Performance Analysis Algorithm Deep Learning For Introduction Face

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Abstract — **Introduction face in world technology own ability Which Enough Good in do his task. introduction face own various problem Which can foundlike error position picture face, part eye, nose as well as ears that are not completely visible and also with the addition of accessories such as glasses, beards on picture face Which influence accuracy introduction face. Algorithm introduction face use Deep Learning with model network nerve imitation Convolutional Neural Network (CNN). Results from research that done measure analysis algorithm Deep Learning with Convolutional Neural Network method for face recognition use Notation Big-O. With level accuracy predictions model reached 0.99928075 or about 99.93%. model is successful identify facial image recognition correctly. Total time 26.18 seconds of execution required to process the image make predictions with the CNN model. Execution complexity time algorithm Big-O Notations (O) in introduction image performed face did not improve significantly with image size (fixed in CNN model), with constant results of CNN model time complexity as constant or O(1) time execution recorded around 26 second. Based on results processtesting training datasets from each of the two image classes face Rose And Jiso, as much 170 image face data training, Andvalidation dataset of 80 facial images. Testing process andmodel execution time results in the level of accuracy at epoch to 25 val_accuracy as big as 1.00% And total time execution epochamounting to 151,587 seconds. Which shows that the algorithm is deep learning method CNN capable identify introduction face someone with Good.**

Keywords — **Deep Learning, Convolutional Neural Network, Introduction Face, Big O, Accuracy**

I. I NTRODUCTION

Understanding Artificial Intelligence (Intelligence Artificial) according to Wikipedia in[1] is intelligence Which added to something system Which Can arranged in context scientific or Can called Also *Artificial Intelligence* (AI) defined as the intelligence of a scientific entity. AI designed like the characteristics of the human brain which can think critically, make decisions and carry out machining processing start from Which easy until complicated. Branch intelligence artificial intelligence (AI) known as purposeful Pattern Recognition to provide solutions to any related problems with introduction or classification, like introduction pattern voice, text patterns, face patterns, DNA patterns and various patterns other. Introduction Pattern Face is something method introduction oriented on face [2].

Introduction pattern is One field in Machine Learning (Machine Learning) is about extracting knowledge from data. This is field study in the intersection of statistics, artificial intelligence, and computer science and is also known as predictive or learning analytics statistics[3]. Introduction pattern face somebody usually matter Which easy to do by man.

Especially on period Now This system processing data based introduction image face in a way automatic has growing rapidly, this is due to high demand For system identification on agency or group For search for data through facial recognition to make it faster and accurate [4]. Previous research conducted by Egie Hermawan with title Classification Introduction Face use Face mask or No with Implement Method CNN. On study This Take several samples of facial objects using face mask or No use face mask. Algorithm Deep Learning with the CNN method will classify and identify image face from data training, data testing And evaluation data. The testing data produces 0.99% for image face Which use face mask And No use After that, the training data will be tested and tested accuracy and produces 79.61% for facial images use face mask And 95.12% For image face Which Nouse mask[5].

Previous research conducted by Noviana Dewi and Fiqh Ismawan with the title Implementation of Deep Learning use Convolution Neural Network For System Introduction Face. On study This method CNN use pre-trained neural networks as method extraction feature Then detection face will produce characteristic features every face (classifier). In introduction face This results accuracy Which obtained is 98%[6]. On study previously collection data using the Haar Cascade Method, draw facial imageshas been detected and will then be stored in the dataset and in process For introduction face. Introduction face will processed by the Convolutional Neural Network method. Picture face Which will recognized is pattern face move on classification. This research used 2 respondents facial data collection. Retrieval of 200 data with 100 face per person. Pattern recognition test results at stage research accuracy is 90% and validation accuracy is 95% [7]. In previous research, identification of faces with masks or even No use CNN. Data will in modify with deep learning method known as DWSC-PCA-SAE (Depth-wise Separable Convolutional Neural Network using Principal Components Analysis and Stacked autoencoder). DWSC-PCA-SAE requires additional processing for create facial image data visualization because this DWSC- PCA-SAE is less able to differentiate between facial applications masked and no masked Which in accordance [8].

Deep Learning with deep CNN methods and efficient used For detect in a way automatic on image X-ray chest. Deep Learning efficient on study This compare model ShuffleNet. EfficientNet And ResNet50. Results his is model CNN ShuffleNet produce accuracy which is less than 18.55 times that of EfficientNet and 22.36 from ResNet50. GPU memory consumed by ShuffleNet is the least, namely 0.646 GB and detection time most fast that is 0.0027 seconds[9]. Deep learning with The CNN method is used for face recognition in the system security of access doors at a bank. Introduction stages face on study This is acquisition picture, preprocessing, extraction, classification and identification. Datasets using faces of 5 bank employee data from 70 facial data on each person. The total data is 350 and is divided in 3 stages of data, namely training data, validation data and test data. From the test results, the program can identify faces with presentations accuracy 95% [10].

In previous research Big-O Notation will be used to find out which algorithm is most suitable, efficient and effective. The data used is 1 million, 10 million and so on 100 million. Study focused on time access And use memory. This research uses a recursive algorithm and iterative algorithm. The results obtained for the recursive algorithm is 25.5147 second 26,847 second And 28.3863 second on resultstime execution And 58.3 MiB, 406.9 MiB And 3882.3 MiB on use memory. Results Which obtained For algorithm iterative is 0.0143 seconds, 0.016 seconds and 0.0133 seconds at time results execution And 57.2 MiB, 405.1 MiB And 3881.7 MiB on use memory [11].

System introduction face in do task his sometimes No always accurate. There is a number of problem Which encountered such as errors in the position of the facial image, the eyes, the nose and ears are not completely visible And Also with exists addition accessories like glasses, Beards on facial images are affecting facial recognition accuracy. Therefore, researchers in This research wants to study the efficiency of the Deep algorithm Learning method Convolutional Neural Network with using Notation Big-O.

II. RESEARCH METHOD

Channel Study Which done on study This depicted in Fig.1 the method that will be used for calculating the efficiency of Deep Learning algorithms with methodsConvolutional Neural Network (CNN) uses Notation Big-O is based on facial image images so that it uses algorithm Deep Learning can help user For facial recognition according to its efficiency, namely the study stage literature, data cleaning, stage preprocessing datasets, stage algorithm deeplearning CNN method, analysis and calculation of Big-o Notation, model evaluation and algorithm performance analysis results stage . Following The research stages that will be carried out consist of 6 stages which will be described by the methodological process flow can seen on picture following:

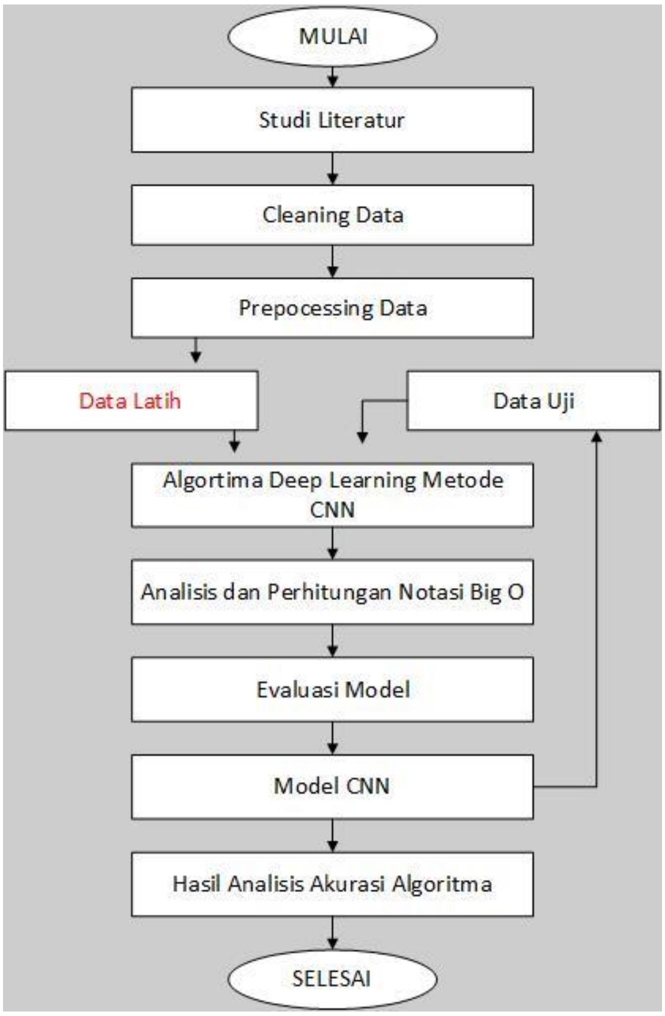

MULAI
Studi Literatur
Cleaning Data
Prepocessing Data
Data Latih
Data Uji
Algortima Deep Learning Metode CNN
Analisis dan Perhitungan Notasi Big O
Evaluasi Model
Model CNN
Hasil Analisis Akurasi Algoritma
SELESAI

Fig. 1 Stages Channel Methodology Study

From Fig.1 Stages study Which will The implementation of each process is explained in sub chapter up with sub-sub chapters following.

A. Stage Studies Literature

Literature Study Stage in this research comes from share References like book, journal national And international, articles and other sources relevant to this research. Consultation with mentor Also Wrong One source literature in research This.

1. Datasets

   Collection data done For obtain information Which needed in frame reach research purposes. Data sources used in study This sourced from data secondary Which taken in a way *open source* on address site web www.kaggle.com. Data set Which used is image face image. Each data set will be resized to 64 x64 before training data is carried out and data testing.

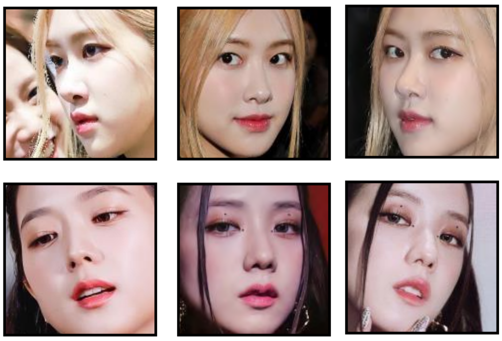


Fig. 2 Sample datasets image face

B. *Data Cleaning*

The data set used in this research will go through the data cleaning stage. Cleaning data is a step taken to identify data errors before preprocessing or processing is carried out.

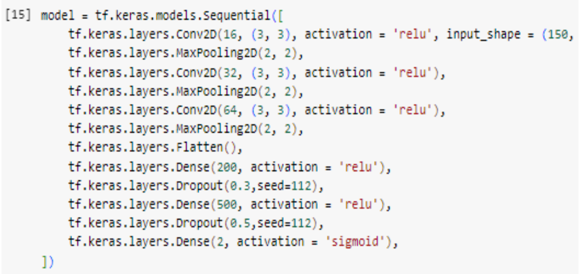
Incomplete, inappropriate and inaccurate data will be re-screened and then deleted or updated. Data cleaning was carried out using the Matlab application.

C. *Stage Preprocessing Datasets*

On stages preprocessing data done For prepare image picture face before process training And testing. This step includes normalization And identification data variations by detecting the smallest details of the dataset size, images that have a tilted orientation. Data used In this study, facial data was downloaded online open source in website www.kaggle.com And a number of reference about Deep Learning, Convolutional Neural Network (CNN) And Notation Big-O. Results data Which has selected will undergo training and testing with 60% amount data For training And 40% data For testing fromtotal amount of data. The best results from this step will be in Continue to the image identification stage. From the results of training and testing will done identification image use Python programming with CNN algorithm.

D. *Algorithm Deel Learning Method CNN*

CNN is an early model of Deep Learning. CNN will do convolution with process filtering before in reduce it using the pooling technique. Identifying image images The face will be input using Matlab. Result of collection data Then processed For form model design system.



```
[15] model = tf.keras.models.Sequential([
         tf.keras.layers.Conv2D(16, (3, 3), activation = 'relu', input_shape = (150,
         tf.keras.layers.MaxPooling2D(2, 2),
         tf.keras.layers.Conv2D(32, (3, 3), activation = 'relu'),
         tf.keras.layers.MaxPooling2D(2, 2),
         tf.keras.layers.Conv2D(64, (3, 3), activation = 'relu'),
         tf.keras.layers.MaxPooling2D(2, 2),
         tf.keras.layers.Flatten(),
         tf.keras.layers.Dense(200, activation = 'relu'),
         tf.keras.layers.Dropout(0.3,seed=112),
         tf.keras.layers.Dense(500, activation = 'relu'),
         tf.keras.layers.Dropout(0.5,seed=112),
         tf.keras.layers.Dense(2, activation = 'sigmoid'),
     ])
```

Fig. 3 Models CNN Detection Face

From Fig.3 in on show stages model Convolutional Neural Network (CNN for facial recognition detect whether a face is present in an image or not. Which has three convolution layer followed by max pooling, Then next with two layers Dense with dropout to prevent overfitting, and ends with a layer output use Activation sigmoid. Activation function sigmoid is used to produce output in a range [0, 1], Which can interpreted as probability.

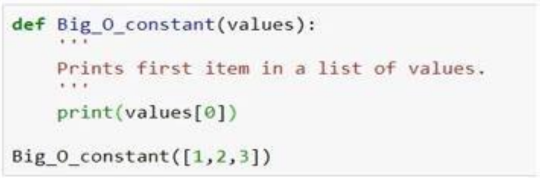
E. *Analysis and Calculations Notation Big-O*

Notation Big-O on research This will do analysis algorithm Deep Learning in introduction face totime execution, how much efficient And complexity linecode in dimensions time as well as complexity room (memory).

Big-O Notation calculations are carried out as they increase number of inputs Which given:

1. O(1) Constant

   This notation is the simplest notation. Notation can be define constant O with No care how much input is given. The function will only be takes a constant step size and displays first value, if the input data is 100 which is in print only 1, if the input data is 100 in print just 1. Mark n will print only 1 items.



```
def Big_O_constant(values):
    '''
    Prints first item in a list of values.
    '''
    print(values[0])

Big_O_constant([1,2,3])
```

Fig. 4 Coding Python Notation O(1) constant

From Fig.4 Algorithm for checking the similarity of sentences (NLP) in chatbots is applied to modified input For inspect the similarities with question from set question Which has determined, Which the answer is available.

Based on keywords, the information required by user understood And information the provided from databases.

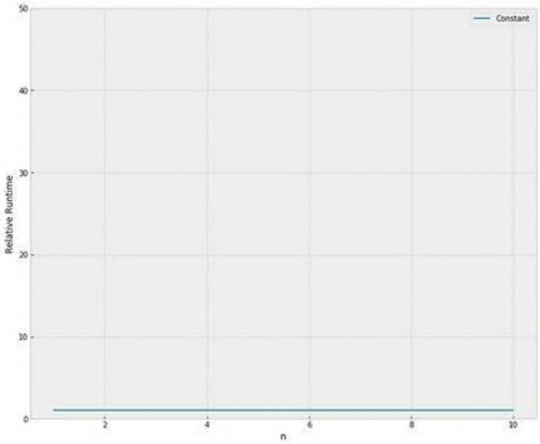
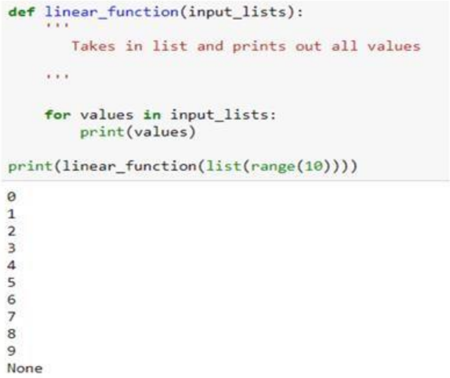


Fig. 5 Implementation databases system

From chart on We can observe that How manyeven mark input, time the process remains constant.

2. O(n) linear
   This notation will depend on the number of inputs will be entered. This function runs in linear time.If we input 100 input data, 100 will be printed time, input 10,000 data input will printed
   10,000 time, mark n will be printed n time.



```
def linear_function(input_lists):
    '''
        Takes in list and prints out all values

    '''

    for values in input_lists:
        print(values)

print(linear_function(list(range(10))))
```

```
0
1
2
3
4
5
6
7
8
9
None
```

Fig. 6 Coding Python Notation O(n) linear

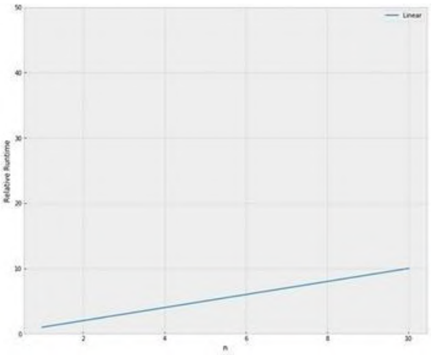
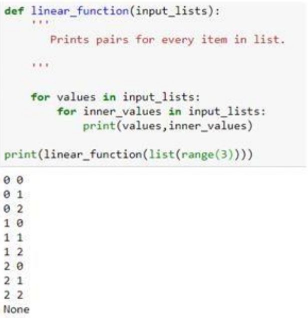


Fig. 7 Chart Notation O(n) linear

From chart on We can observe that runtime depends on the input value because of the input value increase, so runtime Also increase.

3. O(n2) square
   Every n will be multiplied by n tasks or n2. So input totaling 10 will own 102 or 100 operation.



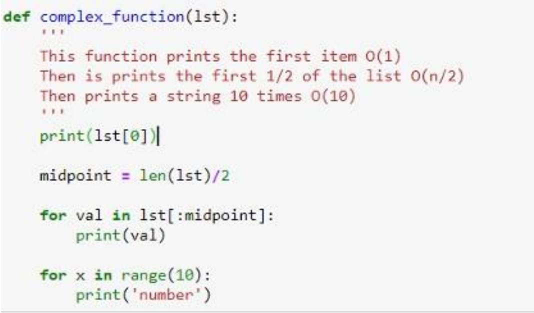
```
def linear_function(input_lists):
    '''
        Prints pairs for every item in list.

    '''

    for values in input_lists:
        for inner_values in input_lists:
            print(values,inner_values)

print(linear_function(list(range(3))))
```

```
0 0
0 1
0 2
1 0
1 1
1 2
2 0
2 1
2 2
None
```

Fig. 8 Coding Python Notation O(n2)
square

1 data face : 1 second ; 10 data face : 100 second ; 100data face : 10,000 second Amount items increase with factor 10, but time increase with factor102 because n = 10 And O(n2) with scale n ^{2} that is 102.

4. Count scale Big-O
   Something function algorithm Can So will more complexIf Lots loops And statement condition Whichused during the process. Combine every operationto get the Big O total is by formula O(1+n/2=10)

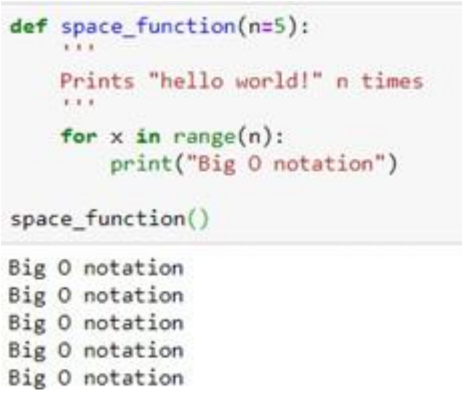


```
def complex_function(lst):
    '''
    This function prints the first item O(1)
    Then is prints the first 1/2 of the list O(n/2)
    Then prints a string 10 times O(10)
    '''
    print(lst[0])

    midpoint = len(lst)/2

    for val in lst[:midpoint]:
        print(val)

    for x in range(10):
        print('number')
```

Fig. 9 Coding Python computes scaleNotation Big-O

In the picture above, n will have a larger data value input 1 And 10 No will become significant And data ½ multiplied by n will have no effect when n has infinite value and the function obtained is O(n).

5. Complexity Room
   In calculation complexity room Which calculatedis size allocation memory on moment process algorithm in progress.



```
def space_function(n=5):
    '''
    Prints "hello world!" n times
    '''
    for x in range(n):
        print("Big O notation")

space_function()
```

```
Big O notation
Big O notation
Big O notation
Big O notation
Big O notation
```

Fig. 10 Coding Python determine variable

Notation Big-O For complexity room On picture on variable only in set One time, So O(1) algorithm and O(n) time complexity Because depend on size mark n.

F. *Evaluation Stage Model*

This stage will test the facial data to be identified using Matlab. Matlab will do the detection face in a way comprehensive. Data face Which has identified will showing face the Correct there is on databases.The system will capture a facial image to see if it matches identity picture face.

G. *Results Performance Analysis Algorithm*

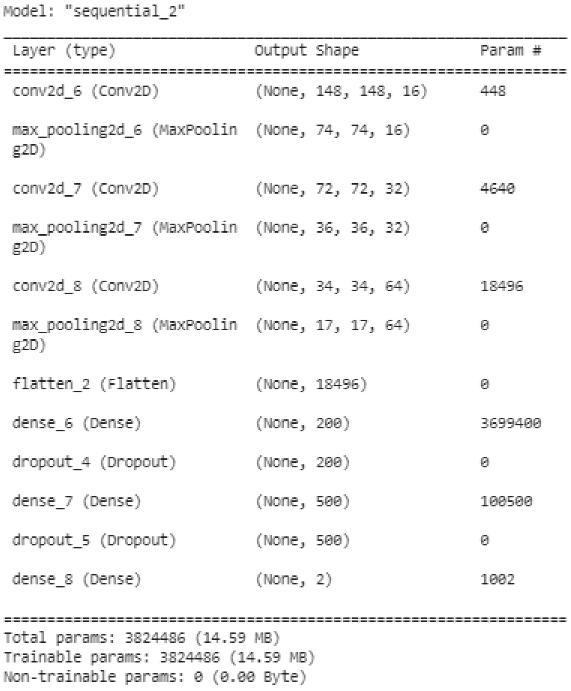
The results of the algorithm performance analysis will be obtained as the image recognition process progresses. Data will be input regularly and its efficiency will be seen based on running time and space.

III. RESULTS _ AND D ISCUSSIONS

In the system testing results process, the CNN model is used on facial recognition identification in face detection can differentiate face someone uses a deep algorithm learning CNN method for face recognition using Notation Big-O.

A. *Deep Learning Method Analysis Results CNN*

Model architecture analysis model Convolutional Neural Network, there are three convolution layers with max pooling to extract features from input images. output from layers convolution flattened And processed through two layers Dense. Activation ReLU is used in convolution and Dense layers, whereas output layers use sigmoid For classification binary, following results model sequential CNN:



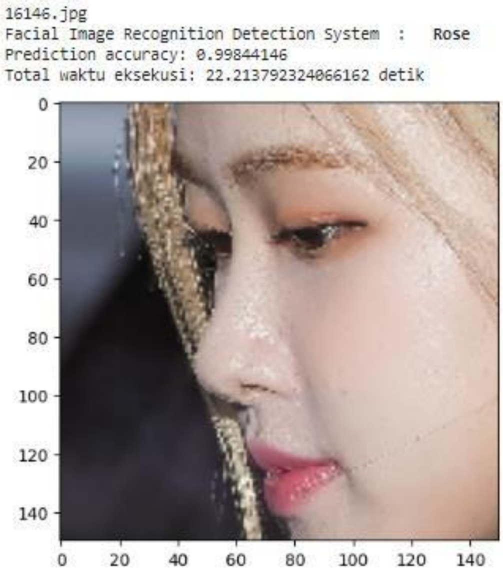
```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_6 (Conv2D)           (None, 148, 148, 16)      448

 max_pooling2d_6 (MaxPoolin  (None, 74, 74, 16)        0
 g2D)

 conv2d_7 (Conv2D)           (None, 72, 72, 32)        4640

 max_pooling2d_7 (MaxPoolin  (None, 36, 36, 32)        0
 g2D)

 conv2d_8 (Conv2D)           (None, 34, 34, 64)        18496

 max_pooling2d_8 (MaxPoolin  (None, 17, 17, 64)        0
 g2D)

 flatten_2 (Flatten)         (None, 18496)             0

 dense_6 (Dense)             (None, 200)               3699400

 dropout_4 (Dropout)         (None, 200)               0

 dense_7 (Dense)             (None, 500)               100500

 dropout_5 (Dropout)         (None, 500)               0

 dense_8 (Dense)             (None, 2)                 1002

=================================================================
Total params: 3824486 (14.59 MB)
Trainable params: 3824486 (14.59 MB)
Non-trainable params: 0 (0.00 Byte)
```

Fig. 11 Results model summary cnn

In the image Fig. 10 total number of parameters trained is 3824486 (14.59 MB), covers all parameter (weight And biased) Which trained from model And in unit bytes (14.59 MB). Total params And trainable params reflect model complexity and how big the memory space is needed to store those model parameters used For introduction image use Convolutional Neural Network.

B. *Implementation Results Recognition System Face*

In this research, after making the process results model CNN Which in accordance with need, furthermore implementation The analysis and deep learning algorithm carried out are as follows detection system introduction facial image:



```
16146.jpg
Facial Image Recognition Detection System  :   Rose
Prediction accuracy: 0.99844146
Total waktu eksekusi: 22.213792324066162 detik
```

Fig.12 Results system detection introduction face

From Fig.12 the results of facial recognition detection, the model is successful recognize faces in images with the file name '16146.jpg'. Results system predict face the identified as "Rose". With level accuracy predictions model reach 0.99928075 or around 99.93%. model succeed in image recognition face with Correct.

Total time execution 26.18 second. Which needed For processing image do predictions with model CNN. Big-O algorithm time complexity execution time information Notations (O) in introduction image face Which done, time execution No increase in a way significant with size picture (still in model CNN), with results still from model CNN complexity time as constant or O(1),time execution recorded around 26 second, enhancement size image or number of images not directly influence time execution in a way proportional, so that complexity time considered constant.

C. System Testing Results

On process after implemented testing with using a previously labeled image dataset, following results accuracy training And testing from model Which produced:

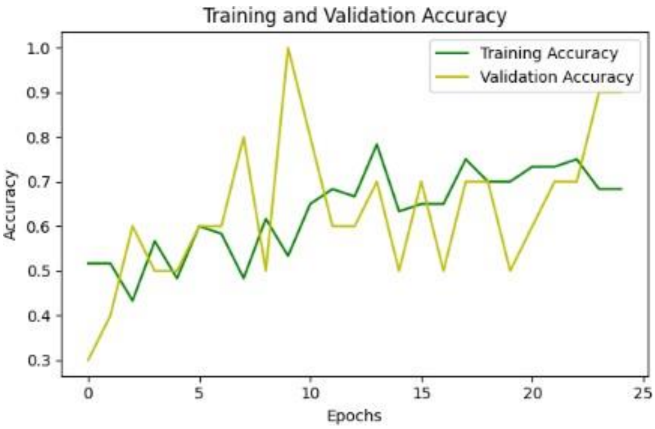
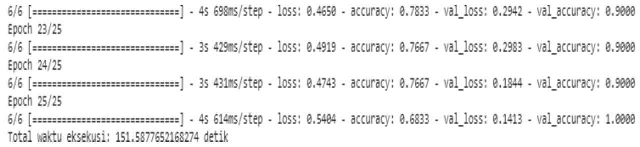


Fig.13 Results accuracy training And testing

From Fig.13 plot of training accuracy (Training Accuracy) and validation (Validation Accuracy) process done during a number of epoch as much 25 epochs Which show accuracy model on the training data as the epoch progresses the higher the training line, the better the model recognizes training data. Meanwhile, validation accuracy test results the yellow line in the plot shows the accuracy of the model on the data validation as the epoch progresses. Validation is used For measure so far where model can generalize to data that has never been seen before. If the validation test runs parallel to the training line, indicating that the model is not overfitting. The following is the epoch data train process and validation as following:



```
6/6 [==============================] - 4s 698ms/step - loss: 0.4650 - accuracy: 0.7833 - val_loss: 0.2942 - val_accuracy: 0.9000
Epoch 23/25
6/6 [==============================] - 3s 429ms/step - loss: 0.4919 - accuracy: 0.7667 - val_loss: 0.2983 - val_accuracy: 0.9000
Epoch 24/25
6/6 [==============================] - 3s 431ms/step - loss: 0.4743 - accuracy: 0.7667 - val_loss: 0.1844 - val_accuracy: 0.9000
Epoch 25/25
6/6 [==============================] - 4s 614ms/step - loss: 0.5404 - accuracy: 0.6833 - val_loss: 0.1413 - val_accuracy: 1.0000
Total waktu eksekusi: 151.5877652168274 detik
```

Based on results process testing training datasets from each – each two class image face Rose And Jiso, as much 170 facial images training data, and as many validation datasets 80 facial images. Testing process and model execution time produces the level of accuracy at the 25th epoch val_accuracy as big as 1.00% And total time execution epoch as big as 151,587 second. Which show that algorithm deep learning method CNN capable identify introduction face somebody with Good.

D. Evaluation Results And Efficiency Analysis Algorithm

Results evaluation is carried out to observe model performance from the algorithm from the validation dataset of each Rose class And Jiso as much 40 datasets image face Which implemented from the system test data carried out depicted in the form of confusion matrix as following:

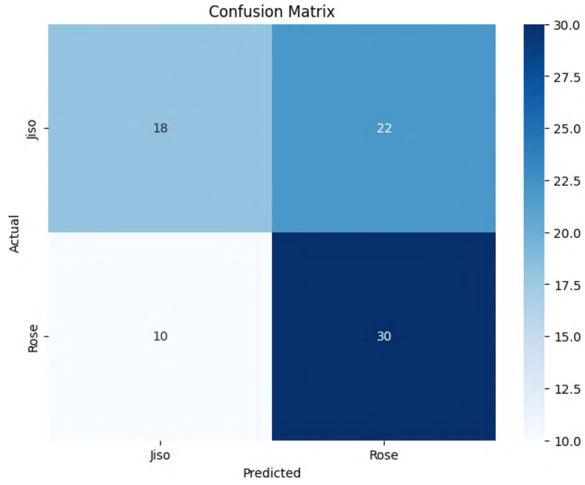


Fig.14 Visualization evaluation Confusin matrix

From results confusion matrix Which generated evaluation performance facial recognition model on validation dataset, evaluation results analysis with confusion matrix Which done with Classification Report precision of Jiso class is 1.00% recall 0.35% and f1-score 52.0% while Rose's precision is 61.0% recalls 1.00% And f1-score 75.0%.

While the epoch results are 1/25 time complexity (Big-O) from training model more focus on growth time or algorithm space relative to the input size. Amount epoch (E) is amount time all over datasets passed by modelduring training, Number of batches (B) is the number of batches used in every epoch, Size batches (S) is amountsamples in each batch and Number of model parameters (P) is amount parameter (weight And biased) Which must optimized during training. With analysis factors The efficiency time complexity can be calculated as following:

Total time = E × (B×S) × P; Produce total complexity time (Big-O): 5736729000. Which show unit digit estimation relatively algorithm.

IV. C ONCLUSIONS

Based on results evaluation And implementation testing Which has been carried out on a facial image recognition detection model using the Convolutional Neural Network (CNN) method for facial recognition using Big-O Notation, then can taken conclusion as following:

1. Results model CNN capable recognize face with accuracy tall, reach 99.93%. Time execution the model recorded approximately 26 seconds to process the image faces show high efficiency in recognition facial image. When testing the model with a dataset has labeled, accuracy training And validation reach 100% on epoch 25th.
2. Time complexity analysis of algorithms with Notation Big-O show that time execution No increase in a way significant along with size picture, produce complexity time Which

constant (O(1)). Enhancement size picture or amount picture No influence time execution in a way proportional. From analysis complexity time on epoch 1/25, the total time complexity (Big-O) is calculated as big as 5736729000 size input Which used show efficiency the algorithm tall.

3. Research results of the CNN model for facial recognition detection use Notation Big-O produce accuracy high, efficient and has low time complexity can accepted for input size used.

R EFERENCES

[1] Siahaan, M., Harsana Jasa, C., Anderson, K., Rosiana, MV, Lim, S., & Yudianto, W. (2020). Application of Artificial Intelligence (AI) Against a Person with a Blind Disability. In Journal Of Information Systems And Technology (Vol. 01).

[2] Raharjo, B. (ND). P Y Foundation Prime Agus Technique Foundation Prime Agus Technique Foundation Prime Agus Technique Learning Machine (Machine Learning).

[3] Xu, L. Yes, Lu, Y., & Li, L. (2021). Embedding Blockchain Technology Into IoT For Security: A Surveys. IEEE Internet Of ThingsJournal, 8(13), 10452–10473. https://Doi.Org/10.1109/JIOT.2021.3060508.

[4] Adi Nugroho, P., Fenriana, I., & Arijanto, R. (2020). Implementation Deep Learning Use Convolutional Neural Network (CNN) On Expression Man. Journal Algor, 2(1). Https://Jurnal.Buddhidharma.Ac.Id/Index.Php/Algor/Index.

[5] Adrianto, L. B., Wahyuddin, m I., & Winarsih, W. (2021). Implementation of Deep Learning for Personal Data Security Systems Use Introduction Face With Method Eigenface Android based. Journal of Information and Communication Technology), 5(1), 2021. https://Doi.Org/10.35870/Jti.

[6] Alom, M.Z., Taha, T.M., Yakopcic, C., Westberg, S., Sidike, P., Nasrin, m S., Hassan, M., Vans Essen, B. C., Awwal, A. A. S., & Asari,
V. K. (2019). A State-Of The-Art Survey On Deep Learning Theory AndArchitectures. In Electronics (Switzerland) (Vol. 8, Issue 3). MDPI AG. https://Doi.Org/10.3390/Electronics8030292.

[7] Cut Al-Saidina Zulkhaidi, T., Maria, E., Engineering Technology Studies Device Soft, P., & Agriculture Country Samarinda, P (2019).Introduction Pattern Form Face With Opencv. JURTI, 3(2).

[8] Institute Of Electrical And Electronics Engineers, & Manav Rachna International Institute Of Research And Studies. (ND). Proceedings Of The International Conference On Machine Learning, Big Data, Cloud And Parallel Computing : Trends, Perspectives And Prospects : COMITCON-2019 : 14th-16th February, 2019.

[9] Janiesch, C., Zschech, P., & Heinrich, K. (N.D.). Machine Learning And Deep Learning. https://Doi.Org/10.1007/S12525-021-00475-2/Published

[10] Majors, YNN, & Computer, I. (2019). Digital Image Processing Comparison Method Histograms Equalization And Specifications On Gray Image. J-Icon, 7(1), 87–95..

[11] Moolayil, J. (2019). Learn Keras For Deep Neural Networks. In Learn Hard For Deep Neural Networks. Apress. https://Doi.Org/10.1007/978-1-4842-4240-7.