ANALYSIS OF MEDICAL IMAGES FOR TUMOR DETECTION USING DEEP LEARNING

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ABSTRACT

Tumours, sometimes referred to as neoplasms, are growths in aberrant tissue that may be identified from the surrounding tissue by their structural differences. Cancer, a major leading cause of mortality that accounts for roughly 13% of all fatalities worldwide, may be caused by a tumour. The global incidence of cancer is rising at an alarming rate. Because there can be a shortage of qualified radiologists at a time of urgent need, automation of tumour identification is necessary. This is beneficial for the methods and procedures used to identify tumours based on the findings of medical imaging tests like mammography, x-ray computed tomography (x-ray CT), and magnetic resonance imaging (MRI). This facilitates the procedures and methods used in tumour detection based on the outcomes of medical imaging tests like mammograms, x-ray computed tomography (x-ray CT), and magnetic resonance imaging (MRI). A subfield of artificial intelligence (AI) and computer science called machine learning focuses on using data and algorithms to simulate how humans learn, gradually increasing the accuracy of the system. The rapidly expanding discipline of data science includes machine learning as a key element. Algorithms are trained to generate classifications or predictions using statistical techniques, revealing important insights in data mining operations. The decisions made as a result of these insights influence key growth indicators in applications and enterprises, ideally. Data scientists will be more in demand as big data develops and grows because they will be needed to help identify the most important business issues and then the data to answer them.

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CHAPTER 1

INTRODUCTION

Lung cancer is the primary cause of cancer death worldwide, with 2.09 million new cases and 1.76 million people dying from lung cancer in 2018. Four case-controlled studies from Japan reported in the early 2000s that the combined use of chest radiographs and sputum cytology in screening was effective for reducing lung cancer mortality. In contrast, two randomized controlled trials conducted from 1980 to 1990 concluded that screening with chest radiographs was not effective in reducing mortality in lung cancer. Although the efficacy of chest radiographs in lung cancer screening remains controversial, chest radiographs are more cost-effective, easier to access, and deliver lower radiation dose compared with low-dose computed tomography (CT). A further disadvantage of chest CT is excessive false positive (FP) results. It has been reported that 96% of nodules detected by low-dose CT screening are FPs, which commonly leads to unnecessary follow-up and invasive examinations. Chest radiography is inferior to chest CT in terms of sensitivity but superior in terms of specificity. Taking these characteristics into consideration, the development of a computer-aided diagnosis (CAD) model for chest radiograph would have value by improving sensitivity while maintaining low FP results. The recent application of convolutional neural networks (CNN), a field of deep learning (DL) , has led to dramatic, state-of-the-art improvements in radiology . DL-based models have also shown promise for nodule/ mass detection on chest radiographs, which have reported sensitivities in the range of 0.51–0.84 and mean number of FP indications per image (mFPI) of 0.02–0.34. In addition, radiologist performance for detecting nodules was better with these CAD models than without them. In clinical practice, it is often challenging for radiologists to detect nodules and to differentiate between benign and malignant nodules. Normal anatomical structures often appear as if they are nodules, which is why radiologists must pay careful attention to the shape and marginal properties of nodules. As these problems are caused by the conditions rather than the ability of the radiologist, even skilful radiologists can misdiagnose. There are two main methods for detecting lesions using DL: detection and segmentation. The detection method is a region-level classification, whereas the segmentation method is a pixel-level classification. The segmentation method can provide more detailed information than the detection method. In clinical practice, classifying the size of a lesion at the pixel-level increases the likelihood of making a correct diagnosis. Pixel-level classification also makes it easier to follow up on changes in lesion size and shape, since the shape can be used as a reference during detection. It also makes it possible to consider not only the long and short diameters but also the area of the lesion when determining the effect of treatment. However, to our knowledge, there are no studies using the segmentation method to detect pathologically proven lung cancer on chest radiographs. The purpose of this study was to train and validate a DL-based model capable of detecting lung cancer on chest radiographs using the segmentation method, and to evaluate the characteristics of this DL-based model to improve sensitivity while maintaining low FP results.

1.1Objective

Medical image analysis plays an important role in modern medicine. Analysing and diagnosing from a mere image is quite difficult, so computer-aided diagnostic approaches have been used to provide insights into the possible disease mechanism.

1.2 Existing System

In the existing system Image fusion is a process of combination information from multimodality images. Multi model images of segmented into regions using automatic segmentation process. The super pixel was used as the basic Processing Unit for efficiency and compact representation. Sparse coding and dictionary learning are implemented in a high dimensional feature space using kernel trick.

1.3 Drawbacks of the Existing System

The existing system has the following drawbacks:

- Fusion system passage information within each decomposition level so that the details of the source image is preserved expressing the artifacts.
- It is difficult to determine whether narrowing of a spinal canal.

1.4 Proposed Technology

In our proposed system we describe the techniques used in the preprocessing of the CT scan image and the 3D-convolutional neural network model that used to classify the patient’s cancerous status. We will detect the cancerous nodule location and also their sizes. And also, the dataset that used to train our model is very small and to achieve a good accuracy needs more dataset, so by using an extra dataset from the different source, we can improve the performance of our model. The machine learning model will predict belongs to one class, so, we will use resampling the dataset and by using balanced datasets that is used to reduce data imbalance problem

1.5 Advantages of the Proposed System

- Sensitivity to noise blurring effects and miss registration.
- Method which uses the efficient risk so you can build in expert knowledge about the problem.
- It is an approximation to a bound on the test error rate and there is a substantial body of theory behind it which suggests it should be a good idea.

CHAPTER 2

LITERATURE SURVEY

1. R.Sathishkumar et.el proposed a method for lung cancer detection using SVM classifier and KNN algorithm. The picture preparation technique is divided into four stages: pre-handling, division, extraction, and grouping. The CT scan picture is first pre-processed. where the ROI (research interest area) is Separated in preparation for segmentation. Discrete Wavelet Transform, segmentation stage(DWT) is used to extract the feature, and utilising a GLCM (Gray level co-occurrence matrix) correlation, entropy, variance, contrast, and so on energy and dissimilarity Following the feature extraction. Feature Extraction uses Binarization and GLCM are two ways used to predict the possibility of lung cancer nearness. In Classification the image is classified using an SVM (Support vector machine), which determines whether the image is normal or tumorous. The SVM was identified as a machine learning algorithm that is defined by a separating hyperplane. A picture handling approach was used to recognise early stage lung cancer development in CT scan images. Limitation is the advanced level of algorithm will be used in the future. while we are in, to raise the level of forecast to include the Extreme gradient boosting process Algorithm for making better use of the data set.
2. Meraj Begum Shaikh Ismail et.el proposed a method for lung cancer detection classification using Machine learning. The primary goal of this study is to determine the early stages of lung cancer and compare the accuracy of several machine learning algorithms. Due to incorrect handling of DICOM pictures, there is a low level of accuracy and a high implementation cost. Many various types of images are utilised in medical image processing, however CT scans are often chosen since they have less noise. TCIA hosts a library of de-identified medical images, mostly in DICOM format. The Lung Image Database Consortium Image Collection (LIDC-IDRI) contains 1018 DICOM lung CT images from 1018 patients. The nodules in the dataset were annotated by four expert radiologists who assessed the lung CT scans separately. Kaggle data science bowl 2017 gives lung CT scans of 1595 patients (146GB) in DICOM format with a set of labels indicating if the patient was diagnosed with lung cancer in the future, even if it was one

year after the scan was done. Limitation is the accuracy of the system can be increased in the future if training is done with a very large image database.

3. Prerana prajapathi et.el proposed a method for lung cancer detection classification using SVM. The Cancer Imaging Archive (TCIA) dataset was used for training and testing, with DICOM being the major image storage format. We conduct image processing techniques on CT scans before training the classifier, such as converting the picture to HU (Hounsfield Unit) scale to obtain a binary image of the lungs, followed by nodule segmentation, which detects nodules within the lungs. GLCM is also used to extract characteristics from CT scans (Gray Level Co-Occurrence Matrix). In Dataset collection TCIA (The Cancer Imaging Archive) is an online CT scan image dataset that is publicly available for researchers in the field of digital image processing. Picture processing technique for reducing image noise and producing a sharper image. Lung segmentation and nodules segmentation are the two elements of segmentation. The Feature Extraction stage of the Computer Aided Diagnosis (CAD) system is critical. For texture feature extraction from CT scan pictures, we employed HARALICK GLCM (Gray Level Co-Occurrence Matrix). The GCLM is a table that shows how frequently distinct pixel brightness values (grey levels) appear in an image. Limitation is the intend to use MRI scan images to detect many forms of lung cancer and other malignancies using the same method.
4. Dr.D.Nagajyothi et.el proposed a method for lung cancer detection using SVM classifier It is proposed that the actions involved in it be done utilising Image pre-processing methods include the use of a median filter followed by segmentation using mathematical morphological processes. To the tumour detected section, geometrical properties such as area, perimeter, and eccentricity are calculated. Data collection is the initial step, and it's where we keep all of the CT scan images. In segmentation, the image's needed ROI (region of interest) is subjected to a procedure termed segmentation, which separates the tumour from the rest of the image. In a Feature Extraction We must calculate the tumour's characteristics from the segmented image. SVM classifier is the classifier employed here. SVM classifiers are supervised learning models with a pattern that can be identified. To classify the data, the best hyper plane is found; it creates two classes with different data points. So that we may select the best hyper plane of classifier with the greatest difference

between the two classes. MATLAB software is used to implement the proposed system's results. Here, we'll utilise an Arduino Uno and an LCD display to print the sort of cancer on the screen. Limitation is advanced level of algorithm will be used in the future. while we are in, to raise the level of forecast to include the Extreme gradient boosting process Algorithm for making better use of the data set.

5. Smita Raut et. el proposed a method for lung cancer detection using machine learning approach. To find the tumour in the photos, we apply digital image processing and a machine learning algorithm in this system. There are two types of detection methods used, one is digital image processing and the other is a machine learning technique. Image capture, grey scale conversion, noise reduction, picture binarization, segmentation, characteristic extraction, machine studying, and most cancers mobile identification are all steps in digital image processing. The second phase is to learn a set of rules using machine learning. The input CT image is processed in pre-processing to increase the image quality. Image Segmentation: Image segmentation is the process of dividing a digital image into several segments. Segments in photographs relate to pixels or super pixels. There are two elements to this output: training and testing. We defined attributes in the training section and tested the image in the testing section to arrive at the project's conclusion. Limitation is this method that uses digital image processing and machine learning to detect cancer cells automatically using a machine learning algorithm.
6. Nidhi S. Nadkarni and Prof. Sangam Borkar focuses mostly on identifying normal and abnormal lung pictures. In their suggested method, impulse noise in the photos was removed using a median filter. Accurate lung segmentation and tumour zone detection are made possible by mathematical morphological operations. From the segmented region, three geometrical features—area, perimeter, and eccentricity—were retrieved and input to the SVM classifier for classification.
7. Vaishnavi. D1, Arya. K. S2, Devi Abirami. T3 , M. N. Kavitha4, studied on lung cancer detection algorithm. Their suggested approach involved pre-processing, which involved removing unnecessary lung CT scan material. To remove salt and pepper sounds, they utilised a median filter. Accurate lung segmentation and tumour zone detection are made possible by mathematical morphological operations. In order to classify the segmented region, seven extracted characteristics—energy, correlation, variance, homogeneity,

difference entropy, information measure of correlation, and contrast—were taken from it. These features were then fed into a feed-forward neural network with a back-propagation method. In the weight space gradient descent approach, the algorithm seeks the error function with the lowest value. In order to reduce the error function, the weights are randomised. The accuracy during training was 96%, and the accuracy during testing was 92%. The specificity was 97.1% and the sensitivity was 88.7%.

8. Vaishnavi. D1, Arya. K. S2, Devi Abirami. T3 , M. N. Kavitha4, studied on lung cancer detection algorithm. In pre-processing they used Dual-tree complex wavelet transform (DTCWT)in which the wavelet is discretely sampled. GLCM is second order statistical method for texture analysis which provide a tabulation of how different combination of Gray level co-occur in an image. It measures the variation in intensity at the pixel of interest. They used Probability Neural Network (PNN) classifier evaluated in term of training performance and classification accuracy. It gives fast and accurate classification.
9. Radhika P R, Rakhi.A.S.Nair, mainly focused on prediction and classification of medical imaging data. They used the discretely sampled Dual-tree Complex Wavelet Transform (DTCWT) for pre-processing. The second order statistical texture analysis approach known as GLCM provides a table of the co-occurrence of various combinations of Gray levels in an image. It gauges the intensity variation at the targeted pixel. They employed a Probability Neural Network (PNN) classifier that was assessed for training effectiveness and classification precision. It provides quick and precise classification.
10. Pankaj Nanglia, Sumit Kumar et all proposed a unique hybrid algorithm called as Kernel Attribute Selected Classifier. They combine SVM and Feed-Forward Back Propagation Neural Network in this, which reduces the difficulty of the classification's computation. They suggested three block processes for the classification, processed the Block 1 is the dataset. The SURF technique is used to extract the feature, then a genetic algorithm is used for optimization. Using FFBPNN, the second and third blocks are classified.

CHAPTER 3

SYSTEM REQUIREMENT SPECIFICATION

Soft requirement specification is a fundamental document, which forms the foundation of the software development process. It not only lists the requirements of a system but also has a description of its major feature. An SRS is basically an organization's understanding of a customer or potential client's system requirements and dependencies at a particular point in time prior to any actual design or development work. It's a two-way insurance policy that both the client and the organization understand the other's requirement from that perspective at a given point in time. 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. It is important to note that an SRS contains functional and non-functional requirements only; it doesn't offer design suggestions, possible solutions to technology or business issues, or any other information other than what the development team understands the customer's system requirements to be.

3.1 Functional Requirement

Functional Requirement defines a function of a software system and how the system must behave when presented with specific inputs or conditions. These may include calculations, data manipulation and processing and other specific functionality.

3.2 Non-functional Requirement

Non-functional requirements are the requirements which are not directly concerned with the specific function delivered by the system. They specify the criteria that can be used to judge the operation of a system rather than specific behaviours. They may relate to emergent system properties such as reliability, response time and store occupancy. Non-functional requirements arise through the user needs, because of budget constraints, organizational policies, the need for interoperability with other software and hardware systems or because of external factors such as:-

3.2.1 Product Requirements

Portability: Since the software is developed in python it can be executed on any platform for which is available with minor or no modifications.

Correctness: It followed a well-defined set of procedures and rules to compute and also rigorous testing is performed to confirm the correctness of the data.

Modularity: The complete product is broken up into many modules and well-defined interfaces are developed to explore the benefit of flexibility of the product.

Non-functional requirements are also called the qualities of a system. These qualities can be divided into execution quality & evolution quality. Execution qualities are security & usability of the system which are observed during run time, whereas evolution quality involves testability, maintainability, extensibility or scalability.

3.2.2 Organizational Requirements

Process Standards: IEEE standards are used to develop the application which is the standard used by the most of the standard software developers all over the world.

Design Methods: Design is one of the important stages in the software engineering process. This stage is the first step in moving from problem to the solution domain. In other words, starting with what is needed design takes us to work how to satisfy the needs.

The design of the system is perhaps the most critical factor affecting the quality of the software and has a major impact on the later phases, particularly testing and maintenance. We have to design the product with the standards which has been understood by the developers of the team.

3.2.3 User Requirements

• The user must be able to visualize Graphical User Interface Window.

• The user must be able to configure all the parameters with neat GUI.

3.2.4 Basic Operational Requirements

The customers are those that perform the eight primary functions of systems engineering, with special emphasis on the operator as the key customer. Operational requirements will define the basic need and, at a minimum, will be related to these following points:-

Mission profile or scenario: It describes about the procedures used to accomplish mission objective. It also finds out the effectiveness or efficiency of the system.

Performance and related parameters: It points out the critical system parameters to accomplish the mission

Utilization environments: It gives a brief outline of system usage. Finds out appropriate environments for effective system operation.

Operational life cycle: It defines the system lifetimes.

3.3 Software Requirement

The software tools used are,

- Operating System - Windows 10
- Language - Python
- Tool - Google Collab

3.3.1 Python

Python is a popular programming language. It was created by Guido van Rossum, and released in 1991.

It is used for:

- web development (server-side),
- software development,
- mathematics,
- system scripting.

What can Python do

- Python can be used on a server to create web applications.
- Python can be used alongside software to create workflows.
- Python can connect to database systems. It can also read and modify files.
- Python can be used to handle big data and perform complex mathematics.
- Python can be used for rapid prototyping, or for production-ready software development.

Why Python

- Python works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc).
- Python has a simple syntax similar to the English language.
- Python has syntax that allows developers to write programs with fewer lines than some other programming languages.
- Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick.
- Python can be treated in a procedural way, an object-oriented way or a functional way.

Good to know

- The most recent major version of Python is Python 3, which we shall be using in this tutorial. However, Python 2, although not being updated with anything other than security updates, is still quite popular.
- In this tutorial Python will be written in a text editor. It is possible to write Python in an Integrated Development Environment, such as Thonny, PyCharm, NetBeans or Eclipse which are particularly useful when managing larger collections of Python files.

Python Syntax compared to other programming languages

- Python was designed for readability, and has some similarities to the English language with influence from mathematics.
- Python uses new lines to complete a command, as opposed to other programming languages which often use semicolons or parentheses.

- Python relies on indentation, using whitespace, to define scope; such as the scope of loops, functions and classes. Other programming languages often use curly-brackets for this purpose.

3.3.2 Google Collab

Collab is a free notebook environment that runs entirely in the cloud. It lets you and your team members edit documents, the way you work with Google Docs. Collab supports many popular machine learning libraries which can be easily loaded in your notebook.

What Collab Offers You

As a programmer, you can perform the following using Google Collab.

- Write and execute code in Python
- Document your code that supports mathematical equations
- Create/Upload/Share notebooks
- Import/Save notebooks from/to Google Drive
- Import/Publish notebooks from GitHub
- Import external datasets e.g. from Kaggle
- Integrate PyTorch, TensorFlow, Keras, OpenCV
- Free Cloud service with free GPU

3.4 Hardware Requirements

The hardware module consists of the following,

- Processor - Intel Core i5
- RAM - 4G or more
- Monitor - 14 inch or more
- Hard disk - 20 GB and more

3.4.1 Processor

A processor is a integrated electronic circuit that performs the calculations that run a computer. A processor performance arithmetical logical, input output and other basics instructions that are passed from an operating system most other performance are dependent on the operations of a processor. Here we have used Intel core i5 processor

Fig 3.4.1 Intel core i5

3.4.2 RAM

A RAM stand for random access memory is one of the most important components I determining your system's performance. RAM gives applications a place to store and access data on short term basis it stores the information your Computer is actively using so that it can be accessed quickly.

Fig 3.4.2 RAM

CHAPTER 4

SYSTEM ANALYSIS

Analysis is the process of finding the best solution to the problem. System analysis is the process by which we learn about the existing problems, define objects and requirements and evaluates the solutions. It is the way of thinking about the organization and the problem it involves, a set of technologies that helps in solving these problems. Feasibility study plays an important role in system analysis which gives the target for design and development.

4.1 Feasibility Study

Depending on the results of the initial investigation the survey is now expanded to a more detailed feasibility study. “FEASIBILTY STUDY” is a test of system proposal according to its workability, impact of the organization, ability to meet needs and effective use of the resources. Seven steps involved in the feasibility analysis are:

- Form a project team and appoint a project leader.
- Enumerate potential proposed system.
- Define and identify characteristics of proposed system.
- Determine and evaluate performance and cost effective of each proposed system.
- Weight system performance and cost data.
- Select the best proposed system.
- Prepare and report final project directive to management.

Three key considerations involved in the feasibility analysis are

- ECONOMICAL FEASIBILITY
- TECHNICAL FEASIBILITY
- SOCIAL FEASIBILITY

4.1.1 ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the

organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available.
Only the customized products had to be purchased.

4.1.2 TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

4.1.3 SOCIAL FEASIBILITY

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

CHAPTER 5

SYSTEM DESIGN

Design is a creative process a good design id the key way to effective system. The system Design is defined as “The process of applying various techniques and principles for the purpose of defining a process or a system in sufficient detail to permit its physical realisation”. Various design feature are followed to develop the system. The design specification describes the feature of the system, the components or elements of the system and their appearance of end user.

5.1 Fundamental Design Concept

A set of fundamental design concept has evolved over the past three decades. Although the degree of the interest in each concept has varied over the year, each has stood the test of time. Each provides the software designer with a foundation from which more sophisticated design methods can be applied. The fundamental design concept provides the necessary framework for “getting it right”. The fundamental design concept is applied in this project to getting right as per the requirements.

5.1.1 Input Design

The input Design is the process of converting the user-oriented inputs in to the computer-based format. The goal of designing input data is to make the automation as easy and free from errors as possible. Providing a good input design for the application easy data input and selection features are adopted. The input design requirements such as user friendliness, consistent format and interactive dialogue for giving the right message and help for the user at right time are also considered for the development of the project. Input design is a part of overall system design whichrequires very careful attention. Often the collection of input data is the most expensive part of thesystem, which needs to be route through number of modules.

5.1.2 Output Design

A quality output is one which meets the requirements of the end user and presents information clearly. In any system of processing are communicated to the user and to other system through outputs. /It is most important and direct source information to the user. Efficient and intelligent output improves the system relationship with source and destination machine.

5.2 Architectural Design

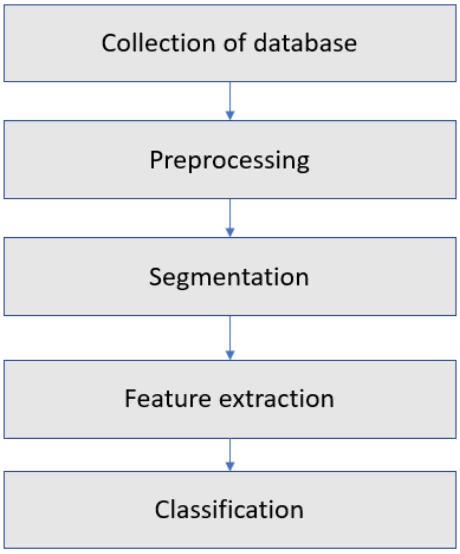


Fig 5.3 Architectural design

5.2.1 Collection of Database

Rationale and objectives: The Lung Image Database is developing a publicly available database of thoracic computed tomography (CT) scans as a medical imaging research resource to promote the development of computer-aided detection or characterization of pulmonary nodules. To obtain the best estimate of the location and spatial extent of lung nodules, expert thoracic radiologists reviewed and annotated each scan. Because a consensus panel approach was neither feasible nor desirable, a unique two-phase, multi-center data collection process was developed to allow multiple radiologists at different centres to asynchronously review and annotate each CT scan. This data collection process was also intended to capture the variability among readers.

Materials and methods: Four radiologists reviewed each scan using the following process. In the first or "blinded" phase, each radiologist reviewed the CT scan independently. In the second or "unblinded" review phase, results from all four blinded reviews were compiled and presented to each radiologist for a second review, allowing the radiologists to review their own annotations together with the annotations of the other radiologists. The results of each radiologist's unblinded review were compiled to form the final unblinded review. An XML-based message system was developed to communicate the results of each reading.

Results: This two-phase data collection process was designed, tested, and implemented across the database. More than 500 CT scans have been read and annotated using this method by four expert readers; these scans either are currently publicly available.

Conclusions: A unique data collection process was developed, tested, and implemented that allowed multiple readers at distributed sites to asynchronously review CT scans multiple times. This process captured the opinions regarding the location and spatial extent of lung nodules.

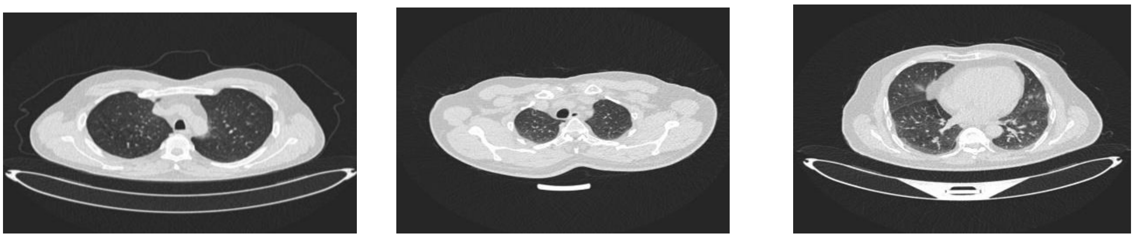


Fig 5.2.1 Collection of database

5.2.1 Pre-Processing

Pre-processing is a common name for operations with images at the lowest level of abstractions both input and output are intensity images. Pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. Image pre-processing methods use the considerable redundancy in images. Image pre-processing methods use the considerable redundancy in images. Neighbouring pixels corresponding to one object in real images have essentially the same or similar brightness value. Thus, distorted pixel can often be restored as an average value of neighbouring pixels.

In recent trend, image processing domain plays a vital part of real time applications in modern world. Such image processing technique helps to carry process on the digitized image to provide better solutions. Various techniques resemble to be tool for image processing, most of these are involves in enhancing the clarity of image, noise free images and compressing the original image to compressed data in order to reduce the storage space.

Image processing is always an interesting field as it gives enhanced visual data for human simplification and processing of image data for transmission and illustration for machine perception. Digital images are processed to give better solution using image processing. Techniques such as Grey scale conversion, Image segmentation, Edge detection, Feature Extraction, Classification are used in image processing

Image processing is a very important area in today’s science and engineering. The processing of digital images can be divided into various classes including image enhancement, image restoration, image analysis, and image compression. Imaging provides methodology to perform some kind of operations on input images. The output is obtained in terms of enhanced images, or some desired information, or some required features. For the sake of smooth workflow, it is important to first capture images and then to process them afterwards. Image processing techniques work on digital images with computing algorithms. Various steps and phases are needed to work on the images. For example, first, one can convert signals from an image sensor into digital images. After that, we can improve clarity and remove noise.

Next, steps may be extracting the size, scaling, or desired objects in a scene. Then, images can be prepared for display. Lastly but not finally, compression of images is a very important phenomenon as it is needed for communication across busy networks. There are various other phases and tasks which need attention depending on nature of applications. These include morphological processing, segmentation, enhancement, object recognition, and colour image processing. Digital image processing involves much more sophisticated and useful computer algorithms. Most of the times, it is based on classification, feature extraction, multi-scale signal analysis, pattern recognition, and projection. Some of the popular techniques that can be used in digital image processing include anisotropic diffusion, Hidden Markov models, image editing, image restoration, independent component analysis, linear filtering, neural networks, partial differential equations, pixelization, point feature matching, principal components analysis, self-organizing maps, and wavelets.

Different Types of image processing technique

1. Image Enhancement

2. Image restoration

3. Image compression

4. Image segmentation

5 Image recognition

6 Image smoothing

5.2.1.1 IMAGE ENHANCEMENT

Image enhancement is the method for providing the results of image to be clearer, by improving from original images so that the results are more suitable for display or further image analysis. It helps in removing noise, sharpening the image, or brightens an image, making it easy to identify key features. The process of enhancing the quality of images from the original image by removing the noise, provide the enhanced image by sharpening the original image and increasing contrast in image.

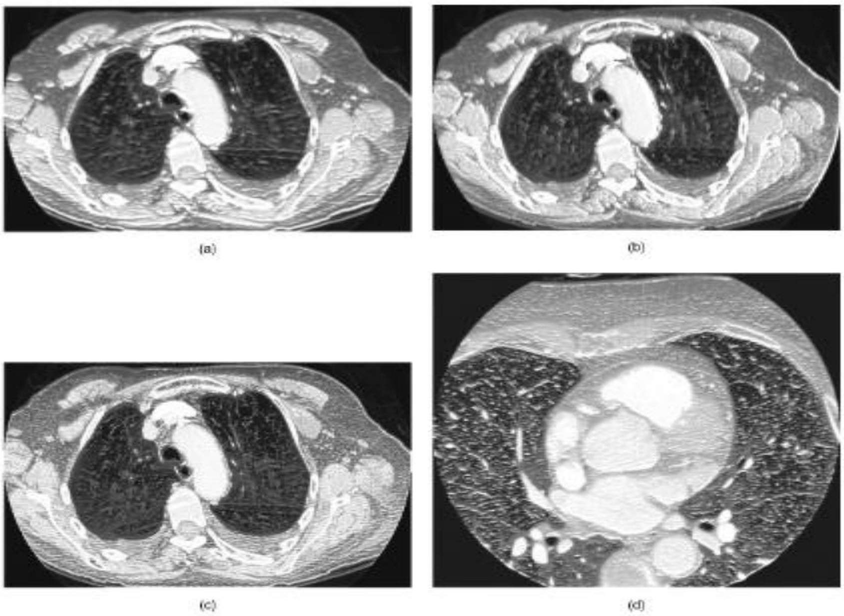


Fig 5.2.1.1.a Input of Enhancement

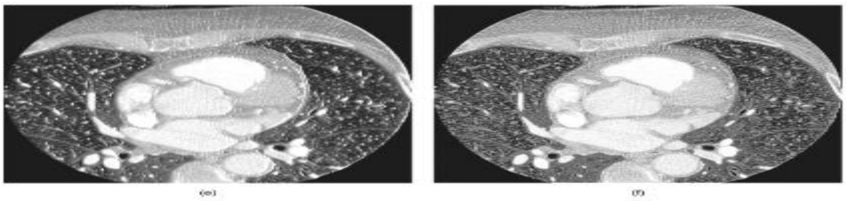


Fig 5.2.1.1.b Output of Enhancement

5.2.1.2 IMAGE RESTORATION

Restoring the clear image from the degraded or corrupted image is provided by the technique called image restoration. Corrupted/Blur images are due to noisy, blur images or camera miscues. Blurring occurs due to formation of bandwidth reduction of an ideal image caused by imperfect image formation process. Thus the images will be restored into original quality by reducing the physical degradation.

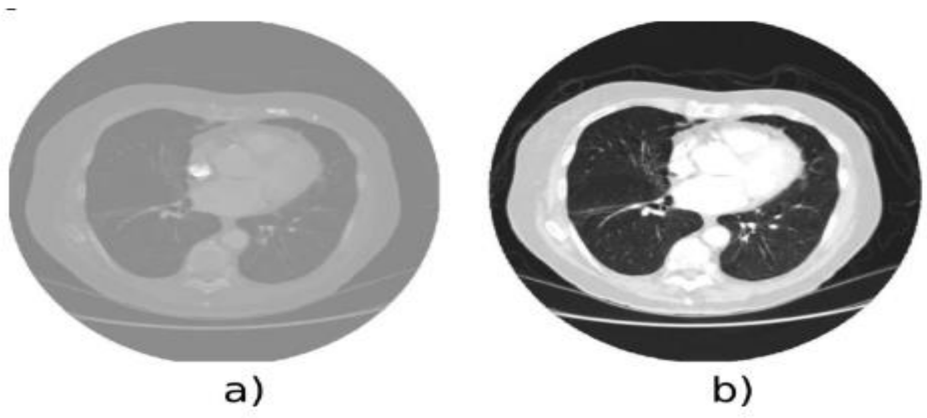


Fig 5.2.1.2 (a)Blur Image (b) Restored image

5.2.1.3 IMAGE COMPRESSION

Image compression is minimizing the size of bytes of a image file without degrading the quality of the image in order to obtain the image in more clarity. The reduction in file size allows more images to be stored in a given amount of disk or memory space. And also reduces the time during sending of images via networks or downloading from webpages.

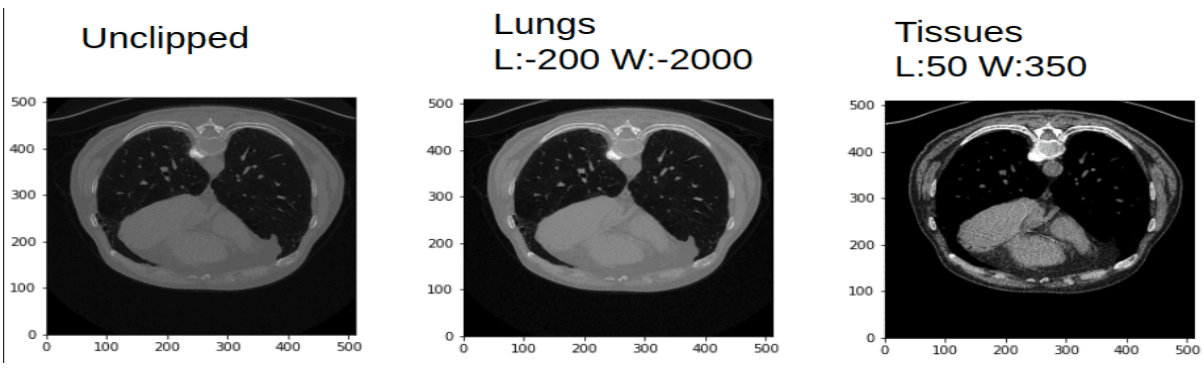


Fig 5.2.1.3 Compressed Images

5.2.1.4 IMAGE SEGMENTATION

Segmenting or partitioning the original image with some defined pixels into number of regions for the purpose of image analysis, depicts the features hidden in the normal image and object recognition, undefined boundary estimation, textures and motions. It is based on region and edges of image segmentation is carried out.

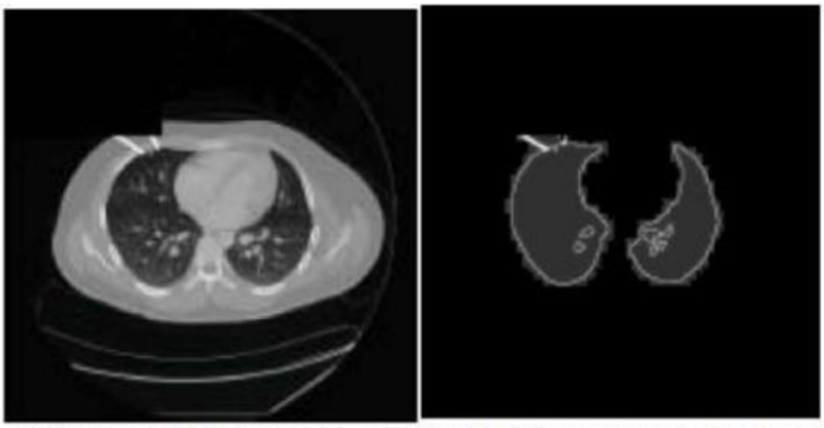
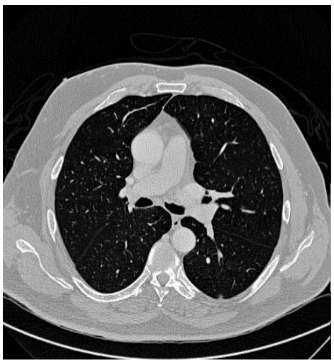


Fig 5.2.1.4 Segmented Image with Original image

5.2.1.5 IMAGE RECOGINITION

Image recognition technique involves in recognizing/identifying and detecting features such as objects in video or images. During the recognition mechanism, images from the database are compared with the current image, if the match is found then further execution of process will be carried out real time application. It helps in authentication and authorization process.

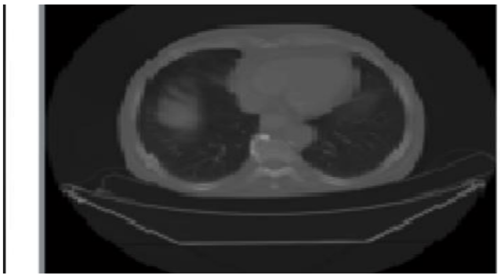


```
For image 1 named 2.png:
Shape of image is: (512, 512)
coarseness: 8.533089
contrast: 73.658229
directionality: 526.890643
roughness: 82.191318
```

Fig 5.2.1.5 Feature Extraction in C T image

5.2.1.6 IMAGE SMOOTHING

With this smoothing technique, noise can be reduced from the image. Image may contain noisy data such as dots, blur, speckles, stains, using this smoothing technique that acts as filter to remove the noisy data. It works Based on the low pass filter, which helps in decreasing the great difference between pixel values by averaging nearby pixel value. Considering single value calculated for an image such as median and average value.



a. Lung C T Image b. Noise free C T image

Fig 5.2.1.6 noise removed images

Advantages

- This one is more accurate than the overlapping method because it is based upon minutia.
- It is an interactive method for recognizing fingerprints.

Disadvantages

- It is more time consuming as compared to the former.
- More complex program.

5.3.3 Segmentation

Lung CT image segmentation is a necessary initial step for lung image analysis, it is a prerequisite step to provide an accurate lung CT image analysis such as lung cancer detection. Image segmentation is a sub-domain of computer vision and digital image processing which aims at grouping similar regions or segments of an image under their respective class labels. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects.

A segmentation could be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up. We consider bottom-up image segmentation. That is, we ignore (top down) contributions from object recognition in the segmentation process. Since the entire process is digital, a representation of the analogue image in the form of pixels is available, making the task of forming segments equivalent to that of grouping pixels. For input we primarily consider image brightness here, although similar techniques can be used with colour, motion, and/or stereo disparity information. All picture elements or pixels belonging to the same category have a common label assigned to them. For example: Let’s take a problem where the picture has to be provided as input for object detection. Rather than processing the whole image, the detector can be inputted with a region selected by a segmentation algorithm. This will prevent the detector from processing the whole image thereby reducing inference time.

Image segmentation is a method in which a digital image is broken down into various subgroups called Image segments which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation in easy words is assigning labels to pixels. All picture elements or pixels belonging to the same category have a common label assigned to them. image processing will involve scanning the heavens for other intelligent life out in space. Also new intelligent, digital species created entirely by research scientists in various nations of the world will include advances in image processing applications.

Segmentation is the partitioning of a digital image into multiple regions, according to some criterion. It builds the threshold between low-level image processing and higher-level analysis and is perhaps the most challenging of all image operations. For example, if we seek to find if there is a chair or person inside an indoor image, we may need image segmentation to separate objects and analyse each object individually to check what it is. Image segmentation usually serves as the pre-processing before image pattern recognition, image feature extraction and image compression.

5.3.4 Feature Extraction

Feature extraction describes the relevant shape information contained in a pattern so that the task of classifying the pattern is made easy by a formal procedure. In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. The main goal of feature extraction is to obtain the most relevant information from the original data and represent that information in a lower dimensionality space. When the input data to an algorithm is too large to be processed and it is suspected to be redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector).

Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input Pattern recognition is an emerging field of research in the area of image processing. It has been used in many applications such as character recognition, document verification, reading bank deposit slips, extracting information from cheques, applications for credit cards, health insurance, loan, tax forms, data entry, postal address reading, check sorting, tax reading, script recognition etc.

Character recognition is also applicable in newly emerging areas, such as development of electronic libraries, multimedia database, and systems which require handwriting data entry. Today, pattern recognition systems are less expensive. Several research works have been done to evolve newer techniques and methods that would reduce the processing time while providing higher recognition accuracy.

The widely used feature extraction methods are Template matching, Deformable templates, Unitary Image transforms, Graph description, Projection Histograms, Contour profiles, Zoning, Geometric moment invariants, Zernike Moments, Spline curve approximation, Fourier descriptors, Gradient feature and Gabor features. As an example, OCR is the process of converting scanned images of machine printed or handwritten text into a computer processable format.

Importance of feature extraction:-

1. When the pre-processing and the desired level of segmentation (line, word, character or symbol) has been achieved, some feature extraction technique is applied to the segments to obtain features, which is followed by application of classification and post processing techniques.

2. It is essential to focus on the feature extraction phase as it has an observable impact on the efficiency of the recognition system.

3. Feature selection of a feature extraction method is the single most important factor in achieving high recognition performance.

4. Feature extraction has been given as "extracting from the raw data information that is most suitable for classification purposes, while minimizing the within class pattern variability and enhancing the between class pattern variability".

5. Thus, selection of a suitable feature extraction technique according to the input to be applied needs to be done with utmost care.

6. Taking into consideration all these factors, it becomes essential to look at the various available techniques for feature extraction in a given domain, covering vast possibilities of cases.

Tamura feature extraction

Tamura et al. proposed that there are six components of the Tamura texture features, which are named coarseness, contrast, directionality, line likeness, regularity, and roughness, respectively. In this paper, three important features, coarseness, contrast, and directionality, are used.

(1) Coarseness. Computational process of coarseness is as follows:

(i) According to formula 1, in the active window of size $2^k \times 2^k$ in the medical image, the mean of the brightness of each pixel is calculated.

$$A_k(x,y) = \frac{\sum_{i=x-2^{k-1}}^{x+2^{k-1}-1} \sum_{j=y-2^{k-1}}^{y+2^{k-1}-1} g(i,j)}{2^{2k}}$$

formula (1)

Where (x, y) represents the position of the region of the selected medical image, g(i, j) represents the mean of the brightness in the i^{Th} , j^{Th}, points in the selected region, and k determines the range of the pixel.

(ii) According to formulae (2) and (3), the mean intensity difference between no overlapping activity windows in the horizontal and vertical directions is calculated.

$$E_{k,h} = \left|A_k\left(x+2^{k-1}, y\right) - A_k\left(x-2^{k-1}, y\right)\right|$$

$$E_{k,v} = \left|A_k\left(x, y+2^{k-1}\right) - A_k\left(x, y-2^{k-1}\right)\right|$$

formula (2) and (3)

Where E_{kh} represents the horizontal difference of this pixel E_{kv} and represents the vertical difference of this pixel.

(iii) Then, according to formula (4), the maximum of is calculated and the optimum size of each pixel s_{best} is calculated according to formula (5).

$$E_k = E_{\max} = \max\left(E_1, E_2, \ldots, E_h\right)$$

$$S_{best}(x,y) = 2^k$$

formula (4) and (5)

(iv) According to the formula (6), the mean value of s_{best} of all pixels in the entire image is calculated, which is called the coarseness F_{crs}.

$$F_{crs} = \frac{1}{m \times n}\sum_{i=1}^{m}\sum_{j=1}^{n} S_{best}(i, j)$$

formula (6)

where is the length of the image and n is the width of the image.

(2) **Contrast**. Generally, the image contrast refers to the brightness level between the darkest black and the brightest white in an image. According to formula (7), the contrast of the medical image is calculated.

$$F_{con} = \frac{\sigma}{{\alpha_4}^{1/4}}$$

formula (7)

where σ is the standard deviation of gray value of the medical image and α_4 is the kurtosis of gray value of the medical image.

*(*3**)** **Directionality**. The directionality is particularly important in medical images, which reflects the texture direction of the human muscle or tissue. The calculation process is as follows:

(i) According to formulae (8) and (9), the modulus of the gradient vector and the local edge direction of each pixel in medical image are calculated.

$$|\Delta G| = \frac{(|\Delta H| + |\Delta V|)}{2}$$

$$\theta = \tan^{-1}\left(\frac{\Delta V}{\Delta H}\right) + \frac{\pi}{2}$$

formula (8) and (9)

Formulae (8) and (9) can be achieved by convolving a 3 × 3 rectangular area around a medical image pixel point with two 3 × 3 masks as shown in Figure 2.

(ii) Firstly, divide the region $0-\pi$ into 16 equal parts and obtain the angle ϕcorresponding to the largest mode of the gradient vector in each equal interval. Then calculate pixel number $n_P$when $|\Delta G|$ in each region corresponding to the angle $\theta$is greater than the threshold. Secondly calculate the number of gradient vectors of all pixels to construct the histogram H_D, and discrete the range values of this histogram, then the peak position H_D of is denoted by ϕ_P. Finally, according to formula(10) , the overall direction of the medical image can be calculated by the sharpness of the peak in the histogram.

$$F_{dir} = \sum_{P}^{n_p} \sum_{\phi \in \omega_p} (\phi - \phi_p)^2 H_d(\phi)$$

formula (10)

Where p is the peak and ω_P is the range of the peak between each valley.

1	1	1
0	0	0
-1	-1	-1

-1	0	1
-1	0	1
-1	0	1

FIGURE 2: Two 3 × 3 masks.

5.3.5 Classification

Millions of photos are produced every day, and in order to organise, retrieve, and analyse them quickly and efficiently, each image needs to be classified. Images can be classified manually, but doing so takes time and may not produce the most precise results. By contrast, using image classifiers to automate the process, many human work hours can be saved while still producing highly accurate results. The dataset for a fundamental classification system consists of photos that are taken and analysed simultaneously. Image classification is the process of grouping or categorising photographs according to their shared characteristics and qualities. In particular, loud, fuzzy, cluttered backgrounds, or poor quality photos can produce misleading or false results. In the categorization process that uses pre-defined criteria, datasets are a crucial component.

A fundamental classification system uses a dataset made up of simultaneously processed and collected images. Image classification is the process of grouping or categorising photographs according to their commonalities and distinguishing characteristics. Particularly if the photographs are noisy, fuzzy, have a busy background, or are of poor quality, it may produce inaccurate or deceptive results. Datasets, which include predefined sample patterns of an object, are a crucial part of the categorization process. To place the test item into the proper class, these patterns are compared with it. The primary premise of image classification is to identify the features in an image. Image classification is a crucial but considerably important problem for many applications, and the task becomes more challenging if every image contains more than one object.

The image classification techniques are divided mainly into three categories:

(a) Supervised classification,

(b) Unsupervised classification, and

(c) Semi-supervised classification.

Supervised classification uses labelled data points and a known group of pixels, or in simpler terms the training is required. Unsupervised classification uses no labelled data and is used when trained pixels are unavailable, or in simpler terms, the training is required and any random data can be used. Semi-supervised classification considered advantages of supervised and unsupervised classification and uses unlabelled data points to remove the need for extensive domain scientist interaction and deal with bias which is the result of poor representation of labelled data. The main principle of an image classifier is to recognize the feature occurring in an image with the help of different mathematical techniques. The image classification process works in a structured format where different tasks are to be performed in an ordered format to achieve the desired results and classifying the image accurately.

The steps for implementing the image classification process are:

• Image Pre-processing : This stage is used to clean out undesirable artefacts and boost crucial image features in order to improve the image data (features) for the models. Reading an image, resizing the image, and data augmentation are all steps in the image pre-processing process (grey scaling, reflection, gaussian blurring, histogram, equalization, rotation, and translation).

• Detection of an Object: This stage involves segmenting the image and locating the object of interest in the image.

• Training and feature extraction: In this step, statistical or deep learning techniques are used to pinpoint the image's most intriguing patterns and features that may be specific to a given class and later aid the model in differentiating between classes. Model training is the process through which the model learns the features from the dataset.

• Classification of the object: Using an appropriate classification technique that contrasts the image patterns with the target patterns, this stage classes any detected items into predetermined classes.

CHAPTER 6

IMPLEMENTATION

6.1 METHODOLOGY

The proposed lung cancer detection system is mainly divided into two parts. In the first part, we are doing pre-processing before feeding the images into 3D CNNs.

We then detected the nodule candidate that is used to train by 3D CNNs to ultimately classify the CT scans as positive or negative for lung cancer to achieve the result.

The proposed CNN architecture mainly consists of the following layers: two convolution layers which follow two max-pooling layers and one fully-connected layer with two softmax units. The network begins with a convolution layer, in which the first convolution layer takes the image with input size in pixels. The second convolution layer consists feature maps with the convolution kernel of 3 × 3. The kernel size for max pooling layers is 2 × 2 and the stride of 2 pixels, and the fully-connected layer generates an output of some dimensions. The outputs are then passed to another fully connected layer containing 2 softmax units, which represent the probability that the image is containing the lung cancer or not. Note that each convolution layer in our CNN model is followed by a rectified linear unit (ReLU) layer to produce their outputs.

Datasets

We used Kaggle datasets (CT scans with labelled nodules). The Kaggle dataset has the location of the nodules in each CT scan. Thus, it will be useful for training the classifier. The inputs are the image files that are in “DICOM” format. The format and configuration of the images are different since the images are captured at different time and from different types of cameras. Actually, the images are of size (z × 512 × 512), where z is the number of slices in the CT scan and varies depending on the resolution of the scanner. Such large images cannot be fed directly into convolutional neural network architecture because of the limit on the computation power. At first, we converted all the images into similar size and format.

SoftMax

SoftMax extends this idea into a multi-class world. That is, SoftMax assigns decimal probabilities to each class in a multi-class problem. Those decimal probabilities must add up to 1.0. This additional constraint helps training converge more quickly than it otherwise would.

The SoftMax function is a function that turns a vector of K real values into a vector of K real values that sum to 1. The input values can be positive, negative, zero, or greater than one, but the SoftMax transforms them into values between 0 and 1, so that they can be interpreted as probabilities.

Most of the time the SoftMax Function is related to the Cross Entropy Function. In CNN, after the application of the SoftMax Function, is to test the reliability of the model using as Loss Function the Cross Entropy Function, in order to maximize the performance of our neural network.

ReLU

Rectified linear activation unit, or ReLU for short. Often, networks that use the rectifier function for the hidden layers are referred to as rectified networks.

The rectified linear activation function overcomes the vanishing gradient problem, allowing models to learn faster and perform better. The rectified linear activation is the default activation when developing multilayer Perceptron and convolutional neural networks.

The Rectified Linear Unit is the most commonly used activation function in deep learning models. The function returns 0 if it receives any negative input, but for any positive value x it returns that value back. So it can be written as f(x)=max(0, x).

6.2 Basic 3D CNN Architecture

Figure 6.2 shows the basic 3D CNN architecture, which consists of input, convolutional, pooling and fully-connected layer.

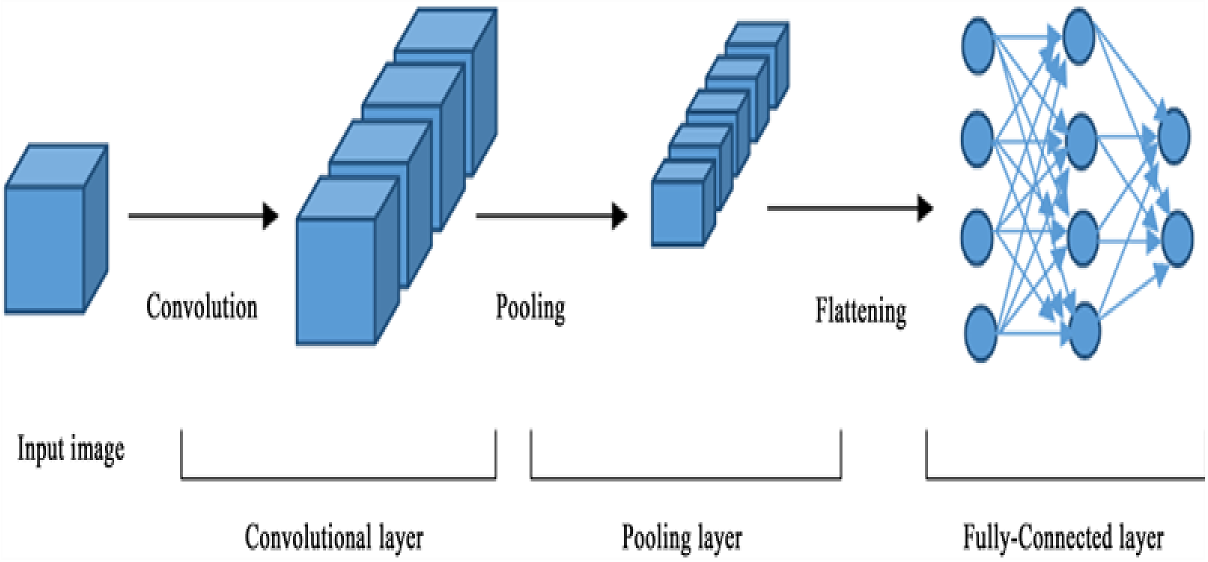


Fig 6.2 3D CNN Architecture

1) Convolutional layer

This layer is where images are translated into feature-map data by convolutional kernels or filters. In a 3D CNN, the kernels move through three dimensions of data (height, length, and depth) and produce 3D maps. A 3D CNN is necessary for analyzing data where temporal or volumetric context is important.

Conv2D

This layer creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs. If use bias is True, a bias vector is created and added to the outputs. Finally, if activation is not None, it is applied to the outputs as well. To specify three Conv2D layers in sequential order, with 3x3 kernel sizes, ReLU activation and 32, 64 and 128 filters, respectively.

Applies a 2D convolution over an input image composed of several input planes. This operator supports TensorFloat32, conv1d is used when you slide your convolution kernels along 1 dimensions (i.e. you reuse the same weights, sliding them along 1 dimensions), whereas tf. layers. conv2d is used when you slide your convolution kernels along 2 dimensions (i.e. you reuse the same weights, sliding them along 2 dimensions) The most common type of convolution that is used is the 2D convolution layer and is usually abbreviated as conv2D. A filter or a kernel in a conv2D layer "slides" over the 2D input data, performing an elementwise multiplication. As a result, it will be summing up the results into a single output pixel.

Each output channel is the sum of the filtered input channels. For 4 output channels and 3 input channels, each output channel is the sum of 3 filtered input channels. In other words, the convolution layer is composed of 4*3=12 convolution kernels.

2 Pooling

Pooling layers are used to reduce the dimensions of the feature maps. Thus, it reduces the number of parameters to learn and the amount of computation performed in the network.
The pooling layer summarizes the features present in a region of the feature map generated by a convolution layer. So, further operations are performed on summarized features instead of precisely positioned features generated by the convolution layer. This makes the model more robust to variations in the position of the features in the input image.
Convolutional layers are the basic building blocks of a convolutional neural network used for computer vision applications such as image recognition. A convolutional layer slides a filter over the image and extracts features resulting in a feature map that can be fed to the next convolutional layer to extract higher-level features. Thus, stacking multiple convolutional layers allows CNNs to recognize increasingly complex structures and objects in an image.

A major problem with convolutional layers is that the feature map produced by the filter is location-dependent. This means that during training, convolutional neural networks learn to associate the presence of a certain feature with a specific location in the input image. This can severely depress performance. Instead, we want the feature map and the network to be translation invariant (a fancy expression that means that the location of the feature should not matter).

3)Flattening

The next step in the process is called flattening. Flattening is used to convert all the resultant 2-Dimensional arrays from pooled feature maps into a single long continuous linear vector. The flattened matrix is fed as input to the fully connected layer to classify the image.

Flattening is converting the data into a 1-dimensional array for inputting it to the next layer. We flatten the output of the convolutional layers to create a single long feature vector. And it is connected to the final classification model, which is called a fully-connected layer.

A flatten operation is a specific type of reshaping operation where by all of the axes are smooched or squashed together. To flatten a tensor, we need to have at least two axes. This makes it so that we are starting with something that is not already flat.

The flattening step is a refreshingly simple step involved in building a convolutional neural network. The reason why we transform the pooled feature map into a one-dimensional vector is because this vector will now be fed into an artificial neural network.

6.3 ARGUMENTS OF CNN

6.3.1 Zero Padding

In convolutional neural networks, zero-padding refers to surrounding a matrix with zeroes. This can help preserve features that exist at the edges of the original matrix and control the size of the output feature map. Zero-padding refers to the process of symmetrically adding zeroes to the input matrix. It's a commonly used modification that allows the size of the input to be adjusted to our requirement. It is mostly used in designing the CNN layers when the dimensions of the input volume need to be preserved in the output volume.

As we just discussed, the convolutional layers reduce the size of the output. So in cases where we want to increase the size of the output and save the information presented in the corners we can use padding layers where padding helps by adding extra rows and columns on the outer dimension of the images .Padding is used to create space around an element's content, inside of any defined borders. This element has a padding of 70px. To sum up, 'valid' padding means no padding. The output size of the convolutional layer shrinks depending on the input size & kernel size. On the contrary, 'same' padding means using padding.

6.3.2 Maxpooling2D

Max pooling operation for 2D spatial data. Down samples the input along its spatial dimensions (height and width) by taking the maximum value over an input window (of size defined by pool size) for each channel of the input. The window is shifted by strides along each dimension.

Max pooling is done to in part to help over-fitting by providing an abstracted form of the representation. As well, it reduces the computational cost by reducing the number of parameters to learn and provides basic translation invariance to the internal representation.

Pooling mainly helps in extracting sharp and smooth features. It is also done to reduce variance and computations. Max-pooling helps in extracting low-level features like edges, points, etc. While Avg-pooling goes for smooth features.

A pooling layer is another building block of a CNN. Its function is to progressively reduce the spatial size of the representation to reduce the amount of parameters and computation in the network. Pooling layer operates on each feature map independently. The most common approach used in pooling is max pooling.

6.3.3 Other arguments as follows:-

1) filters: Integer, the dimensionality of the output space (i.e. the number of output filters in the convolution).

2) kernel_size: An integer or tuple/list of 3 integers, specifying the depth, height and width of the 3D convolution window. Can be a single integer to specify the same value for all spatial dimensions.

3) strides: An integer or tuple/list of 3 integers, specifying the strides of the convolution along each spatial dimension. Can be a single integer to specify the same value for all spatial dimensions. Specifying any stride value != 1 is incompatible with specifying any dilation_rate value != 1.

4) dilation_rate: an integer or tuple/list of 3 integers, specifying the dilation rate to use for dilated convolution. Can be a single integer to specify the same value for all spatial dimensions.

Currently, specifying any dilation_rate value != 1 is incompatible with specifying any stride value != 1.

5) groups: A positive integer specifying the number of groups in which the input is split along the channel axis. Each group is convolved separately with filters / groups filters. The output is the concatenation of all the groups results along the channel axis. Input channels and filters must both be divisible by groups.

6) activation: Activation function to use. If you don't specify anything, no activation is applied (see keras. activations).

7) kernel_initializer: Initializer for the kernel weights matrix (see keras. initializers). Defaults to 'glorot_uniform'.

8) bias_initializer: Initializer for the bias vector (see keras. initializers). Defaults to 'zeros'.

9)kernel_regularizer: Regularizer function applied to the kernel weights matrix (see keras. regularizers).

10) bias_regularizer: Regularizer function applied to the bias vector (see keras. regularizers).

11) activity_regularizer: Regularizer function applied to the output of the layer (its "activation") (see keras. regularizers).

12) kernel_constraint: Constraint function applied to the kernel matrix (see keras. Constraints).

13) bias constraint: Constraint function applied to the bias vector (see keras. Constraints).

CHAPTER 7

SYSTEM TESTING

Test case ID	Test case Description	Test Data	Expected Result	Actual Result	Pass/Fail
1	Input dataset	Testing dataset	Data set loaded	Successfully loaded	Pass
2	Analyse data set	Dataset Analysed	Features selected	Features successfully tested	Pass
3	Pre-processing	Noise removal and sharpen the images	Noise removed	Successfully tested	Pass
4	Feature extraction	Extract features	Increase the accuracy	Successfully extracted	Pass
5	Segmentation	Determine boundaries and shapes	Boundaries and shapes determined	Successfully determined	Pass
6	Classification	Classify whether cancerous or non-cancerous	Classified whether cancerous or non-cancerous	Successfully classified	Pass
7	Apply algorithms	CNN Algorithm tested	CNN Algorithm applied	Algorithm successfully applied	Pass

CHAPTER 8

CONCLUSION AND FURURE ENHANCEMENT

Lung cancer is one of the most dangerous diseases and the most common cause of death, the severity of the disease lies in the difficulty of diagnosing it in the early stages. This paper tries to endeavour to investigate of three classifiers to find the best classifier could classify lung cancer in early stage. The informational indices included in this study were derived from UCI databases for lung cancer patients. The focus of this paper is on using WEKA Tool to investigate the accuracy of classification algorithms. The results show that the Support Vector Machine (SVM) give the best accuracy 95.56%, that can detect lung cancer in its early stages and save several lives and, K-Nearest Neighbour KNN It gave less accuracy 88.40%. We have used KAGGLE data set in our project. The goal of pre-processing is to enhance the quality of the raw CT picture. This involves some processes on the image that improve particular visual details and data. In Pre-processing, we have used Histogram equalization technique. Segmentation is done to depict an image in a more straightforward manner or in a way that is more significant and simpler to comprehend. This stage determines whether the identified nodule is benign or cancerous. In Feature extraction, Using cardiac CT images as proof, the Tamura method was utilised to extract texture information from the segmented pictures. Tamura texture has six elements that correlate to the six psychologically significant characteristics of texture features: roughness, contrast , direction of degrees , regularity and rough. In Classification, A classifier called Support Vector Machine (SVM) is employed. The SVM algorithm for supervised machine learning defines the function that divides data into two classes, they are cancerous and non-cancerous with the accuracy of 93.67%.

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SNAPSHOTS

```
[ ] import numpy as np
    import pandas as pd
    import matplotlib.pyplot as plt
    import seaborn as sns

    # Display the Image Data
    from PIL import Image
    import cv2
    import os
```

```
[ ] import os
```

```
[ ] from google.colab import drive
    drive.mount('/content/drive')

    Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
[ ] os.listdir('/content/drive/MyDrive/')
```

```
[ ] from tensorflow.keras.preprocessing.image import ImageDataGenerator, load_img, img_to_array
    from numpy import expand_dims
```

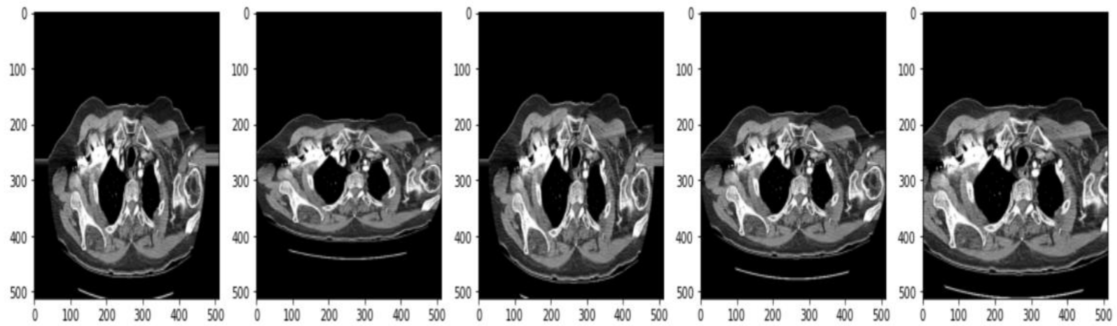
```
[ ] img = load_img(train_n + 'CT0013.png')
    data = img_to_array(img)
    data

    array([[[0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.],
            ...,
            [0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.]],

           [[0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.],
            ...,
            [0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.]],

           [[0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.],
            ...,
```

```
[ ]        ...,
           [[0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.],
            ...,
            [0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.]],

           [[0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.],
            ...,
            [0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.]],

           [[0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.],
            ...,
            [0., 0., 0.],
            [0., 0., 0.],
            [0., 0., 0.]]], dtype=float32)
```

```
[ ] data.shape

    (512, 512, 3)

[ ] samples = expand_dims(data, 0)
    samples

    array([[[[0., 0., 0.],
             [0., 0., 0.],
             [0., 0., 0.],
             ...,
             [0., 0., 0.],
             [0., 0., 0.],
             [0., 0., 0.]],

            [[0., 0., 0.],
             [0., 0., 0.],
             [0., 0., 0.],
             ...,
             [0., 0., 0.],
             [0., 0., 0.],
             [0., 0., 0.]],
```

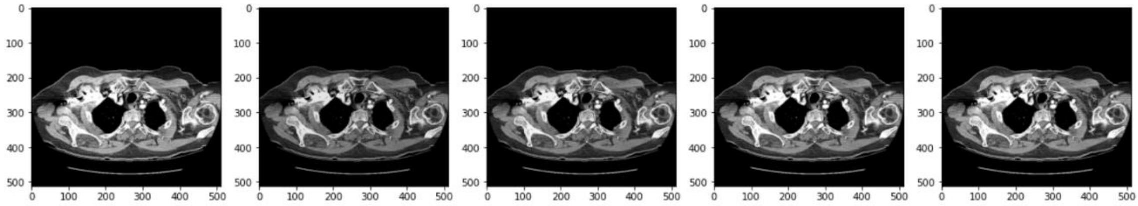
```
            [[0., 0., 0.],
             [0., 0., 0.],
             [0., 0., 0.],
             ...,
             [0., 0., 0.],
             [0., 0., 0.],
             [0., 0., 0.]]]], dtype=float32)

[ ] samples.shape

    (1, 512, 512, 3)

[ ] datagen = ImageDataGenerator(zoom_range = 0.2)
    IDG = datagen.flow(samples, batch_size = 1)
    fig, ax = plt.subplots(1, 5, figsize = (20,15))
    for i in range(5):
        fig = plt.figure()
        batch = IDG.next()
        image = batch[0].astype('uint8')
        ax[i].imshow(image)
    plt.show()
```

[ ]



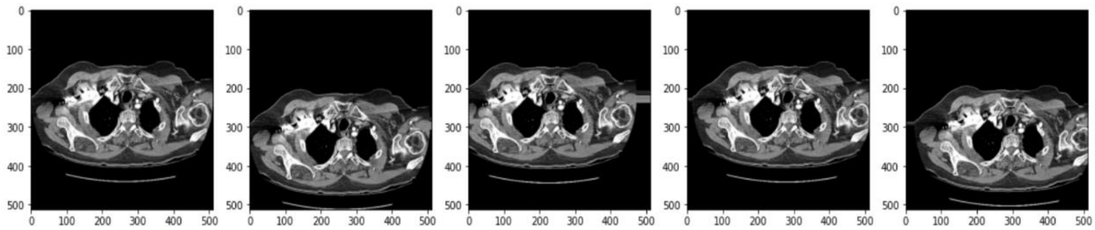

```
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
```

```
[ ] datagen = ImageDataGenerator(brightness_range= [0.8, 1.3])
    IDG = datagen.flow(samples, batch_size = 1)
    fig, ax = plt.subplots(1, 5, figsize = (20,15))
    for i in range(5):
        fig = plt.figure()
        batch = IDG.next()
        image = batch[0].astype('uint8')
        ax[i].imshow(image)
    plt.show()
```



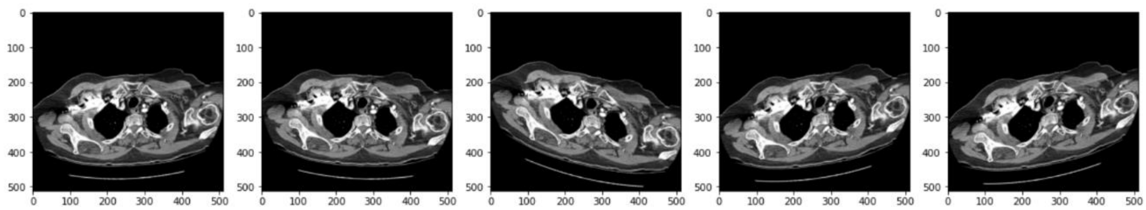
```
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
```

```
[ ] datagen = ImageDataGenerator(height_shift_range = 0.08, width_shift_range = 0.08)
    IDG = datagen.flow(samples, batch_size = 1)
    fig, ax = plt.subplots(1, 5, figsize = (20,15))
    for i in range(5):
        fig = plt.figure()
        batch = IDG.next()
        image = batch[0].astype('uint8')
        ax[i].imshow(image)
    plt.show()
```



```
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
```

```
[ ] datagen = ImageDataGenerator(shear_range = 20)
    IDG = datagen.flow(samples, batch_size = 1)
    fig, ax = plt.subplots(1, 5, figsize = (20,15))
    for i in range(5):
        fig = plt.figure()
        batch = IDG.next()
        image = batch[0].astype('uint8')
        ax[i].imshow(image)
    plt.show()
```



```
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
<Figure size 432x288 with 0 Axes>
```

```
[ ] train_datagen = ImageDataGenerator(rescale = 1./255, zoom_range=0.2, height_shift_range=0.08, width_shift_range=0.08,
                                       brightness_range= [0.8, 1.2], fill_mode = 'nearest')
    test_datagen = ImageDataGenerator(rescale = 1./255)
```

```
[ ] train_set = train_datagen.flow_from_directory(train_folder, target_size=(224,224), batch_size = 32, class_mode='categorical')
    test_set = test_datagen.flow_from_directory(test_folder, target_size=(224,224), batch_size = 32, class_mode='categorical')
    val_set = test_datagen.flow_from_directory(val_folder, target_size=(224,224), batch_size = 32, class_mode='categorical')
```

```
Found 1271 images belonging to 2 classes.
Found 1359 images belonging to 2 classes.
Found 1460 images belonging to 2 classes.
```

```
[ ] train_set.image_shape
```

```
(224, 224, 3)
```

```
[ ] from tensorflow.keras.models import Sequential
    from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dropout, ZeroPadding2D, Dense
    from tensorflow.keras.optimizers import Adam
```

```
[ ]
    def build_model():
        model = Sequential()
        # Conv Layer - I
        model.add(ZeroPadding2D((1,1), input_shape = train_set.image_shape))
        model.add(Conv2D(filters=64, kernel_size=(3,3), activation='relu'))
        model.add(MaxPooling2D(pool_size=(2,2), strides=(2,2)))

        # Conv Layer - II
        model.add(ZeroPadding2D((1,1)))
        model.add(Conv2D(filters=128, kernel_size=(3,3), activation='relu'))
        model.add(MaxPooling2D(pool_size=(2,2), strides=(2,2)))

        # Conv Layer - III
        model.add(ZeroPadding2D((1,1)))
        model.add(Conv2D(filters=256, kernel_size=(3,3), activation='relu'))
        model.add(MaxPooling2D(pool_size=(2,2), strides=(2,2)))

        # Conv Layer - IV
        model.add(ZeroPadding2D((1,1)))
        model.add(Conv2D(filters=512, kernel_size=(3,3), activation='relu'))
        model.add(MaxPooling2D(pool_size=(2,2), strides=(2,2)))

        model.add(Flatten())

        # Input Layer - I
        model.add(Dense(units = 256, activation = 'relu'))
        model.add(Dropout(0.5))
```

```
[ ]     model.add(Dropout(0.5))
        # Output Layer
        model.add(Dense(units = 2, activation='softmax'))

        # model compile
        model.compile(optimizer = 'Adam', loss = 'categorical_crossentropy', metrics = ['accuracy'])
        return model
```

```
[ ] model = build_model()
```

```
[ ] model.summary()
```

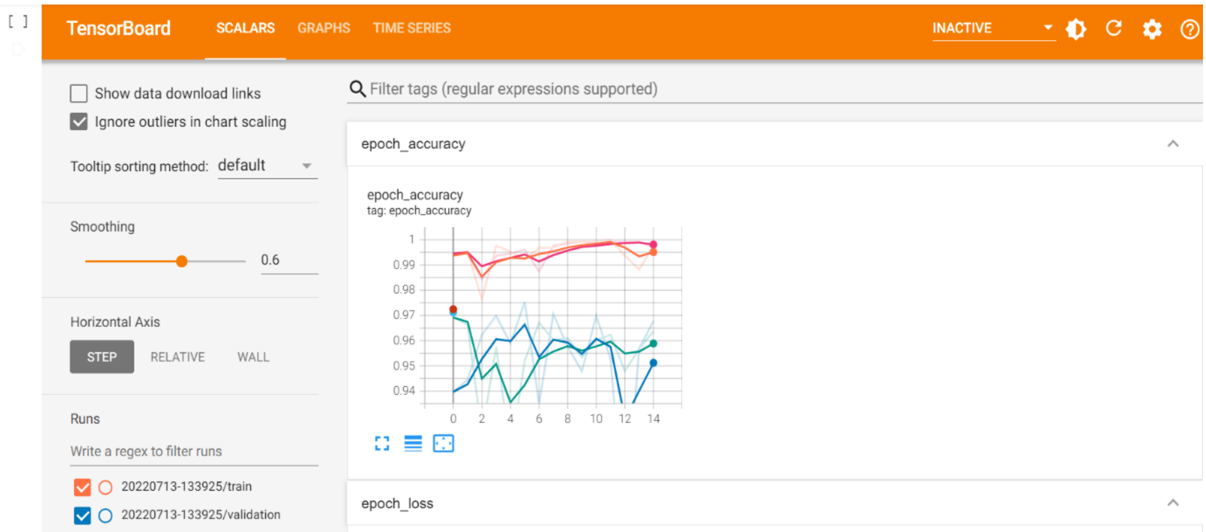
```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 zero_padding2d_4 (ZeroPaddi  (None, 226, 226, 3)      0
 ng2D)

 conv2d_4 (Conv2D)           (None, 224, 224, 64)      1792

 max_pooling2d_4 (MaxPooling  (None, 112, 112, 64)     0
 2D)

 zero_padding2d_5 (ZeroPaddi  (None, 114, 114, 64)     0
 ng2D)

 conv2d_5 (Conv2D)           (None, 112, 112, 128)     73856
```

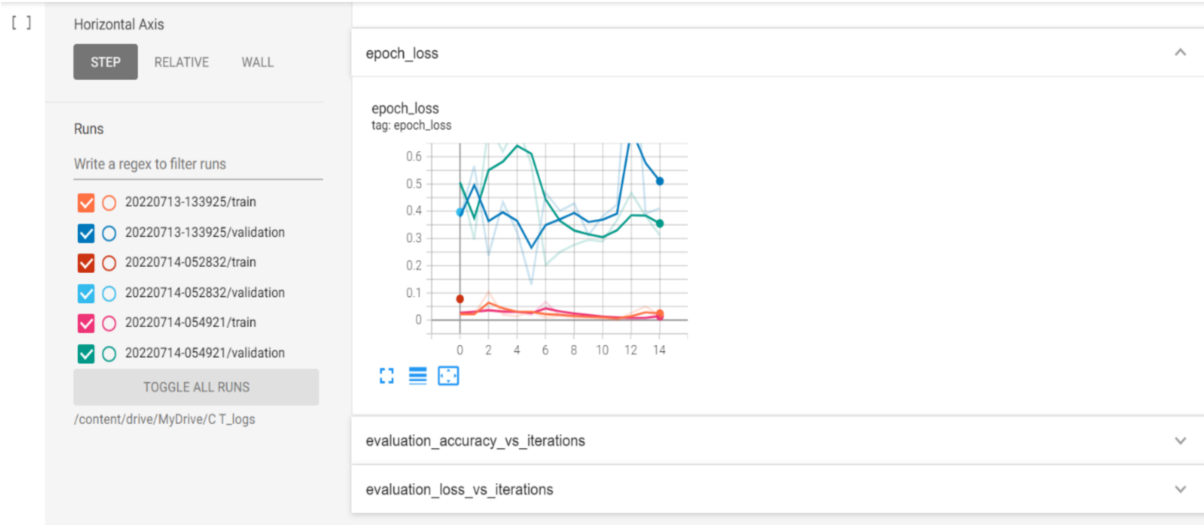
```
[ ] Total params: 27,241,858
    Trainable params: 27,241,858
    Non-trainable params: 0
    _________________________________________________________________
```

```
[ ] from tensorflow.keras import callbacks
    filepath = "/content/drive/MyDrive/C T_logs"
    checkpoint = callbacks.ModelCheckpoint(filepath, monitor='val_loss', save_best_only=True, mode = 'min', verbose = 1)
    checkpoint

    <keras.callbacks.ModelCheckpoint at 0x7f7fca1725d0>
```

```
[ ] import datetime
    from tensorflow import keras
    logdir = os.path.join("/content/drive/MyDrive/C T_logs", datetime.datetime.now().strftime("%Y%m%d-%H%M%S"))
    tensorboard_callback = keras.callbacks.TensorBoard(logdir)
```

```
history = model.fit_generator(generator=train_set, epochs=15, shuffle=True, validation_data=val_set,
                              steps_per_epoch=40,callbacks = [checkpoint, tensorboard_callback], verbose = 1)

Epoch 2/15
40/40 [==============================] - ETA: 0s - loss: 0.0532 - accuracy: 0.9803
Epoch 2: val_loss did not improve from 0.28097
40/40 [==============================] - 43s 1s/step - loss: 0.0532 - accuracy: 0.9803 - val_loss: 0.3332 - val_accuracy: 0.9548
Epoch 3/15
40/40 [==============================] - ETA: 0s - loss: 0.0205 - accuracy: 0.9953

Epoch 3: val_loss improved from 0.28097 to 0.15788, saving model to /content/drive/MyDrive/C T_logs
INFO:tensorflow:Assets written to: /content/drive/MyDrive/C T_logs/assets
40/40 [==============================] - 33s 820ms/step - loss: 0.0205 - accuracy: 0.9953 - val_loss: 0.1579 - val_accuracy: 0.9630
Epoch 4/15
40/40 [==============================] - ETA: 0s - loss: 0.0328 - accuracy: 0.9929
Epoch 4: val_loss did not improve from 0.15788
40/40 [==============================] - 31s 774ms/step - loss: 0.0328 - accuracy: 0.9929 - val_loss: 0.4756 - val_accuracy: 0.9459
Epoch 5/15
40/40 [==============================] - ETA: 0s - loss: 0.0581 - accuracy: 0.9898
Epoch 5: val_loss did not improve from 0.15788
40/40 [==============================] - 29s 721ms/step - loss: 0.0581 - accuracy: 0.9898 - val_loss: 0.2644 - val_accuracy: 0.9582
Epoch 6/15
40/40 [==============================] - ETA: 0s - loss: 0.0529 - accuracy: 0.9843
Epoch 6: val_loss did not improve from 0.15788
40/40 [==============================] - 29s 731ms/step - loss: 0.0529 - accuracy: 0.9843 - val_loss: 0.4132 - val_accuracy: 0.9370
Epoch 7/15
40/40 [==============================] - ETA: 0s - loss: 0.0537 - accuracy: 0.9835
Epoch 7: val_loss did not improve from 0.15788
40/40 [==============================] - 29s 716ms/step - loss: 0.0537 - accuracy: 0.9835 - val_loss: 0.2629 - val_accuracy: 0.9479
Epoch 8/15
40/40 [==============================] - ETA: 0s - loss: 0.0146 - accuracy: 0.9969
Epoch 8: val_loss did not improve from 0.15788
40/40 [==============================] - 28s 712ms/step - loss: 0.0146 - accuracy: 0.9969 - val_loss: 0.3324 - val_accuracy: 0.9699
Epoch 9/15
40/40 [==============================] - ETA: 0s - loss: 0.0041 - accuracy: 0.9992
Epoch 9: val_loss did not improve from 0.15788
40/40 [==============================] - 30s 747ms/step - loss: 0.0041 - accuracy: 0.9992 - val_loss: 0.3360 - val_accuracy: 0.9555
Epoch 10/15
40/40 [==============================] - ETA: 0s - loss: 0.0114 - accuracy: 0.9976
```






```
[ ] model.evaluate(val_set)

    46/46 [==============================] - 8s 164ms/step - loss: 0.1579 - accuracy: 0.9630
    [0.15787570178508759, 0.9630137085914612]

[ ] model.evaluate(test_set)

    43/43 [==============================] - 387s 9s/step - loss: 0.3738 - accuracy: 0.9367
    [0.3737989366054535, 0.9367181658744812]

[ ] yhat = np.argmax(model.predict(test_set), axis = 1)
    yhat

    array([1, 0, 0, ..., 1, 0, 0])

[ ] ytest = test_set.classes

[ ] from sklearn.metrics import confusion_matrix, classification_report
    confusion_matrix(ytest, yhat)

    array([[715, 237],
           [323,  84]])
```

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Feature Extraction in the Analysis of Medical Images

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Abstract: *In the image downloading process, image processing method, data mining method, and computer scanning technique, feature removal is an important step. The process of extracting logical data from original data is known as feature extraction. However, many FE methods still struggle with the difficulty of extracting relevant features that can accurately capture the basic content of a piece of data or database. We provide a survey of existing methods of extracting features used in recent years in this work. Brightness, homogeneity, entropy, meaning, and strength were shown to be the most of the distinctive features that could be obtained when using global learning and development community features extraction method in the images in the study. In addition, it was found that the extraction methods are not specific to the application and can be used in a variety of situations.*

Keywords: Image processing, data mining, Homogeneity, Entropy.

I. INTRODUCTION

Many processes including computer detection, object and the location detection, image processing method, image retrieval process, speech recognition process, data mining work, pattern detection process, machine learning work, and bioinformatics process have become clear requirements for the extraction methods. It will be used to extract the most of the distinctive features of a database and is used to represent the data and also to interpret the data. As the famous saying goes, "a picture costs a thousand words." Data is a combination of many outstanding features. Digital image processing, on the other hand, is a computer-based process that manages colour, binary, grey images and Image Recovery is a computer's ability to retrieve images on a specific domain site, or that can be a text image or non-text image. Images with a comparable or different location are computerized using IR. It is done by the process of searching and browsing, or in the process of retrieving images on a large set of data base of various images. Text-based Image recovery and the Content-Based Image Recovery, and Mixed Image Recovery (MIR) are three types of image acquisition techniques, and TBIR is widely used This method is mainly used in standard systems. Text can also be extracted from the image using IR. There are two types of problem with TBIR: the first is related costs and the second is the distorted outcomes available. CBIR technology is used to solve this problem. The effective use of CBIR technology for image processing is excellent. CBIR is a technology that integrates a wide range of the technologies to applications in human perception, information science, signal the processing and multimedia and for pattern recognition and also for human computer interactions. The different algorithms used in the CBIR are classified into two categories. Feature selection process, Feature release method, and the feature editing are three process elements. Selecting content features in an image, using image processing and computer recognition. Filters and wrappers are two FE pieces. Wrappers use aggregation, separation, or recognition algorithms. Although filters do not include machine learning. This study provides an overview of the different FE mechanisms. In a few types of processing, FE plays an important role. We provide a recent development survey on feature extraction in the paper. Feature extraction is a system for extracting the raw data from an images and used for the classification and the basic goal of feature extraction methods is to extract the data from the raw data to represent a low dimensional environment. As a result, data from big data with less information is translated into a vector feature. The selected feature set will release the required information if the features are carefully extracted.

II. RESEARCH OF TYPES OF SUBJECT REMOVAL

In the stream of computer vision or in the image processing, factors play a vital role in identifying useful information. Integrated image is subject to a number of pre-processing techniques such as standardization, retrieval, duplicate, measurement, etc. before removing the image element. As shown in Figure 1, the features are divided into two categories: standard features and the domain-specific features .GF refers to application-based features such as colour, form, and textures, while DSF refers to application-based features such as visual and human features. Both are divided into three categories: like pixel level features, local type features (features are analysed based on image classification acquisition), and global type features (features are tested for image). The categories of image elements, as well as their structures and models.

2.1 A Colour Feature

In computer vision or image processing, factors play a vital role in identifying useful information. An image from before colour markers is widely used to extract visual features in the form of a video or image. Colour is one of the most important elements of an image and is defined by colour space and the models such as Red-Green-Blue, HMMD visualization, HSV, and the LUV. Colour elements hold up well when translated or viewed at different angles. Colour space is used for the specification of different colour features. once the colour space of the image is selected, the elements associated with the image can be easily removed. Colour correlogram, colour histogram, colour coherence vector, and colour times are among the many colour features described in the literature CM is a basic and effective element among them.

Red-Green-Blue(RGB) and Hue-Saturation Value(HSV), and Luminance-chrominance, Hue-Max and Min-Diff, and CIE LUV RGB are some of the colour space widely used in the study. Filling in the space in HSV indicates how bright the colour is and is represented by Eq (1). If the Maximum values like - (maximum R, G, and B value) are zero, the filling value of the space is zero; otherwise.

Saturation= Max-Min/Min eq(1)

The value (V) defines how bright or dark a colour is which is equal to the Max value and Hue(H) specifies one colour family and angle from o degree to 360 degree which is represents by eq(2) . In Eq(2) maximum value of its represented by Max and minimum value of R, G ,B is denoted by Min

$$\text{Hue} = \begin{cases} 0 & \text{if Max==Min} \\ 60*\frac{G-B}{max-Min} & \text{if Max== R and G >=B} \\ 60*\frac{G-B}{max-Min} & \text{if Max== R and G >=B} \\ 360*(60*\frac{G-B}{max-Min}) & \text{if Max ==R and G<B} \\ 60*(2.0*\frac{B-R}{max-Min}) & \text{if G== Max} \\ 60*(4.0*\frac{R-G}{max-Min}) & \text{otherwise} \end{cases} \quad \text{eq(2)}$$

YCbCr represents the luminance (Y0 ,blue chrominance (Cb) and red chrominance (Cr) as given by matrix in eq (3).

$$\begin{vmatrix} Y \\ Cb \\ Cr \end{vmatrix} = \begin{vmatrix} 0.299 & 0.587 & 0.114 \\ 0.169 & -0.331 & 0.500 \\ 0.500 & -0.419 & -0.081 \end{vmatrix} \begin{vmatrix} R \\ G \\ B \end{vmatrix} \quad (3)$$

The HMMD colour spacing method is close to the colour space that looks homogeneous. There are five different parts: Hue is similar to Eq. (2), Max represents the black colour in the image and Min represents the white colour in the image, Diff represents the difference between High and Low values, which determines the pure colour of the image / direct, and Total represents the Max and Minor scale. numbers, which reflect the brightness of the colour. A combination of the H, Diff, Sum or H and Max and Min is required to create the HMMD colour space. The International Commission on Illumination adopted the CIE colour scheme (L *, U *, V *) in 1976, commonly known as CIE LUV. It is widely used in systems using coloured lights.

In accordance to the colour distribution, which is going to defines the colour space and the colour layout, and also the MPEG standard includes many of the colour definitions that represent the different aspects of the coloured element. As a result, another method of extracting nutrients may be based on their colour. Shameless self-promotion for Color Cards, Framework or Graphics Group, Colour Structure and Colour Structure Definition are five key tools used to describe colour . Image colour distribution is shown by CSD, DCD, and SCD, while GoF and GoP or the CLD reveals the relationship between the series of images or the sequences. Colour structure definition provides a detailed description of image colours. Allows the definition of mathematical features such as variability and distribution, as well as the high coloured values. DCD on the other side, allows for faster and more accurate identification of images in an image.

The coloured histogram process in the HSV coloured space is represented as SCD, which can be hidden using the Har transform. SCD is used for the primarily to simulation. GoP is a type of the SCD that uses a collection of the frames from a video or image collections. Different colours of the video frames or the images are collected in this process. CSD uses a moderate shortcut type windows to separate the compressive colour distribution. Colour histograms are used in this process as well. CSD only works with HMMD colour space. The CLD method is advanced for programs that require faster browsing and search. It is a small description that can be applied to both photos and videos. The Discrete Cosine Transform coefficients are used in the CLD method. CLD and DCD are the most commonly used adjectives because of their benefits. DCD assists in the functional definition of the bright colours of the image, while CLD assists in preserving the local distribution of the image colour. When it came to choosing adjectives, these factors were important. Colour space conversion, colour space integration method like CIE LUV, and per cent centimetres calculation are all part of the DCD output process. In table I we present the different colour descriptors.

2.2 Feature for Textures

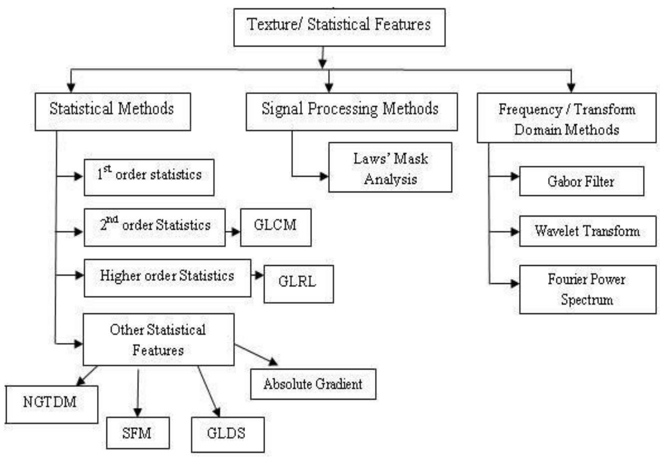

Figure 1. Strategies for extracting a different texture element.

Colour elements use the individual pixel but the texture features uses groups of pixels. The texture is used by the human visual system to analysed and visualize images. The quality of the homogeneity of the texture defines the visible patterns. Texture elements are divided into two types: local and spectral. Figure 1 shows several episodes. Features are rendered to the local TF by calculating the pixel in the first image, but in the visible TF, the images are first converted into a background image and the elements are extracted to get the correct image. Because the sample is the background of the image frequency by defining the stop parameters and the frequency range, the Gabor filter is widely used in TF

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extraction. Table II compares and contrasts these two methods of extracting TF. Image Sharing is a popular local TF app for extraction. This method is used to convert differences in the local structures of the geometric or in the stochastic elements into grey values.

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First Order Statistics, Gray Level Run Length Matrix method, Gray Level Co-occurrence Matrix method Neighbourhood Gray Tone Difference Matrix method ,and Statistical Feature Matrix are all some of the examples of this . The legal mask features are used in signal processing for FE methods, while the Gabor wavelet, Furrier of Power Spectrum features and the differential wave conversion are used in background conversion methods, as shown in below Table III .

Table I: Colour descriptor merits and demerits.

Colour method	**Merits**	**Demerits**
DCD	Robustness, compact and perceptual meaning	Post-processing process needed for the spatial information
CSD	Uses the spatial information (SI)	Sensitive to the noise and rotation and scales
SCD	Scalable and complexity	No use of SI, less accurate if the process is complex
CM	Robustness and compact	sufficient to be describe in all colours, no use of SI
CCV	Usage of SI	Has the high dimension and the computational cost
Histogram	Intuitive and the simple to the computation process	Sensitive to the noise, high dimension and no use SI,
Correlogram	Usage of SI	Sensitive to the noise, rotation and scaling, high computational cost is required

TABLE II: Different between the extraction methods.

Texture feature types	**Advantages**	**Disadvantages**
Spatial	Easy to understand the method and it shares similar properties in small neighborhood and also when extracted from any shape they don’t lose the original data in the process.	Sensitive to the alternation and the noise
Spectral	Requires less computation time and also it has property of Robustness	It needs the square image regions with sufficient size and it can’t distinguish between the objects made of the same material

2.3 Features of Shape

To identify and identify real-world objects, physical features are important. They are a common visual indicator that people use to test similarities and similarities. There are two types of SF: regional and contour-based. contour based determines the SF from the boundary, while the RB pulls the elements into a complete object. The Hough Transform has been described as a useful tool for extracting geometric features from forms and identifying lines and edges. Pattern recognition process and image processing method, and also computer vision are all areas where it can be used.

TABLE III: Various features from the different feature extraction methods

Various features	Features
First order statistics	Third moment, homogeneity, smoothness, mean, standard deviation, and entropy
GLCM features	Contrast, correlation, difference entropy, angular moment, inverse difference moment, variance, and difference variance
GLRLM features	Short run high grey emphasis, short run low grey emphasis, run length non uniformity, long run emphasis, long run high grey emphasis, low grey level run emphasis, and grey level non uniformity.
GLDS features	Energy, entropy, homogeneity, contrast, and mean
NGTDM	Strength, intricacy and contrast, coarseness, and business
SFM	Sharpening, contrast, regularity, and roughness
FPS	Angular sum and radial sum
Gabor filter based	Mean and variance
Shape features	Area, eccentricity, solidicity, circumference, diameter, Euler number, orientation, concave area, extent, major axis, and minor axis

III. APPLICATIONS FOR STRENGTH OF WARRANTY AND ITS TERMS

Feature domain identifies, finds, and analyses areas of interest using the in-app features. Algorithms are developed in this way using supervised learning or non-supervised learning methods. Other studies in the literature have highlighted the various methods used by writers to identify and consider key points of drawings.

3.1 Digging The Text

In text mining and data retrieval, extracting a text feature is very useful. The concept of archaeology was first introduced in the year of 2000. It is a way of extracting relevant information from the text. Text mining is used in the data mining and also in the various methods for obtaining the information where data is required for patient records and health insurance data and also in the social networks, and media. It is also used for the computer detection and image processing systems such as detecting and identifying the license plate numbers. Given a survey of many excavations works and methods.

3.2 Image Processing

Image processing is one of the ways of doing tasks using image. It is done to obtain certain information that is important to it. Image processing complete. It is a type of the signal processing where the input used is image and the output obtained can be in that image form or in its features form. Image processing is one of the fastest-growing technologies today. It is also an important research field in engineering and computer science.Analog and the digital image processing are two types of image processing methods which is used. Solid copies, such as prints and photographs, can benefit from analogue image processing. When using these visual aids, image analysts use a variety of translation bases. Digital image processing techniques allow computer-assisted conversion of digital images. Pre-processing, scaling, and presentation, and extracting information, are the three most common processes all data types must go through when using digital techniques.Medical research has made extensive use of image processing, which has led to more effective and more effective treatment methods. For example, it can be used in breast screening to detect breast cancer early using a sophisticated lump screening algorithm. Because medical applications require highly processed image processors, these applications require extensive development and testing before they can be approved for us.

3.3 Data Mining

Learning from traditional data strategies required that data be in the same format. Data should be encrypted in numerical format, such as true or false, numeric, or numeric. Additionally, a specific learning goal must be established to differentiate. Although some databases are organized in the same format, many others are made up of a combination of number and name fields, and each data field contains hundreds of possible combinations and a few field definition

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conditions. In a real-world data mining application, interpreting, classifying, and encoding data on relevant features takes time.

IV. RESULTS

We give some of the extracted GLDS features from the photos in this part. The parameters in Table were derived from the photos. The results reveal that visual contrast varies a great deal.

TABLE IV: Feature extracted from GLD method

Image	Homogeneity	Contrast	Energy	Entropy	Mean
1	0.76	296.75	0.54	1.55	4.72
2	0.74	390.13	0.52	1.68	5.79
3	0.83	338.60	0.66	1.22	4.46
4	0.76	201.61	0.53	1.46	3.48
5	0.49	239.12	0.20	2.47	5.83
6	0.66	183.85	0.40	1.84	4.06
7	0.72	241.21	0.49	1.64	4.13
8	0.74	162.17	0.50	1.53	3.29
9	0.68	172.60	0.41	1.74	3.52
10	0.67	136.41	0.39	1.75	3.20

V. CONCLUSION

Feature extraction is one of the commonly utilised method. It is an efficient strategy in a range of applications as well as academic subjects. This study looked into the methodology, types, and applications offeature extraction. The types of features to be extracted are determined by the applications of feature extraction. The accuracy of the extraction and the performance of extraction methodologies are moresignificant elements to consider when performing feature extraction.

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