CHAPTER IV

ANALYSIS AND DESIGN

4.1 Analysis

The problem is processing the image in the program must run in order, which begins with an preprocessing image and identification process. If the process does not sort then the results obtained will insufficient because the process is related to one another. As an example, sharpening is very important process for edge detection process because the result of sharpening will make the edge of the image or signature would be more clear.

Preprocessing of the image is performed with some purpose which is the image to be identified has a good image, eliminate another component of the image like noise, and the image would be easily interpreted.Preprocessing image which consists of sharpening, filtering, grayscale, tresholding, and edge detection. After the completion of the preprocessing of images, then enter the process of calculation the correlation coefficient formula.
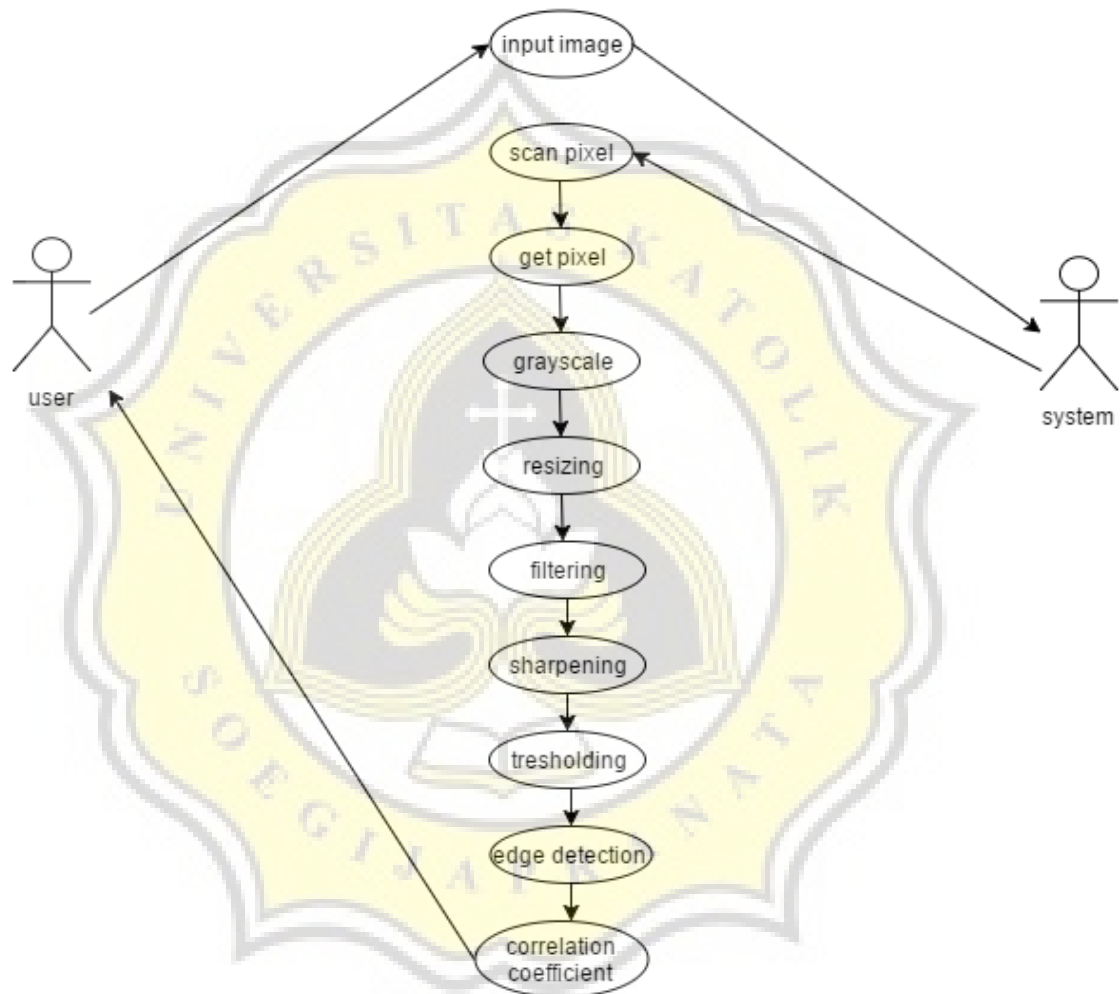
4.2 Design

4.2.1 Use Case Diagram

Figure1 : Usecase diagram

First of all the input images which is signature image through the process of preprocessing image. The output of the preprocessing image becomes the input of the identification process image. The results of the identification process are then became the decision how the level of similarity between test image and reference image.
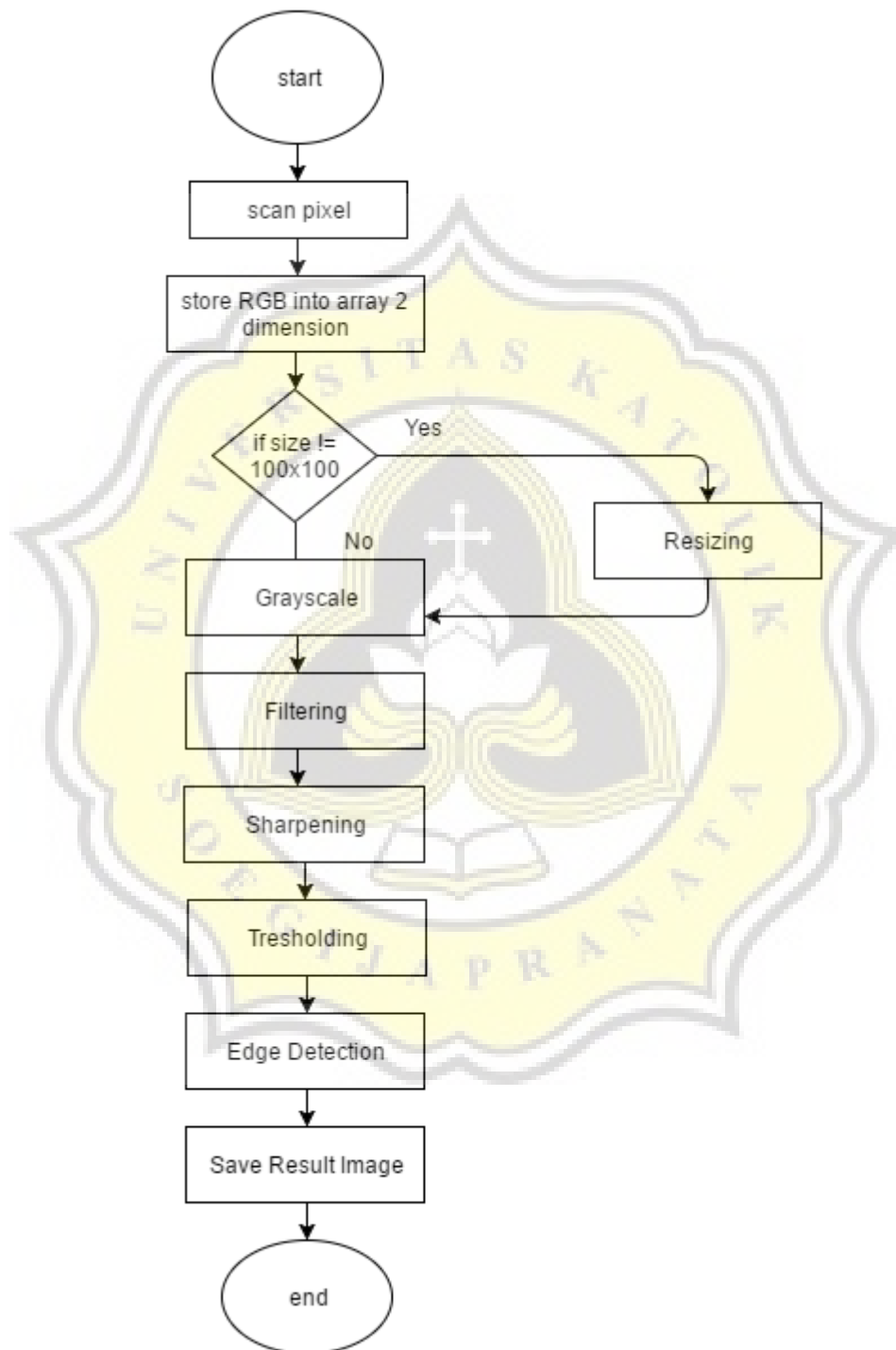
4.2.2 Flow Chart

Figure2 : flowchart preprocessing

Preprocessing starting with scans the input image pixel then inserted into a 2 dimensional array. After it then program checked whether the size of the image is not the same as 100 x 100, if it meets then going through the process of resizing. After the process of resizing is done, then sequentially through grayscale, filtering, sharpening, tresholding and edge detection.
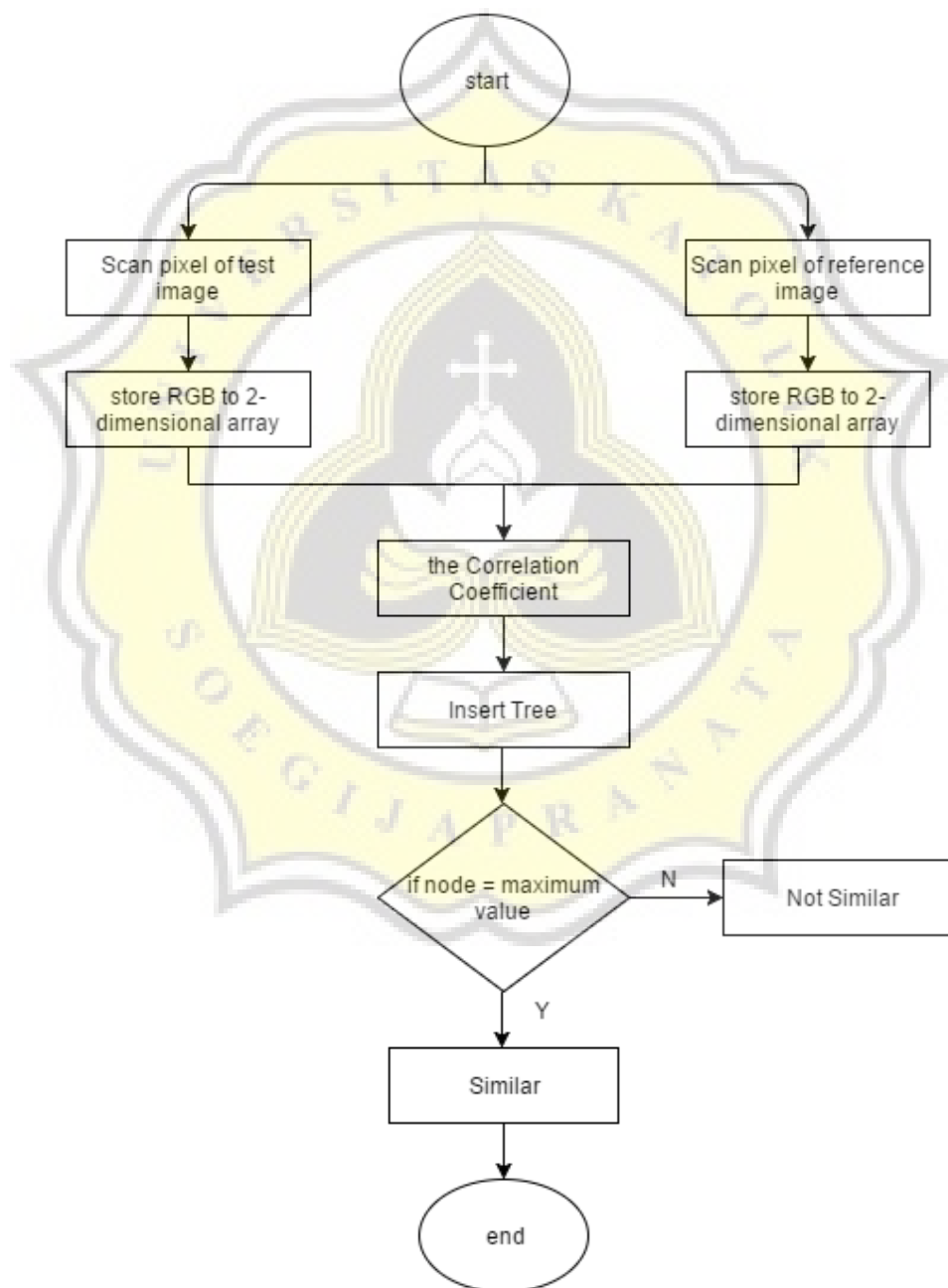

Figure3 : flowchart identification

The process of identification is that looking for the value of the coefficient of correlation between the 2 images i.e. test image and reference image. Both pixel images inserted in the 2 dimensional array and enter into the process of calculating the coefficient of correlation. One by one the value of the correlation coefficient inserted into tree with the purpose to look for the most value maximum.

The program begins with the input image signature and scanned pixels per pixel for stored into the 2 dimensional array. The first process from preprocessing images is the process of grayscale. Grayscale is a process of changing original image into the image that only contains grey color. Each pixel has a gray color with different grey levels. Each pixel in the grayscale images (red, green and blue) have the same value. To change the input image into a grayscale image is by taking a rgb value and taking the average value from all three so the obtained formulas

$$S = \frac{r + g + b}{3}$$

Figure4 : grayscale formula

If size of the image is larger than 100 x 100 then the image will go to the process of resizing. Resizing images aims the test image have the same size as reference image so that the identification process can be done. Resizing image including the process of interpolation where the interpolation is a method to add or reduce the number of pixels in the image. The methods used for resizing is the nearest neighbor interpolation method. Nearest neighbor interpolation method is a method to change the size of an image with the new color of the pixel with the color of the closest pixel from the original image. One of the advantages of the nearest neighbor

interpolation method is not changing the color information from the image. The illustrations are as follows

0	1		0	0	1	1
2	3		0	0	1	1
			2	2	3	3
			2	2	3	3
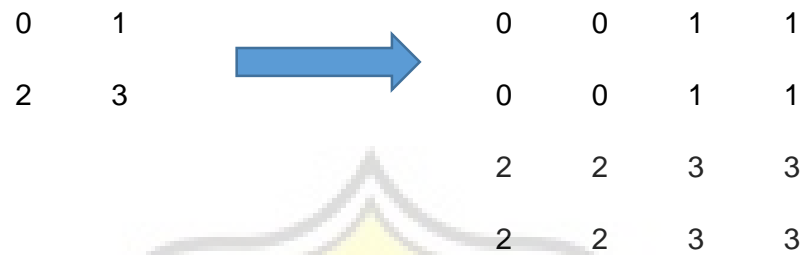
Figure5 : matrix resize

The 2 x 2 matrix is the image that will be resizing into a new image which is illustrated by matrix-sized 4 x 4. This method will fill the values in the 4 x 4 matrix with the closest value in the matrix 2 x 2 size. For example, value 0 in the 2x2 matrix is duplicated into 4x4 matrix due to fill value in the matrix.

After resizing then the image go to the filtering process. Filtering process used to eliminate the noise in the image so that it produces a better image. The process of filtering using the mean filtering method that is by taking the pixel neighbors as much as 3 x 3 and calculate the average value. This method can also be called neighborhood averaging that is noise reduced from image from the results of blurring image. Output from filtering process will be used in the process of sharpening.

$$\begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{matrix} \quad / 9$$

Figure6 : filtering formula

The process of filtering produce blur images so that after that through the process of sharpening. Sharpening image is one kind of the convolution process. Convolution is a multiplication between matrix image and a kernel matrix or mask. There are a variety of kernel matrices which one have a different function. Convolution can be used in a variety of image processing, including smoothing, sharpening, blurring and embossing. For kernel matrix used for sharpening process is

$$G(x,y) : \begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Figure7 : sharpening kernel

Tresholding is change the value of a pixel in the image with a certain threshold parameters. A pixel can be said to a certain threshold if meet the terms that are mapped. For example, the value of a pixel = 50 and threshold 1 is 0-100 and threshold 2 is 100-200 then the pixel values entered into the threshold 1. The formula normally used is

$$Fo(x,y) = o , f1(x,y) < 128$$

$$Fo(x,y) = 255 , f1(x,y) >= 128$$

Figure8 : tresholding formula

The image that detected the edge is both picture i.e. test image and reference image. The advantages of the method takes the principle of gaussian function and laplacian that is known for resurrecting the HPF. The advantage of this method was able to eliminate the noise/noise during the

process of edge detection. In the process, the method uses the Sobel operator where is a matrix-shaped with the order 3 x 3,5 x 5,7 x 7 and so on. Sobel operator is used to process the middle part of the matrix a (i, j) for calculated and obtained a new pixel value. The value of the pixel that would like to be examined using techniques of spatial filtering that is by taking the surrounding pixel values and incorporated into a matrix.

a0	a1	a2
a7	aij	a3
a6	a5	a4

Matrix that contains the pixel values then calculated by multiplication Operators perform with Sobel Operator. There are 2 calculation for the vertical and horizontal directions while the gradient was obtained from the roots of the quadratic sum of the two values.

$$\text{Gx}: \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \qquad \text{Gy}: \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

$$M = \sqrt{Gx^2 + Gy^2}$$

Figure9 : sobel kernel and formula

When it is already finished then both taken the pixel and put in a 2 dimensional array for calculated the coefficients of correlation. The program will be finished with an output that is deciding whether the relationship between two images which is strong or not. The coefficient of Correlation is

a technique in statistical to calculate the value of a strong linear relationship between 2 variables and also to know the shape of the relationship between the two variables with the results of the quantitative. As for the formulas and Tables of the correlation Relationship is :

$$r = \frac{\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}\left(x_{ij} - \bar{x}\right)\left(y_{ij} - \bar{y}\right)}{\sqrt{\sum_{i=0}^{M-1}\sum_{j=0}^{N-1}\left(x_{ij} - \bar{x}\right)^2 \cdot \sum_{i=0}^{M-1}\sum_{j=0}^{N-1}\left(y_{ij} - \bar{y}\right)^2}}$$

Figure 10 : correlation coefficient formula

Description :

X = pixel first image

Y = pixel second image

$\bar{x}$ = average value of pixel first image

$\bar{y}$ = average value of pixel second image
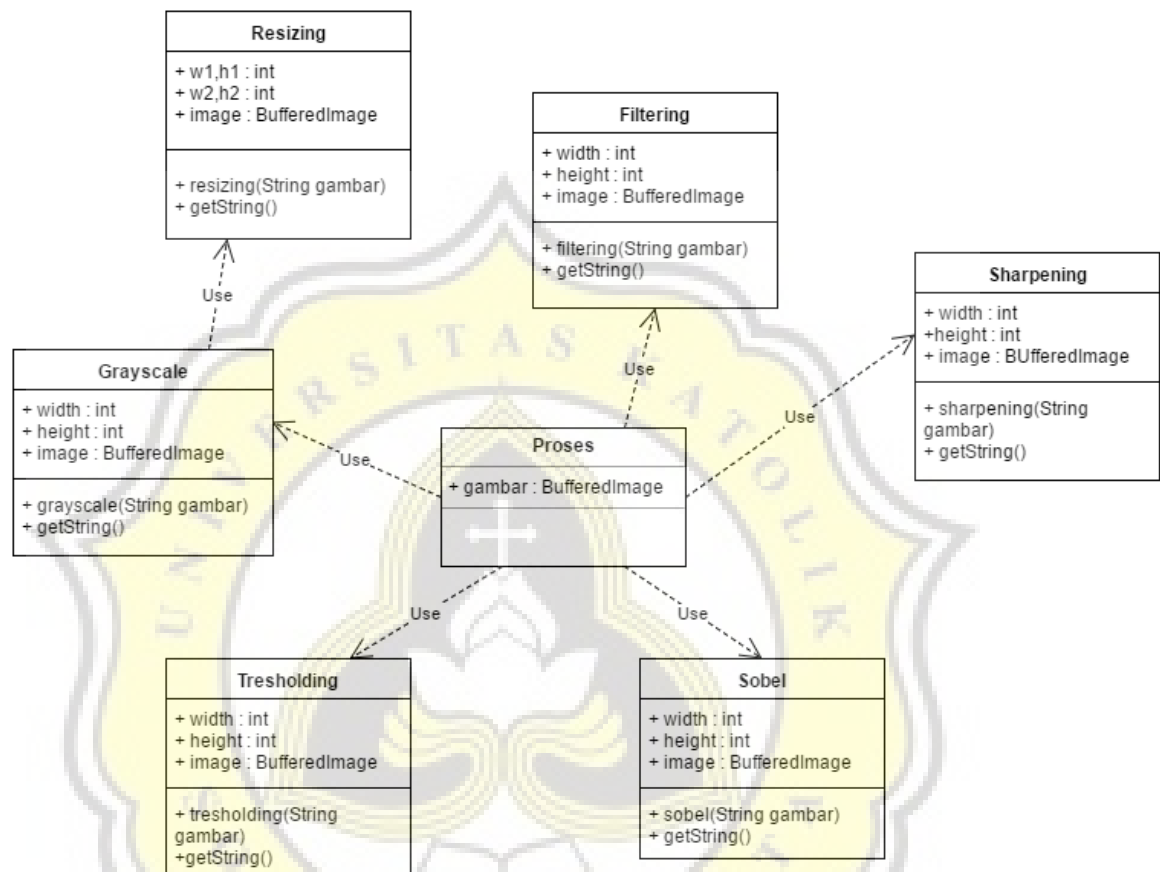
4.2.3 Class Diagram

4.2.3.1 Preprocessing

Figure11 : class diagram preprocessing

Explanation of the class diagram above is :

1. Proses.java

     This class runs the process of sharpening, grayscale, tresholding, filtering, resizing and sobel sequentially. After the image was already inputed, then the program check whether the size is larger or smaller than 100 x 100. When true, then the image will go into the resizing process so the output image size is 100 x 100. After that the result image from resizing will go into the grayscale and filtering for removed the noise, then

sequentially goes into the process of sharpening, tresholding and the last is edge detection with sobel method. All the image results of the process will be inserted in a folder according with the type of the image i.e. reference image or test image.

2. Grayscale.java

Contains a method to do the grayscale process named "grayscale" by using input image from passing variable named "gambar". There is also method getString () to access an image file from the output of the grayscale process.

3. Filtering.java

Contains a method to do the filtering process named "filtering" by using input image from passing variable named "gambar". There is also method getString () to access an image file from the output of the filtering process .

4. Sharpening.java

Contains a method to do the sharpening process named "sharpening" by using input image from passing variable named "gambar". There is also method getString () to access an image file from the output of the sharpening process.

5. Tresholding.java

Contains a method to do the tresholding process named "tresholding" by using input image from passing variable named "gambar". There is also

method getString () to access an image file from the output of the tresholding process.

6.   Sobel.java

      Contains a method to do the edge detection process named "sobel" by using input image from passing variable named "gambar". There is also method getString () to access an image file from the output of the edge detection process.
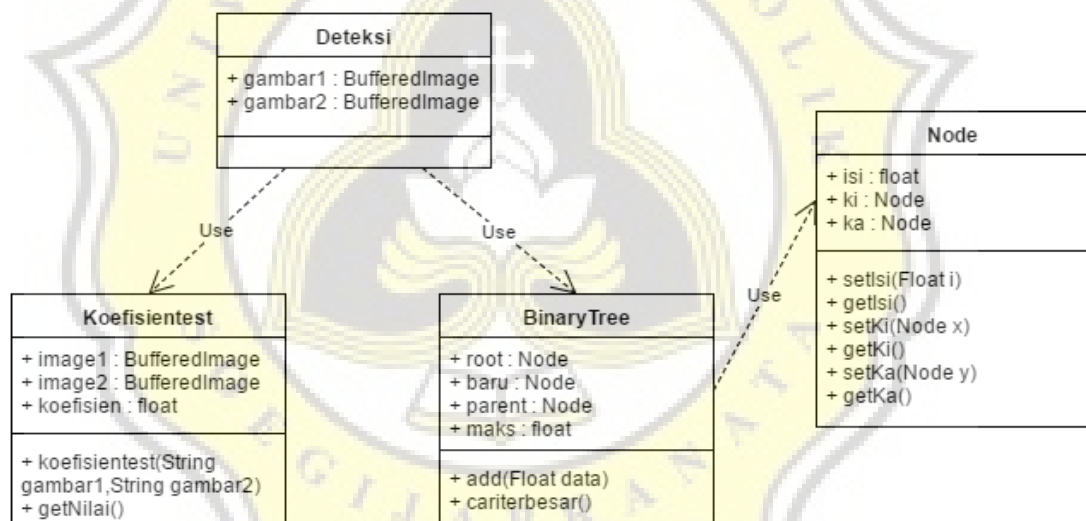
4.2.3.2 Identification

Figure12 : class diagram identification

Explanation of the class diagram above is :

1.   Deteksi.java

      The class that performs identification process and insert into the tree data structure This class uses the 2 type of image i.e. test image/input image

and reference image. The identification process proceeds with calculating the value of the coefficient correlation between the input image and each reference image as much as in the "dbgambar" folder. The value of the correlation coefficient of each reference image will be inserted into the tree data structure for later used for searching the most maximum value.

2. Koefisientest.java

Using 2 input image to find the correlation coefficient value. The results of the correlation coefficient value has a float data type and can be accessed by calling the getNilai() method.

3. BinaryTree.java

There is a method named "add" to insert correlation coefficient values into the tree by using the passing variable value. In the "BinaryTree.java" class also contains methods for finding the maximum value i.e. method "cariterbesar ()". Method "cariterbesar" used to know which reference image has a maximum correlation coefficient values against the test image.