Classification of Thorax X-ray Results on Corona Virus Infection Based on Internet of Things (IoT)

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Abstract. The spread of the corona virus in Indonesia is still growing until now. One important thing to note is about the handling of patients exposed to the corona virus. This study aims to be able to classify thorax x-ray images against corona virus infection based on the Internet of Things (IoT). IoT is a concept of internet connectivity that is connected continuously between remote devices. This study uses a supervised learning method, namely directed learning in which the expected results of the user have been trained in advance and the information is stored in the system (database). The training data used is a Thorax x-ray image that is processed based on image processing with segmentation and edge detection based on the Sobel operator with real time connected to the internet. The results showed that the 100 times experiment obtained the accuracy value of the normal Thorax X-ray image of 94% and the Thorax covid-19 X-ray image of 96%. Overall system test showed 95% on target and 5% error.

1. Introduction

The spread of the Corona virus (COVID19) originated in the city of Wuhan, China, and has spread to many countries such as South Korea, Iran, the United States, Italy, and also Indonesia. In China, the latest Coronavirus on August 2, 2020 has killed 680,894 people with a total of 17,660,523 cases [1]. Meanwhile in Indonesia, the number of corona virus positive patients who have died as of August 2, 2020 is 1,883 people and the total cases reached 32,033 people [2]. It is very possible that this number can continue to grow in the future. With the very fast transmission of the virus, the Indonesian government has given an ultimatum to always be vigilant and implement measures to prevent the spread of the virus against oneself and others. The world government also continues to make various efforts to suppress the spread of Covid19. Starting from the physical distancing policy [3] to the use of technology is needed to reduce the spread of the corona virus. The Covid19 pandemic in Indonesia is now increasing rapidly and extending to the periphery of Indonesia, such as in eastern Indonesia, namely NTT, Maluku and Papua [4]. The delay in the results of the Covid19 swab or polymerase chain reaction (PCR) test is a problem in a number of areas. Swab test results in some areas in certain areas are very limited and take a lot of time and can even be known after an average of 7-14 days patient specimens are sent to the city or province. The duration of the swab test results is a separate obstacle in handling Covid19.

Symptoms of the corona virus include fever, cough, shortness of breath, which can be a sign of various diseases, ranging from flu, throat infections to colds [5]. Now experts and researchers have more complete information about how this viral infection continues to spread and spread rapidly. When the virus starts to spread, it will spread and infect cells in the body. Symptoms can be felt at the back of the throat in the form of pain in the throat and can also cause a dry cough. Then the virus spreads extra quickly and can get to the ducts of the lungs and then into the lungs [6]. This virus results in damage to the tissue in the lungs, making the tissue swell, making it more difficult for the lungs to
carry out the process of oxygen intake and carbon dioxide removal. X-rays of the lungs or often referred to as Thorax X-rays are a reference to find out the developing corona virus infection in the body. That is the reason, in addition to throat swab examinations, chest x-rays or chest x-rays are also used as one of the tests carried out to detect Covid-19. With the development of information technology today, it is very necessary to develop an internet-based system and cloud computing [7]. The system that will be developed is intended to help medical personnel to simplify and accelerate the results of Thorax x-rays to patients in real time.

Internet of Things (IoT) is one of the main areas of innovative technology based on embedded systems. The concept of IoT is an electronic device that "communicates" between systems without human assistance, so that objects share information through the World Wide Web automatically [8]. By using IP (data transfer protocol), communication between global networks becomes more accessible and allows the system to be consolidated from the system itself, creating a network within the network. This research will use a supervised learning method with an image processing model with the stages of image refinement, segmentation, and edge detection. The supervised learning method is supervised learning where the results expected by the user have been trained in advance and the information is already in the system (database) [9]. The data used were X-rays of the Thorax that had been selected for the indication of the corona virus. Image processing is a form of signal from input in the form of images and transforms into other patterns that can be read by the output system with certain techniques as specified [10]. Image processing is used to reduce image signal data errors that occur due to transmission and during signal acquisition, as well as to improve the quality of image appearance so that it is easier for the system to interpret by manipulating and analyzing the image [11]. The image processing system is used to determine the class in the results of image processing of patients infected with the corona virus in real time percentage results.

2. Research Methods

The method used in the classification of Thorax x-rays against Coronavirus infection based on the Internet of Things (IoT) is a supervised learning method to classify Thorax images of Covid19 patients. Supervised Learning is a problem solve method where the results are expected by users [12], it is known and the information is already in the system. This learning method can work by reusing data and output results that have been entered by the user or done by the previous system [13]. Classification refers to data from https://www.kaggle.com/nabeelsajid917/Covid-19-x-ray-10000-images [14]. Data from Kaggle are X-rays of the Thorax or lungs that have been selected and separated between normal X-rays of normal lungs and X-rays of positive lungs with Covid19.
2.1 Image Enhancement

Image enhancement is the first step in the image processing process. Image quality improvement is needed because the image being tested is usually of poor quality, such as noise and blur or less sharpness [15]. The aim is to improve image quality to highlight the characteristics of an image for image analysis or information.

2.2 Segmentation

Segmentation is carried out to separate certain areas in the image, where these regions have homogeneity including texture, intensity and color. Segmentation has the aim of separating the main image area from the background, so that the points in the image can be easily analyzed [16]. Thresholding is a technique for segmenting images based on the brightness level of the image. By determining the appropriate threshold for each binary level target image with a pixel intensity value of 0 or 1. Following are the steps for determining the threshold using the iteration method [17].

a. Determines the initial threshold value \( T_0 \).
b. The image is divided into two parts using the initial threshold value in step a. \((R1 \text{ and } R2)\).
c. Calculate the average intensity value in each area \( (\mu_1 \text{ and } \mu_2) \).
d. Calculate the threshold value of the new area from the sum of the mean intensity values divided by \(2. [T = (\mu_1 + \mu_2) / 2] \).
e. Repeat steps a through d until the mean intensity values \( (\mu_1 \text{ and } \mu_2) \) do not change.

2.3 Edge Detection with Sobel Operators

Edge detection in an image is a further process after image segmentation, edge detection can produce more dominant edges of the image object, the goal is to mark the part that becomes the image detail. Sobel operator performs 2D calculations on a space in an image in the hope that later high-value areas will appear in the image that are dominant from the detection of the edges of an image. Sobel operator is used to find the gradient of each input image pixel that has been converted to grayscale in the previous process. In theory, a matrix of at least \(3 \times 3\) size is required as the kernel. Sobel operator shows a \(3 \times 3\) kernel as shown in Figure 2 [18]:

**Figure 1.** Supervised Learning Methods for classification of Thorax X-rays against Covid19
3. Results and Discussion

There are 70 samples of Covid19 lung infection samples obtained from the Kaggle website (https://www.kaggle.com/nabeelsajid917/Covid-19-x-ray-10000-images). By using the above method the sample is processed into a dataset and stored on the server. The data stored is the percentage of the calculation result with the segmentation technique and edge detection of the Sobel operator as follows:

![Figure 3. (a) Original image, (b) Image after conversion, (c) Image segmentation results, (d) Image edge detection results](image)

From the original image (Figure 3.a) which has been repaired (Figure 3.b), the segmented image (Figure 3.c) is obtained with the number of pixels $S = 275696$. The segmented image is used again to perform edge detection. The result obtained is $ED = 5150$. Calculating the percentage of X-rays:

\[
P = \frac{ED}{S} \times 100\%
\]

\[
P = 5150 / 275696 \times 100\%
\]

\[
P = 1.87\%
\]

$ED$ = White Color Edge detection  
$S$ = White Color Segmentation  
$P$ = Rontgen Image Percentage

The calculation is carried out until the sample data is 70 and the dataset table below is obtained and then stored on the server. The calculation will be carried out again if there is new data that you want to add or subtract to the dataset for the embedded system to study.

| No | ED   | S      | P    | No | ED   | S      | P    | No | ED   | S      | P    |
|----|------|--------|------|----|------|--------|------|----|------|--------|------|
| 1  | 5150 | 275696 | 1.87%| 26 | 1229 | 264616 | 0.46%| 51 | 8879 | 177595 | 5.00%|
| 2  | 8579 | 295138 | 2.91%| 27 | 9181 | 171681 | 5.35%| 52 | 9914 | 73302  | 13.52%|
| 3  | 5578 | 93141  | 5.99%| 28 | 6638 | 84578  | 7.85%| 53 | 5492 | 250176 | 2.20%|
From the data above, it is obtained that the Maximum Segmentation Value = 296511 and the Minimum Segmentation Value = 63777. The maximum and minimum segmentation values are used as parameters to store log data during the test. From the data above, it is also obtained that the percentage intervals of Covid19 infected lung X-rays are as follows:

| Min   | Max   | Range           | Identification         |
|-------|-------|-----------------|------------------------|
| 0.46% | 13.52%| 0.0046 - 0.1352 | Covid19 (On suspicion) |

The percentage interval in table 2 will be used as a feature to classify the test data into the Covid19 or normal infection category. From the table above, it can be seen that the percentage interval with suspected Covid19 infection is between 0.46% and 13.52%.

**System Test**

![Figure 4.1. Main page](image1)

![Figure 4.2. Camera page](image2)
In using this system, users can access the following link: https://coding.my.id/covid19/. Users must prepare an external camera with a minimum of a normal lens (focal 35mm to 50mm) to a super telephoto lens (300mm and above) so that the results obtained are more accurate. Connect an external camera to the computer. After the camera is connected to the system press the "Open Camera" button. On the camera page (Figure 4.2) there is a panel to display the camera's capture. To perform classification, the user must point the camera at the Thorax X-ray image. Make sure the Thorax X-ray results look perfectly on the panel.

![Normal lungs](image1.jpg) ![Lung infected with Covid19](image2.jpg)

The system will calculate in real time when getting the target x-ray image successfully segment the image with the results:

\[ S.\text{Min} \leq x \leq S.\text{Max} \]

\( S.\text{Min} \) = Minimum Segmentation Value  \\
\( x \) = Camera panel segmentation value  \\
\( S.\text{Max} \) = Maximum Segmentation Value

If \( x \) is fulfilled, the edge detection calculation will be carried out and produce the edge detection value of the test x-ray image. The results of edge detection were compared in the percentage interval table for X-rays of the infected lungs with Covid19. After getting the classification the data is stored in the data log and used to determine the percentage of suspicion of being infected with Covid19. The following is the log data in the test above:

1. Normal lung test (Figure 5)

```plaintext
Log_data[1]=0.00653:COV,Log_data[2]=0.00054:N,Log_data[3]=0.00149:N,Log_data[4]=0.00132:N,Log_data[5]=0.0006:N,Log_data[6]=0.00148:N,Log_data[7]=0.00113:N,Log_data[8]=0.00167:N,Log_data[9]=0.00117:N,Log_data[10]=0.00201:N,Log_data[11]=0.00095:N,Log_data[12]=0.00207:N,Log_data[13]=0.00192:N,Log_data[14]=0.00097:N,Log_data[15]=0.0158:N,Log_data[16]=0.00124:N,Log_data[17]=0.00283:N,Log_data[18]=0.00064:N,Log_data[19]=0.00022:N,Log_data[20]=0.00124:N,Log_data[21]=0.00249:N,Log_data[22]=0.00251:N,Log_data[23]=0.002:N,Log_data[24]=0.00231:N,Log_data[25]=0.00396:N,Log_data[26]=0.00281:N,Log_data[27]=0.00093:N,Log_data[28]=0.00078:N,Log_data[29]=0.0004:N,Log_data[30]=0.00017:N,Log_data[31]=0.00235:N,Log_data[32]=0.00468:COV,Log_data[33]=0.00235:N,Log_data[34]=0.00221:N,Log_data[35]=0.00185:N,Log_data[36]=0.00233:N,Log_data[37]=0.00281:N,Log_data[38]=0.00292:N,Log_data[39]=0.00286:N,Log_data[40]=0.00232:N,Log_data[41]=0.00131:N,Log_data[42]=0.00364:N,Log_data[43]=0.00328:N,Log_data[44]=0.00328:N
```

6
\[a[44]=0.00343:N, \text{Log_data}[45]=0.00322:N, \text{Log_data}[46]=0.00327:N, \text{Log_data}[47]=0.00283:N, \text{Log_data}[48]=0.002:N, \text{Log_data}[49]=0.00324:N, \text{Log_data}[50]=0.00074:N, \text{Log_data}[51]=0.0012:N, \text{Log_data}[52]=0.00418:N, \text{Log_data}[53]=0.00267:N, \text{Log_data}[54]=0.00433:N, \text{Log_data}[55]=0.00327:N, \text{Log_data}[56]=0.00283:N, \text{Log_data}[57]=0.0024:N, \text{Log_data}[58]=0.00324:N, \text{Log_data}[59]=0.00074:N, \text{Log_data}[60]=0.0012:N, \text{Log_data}[61]=0.00418:N, \text{Log_data}[62]=0.00267:N,\]

Percentage of suspicion:

|           | Normal = \text{Log_data}\_N / \text{Log_data}.length x 100% | Covid19 = \text{Log_data}\_COV/\text{Log_data}.length x 100% |
|-----------|-------------------------------------------------------------|-----------------------------------------------------------|
| Normal    | 60 / 62 x 100%                                             | 2 / 62 x 100%                                             |
| Normal    | 96.77419355                                               | 3.225806452                                               |
| Normal    | 97%                                                        | 3%                                                         |

2. Lung Test for Covid19 infection (Figure 6)

\[
\text{Log_data}[1]=0.00754:COV, \text{Log_data}[2]=0.01176:COV, \text{Log_data}[3]=0.00912:COV, \text{Log_data}[4]=0.00743:COV, \text{Log_data}[5]=0.00679:COV, \text{Log_data}[6]=0.00622:COV, \text{Log_data}[7]=0.00577:COV, \text{Log_data}[8]=0.00206:COV, \text{Log_data}[9]=0.0055:COV, \text{Log_data}[10]=0.0079:COV, \text{Log_data}[11]=0.01002:COV, \text{Log_data}[12]=0.00818:COV, \text{Log_data}[13]=0.00765:COV, \text{Log_data}[14]=0.00632:COV, \text{Log_data}[15]=0.00499:COV, \text{Log_data}[16]=0.0079:COV, \text{Log_data}[17]=0.00736:COV, \text{Log_data}[18]=0.00629:COV, \text{Log_data}[19]=0.00514:COV, \text{Log_data}[20]=0.00755:COV, \text{Log_data}[21]=0.0112:COV, \text{Log_data}[22]=0.00771:COV, \text{Log_data}[23]=0.01197:COV, \text{Log_data}[24]=0.00555:COV, \text{Log_data}[25]=0.00748:COV, \text{Log_data}[26]=0.00748:COV, \text{Log_data}[27]=0.00849:COV, \text{Log_data}[28]=0.01196:COV, \text{Log_data}[29]=0.00539:COV, \text{Log_data}[30]=0.00813:COV, \text{Log_data}[31]=0.01175:COV, \text{Log_data}[32]=0.01306:COV, \text{Log_data}[33]=0.00728:COV, \text{Log_data}[34]=0.01016:COV, \text{Log_data}[35]=0.01248:COV, \text{Log_data}[36]=0.00927:COV, \text{Log_data}[37]=0.00966:COV, \text{Log_data}[38]=0.00779:COV, \text{Log_data}[39]=0.00868:COV, \text{Log_data}[40]=0.00764:COV, \text{Log_data}[41]=0.00746:COV, \text{Log_data}[42]=0.00861:COV, \text{Log_data}[43]=0.00721:COV, \text{Log_data}[44]=0.00767:COV, \text{Log_data}[45]=0.01275:COV, \text{Log_data}[46]=0.01056:COV, \text{Log_data}[47]=0.00509:COV, \text{Log_data}[48]=0.00546:COV, \text{Log_data}[49]=0.00725:COV, \text{Log_data}[50]=0.00997:COV, \text{Log_data}[51]=0.00958:COV, \text{Log_data}[52]=0.00683:COV, \text{Log_data}[53]=0.00512:COV, \text{Log_data}[54]=0.00774:COV,\]

Percentage of suspicion:

|           | Normal = \text{Log_data}\_N / \text{Log_data}.length x 100% | Covid19 = \text{Log_data}\_COV/\text{Log_data}.length x 100% |
|-----------|-------------------------------------------------------------|-----------------------------------------------------------|
| Normal    | 1 / 54 x 100%                                             | 53 / 54 x 100%                                             |
| Normal    | 1.851851852                                               | 98.14814815                                               |
| Normal    | 2%                                                         | 98%                                                       |

The following are the results of the advanced system test.
Table 3. Normal Thorax X-ray image test:

| No | Test Data         | Percentage of Calculation Result | Identification | Information |
|----|-------------------|----------------------------------|----------------|-------------|
|    |                   | Normal | Covid19 |                   |             |
| 1  | Normal Test 1     | 60%    | 20%     | Normal (60%)      | Success     |
| 2  | Normal Test 2     | 99%    | 1%      | Normal (99%)      | Success     |
| 3  | Normal Test 3     | 98%    | 2%      | Normal (98%)      | Success     |
| 4  | Normal Test 4     | 76%    | 24%     | Normal (76%)      | Success     |
| 5  | Normal Test 5     | 85%    | 15%     | Normal (85%)      | Success     |
| 6  | Normal Test 6     | 73%    | 27%     | Normal (73%)      | Success     |
| 7  | Normal Test 7     | 56%    | 44%     | Normal (56%)      | Success     |
| 8  | Normal Test 8     | 46%    | 54%     | Covid19 (54%)     | Error       |
| 9  | Normal Test 9     | 83%    | 17%     | Normal (83%)      | Success     |
| 10 | Normal Test 10    | 91%    | 9%      | Normal (91%)      | Success     |
| 11 | Normal Test 11    | 95%    | 5%      | Normal (95%)      | Success     |
| 12 | Normal Test 12    | 95%    | 5%      | Normal (95%)      | Success     |
| 13 | Normal Test 13    | 94%    | 6%      | Normal (94%)      | Success     |
| 14 | Normal Test 14    | 90%    | 10%     | Normal (90%)      | Success     |
| 15 | Normal Test 15    | 89%    | 11%     | Normal (89%)      | Success     |
| 16 | Normal Test 16    | 84%    | 16%     | Normal (84%)      | Success     |
| 17 | Normal Test 17    | 93%    | 7%      | Normal (93%)      | Success     |
| 18 | Normal Test 18    | 82%    | 18%     | Normal (82%)      | Success     |
| 19 | Normal Test 19    | 87%    | 13%     | Normal (87%)      | Success     |
| 20 | Normal Test 20    | 89%    | 11%     | Normal (89%)      | Success     |
| 21 | Normal Test 21    | 42%    | 58%     | Covid19 (58%)     | Error       |
| 22 | Normal Test 22    | 48%    | 52%     | Covid19 (52%)     | Error       |
| 23 | Normal Test 23    | 92%    | 8%      | Normal (92%)      | Success     |
| 24 | Normal Test 24    | 99%    | 1%      | Normal (99%)      | Success     |
| 25 | Normal Test 25    | 99%    | 1%      | Normal (99%)      | Success     |
| 26 | Normal Test 26    | 89%    | 11%     | Normal (89%)      | Success     |
| 27 | Normal Test 27    | 91%    | 9%      | Normal (91%)      | Success     |
| 28 | Normal Test 28    | 87%    | 13%     | Normal (87%)      | Success     |
| 29 | Normal Test 29    | 91%    | 9%      | Normal (91%)      | Success     |
| 30 | Normal Test 30    | 77%    | 23%     | Normal (77%)      | Success     |
| 31 | Normal Test 31    | 75%    | 25%     | Normal (75%)      | Success     |
| 32 | Normal Test 32    | 80%    | 20%     | Normal (80%)      | Success     |
| 33 | Normal Test 33    | 77%    | 23%     | Normal (77%)      | Success     |
| 34 | Normal Test 34    | 71%    | 29%     | Normal (71%)      | Success     |
| 35 | Normal Test 35    | 82%    | 18%     | Normal (82%)      | Success     |
| 36 | Normal Test 36    | 82%    | 18%     | Normal (82%)      | Success     |
| 37 | Normal Test 37    | 93%    | 7%      | Normal (93%)      | Success     |
| 38 | Normal Test 38    | 82%    | 18%     | Normal (82%)      | Success     |
| 39 | Normal Test 39    | 88%    | 12%     | Normal (88%)      | Success     |
| 40 | Normal Test 40    | 88%    | 12%     | Normal (88%)      | Success     |
| 41 | Normal Test 41    | 94%    | 6%      | Normal (94%)      | Success     |
| 42 | Normal Test 42    | 72%    | 28%     | Normal (72%)      | Success     |
| 43 | Normal Test 43    | 72%    | 28%     | Normal (72%)      | Success     |
| 44 | Normal Test 44    | 72%    | 28%     | Normal (72%)      | Success     |
| 45 | Normal Test 45    | 94%    | 6%      | Normal (94%)      | Success     |
| 46 | Normal Test 46    | 78%    | 22%     | Normal (78%)      | Success     |
Table 4. Thorax x-ray test for exposure to covid-19:

| No  | Test Data   | Percentage of Calculation Result | Identification | Information |
|-----|-------------|----------------------------------|----------------|-------------|
|     |             | Normal    | Covid19                         |               |             |
| 1   | Covid19 Test 1 | 1%       | 99%                             | Covid19 (99%) | Success     |
| 2   | Covid19 Test 2 | 2%       | 98%                             | Covid19 (98%) | Success     |
| 3   | Covid19 Test 3 | 1%       | 99%                             | Covid19 (99%) | Success     |
| 4   | Covid19 Test 4 | 0%       | 100%                            | Covid19 (100%)| Success     |
| 5   | Covid19 Test 5 | 1%       | 99%                             | Covid19 (99%) | Success     |
| 6   | Covid19 Test 6 | 0%       | 100%                            | Covid19 (100%)| Success     |
| 7   | Covid19 Test 7 | 0%       | 100%                            | Covid19 (100%)| Success     |
| 8   | Covid19 Test 8 | 1%       | 99%                             | Covid19 (99%) | Success     |
| 9   | Covid19 Test 9 | 0%       | 100%                            | Covid19 (100%)| Success     |
| 10  | Covid19 Test 10 | 10%     | 90%                             | Covid19 (90%) | Success     |
| 11  | Covid19 Test 11 | 10%     | 90%                             | Covid19 (90%) | Success     |
| 12  | Covid19 Test 12 | 7%      | 93%                             | Covid19 (93%) | Success     |
| 13  | Covid19 Test 13 | 17%     | 83%                             | Covid19 (83%) | Success     |
| 14  | Covid19 Test 14 | 22%     | 78%                             | Covid19 (78%) | Success     |
| 15  | Covid19 Test 15 | 14%     | 86%                             | Covid19 (86%) | Success     |
| 16  | Covid19 Test 16 | 29%     | 71%                             | Covid19 (71%) | Success     |
| 17  | Covid19 Test 17 | 10%     | 90%                             | Covid19 (90%) | Success     |
| 18  | Covid19 Test 18 | 17%     | 83%                             | Covid19 (83%) | Success     |
| 19  | Covid19 Test 19 | 57%     | 43%                             | Normal (57%)  | Error       |
| 20  | Covid19 Test 20 | 6%      | 94%                             | Covid19 (94%) | Success     |
| 21  | Covid19 Test 21 | 15%     | 85%                             | Covid19 (85%) | Success     |
| 22  | Covid19 Test 22 | 30%     | 70%                             | Covid19 (70%) | Success     |
| 23  | Covid19 Test 23 | 13%     | 87%                             | Covid19 (87%) | Success     |
| 24  | Covid19 Test 24 | 17%     | 83%                             | Covid19 (83%) | Success     |
| 25  | Covid19 Test 25 | 17%     | 83%                             | Covid19 (83%) | Success     |
| 26  | Covid19 Test 26 | 3%      | 97%                             | Covid19 (97%) | Success     |
| 27  | Covid19 Test 27 | 27%     | 73%                             | Covid19 (73%) | Success     |
| 28  | Covid19 Test 28 | 27%     | 73%                             | Covid19 (73%) | Success     |
| 29  | Covid19 Test 29 | 67%     | 33%                             | Normal (67%)  | Error       |
| 30  | Covid19 Test 30 | 16%     | 84%                             | Covid19 (84%) | Success     |
| 31  | Covid19 Test 31 | 5%      | 95%                             | Covid19 (95%) | Success     |
| 32  | Covid19 Test 32 | 10%     | 90%                             | Covid19 (90%) | Success     |
| 33  | Covid19 Test 33 | 3%      | 97%                             | Covid19 (97%) | Success     |
| 34  | Covid19 Test 34 | 26%     | 74%                             | Covid19 (74%) | Success     |
| 35  | Covid19 Test 35 | 21%     | 79%                             | Covid19 (79%) | Success     |
| 36  | Covid19 Test 36 | 15%     | 85%                             | Covid19 (85%) | Success     |
| 37  | Covid19 Test 37 | 24%     | 76%                             | Covid19 (76%) | Success     |
| 38  | Covid19 Test 38 | 27%     | 73%                             | Covid19 (73%) | Success     |
| 39  | Covid19 Test 39 | 11%     | 89%                             | Covid19 (89%) | Success     |
Based on the experiment, the whole system has been tested 100 times which are divided into 2. The results of the experiment obtained an accuracy value on the normal Thorax X-ray image test of 94% with a deviation of 0.132 and the Thorax Covid19 X-ray image test was 96% with a deviation of 0.130. In table 3, 50 normal Thorax X-rays, it is known that 47 times the system test succeeded according to the target and there were 3 system errors found. In table 4, Thorax Covid19 x-rays were carried out 50 times, it is known that 48 times the system test was successful on target and there were 2 system errors found. It is known that research shows the overall performance of the normal Thorax X-ray system test and Covid19 Thorax X-ray comprehensively with an accuracy of 95% and an error of 5%.

4. Conclusion

Based on the results of the development of the Thorax x-ray result classification system against the Internet of Things (IoT) -based corona virus infection, it can be seen that being able to develop an IoT system for the classification of Thorax x-ray results against corona virus infection using the supervised learning method with Image processing algorithm with segmentation and edge detection based on Sobel operator. The results showed 95% were successfully accurate and 5% encountered errors. It was concluded that the successful system could be used to test the Thorax x-ray results in the classification of the positive percentage infected with Covid19 in real time via the internet network. However, it still needs further development to maximize the accuracy of the image processing results on this IoT system. This system is used to help test one of the tests that shows the presence or absence of the corona virus in a patient, so you still have to consider other tests to determine the test results of a patient infected with Covid19.

5. References

[1] Worldometer, "COVID-19 CORONAVIRUS PANDEMIC," 30 Mei 2020. [Online]. Available: https://www.worldometers.info/coronavirus/.
[2] G. T. P. P COVID-19, "Peta Sebaran COVID-19," 20 February 2020. [Online]. Available: https://covid19.go.id/.
[3] J. Widodo, Pembatasan Sosial Berskala Besar dalam Rangka Percepatan Penanganan Covid-19, Jakarta: Peraturan Menteri Kesehatan Nomor 9 Tahun 2020 tentang Pedoman PSBB, 2020.

[4] A. Ramadhan, "Kementrian Kesehatan minta masyarakat waspadai malaria di tengah pandemi COVID-19," 25 April 2020. [Online]. Available: https://www.antaranews.com/berita/1443872/kemkes-minta-masyarakat-waspadai-malaria-di-tengah-pandemi-covid-19.

[5] World Health Organization , "What is COVID-19?," August 2020. [Online]. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-coronaviruses#:~:text=symptoms.

[6] d. R. Fadli, "Coronavirus," 1 July 2020. [Online]. Available: https://www.halodoc.com/kesehatan/coronavirus.

[7] A. E. Hassanien, H. Aboul-Ella and H. H. Elmoussalami, "Automatic X-ray COVID-19 Lung Image Classification System based on Multi Level Thresholding and Support Vector Machine," medRxiv - The preprint server for health sciences, pp. 1-8. DOI: 10.1101/2020.03.30.20047787, 2020.

[8] R. R. Tjandrawinata, "Industri 4.0: revolusi industri abad ini dan pengaruhnya pada bidang kesehatan dan bioteknologi," Dexa Laboratories of Biomolecular Sciences (DLBS), 2016.

[9] A. E. A. Abraham, "Hands-On Machine Learning with Scikit-Learn," Frontiers in Neuroinformatics, pp. Vol. 8. 1-10. https://doi.org/10.3389/fninf.2014.00014, 2014.

[10] H. Pangaribuan, "Edge Detection Optimization Using the Segmentation Method," INFORMATION SYSTEM DEVELOPMENT [ISD] , pp. 30-38. Vol-4, 2019.

[11] P. E. a. Rukmani, "Industrial Monitoring Using Image Processing, IoT and Analyzing the Sensor Values Using Big Data," Procedia Computer Science, pp. 991 - 997. https://doi.org/10.1016/j.procs.2018.07.077, 2018.

[12] V. K. Harleen Kaur, Predictive modelling and analytics for diabetes using a machine learning, New Delhi. India: Department of Computer Science and Engineering School, of Engineering Sciences and Technology, 2016.

[13] R. Sathya and A. Abraham, "Comparison of Supervised and Unsupervised Learning Algorithms for Pattern Classification," (IJARAI) International Journal of Advanced Research in Artificial Intelligence, pp. Vol. 2, No. 2, pp 34 - 38. https://doi.org/10.14569/ijarai.2013.020206, 2013.

[14] N. Sajid, "COVID-19 Patients Lungs X Ray Images 10000." 23 Maret 2020. [Online]. Available: https://www.kaggle.com/nabeelsajid917/covid-19-x-ray-10000-images.

[15] N. Nafi’iyyah and S. Mujilahwati, Buku Ajar Citra Binarisasi Dan Enhancement, Yogyakarta: Deepublish - CV Budi Utama, 2018.

[16] R. Munir, Pengolahan Citra Digital dengan Pendekatan Algoritmitk, Bandung: Informatika, 2004.

[17] A. Kadir and A. Susanto, Teori dan Aplikasi Pengolahan Citra, Yogyakarta: Andi, 2013.

[18] M. Ghozali and H. Sumarti, "Deteksi Tepi pada Citra Rontgen Penyakit COVID-19 Menggunakan Metode Sobel," Jurnal Imaging Diagnostik, pp. 51-59. https://doi.org/10.31983/jimed.v6i2.5840, 2020.