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Improvements in the Detection of Both Noncancerous and Cancerous Lung Tumors by Artificial Neural Networks Compared to Support Vector Machines

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Abstract. The main objective of the research is to evaluate the efficacy, specificity, and sensitivity of two approaches—a support vector machine (SVM) and an artificial neural network (ANN)—in differentiating between benign and malignant lung tumors. For this investigation, data sets were acquired from Github. For the ANN and SVM, a total of 40 lung CT scans were employed. With a review course power of 0.8 and a maximum acceptability error of 0.5, the sample size in each group is examined. When used to identify cancers in lung CT images, Artificial Neural Networks perform with an accuracy of 92%, whereas Support Vector Machines do better with an accuracy of 84% and a significant level of p 0.05. When it comes to distinguishing between benign and malignant lung tumours, the artificial neural network technology outperforms the Support Vector Machine method in terms overall accuracy, sensitivity, and specificity.

Keywords: Novel Identification, Accuracy, Sensitivity, Specificity, Artificial Neural Networks, Computer Tomography Images.

INTRODUCTION

In order to detect tumour cells in the lungs, machine learning techniques such as Artificial Neural Networks and Support Vector Machines were used [1]. Early tumour detection and classification enable treatment of the disease in its early stages [2]. An algorithm that learns, ANN, performs better on classification problems [3] [4]. Finding anomalies in the tissues of the lung is the primary clinical application of the technique for lung tumour new detection. Consequently, effective and suitable treatment requires early tumour identification. There are a variety of supervised learning classifiers used in diagnosis, including KNN, SVM, ANN, PNN, HMM, etc. One area where detection might be useful is in determining how far cancer has gone [5]. This aids in analysing how well the medication is functioning as well as any indications that cancer cells are still alive after treatment.

The unique detection of benign and malignant tumours using lung CT scans has been the subject of numerous studies. 316 articles from the years (2015–2020) were published in the IEEE database, while over the previous five years, there have been 197 publications in Google Scholar. Deep learning, artificial intelligence, and neural networks, three recent cutting-edge technologies, effectively support medical image processing [6]. For both segmentation and classification in this study's examination of damaged lung CT images, various approaches and modifications of pre-trained networks are applied [7]. A novel Artificial Neural Network provides accuracy of 92% for identifying benign and malignant tumours in lung CT images, and a Support Vector Machine obtained accuracy of 84% [8].

It is determined by the results of this research survey that greater precision is required for novel classification and identification of benign and malignant tumours.. The primary goal is to distinguish between benign and malignant lung cancers using ANN and to assess its accuracy and sensitivity in comparison to the SVM classifier.

MATERIALS AND METHODS

The study is conducted at the ECE department at SIMATS's Saveetha School of Engineering in Chennai. For the ANN (group 1) and SVM (group 2), the sample size is 40. 80% of the photos are employed for coaching and

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20% are used for testing in the samples calculated by Clinical. A protest performance of 80% and a maximum acceptability error of 0.05 are used in the analysis of the sample size [8].

Lung cancers may be better identified and categorized with the use of neural networks. An artificial neural network's input, hidden, and output layers were used to train and evaluate the dataset in this innovative cancer detection method [2]. For problems involving classification and prediction, ANNs are often used [9]. An artificial neural network (ANN) is a mathematical concept with three levels: input, output, and hidden. Before the output layer uses the data for categorization, the input layer processes it. The two steps that the ANN Model takes to detect cancer are training and validation. Training the networks using a dataset is the first step. Finding worrisome tumours in lung CT images becomes faster, more sensitive, and more precise when an artificial neural network is trained and evaluated using a back-propagation algorithm technique. This method gets rid of the discrepancy between the two data sets.

Support Vector Machine classifies data into two groups using the best linear separation hyper plane [3]. It is a supervised learning method. A hyper plane is formed when the two datasets have the biggest possible margin [10]. Support vector machine classifier input pictures are typically JPG or PNG examples taken from training datasets. There are a number of factors, such as camera settings and light fluctuations, that may introduce unwanted noise into an image; however, there are pre-processing techniques that can reduce or eliminate this noise. As part of the image segmentation process, the picture is first split into sub images up to the depth levels of the pixels, and then each pixel is assigned a distinct label according to its properties. What we call "Feature Extraction" is really the process of organizing all of the pictures into relevant records and giving labels to each detail. The new classifier uses hyper plane construction to categorize and label the input images. To help sort data into different buckets, hyper planes may adopt different shapes based on the input distribution [2].

In the realms of analysis and design, MATLAB reigns supreme. We have all the necessary simulation add-ons installed on 64-bit MATLAB (2014) software [3] [4]. As described by example data, configuration entails setting up the network to be compatible with the issue that has to be solved. The network's configurable different parameters will need to be modified once they have been configured in order to optimize performance of the network. The network is trained during this tuning procedure. Example data must be sent to the network during configuration and training. The method is designed to segment the lungs from lung CT scans and identify malignancies. These pictures are divided between benign and malignant tumour pictures. Various combinations of already-existing attributes are employed for the accurate sorting of medical imaging.

Specificity and sensitivity are the two statistical indicators of a binary classification effectiveness in the medical sector. While specificity takes into account the percentage of correctly identified negative values, sensitivity specifies the percentage of actual positive values that are correctly identified. The ratio of all the samples that are actually positive to the sample that tested positive (TP) is known as sensitivity. The quality of the data and the quantity of errors in a dataset are both factors in accuracy. It measures how closely information conforms to real or conventional values.

Statistical analysis

We used IBM SPSS software, version 21, to conduct the statistical analysis [5]. The SPSS graph is created by importing descriptive data from the Excel sheet. This data includes the mean, standard deviation, error of the artificial neural network, and the support vector machine [5]. The accuracy and sensitivity are evaluated using a distinct sample T test. The input photos and pixel size are the possible outcomes. The response variable are sensitivity, specificity, and accuracy.

RESULTS

The findings demonstrated that the artificial neural network outperformed the support vector machines technique when it came to distinguishing between benign and malignant lung tumours.

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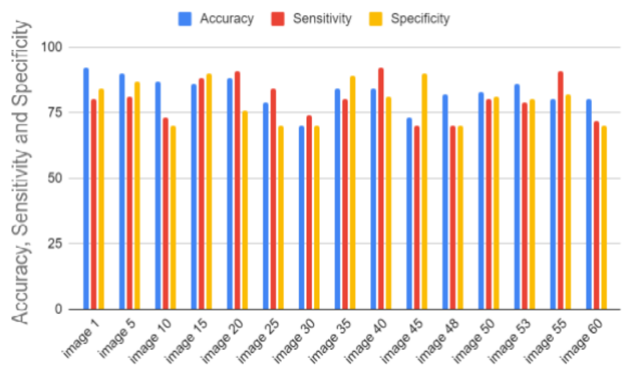
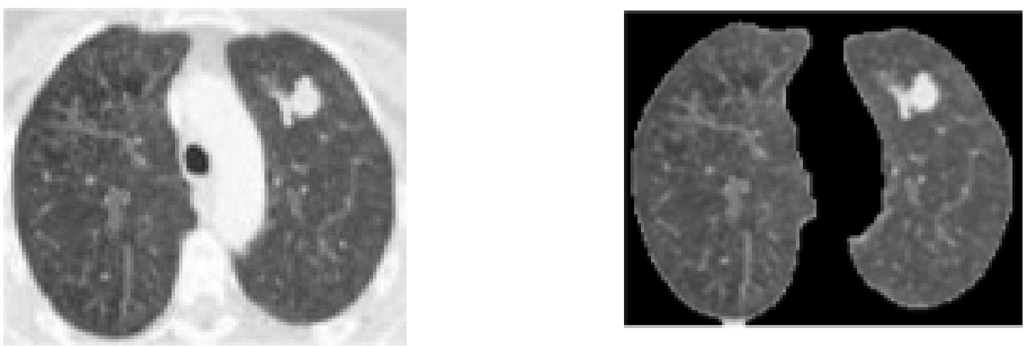


FIGURE 1. Shows detecting malignant and benign tumours with a high degree of specificity, sensitivity, and accuracy. The Y-axis displays the accuracy, sensitivity, and specificity, while the X-axis displays the number of samples.



(a) (b)

FIGURE 2. The method's output for segmenting benign lung tumour pictures. Figure 2(a) includes The segmented image of the harmless lung tumour is shown in Figure 2(b), whereas Figure 2(a) provides the input image.

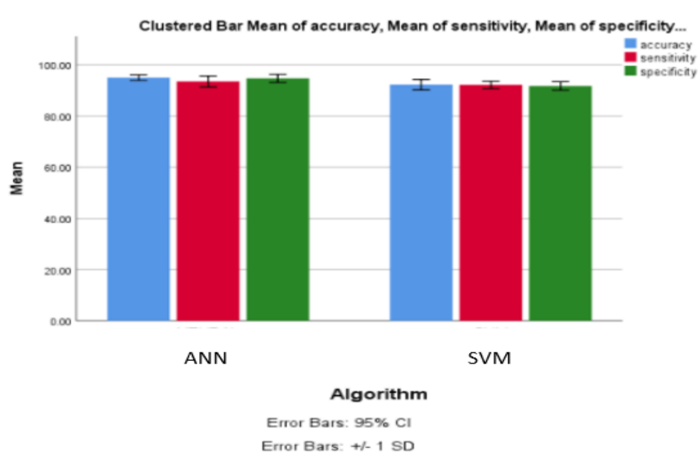


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FIGURE 3. The According to SPSS statistical study, Artificial Neural Networks (92%) outperform Support Vector Machines (84%). As shown on the X-axis, ANN and SVM are compared. The Y-axis shows the overall sensitivity and accuracy, with a standard deviation of +/-1.

Statistical comparisons were made for the specificity, accuracy, and sensitivity in identifying malignant and benign lung tumours (Figure 1). For the purpose of identifying benign and malignant lung cancers, Figure 2 displays the input and output images. The average accuracy for ANN was 92% and for SVM it was 84%, according to the SPSS findings shown in Fig. 3. The average sensitivity, specificity, accuracy, and accuracy are shown in the SPSS graph with a standard deviation of one standard deviation for detection accuracy.

Figure 1: Statistical Analysis of SVMs and ANNs. While SVM averages 84% accuracy with a standard deviation of 3.52301, ANN has a standard deviation of 1.65042 at 92%.

	Group	N	Mean	Standard Deviation	Std. Error Mean
Accuracy	ANN	20	92.000	1.65042	0.26631
	SVM	20	84.5000	3.52301	0.61937
Sensitivity	ANN	20	86.2500	2.41872	0.73471
	SVM	20	83.5000	1.03714	0.45362
Specificity	ANN	20	91.6110	1.58316	0.59341
	SVM	20	87.5000	2.12860	0.48952

TABLE 2. With p-values for accuracy, specificity, and sensitivity all below 0.05, the group statistics independent sample t-test found that the artificial neural network was statistically significant.

		Levene's test for equality of variance		T-test for Equality of Means					95% confidence interval of the difference	
		F	Sig	t	df	sig(2 tailed)	Mean diff	Std. error	Lower	Upper
Accuracy	Equal Variances assumed	2.062	0.03	2.173	17	0.003	2.752	0.678	1.337	4.136
	Equal Variances not assumed			2.176	12.447	0.001	2.752	0.678	1.324	4.148
Sensitivity	Equal Variances assumed	0.022	0.04	1.926	17	0.017	1.162	1.473	-.462	2.634
	Equal Variances not assumed			1.655	16.41	0.137	1.162	0.787	-.642	3.936
Specificity	Equal Variances assumed	0.756	0.027	4.631	17	0.01	2.617	0.856	1.847	4.671
	Equal Variances not assumed			4.513	14.96	0.01	3.512	0.728	1.869	4.673

Table 1. Shows the statistical analysis of comparison of the accuracy of ANN (92%) and standard deviation (1.65042) with SVM accuracy (84%) and standard deviation(3.52301). Table 2. shows that the independent sample t-test has a significance of 0.03 for accuracy and 0.04 for sensitivity which is less than the standard significance range. The results show that SVM and ANN are two completely different methods.

DISCUSSION

In this study, it was found that utilising an artificial neural network to identify benign and malignant lung cancers performed better than using a support vector machine. In the statistical analysis, ANN obtained a standard deviation of 1.65042 with a mean error of 0.26631 and SVM obtained a standard deviation of 3.52301 with a mean error of 0.2663. (0.61937). The accuracy of two algorithms is compared using an unbiased sample t-test. The ANN classifier achieved an accuracy rate of 92%, which was statistically significant (p0.05). while the SVM classifier's accuracy was 84%. In this investigation, the ANN classifier outperformed the SVM classifier at detecting lung tumours.

According to earlier studies with similar results, artificial neural networks perform better as classifiers than support vector machines. The study was done to separate benign and malignant tumours from lung computed tomography pictures. The analysis of lung cancer prediction and classification utilising machine learning techniques such as CNN, SVM, ANN, and Watershed Segmentation revealed that ANN had a 94% accuracy rate [26]. Massive Artificial Neural Network attained a sensitivity of 66.42% (93/140 photos) and a precision of 66.76% (2.5 false positives per image) without the soft tissue approach from the CAD scheme [7]. The soft tissue method has been used to discover several nodules that are ringed by ribs and clavicles. It is quite sensitive (72.8%) and accurate (72.96%), with a false positive rate of just one.

There is a 79% success rate in non-small cell lung cancer when applying robotic staging into radiances-based tumour prediction utilizing Cascading Neural Networks [8]. The EFFI-ANN outperformed another ANN, the ICDS SPLD-ANN, with a precision of 85% [9]. With the addition of this information to the existing body of knowledge, ANN can be used to identify lung cancer in CT images [10]. When compared to other classification algorithms and low-dose CT scan pictures, ANN with visual insights for early diagnosis of lung cancer adopting Gradient-Weighted Class activation framework obtained a classification performance of 97.17%. [4]

The dataset under analysis is one of the variables impacting accuracy. If the input data has more properties, the performance level can be enhanced more significantly. When processing large amounts of data, detection performance may suffer and take longer as the number of features for each sample rises. By providing more samples, the performance can be enhanced to get around the restrictions.

CONCLUSION

In this research, we looked at how well artificial neural networks and support vector machines can distinguish between benign and malignant lung tumours. In the detection of lung cancers, ANN has a greater accuracy (92%) and SVM has a lower accuracy (84%) than ANN. SVM is much less accurate than an ANN classifier.

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