

PAPER • OPEN ACCESS

Contour to Centroid Distance Graph as Feature in Hand Gesture Recognition

To cite this article: F Fachri Yanuar Rudi and Eko Mulyanto Yuniarno 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **536** 012150

View the [article online](#) for updates and enhancements.

Contour to Centroid Distance Graph as Feature in Hand Gesture Recognition

Fachri Yanuar Rudi F*, Eko Mulyanto Yuniarno

Jurusan TIK Politeknik Negeri Lhokseumawe, Fakultas Teknologi Industri, Jurusan Teknik Elektro, Program Studi Jaringan Cerdas Multimedia ITS Surabaya

*Corresponding author: fachri.yanuar@gmail.com

Abstract. Hand gesture is often used as a way of communication that is intuitive and convenient in everyday human life. Kinect camera gives cheaper and easier way to research about the hand gesture than data glove. This research combines previous research Finger-Earth Mover's Distance (FEMD) base and Fuzzy to recognize hand gestures captured by Kinect camera. The results are graphic of each gesture obtained from a distance of centroids to hand contour. This research will be followed by next research applying fuzzy of classifying each graph of hand gesture.

1. Introduction

Hand gesture is often used as a way of communication that is intuitive and convenient in everyday human life [1]. Humans use gestures (gesture) in everyday life as a means of communication, for example, pointed to an object to direct one's attention to an object, waving a hand as an expression of welcome, show figures and others.

Several kinds of techniques for hand gesture recognition as the approach is based on 2-dimensional location of the tip of the finger with the palm of the hand by [2], recognition of hand gestures in real-time performed by [3]. The introduction of dynamic hand gesture made by [4].

The need to simplify the control of increasingly complex equipment and the desire to provide a more natural means of interacting with computers has led to considerable interest in developing human computer interaction using hand gestures. Human and computer interaction using hand gestures have been studied by several researchers such as [5], and also [6]. One of the most famous in recognizing hand gestures as input to the device is a Nintendo Wii [7].

The Kinect camera development also contributes produce new ways of interacting with computers. The use of the Kinect camera as a motion capture gesture has been studied by several researchers such as [8], [9]. Kinect camera provides a new way to interact with a computer when human become the controller.

Kinect camera makes it easy for to develop a gesture recognition is cheap and easy compared than using special gloves. In addition to positive values that is owned by the Kinect camera, there is the disadvantage of the low resolution of the Kinect camera causing trouble in the next process that requires a high level of accuracy in gesture recognition. Especially hand only has a small portion in the frame so the making of research on hand gesture recognition using Kinect camera even has a significant challenge. One of the problems faced by researchers is the clipping or merging several fingers making it difficult for the recognition the fingers.



Ron et al [9] has been conducting research hand gestures recognized using Kinect camera. They use the Earth Mover's Distance algorithm that has been modified to be used on a hand gesture recognition called Finger-Earth Mover's Distance. The algorithm was developed to reduce the impact of the deficiencies Kinect camera, so the recognition of hand gestures can be better than before.

This study is based on research Ren and will be combined with the fuzzy classifying hand gestures. Hand gesture of the right hand will be captured by the camera and then will be cropped kinect based on the z-axis image. After segmenting the hand section which has been acquired will be performed preprocessing to remove noise contained in the surrounding area. Once the preprocessing is complete then the distance will be measured from the midpoint of the hand (centroid) to hand contour.

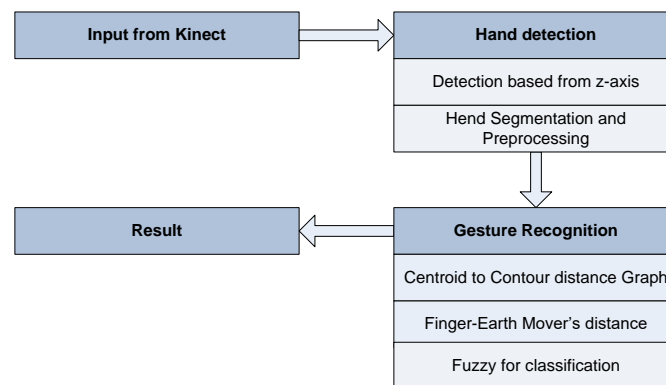


Figure 1. Research diagram.

2. Hand Gesture Recognition

2.1. Kinect Input and Hand Detection

Kinect camera provides output of RGB and depth in which each can be used. In this research using only the depth output from Kinect camera. Then the skeleton tracking will perform to get the position of the right hand to be used in the next process. The skeleton is tracked using Matlab skeletal tracking. Right hand is indices on number 12 of skeleton joint Matlab.

When the position of the right hand is detected it will be marked where the mark is a reference in the next hand segmentation. Removal of background objects performed by utilizing the hand distance detected by the camera.



Figure 2. Hand Detection.

2.2. Hand Segmentation and Pre-processing

Hand segmentation is done by detecting distance of right hand and other object surrounding the hand. After distancing of the hand detected, the hand will be separated from other object using the differences of hand. Every object that has distance more than 50 from hand will be deleted.

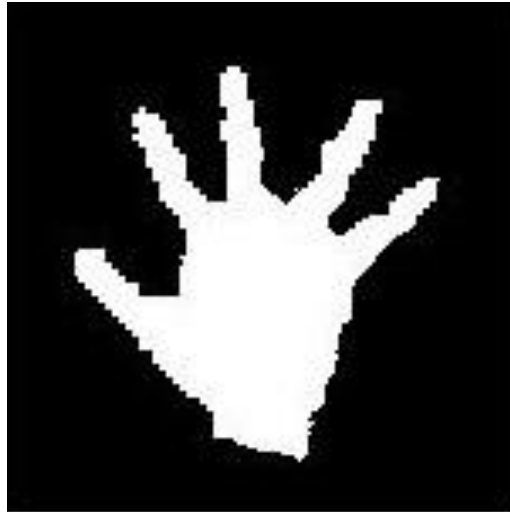


Figure 3. Hand Segmentation.

Pre-processing performed to improve the quality of the image so that it becomes better later in the process. In this research, image quality improvement by using the opening operation [10].

$$f \circ s = (f \ominus s) \oplus s$$

Where f is an image, and s is masking matrix 3 by 3 that all the value is one.

2.3. Centroid.

The next thing needed is to get the centroid of hand. To get centroid first of all hand region must be calculated. Centroid of a two-dimensional shape is the average position of all the point in the shape. The centroid of a subset X of R^n can be computed by the integral [11].

$$C = \frac{\int xg(x)dx}{\int g(x)dx}$$

Figure 4. shows the blue circle in the middle of a hand is the centroid.



Figure 4. Centroid of hand.

2.4. Distance from Centroid to Hand Contour

The distance from the centroid to hand contour is transformed into a graph. Edge detection is necessary to get hand contour. This research use Sobel edge detection and the result as shown in Figure 6. After edge detected it will tracked from the bottom of hand circularly by clockwise in the whole hand area. Edge tracking using 5 by 5 masking matrices that detects any edge.

13	0	10	0	14
0	5	2	6	0
9	1	X	3	11
0	8	4	7	0
16	0	12	0	15

Figure 5. Contour detection matrix

X is the detected pixel as hand contour it will be set not pixel after the contour pixel is detected. Zero value means the matrix index that is not used in contour detection. 1 until 16 value is detection sequences that will search for hand contour pixel.

Every contour detected, the coordinate will be recorded and the distance from centroid will be calculated and stored as vector matrix. The distance from the centroid to hand contour calculated using Euclidian distance.

$$d = \sqrt{(c_x - x_i)^2 + (c_y - y_i)^2}$$

Where d is distance, c_x is x-axis coordinate of centroid, c_y is y-axis coordinate of the centroid. x_i is x-axis of detected hand contour and y_i is y-axis coordinate of detected hand contour. Every distance will be inserted in vector matrix to make hand contour graphs. Figure 6 shows graphic generated from hand contour.

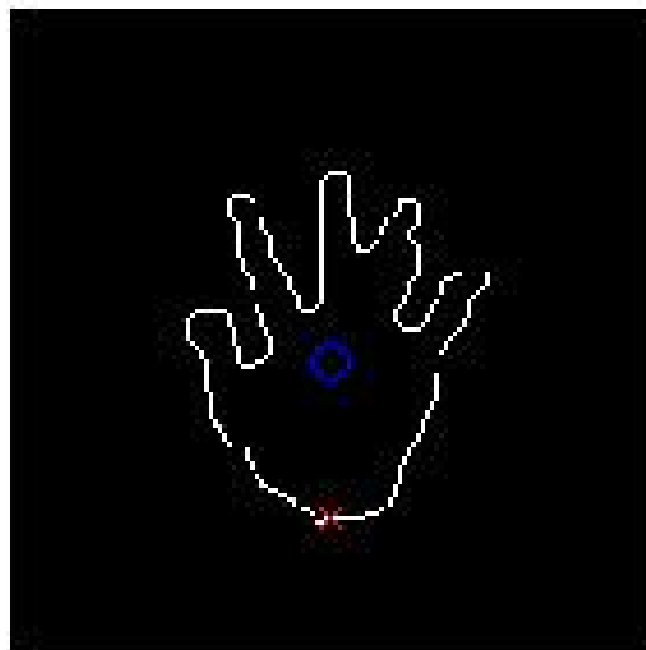


Figure 6. Hand Contour.

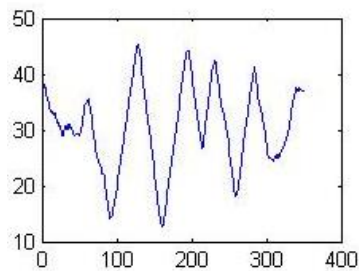


Figure 7. Hand contour graphic.

In order, all graphics have the same length, normalization should be performed using resampling function in Matlab.

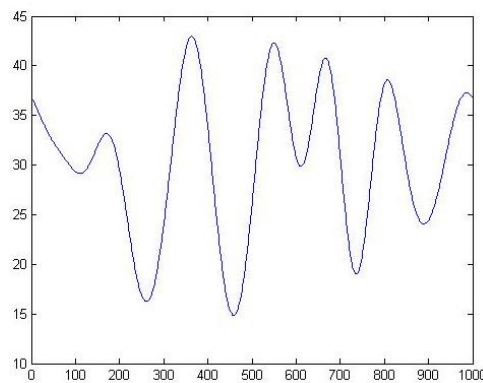


Figure 8. Normalized Contour Graphic.

References

- [1] X. Shen, G. Hua, L. Williams dan Y. Wu, "Dynamic hand gesture recognition: An exemplar-based approach from motion divergence fields," 2011.
- [2] J. Davis dan M. Shah, Recognizing Hand Gestures, European Conference on Computer Vision, 1994.
- [3] T. H. H. Maung, "Real-Time Hand Tracking and Gesture Recognition System Using Neural Networks," *World Academy of Science, Engineering and Technology*, 2009
- [4] A. Ramamoorthy, N. Vaswani, S. Chaudhury and S. Banerjee, Recognition of Dynamic Hand Gestures, 2002
- [5] T. Starner and Pentland, Real-Time American Sign Language Recognition from Video Processing Using Hidden Markov Models, MIT Media Lab, 1995.
- [6] R. Kjeldsen and J. Kender, Visual Hand Gesture Recognition for Window System Control, IWAfGR, 1995.
- [7] A. Just dan S. Marcel, "A comparative study of two state-of-the-art sequence processing techniques for hand gesture recognition," 2008.
- [8] M. Tang, "Recognizing Hand Gestures with Microsoft's Kinect," Department of Electrical Engineering Stanford University, 2011.
- [9] Z. Ren, J. Yuan, J. Meng and Z. Zhang, "Robust Part-based Hand Gesture Recognition based on Finger-Earth Mover's Distance," IEEE, 2012.
- [10] N. Efford, Digital Image Processing: A Practical Introduction Using Java, Pearson Education, 2000.
- [11] M. H. Protter and J. C. B. Morrey, College Calculus with Analytic Geometry (2nd ed.), Addison-Wesley, 1970.