted feature-based approaches to produce adequate results. The accuracy of finding objects has significantly improved with the recent developments in deep learning, particularly for generic detection of objects. Moreover, most models currently lack efficient optimization for the algorithm's structure, which incurs high processing costs during training and deployment. This paper offers a variety of image processing techniques for breast tumor classification. Finding breast tumor is the study's main objective. In order to accurately detect and classify images as benign or tumor, a number of methods and algorithms have been developed. In this particular experiment, ultrasound pictures of three different class kinds—malignant, benign, and normal—were combined with dl-based models. The prediction and detection of tumor pictures is done using five models: InceptionResNetV2, InceptionV3, VGG16, VGG19, and DenseNet169, to classify breast tumor stages. Finally, the results of the approach are assessed using two different measures of efficiency. Four possible outcomes—TP, TN, FP, and FN—are used in the first reliability set, a performance evaluation for the stages of tumor that follow. We next apply the above algorithms to analyze the accuracy of each type of breast tumor in mistake scenarios. The InceptionResNetV2 approach, which I suggest, allows for the autonomous recognition of breast tumors with an accuracy rate of 91.82%.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The second greatest cause of mortality for women is breast tumor. Since early detection can significantly lower mortality (by 40% or more), it is essential for the management of breast tumor [1]. Mammograms used to be the primary method for identifying breast tumor. However, because of its poor specificity, mammography not only puts patients at risk for health problems, but it also results in 65–85% of needless biopsy operations [1]. Using ultrasound is a far superior alternative; it can minimize needless biopsies by 40% and enhance total tumor   diagnosis by 17% [1]. The ability of clinicians to detect tumors with ultrasonography now depends on their knowledge and expertise, particularly when it comes to the markings and measures of tumors. Specifically, an ultrasound technician finds a favorable angle to make the tumor visible on the display, then holds the probe in place for a considerable amount of time with one hand while marking and measuring the growth on the screen with the other. Finding malignancies in ultrasound images of breasts is a challenging task since even a small shake of the hand that's holding the instrument can significantly affect the image quality. For this reason, automated automatic tumor identification technology is in considerable demand for identifying countries of greatest interest. There have been several prior approaches that address the automated identification of breast tumor ROIs. In [2], the breast tumor was identified using a self-organized map neural network system. Using local colors and a local color co-occurrence matrix—a joint density function with the probability of two positions—it is possible to automatically extract the ROIs. When compared to the fundamental texture function, the color level overlap matrix may provide detailed information about the image's amplitude, direction, and interval. An automated ROI creation approach including two components— automatic seed point identification and region growing—was developed by Shan et al. in [3]. The technique relies on textural features, though, and low contrast or the presence of a fat region next to where the tumor is located make these features ineffective for ultrasound breast pictures [4]. In [5], an experienced texture classifier with previous experience criteria was utilized to identify the final ROIs for tissue samples as part of a supervised learning strategy to divide the breast tissue into distinct groups. However, the suggested method's resilience was diminished

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because of the rigidity of the added limitations. By putting out a completely automated, adaptive ROI creation method with flexible limitations in [4], the writers enhanced the approach in [5].

A multitude of DL techniques may be employed to identify the breast tumor. The preliminary processing, sorting, segments extraction of features, and photo collection are all included in the proposed paradigm. The majority of a process sequence may be approached in a variety of ways by using computerized image analysis and deep learning, or DL. It takes many steps in contrasting paintings that may be used to accurately identify the different stages of breast tumors. To begin training the computer, obtain compromised photographs in JPG, PNG, and Tiff style files and scan them. Those are the pictures of breast tumor that the system displays first. This changed the energy density of the original png file type twice again.

As mentioned earlier, precise staging of the disease and enhanced medical progress depend on the implementation of a fully autonomous computerized technique for breast tumor identification. Numerous techniques, such as huge amounts of data, image processing, and the emergence of the World of Things, are employed to classify this breast tumor. The benefits of the DL techniques are also shown for this goal. The implementation of deep learning technology has enabled the computer to learn and make judgments on its own. Several kinds of neural networks— unsupervised or learned instruction, reinforcement teaching, and neural networks—can be used to achieve deep learning. In this study, the detection of breast tumor necessitated the creation of many intricate deep learning algorithms, which will also complete the classification assignment.

Categories of breast tumor tumors are examined in this research. Following image identification, a variety of processing techniques are applied to address the particular problems presented by the actual tumor images in order to achieve multiple objectives. The following goals can be accomplished via photo analysis:

- Identifying various breast tumor classifications from images of the various tumor types.
- Using the measurements from DL simulations to evaluate the breast tumor's severity.

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1.2 Objectives

Technology has advanced significantly in the modern era. Inventiveness may assist in solving any issue. As a result, a lot of research has been done to help the medical industry expand. The largest weakness now confronting the healthcare industry is the different phases of breast tumor. A person's body is vulnerable to several diseases, including tumor. The primary goal of this effort was to use deep learning methods to identify three distinct types of breast tumor. The primary objective is to accurately categorize the various types of breast tumor for the purpose to forecast its aggressiveness. breast tumor is similar to other malignancies. My objective is to use DL training together with an image analysis technique to classify photos of different stages of breast tumor. Consequently, I have been able to set the following objectives:

- To support the medical community and patients.
- To forecast the three stages of breast tumor photos using deep learning.
- To gather data for the purpose of predicting breast tumor.
- Gaining a thorough comprehension of the deep learning-related areas.
- Using a variety of techniques to improve results.

1.3 Motivation

I was drawn to designing items for the medical industry since it is the most crucial aspect of any medical sites. The medical establishment and society as a whole believe that they touch on a wide range of illness categories, of which breast tumor is just one. This is the reason I made the decision to become a doctor and treat female patients suffering breast malignancies of all sorts utilizing AL & DL. Coming up with a paper topic that will satisfy the research criteria required some effort. I so sought advice from one of my esteemed instructors. Given the prevalence of breast tumor in today's society, I was advised to research relevant topics. I was thrilled to choose the medical sector as the topic of my studies. That's why I decided to write a study with the title " **Breast Tumor Detection Using Deep Learning** ". Furthermore, I see that researchers are exploring new areas in medicine in an attempt to complement my own research, and that society is utilizing new findings to enhance the medical field. The following inspired us to undertake this type of study project. Since ai has linked everything in my environment, deep learning is crucial.

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1.4 Rationale of study

Certainly, because so many research have been done in fields like object recognition and image processing, there has been progress in these areas. The topic " **Breast Tumor Detection Using Deep Learning** " has relatively few finished publications at this time. I thus employ a variety of algorithms and classification techniques in my study. I developed a model and forecast just for this problem. My careful planning made it possible for me to finish the assignment on time. The basic process of processing images may be divided into many subcategories, including data reduction, measurement manufacturing, picture improvement, conservation, and reinforcement. Digital photos have the advantage of requiring less storage space. Pictures aren't flawless. Images may include flaws from issues that arose during the digitization process. Photographs that have been damaged can be restored using image enhancement methods. Applying deep learning techniques is another strategy that might be utilized to locate them.

1.5 Research Question

The study was finally completed after much dedication and labor. For me, this was a very challenging undertaking. The development of a precise, workable, and fair system is hampered by several issues. The following significant questions have the answers that researchers would like to know in order to investigate this subject further and examine these ideas:

- I want to do a deep learning research; can I utilize raw picture data?
- Must unprocessed data be authorized?
- Is it possible to use a deep learning strategy for preprocessing the data first?
- Do these tactics and approaches have any benefit for the medical industry?
- In what ways might patients benefit from these approaches and research?

1.6 Expected Outcome

Many facts are included in this section because those circumstances led to my most basic anticipated outcome. Several techniques of categorization are being utilized to categorize the various forms of breast tumor in order to aid future research and predict the true prognosis of the

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illness. This based on research project aims to provide a thorough, effective strategy or methodology that uses a prediction algorithm developed on a raw data to identify distinct stages of breast tumor . As a result, the list of all of the previously indicated predicted consequences is as follows:

- Based on the tumor inquiry, I will demonstrate that breast tumor exists in phases one through three.
- A better understanding of how deep learning is used to differentiate between images of tumor and breast tumor .
- I wish to compare my findings with those of previous studies using outdated picture data.

1.7 Report Layout

A brief description of the research project's method, including its goals, inspiration sources of information, purpose, and anticipated results, was given in the opening chapter. Furthermore, included in this section is the investigation's general framework.

The advancements achieved at this point in the field are covered in Chapter 2. In further detail, the depth resulting from this subject's restrictions is illustrated in the second chapter's last part. A concise overview of the primary obstacles or constraints that the research is confronting is provided. This chapter summarizes the topic, lists the obstacles that must be overcome to complete the project, and contains sections on pertinent reading.

Chapter 3 provides an explanation of the conception of this study project. This chapter goes into further information on the statistical methods used to address the theoretical component of the inquiry. In this section, procedural approaches to deep learning technologies are also demonstrated. The procedure for gathering datasets and the system for preparing data are described in the next chapter. Confusion matrix evaluation is also incorporated in the later portion of this subdivision to evaluate the method and provide the classifier's accuracy tag. Implementation analysis is necessary when employing deep learning techniques to guarantee genuine correctness. The study's purpose and tools, workflow, data collecting procedure, processing of data, recommended model, style of

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instruction, and the operational requirements that had to be fulfilled in order to construct this project are just a few of the subjects that are covered in this part. A detailed explanation of all the DL techniques and classifications utilized in this study is included for each technique.

The outcomes of the experiment, a performance assessment, and a discussion of the results are presented in Chapter 4. This chapter contains a few test shots to help with the project's implementation. This chapter ends with an overview of dl techniques.

A summary of the research, an examination of the results, and details on next activities were included in Chapters 5 and 6. As the validated example in this chapter demonstrates, the project report conforms with all criteria throughout. The chapter's last part explores the shortcomings of my present efforts and how they may impact future workers pursuing comparable objectives. Sustainable and the environment at large are impacted by this.

CHAPTER 2
BACKGROUND

2.1 Introduction

The study results, difficulties, relevant literature, and research summary are the primary subjects covered in this part. In "related Functions," I will look at research papers that have been authored by other authors and talk about how their ideas and correctness are related. The papers, methodologies, and reliability of other academic publications that are pertinent to my research will be covered in the part that focuses on comparable studies. I will offer a synopsis of my relevant work under the category for research descriptions. In performing this research, I explain how I overcome every challenge I had as well as how in the toughest portions, I improved the accuracy of each stratum. All of it has previously been investigated.

2.2 Related Works

Research and development on the categorization of breast tumor utilizing photos from different phases of the disease have been extensive. This is a summary of many techniques that several researchers have examined to aid in the identification of various breast tumor s.

A heuristic regional proposal approach and CNN were coupled to create the Region-based neural networks using convolution (R-CNN) introduced by Girshick et al. [6]. But R-CNN has certain significant shortcomings: Due to the repeated collection of features, (1) the process of training takes a long time, and (2) the phase of detection moves slowly. He et al. [7] created Space Pyramids the Combination Net (SPP-Net) to increase the speed of R-CNN.SPP-Net doesn't demand that suggested areas be resized to a specific size, in contrast to R-CNN. SPP-Net significantly reduces the detection time because the convolution operation is only completed once because to value caching. Nonetheless, there are still two significant problems: (1) the phase of training is quite complicated; and (2) the fine-tuning stage is unable to modify the layers of convolution, which limits the ability of SPP Net to execute better. Lately, scientists have also looked into potential strategies to avoid suggesting areas for detection right away.One single convolutional neural network, or CNN, was used, for example, by I Only Looked Twice (YOLO)[8] to forecast the borders or labeled classes of observed areas. YOLO is appropriate for real-world applications since it restricts the amount of boundary boxes, which prevents recurrent detection of the same item and

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significantly increases detection speed. But YOLO has the same issues with small-scale object detection as Faster R-CNN. Liu et al. [9] developed ssd by creating boundaries with varying widths and ratios of aspect using map features of various levels in order to address the problems seen in YOLO. Such CNN-based techniques, however, are limited to broad object detection. We use them to find tumor s in our recently gathered breast ultrasound collection in this research.

Recent advancements in deep learning models, including convolution neural network models (CNN), have important ramifications for diagnosis in medicine. Kott et al. [10] used a deep residue CNN to aid in the histopathologic identification of prostate tumor. The algrithm showed 91.5% classification accuracy at a basic level in distinguishing between benign and malignant picture regions. Ismael et al. [11] described a method for automatically classifying brain tumors using neural networks built with residuals (ResNet50 architecture). Accuracy of the patient-level model was 0.97. Dermo copy photos were categorized by Harangi et al. [12] using the deep internet search Concept.

The classification of bone fractures was studied by Karanam et al. [13] using machine learning and deep learning techniques. Fractures have been evaluated, classified, and identified by ResNeXt101, InceptionV3, SVM, random forests, and K-nearest neighbor (KNN). Test outcomes increased by 93.75% following the use of ResNeXt101. For radiologist along with other medical practitioners, the approach shown here helps with fracture diagnosis, categorization, and therapy suggestions. According to research done in this field, most minds lack an interest in assessing bone splits, while numerous educators are intrigued in categorizing bone fractures.

Hrzˇic´ et al. [14] proposed a fracture diagnostic and classification method using X-ray pictures. This method used local entropy to minimize noise in X-ray images. The nearby sensitivity calculated by Shannon was computed for every pixel in the image using a rolling 2D window. Once the initial picture was segmented, the theory of graphs was applied to images to enhance edge detection and eliminate negative bone outlines. In the end, a variation between the recoverable and expected outlines was determined in order to identify and classify the fracture. The study finds a normal certainty of 86.22% and a discovery rate of 91.16%.

To sum up, more research is required to completely comprehend the process of computerized classification and identification of breast tumor. However, getting a fast, accurate, and fairly priced examination still depends on the radiologist's skills. The literature demonstrates how faulty and untrustworthy earlier studies was. Furthermore, the recommended method is not supported by any systematic plan for the early detection of breast tumor. I used five distinct models to anticipate and recognize different tumor   pictures in order to use an internet application to diagnose different stages of breast tumor: InceptionV3, VGG16, VGG19, DenseNet169, and InceptionRestNetV2.

2.3 Research summary

The majority of my research focused on the many strategies that society provides. breast tumor has been discovered photos have been categorized in five different ways overall using a deep learning-based algorithm. With my online dataset, I used a variety of methods. A web-based database I created utilizing data from various websites served as the main source for data in this case. I will be able to assess the viability of the five strategies I used and look at things like the impact of the extra data I provided using the same source. The updated dataset and the prior dataset it was combined with include exact duplicates. You may categorize them into similar groups and classes and describe their meanings by adding tags.

2.4 Challenges

The organization of pictures revealed to be considerably too difficult for this research, thus the main issues are obtaining and interpreting the material. We had a hard time finding out about this problem until we maintained searching the internet for details and browsing the Kaggle database. I used a number of tools and techniques to clean and organize my dataset. My system required a long time to process the huge datasets because of their various tiers and different epoch scopes. I was therefore forced to endure a drawn-out wait for the result. The previous datasets on this issue did not adequately represent my knowledge after several testing, therefore I had to get datasets for a number of sources which included the ideal for identifying three phases of breast tumor. Having little experience with research, I had to work hard to determine the best ways to complete the homework as soon as possible. As in the previous instance, there were problems with DL models' categorization when picture data was prepared.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

The section that follows provides a detailed explanation of the strategies and techniques I employed to classify the various disease categories I examined. The data collection and analysis, together with the suggested model—which is further elucidated by the pertinent estimation, graph, table, and explanation—are the primary components. The highest level of precision for the study was obtained by segmenting and predicting using my web data and the DL classification framework. I summarized my statistical assumptions at the conclude of the chapter. While images of breast tumor might depict a wide range of pre tumor processes, I focused my study on three main tumor classes: benign, malignant, and normal. There are differences throughout the three stages of breast images in this collection. Every one of the subject's images were used by three different class kinds in the present research to offer instruction.

3.2 Study Subject and Equipment

A studied subject is an area of study that has been examined and investigated to provide clarity on concepts for model creation, goal accomplishment, information collection, management, training, and performance enhancement. I discuss the tools and procedures I use to measure. NumPy was used in conjunction with Python programming and Microsoft software to create Sk-learn, OpenCV, and other applications. Google Co Labs only uses its infrastructure for teaching and testing. Python may be used by workers at Google's Colab to create algorithms for deep learning and data extraction methods.

Library function:

- **Matplotlib:** A set of methods known as Py-plot plotting is one of Matplotlib's display capabilities. Among its numerous applications is form creation; it's useful for, say, drawing boundaries and highlighting lines inside a plot.

- **NumPy:** Python matrix involvement is a common use case that may be fulfilled by employing the NumPy library. The topics covered include matrices, linear algebra fundamentals, and the Fourier transform. The NumPy module provides resources and tools to enable working with matrices of different sizes in Python easier. NumPy makes it possible to construct arrays accurately and scientifically. A library for Python which is used in computational tasks is called NumPy. A different term that it uses is "a broad spectrum of types of Python".

- **Sk-learn:** This application is useful and easy to use for analyzing forecast data. Anyone can use and modify the open-source software to suit their specific requirements. NumPy, SciPy, and Matplotlib were utilized through expansions.

- **Seaborn:** This popular graphing setup is well known for being simple to use and for having previously been integrated with matplotlib, which makes it an effective tool for producing eye-catching and attractive data visualizations.

- **CV2:** OpenCV-Python is a collection of Python bindings designed to address computer vision problems. Additionally, it makes it possible to identify certain individuals, items, and even handwritten language in photos and videos.

- **Job-lib:** There is a chance that this more effective way of avoiding doing the same calculation repeatedly will save a substantial amount of time and money.

- **H5py:** The h5py package provides an abstraction over native high-density5 material in Python. NumPy makes it easy to handle and store massive volumes of quantitative data in HDF5.

- **OS:** Developers can utilize the variety of tools offered to them by the Py OS part to communicate with the software running on the computer they are currently using.

- **TensorFlow:** Using this freeware Python math framework, you may create artificial neural networks and self-education methods more quickly and easily.

3.3 Working Process

It is possible to identify the best way to assess the data used in this investigation by employing a range of techniques or methods. This research employs a multi-step methodology that comprises selecting the model, developing it, acquiring data, improving and fine-tuning it, and producing it.

Step 1: Gathering Data: I employed Kaggle to obtain online statistics data, which I subsequently evaluated to construct an accurate set of my own. Because it is difficult to locate the dataset and collect information pertaining to particular breast tumor phases three images of the malignancy, a big, complete dataset is not easily accessible in this field.

Step 2: Preprocessing the Data: Unprocessed data of all kinds were collected from various medical-related websites and handled separately. Defects and complexity are possible in many data sets. Having technically internalized this information, I move on to the next step using the chosen data set.

Step 3: Preparing the dataset: The results were clipped and continued to expand following the analysis of each class. I had to resize and add data for it to work. I restricted the total number of adjustments that I performed to those that were highest and most appropriate ones since I was concerned about extreme fitting.

Step 4: Model Selection: After you've made your decision, train and evaluate the chosen model with the available data to improve accuracy. DL employs a large range of models. Several prototypes of the idea were tested using my equipment in order to choose the best arrangement for accurately calculating data.

Step 5: Performance Evaluation: The entirety of the results is covered in this section. After testing, validation, and training throughout the course of the three courses, these tactics provided us with an insufficient level of dependability. Along with the matrix of uncertainty, recall, effectiveness, and f1 evaluation graphics, an online application was also developed for the diagnosis of breast tumor using photos of the disease at different stages.

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Step 6: Final Thoughts and Prospects: A chronology and synopsis of the development are provided in the next section.
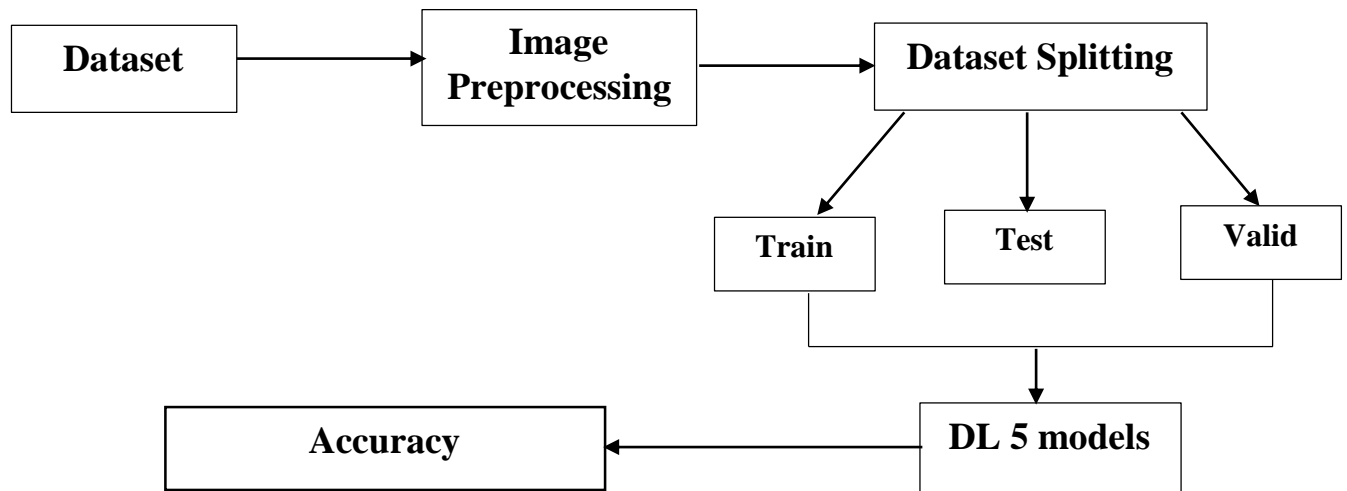

Fig 3.1: Total workflow for research

The basic model has been used to classify breast tumor, as shown in Figure 3.1. To generate a dataset, internet data must first be collected from many Kaggle providers. After then, the picture has been augmented with data, tagged, resized, and classified. Then the machine may be able to collect this information. With this knowledge, I could use new datasets to train, evaluate, and certify my proposed deep learning techniques. Because of the performance of the algorithm and the online application, images of breast tumor may be utilized to detect 3 classes having the finest accuracy achievable using DL models.

3.4 Data Collection Procedure

In all, I have accumulated 1588 photographs. I got online datasets from the Kaggle database. According to the form of breast tumor, the dataset is divided into three classes, which are as follows: breast tumor progresses from breast tumor in three stages. This tumor dataset is divided into three groups overall. There are 901 photos in the benign data, 421 in the malignant data, and 266 in the normal class. Half of the data are used for test and validation, whereas the other 20 per cent are split between train and test.
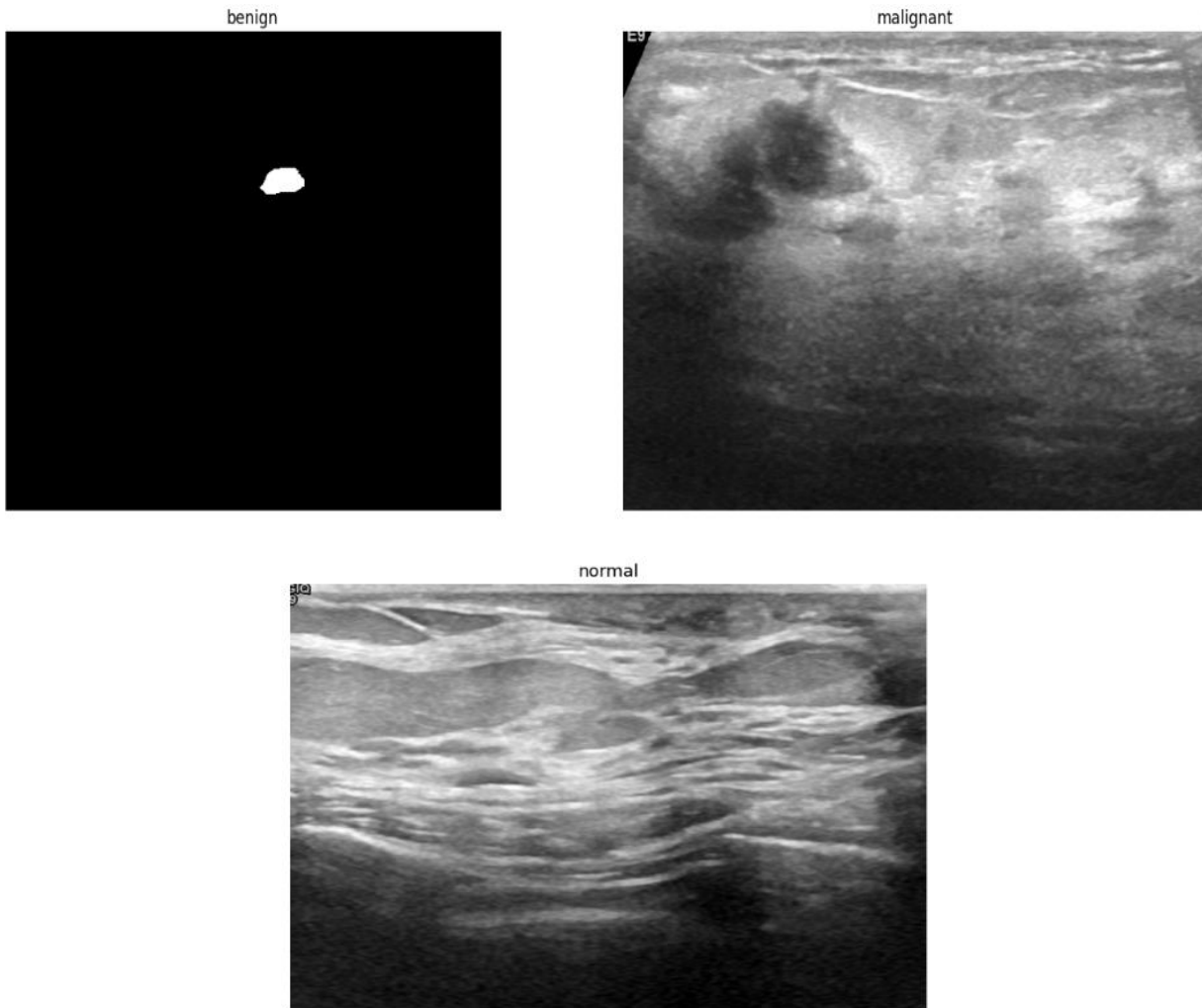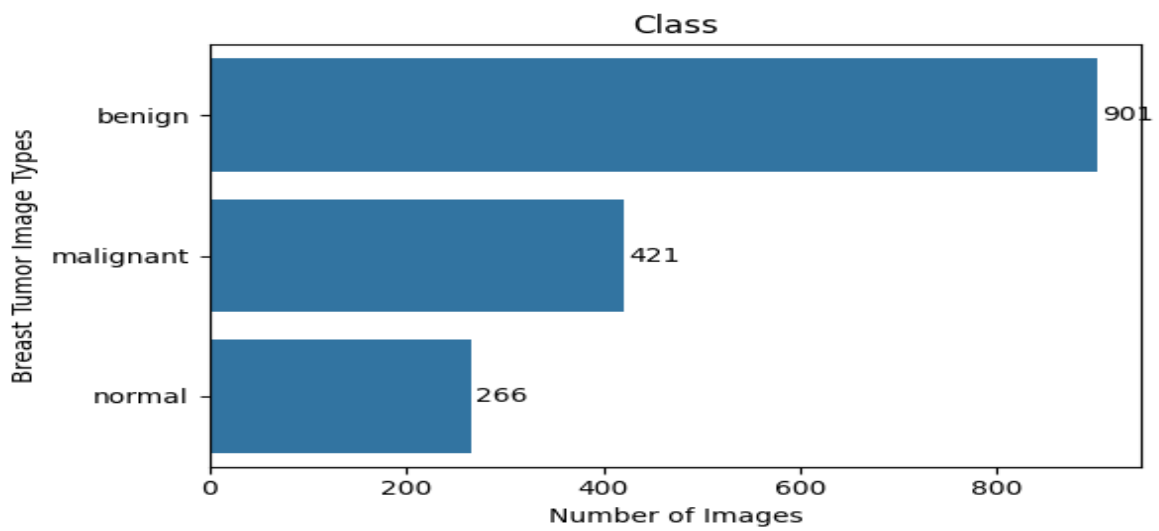
Fig 3.2: 3 classes of breast tumor.

Fig 3.3: Dataset class contains all images.

Table 3.1: Tabular dataset

Classes of Data	Quantity
All Image	1588
Benign	901
Malignant	421
Normal	266

Label Maker:

Methods involving deep learning are frequently used when analyzing data which contain a large number of tags dispersed over many columns or in a single column. These IDs might be words or whole numbers. In an attempt to make the text easier for people to read, terms that indicate the topic that is being learned are frequently used.

Encoding is the process of converting tags into a computer-readable alphanumeric form. Among the steps in this procedure is label coding. The algorithms employed by DL have the last word on how much of these labels are used. The dataset design stage must be implemented for uncontrolled training.

3.5 The application of statistics

3.5.1 Manipulation of Data

Data processing makes up the majority of data. When gathering data, it's crucial to take the data processing method into account. Refined data is incredibly helpful when using internet data. I collected relevant information for the different phases of breast tumor . Subsequently, data was integrated with information from actual medical areas to produce a huge dataset containing three categories. The resultant change's effectiveness frequently depends on the initial data mining that was done. Better-created data will yield more accurate results. A system that is used for processing data consists of two stages: gathered data and resupplied data. Put another way, this is the primary obstacle to this kind of grounded in research effort.

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I. Data preparation and accumulate: All of the images in the set that I used were produced by merging the various online field data width and height that Kaggle had collected from healthcare establishments. Because my model required a certain quality for each picture, I modified the code in order to reduce the image to a fixed 500×500-pixel size. In addition, as a preprocess, I have ended every picture in the model with "png". I prepared the pictures for classification by grouping them. I also made some more image editing after data augmentation. For this reason, the framework was trained using the divided version of the entire datasets.

- Pictures with set sizes determined by codes.
- Changing a variety of file formats to png.
- Eliminate any old pictures.
- Deleted unnecessary pictures.

```
print("The classes:\n", np.unique(df['label']))

The classes:
 ['benign' 'malignant' 'normal']
```

Fig 3.4: All classes name of Breast tumor.

3.5.2 Data for Training, Testing and Validation

One of the most popular activities in deep learning is investigating and creating techniques that can extract information from files and deliver results based on that understanding. These algorithms accomplish their goals by generating an equation from the input data that they may then utilize to analyze or extrapolate information from. These inputs are often separated into many data sets prior to being utilized in the model-building process. When developing a model, the three distinct data sets—train, true to self, and test—are usually used. Divide the initial dataset used for training in half, setting aside 50% and 50% for verification and evaluation and 20% and 80% for trained.

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3.5.3 Model of classifying

1. **InceptionResNetV2:** First off, two more complex neural network designs, Inception and ResNet, were combined to create ResNetV2, which has a neural network architecture. Using remnant links, a crucial component of ResNet, it is an expansion of the Inception design. Google researchers introduced InceptionResNetV2 as a network that is a part of the Inception family. It is renowned for displaying outstanding performance in a number of visual analytic applications, including as object identification and picture classification. It showed excellent results when applied to the ImageNet large-scale visual recognition contest (ILSVRC). Considering that Inception Res Net V2 is a rather large and computationally costly model, its adoption in studies and uses wherever computing capabilities are not an issue may be more widespread.
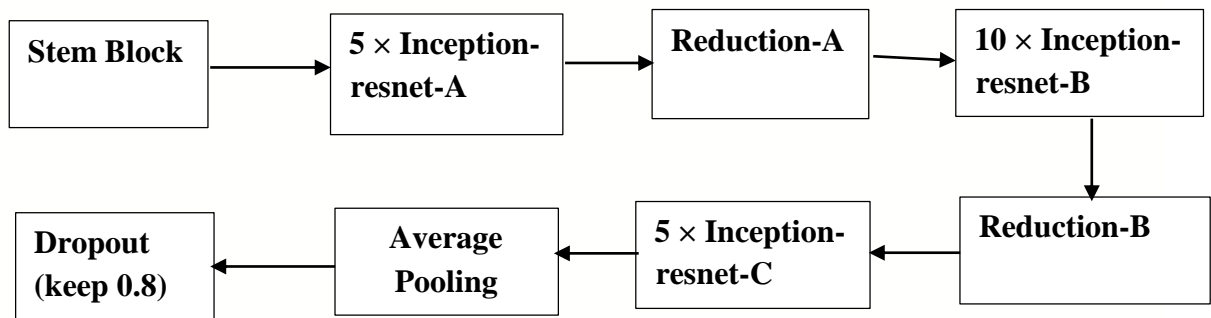

Fig 3.5: Model workflow of InceptionResNetV2.

2. **InceptionV3:** The structure of CNN InceptionV3 is employed for picture recognition and classification. It is a component of the set of Brainstorm DL ideas that the company's staff developed in order to go ahead. The InceptionV3 device is well known for its intricate design and creative use of the Beginning paragraph," a unique feature that raises the precision and general efficiency of the system. The design of the InceptionV3, which deep neural system consists of 48 layers. A convolutional layer, fully linked layers, additional classification techniques, and levels with optimal pooling are examples of combinations. Networks can gather data at several levels of abstraction thanks to the periodic merging and tiered randomly of the Creativity section (1x1, 3the amounts of x3, which form as well as 5x5).
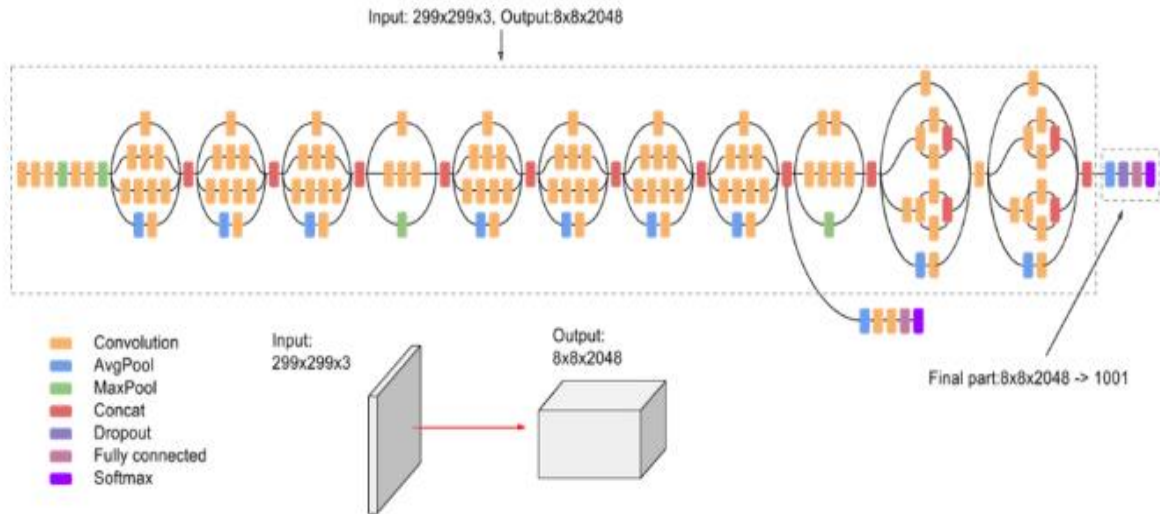
Fig 3.6: Model workflow of InceptionV3.

3. **DenseNet169:** The majority of Dense Network systems that were created for image classification generally employ the densenet-169 model. The ratio of density and accuracy are where the small net-121 model differs most from the other models. With a download size of around 55 MB for the densenet-169 version and just about 31 MB for the densenet-121 model. The authors changed the teaching format from Blaze to Caffe. With the help of the ImageNet picture library, pre-training was done on all three fundamental models. A number of layer types are present in the DenseNet169 design, including maxpool, thick, transitional, and convolutional layers. SoftMax and Relu are also included in the design as activation elements. The DenseNet-169 Configuration Details As is evident, the convolution, combined, and completely connected layers represent the three separate tiers that make up the CNN structure.
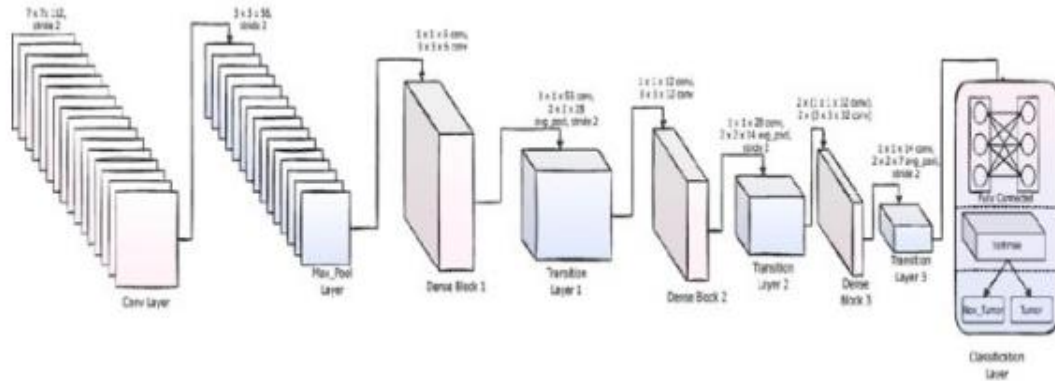
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Fig 3.7: Model workflow of DenseNet-169.

4. **VGG16:** VGG16 is the abbreviation for the VGG model, which is also known as VGG Net. Sixteen-layer the convolutions (CNNs) make up a neural network architecture. A pretrained neural net version of the ImageNet database contains over a million pictures taught. The recently trained system can recognize 1000 distinct item categories from images, including a range of animals, a computer mouse, a keyboard, and pencil. Consequently, the network may learn a wide variety of rich optical visualizations of features. An picture with dimensions of 224 inches by 224 inches might be handled by the network. For other preconditioned networks, see MATLAB's Recently trained Asynchronous Neural Networks techniques.
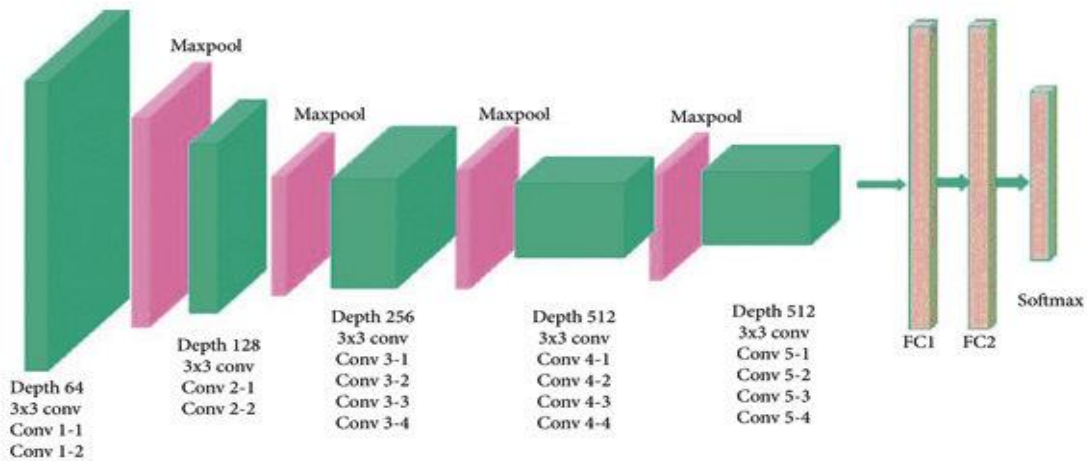

Fig 3.8: Model workflow of VGG16.

The picture parameters (224, 224, 3) are sent to the server. The initial two tiers consist of sixty-four channels with identical cushioning and a 3*3 filter area. The step (2, 2) max

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pooling layer is succeeded by a convolution layer with filter size (3, 3) and 128 filter measures. In the same order as the layer before it, the largest pooling layer of frequency (2, 2) comes next. One to three filtering sizes of a set of 256 filters are placed after two convolutional layers. Following two distinct sets of three independent layers created using convolution, there is a maximum gather layer. The spacing and size of each of the 512 lenses are the identical (3, 3).

5.   **VGG19:** The VGG19 model is a variant based on the VGG model that consists of 19 convolutional layers, 3 fully connected layers, 5 maximally pooled parts, and 1 Softer Maximum layer. Since an RGB image with a preset dimension of (224 * 224) was assigned to this network, the matrix's structure was (224,224,3). The average Cmyk values for every pixel, which was calculated for the whole training set, was removed as the single preprocessing step. They were able to fill the complete image by employing kernels with a (3 * 3) quantity and a one pixel swing. Spatial padding was used to maintain the image's depth. Through the use of Speed 2 over 2 * 2.-megapixel glass, maximum pooling was accomplished. Next, in order to enhance non-linearity, speed up computation, and improve modeling sorting, a new uniform unit (ReLu) was implemented. Compared to earlier models that utilized sigmoid or tanh functions, the ReLu proved to be significantly superior. Three of the 4096-sized layers that were produced were entirely connected. There is an extra layer having a starting channels rate of 1000 appended for a 1000-way categorization, as well as the final layer called as the soft max algorithm.
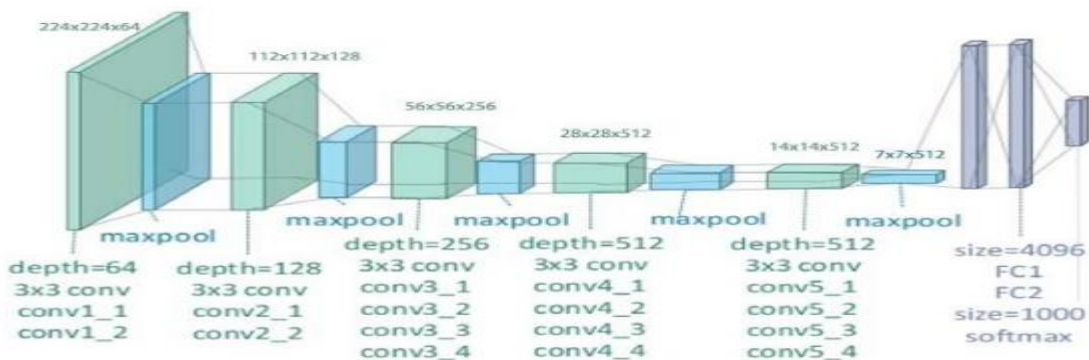

Fig 3.9: Model workflow of VGG19.

3.6 Implementation

The data set has to be used to ensure accuracy after completing all subsequent activities. To make the task easier to complete, I divided it up into its most crucial parts. I have to follow these rules in order to make sure that my job turns out well.

- Collection of datasets
- All steps of image preprocessing
- Image prediction for 3classes.
- Implementations of models.
- Discussed about accuracy and performances.

I collected every one of my info online with programs like Kaggle. I chose a dataset that made sense for the various stages of breast tumor. After that, I could go to work on getting the data ready. In this case, I eliminated everything superfluous from my data, such as noise, incorrect images, incorrectly scaled images, etc. Furthermore, I use generators of data to perform the longer train, test, & validation intervals.

I began experimenting with the code in order to gain a feel for how to put the concept into practice. I assessed each of the five employed algorithms' accuracy. After the process was finished, I evaluated its accuracy. I weighed the accuracy and determined which would be more useful for my goals. In the instance of breast tumor, this has shown to be fairly trustworthy using various stages of tumor image data. Following a detailed examination of all pertinent mathematical and philosophical concepts and methods, a set of preconditions has been established that are necessary for each and every effort at picture categorization. Some outcomes that could be necessary are as follows:

1. Hardware and Software Requirements

- Operating Systems: Windows 7 or later;
- Hard Drive: 1 TB or more;
- RAM: 4 GB or less

2. Development Tools

- Environment of python

- PyCharm.

- Google Colab.

- VS Code.

CHAPTER 4

EXPERIMENT RESULTS AND DISCUSSION

4.1 Introduction

This section uses an approach to classify breast tumor stage photographs in order to show that a breast tumor stage progresses. The images were acquired, the information was assessed, the information was refined, the information's volume was adjusted, the models were displayed, and advice was given based on the correctness of the model. Here, the findings of my investigation are presented and discussed.

4.2 Experimental Result

Images of various stages of the disease have been employed by many algorithms to forecast the diagnosis of breast tumor. I thus used a variety of strategies during the procedure. I analyzed and balanced several options before deciding on the best plan of conduct for the test at hand. I tried a range of methods in an effort to improve the caliber of my work. employed open datasets from Kaggle that were gathered for three stages of education. The three sets of photos represent each phase of breast tumor. I took advantage of the dictionaries, content classification techniques, and Python tools that were already in place. The dataset is relevant as breast tumor s 3 classes are investigated using deep learning. This work makes use of Python deep learning frameworks for classification to identify the right forms of breast tumor from pictures of the disease at various stages using deep learning once again. creating an internet application to test if tumor images can be used to distinguish between breast tumor classes.

4.3 Applying Descriptive Analysis with DL models

My categorization techniques had an impact on the findings I obtained. Using five distinct Deep Learning algorithms on images of breast tumor, I have accurately recognized the disease's stages. InceptionResNetV2, DenseNet169, InceptionV3, VGG16, and VGG19 are the three phases of breast tumor that I identified using deep learning techniques during a 20-epoch period. These tactics have shown promising outcomes in terms of accuracy. Every model used the same dataset,

which included data that was published publicly available as well as my own dataset, which I got straight from an open platform using Kaggle. I evaluated the algorithms' soundness using Matlab's packaged libraries after completing the dataset construction.

Table 4.1: Accuracy Table

Models	Accuracy %
InceptionResNet-V2	91.82%
DenseNet-169	75.47%
Inception-V3	81.13%
VGG-16	88.05%
VGG-19	86.79%

The next section displays the effectiveness for many models. The process made use of PyCharm and CoLab, two open-source applications. Out of the five models used, InceptionResNetV2, DenseNet169, InceptionV3, VGG16, and VGG19 had the greatest reliability, 91.82%, followed by the InceptionResNetV2 models.

```
              precision    recall  f1-score   support

      benign       0.89      0.97      0.93        88
   malignant       0.93      0.82      0.87        50
      normal       1.00      0.95      0.98        21

    accuracy                           0.92       159
   macro avg       0.94      0.91      0.93       159
weighted avg       0.92      0.92      0.92       159
```

Fig 4.1: Classification Report of InceptionResNetV2.
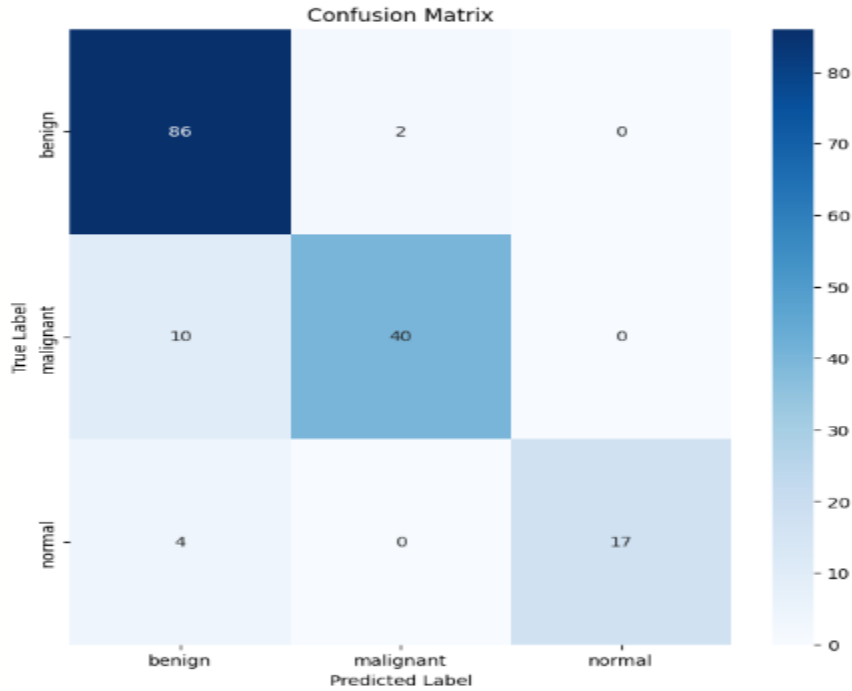
Fig 4.2: Confusion matrix of InceptionResNetV2.

To attain the best accuracy, the entire classifying report for the InceptionResNetV2 classifiers is just the one that is shown.

The train & validation precision and loss of the InceptionResNetV2 models at an epoch of 20 are displayed in Figures 4.3 and 4.4 below.
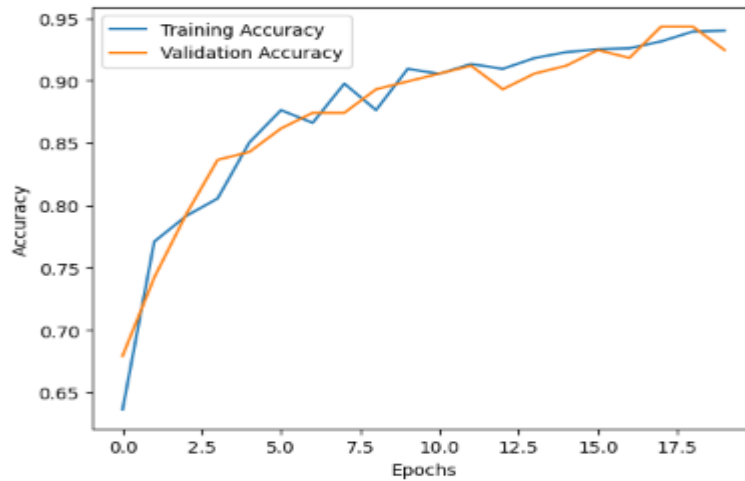

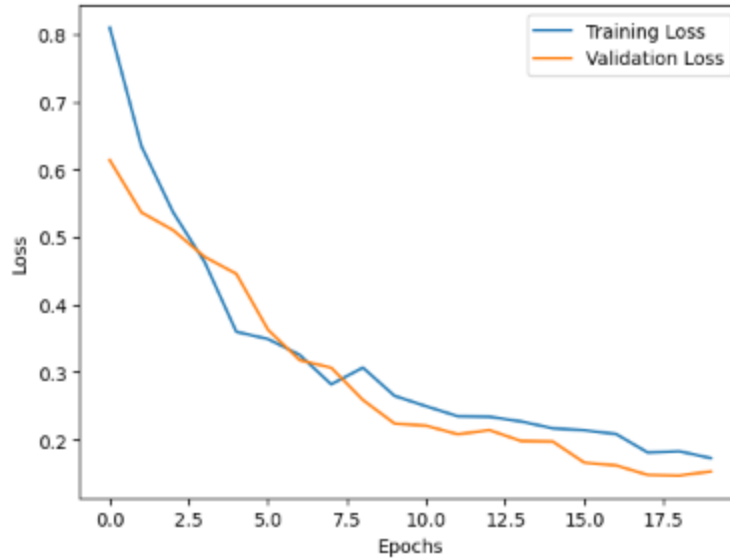Fig 4.3: Accuracy Curve of InceptionResNetV2 validation and training.

Fig 4.4: Loss Curve of InceptionResNetV2 validation and training.

4.4 Discussion

In order to forecast breast tumor, my study will make use of DL techniques and three stages of image data. In any field, each phrase must be given significant weight throughout the classification process. My study has always been centered on using phase classification to determine the etiology of breast tumor. Additionally, the datasets were divided into succeeding classes using the dl models. The data of a study are among its most crucial elements. The outcomes of a similar study might differ significantly based on the data that are now available. I was certain that other researchers utilizing either of the two previously accessible datasets would come to a different result because this was a blend of known datasets. You may counter that considering I used further information; my estimate is a little bit closer to reality.

I used a number of DL method strategies and accuracy ratings to help us accomplish our objective. For this project, I employed five distinct algorithms in all. Before I could begin, there were a few items I needed to acquire. Indeed, I did choose the algorithm and begin working with it. I then ascertained the accuracy of each algorithm. As I've stated previously. By combining these two approaches, I was able to get the greatest accuracy of 95.43% using the InceptionResNetV2

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modeling, where are the forecasts for the following three categories. This is particularly significant in light of the data I provided, which outperformed the other predictive models in terms of diagnostic performance when it fell to the three stages of breast tumor diagnosis courses that made use of web resources and pictures of the condition.

Precision: One often used indicator to assess the efficacy of the model is accuracy, or the preciseness in the exact forecasts generated by the formula. Efficiency may be computed by taking the total number of true positives and multiplying it by the total number of precise projections.

$$\text{precision} = \frac{TP}{TP+FP}$$

Recall: Retrieval is the proportion of suitable cases that were eventually located and obtained, independent of all pertinent instances. When a procedure has a high recall rate, it is assumed to have produced the most relevant findings.

$$\text{recall} = \frac{TP}{TP+FN}$$

F1-Score: A test's validity is determined by two factors: recall and efficiency. Accuracy and recall work in harmony.

$$\text{F1} = \frac{2 \times precision \times recall}{precision + recall}$$

Accuracy: The relationship between the acceptable price and a predicted value is known as reliability.

$$\text{accuracy} = \frac{TP+TN}{TP + FN + TN + FP}$$

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CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABILITY

5.1 Society Impact

There might be several significant societal ramifications from using neural networks, or DL, to detect breast tumor. The rapidity and high precision that the algorithms used by DL can analyze medical imaging data, such as MRI and ultrasound pictures, makes it possible to identify breast tumor early on. Early detection is crucial in order to improve survival rates and decrease the overall impact that the illness has on individuals and their families. By reducing the expense of the expensive medicines required for advanced stages, early detection of breast tumor through DL can lead to less late as well as more controllable stages of the illness, which may reduce the financial strain on healthcare institutions. Deep learning (DL) has the potential to accelerate research by analyzing massive amounts of medical data, identifying patterns, and even making connections. The application of DL in the detection of breast tumor may lead to increased awareness and education regarding the importance of early monitoring. People can be made aware of the benefits of early detection, which can encourage regular screening procedures and aggressive health habits. Early detection and improved outcome of therapy can significantly impact the mental and emotional well-being of breast tumor patients and their families as a whole. In conclusion, if DL is included into the diagnosis of breast tumor, there will be a lot genomic promise for improved healthcare outcomes, from swift detection and tailored therapy to greater accessibility and reduced healthcare expenditures.

5.2 Environment Impact

The detection of breast tumor using Deep Learning (DL) has a lower direct ecological impact than some other uses, such energy production or industrial processes. Deep learning techniques often require substantial computing capacity for both training and inference. If instruction in deep neural networks makes substantial use of powerful computer infrastructure, it may lead to increased energy consumption and associated environmental implications. Large amounts of medical data are needed for DL algorithms within the healthcare sector to be trained and validated. Energy-intensive data centers could be required by large-scale healthcare systems to store and handle this data. It is essential to utilize ecological storage of data practices in order to lessen the impact on

the natural environment. Due to the rapid advancements in DL technology, older equipment may become obsolete, contributing to the increasing quantity of electronic trash (e-waste). It is critical to weigh the potential benefits of DL applications for healthcare against their effect on the environment. These benefits may include enhanced outcomes for patients, early disease detection, and more efficient treatment methods. Reducing the environmental effect learning these methods may be achieved by the use of sustainable data management practices, solar power for computers, and more environmentally friendly DL algorithms.

In summary, even if the ecological impact of digital learning in the detection of breast tumor is very small, it is crucial to consider the energy & resource consequences throughout each stage associated with the technology's evolution in order to ensure acceptable and consistent deployment.

5.3 Ethical Aspects

The employing of DL algorithms for breast tumor diagnosis raises several ethical questions that need to be addressed to ensure the acceptable and equitable implementation of these technologies. Deep learning models rely on large datasets, a large number of which contain sensitive and confidential health data. Adopting strict data security protocols and ensuring robust privacy protection are essential to preventing unauthorized access, breaches, and misuse of patient data. Patients should get adequate education on the features of the technical advancements, potential benefits, and any risks or limits before utilizing DL in breast tumor screening. People are guaranteed to be informed of how their private information will be treated by informed consent, which gives them the power to make thoughtful choices about their engagement. Diagnostic accuracy may vary amongst groups of people as a result of DL models inadvertently perpetuating biases present in the training set. Algorithmic bias needs to be addressed to provide fair and impartial outcomes for all patient populations. If DL models are generated by research studies, then ethical research practices, such as obtaining authorization from the academic inspection board (IRB), reducing participant risks, and ensuring responsible application of study results, have to be adhered to. Addressing these ethical concerns is essential to fostering public trust, safeguarding patient welfare, and promoting the moral and ongoing use of DL in breast tumor detection within healthcare systems. It is crucial that clients—such as patients, medical professionals, and

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technology developers—engage in frequent ethical reviews and discussions in order to resolve these complicated ethical issues.

5.4 Sustainability Plan

The development of a long-term plan for making use if DL so identifying signs of breast tumor requires consideration of several elements in order to ensure the ethical, moral, and environmentally responsible use of the technology. Optimizing modeling design and energy-efficient procedures can help lower the environmental impact associated with DL computations. Consider using equipment designed with less electricity use, such as GPUs. Look at how employing renewable energy sources may help servers and digital infrastructure. Healthcare professionals should undergo ongoing training on the usage and comprehension of DL outputs to ensure that they are successfully incorporated into clinical operations. Programs for education regarding the ethical and environmental implications of digital health should be available to all parties involved. Maintain the cutting line of long-term DL for medical procedures by collaborating with academic institutions, commercial partners, and governmental organizations. Engage in activities that promote the moral and sustainable use of DL innovations in the medical field. By implementing these sustainable methods into the process, the development and implementation of DL over breast tumor detection may be made more morally and environmentally sound, as well as advantageous to the communities' and peoples' overall well-being. The sustainability plan will require frequent reviews and updates to stay current with emerging technologies and ecological concerns.

CHAPTER 6

CONCLUSION AND FUTURE RESEARCH

6.1 Summary of the Study

I have a lot more knowledge about the subject now that I asked this question. The sensitive issue of breast tumor is one. This contributes significantly to the annual decline in the medical industry. I have been able to utilize deep learning to identify among breast tumor 3 classes because of the dataset's photographs of breast tumor. As I've already demonstrated, I use a variety of online the Kaggle tool breast tumor stage images to gather as much detail as I'm able for the purpose of research. By utilizing it for modeling my application's techniques on a tumor stages scheme, I had been able to improve my ability to identify specific tumor types. A few of the issues were resolved right away. I overcame my obstacles and completed the task at hand. Depending on the user, different DL algorithms provide different results. I go into more information about this in the part that follows.

6.2 Conclusion

This study shows how excellent my techniques and conclusions are. I believe that when my examination is finished, more study in this field will begin. I've completed this research and have a ton of suggestions on how to make my work better. There were a few mistakes I made while working. I discovered that there were further study directions I might have taken. While fixing any flaws or potential issues, it will enable us to continue working on the current project. In addition, I suggest ways that these insights may be used in further studies to provide more comprehensive solutions to the issues raised by this inquiry. I'm confident that taking this test will increase my understanding of the various facets of the medical subject I've chosen to research. I believe it will help improve state-of-the-art technology methods and studies that are going to allow us to contribute more to the medical field and enable the utilization of breast tumor images for the detection of the illness at various stages. I wish to provide a unique approach for categorizing breast tumor based on tumor photos of healthy individuals by utilizing DL to determine the

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existence of these three groups of the disease—benign, malignant, and normal—are all phases. creating an internet-based program for classifying images of breast tumor additionally.

6.3 Possible impacts

Algorithms for deep learning can be used to diagnose tumor stages based on images more precisely. They can be programmed to identify intricate trends or tumors that might prove challenging for skilled radiologists to identify with the aid of massive datasets. The use of deep learning for the detection of breast tumor may make it easier for people to receive healthcare services in underdeveloped or remote areas where access to trained medical workers may be limited. Physicians might better direct their efforts if they knew precisely which patients have the highest risk of developing breast tumor. Among other things, this includes efficiently deploying medical workers and providing tailored therapies to those who are in greatest need treatments.

6.4 Future Work

Future study in this field of medicine has several directions, particularly within the purview of my studies. I was always considering how I might improve my work. As I previously said, I have also discovered a few flaws, and these faults offer opportunities to improve this research. By putting my work into practice and enhancing prediction results with greater opportunities to capture high accuracy, I will attempt to correct this inaccuracy. If there are any mistakes, I intend to correct them. I have a few additional objectives in mind. This prediction—which makes use of images of breast tumor for making tumor diagnoses—may necessitate further research in this field. I will incorporate elements such as the InceptionResNetV2 imitated classes of categorization for breast tumor along with additional parts that I employ to generate known as breast tumor classification which users can use to determine the three types of breast tumor so as to maximize the advantages and assist the user. I believe that pursuing a profession in this field will enable me to advance the field of medical technology and strengthen its significant influence on healthcare. I could help with the early detection of breast tumor in women.

Reference

[1] H.D. Cheng, J. Shan, W. Ju, Y.H. Guo and L. Zhang, "Automated breast tumor detection and classification using ultrasound images: a survey", Pattern Recogn. 43, 299–317, 2017.

[2] Y. Su and Y. Wang, "Automatic detection of the region of interest from breast tumor ultrasound image", Chin. J. Biomed. Eng. 29(2), 178–184, 2015.

[3] J. Shan, H.D. Cheng and X.Y. Wang, "Completely automated segmentation approach for breast ultrasound images using multiple-domain features", Ultrasound Med. Biol. 38(2), 262–275, 2012.

[4] M. Xian, Y.T. Zhang and H.D. Cheng, "Fully automatic segmentation of breast ultrasound images based on breast characteristics in space and frequency domains", Pattern Recogn. 48(2), 485–497, 2015.

[5] B. Liu, H.D. Cheng, J.H. Huang, J.W. Tian, X.L. Tang and J.F. Liu, "Fully automatic and segmentation-robust classification of breast tumors based on local texture analysis of ultrasound images", Pattern Recogn. 43(1), 280–298, 2010.

[6] R. Girshick, J. Donahue, T. Darrell and J. Malik, "Rich feature hierarchies for accurate object detection and semantic segmentation", In: CVPR, pp. 580–587, 2014.

[7] K. He, X. Zhang, S. Ren and J. Sun, "Spatial pyramid pooling in deep convolutional networks for visual recognition", Springer, Cham, 2014. doi:10. 1007/978-3-319-10578-9 23

[8] J. Redmon, S.K. Divvala, R. Girshick and A. Farhadi, "You only look once: unified, real-time object detection", In: CVPR, pp. 779–788 , 2015.

[9] W. Liu, D. Anguelov, D. Erhan, C. Szegedy, S. Reed, C.-Y. Fu and A.C. Berg, "SSD: single shot MultiBox detector", In: B. Leibe, J. Matas, N. Sebe and M. Welling, ECCV 2016. LNCS, vol. 9905, pp. 21–37. Springer, Cham, 2016. doi:10. 1007/978-3-319-46448-0 2

[10] O. Kott, D. Linsley, A. Amin, A. Karagounis, C. Jeffers, D. Golijanin, T. Serre and B. Gershman, "Development of a Deep Learning Algorithm for the Histopathologic Diagnosis and Gleason Grading of Prostate tumor Biopsies: A Pilot Study", 7, 347–351, 2019.

[11] S.A.A. Ismael, A. Mohammed, H. Hefny, "An enhanced deep learning approach for brain tumor MRI images classification using residual networks", Artif. Intell. Med. 2020, 102, 101779.

[12] B. Harangi, A. Baran and A. Hajdu, "Assisted deep learning framework for multi-class skin lesion classification considering a binary classification support", Biomed. Signal. Process. Control 2020, 62, 102041.

[13] S.R. Karanam, Y. Srinivas, S. Chakravarty, "A systematic approach to diagnosis and categorization of bone fractures in X-ray imagery", International Journal of Healthcare Management, pp. 1–12, 2022, doi: 10.1080/20479700.2022.2097765

[14] F. Hržić, S. Tschauner, E. Sorantin and I. Štajduhar, "Fracture Recognition in Paediatric Wrist Radiographs: An Object Detection Approach." *Mathematics*, *10*(16), p.2939, 2022.

[15] S. K. Alam, E. J. Feleppa, M. J. Rondeau, A. Kalisz, and B. S. Garra, "Computer-aided diagnosis of solid breast lesions using an ultrasonic multi-feature analysis procedure," Bangladesh Journal of Medical Physics, vol. 4, no. 1, pp. 1–10, 2013.

[16] W. Nawaz, S. Ahmed, A. Tahir, and H. A. Khan, "Classification of breast cancer histology images using ALEXNET," in International Conference Image Analysis and Recognition, pp. 869–876, Póvoa de Varzim, Portugal, 2018.

[17] X.Qi,L.Zhang,Y.Chenetal., "Automateddiagnosis ofbreast ultrasonography images using deep neural networks," Medical Image Analysis, vol. 52, pp. 185–198, 2019.

[18] Q. Huang, F. Zhang, and X. Li, "Machine learning in ultrasound computer-aided diagnostic systems: a survey," BioMed Research International, vol. 2018, Article ID 5137904, 10 pages, 2018.

[19] M.Wei,Y.Du,X.Wu,andJ.Zhu,"Automaticclassificationof benign and malignant breast tumors in ultrasound image with texture and morphological features," in 2019 IEEE 13th InternationalConferenceonAnti-counterfeiting,Security,andIdentification (ASID), pp. 126–130, Xiamen, China, 2019.

[20] W. C. Shen, R. F. Chang, W. K. Moon, Y. H. Chou, and C. S. Huang, "Breast ultrasound computer-aided diagnosis using BI-RADS features," Academic Radiology, vol. 14, no. 8, pp. 928–939, 2007.

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