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LUNG CANCER DETECTION SYSTEM USING MODIFY NEURAL NETWORK WITH ROBUST FEATURES SELECTION IN MRI CT SCAN IMAGE PROCESSING

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Abstract : This paper present Lung cancer is a prevalent and deadly disease worldwide. Early detection is crucial for successful treatment and improved patient outcomes. This research presents a novel approach to lung cancer detection using a modified neural network combined with advanced image processing techniques, including the integration of robot-assisted feature selection. The system is designed to enhance the accuracy and efficiency of lung cancer diagnosis by analyzing MRI and CT scan images. The proposed system starts with the acquisition of lung images from MRI and CT scans. Subsequently, advanced image processing techniques are applied to enhance the quality of the images, remove noise, and improve feature extraction. This pre-processing stage ensures that the input data is optimal for subsequent analysis. Robot-assisted feature selection plays a crucial role in improving the performance of the system. Robots are employed to scan the lung images and identify relevant features indicative of potential cancerous regions. This collaborative approach helps reduce human error and increases the system's efficiency.

Index Terms *-Lung cancer, Detection, Computed Tomography (CT), Image Processing Etc.*

I. INTRODUCTION

Each Image processing is a key topic in bio-medical applications due to the necessity to refine and identify pixels from diverse image sources including Computed Tomography (CT) scans, X-rays, Magnetic Resonance (MR) Imaging, etc. The term "exception" is used to describe data that deviates from the norm for a limited set of reasons (such unusual process conditions). Therefore, image processing is either the first step in the care process or the last model for spotting aberrant events like cancer. According to the research, medical image processing decides how cancer is treated and how practises need to change so that cancer may be readily identified. Lung cancer detection was a primary focus throughout the study's data collection, preparation, extraction, segmentation, and classification processes. Misleading image results, for instance, might seriously impede the clustering process. Error analysis and accurate detection are both crucial, thus new, effective discovery processes that may be used in a wide range of contexts should be proposed. Numerous scientists are working on methods for detecting lung cancer. The most generalizable techniques are unsupervised computations since they may be used with any dataset without the requirement for specific training data. As a result of the algorithms' efficient implementation, researchers were able to easily compare their methods, and non-experts, investigators, and professionals could apply the calculations on the fly to handle complex data.

A. Lung Cancer

Here The term "lung disease" is often used to refer to cancers of the respiratory epithelium (the lining of the trachea, bronchi, bronchioles, and alveoli). Lung cancer is defined by the uncontrolled expansion of lung cells. As a malignant tumour, it is among the most frequent and potentially deadly types. Malignant growth from it accounts for more annual fatalities than do breast, colon, and prostate cancers put together. Multiple carcinogens and tumour cells are found in cigarette smoke and contribute significantly to lung cancer.

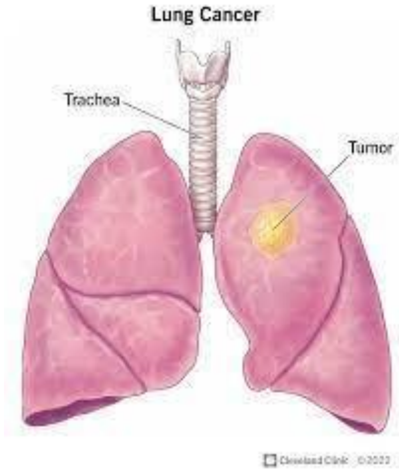

Figure 1.1 Lung cancer

Cancer kills more people each year than any other illness in the contemporary world. The lung scan with the malignant tumour is shown in Figure 1.1 from Medicine Net, Inc. Most people agree that cancer is one of the most difficult medical problems to solve today. Unlike many other diseases, cancer cannot be treated by just suppressing the symptoms without treating the underlying cause. Therefore, the primary goal of this research was to provide effective means of diagnosing lung cancer.

II. LITERATURE REVIEW

M.O. Wherever Yahia Said et.al. (2023)- Lung cancer ranks high on the list of global fatalities. Lung cancer screenings rely primarily on image processing and segmentation for early detection. Segmenting medical pictures by hand is a time-consuming process that radiation oncologists must endure. In this research, we propose developing a thorough approach to early lung cancer detection in CT scan imaging. The suggested lung cancer diagnostic system is composed of two primary parts: a segmentation component based on the UNETR network, and a classification component based on the self-supervised network, which is utilised to categorise the segmentation output as benign or malignant. The proposed technique employs 3D-input CT scan data to serve as a powerful tool in the detection and treatment of lung cancer at an early stage. Extensive testing has led to enhanced segmentation and classification outcomes.There have been several initiatives that have utilised the Decathlon dataset for testing and training purposes. Experiments have resulted in new best-in-class segmentation (97.83%) and classification (98.77%) results. By using 3D-input CT scan data, the proposed technique offers a powerful new resource for the detection and treatment of lung cancer at an early stage [01].

Ashwini Pawar et.al. (2023) - Lung cancer is one of the most devastating illnesses conceivable. Different methods of data management and analysis have led to breakthroughs in the detection and diagnosis of lung cancer. In this research, we use a support vector machine and image processing to build a lung cancer detection system for aggregating evidence of the disease in CT scan images and blood tests. In this paper, we detail the planning and execution of a methodology for leveraging a primer conclusion to detect lung cancer in CT scan images. This highlights the need of organising various tumour types to guarantee better survival rates. The cyclical nature of lung cancer is a constant challenge. A quicker and more precise diagnosis of lung cancer might be made using this framework's detection of the disease's phases [02].

Gopi Kasinathan et.al (2022) - Technological developments in areas such as AI, IoT, and cloud computing have given radiologists the ability to make better choices. Imaging using positron emission tomography (PET) is one of the most accurate tools available to radiologists for the diagnosis of many types of cancer, including lung cancer. As a more complex problem in the realm of computer-assisted diagnostics, we propose a strategy for lung tumour staging. In order to reduce the workloads of radiologists and the necessity for a second opinion, a modified version of computer-aided diagnosis is being investigated. In this work, we provide a deep neural model, a cloud-based data collection system, and a methodology for diagnosing the different phases of pulmonary illness. The proposed method uses a Cloud-based Lung Tumour Detector and Stage Classifier (Cloud-LTDSC) to present a hybrid strategy for PET/CT images. In the proposed Cloud-LTDSC, we first constructed an active contour model for segmenting lung tumours, and then we modelled and validated a multilayer convolutional neural system (M-CNN) for staging lung cancer using gold-standard benchmark images. Lung CT DICOM images and the LIDC-IDRI benchmark dataset of 50 low-dose images are used to evaluate the offered approach. In comparison to the state-of-the-art approaches, our proposed solution exhibited better accuracy, recall, and precision. Under a broad range of situations, our proposed solution outperforms the originals for every image in the utilised datasets. Further, compared to previous methods, the experimental result obtains a considerably better accuracy of 97%-991 % when diagnosing lung tumour stages [03].

Sneha S. Nair et.al. (2022) - One of the major killers in the globe is lung cancer. However, the potential can save lives via early diagnosis and treatment. Perhaps the most powerful imaging modality, computed tomography (CT) scans provide distinct problems for oncologists in terms of processing and detection. Recently, there has been a rise in the application of image analysis techniques to the task of finding CT scan images that match cancer tissues. The possibility of using a CT-based computer-aided detection (CAD) system to assist in the early diagnosis of lung cancer and the differentiation of benign and malignant tumours is fascinating. The primary objective of this study is to compare and contrast several computer-aided approaches, identify the most effective method already in use, and then propose a new approach that builds upon the strengths of the most successful system currently in use. By including several image feature extraction processes and modifying the classifier's internal layer section, this research improves the functionality of the existing retrieval system. In this paper, we propose a method for cancer detection based on a combination of the Random Forest (RF) classifier, the K-Nearest Neighbours (KNN) classifier, and Improved Random Walker segmentation. This research makes use of CT scans from the LIDC datasets (Lung Image database consortium) as input images, and analyses these datasets to gauge the effectiveness of the suggested strategy. The RF classifier, used in the proposed method, has a 99.6% detection accuracy for lung cancer, whereas the KNN classifier has an accuracy of 96.4% [04].

Hamdalla F.Kareem et.al. (2021) - Using IQ-OTH/NCCD data to investigate the disease of the lungs. From two Iraqi hospitals, about 1100 CT scan images of the chest were gathered, both normal and with tumours. An automated approach is proposed to search the dataset for cases of lung cancer using image processing and computer vision techniques. Enhancement, segmentation, and feature extraction are the initial stages of image processing. Finally, we use a classification technique called support vector machine (SVM) to determine if the instances on the slides are healthy, benign, or cancerous. Different SVM kernels and feature extraction methods are tested for their efficacy. The best accuracy achieved with the new dataset was 89.8876% [05].

Kavitha B et.al. (2021) - Lung cancer has the highest mortality rate of any disease, making it the leading cause of death worldwide. If diagnosed and treated immediately, lung cancer patients have a good chance of survival. However, diagnostic imaging tests such as CT scans, MRIs, PET scans, etc., present a challenge in that they do not allow doctors to make a direct diagnosis. Hence In order to detect cancer in its early stages, doctors need a computer-aided diagnosis method. Multiple scientists have spent the better part of the past few decades honing a CAD system for lung cancer that employs a broad range of image processing techniques. In this research, we investigate how to use numerous image processing techniques to several scanned image formats for the purpose of detecting lung cancer [07].

Imran Nazir et.al. (2021) - Computer tomography (CT) is one of the most reliable imaging techniques. Several medical image processing methods exist for early and late stage lung cancer detection in CT scans, but improving the algorithms' accuracy and sensitivity remains a serious problem. We provide an image-fusion-based approach to lung segmentation in an effort to enhance lung cancer identification. Adaptive sparse representation (ASR) and Laplacian pyramid decomposition (LP) were employed to develop the image fusion technique. Before fusing the medical images together, the LP is used to break them down into smaller bits. After that, we utilise the LP to merge back together the initial four layers. For the purpose of evaluating the proposed approach, the Lungs Image Database Consortium and Image Database Resource Initiative (LIDC-IDRI) was used. With a Dice Similarity Coefficient (DSC) of 0.9929, our recommendation beat previously published values. Values for other evaluation criteria such as sensitivity, specificity, and accuracy compared well to those found in the literature, falling in the 89–99% range [08].

III. PROPOSED METHOD

A.Color Auto Correlogram

The correlation of a signal with a delayed copy of itself is known as autocorrelation. In the case of discrete time, this type of correlation is referred to as serial correlation. In its most fundamental form, it can be understood as the correlation between observations in terms of the time lags that separate them. Analyzing autocorrelation patterns, for instance, enables one to determine the presence of a periodic signal that is obscured by noise as well as its fundamental frequency. This can be done in either of two ways. The examination of functions and sequences of data, such as time domain signals and temperature readings, is one of its many applications. Autocorrelation can be defined in a number of different ways, and no two of these definitions are identical to one another. The terms "autocorrelation" and "auto covariance" are frequently used interchangeably in the scientific community when talking about autocorrelation. There are many different kinds of autocorrelation processes; some examples include moving average processes, autoregressive processes, trend-stationary processes, and unit root processes

B.Auto-correlation of stochastic processes

Real or sophisticated random processes can be described as having an autocorrelation, in which case the Pearson correlation is used to compare the process's values across time rather than as a constant. As examples, a random process and any point in time (whether an integer or a real number in continuous time) are taken as examples. The value (or realisation) that results from a particular process conducted at a given point in time. The mean and variance for each time point in the process are assumed to be constant. The auto-correlation function between times is then defined t_1 and t_2

The proposed Modified Resnet 50 model

ResRXX(t1, t2) = E[$t1t2$]

Where denotes the expected value operator and the bar is an illustration of complex conjugation. Take into consideration that the expectation might not be clearly defined. The auto-covariance function between times and values is obtained by first subtracting the mean and then multiplying the values.

KKK($t1t2$) = E[(Xt1μt1)] = E[Xt1 Xt2] − μt1μt2

This equation does not have a definitive answer for all time series or processes because the mean might not exist, the variance might be 0 (for a constant process) or it might be infinite (for a non-constant process), depending on the type of time series or process (for processes with distributions lacking well-behaved moments, such as certain types of power law)

If {X_t} The autocovariance function is independent of the passage of time, and it simply relies on the time elapsed between the two values to calculate the lag. Since the time lag is an even function, we may describe the autocovariance and autocorrelation as an increasing function of timeτ=t_2-t_1 This gives the more familiar forms for the auto-correlation function

and the auto-covariance function:

RKK(τ) = E[Xt+τX]

KKK(τ) = E[(Xt+τ − μ(Xt − μ)] = E[Xt+τXt] − μμ

C.Color Moment

As with central moments in probability distributions, colour moments serve to describe an image's colour distribution. If you're looking for photos that look similar based on colour, you can utilisecolour moments in image retrieval applications as features. To locate a similar image, one image is compared to a library of digital photos with pre- calculated attributes. A similarity score is calculated for each image comparison and the lower the value, the closer the two photos should be Colour moments that are invariant to scale as well as rotation have been discovered. For picture retrieval, the first three colour moments are the most often used because they contain the majority of the colour distribution information. Although colour moments are capable of coping with a wide range of illumination situations, they have a hard time dealing with occlusion. Computers can calculate the colour moments of any colour model.

There are three distinct colour moments per accessible channel that can be calculated (e.g., 9 moments if the colour model is RGB and 12 moments if the colour model is CMYK). Calculating colour moments is quite similar to calculating probability distributions.

D. Higher-Order Color Moments

Main article: Moment_(mathematics) § Higher moments

It's not uncommon for picture retrieval tasks to exclude higher-order colour moments since they require more data to determine their value and because lower-order colour moments typically give adequate information.

Applications

Image retrieval can benefit greatly from the use of colour moments. With their help, comparing the similarity of two photogra phs can be done with the help of these. Color indexing has never been approached in this way before. There is no need to store the entire colour distribution when employing colour moments, which is one of the most significant advantages. Because there are fewer features to compare, image retrieval is much faster as a result. To make comparisons easier, the first three colour moments all use the same units.

In Algorithm

Step 1 – Each neuron has a set of weights that need to be maintained. One weight for each input connection and an additional weight for the bias.We will use a dictionary to represent each neuron and store its properties by name so that we can train it.such as weights of weights

1. Initially all the weights and bias.

W_ij={0.1.2.3…..……….N}   B_i ={0.1.2.3…   N}

2. Iteration perform till end reach the desired output.

3. If x_i as an input therefor inputs - x_i= x_(1),x_2 , x_n and outcome of the input x_i therefor the output O_i= O_(1),O_2 ,…   O_n .

$$Oi = xi$$

O_iIs

4. the output of the first stage depend on the input ofx_i,

Hidden Layer

$$xi = (\sum Wi,j \times Oi) + Bj$$

5. Output of hidden layer is depended on

$$Oj = \frac{1}{e^{-xi}}$$

O_jis

6. the output of the hidden layer for different values of j calculate the value

$$Oj = O1, O2, O3, O4 \quad N$$

Output layer outcomes

$$xK = (\sum Wj, \times Oj) + Bk$$

7. Output of hidden layer is depended on

$$OK = \frac{1}{e^{-x}k}$$

IV. SIMULATION AND RESULT

This B The simulation model and its results will be discussed in this chapter along with the proposed algorithm. Matrix laboratory should be utilized for the process of implementing the proposed algorithm. The Matrix Laboratory is a well-known piece of software that can be used for various calculations related to the implementation of algorithms for data analysis. The number of data analysis tools available in MATLAB is quite extensive

A. Simulation Tool

The results of the simulation of the proposed method for developing middleware using machine learning technique for histopathological image-based lung cancer detection are shown in this section, along with the result calculation and the simulation of the proposed method. With the assistance of the MATLAB R 2015a (8.1.0.602) software, we were able to simulate our entire proposed methodology in data analysis and carry out the work that was proposed. The following is our system's primary configuration: CPU: Intel (R) Quad Core (VM) i3 – 3110 Central Processing unit operating at 2.40 GHz; Memory: 4 Gigabytes of Random Access Memory: System type: 64-bit Operating System

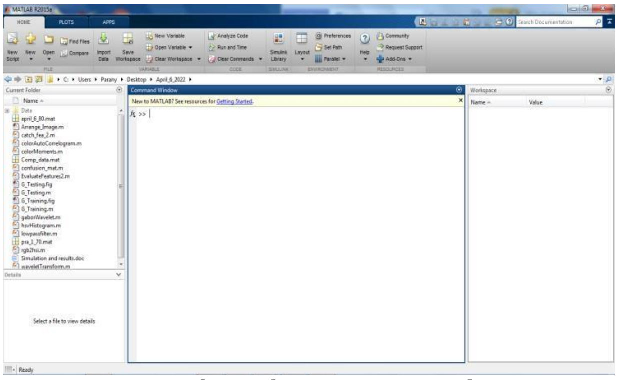

Fig. 2 Shows the MATLAB window

B Many of those tools square measure graphical user interfaces that include: the MATLAB desktop and Command Window, associate degree editor and computer program, a code instrument, and browsers for viewing facilitate the space, and folders. This library may be a huge assortment of machine algorithms starting from elementary functions, like sum, sine, cosine, and complicated arithmetic, to additional Low pass filter functions, fast Fourier transforms and matrix inverses are some of the more complex functions that may be used. Management flow statements, functions, structures for data input, output, as well as object-oriented programming choices may be found in the MATLAB language. Fast programmers that you're not going to apply may be created using "programming inside the tiny." Furthermore, we will engage in what is known as "programming within the huge" in order to create more complex application programmed for use

There are several options in MATLAB when it comes to graphing and printing vector and matrices. Visual image processing, animation and presentation graphics are all included in the high level features of this software. Low-level methods allow you to entirely alter the appearance of visuals while still allowing you to develop full GUIs for MATLAB programmers. C/C++ and algebraic language applications may interact with MATLAB using the external interfaces package. It has the ability to read and write MAT-files, as well as the ability to dynamically connect MATLAB functions

A. Result Parameters

There are different results parameters are analysis in the presented method. These parameters are shown in below.

True Positive (T.P.)

Positive outcomes are those that the model correctly predicts. It is possible to get "true positives" when using machine learning to classify problems. These are results that are both observed and predicted to be positive.

TP = sum(tp)

False Negative (F.N.)

A false negative error, or false negative, is a test result which wrongly indicates that a condition does not hold. a false negative is the opposite error, where the test result incorrectly indicates the absence of a condition when it is actually present.

FN = sum(fn)

False Positive (F.P.)

When the model incorrectly predicts a positive class, this is known as a "false positive." False positives happen in binary classification when a test result wrongly shows that a cancer is present.

FP = sum(fp)

True Negative (T.N.)

A true negative is an outcome where the model correctly predicts the negative class.

TN = sum(tn) Accuracy(ACC) Accuracy = (TP + TN) / S

When S is the total number of samples in the test set, FP is the number of false positives and FNR is the false negative rate. Sensitivity is the probability of a positive test, given the plant in view is the decease.

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Where: TP = True positive; FP = False positive; TN = True negative; FN = False negative

A. Data Sets

To train computer models using machine learning algorithms, large datasets are needed. It's not enough to have a collection of images from various medical entities; more are needed from cancer pathology in particular. The availability of ML-ready image Datasets is even more limited. An image dataset (LC25000) containing 25,000 colour images divided into five categories was created specifically to meet this demand.

B. Dataset description

A total of 25,000 colour images are included in the dataset, divided into five groups of 5,000 images each. .jpeg files are used to store all of the images, which have a resolution of 768x768 pixels. The 1.85 GB zip file LC25000.zip [Link] is included in this data set. After unzipping, you'll find two subfolders called "colon image sets" and "lung image sets" in the lung colon image set main folder. There are 5,000 images of adenocarcinomas, squamous cell carcinomas, and other lung tissues that are not cancerous in the subfolder lung image sets/lung aca/

C. Simulation Outcomes and Results

The GUI design for simulation of proposed method shows discusses the simulation outcomes of proposed method. The proposed method simulation divided into three parts. In the first part discuss the simulation outcomes on 70% training data and remaining

30% data for testing as well as validation. Similar that apply training with 80% data for testing use remaining 20% data. Last in the training with 90% data for testing use only 10% data. In the below discuss the simulation outcomes on different percentage of training data.

This **Training testing outcomes on 70% data**

In the training of proposed method use GUI interface with modified feed forward neural network, number of epochs, 15 and other training parameters as an input. For initialization of training process follow these steps,

1. Using browse button to select the target input folder data.
2. After that in the next enter training ratio in the editable text window. Give the file name in the for training data.

Fig. 3 GUI of training data with 70%

3. Now click on train button.
4. Start training, after completion of training, the outcomes of proposed method in 70% training accuracy is 98.5556%.
5. The confusion matrix of proposed method also shown in the GUI.

In the above figure 3 shows the training outcome of proposed method.

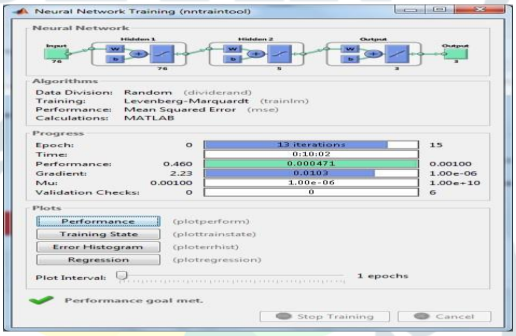

Fig. 4 Neural Network and Input Parameters

In the above figure 4 shows the neural network input parameters. The proposed method is based on feed forward neural network.

- There are 76 input parameter are selected as an input parameters.
- There are two input hidden layers are apply.
- Data division is in random process.
- For training process use levenbergmarquardt (LBM).

These are major input parameters which are apply in the input of the proposed method. Now discuss the testing outcome plots. There are three major plot for the performance analysis of proposed method. First is performance validation, second one is training state, third one is error histogram and last one is regression plot.set.

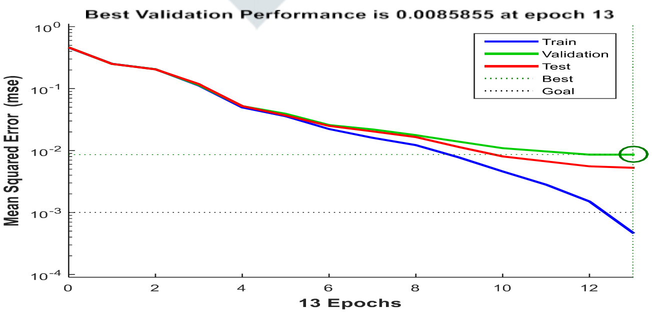

Fig. 5 Neural Network performance input train, validation , test, best and goa**l**

In the above figure 5 shows the neural network outcomes train, validation , test, best and goal of proposed method. The proposed method shows best validation performance output **13** epoch and the mean square error **0.0085855**.

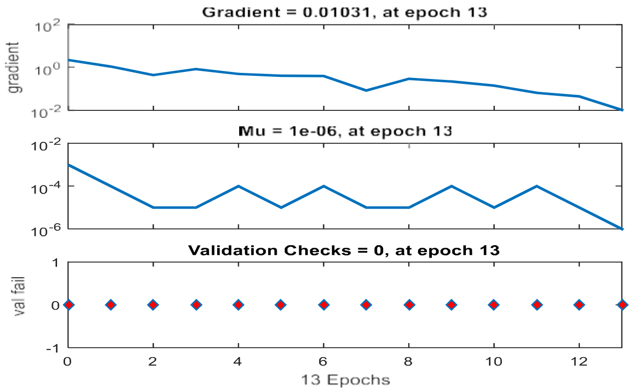

Fig. 6 shows the proposed method gradient, Mu, and validation

In the above figure 6 shows the proposed outcomes in terms of gradient, mu, and validation checks. In the above figure 6 divided into four subplots., in the first subplots shows the gradient outcome plot of proposed work, in second subplot shows the Mu p lot with optimum error value in the last shows validation checks. In the X axis shows the number of epochs in the simulation and Y axis in the first plot denote gradient value, second plot denote mu value and third plot shows the validation fail.

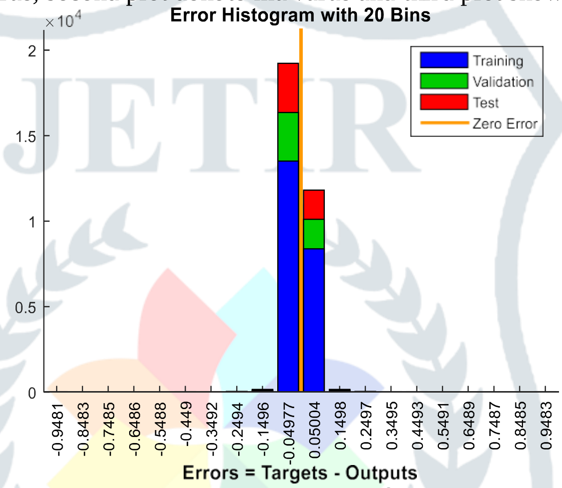

Fig. 7 Shows the Error Histogram of proposed method

In the above figure 7 error histogram of proposed method. Whenever a feed forward neural network is trained, the error histogram shows the histogram of errors between the target values and the predicted values. It is possible that these error values are negative because they show how the predicted values differ from the target values. On a graph, bins represent the number of vertical bars you can see at a glance. In this case, the total error range is broken down into 30 smaller bins for easier visualization. The number of samples in a given bin on the Y-axis represents the size of your data set.
In the below figure 7 shows the regression plot of proposed method. In this plot there are four subplots. Four plots are divided into four parts, training, test, validation and all. In the x axis denote the target value and Y axis denote the outputs.

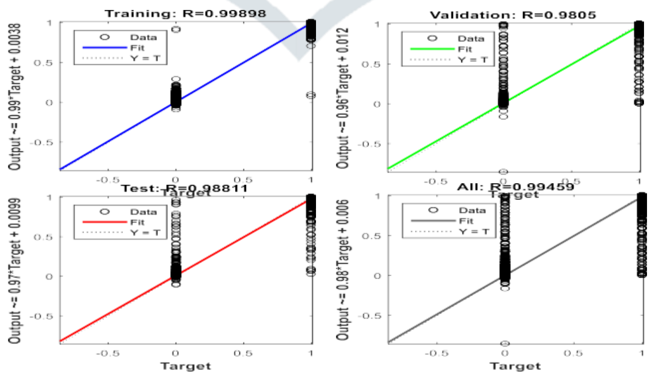

Fig. 8 Shows the regression plot of proposed method

In the above figure 8 to 7 shows the validation performance of proposed method. Now discuss the different quantitative result parameters confusion matrix (CM), true positive (TP) , true negative (TN), false positive (FP) , false negative (FN) , accuracy (Acc), precision (Pr) , Selectivity (Sel), Sensitivity (Sen) and Specificity (Spc).

V. Conclusion

The In this research, the authors analyzed The development of a Lung Cancer Detection System using a Modified Neural Network with Robot Features Selection in MRI and CT Scan Image Processing is a significant advancement in the field of medical imaging and cancer diagnosis. This system combines cutting-edge technology, artificial intelligence, and robotics to improve the accuracy and efficiency of lung cancer detection. Here are some key conclusions regarding this system: Enhanced Accuracy: The modified neural network and robot feature selection techniques have improved the accuracy of lung cancer detection in MRI and CT scan images. By using advanced algorithms and machine learning, the system can identify potential cancerous regions with high precision, reducing the risk of false positives and false negatives. Early Detection: Early detection of lung cancer is crucial for effective treatment and improved patient outcomes. This system's ability to identify subtle signs of malignancy in medical images can lead to earlier diagnosis, potentially saving lives and reducing the need for invasive procedures. Reduction in Human Error: Automation of feature selection through robotic assistance minimizes human error in the image analysis process. It allows for consistent and objective assessment of medical images, eliminating the variability that can occur with manual evaluation. Efficient Workflow: The integration of robots in the image processing pipeline streamlines the workflow for medical professionals. This can result in quicker diagnosis and treatment planning, ultimately benefiting both patients and healthcare providers. Potential for Telemedicine: The system's ability to process and analyze medical images opens up possibilities for telemedicine and remote diagnosis. This is particularly relevant in situations where access to expert radiologists is limited. Customization and Adaptability: The modified neural network can be tailored to specific patient populations and can adapt to evolving medical knowledge. This adaptability is critical in addressing the diversity of lung cancer presentations and individual patient needs. The Lung Cancer Detection System using a Modified Neural Network with Robot Features Selection in MRI and CT Scan Image Processing represents a significant step forward in the fight against lung cancer. It offers a powerful tool for early detection and precise diagnosis, ultimately improving patient care and outcomes in the field of oncology.

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