K-Means Clustering in Moving Objects Extraction with Selective Background

by Moch Arief Soeleman

K-Means Clustering in Moving Objects Extraction with Selective Background

Moch Arief Soeleman[1], Aris Nurhindarto[2], Ricardus Anggi Pramunendar[3]
Faculty of Computer Science Dian Nuswantoro University
Semarang, Indonesia
arief22208@gmail.com[1], arisnurhindarto@yahoo.com[2], ricardus.anggi@research.dinus.ac.id[3]

Abstract - We presents a technique for moving objects extraction. There are several different approaches for moving object extraction, clustering is one of object extraction method with a stronger teorical foundation used in many applications. And need high performance in many extraction process of moving object. We compare K-Means and Self-Organizing Map method for extraction moving objects, for performance measurement of moving object extraction by applying MSE and PSNR. According to experimental result that the MSE value of K-Means is smaller than Self-Organizing Map. It is also that PSNR of K-Means is higher than Self-Organizing Map algorithm. The result proves that K-Means is a promising method to cluster pixels in moving objects extraction.

Keywords : extraction, clustering, moving object.

I. INTRODUCTION

The video application areas automated visual observation of a person or group, content-based visual image analysis, video tagging, and a mutual human-computer are facing important and bold problem which is moving object extraction. The video segmentation process must be successfully taken before we move to next processes such as extraction process on feature, identification, and the basic cognitive process of arranging into categories.

The video moving objects extraction process is aimed to separeted into parts an image sequence into typically particular areas which is able to enclose significant labels afterward, in which a set of region is broken down with the exact same one and similar kind attributes such as pixel degree, a visual attribute, motion. Problems of moving objects extraction have been discussed in many literature, in which according to their primary approaches is roughly classified into three categories, they are: dissimilar temporal [1] [2]; motion optical flow [3] [4] [5]; and background difference.

. The initial mode for analysing the frame sequence in video is through background model in [6] that compose in maintaining recent shape of moving objects from the background element. The background model is useful for segmenting video streams of the background to foreground.

The background subtraction is commonly applied to moving object recognition, which contains in upholding an update archetype of background and perceiving moving objects as those that diverge from such an archetype. In the comparison to other oncoming, for example optical flow in [8], this oncoming is feasible for the actual time that applications takes a process to occur by computation process.

Based on the background subtraction in [9], we determines to apply selective background in moving object extraction. In this paper, we assess the performance of clustering algorithm for extraction in moving objetcs.

II. RELATED WORK

An efficient background registration technique algorithm for efficient segmentation moving object have proposed in [10], this method was applied to structure consistent background from collected different frame motion information. This technique separates area by comparing the existing frame from the structured background.

A vigorous foreground partitioning algorithm have presented in [11], this approach is used to put into group whether it includes in the part of a scene behind objects in the foreground or employed a several intensity and refine a distinguishing information which having structure process in the later.

The consistent foreground segmentation approach have projected in [12], researchers incorporate temporal image analysis and recommendation background frame to overcome the glitch occurs on outdoor daylight sections which cause adjustment of the intensities on the background recommendation image of moving object segmentation. The purpose of using transient image analysis is to discover the object in every frame whether it is moving or static that emerged problem in background model.

Other approaches have been used in [13], the method combines two video segmentation technique using key-frame retraction and object-based method which have

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

been contructed for effective and robust based video segmentation algorithm and statistical clustering.

III. REVIEW OF RELATED THEORY

In this section, we describe of how extraction– moving objects based on clustering technique between K-Means and Self-Organization Map algorithm are presented.

a. K-Means Algorithm

The k-means algorithm is a hard clustering technique that divides the objects into k clusters, until each objects are being clustered to one and only one membership to minimize the sum of squared distances between each data point and the empirical mean of the corresponding cluster.

Algorithm 1: K-Means Algorithm

1) Select objects to be k initial centroid randomly
2) Estimate the distance of each centroid of each object by using space or similarity metric; use nearest centroid point to define each object at the cluster.
3) Calculate the latest centroid point.
4) Observe the result. If it turns to be different from the previous one, then return to step 2

3.2 Self-Organization Map Algorithm.

Self-Organization Map (SOM) is an iterative algorithm in [16] [17] and one of the widely used algorithm for. clustering. SOM comprises the competitive and cooperative stage

Algorithm 2 : Self-Organizing Map algorithm

1. Initialize the learning rate α, radius of the neighbor function r and random values for the initial weight $w_{ij} \in W$
2. Repeat until α reaches 0
   a. For k=1 to n
   b. The competitive stage: for all $w_{ij} \in W$ find the winning neuron

      that minimize $d_{ij} = \|x_k - w_{ij}\|$
   c. The cooperative stage: renew each unit $w_{ij} \in W$: $w_{ij} = w_{ij} + \alpha h(w_{winner}, w_{ij}, r)\ \|x_k - w_{ij}\|$
   d. Lessen the rate of α and r

IV. CLUSTERING-BASED OF MOVING OBJECT EXTRACTION

In this section, we describe of how to extract moving object by using clustering techniques modelling. In each frame, there are steps which is necessary by to perform moving object extraction and it is shown in Fig. 1. The sub steps are described below:

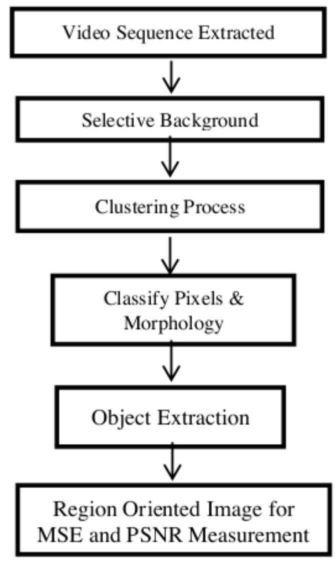


Figure 1. Diagram of Extraction Moving Object

a. Background Subtraction

In case of our background model with selective background is applied to detect the intensity different of current and background image, we addopt double different method also known three different method [18]. In the early stages video files are captured and broken into digital images based on video frames.

The extraction process is performed on a video where for each frame in a certain time unit is converted into digital image form. Digital imagery is generated in the form of JPEG (Joint Photographic Experts Group). Next to each pixel in the digital image is converted to a double type that has a range of values between 0 and 1.

The pixel value 0 for the weak colour component and the value of 1 means a strong colour component. Although converted into a double type, but the digital image is still in the RGB colour domain.

This following step of background subtraction with selective background:

1. Extract all frames on the video
2. Search for background frames automatically by calculating the mode values in each frame

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

3. Convert Current Frame and Background Frame to grayscale image
4. Reduce between the two frames
5. Convert the resulting image to binary image
6. Perform morphological operations to eliminate noise
7. Make image of morphological operation result as masking to visualize moving object

The result of background subtraction with selective background can show in figure 2.

(a) Background Frame

(b) Frame #697

(c) Moving Object with Background Subtraction

Figure 2. Result of object detected with Background Subtraction

b. Clustering using K-Means, SOM Algorithm

In this stage, we used two methods for moving object extraction and tracking which is in paralel process between SOM and K-means. Two different dataset have been used in each experiment for moving object extraction.

c. Morphology

A better extraction result is significant, so it needs morphology in the performance [19]. In the manipulation process of image features, mmorphology is applied which is based on shape [20], using basic operation such as dilatation, erosion, opening, and closing. Sequential combination of dilatation and erosion is presented in opening and closing. In [21], it is stated that the aim of opening process erosion which is followed by dilatation is encircling corner from inside the objects to obtain filter detail and simplified images. Meanwhile, small gaps within the object are closed by the closing (dilatation followed by erosion). This paper applies closing to eliminate the flawed in foreground recognition.

d. ROI Cropping for measurement

This stage is processed to create image ground truth, where as the human operation is cropping region of interest image reference in moving object clustering for comparing the performance of moving object extraction to calculate the MSE and PSNR.

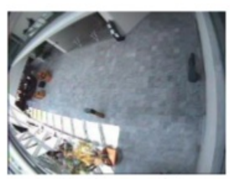
V. EXPERIMENTAL RESULT

a. Data and Results

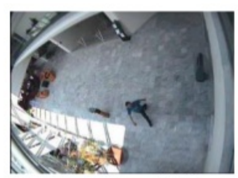
Algorithms implemented in the process of moving objects extraction was having an experimental result aimed for image sequences. It had been proved in the performance of the proposed method is tested in a sequence of moving images in real video. We defined two sequences which represented significant standard situations for video surveillance systems. The video processing was applied on moving objects in which the goal intended to be attained extracted moving objects in the building. We utilized Matlab sofware ver. 2017b and RAM on PC with processor i3-6100, 3.70 GHz, with memory 4.00 GB.

1) Sequence Walk1 : Sequence Walk1 of the database CAVIAR Project was labeled and comprise 611 frames of 484 x 288 in spatial resolution, acquired at frequency 25 fps. It was an example of difficult sequences, where the lighting condition was not as clear as previous area and the moving human tended to cover-up the path.

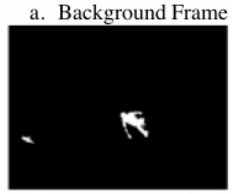
2) Sequence Walk2 : Sequence Walk2 of the 2nd database CAVIAR project was labelled and comprised 700 frame of 388 x 288 in spatial resolution, attained at frequency 25 fps. We have been assigned to test the method capability to segmenting more than one moving object. Finally, we found that K-Means was quite successful in moving objects extraction.



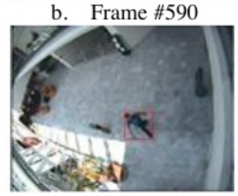
a. Background Frame



b. Frame #590



c. Object Detected



d. Object Tracked

Figure 3. Result of moving object extraction using K-Means (Walk1 dataset)

[1] http://homepages.inf.ed.ac.uk/rbf/CAVIAR/

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

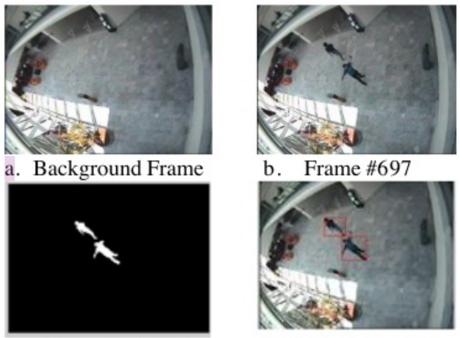


Figure 4. Result moving object extracted using K-Means with Rest_WiggleOnFloor dataset.

b. Performance Evaluation

In the measurement of performance in the process of moving object extraction, Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR) were applied. Both measurements are used for calculate the altered quality that renders of extracted and ground truth of image frame [22] in which better image segmentation was by having lower value of MSE and higher value of PSNR [23]. Those values of MSE and PSNR were obtained by the measurement process using [12] and [23], respectively.

$$MSE(R,Q) = \frac{1}{MN}\sum_{h=1}^{M}\sum_{j=1}^{N}[R(h,j) - Q(h,j)] \quad (1)$$

$$PSNR(R,Q) = 10.\log_{10}\left(\frac{\max^2}{MSE(R,Q)}\right) \quad (2)$$

In which R represents ground truth image, Q represents extraction frame of size $M \; x \; N$ and max is image maximum achievable pixel value.

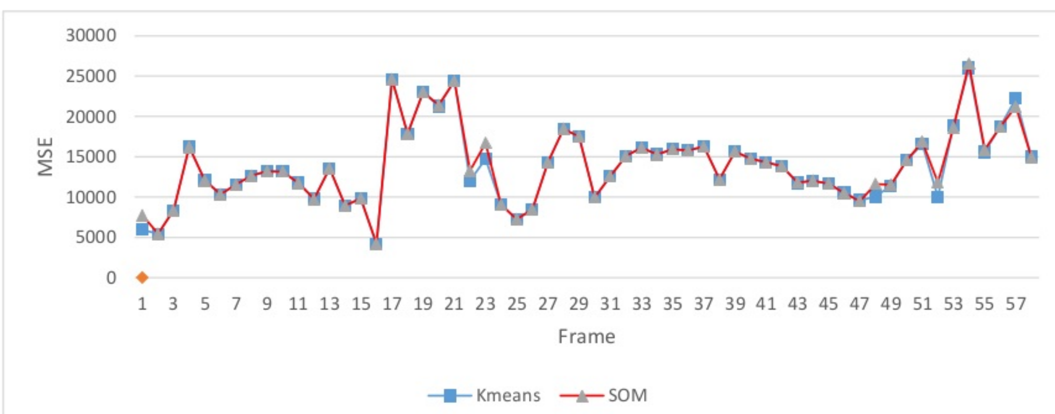


Figure 5. MSE of Walk1 Dataset using K-Means, SOM

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

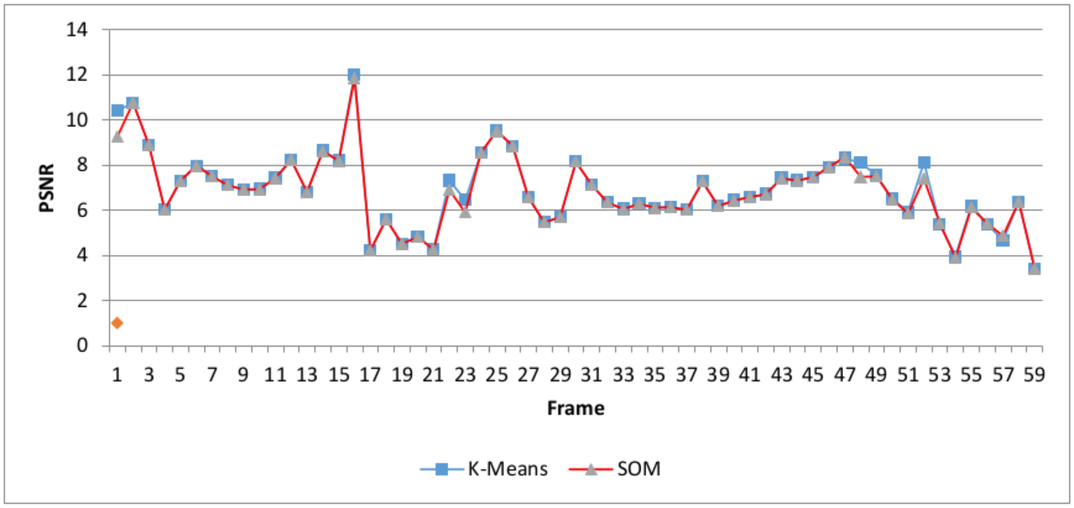


Figure 6. PSNR of Walk1 Dataset using K-Means, SOM

In two video used, we evaluated the comparison of object moving extraction. They are, video of human walking sequence in hall, and two people walking from same direction. Table 1 and Table 2 showed the MSE and PSNR of two video using K-Means and Self Organizing Map algorithm. K-Means produced better extraction result.

TABLE 1. Average MSE of K-Means and SOM

No.	Dataset	K-Means	SOM
1	Dataset1	13.83	13.97
2	Dataset2	9.7	9.80

The MSE of K-Means was having result that was lower than the MSE SOM, and the PSNR was higher than the PSNR of SOM. Fig. 4 and Fig. 5 illustrated the MSE and PSNR of dataset Walk1, correspondingly.

TABLE 2. Average PSNR of K-Means and SOM

No.	Dataset	K-Means	SOM
1	Dataset1	6,93	6,87
2	Dataset2	8,66	8,66

VI. CONCLUSIONS

We presented study of moving object extraction by using clustering techniques. Based on the results of research and experiments that have been done, it can be concluded that background subtraction techniques with a selective background to produce a good detection process. In static environments with indoor locations where the intensity of the lighting is relatively fixed, the background used can be manually modelled. However, in an environment with dynamic conditions, an adaptive background to environmental conditions is required. This research can also detect pedestrian objects quite well only by using selection techniques based on the size of the object. To improve accuracy, a comparison technique can be performed with pre-prepared training data. In addition, based on the results of trials that have been done, the proposed method

The outcome showed which the achievement of object moving extraction using K-Means is better than SOM algorithm. K-Means generated smaller MSE and greater PSNR opposed to SOM.

References

[1] N. Paragios and R. Deriche, "Geodesic active contours and level sets for the detection and tracking of moving objetcs," *IEEE Trans. Pattern*

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

Analysis and Machine Interface, vol. 22, no. 3, pp. 266-280, 2000.

[2] K. Ng and E. Delp, "Object tracking initialization using automatic moving object detection," in *Proc of SPIE/IS&T Conference on Visual Information Processing and Communication*, January 2010.

[3] Hui.Y, Yilin.C, Yanzhuo.M, Donglin.B and Zhaoyang.L, "Motion feature descriptor based moving objects segmentation," *High Technology letters,* vol. 18, no. 4, pp. 84-89, 2012.

[4] S. Fejes and L. Davis, "What can projections of flow fields tell us about the visual motion," in *ICCV Conference*, Bombay, India, 1998.

[5] L. WIxson and M. Hansen, "Detecting salient motion by accumulating directional-consistent flow," in *ICCV Conference*, Corfu, Greece, 1999.

[6] Bovic, The hand book of image and video processing, Academic Press, 1998.

[7] K. Srinivasan, K. Porkumaran and G. Sainarayanan, "Improved background subtraction techniques for security in video applications," in *3rd International Conference on Anti-couterfeiting Security, and Identification in Communication* , 2009.

[8] M. M. A. e. Azeem, "Modified background subtraction algorithm for motion detection in surveillance systems," *Journal of American Arabic Academy for Science and Technology,* vol. 1, no. 2, pp. 112 - 123, 2010.

[9] L. Maddalena and A. Petrosino, "A self-organizing approach to background subtraction for visual surveillance applications," *IEEE Transactions on Image Processing* , vol. 17, no. 7, pp. 1168 - 1177, July; 2008.

[10] S. Y. Chien, S.-Y. Ma and L.-G. Che, "Efficient moving object segmentation algorithm using background registration technique," *IEEE Trans. Circuit and System for Video Technology,* vol. 12, no. 7, 2002.

[11] H. Kim, R. S. I. Kitabara, T. Toriyama and K. Kogure, "Robust foreground segmentation from color video sequences using background subtraction with multiple threshold," in *Proc. KPJR*, 2006.

[12] P. Spagnolo, T. D. Orazio, M. Leo and A. Distante, "Moving object segmentation by background subtraction and temporal analysis," *Journal Image and Vision Computing,* vol. 24, pp. 411 - 423, 2006.

[13] L. Liu and G. Fan, "Combined key-frame extraction object-based video segmentation," *IEEE Trans. Circuit and Systems for Video Technology,* vol. 15, no. 7, 2005.

[14] V. Bhandari, K. B. R and K. M.M, "Moving object segmentation using fuzzy c-means clustering affine parameters," *Computer Network and Intelligent Computing Communication in Computer and Information Science,* vol. 157, pp. 205-210, 2011.

[15] S. Shambharkar and S. Tirpude, "Fuzzy C-Means clustering for content based image retrieval system," in *Proc of International Conference on Advancements in Information Technology with workshop of ICBMG*, 2011.

[16] T. Kohonen, "Self-organized formation of topologically correct feature map," *Biological Cybernetics* , vol. 43, no. 1, pp. 59-69, 1982.

[17] T. Kohonen, "Self-organizing map," *Springer Verlag,* 1997.

[18] B. Sugandi, H. S. Kim, J. K. Tan and S. Ishikawa, "Tracking of moving object by using low resolution image," in *International Conference on Innovative Computive, Information and Control*, 2007.

[19] K. Mahesh and K. Kuppusamy, "A new hybrid video segmentation algorithm using fuzzy c-means clustering," *International Journal of Computer Science* , vol. 9, no. 2, 2012.

[20] C. Nagaraju, S. Nagamani, G. R. Prasad and S. Sunitha, "Morphological edge detection algorithm based on multi-structure elements of different directions," *International Journal of Information and Communication Technology Research,* vol. 1, no. 1, 2011.

[21] A. Amer, "New binary morphological operations for efective low-cost boundary detection," *International Journal of Pattern Recognition and Artificial Intelligence,* vol. 17, no. 2, 2002.

[22] K. Bhoyar and O. Kakde, "Color image segmentation based on color histogram," *International Journal of Image Processing (IJIP),* vol. 3, no. 6, pp. 282-293, 2010.

[23] Z. Qu, "Two allgorithms of image segmentation and measurement method of particle's parameters," *An International Journal Applied Mathematic and Information Science,* no. 1, pp. 105 - 109, 2012.

Author Profile

M. Arief Soeleman Graduated from Dian Nuswantoro University in 1999, then continued his Master's Degree in Informatics Engineering at Dian Nuswantoro University and graduated in 2004. Graduated his Doctoral Program at the Electrical Engineering Program in 2016 at Sepuluh Nopember Institute of Surabaya. Field of Research on computer vision and image processing

Aris Nurhindarto Graduated from Dian Nuswantoro University in 1999, then continued his Master's Degree in Informatics Engineering at Dian Nuswantoro University and graduated in 2004. Field of interest Photography research and information system

Ricardus Anggi Pramunendar, Graduated from Dian Nuswantoro University in 2009, then continued his Master of Computer Science program at UTEM Malaysia and graduated in 2012. He is currently completing a Doctoral program at Gadjah Mada University majoring in Electrical Engineering. Research and numerous publications on computer vision and image processing

https://sites.google.com/site/ijcsis/
ISSN 1947-5500

K-Means Clustering in Moving Objects Extraction with Selective Background

ORIGINALITY REPORT

10%	7%	10%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	archive.org Internet Source	2%
2	docshare.tips Internet Source	2%
3	Moch Arief Soeleman, Mochamad Hariadi, Mauridhi Hery Purnomo. "Adaptive threshold for background subtraction in moving object detection using Fuzzy C-Means clustering", TENCON 2012 IEEE Region 10 Conference, 2012 Publication	2%
4	Lucia Maddalena. "A Self-Organizing Approach to Background Subtraction for Visual Surveillance Applications", IEEE Transactions on Image Processing, 07/2008 Publication	1%
5	www.waset.org Internet Source	1%

www.pubmedcentral.nih.gov

6	Internet Source	<1%
7	Aldhi Ari Kurniawan, Heru Agus Santoso, M. Arief Soeleman, Ahmad Zainul Fanani. "Intrusion Detection System as Audit in IoT Infrastructure using Ensemble Learning and SMOTE Method", 2019 5th International Conference on Science in Information Technology (ICSITech), 2019 Publication	<1%
8	Giorgio Gemignani. "Real-Time Stopped Object Detection by Neural Dual Background Modeling", Lecture Notes in Computer Science, 2011 Publication	<1%
9	link.springer.com Internet Source	<1%
10	technodocbox.com Internet Source	<1%
11	M. A. Soeleman, Mochamad Hariadi, Eko Mulyanto Yuniarno, Mauridhi Hery Purnomo. "Automatic Moving Objects Segmentation Enhancement Based on Fuzzy C-Means with Gabor Filter and Minkowski Distance", International Review on Computers and Software (IRECOS), 2015 Publication	<1%

12	dspace.nitrkl.ac.in Internet Source	<1%
13	www.ijetas.com Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		