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Enhanced Optimized MSVM Classification of Lung Cancer in Biomedical CT Image Database

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Abstract: *Lung cancer is the major tumor, which is featured by the regulated cell development of the tissues of the lung. Lung cancer is the main cancer diagnosed globally. Mostly, the large amount of the death takes place due to lung disease as compared to other diseases. However, it is necessary for the early detection and diagnosis of the disease for the maximum survival rate of the cancer patient. The cancer cell identified from the MI (Medical Images), and numerous image processing and computing methods to identify the cancer cells. MRI images have the features of the high resolution, maximum clarity, less noise and distortion value. This existing system presented an effective CNN (EF-CNN) method for the identification of the lung cancer. The previous method contains the convolution layers that include different layers such as; (i) Convolution (ii) Pooling (iii) Maximum pooling (iv) Fully connected, and (v) SoftMax layer. In proposed article used the HoG method to extract the features and Artificial Bee Colony algorithm is a meta-heuristic method and used to select the extracted features in the lung images. It finds for high-level artificial feature selection. It finds the best cost parameter vector, which reduces the cost or objective function. MSVM (Multi-support Vector Machine) classification method is used to predict the cancer lung images. The proposed system accurately determines the disease or detection category image. The result shows that the train and test feature is the most important point for classifying the lung images according to the disease. In research model's performance, accuracy rate value is 97.8 %, recall, value is 98 %, precision rate value is 97%, Processing Time value is 110 milliseconds, and Testing loss value is 0.4150.*

Key words: Lung Cancer Medical Image, Histogram Orientation Gradient, Artificial Bee Colony algorithm and MSVM Classification Method.

1. INTRODUCTION

Cancer is the main essential terminal disease worldwide, considered the expected death rate up to 9.65 million in 2018. Large categories of the cancer disease is mainly occurred diseases that causes death and it is detected in both the genders above the expected death of about 1.75 million in the year 2018. The unexpected development of the abnormal cells that are not standard in more than one lung is lung cancer. However, the non-standard cells disturb the functioning of the standard lung cell that cause infected tissues in the lungs [1]. Lung cancer is mainly of the two kinds; one is the non-small lung disease (NSLD) [2] and other is the small lung cancer (NLC). Normally, 85% of the lung disease is mainly caused because of the NSLD and 15 % are caused due to NLC [3]. Lung cancer is one of the deadly diseases that caused the countless deaths all over the world. Lung cancer is also called as the lung carcinoma (LC), that is the malignant lung tumor featured by the non-standard growth of the tissues in the lungs. This developed tissue may result in the progression of the metastasis close to tissues and other portions of the body. Mainly the cancers initiate from the lung are called as the primary lung cancers. The major symptoms of the disease are cough with blood, loss of weight, breathlessness, and ache in chest [4].

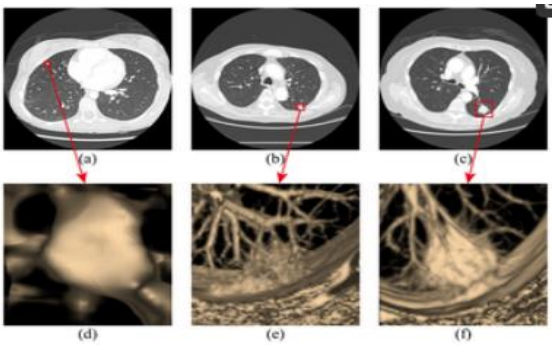


Fig-1: Three types of lung nodules. a) isolated nodule, b) 3D image of isolated nodule, c) juxta-pleural nodule, d) 3D image of juxta-pleural nodule, e) juxta-vascular nodule and, f) 3D image of juxta-vascular nodule.

Generally, an individual who smokes a large number of the cigarette packets in a single day may have higher risk of the lung cancer as compared to persons who never

smoke. Large persons suffer from lung cancer due to usage of tobacco. Moreover, other surrounding issues like as air pollution, and extreme alcohol may cause lung cancer disease. The disease may initiate from single or both the lungs. The infection may spread over the brain that may cause the problem of the eyesight, and may be weakness of body. However, the premature estimation of the disease plays an essential role in the diagnosis procedure and efficient preventative method [5].

During the detection of the lung disease in CT pictures, the major stages are included. At every stage, the various methods are applied lead in various accuracies in detection of lung disease. Initially, CT picture is pre-processed for the removal of the noise that is available in picture. Segmentation of the picture is done using region of interest(ROI). After that, extraction of features and then classified the extracted features. The different stages included for the detection of the lung disease are [6]:

Step I: It is the essential method, which included in the lung cancer detection. It is required to enhance the accuracy and remove certain areas of the CT picture like contextual and related tissues. The disease may be detected at the time of the classification stage.

Step II. The procedure of associating the digital picture into larger portions and usage of the eliminated data and detect the objects in a simple way from the segmentation procedure efficiently. The segmentation of the picture are different methods comprising Otsu technique, watershed segmentation, k means clustering.

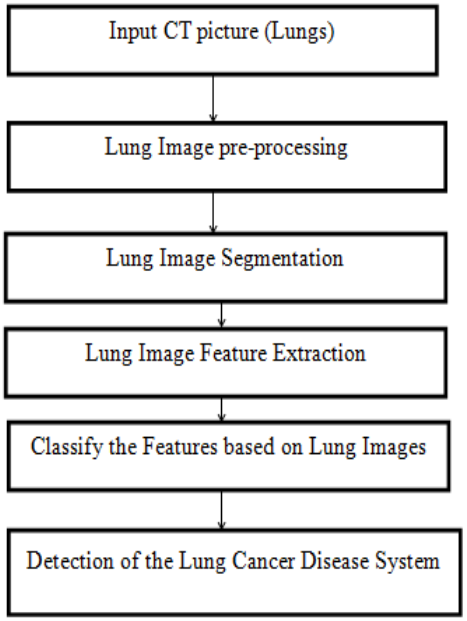


Fig-2: Process of Lung Cancer Image [7]

Step III. The extraction of the features is a main stage in image processing, boundary which conveys data of picture that required to be extracted. The texture of the picture is determined, which the spatial relation of pixel is measured using GLCM (gray level co-occurrence matrix). GLCM computes the two pixels with specified rate and spatial relation that take place in the picture that determine the texture of the picture.

Step IV. The type of SML (supervised machine learning) when approach classified new reductions from current instances of marked information is available but required classification. Various classification approaches are acquired on extracted feature pictures such as SVM (Support vector machine), CNN (convolution neural network) and BPNN (back propagation neural network).

The applications of the medical image are described as [8]: The digital information is non-changeable and it may continually retain the actual data, instead of in what manner the information is replicated. Digital image processing is an essential equipment to medical -doctors that adequately find demonstrated pictures.

- The picture is displayed immediately acquired after achieving.
- Medical doctors may simply understand the improved pictures.
- It enumerates the alterations over the time-interval.
- Rapid assessments of pictures may be done.

Some of the applications of the lung cancer detection described as; (i) The pre-mature recognition of the cancer has recognised that improved the chances of effective treatment. (ii) The detection of the disease in more efficient approach [9]. (iii) The planned model is more effective that provides the desired outcome. (iv) Present suitable accuracy and picture quality [10].

In the research work, description of the image improvement of the image without altering the data content in an image. Lung cancer image segmentation is the procedure of partitioning a DI into various image segments. The main objectives of segmentation are an easy representation of an image into something that is more reliable and analysed. The lung cancer image feature extraction is normally gives creating novel features which are composites of existing characteristics. Feature selection is a hand choosing characteristics which are mainly discriminative. This has a lot more to do with FE and Selection than analysis. The classification mode is normally procedure regarded to categorized, the procedure in which objectives and lung regions are detected, and understand.

The above paper elaborates the introduction of Lung Cancer Image (LCI) Detection and classification, advantages, application and process in section I. Section II discussed about the existing research methods, performance metrics and issues. The section III and IV explained the proposed flow chart and result analysis with various parameters. The conclusion and Future scope defined that the section V.

2. PRIOR WORK

Detailed analysis several articles in Lung Cancer Disease Detection that includes different approaches. The methods are used in machine learning (ML), deep learning (DL) classifiers and feature extraction and filtration or ROI detection of the proposed approach.

Tripathi, P et al., 2019 [11] proposed research on the comparative analysis of different MRI image segmentation methods for the recognition of the lung cancer. The various techniques include Marker control watershed segmentation, edge recognition and PDE based segmentation methods. In this research, the comparative study of various planned modules considered. Presence, number of the techniques presented in the recognition of the cancer disease. A complete study on various segmentations approaches utilized for the identification of the cancer disease. In addition, the number of the classifier models was associated with diverse segmentation approaches for the detection of the lung cancer utilizing image-processing algorithms. Moreover, the survey on the classification of the scanned MRI image using the support vector machine model. It had observed that the CT scanned pictures provide suitable outcomes.

Ponnada T et al., 2019 [12] presented an effective CNN for the recognition of the lung cancer disease. An efficient planned algorithm comprised CNN layers named as Convolution layer, Max-Pool layer, Convolution layer, Max-Pool layer, fully connected layer, fully connected layer and Soft-Max layer. The proposed approach utilized lung CT scan pictures from LIDC-IDRI dataset and Mendeley database. A proposed algorithm had the specified association of the CNN layers along with the metrics (Complexity, Height, Width, filter Elevation and filter breadth). It was estimated from the outcomes that ICDSSPLD-CNN, EASPLD-CNN and EFFI-CNN were comparable to the lung cancer recognition consequences of ICDSSPLD-CNN, EASPLD-CNN and EFFI-CNN.

Günaydin, Ö et al., 2019 [13] proposed research on the machine learning algorithms that was comparable whereas the recognition of the lung cancer (LC) nodule was done. They analysed PCA, KNN, SVM, NB, DC, ANN for the anomaly recognition of the disease. The different ML models were compared after pre-processing and in the absence of the pre-processing. Experimental outcome showed the ANN that presents the suitable outcome with an accuracy rate of about 82.44, DC provides accuracy of about 95.32%. In this research, the various ML models were to identify the lung cancer disease from chest radiographs. They used PCA for the reduction of the size of the chest radiographs. It improved the accuracy in KNN and SVM machine learning classifiers.

Kurkure, M et al., 2016 [14] focused on the pattern and the growth of the network for the previous diagnosis and identification of the lung cancer from CT scan, X ray pictures. Genetic algorithm was used for the optimization procedure in the planned model. In addition, the optimization approach permits the medical experts to recognize the nodules available in the lungs in the early phase of the life. The suitable features of the GA (Genetic Algorithm) and NB (Naïve Bayes) classifier were used as manual explanations that were time consuming and severe situation for the classification of the cancer pictures at a faster rate. The suitable outcomes were acquired, where the planned approach achieved the accuracy up to 80% at the classification stage. Generally, the classification accuracy was acquired up to 80% accuracy.

Vas, M et al., 2017 [15] implemented LC recognition approach utilizing numerical morphological users for segmentation of the lung area of interest where Haralick characteristics were removed and utilized for classifying the cancer using ANN approach. The planned model acquired in the proposed research aimed to develop an automatic scheme for lung cancer recognition. Additionally, the median- filter eradicates the impulse noise in the pictures acquired for better performance rate. Moreover, the morphological ideas were provided with the suitable results during the segmenting purpose. ANN recognized as a better classifier to achieve better accuracy rate. The proposed model achieved the accuracy up to 92.34% of the medical data set.

Da Silva, G. et al., 2020 [16] proposed research on the structure of the CNN that helped in the classification of the lung malignancy of the lung nodules using deep learning method. The classification was done in the absence of the computer tomography model. The proposed method was tested on the lung picture dataset consortium and an image dataset resource initiative with maximum accuracy 82.3%, sensitivity 79.34% and specificity as 83.2%.

Teramoto, A. et al., 2020 [17] implemented a decision support scheme using CT and microscopic picture during the diagnosis of image that leads to suitable management. In this research, they implemented the

radiance methods using the deep learning models. Using the proposed method, the lung cancer disease was detected for diagnosis purpose.
Table I described the various methods with machine and deep learning algorithms. It described the various performance metrics, methods and drawbacks in Lung Cancer Detection System.

Table - I: COMPARATIVE ANALYSIS

Author's Name	Year	Methods	Parameters	Issues
Priyanshu et al., [11]	2019	PDE based segmentation, watershed segmentation and Otsu segmentation SVM	Area Perimeter Eccentricity and Mean Intensity	Lung image Distorted Image
Venkata et al., [12]	2019	EFFI-CNN method	Accuracy Precision Recall Loss Processing Time	Less accuracy
Ozge et al., [13]	2019	PCA KNN NB SVM DT and ANN	Accuracy Specificity Sensitivity	Classification problem
Manasee et al., [14]	2016	GA NB	Precision Recall	Optimize Problem
Moffy et al., [15]	2017	Haralick Features, Haar Wavelet and GLCM, ANN	Accuracy Specificity Sensitivity	Time consuming
Giovanni et al., [16]	2020	CNN	Accuracy Specificity Sensitivity	Overfitting

3.PROPOSED METHODOLOGY AND GAPS

Lung cancer is the most common reason of cancer death in the world. Early detection of lung cancer will greatly help to save the patient. Hence, it is essential to detect the lung cancer detection. Various methods have been introduced for lung cancer detection using different samples of images. Existing works have used Accuracy rate decrease, high loss test sets, image degradation (Quality degrade). Proposed technique used is MSVM. CNN model detects the cancer with 95% accuracy which is higher than the current model and classifier has accuracy of 87%.

The main problem points are:

- High Processing Time
- Less Accuracy Rate
- High Error Rates and
- High Loss

Table II described the various gaps in exiting papers and surveyed.

Table –II: RESEARCH GAPS

Author Name	Research Gaps
Venkata et al., 2019 [18]	High Loss and Processing Time
Priyanshu et al., 2018 [19]	Over segmentation
Radhika et al., (2018) [20]	Chest Issues
Özge et al., 2019[12]	Regression Issue
Venkata Tulasiramu [13]	Loss test set is high; Accuracy rate = 87%; Degrade medical images

This research work is to classify cancer images for the detection of lung cancer disease. In this work, firstly image pre-processing phase is used to reduce the image dimensionality, to identify the noises in the uploaded image and enhance an image quality. K-means clustering algorithm is used to divide the image into forms such as Cluster -1 and Cluster -2. After that HoG and ABC algorithm is used to extract the unique feature sets in the geometric format and select the feature or compress the feature set with cost function. At the last, MSVM classification is used to classify the cancer image and evaluate the performance metrics such as a Loss test set, Accuracy, precision and recall rate. The main process:

- To develop k-means clustering and HoG algorithm to extract the features in the geometric pattern.
- To implement ABC and MSVM algorithm to detect the cancer images.
- To compute the performance metrics and compared with the existing techniques.

The detailed methodology of the work is as given in figure 3. This proposed work is divided into following steps:

Phase 1: Initially, It analysis the various research paper and study the various methods and datasets. It collects the data set from the www. Kaggle.com site. It stores the. dicom and .tiff format lung cancer images. The online data set images are categories into two phases such as:

(i) Negative and

(ii) Positive in technical name Malignant and Benign images.

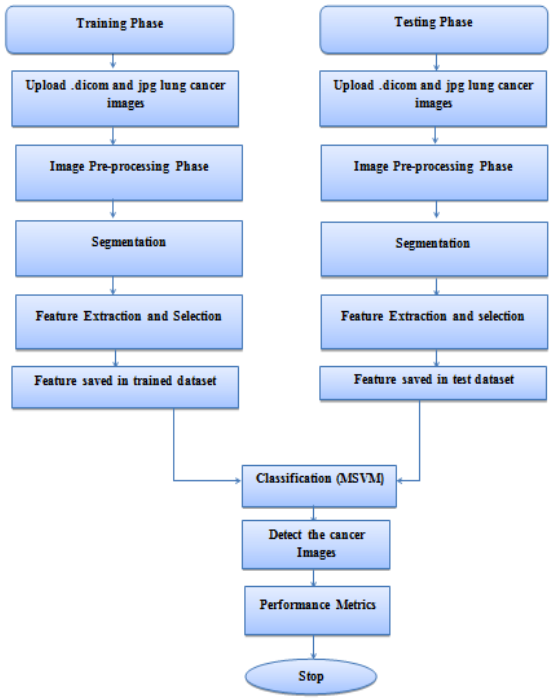


Fig - 3: Proposed Flow Chart

In the training section, upload the lung cancer images and creates the image histogram in the uploaded image or input image. It resizes the lung cancer image 256*256 image format. It creates the resize image histogram in the lung cancer image.

Phase 2: It converts three dimensional images to two dimensional images in lung cancer. It reduces the dimension size and unwanted noises visible in the image. After that applies the filtration method to remove the unwanted noise in the input image.

Phase 3: In this section, it applies the image histogram method to enhance the lung images. First Image shows the improved image. Second Image shows the area detection rate and segmented image shown in the third image.

Phase 4: In this section, developed a feature extraction algorithm to extract the global type of features. After that applied the feature extraction algorithm to improve the feature set values and given the structure format.

Phase 5: The classification model is implemented to detect the lung cancer images and calculate the performance metrics such as accuracy rate, processing time, and loss, precision and recall parameters and compared with existing (EFFI-CNN) methods.

4. RESULT ANALYSIS

This section explained various parameters used for the proposed methods. The lung cancer data set has elaborated that recognize the diagnostic methods of the lung disease. The discussion of the results has done where graphical approach has given along with comparative analysis and tables.

- **Accuracy Rate**

It is the method for the evaluation of the classification model. It is the ratio of the number of the accurate predictions to the total amount of the predictions.

$$\text{Accuracy} = \frac{number\ of\ the\ predictions}{total\ amount\ of\ the\ predictions} \quad \text{(i)}$$

- **Precision**

It is the measurement of the output related to the theoretical value. It is the degree of the reliability between the non-dependent measurements of the similar quantity.

$$\text{Precision} = \frac{TP}{TP+FP} \quad \text{(ii)}$$

Here, TP is true positive and FN is the false negative values.

- **Recall**

It is the ratio of the true positive to the sum of the true positive and false positive value.

$$\text{Recall} = \frac{TP}{TP+FP} \quad \text{(iii)}$$

- **Processing Time**

It is the time interval from starting unless the complete data is processed. The formula of the processing time is given as;

$$\text{Processing Time} = \frac{Data\ Packet}{BitRate} \quad \text{(iv)}$$

Dataset:

The intellectual organization and medical image associated to generate the database that has 1018 cases. Every subject contains the pictures from the medical thoracic CT scan and connected XML file that lists two stage picture annotation procedure presented by expert radiologist. In the initial stage, every radiologist separate reviews every CT scan and label the lesions related to more than two classes. In the succeeding read stage, every radiologists separately review the own labels and labels of more than two radiologists to make the last estimation. The main goal of the procedure is the identification of data wholly as a probable complete lung nodule. The main goal of this procedure is the identification as probable complete lung nodule in every CT scans without the need affected agreement.

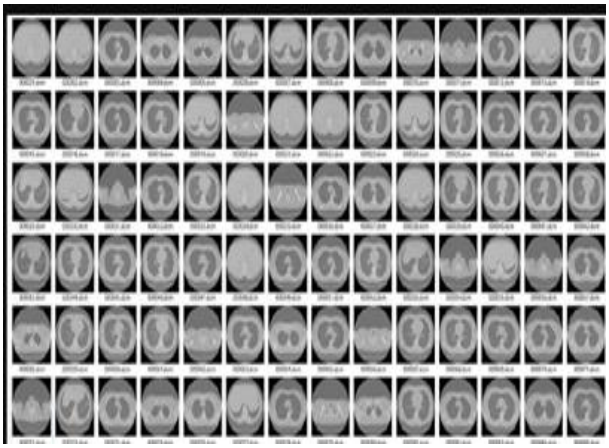


Fig - 4: Dataset in Lung Images

The research framework is simulated in MATLAB and GUIDE has developed a project desktop application. In this analysis, total 200 categories of lung cancer image (LCI) samples were used under camera and almost 100 image samples from each LCI were filled in the training module. The testing section has performed the research classification MSVM algorithm, enduring database images of LUNG cancer images were selected for testing section. Developed an experimental analysis of research work, lung cancer image (. Dicom) were stored in defined format. A computer system for detection of lung cancer images:

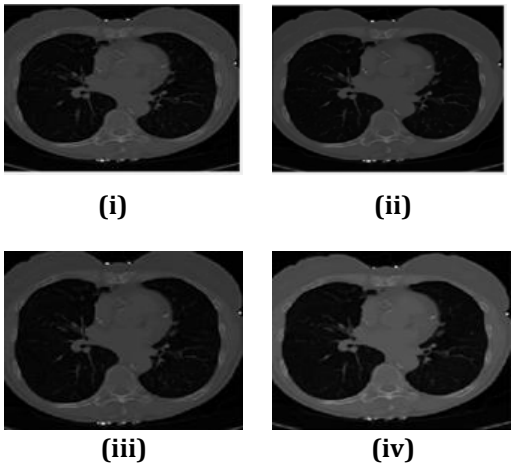
- Positive and
- Negative.

Images are usually depends on characteristics like histogram, image contrast and regions etc. The complete research proposed work is normally concerned with several regions, contrast and histogram, image enhancement and segmentation is playing a main role in developing this new system. Different metrics are calculated in DIP (Digital Image Processing) methods such as image histogram and segmentation etc. This research proposal work has improved the mathematical parameters and compared with existing methods. The proposed Mathematical Metrics are shown in below:

- Accuracy Rate
- Precision
- Recall
- Processing Time
- Loss etc.

To develop a main interface with the help of project desktop application is divided into two different sections as follows:

- Train section and
- Test section



(i) **(ii)** **(iii)** **(iv)**

Fig - 5: (i) Input Image (ii) Resized Image (iii) Conversion Image (iv) Noisy Image

Figure 5 (i) shows the upload the test image from the testing folder. It creates the image histogram into uploaded image. Figure 5(ii) It resizes the uploaded image into 256*526 format. After that creates the image histogram in the resized image. Figure 5(iii) shows the conversion 3D (Three Dimensional) into 2D (Two Dimensional) Lung cancer images. Figure 5(iv) It filtered the uploaded image with the help of Median Filter. In this Filter method, is used in image processing to optimize the noise level in the converted image.

(i) **(ii)** **(iii)**

Fig - 6: Image Histogram Equalization (ii) Normal Area Detected and (iii) Segmented Final Image

Figure 6 (i) shows the image histogram image in the filtered image. It is a computer image processing method used to enhance the image contrast the. It achieves enhanced image by efficienctly distribution out the most reliable values that is widening out the intensity range of image. Fig 6 (ii) it shows the area of the lung cancer image. Fig 6. (iii) Kmeans clustering algorithm has developed to extract the region in the form of clusters like Cluster 1 and Cluster 2. It detects the final segment image.

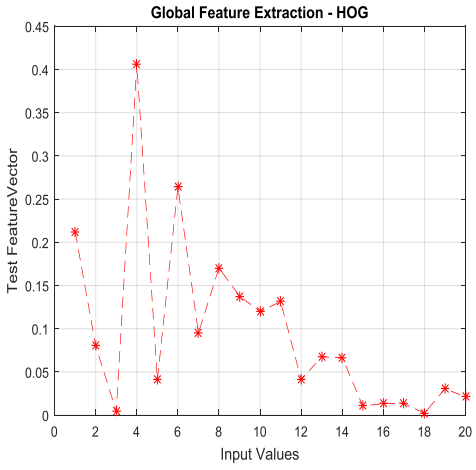


Fig - 7: Feature Extraction Process (HoG)

Figure 7 . shows the feature extraction graph based on HoG method. It is feature extraction used in CV and IP for the main motive of detection of lung cancer images. This approach counts the amounts of gradient, orientation in local positions of a lung images. This approach is same to that of region oriented histogram, invariant feature varying descriptors and shape and size context, but differs in that it is calculated on a dense area of uniformal space cells and uses over-lapping local image contrast normalized for enhanced the proposed system accuracy rate.

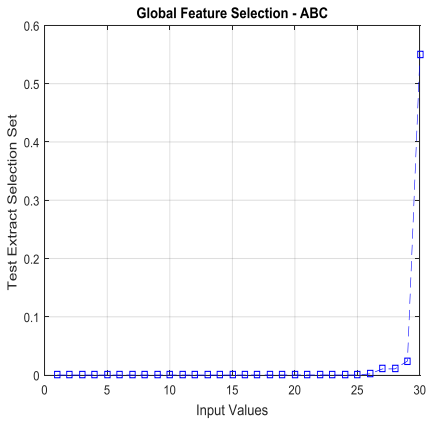


Fig - 8: Instance Selection by ABC

Figure 8 shows the feature selection graph is based on artificial bee colony optimization algorithm. It is a main process for lung cancer image detection, when automatically choose to extract features which contribute unwanted features in image data can decrease the performance of the model and make MSVM model analysis is based in irrelevant feature set. This method selects the relevant features with the help of Cost Function. The Lung cancer of uploaded image of the MRI or CT is detected using the multisupport vector machine classification algorithm. It detects the lung cancer image with category wise and evaluates the performance metrics such as precision, recall, accuracy rate, Loss and Processing Time.

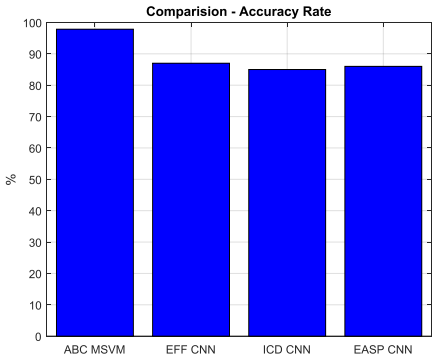


Fig - 9: Comparison – Accuracy Rate(%)

Fig 9 defines the research algorithm performance with the accuracy rate evaluated by ABC-MSVM and other classification method. The propose method has implemented in the lung cancer image detection system to enhance the accuracy parameter as compared with the existing algorithms (EFFI-CNN, ID-CNN and Others). The propose model accuracy rate has increased, according to the increase the number of multiclass or groups. The proposed accuracy rate value is 97.8 percent.

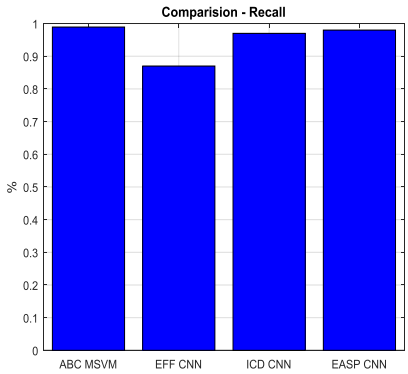


Fig - 10: Comparison- Recall Rate (%)

Figure 10. defines the research algorithm performance with the recall rate evaluated by ABC and MSVM classification method. Recall rate is particularly significant model calculation factor. The recall is defined as the completion percentage of lung images correctly detected, which are important. Recall is also called sensitivity rate. The proposed model recall rate has increased, according to the increase the number of groups. The proposed recall rate value is 0.98 percent.

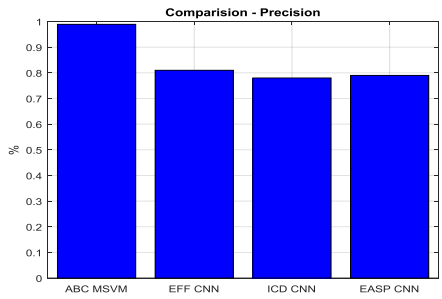


Fig - 11: Comparison- Precision Rate (%)

Above Figure 11. shows the research parameter performance with the precision rate evaluated by ABC-MSVM and other classification method. Precision rate is particularly vital model calculation factor. The precision is defined the percentage of lung .dicom images detection, which are important. Precision is also called positive predictive value rate. The research software model precision rate has increased, according to the increase the number of groups. The proposed precision rate value is 0.97 percent.

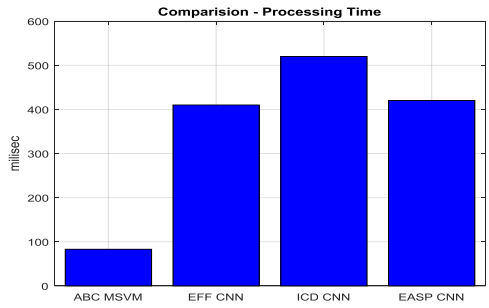


Fig - 12: Comparison : Processing time (Millisec)

Figure 12. show the research parameter performance with the precision rate evaluated by ABC-MSVM and Other classification method. It defines train the various images of how long expected it has taken us to procedure an application under normal phases. It initializes the train image and test images received an application and finalize when the research work create a decision. The testing system has arrived in the research model.

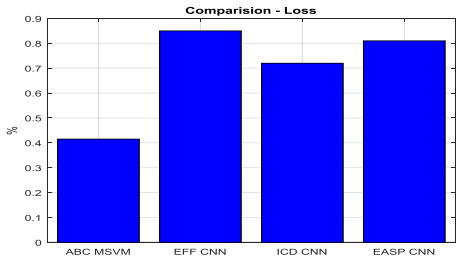


Fig - 13: Comparison – Loss Rate (%)

Figure 13. shows the research parameter performance with the testing loss rate evaluated by ABC and MSVM classification method. It has a vital task in that it must truly distill all feature set of the model down into a single number in such a way that enhancements in that number are detected and sign better images.

TABLE III. PERFORMANCE PARAMETERS:

PROPOSED AND EXISITING CLASSIFICATION MODEL

Parameters	EFF-CNN	ICD-CNN	EASP-CNN	ABC+MSVM
Accuracy Rate (%)	87	85	86	97.8
Precision Rate (%)	0.85	0.78	0.79	0.97
Recall Rate (%)	0.81	0.97	0.98	0.98
Processing Time (Milisec)	410	520	420	110
Testing Loss (%)	0.870	0.72	0.81	0.4150

Table III shows the comparison analysis with proposed and existing system. In the proposed system gives a better accuracy rate, recall, precision and testing loss and processing time as compared with the Existing three CNN Model. The CNN normal model taken more time, but ABC+MSVM is a fast classification and more dependable method. It has removed the processing time as compared with the existing CNN method.

5. CONCLUSION

The concluded that the detection of the various lung cancer diseases using medical image processing models. The .dicom images are used for the detection of the lung disease. The global kind of the features like as region,

length, width have been extracted in MATLAB 2016a. In addition to that, k mean clustering is used to segment the picture data into various kinds of the classes or groups.The groups demonstrated that the output is in the form of the normal cluster and abnormal category of the lung cancer pictures. The global features computed through the histogram oriented gradient (HoG) technique. HoG is used for extraction of the features and identify on the shape of the picture. It is capable to provide the instruction to boundary and extracting the gradient and arrangement of the edges. The direction edges computed in local directions and, ultimate image differentiated into small edges. It generates the histogram for different edges separately. ABC algorithm is the Meta heuristic technique that is used for the selection of the extracted in lung pictures. It searches the high-level selection of the features. In addition, it searches the cost parameter vector that decreases the cost and selective function. Along with that, the prediction of the lung images is analysed using Multi-support Vector Machine (MSVM) classification technique. The proposed model identified the disease and detection class image accurately. Result outcomes showed that the trained and tested features are the most essential feature for the classification of the lung picture in accordance to disease. Experimental analysis is done to compute the parameters namely, accuracy, precision, recall and root mean square error.

6. FUTURE SCOPE

Future scope, will implement on improving the cancer detection rate through several image segmentation techniques such as FCMC method, Threshold based method, adaptive histogram or ostu method. Various conversion features can be integrated to create the positive impact on the testing loss and the cost of the scheme.

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