

IMAGE RETRIEVAL OBJECT GANESHA IMAGE USING INVARIANT MOMENT METHOD

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Abstract

In the findings of the statue of Ganesha in Trowulan Mojokerto area is no longer intact, because the statue of Ganesha is found to have been on the surface of soil or underground, so the archaeologist is very difficult to categorize the findings. This research proposes to overcome the above problems it is necessary to the Image Retrieval system (image retrieval) that can provide information about the results of the discovery of such historic objects. For the image taken as Image Retrieval as an example of research trials is the Ganesha statue. From the Ganesha Statue is searched for feature extraction value by using Moment Invariant method, after which to get the result of image retrieval using Manhattan method. Image Retrieval information system work is image of Ganesha statue in pre-processing with size 200x260 pixel BMP, then image in edge detection using Roberts method and extraction of Moment Invariant feature and inserted into database as data training. For data testing the same process with data training so searched the closest distance using Manhattan method. From the results of 15 image testing statues Ganesha level to the accuracy of the true states there is 62% and stated wrong 38%. Research can be further developed using various methods to improve image retrieval accuracy.

Keywords: The Statue of Arca Ganesha, Image Retrieval, Moment Invariant, Roberts Edge Detection, Manhattan

INTRODUCTION

In the Trowulan area is one of the largest historical heritage of Majapahit kingdom in the archipelago. The findings encountered in the form of statues, temples, inscriptions, earthenware and metal tools. The statue that is often found is the statue of Ganesha because the Majapahit kingdom is a Hindu Shiva. Ganesha statue is found no longer intact because it has long surface on the ground or underground.

The Statue of Ganesha is one of the famous gods in Hinduism and much worshiped by Hindus, who have titles as Gods of knowledge and intelligence, Gods protectors, Gods of rejection/disasters and God of wisdom [1].

In this study used Image Retrieval process to determine the resemblance of the statue of Ganesha which is found in incomplete form with the data set of the statue of Ganesha that has been found. Image Retrieval is a process to get a number of images based on one image input [2]. The principle of image retrieval is the feature extraction of a number of objects have been stored in the database, then when an image is used as a query [3]. The feature will be calculated by distance to the features of all objects contained in the database. The result of this distance is often called a ranking [2].

Image retrieval can be divided into two types: context-based and content-based. Retrieval of content-based images refers to image features such as colors, textures, shapes, semantics or sensations they cause [4].

Image retrieval using good feature extraction for scaling, rotation, affine, and linear transformation images using the Invariant Moment method [5]. Moment Invariant on the image is used in the classification and pattern matching because the Manual Moment Invariant effectively provides image content information [5].

The Moment Invariant algorithm has been known as one of the most effective methods for extracting descriptive features. In essence, the algorithm produces the characteristic properties of objects from binary images [6]. To get a binary image object can use edge detection. Edge detection can be used to further sharpen the image structure. If an object uses this structure information, it will actually capture the structure information and will be a valid measure and evaluate the integrity of the

structure to make the image more meaningful [6].

IMAGE RETRIEVAL USING INVARIANT MOMENT

This section explains about Image Retrieval, Edge Detection, Moment Invariant definitions and Manhattan distance calculations. The development of the image retrieval system is expected to be used as a reference for future research in the study of pattern recognition of the statue of Ganesha.

Image Retrieval

Image retrieval is the process of getting a number of imagery based on the image input [2]. The more specific term is content based image retrieval (CBIR) or image retrieval based on its content [2]. The term was first proposed by Kato in 1992 [7].

The image retrieval system can be divided into two types: context-based and content-based content [4]. Content-based image retrieval system refers to image features such as colors, textures, shapes, semantics or sensations they cause [4].

The principle of image retrieval is the feature of a number of objects have been stored in the database, then when an image is used as a query material, the feature will be calculated after the pre-processing and segmentation [2]. Features obtained compared to the features of all objects contained in the database, through the calculation of the distance of the feature [2]. The result of this distance is often referred to as a score or ranking [2].

Edge Detection

In previous research, some popular edge detection algorithms (Roberts, Prewitt, Sobel, LoG and Canny) were used for texture analysis process [8].

Many studies argue that the structure of the image consists of the edges of the visible objects in the structure of the image can still be observed even though the image changes in scale [6].

In previous studies using edge detection was Hocenski's study, et al. In 2006 with visual inspection part of automation system [9]. Research Ali, et al. In 2001 boundary object by selecting the remote sensing image feature [10]. Research Pirzada, et al. In 2013 feature extraction from images taken by satellite [11]. And Bao's research, et al. In 2013, the extraction of medical image characteristics [12].

Based on previous research, this research uses Robert edge detection operator which has a fast and simple structure [8][13]. The Robert edge detection operator has a 2x2 convolution kernel and as shown in Figure 1 both convolution kernels are rotated 90° to each other.

1	0
0	-1

0	1
-1	0

Figure 1. Kernel Robert

The kernel as shown in Figure 1 is set in the order in the image and then the edge image is obtained by the count of two results [8].

Moment Invariant

The moment invariant feature is useful for declaring objects by calculating object areas [2]. This feature uses a basic moment of a normalized center [2][14]. The resulting Moment can be used to handle translation, scaling, and rotating images [2][5].

Central Moment is the spatial moment calculated relative to the center of mass [2]. If the center of mass is (\bar{y}, \bar{x}) . The central moment is written by Equation 1.

$$\mu_{ij} = \sum_{x=1}^M \sum_{y=1}^N (x - \bar{x})^i (y - \bar{y})^j I(x, y) \quad (1)$$

In order for the central moment to be free of translation, scaling, and rotation it needs to be normalized [2]. Normalized center moments can be written in Equation 2.

$$\eta_{ij} = \frac{\mu_{pq}}{\mu_{00}^{\gamma}}, \gamma = \frac{i+j+2}{2} \quad (2)$$

Creator, Hu creates seven moment Invariant written with Equation 3 [2][15]. These seven invariant moments will become the reference in

this research as the extrusion of feature form on the statue of Ganesha.

$$\begin{aligned} \emptyset_1 &= \eta_{20} + \eta_{02} & (3) \\ \emptyset_2 &= (\eta_{20} - \eta_{02})^2 + (2\eta_{02})^2 \\ \emptyset_3 &= (\eta_{30} - 3\eta_{12})^2 + (\eta_{03} - 3\eta_{21})^2 & (12.15) \\ \emptyset_4 &= (\eta_{30} + \eta_{12})^2 + (\eta_{03} + \eta_{21})^2 \\ \emptyset_5 &= (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] + (\eta_{03} - 3\eta_{12})(\eta_{03} + \eta_{21})[(\eta_{03} + \eta_{12})^2 - 3(\eta_{12} + \eta_{30})^2] \\ \emptyset_6 &= (\eta_{20} - \eta_{02})[(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{03} + \eta_{21}) \\ \emptyset_7 &= (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] + (\eta_{30} - 3\eta_{12})(\eta_{21} + \eta_{03})[(\eta_{03} + \eta_{21})^2 - 3(\eta_{30} + \eta_{12})^2] \end{aligned}$$

The Calculation of Manhattan Distance

The method of measuring the similarity distance for image retrieval using the Manhattan method is often called the City Block Method. Manhattan is a form of the Minkowski method, for which Manhattan uses value [16]. Then the Manhattan Equation can be written in Equation 4.

$$M = \sum_{i=1}^m \sum_{j=1}^n |x_{i,j} - y_{i,j}| \quad (4)$$

SYSTEM OVERVIEW

In the framework of research for Image Retrieval system can be explained the existence of two process that is process of training and testing process. In the data intercession training image input is done by the process of preparing the image size in the form of pixel units and black image background to make it easy to distinguish the background and image foreground The next process is done image grayscale process to Roberts edge detection, after obtaining the image of the edge of the statue Ganesha performed form feature extraction process using the Moment Invariant method to get the extraction features of the form values entered into the database.

The testing process for preprocessing, edge detection and extraction features are the same way as the testing process, but next to Image Retrieval is a process of calculating the distance between data training in the database with data testing using Manhattan method to get the

selection of image results. Image Retrieval system design can be seen in Figure 2.

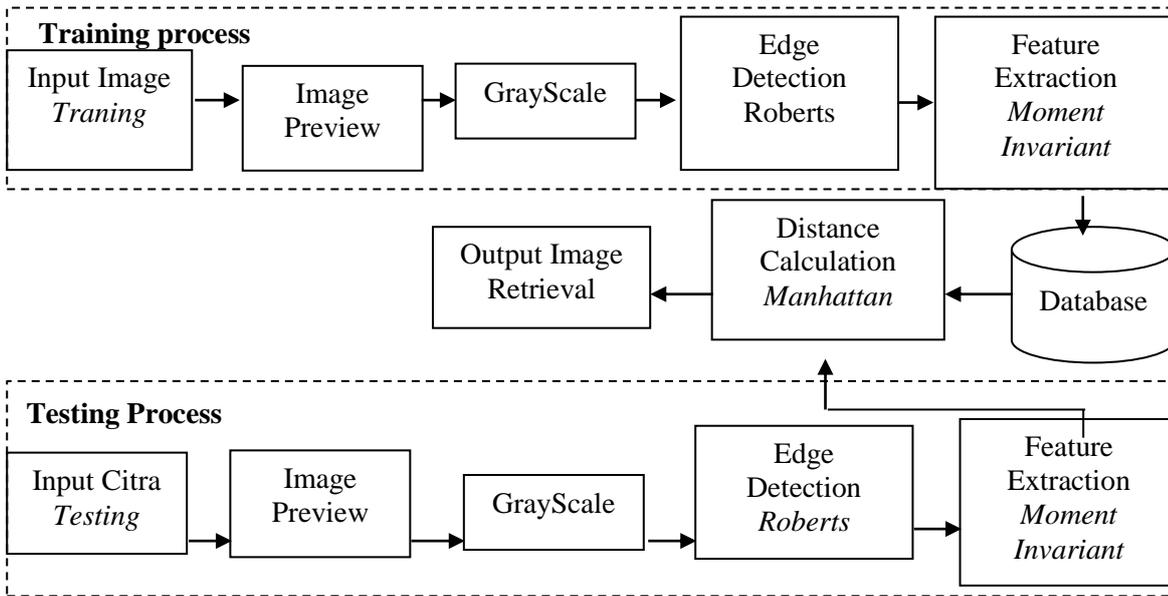


Figure 2. Image Retrieval System

Image Preview

Image preview is done to change the image in the form of BMP files and image size in the form of 200x260 pixels. For background image of Ganesha statue in the form of black color is used to facilitate the process of edge detection and extraction feature image form statue Ganesha.



Figure 3. An example of the image of a statue of Ganesha (a) an incomplete Ganesha statue; (b) the statue of Ganesha is found still intact

GrayScale Image

This grayscale type image handles gradations of black and white that produce a gray color effect [2]. In the grayscale image, the color is expressed in intensity. In this case, the intensity ranges from 0 to 255 [2].



Figure 4. Grayscale Image Statue Ganesha

Edge Detection Using Roberts Method

After the image converted in the form of grayscale image, the image is done Roberts edge detection process to get the shape of the statue of Ganesha.

From the results of the detection of Robert's edge can be seen in Figure 5. The results on Roberts edge detection are strongly affected by noise, thus providing weak responses to the edge.

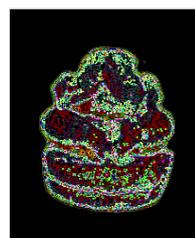


Figure 5. Ede Detection Roberts Statue Ganesha

Table 1. Design of Data Tranning in Database

No	Field Name	Field Type	Field Size
1	Nama Citra	Text	255
2	M1	Number	Double
3	M2	Number	Double
4	M3	Number	Double
5	M4	Number	Double
6	M5	Number	Double
7	M6	Number	Double
8	M7	Number	Double
9	Ket	Text	255

Feature Extraction Moment Invariant

The use of Moment Invariant method for extraction of Ganesha statue image using seven Moment Invariant in Equation 3. The use of seven Moment Invariant is used to determine vector moment variable center on image of Ganesha statue.

Data Storage Feature Extraction In The Database

To facilitate the data storage of training used data storage media in the database. The database used is Microsoft Access with a design that can be seen in Table 1.

Distance Calculation Manhattan

To get the results of Image Retrieval done calculation of data training with data testing, where the data Training stored in the database is done distance calculation by data testing using Manhattan method. After obtaining the value between data training with data testing with Equation 4, then ordering the smallest data to the largest of the value of the calculation of data distance training and data testing. To get a good accuracy value taken three image data image retrieval.

RESULT AND DISCUSSION

Mechanical Testing

The data used for testing is the incomplete Ganesha statue of 15 images of 35 images of

the Ganesha statue intact. So the total image that will be used as tranning and testing a number of 50 images of the statue of Ganesha. Ganesha image retrieval that is not intact as data testing used for image retrieval is to get the shape and characteristic of the statue of Ganesha.

From the image retrieval result, three images with the smallest order value of Manhattan distance counting result.

Testing Result

The result of Ganesha image testing done by image retrieval system process is obtained from Ganesha image input which is not intact. An example of an incomplete Ganesha image input and three image results from the image retrieval can be seen in Figure 6.

The results obtained from the image retrieval system shown in Figure 6, there are three images of ganesha statues that have the same characteristics with the image of Ganesha statue input is the sitting position of the two soles meet or face (Utkutikasana).

In addition to the position of sitting statues Ganesha also described similarities other features between the image of the statue Ganesha image with the results of three images of the statue of Ganesha is depicted human-headed elephant head, wearing Hara sumping (necklace), upawita and belt, buckle bun, wide ear, four hands wear kankana Bracelet), four-handed with a two-handed position on the right hand holding an ivory fracture and the left holding modaka (bowl), while two right-handed axes hold the ax and the left hold aksamala (tasbih), the trunk's position sucking into the bowl, and the second Feet wearing bracelet.

Table 2 describes the extraction value of the Moment Invariant feature on the Ganesha statue image data imaging performed by Manhattan distance calculation with the data training in the database. The results of the calculation of the overall distance of the database database is done by the smallest data to get the output data retrieval image of Ganesha statue that is similar to the statue of Ganesha input.



Figure 6. (a) Input of Ganesha statue image; (b) Image retrieval result of Ganesha statue 1; (c) Results of Image Retrieval statue of Ganesha 2; (d) Image Results Retrieval statue Ganesha 3

Table 2. Extraction Result Feature Moment Invariant Image Data Testing Arca Ganesha

Name Image	Extrusion Value Moment Invariant Feature						
	M1	M2	M3	M4	M5	M6	M7
Patung_ganesa38	0.643571	0.045432	0.0003413	0.001675	-4E-6	0.000356	-3E-6

Table 3. Manhattan Distance Results

No	Name Image Output	Distance Value
1	Patung_ganesa42	0.013274
2	Patung_ganesaa39	0.09344
3	Patung_ganesa40	0.094568

The result of Manhattan distance calculation value between the image input with the name of the ganesha statue can be seen in table 3 which is sorted from the smallest value and taken the three smallest value of the overall value.

The results of all 15 Ganesha statue image testing data can be seen in Table 4 as the result of Manhattan distance count and table 5 as the material of characteristic analysis from Ganesha statue to calculate the success rate.

Analysis of Test Result

The test data compares the characteristics of the input image and the three output image results consisting of the sitting position of the statue of Ganesha and the number of Ganesha statues. The results obtained from the test were 62% (sixty percent) stated true and 38% (thirty eight percent) stated incorrectly out of a total of 90 (ninety) characteristics of the output image.

Table 6 describes the results of testing accuracy on Ganesha statue image. For analysis the results obtained are influenced by the image of input testing which suffered severe damage to the ganesha statue (Figure 7), where there is

damage to the loss of hands, head, or feet caused by nature or vandalism.

The image of Ganesha statue input that suffered severe damage was declared as data testing used as an analysis material for arkeologi to analyze the amount of damage and analyze the type of statue Ganesha for further research. If the initial reconstruction of the statue Ganesha damaged can be compared with the three statues Image Retrieval Output so that it can describe the origin of the statue Ganesha.

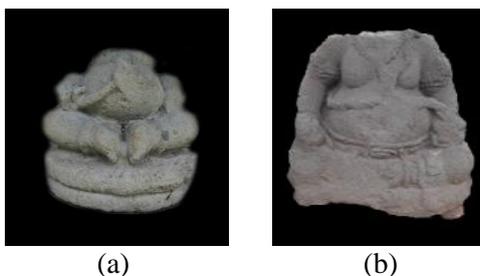


Figure 7. (a) The Ganesha statue is missing head and hand; (b) Ganesha statue is missing head and legs

CONCLUSION

The conclusion of Gansha image retrieval system is the result that affect the accuracy of the image retrieval using Moment Invariant method is the image of Ganesha statue input which suffered severe damage that is on hand, head or leg.

For good Ganesha statue input that is still the form of hands, feet or head then the accuracy is very high.

Table 4. Manhattan Distance Calculation (JAM) On Ganesha Testing and Training Arca

No	Name Image Input	Results Image Retrieval					
		Image 1	JM1	Image 2	JM 2	Image 3	JM3
1	Patung_ganesa48	Patung_ganesa36	0.068	Patung_ganesa34	0.110	Patung_ganesa30	0.118
2	Patung_ganesa49	Patung_ganesa22	0.413	Patung_ganesa16	0.526	Patung_ganesa25	0.537
3	Patung_ganesa44	Patung_ganesa26	0.0808	Patung_ganesa23	0.095	Patung_ganesa36	0.113
4	Patung_ganesa47	Patung_ganesa29	0.089	Patung_ganesa40	0.126	Patung_ganesa34	0.146
5	Patung_ganesa43	Patung_ganesa41	0.034	Patung_ganesa39	0.056	Patung_ganesa37	0.056
6	Patung_ganesa50	Patung_ganesa41	0.057	Patung_ganesa40	0.105	Patung_ganesa39	0.115
7	Patung_ganesa6	Patung_ganesa21	0.566	Patung_ganesa42	0.858	Patung_ganesa8	0.091
8	Patung_ganesa28	Patung_ganesa40	0.038	Patung_ganesa42	0.056	Patung_ganesa41	0.081
9	Patung_ganesa27	Patung_ganesa40	0.108	Patung_ganesa42	0.220	Patung_ganesa41	0.278
10	Patung_ganesa20	Patung_ganesa17	0.0489	Patung_ganesa42	0.061	Patung_ganesa8	0.088
11	Patung_ganesa33	Patung_ganesa31	0.048	Patung_ganesa35	0.061	Patung_ganesa32	0.077
12	Patung_ganesa4	Patung_ganesa7	0.035	Patung_ganesa18	0.039	Patung_ganesa12	0.068
13	Patung_ganesa45	Patung_ganesa36	0.092	Patung_ganesa32	0,094	Patung_ganesa23	0.102
14	Patung_ganesa46	Patung_ganesa23	0.092	Patung_ganesa30	0.094	Patung_ganesa36	0.102
15	Patung_ganesa38	Patung_ganesa42	0.0132	Patung_ganesa39	0.093	Patung_ganesa40	0.094

Table 5. Data Testing Results Based on Characteristics of Ganesha Arca

No	Name Image Input	Input Image Feature	Results Image Retrieval					
			Image Feature Position			Number of Image Hand		
			1	2	3	1	2	3
1	Patung_ganesa48	Utkutikasana,Tangan 4	Utkutikasana	Utkutikasana	Utkutikasana	4	2	4
2	Patung_ganesa49	Utkutikasana,Tangan 2	Utkutikasana	Utkutikasana	Utkutikasana	2	4	4
3	Patung_ganesa44	Utkutikasana,Tangan 4	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
4	Patung_ganesa47	Utkutikasana,Tangan 2	Utkutikasana	Utkutikasana	Utkutikasana	2	4	2
5	Patung_ganesa43	Utkutikasana,Tangan 2	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
6	Patung_ganesa50	Utkutikasana,Tangan 2	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
7	Patung_ganesa6	<u>Utkutikasana,Tangan hilang</u>	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
8	Patung_ganesa28	<u>Utkutikasana,Tangan Hilang</u>	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
9	Patung_ganesa27	<u>Utkutikasana,Tangan Hilang</u>	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
10	Patung_ganesa20	Stanka, Tangan 4	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
11	Patung_ganesa33	Utkutikasana,Tangan 4	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
12	Patung_ganesa4	<u>Tangan 4,Kaki hilang</u>	Utkutikasana	Utkutikasana	Ardhapyankasana	4	4	4
13	Patung_ganesa45	Utkutikasana,tangan 2	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
14	Patung_ganesa46	Utkutikasana,tangan 2	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4
15	Patung_ganesa38	Utkutikasana,Tangan 4	Utkutikasana	Utkutikasana	Utkutikasana	4	4	4

Table 6. The Results of Testing Accuracy on Ganesha Statue Image

No	Name Image Input	Analysis Result		Degree of Accuracy
		True	Wrong	
1	Patung_ganesa48	5	1	83%
2	Patung_ganesa49	4	2	67%
3	Patung_ganesa44	6	0	100%
4	Patung_ganesa47	5	1	83%
5	Patung_ganesa43	3	3	50%
6	Patung_ganesa50	3	3	50%
7	Patung_ganesa6	3	3	50%
8	Patung_ganesa28	3	3	50%
9	Patung_ganesa27	3	3	50%
10	Patung_ganesa20	3	3	50%

11	Patung_ganesa33	3	3	50%
12	Patung_ganesa4	3	3	50%
13	Patung_ganesa45	3	3	50%
14	Patung_ganesa46	3	3	50%
15	Patung_ganesa38	6	0	100%
Total		56	34	90
Degree of Accuracy		62	38%	

ACKNOWLEDGMENT

The author would like to thank the Menristekdikti (Minister of Research and Technology for Higher Education Republic of Indonesia) for his financial support in the form of PDP Grants (Research Lecturer Beginner).

REFERENCES

- [1] "Ganesa," *Wikipedia bahasa Indonesia, ensiklopedia bebas*. 2017.
- [2] A. Kadir and A. Susanto, "Teori dan aplikasi pengolahan citra," *Yogyak. Andi*, 2013.
- [3] P. A. Hemalatha, K. S. Ravich, and B. Santhi, "Query By Image Content using Discrete Cosine Transform," 2013.
- [4] S. N. Endah, "Content Based Image Retrieval Using Expression Sentivity By Fuzzy Inference System," *Kursor*, vol. 8, no. 1, pp. 21–32, 2015.
- [5] A. Amanatiadis, A. Gasteratos, S. A. Chatzichristofis, and E. G. Karakasis, "Image Moment Invariants as Local Features for Content Based Image Retrieval using the Bag-of-Visual-Words Model," 2015.
- [6] P. Premaratne and M. Premaratne, "Image matching using moment invariants," *Neurocomputing*, vol. 137, pp. 65–70, 2014.
- [7] Zhang D., "Image Retrieval Based Shape." Unpublished Dissertation, 2002.
- [8] Ş. Öztürk and B. Akdemir, "Comparison of edge detection algorithms for texture analysis on glass production," *Procedia-Soc. Behav. Sci.*, vol. 195, pp. 2675–2682, 2015.
- [9] Z. Hocenski, S. Vasilic, and V. Hocenski, "Improved canny edge detector in ceramic tiles defect detection," in *IEEE Industrial Electronics, IECON 2006-32nd Annual Conference on*, 2006, pp. 3328–3331.
- [10] M. Ali and D. Clausi, "Using the Canny edge detector for feature extraction and enhancement of remote sensing images," in *Geoscience and Remote Sensing Symposium, 2001. IGARSS'01. IEEE 2001 International*, 2001, vol. 5, pp. 2298–2300.
- [11] S. J. H. Pirzada and A. Siddiqui, "Analysis of edge detection algorithms for feature extraction in satellite images," in *Space Science and Communication (IconSpace), 2013 IEEE International Conference on*, 2013, pp. 238–242.
- [12] C. Bao and C. Sheng, "A parameterized logarithmic image processing method based on Laplacian of Gaussian filtering for lung nodules enhancement in chest radiographs," in *Instrumentation and Measurement, Sensor Network and Automation (IMSNA), 2013 2nd International Symposium on*, 2013, pp. 649–652.
- [13] L. G. Roberts, "Machine perception of three-dimensional solids," Massachusetts Institute of Technology, 1963.
- [14] L. Diao, J. Peng, J. Dong, and F. Kong, "Moment invariants under similarity transformation," *Pattern Recognit.*, vol. 48, no. 11, pp. 3641–3651, 2015.
- [15] S. Theodoridis, *Pattern Recognition*. San Diego: Academic Press, 2006.
- [16] Arif Muntasa, *Pengenalan Pola, Aplikasi Pengenalan Wajah, Analisis Tekstur Obyek, Pengenalan Plat Nomer Kendaraan, dan Pembulu Darah*, Ed. 1. Yogyakarta: Graha Ilmu, 2015.