Application Of The Viola Jones Algorithm On Face Detection

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Abstract
The face is the central organ for human expression, recognition, and communication. The face consists of four very important sense organs, namely the nose, eyes, ears, and tongue. The human brain has the privilege of recognizing someone based on their face. Face Detection is used to find out faces or nonfaces in an image and this section is the first step in the face detection process so its presence is very vital. Face detection task is very easy for humans, but this task is very complicated for computers because there are several stages that must be passed to detect faces. Where in this study the author designed and made an application for the application of the viola jones algorithm on face detection by discussing Python programming and using the Mysql database. The application of the viola jones algorithm on face detection goes well. Faces can be recognized by the application and display face owner information. Where the test is divided into 5 (five) including lighting testing with a test percentage level of 66.67% of detected faces, testing distance testing of 100% of faces detected at a distance of 1-100 cm, testing the number of faces there are 6 (six) results detected with 2 (two) faces, where faces must be approximately 10 cm apart so that faces can be detected and no results are detected on 3 (three) faces. So it can be concluded that the application cannot capture all faces detected by the camera. different face testing percentage test 100% the application can detect different people's faces with a single face.

*Keywords: **Face Detection, Image, Viola Jones***

INTRODUCTION

The face is the central organ for human expression, recognition and communication. The face consists of four very important sense organs, namely the nose, eyes, ears and tongue. In the human body, the face is at the front of the head and extends from the forehead to the chin. The shape and appearance of the face is assessed based on the structure of the bones and facial muscles. The human brain has the privilege of recognizing someone based on their face. Computer Vision is one of the fields of science in the computer world that discusses how computers can read data from images or videos. One application of computer vision in the field of image processing is face detection. Face Detection is used to find out faces or non faces in an image and this section is the first step in the face detection process so that its presence is very vital. Face detection task is very easy for humans, but this task is very complicated for computers because there are several stages that must be passed to detect faces.
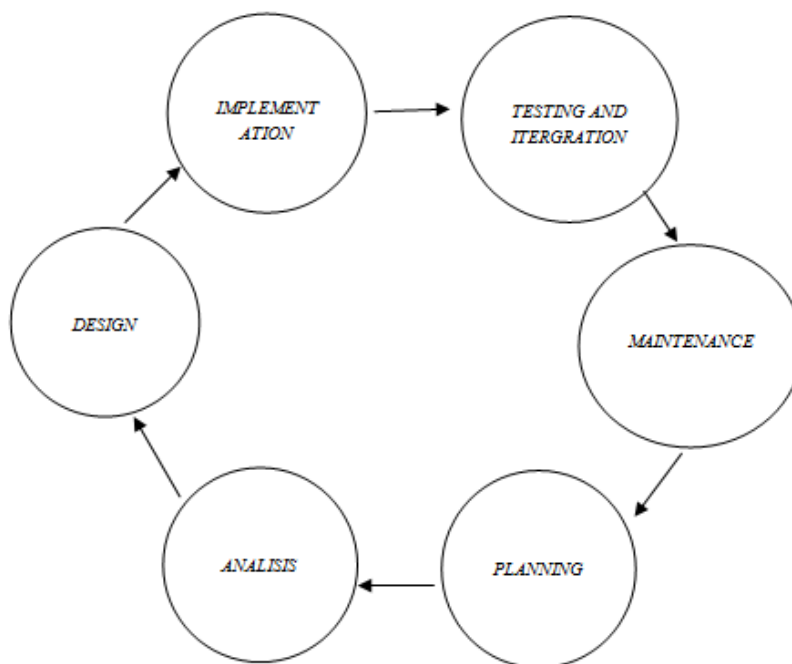
860

RESEARCH METHODS

Figure 1. Research Workflow

Based on the picture above, it can be explained that there are several stages used in making this application program, namely as follows:

1. **Planning**

   Planning is the stage where the author identifies and determines the scope that needs to be done in the process of developing face detection applications. At this stage, the author collects all the information needed in the process of developing a face detection application.

2. **Analysis**

   The next stage is the analysis process. At this stage, the author will analyze the functional requirements of the face detection application. The author conducts an analysis to find out what are the problems that can hinder the creation of the application, what are the targets to be achieved, what are the main objectives of developing the face detection application, what is the function of the application to be developed, and others.

3. **Design**

   Based on the results of planning and analysis that have been determined previously, the author will make a design plan or design specifications. Several design aspects will be determined such as:

   - *Architecture*: programming language to be used, the overall software design, and others.
   - *User Interface*: defines how the user interacts with the application and how the face dection application responds.

4. **Implementation**

   In this phase, the process of creating a face detection application begins. The author starts to build the whole face dection by writing code using the chosen programming language.

5. **Testing And Itergration**
    At this stage, after the implementation stage has been completed, at this stage the face detection application is tested, whether the face dection application can run as expected or not.

6. **Maintenance**
    The last stage is the maintenance process or application maintenance. At this stage, the author performs application maintenance and routine updates so that application performance remains optimal. Some of the maintenance activities carried out are:

The Role of The System
In this face detection application the author uses the viola jones application in solving problems. Where this design uses activity diagrams and use case diagrams to run the application to be designed.
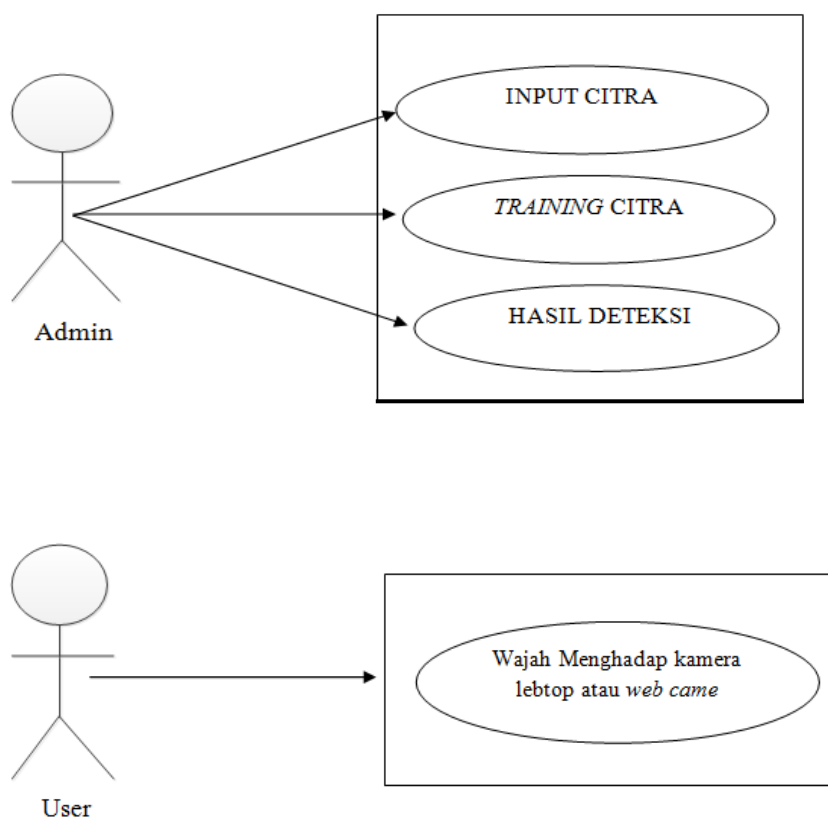
Figure 2. Use Case Diagram Face Detection

The use-case diagram above illustrates that the user runs a face detection application in the detection process on an image, the application will capture the image using a camera / web cam that is connected to the application. If the image to be detected has been obtained, then the next process the application performs the training process. In the final stage, the application displays the detection results. The main object in this detection process is the face, if a face is detected, the application will display information to the user that a face has been detected.

Furthermore, to better understand the activity of the face detection application in the system being built, you can see the process diagram of the face detection application activity, such as the following digital image activity diagram:
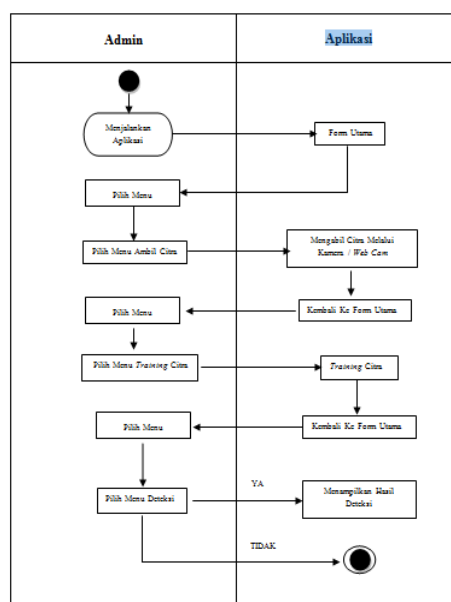
Figure 3. Face Detection App Activity Diagram

RESULTS AND DISCUSSION

User System Interface

The appearance of the application is designed using the Python programming language with the application of the viola jones algorithm using the Mysql database, which is as follows:

Login Page

After the program is run, the application displays the login page, on the admin login page enter the username and password to enter the main menu page. The login page display is as follows:
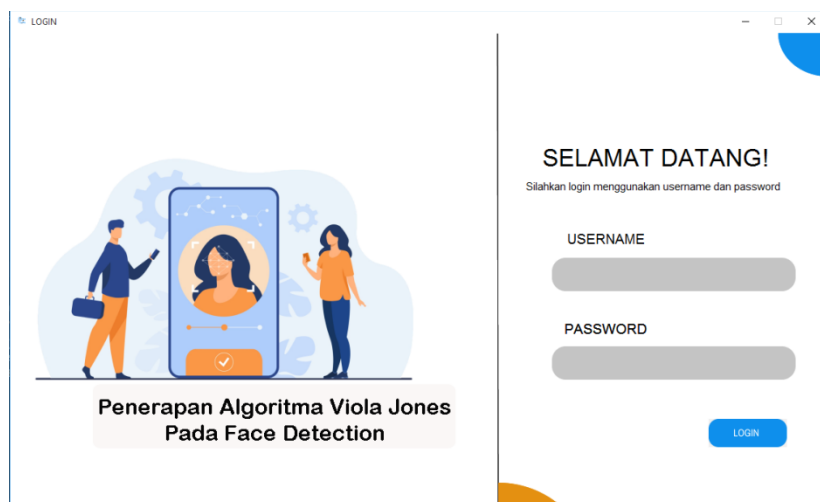

Figure 4. Face Detection App Activity Diagram

Main Page

On this page the admin inputs the username and password to enter the main menu page. Where the admin inputs user data and takes an image of the user's face by clicking the take picture button where the camera automatically takes 30 images of the user's face.
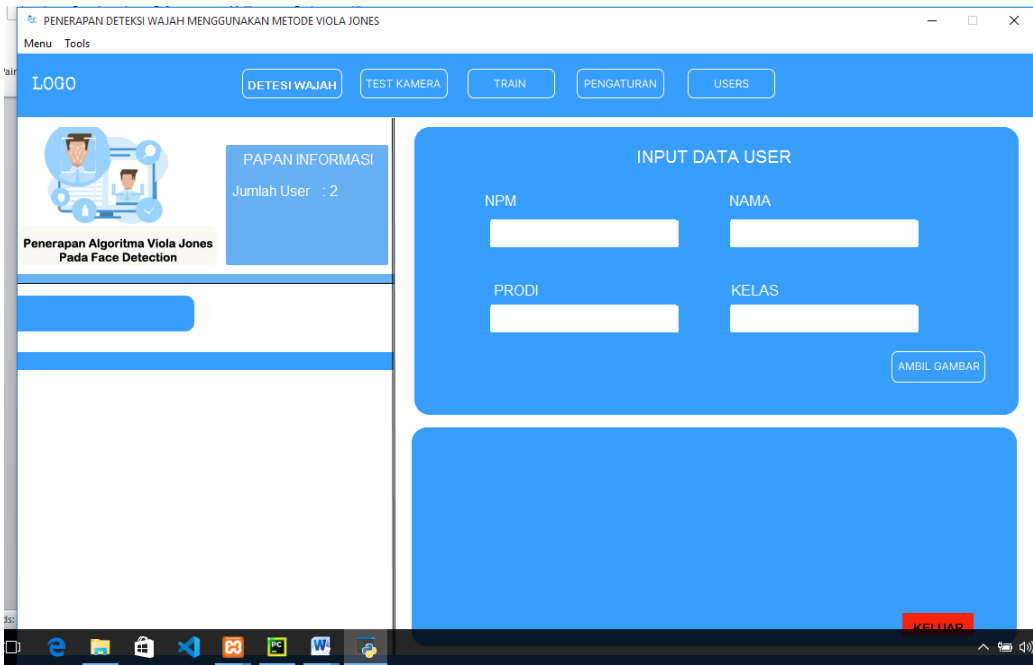
Figure 5. Main Page

Main Page (Train Button)

Admin performs user data input and facial image retrieval on the main page to train facial images by clicking the train button
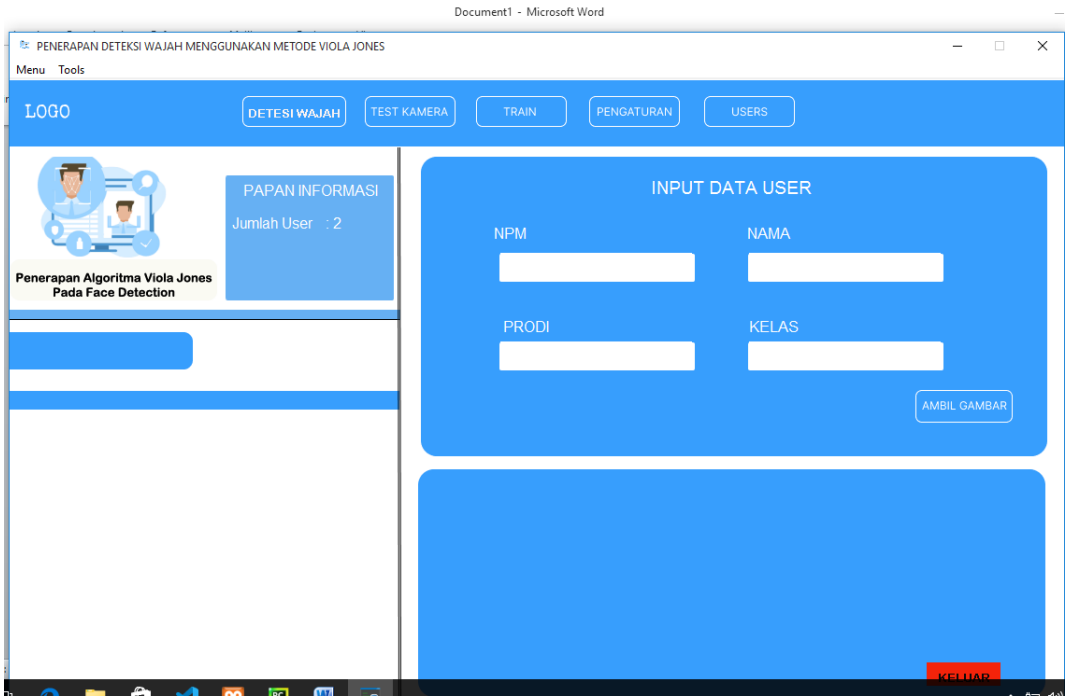

Figure 6. Main Page (Train Button)

Main Page (Face Detection Button)

After the face is completed in the training stage, to see the results, click the face detection button. Where the application automatically recognizes the owner of the face when the face is brought near the laptop / web cam camera.
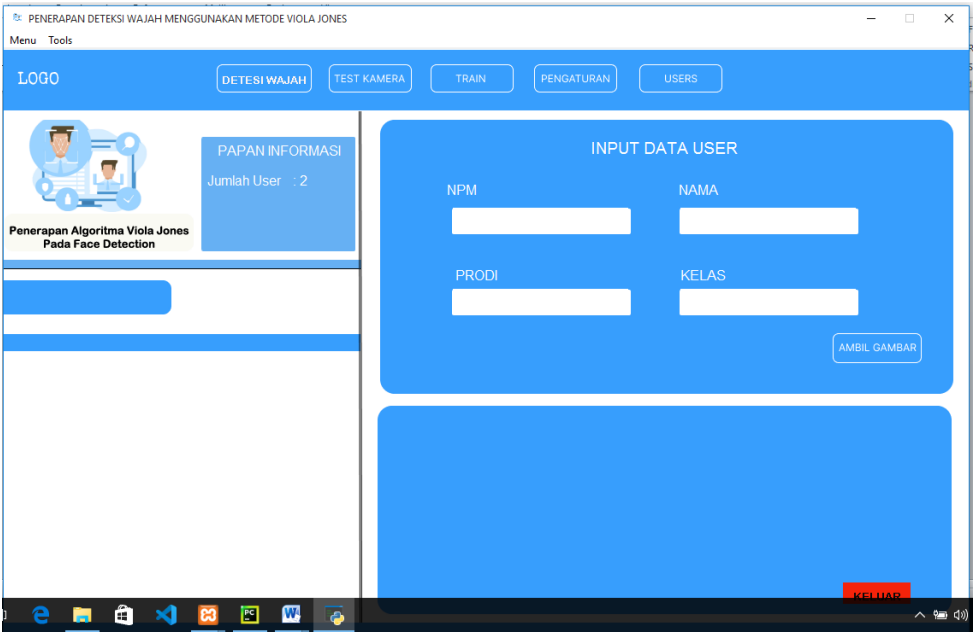
864
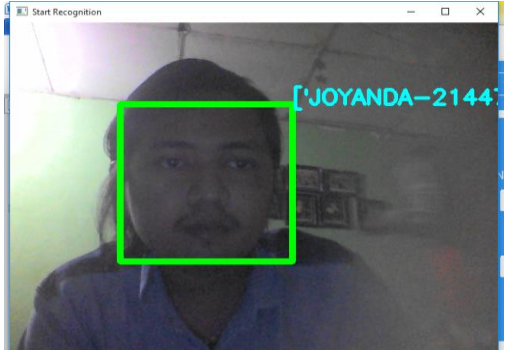
Figure 7. Main Page (Face Detection Button)

Detection Display Results

The display of face detection results where the face is recognized and on the result display there is a square around the face area and displays the name of the owner of the face and the user's npm.

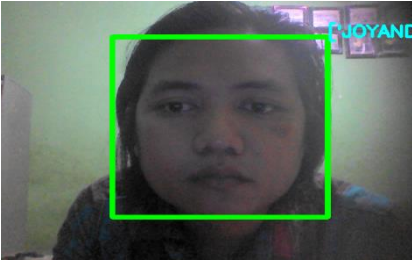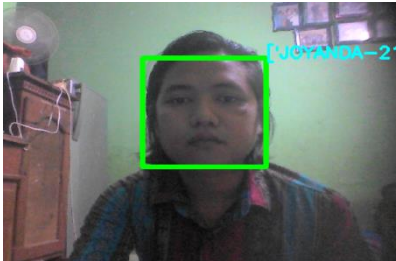**Figure IV. 8 Detection Display Results**

Application Trial
Lighting Test

Face Drawing	Lighting	Results
	Bright	Detected
	Dim	Detected
	Dark	Not Detected

The results of the lighting test have 2 (two) results detected in the test, so it can be concluded that the lighting when it is needed in the use of the application even though the face image has been captured on the camera but the result is that the face is still not detected. With the percentage level of lighting test results are:

$$\frac{\text{Test Results Detected}}{\text{Sum Test}} \ \text{x 100}$$

$$\frac{2}{3} \ \text{x 100} \ = \ 66{,}67 \ \%$$

Distance Test

Face Drawing	Distance	Results
	10 -15 cm	Detected
	16 - 30 cm	Detected
	31- 45 cm	Detected
	46 - 60 cm	Detected
	61 - 100 cm	Detected

The results of the distance test have 5 (five) results detected in the test, so it can be concluded that the distance of the face from 1-100 cm the face is still detected, where the farther the distance from the face to the face camera will not be detected. The percentage level of distance testing is:

$$\frac{\text{Test Results Detected}}{\text{Sum Test}} \text{ x } 100$$

$$\frac{5}{5} \text{ x } 100 = 100 \text{ \%}$$

Face Count Test

Face Drawing	Number Of Face	Results
	1 Face	Detected
	2 Face Position 1	Detected
	2 Face Position 2	Detected
	2 Face Position 3	Detected
	2 Face Position 4	Detected

	2 Face Position 5	Detected
	2 Face Position 6	Detected
	3 Face Position 1	Not Detected
	3 Face Position 2	Not Detected
	3 Face Position 3	Not Detected

The results of testing the number of faces there are 6 (six) results detected with 2 (two) faces, where faces must be approximately 10 cm apart so that faces can be detected and no results are detected on 3 (three) faces. So it can be concluded that the application cannot capture all faces detected by the camera. With the percentage level of the overall test results are:

$$\frac{\text{Test Results Detected}}{\text{Sum Test}} \text{ x } 100$$

$$\frac{6}{9} \text{ x } 100 = 66,66 \text{ \%}$$

Face Position Face

Face Drawing	Position Face	Results
	Straight View	Detected
	View To The Left	Not Detected
	View To The Right	Not Detected
	Wearing Glasses	Detected
	Using Mask	Detected

The results of the face position test have 3 (three) results detected in the test, so it can be concluded that the face position must face the front of the camera so that it can be detected. With the percentage level of the test results of the face position are:

$$\frac{\text{Test Results Detected}}{\text{Sum Test}} \text{ x } 100$$
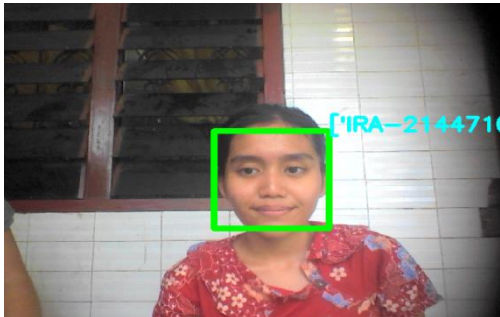
$$\frac{3}{5} \text{ x } 100 \text{ = } 60 \text{ \%}$$

870

Testing Different Faces

Face Drawing	Different Faces	Results
	First Face	Detected
	Second Face	Detected
	Third Face	Detected

The results of the facial position test have 3 (three) results detected in different face tests, so that position conclusions can be dr $\quad$ x 100 $\quad$ application can detect the faces of different people with a single face. With a different percentage level of facial test results are :

$$\frac{\text{Test Results Detected}}{\text{Sum Test}}$$

$$\frac{3}{3} \quad \text{x } 100 \ = \ 100 \ \%$$

871

CONCLUSION

1. The application of the viola jones algorithm on fce detection goes well. Faces can be recognized by the application and display face owner information. Where the test is divided into 5 (five) including lighting testing with a test percentage level of 66.67% of faces detected, testing the distance of 100% of faces detected at a distance of 1-100 cm, testing the number of faces there are 6 (six) results detected with 2 (two) faces, where faces must be approximately 10 cm apart so that faces can be detected and no results are detected on 3 (three) faces. So it can be concluded that the application cannot capture all faces detected by the camera. different face testing percentage test 100% the application can detect different people's faces with a single face.

2. When the application of the viola jones algorithm on face detection detects a face that has not been inputted, it will give an unrecognized face message.

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