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Examining The Effect of Pre-processed Covid-19 Images On Classification Performance Using Deep Learning Method

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Abstract

In recent years, researchers have been using different artificial intelligence models to process x-ray images and make a determination about the patient's condition. Pre-processing is applied to medical images by many researchers. In this way, researchers know that the results they will obtain will be better and that their study results will be more accepted in the literature. As with all other medical images, pre-processing of Covid-19 images is generally done to obtain better classification results. In this study, some pre-processing was done with Covid-19 images. Experimental studies were performed using the ResNet18 deep learning model. According to experimental studies carried out on non pre-processed images, an average accuracy of 0.85206% was obtained in the test processes, while an accuracy rate of 0.93086% was obtained in the test processes obtained from pre-processed images. It was observed that better results were obtained by processing pre-processed images with the same model.

Keywords: "Covid-19, deep learning, image pre-processing."

1. Introduction

Today, studies in the field of artificial intelligence continue to appear very quickly and decisively in different areas all over the world. The development of modern technologies such as deep learning helps radiologists automatically detect lung diseases from x-ray images [1]. Ways to detect Covid-19 are clinical symptom examination, pathology tests, and lung x-ray [2]. In the automatic classification study, the data set was divided into two according to the principle of 80% training and 20% testing. In the study, results ranging from 0.81 to 0.83 were obtained for sensitivity and F-1 score parameters [3]. In a different study, Covid-19 classification was made from deep learning-based X-Ray images. Using three classes, an accuracy value of 98.3% was achieved [4]. In the classification study carried out by Ouyang et al. with the ResNet-34 architecture, CT images were used, including Covid-19 and non-Covid-19. The study was carried out according to the five-fold cross-validation procedure. As a result of the experiments, the accuracy parameter was obtained as 0.875 [5]. In the automatic classification study conducted by Jaiswal et al., experiments were carried out according to 68% training, 17% validation and 15% test separation. As a result of the experiments, the accuracy parameter was calculated between 0.90 and 0.96 [6]. Wang et al. proposed a model with high architectural diversity and long-range selective connections, which they called Covid-Net [7]. Albahli et al. reached a success rate of 92% in their study based on enhanced DenseNet [8]. In a different study, the accuracy parameter was calculated as 0.99 and the F-1 score parameter was calculated as 0.98 [9]. In the study conducted by Liang et al., the sensitivity parameter was 0.99 and the accuracy parameter was 0.98 [10]. Different deep learning architectures were used in the classification study carried out by Alshazly et al. As a result of the experiments, the accuracy parameter was calculated between 0.92 and 0.99 [11]. In the Covid-19 and not Covid-19 classification study, the experiments were determined as 85% training, 5% verification and 10% testing rate. As a result of the experiments, the accuracy parameter was calculated as 0.97 [12]. Different methods were proposed in the literature to obtain the best results using different deep learning and machine learning models [13-16].

In this study, Covid-19 detection was performed using ResNet18 architectures. The aim of this study was to examine the performance of the images to be given as input to deep learning models after pre-processing. The statistical results obtained were given and explained in detail in the experimental studies section.

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2. Material and Methods

In this study, ResNet18 architecture was used as the deep learning model. Experimental results were compared statistically with Confision Matrix (CM). The images in the database and their state after pre-processing were shown. ResNet architecture is a type of neural network proposed by He and colleagues in their article “Deep Residual Learning for Image Recognition” to facilitate the training of significantly deeper networks [17]. x is the residual connection to the straight line that carries the layer input to the summation process. Jump links can jump between different layers. Residual block inputs can propagate more quickly over remaining connections between layers. Before connection, our input ‘x’ is multiplied by the weights of the layer and a bias term is added. It then passes through the activation function f() and the output is determined as H(x). [18]. The residual learning block structure is shown in Figure 1 [17].

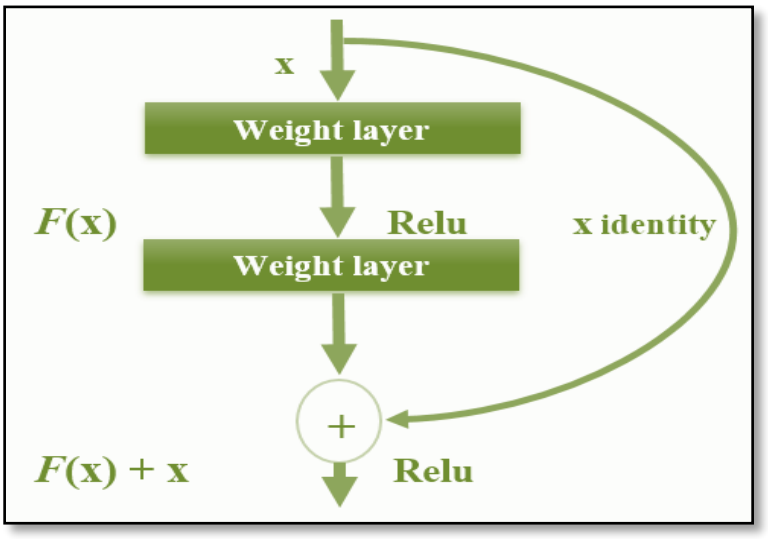
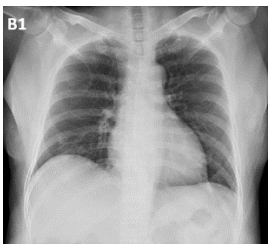
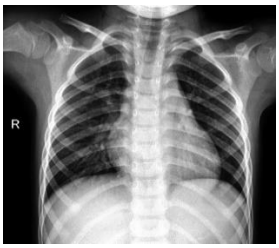
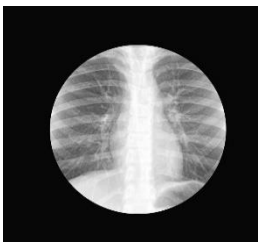


Figure 1. Residual learning block structure

Confusion Matrix; It is used as a benchmark to evaluate the performance of deep learning models in solving classification problems. This matrix is an NxN matrix that tells us the number of correct and incorrect predictions made by the deep learning model compared to the actual results in the data.

Images belonging to three different classes in the database used in this study are shown in Table 1 [19].

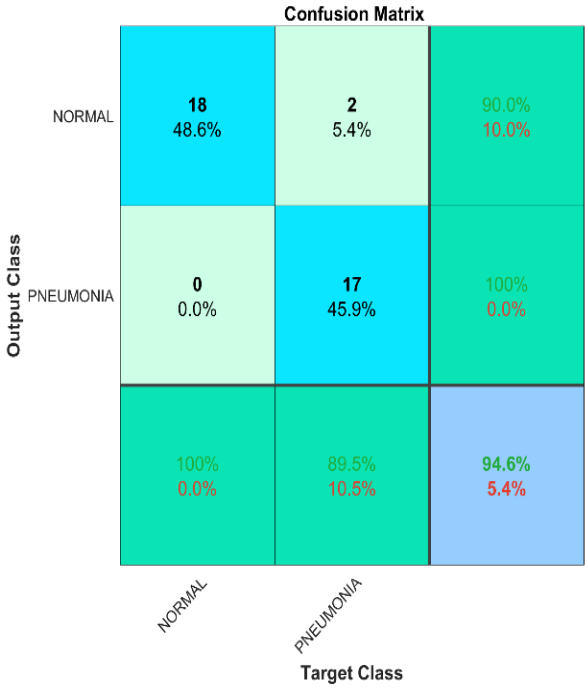
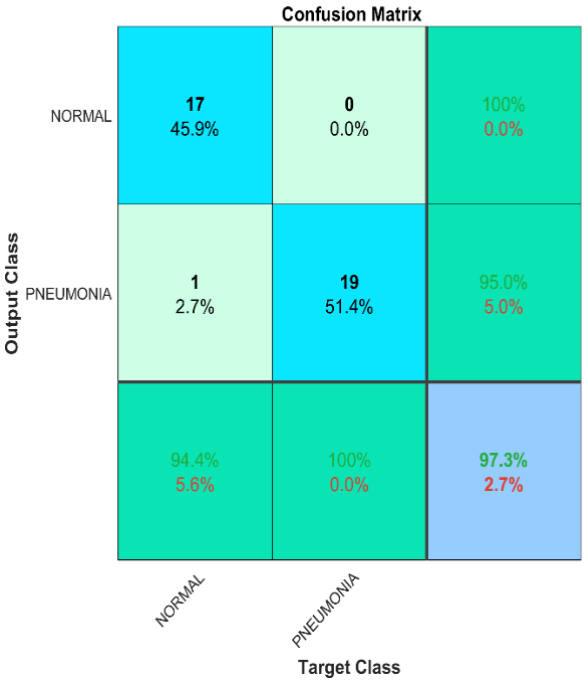
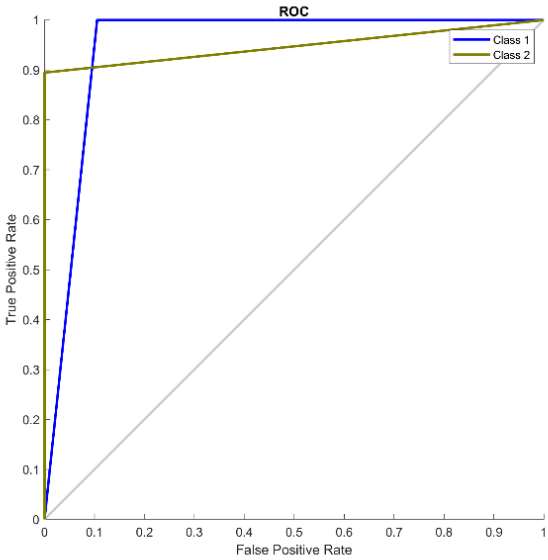
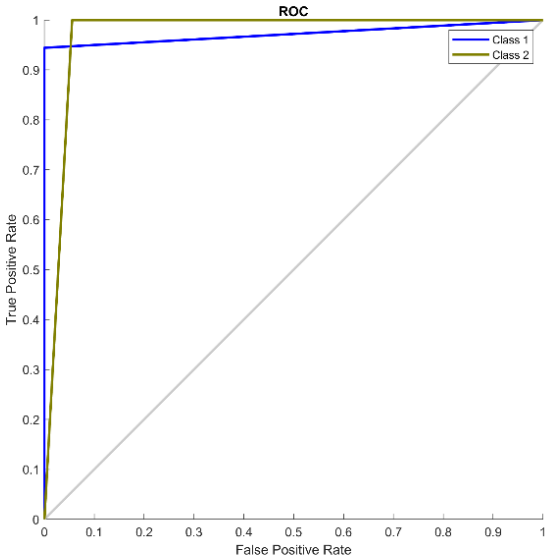
Table 1. Images in the database

Covid	Normal	Pre-process-Covid	Pre-process-Normal
			

3. Experimental Results

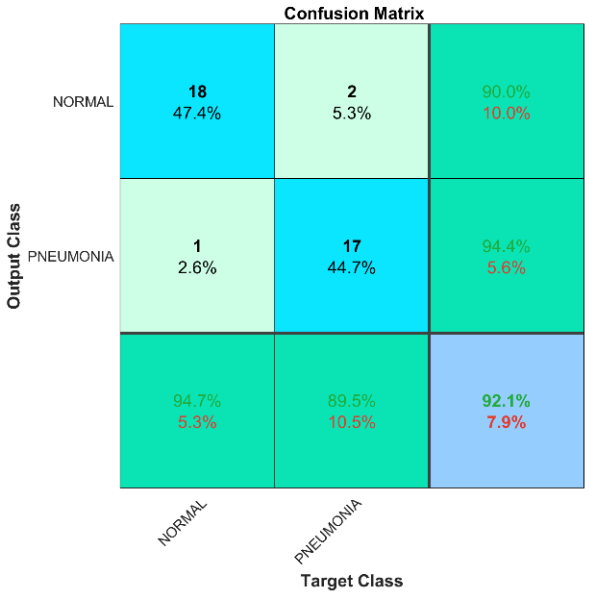
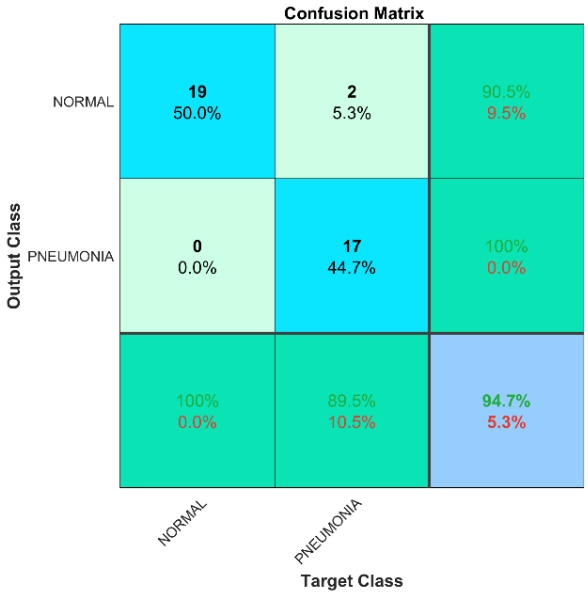
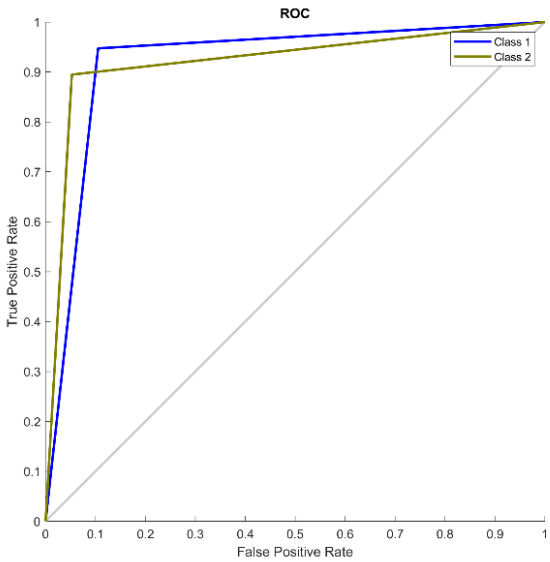
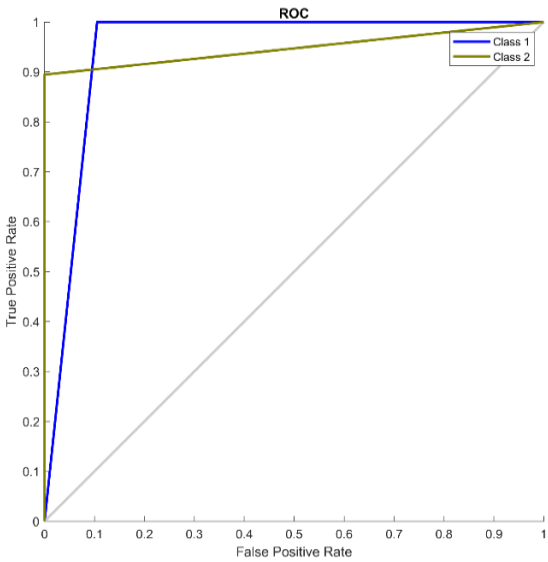
In this study, 3 different Covid-19 images were classified in experimental studies using 5-fold corssvalidation. CM results obtained as a result of experimental studies conducted with the ResNet18 deep learning model for the 1.Fold are shown in Table 2.

Table 2. 1.Fold CM results

Normal images	Pre-processed images
	
	

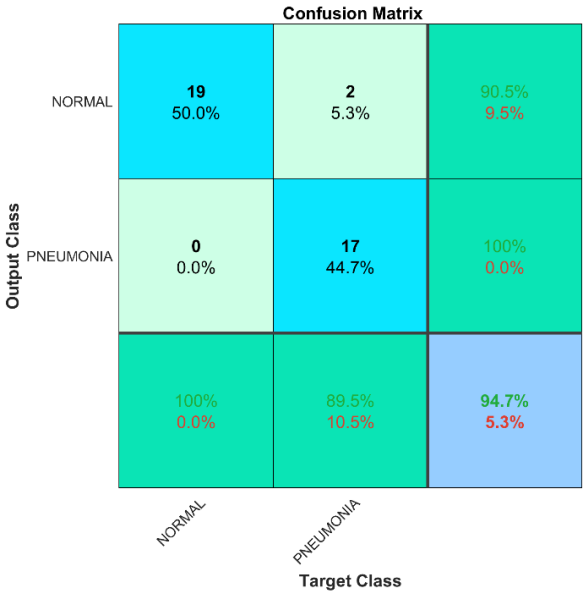
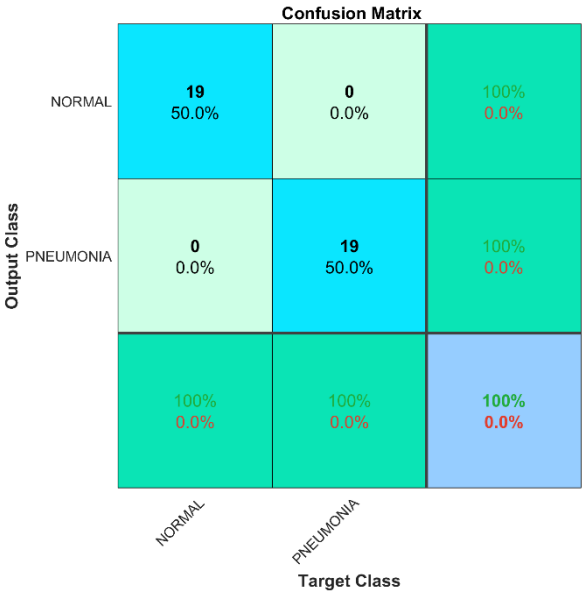
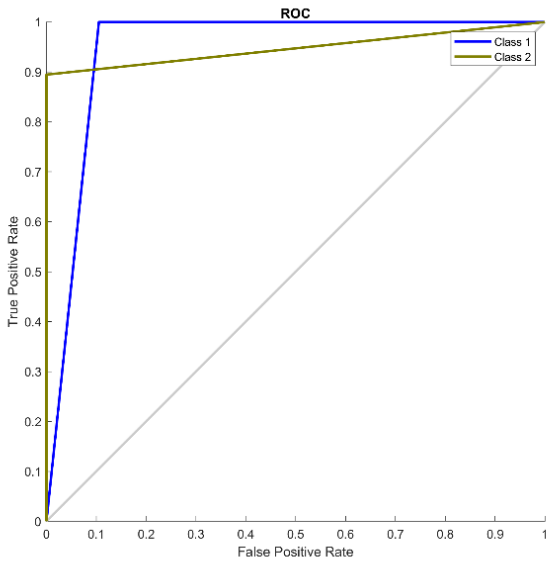
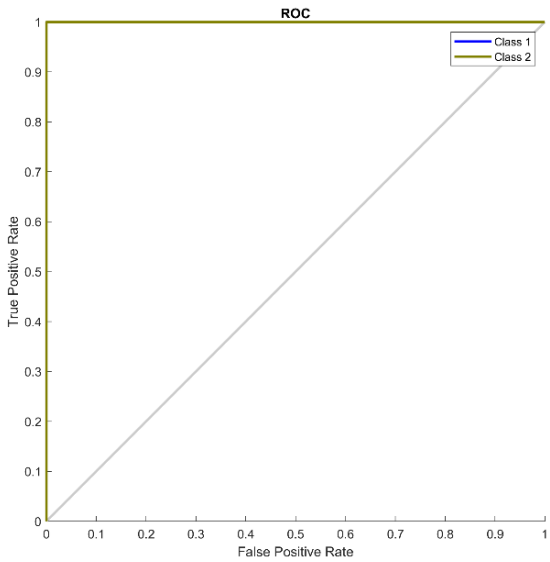
2.Fold CM results are shown in Table 3.

Table 3. 2.Fold CM results

Normal images	Pre-processed images
	
	

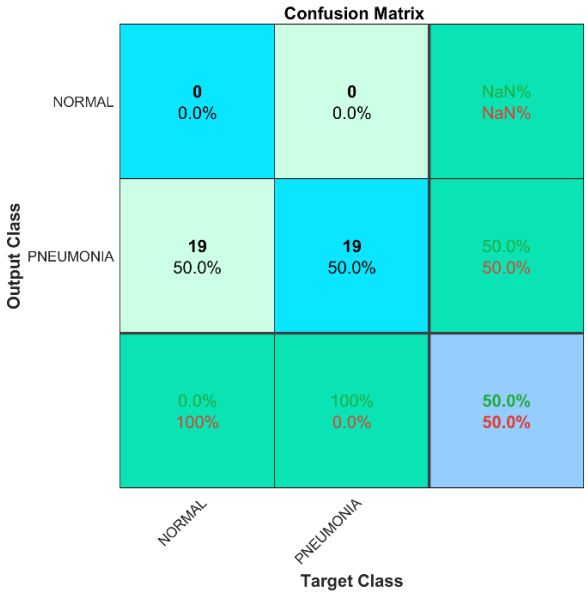
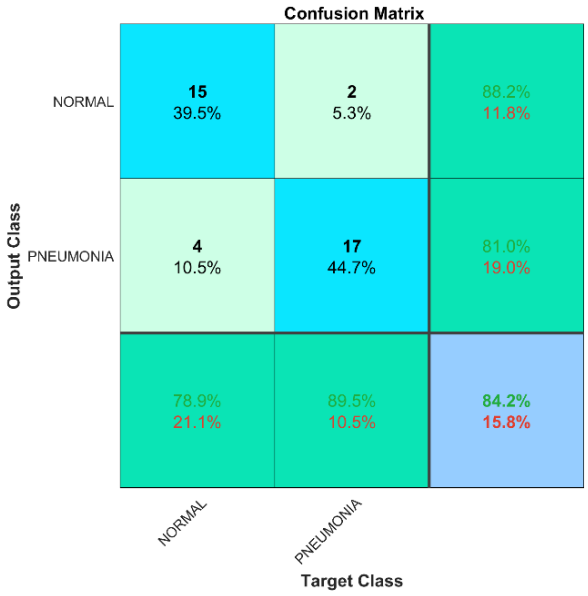
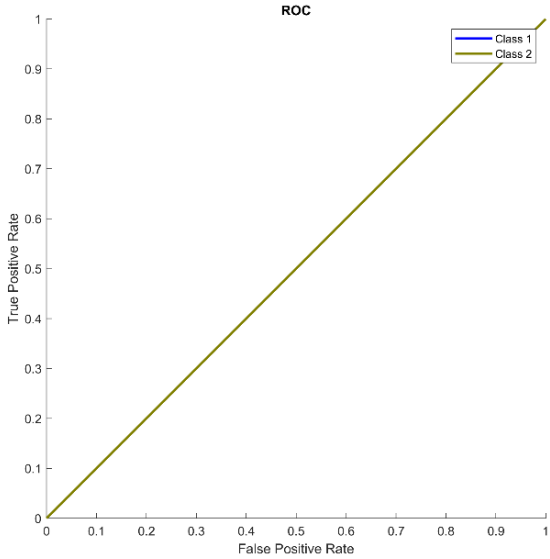
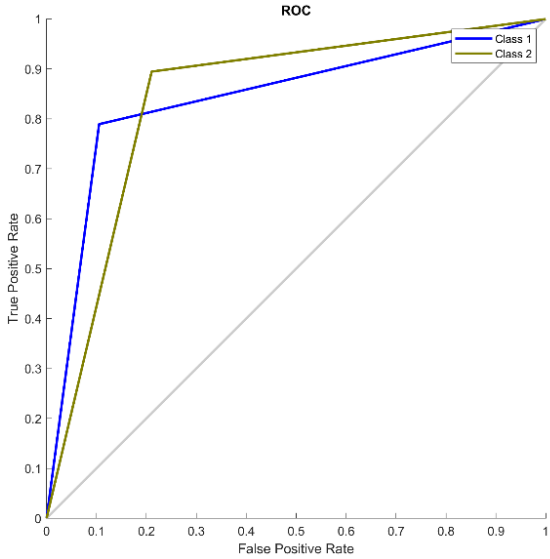
3.Fold CM results are shown in Table 4.

Table 4. 3.Fold CM results

Normal images	Pre-processed images
	
	

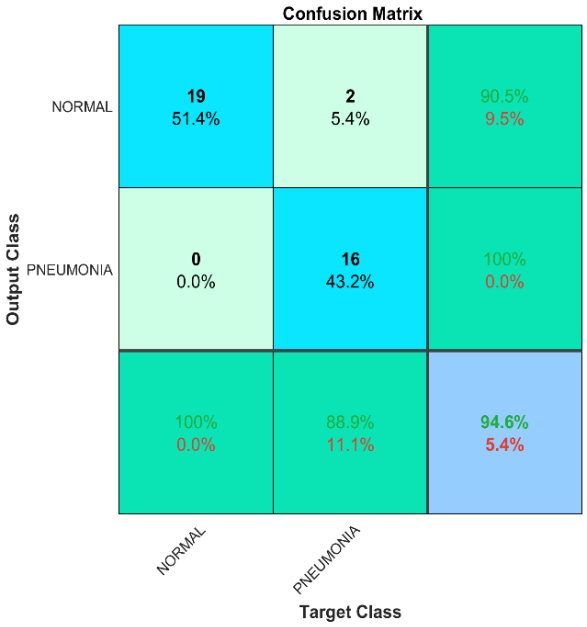
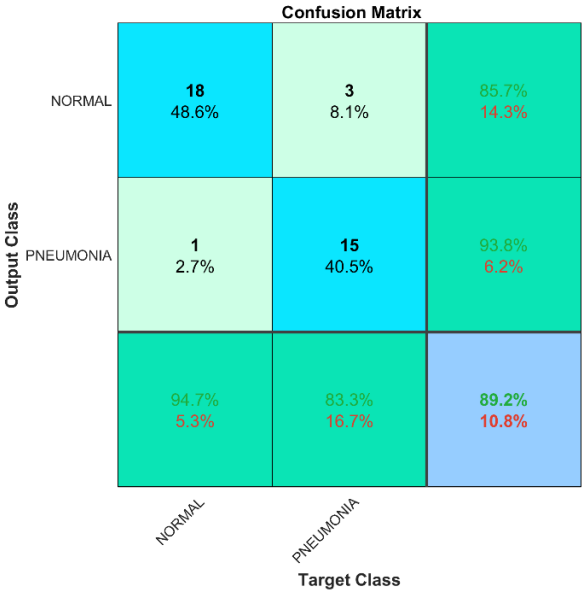
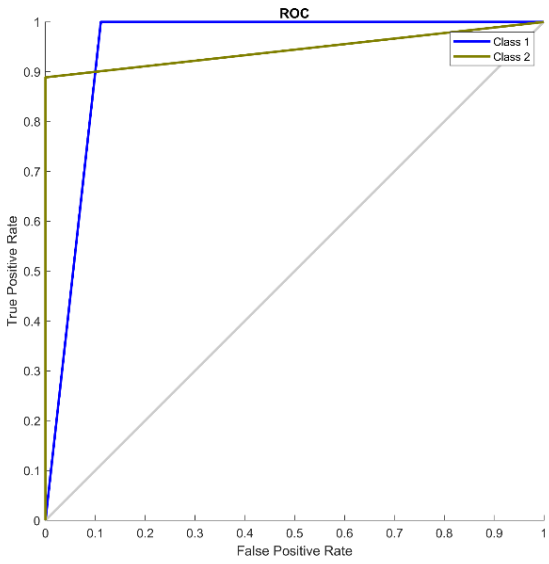
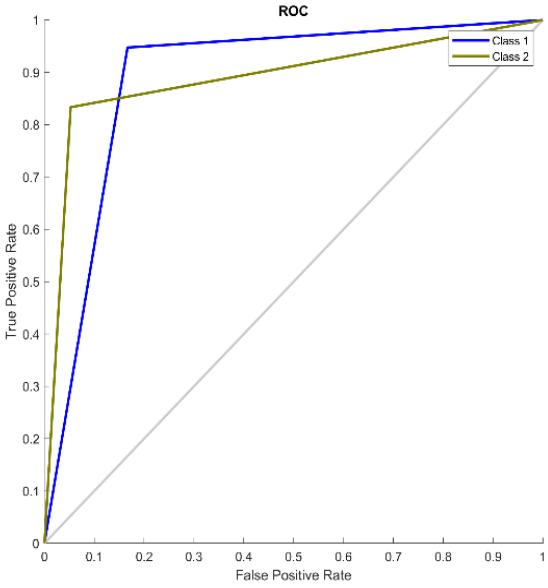
4.Fold CM results are shown in Table 5.

Table 5. 4.Fold CM results

Normal images	Pre-processed images
	
	

5.Fold CM results are shown in Table 6.

Table 6. 5.Fold CM results

Normal images	Pre-processed images
	
	

In this study, the experimental results obtained as a result of the pre-processing for Covid-19 detection are shown in Table 7.

Table 7. Results with Pre-process

	Sensitivity	Specificity	Accuracy	F-1 Score
1.Fold	0.9722	0.9722	0.9729	0.9728
2.Fold	0.9473	0.9473	0.9473	0.9472
3.Fold	1	1	1	1
4.Fold	0.8421	0.8421	0.8421	0.8416
5.Fold	0.8903	0.8903	0.8918	0.8911

When we look at the CM results in general, we see that an average accuracy rate of 0.85206% is obtained from images without pre-processing, while an average accuracy rate of 0.93086% is obtained from pre-processed images. Pre-processed images gave more accurate results because some unnecessary images were cleaned.

4. Conclusions and Future Works

Analyzing medical images by doctors using artificial intelligence techniques is of great importance for faster and more accurate diagnosis. In this study, the effect of pre-processed images to detect Covid-19 on the classification result was examined using the ResNet18 deep learning model. Experimental studies compared fold to fold. Transactions were carried out by performing 5-fold cross validation. According to the results obtained as the average of these folds, the best accuracy value was obtained as 1 from the 3.Fold, and the worst accuracy value was obtained as 0.8421 from the 4.Fold. As a result of the experimental studies, better classification results were obtained from pre-processed images. In future studies, classification can be performed on images using different image pre-processing and different deep learning models.

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