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Application of Coconut Recognition Using Laplacian of Gaussian and HSV based on Android

Made Dwi Mulyawan[1], Ni Made Ika Marini Mandenni[2], Gusti Made Arya Sasmita[3]

[1]Research Scholar, Information Technology, Faculty of Engineering, Udayana University, Bali, Indonesia

[2]Lecturer, Information Technology, Faculty of Engineering, Udayana University, Bali, Indonesia

[3]Lecturer, Information Technology, Faculty of Engineering, Udayana University, Bali, Indonesia

ABSTRACT

Madan coconut is a type of the coconut that can be used as a traditional medicine and means of upakara for Hindus in Bali, Indonesia. Madan coconut has various special characteristics or features in each species, but with many features of each type makes it difficult to remember and recognize the types of Madan coconut. Implementation of digital image processing technology can be a solution to facilitate in recognizing the types of Madan coconut. Shape and color are the main features that can be used to recognize the types of Madan coconut, while Laplacian of Gaussian and HSV methods are used to obtain both features. The Laplacian of Gaussian method was used to detect the coconut shape, meanwhile, HSV was used to detect the coconut color. Both features had to undergo the extraction stage through Invariant Moments and a matching process using Euclidean Distance calculations to find the smallest distance in the recognition process. This designed application was able to generate success in recognizing coconut type based on its form feature to 52.5% and 85% of its color feature, with a percentage success of matching was 70%.

Keywords: Coconut Madan, Laplacian of Gaussian, HSV, Invariant Moments, Euclidean Distance.

1. INTRODUCTION

Madan coconut is a coconut that has special characteristics or features contained in its fruits, this type of coconut can be used as a traditional medicine and material of *upakara* for Hindus in Bali, Indonesia. The special features possess by *madan* coconut are generally found in its color, shape, and size of the fruit. With many special features of each type make it difficult to remember and recognize each of them. A research with the application of digital image processing technology in recognizing the object has been widely done at this time, but a solution to ease the recognition of *madan* coconut has never been done. The shape and color features of the coconut can be used as the main features in recognizing the coconut type, both of these features can be identified by using Laplacian of Gaussian and HSV methods. The shape and color features that have been obtained then need to go through the extraction process with Invariant Moments method that produces the moment value to be used in the matching process with Euclidean Distance calculation.

2. RESEARCH METHODOLOGY

The research methodology used in the development of Application of Coconut Recognition is Design Science Research Methodology (DSRM). The methodology was focused on problem-solving and system development [1]. DSRM has six stages used as a reference in conducting research such as below:

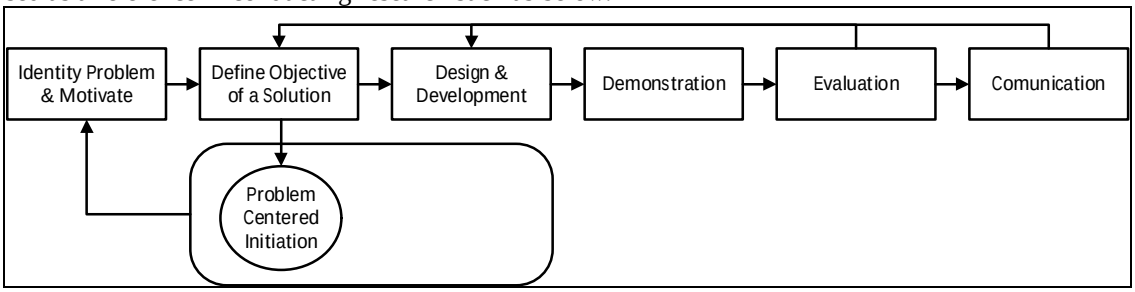


Figure1 Design Science Research Methodology

The research methodology used in the development of Application of Coconut Recognition is shown in Figure 1. DSRM consists of problem identification and motivation, identifying object and solution of the problem, design and development, demonstration, evaluation and communication focused on the purpose of solving the problem.

2.1Application's Overview

Application of Coconut Recognition is an android based application that supports image processing technology for coconut recognition process. This application implements Laplacian of Gaussian and HSV methods to recognize the shape and color of the coconut. The application works as below:

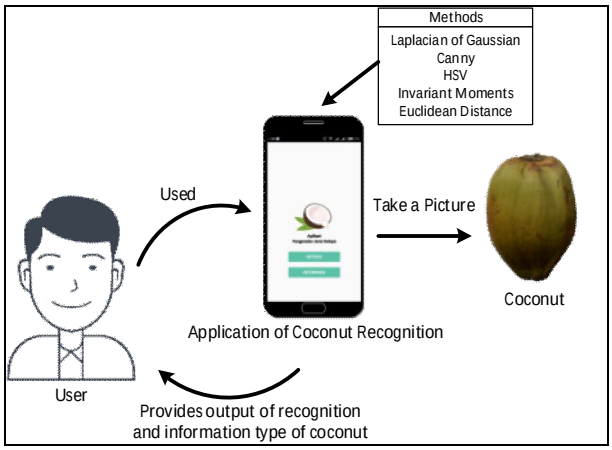


Figure2 Application Overview

Figure 2 is an overview of how Application of Coconut Recognition works. The coconut recognition process is conducted through the detection of the shape and color of the coconut fruit image, this application provides an output of the recognition and information of the coconut type to the user.

2.2 System Architecture Design

System architecture design is an overview of the entire process on the application and features that exist within it, which aimed to facilitate in understanding the process on the application.

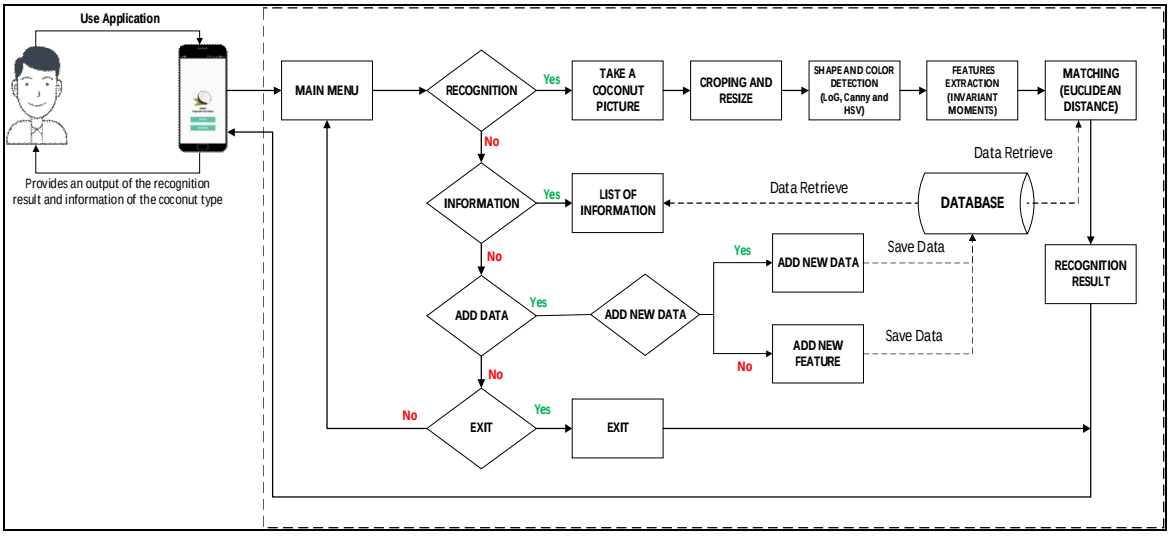


Figure 3 System Architecture Design

Figure 3 is a system architecture design of Application of Coconut Recognition. The design of this architecture consists of processes on the Recognition, Information, and Add Data features, these three features use the database as a storage and retrieval of data. The Recognition feature consists of several processes in which image acquisition, pre-processing, feature extraction, and matching are used as a primary function in recognizing coconut type. Information feature can be used to display information about the characteristic of *madan* coconut types and its benefits, while the Add Data feature is used to adding the data on the database.

3. LITERATURE REVIEW

Coconut (*Cocosnucifera L.*) is a versatile plant because every part of this plant is beneficial for humans [2]. Types of coconut in Bali can be classified into ordinary coconut and *madan* coconut. *Madan* coconut is a type of coconut that has special characteristics or features used to distinguish it [3], [4]. This type of coconut is commonly used as a traditional medicine ingredient and a complementary equipment for *upakara* for Hindus in Bali, Indonesia [5].

3.1 Types of Madan coconut

Madan coconut has special features for each type. The types of madan coconut that is usually used as a traditional medicine ingredient and an equipment for Hindu's ceremonies are as follows: [3]-[5]

3.1.1 Kelapa Be Julit

Kelapa Be Julit has special features that lie in its leaflet and footstalk at its end which is shaped like fresh water eels (Julit fish). This type of coconut has elongated round shape and green on its surface. It is usually used on the offerings of PadudusanAgung ceremony.

3.1.2 Kelapa Bojog

KelapaBojog has special features on ash-gray or blackish fibers that resemble ape feathers. This type of coconut has a round elongated shape and in brownish green color. This type of coconut is commonly used for BantenPanyegjeg and BantenDaksina.

3.1.3 Kelapa Bulan

KelapaBulan is a coconut that has a round shape and usually white or whitish yellow color. This type of coconut is usually used as a complement in BantenPadudusan and BantenPengenteg.

3.1.4 Kelapa Udang

KelapaUdang is a type of coconut that has red petals and brown on its fruit peel. This type of coconut is usually used as a complement in BantenCaru and as a mixture of traditional medicine.

3.1.5 Kelapa Sudamala

KelapaSudamalahas special features on the two-pronged leaf petals and brownish green color on its fruit peel. This type of coconut is usually used as a complement in BantenPadudusan, BantenCaru and as a medicine for patients with prolonged headaches.

3.1.6 Kelapa Mulung

KelapaMulung is a type of coconut that has special features on its fruit peel which is green and the red on the bottom of fruit petals. This type of coconut is usually used as an equipment for BantenPadudusan Alit Ceremony, BantenCaru and can be used as a traditional medicine to cure stomach and fever.

3.1.7 Kelapa Gadang

KelapaGadang or green coconut is a type of coconut that has a round shape and green color. It can be used as a complement in BantenDurmangala and used as an abdominal pain medication.

3.1.8 Kelapa Gading

KelapaGadingor yellow coconut has special features on yellow fruit peel and round shape. This type of coconut is commonly small, and usually used in BantenPrayascita, BantenPagedong-Gedongan and BantenPengenteg.

3.1.9 Kelapa Mice

Kelapa mice have special features in the fruit shape that has curved portions like a hook on the bottom and brownish green color. This type of coconut can be used as a traditional medicine.

3.1.10 Kelapa Surya

Kelapa Surya is a type of coconut that has a special feature as bright red yellow fruit peel. This type of coconut is usually used as a complement in BantenPengelukatan, BantenGarbhawedana ceremony, as well as traditional medicine.

3.2 Laplacian of Gaussian

Laplacian of Gaussian is one of the operators or edge detection methods developed from the second derivative. Laplacian of Gaussian is formed from Gaussian process and followed by Laplace operation. The resulting edge is less affected by noise because the Gaussian function is to reduce noise [6]. The function of Laplacian of Gaussian is as follows:

$$LoG(x,y) = -\frac{1}{\pi\sigma^4}\left[1 - \frac{x^2+y^2}{2\sigma^2}\right]e^{-\frac{x^2+y^2}{2\sigma^2}} \quad (1)$$

3.3 HSV (Hue Saturation and Value)

HSV or Hue Saturation and Value is almost resemble color model to the RGB color model in describing the colors received by the human eye [6],[7]. Calculation of image conversion having RGB color (*red*, *green*, *blue*) to HSV can be done using the following formula:

$$H = tan\left(\frac{3(G-B)}{(R-G)+(R-B}\right) \quad (2)$$

$$S = 1 - \frac{min(R,G,B)}{(R-G)+(R-B)} \quad (3)$$

$$V = \frac{R+G+B}{3} \quad (4)$$

3.4 Canny Edge Detection

Canny edge detection is used to detect the edges of the coconut image based on color differences, so that the coconut shape can be seen. The first step determines the image gradient that can be calculated by the formula [6]:

$$|G| = |Gx| + |Gy| \quad (5)$$

The next step is to determine the direction of the edge by using the following formula [6]:

$$\theta = arctan\left(\frac{Gx}{Gy}\right) \quad (6)$$

3.5 Gaussian Filter

The Gaussian Filter is used for smoothing, blurring, and noise removal processes for edge detection [6]. This filter is used in order to get the actual edge during the edge detection process [8]. Gaussian Filter can be calculated by the following equation [9]:

$$G(x,y) = \frac{1}{2\prod\sigma^2}e - \frac{x^2+y^2}{2\sigma^2} \quad (7)$$

Parameter σ in the equation can be used to adjust the image fineness level in the blurring process.

3.6 Invariant Moments

Moment can describe an object in terms of area, position, orientation, and other undefined parameters. A set of *Invariant Moments* is very useful in creating vectors for object recognition. This method produces seven moments which is the value of the feature performed by the extraction process. The formula of Invariant Moments can be seen in references [6], [10].

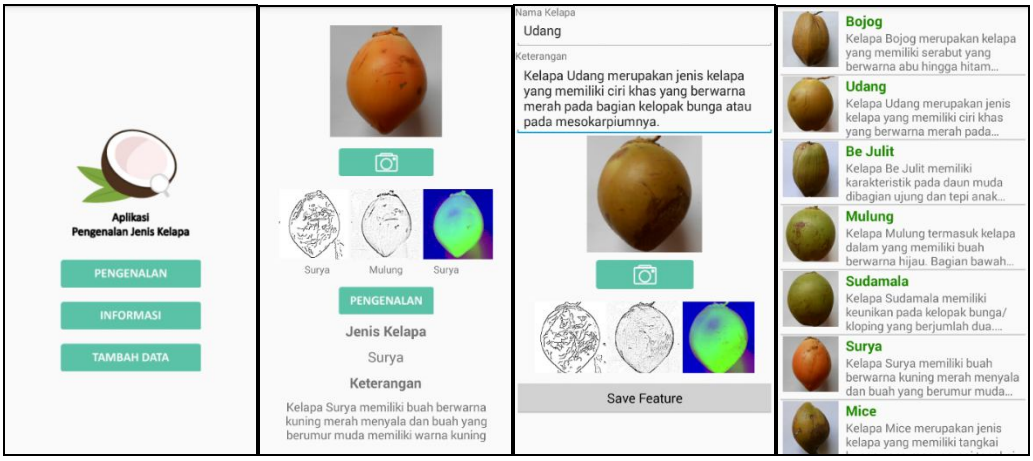
3.7 Euclidean Distance

Euclidean Distance is the metric that most commonly used to calculate the similarity between two vectors [6]. The Euclidean Distance calculation to find the distance between the two vectors to be matched can use the following formula:

$$d_{ij} = \sqrt{\sum_{k=1}^{n}(x_{ik} - x_{jk})^2} \quad (8)$$

4. RESULT AND DISCUSSION

Application of Coconut Recognition is an application designed on the Android platform by using OpenCV Library. This application requires an OpenCV Manager on the device to run in line to its function. This application has two main processes; registration and recognition as well as additional features that can be used to provide information for user.



(a) (b) (c) (d)

Figure 4 (a) Main Menu (b) Recognition feature (c) Add Data feature (d) Information feature

Figure 4 (a), (b), (c), and (d) are screenshots of the features contained in the application. The feature consists of recognition that can be used for the recognition process, add data that can be used as a process of adding data, and information that serves to display information of the coconut type as well as the features and the function of *madan* coconut. This application requires data in the form of image coconut fruit used in the registration and recognition process. Data of coconut type used in this research can be seen in Table 1.

Table 1: List of Coconut *Madan* Types Samples

No.	Coconut Name	Samples Total
1	*Kelapa Bulan*	4
2	*Kelapa Udang*	4
3	*Kelapa Surya*	4
4	*Kelapa Gadang*	4
5	*Kelapa Gading*	4
6	*Kelapa Mulung*	4
7	*Kelapa Sudamala*	4
8	*Kelapa Bojog*	4
9	*Kelapa Mice*	4
10	*Kelapa Be Julit*	4

Table 1 is a list of samples to be used as a recognition test. 40 data of Sample then perform recognition process through the adjusting process with reference data stored in the database, it is necessary to determine the extent to which the application can make the recognition process of *madan* coconut type. The details of the coconut recognition process done on the application such as follows:

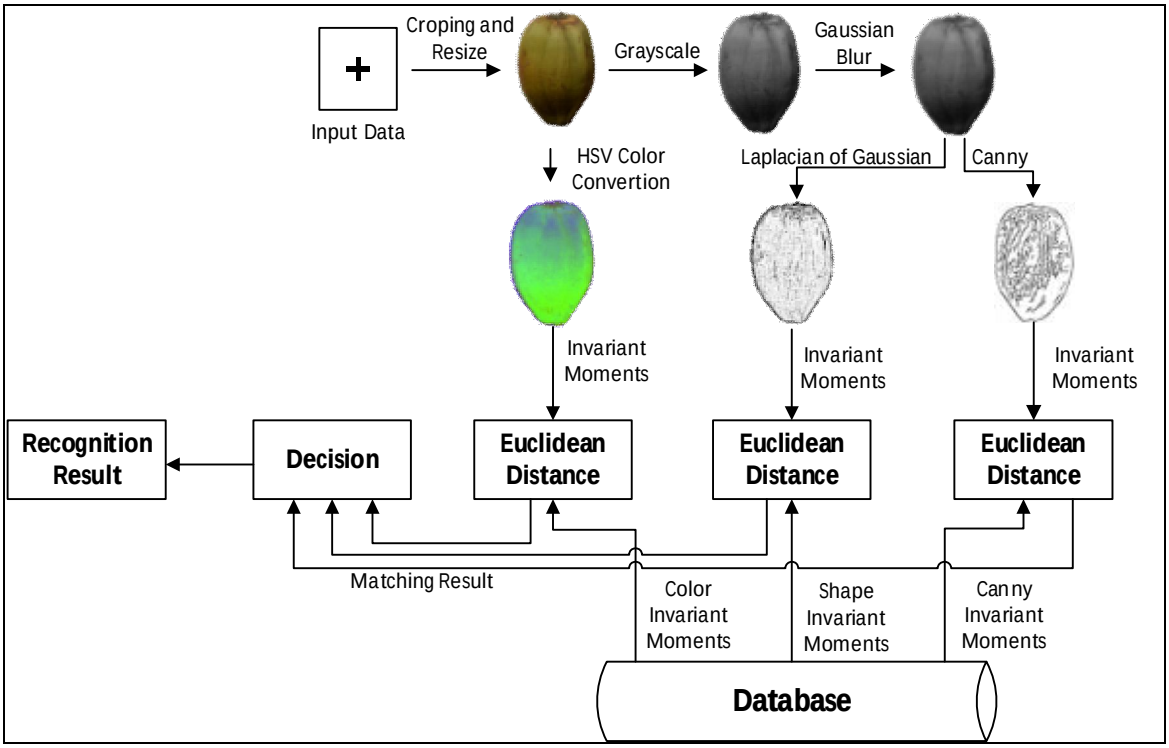


Figure 5 Detail Process of Recognition

Figure 5 is the detail of the recognition process consist of image acquisition, pre-processing, extraction feature, and adjusting. Image acquisition is the initial stage of this process, the entered image will be cropped and resized. The ready-to-process image then enters the pre-processing stage, at this stage the image will be converted to HSV color, shape detection and binary image conversion. The result of the pre-processing will perform feature extraction process to get the moment values that can be used in the matching process, this process uses Invariant Moments method. The value of the moment that has been obtained then carry out the matching process with the reference moment value contained in the database, the results of these three matching process will then enter the decision process to determine the end result of the recognition process. The following is the result of the recognition process of 40 samples of *madan* coconut by using Canny, Laplacian of Gaussian, and HSV methods.

Table 2: Feature Matching Results

Coconut Name	Canny	LoG	HSV
Kelapa Bulan	1	3	4
Kelapa Udang	1	2	3
Kelapa Surya	4	1	4
Kelapa Gadang	2	2	4
Kelapa Gading	1	7	3
Kelapa Mulung	3	2	3
Kelapa Sudamala	1	1	4
Kelapa Bojog	2	3	3
Kelapa Mice	1	3	3
Kelapa Be Julit	1	1	3
Success Rate	**42.5%**	**52.5%**	**85%**

The data in Table 2 is the result of the shape and color recognition process of 40 samples of coconut type using the application. Based on these experimental results, the recognition using Laplacian of Gaussian resulted 52.5% success rate, 85% of HSV method, and 42.5% of Canny method. This recognition process uses Canny method as a support method to recognize the features of coconut shape. The results of the recognition process with the combination of shape and color features can be seen in Table 3 below:

Table 3: Recognition Result of Coconut *Madan*

Coconut Name	Recognized	Unrecognized
Kelapa Bulan	4	0
Kelapa Udang	2	2
Kelapa Surya	4	0
Kelapa Gadang	3	1
Kelapa Gading	2	2
Kelapa Mulung	3	1
Kelapa Sudamala	2	2
Kelapa Bojog	3	1
Kelapa Mice	3	1
Kelapa Be Julit	2	2
Success Rate	**70%**	**30%**

Table 3 is the result of the coconut type recognition with combination of shape and color features that resulted in a success rate of 70%, and unsuccessful rate of 30%. The type of coconut can be identified through decision-making based on the results of the recognition process of the method used. The recognition of coconut types will work if the shape and color features of coconuts are recognized by the application, thus Canny method is required as a support method in the decision-making process to determine the result of coconut type recognition.

5. CONCLUSION

Application of Coconut Recognition is an application that can be used to alleviate the recognition of of*madan* coconut types. This application uses Laplacian of Gaussian, Canny, and HSV methods to recognize the shape and the color features of the coconuts. Based on the experimental results, the recognition of the coconut type using Laplacian of Gaussian resulted in a success rate of 52.5%, 42.5% of Canny method, and 85% of HSV method. Application that has been designed is able to produce coconut type recognition with a combination of shape and color features with 70% of successful rate and 30% of unsuccessful rate. The result of the recognition process using this application is strongly influenced by the lighting when capturing the image used as a sample, because it can produce noise that can affect the detection of the coconut shape and color.

REFERENCES

[1] K. Peffers, Marcus, Rothenberger, and S. Saterjee, "A Design Science Research Methodology for Information System Research", Journal of Management Information Systems, Vol.24, Issue 23 (8), pp. 45-78, 2007.
[2] E.T. Tendaand J. Kaumanuang, "Phenotipic Variation of Tall Coconut in Pacitan, TulungAgung and Lumajang, East Java", Palma Bulletin 32, pp. 22-29, 2007
[3] E. Kriswiyanti, "Characteristic Variation of Coconut (Cocos nucifera L.) as Materials of Upakara Padudusan Alit Ceremonial in Bali",Biology News, Vol. 11. No.3, pp. 321-327, 2013.
[4] E. Kriswiyanti, "Keanekaragaman Karakter Tanaman Kelapa (Cocos nucifera L.) yang digunakan Sebagai Bahan Upacara Padudusan Agung", Jurnal Biologi. Vol. 17. No.1, pp. 15-19, 2013
[5] I.K.Sardiana, "Taman Gumi BantenEnsiklopediTanamanUpakara", Udayana University Press, Denpasar, 2010.
[6] D. Putra,"Pengolahan Citra Digital",PenerbitAndi, Yogyakarta, 2010.
[7] P.P.Andika, P.A. Bayupati, and K.A.Wirdiani, "RancangBangunAplikasiPendeteksiTipedanNilai Resistor Berbasis Android", JurnalLontar, Vol. 6 No.1, pp. 529-541, 2015.
[8] S.F. Kurniawan, K.G. Darma Putra, and A.A.K. Oka Sudana, Bone Fracture Detection Using OpenCV", Journal of Theoretical and Applied Information Technology, Vol. 64 No. 1, pp. 249-254, 2014.
[9] F. Bozkurt, M. Yahanoglu, and F.B. Gunay, "Effective Gaussian Blurring Process on Graphics Processing Unit with CUDA" International Journal of Machine Learning and Computing, Vol. 5 No. 1, pp. 57-61,2015.
[10] Z. Huang and J. Leng, "Analysis of Hu's Moment Invariants on Image Scaling and Rotation", In Proceedings of the International Conference on Computer Engineering and Technology (ICCET), pp. 476-480, 2010.

AUTHOR

Made Dwi Mulyawan,Male,is a student at Department of Information Technology, Udayana University, Bali and currently working toward the Bachelor of Information Technology. His research interests are Digital Image Processing, Java Programming, and Android Programming.

Ni Made Ika Marini Mandenni,Female,is a lecturer at Department of Information Technology, Faculty of Engineering, Udayana University Bali, Indonesia. She got her bachelor's degree at Informatics Engineering, Adhi Tama Institute of Technology in 2002 and master's degree in Informatics Engineering, SepuluhNopember Institute of Technology in 2008. Her research interests are Expert System, Biometrics, and Image Processing.

Gusti Made Arya Sasmita, Male, is a lecturer at Department of Information Technology, Faculty of Engineering, Udayana University Bali, Indonesia. He got his bachelor's degree in Electrical Engineering, Udayana University, Bali in 1997 and master's degree in Informatics Engineering, GadjahMada University in 2003. His research interests are Audit and Network Security.