



IJCSIS Vol. 16 No. 6, June 2018
ISSN 1947-5500

**International Journal of
Computer Science
& Information Security**

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Pennsylvania, USA

Indexed and technically co-sponsored by :



AUTHOR SERIES



K-Means Clustering in Moving Objects Extraction with Selective Background

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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 separated 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 objects.

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

been constructed 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:

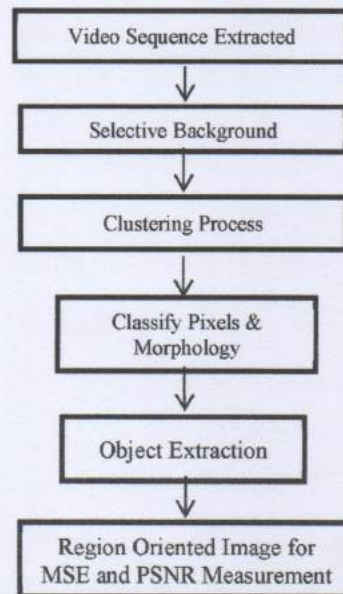


Figure 1. Diagram of Extraction Moving Object

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 adopt 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

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.

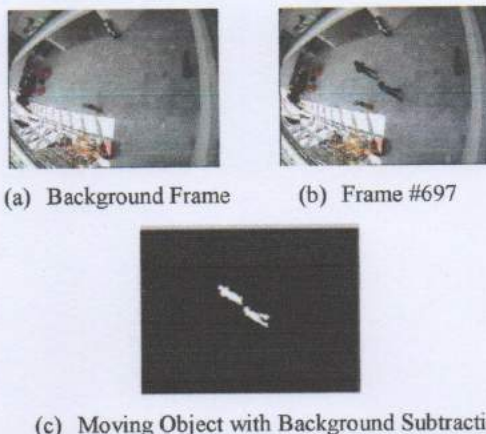


Figure 2. Result of object detected with Background Subtraction

b. Clustering using K-Means, SOM Algorithm

In this stage, we used two methods for moving object extraction and tracking which is in parallel 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, morphology 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 software 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 Project¹ 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.

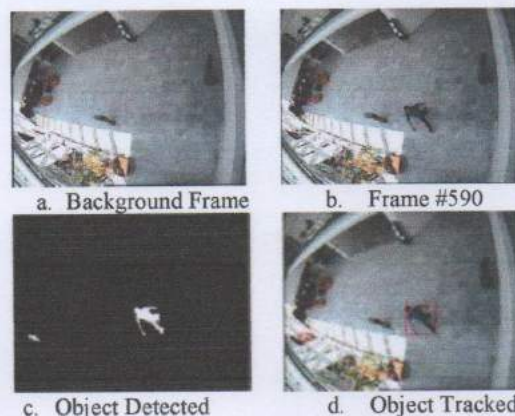
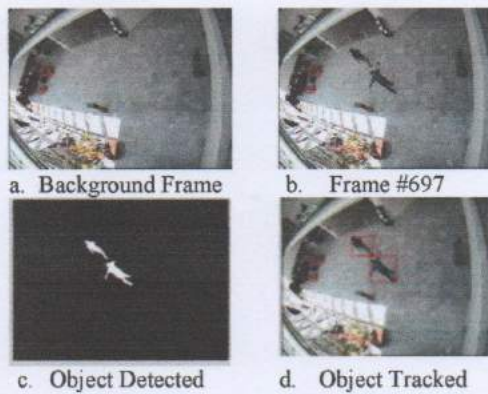


Figure 3. Result of moving object extraction using K-Means (Walk1 dataset)

¹ <http://homepages.inf.ed.ac.uk/rbf/CAVIAR/>



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

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.

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

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

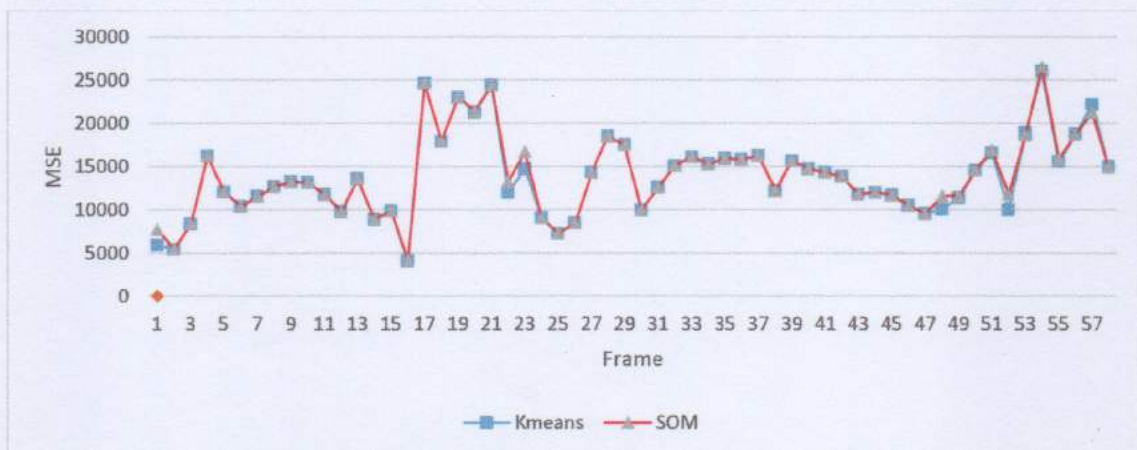


Figure 5. MSE of Walk1 Dataset using K-Means, SOM

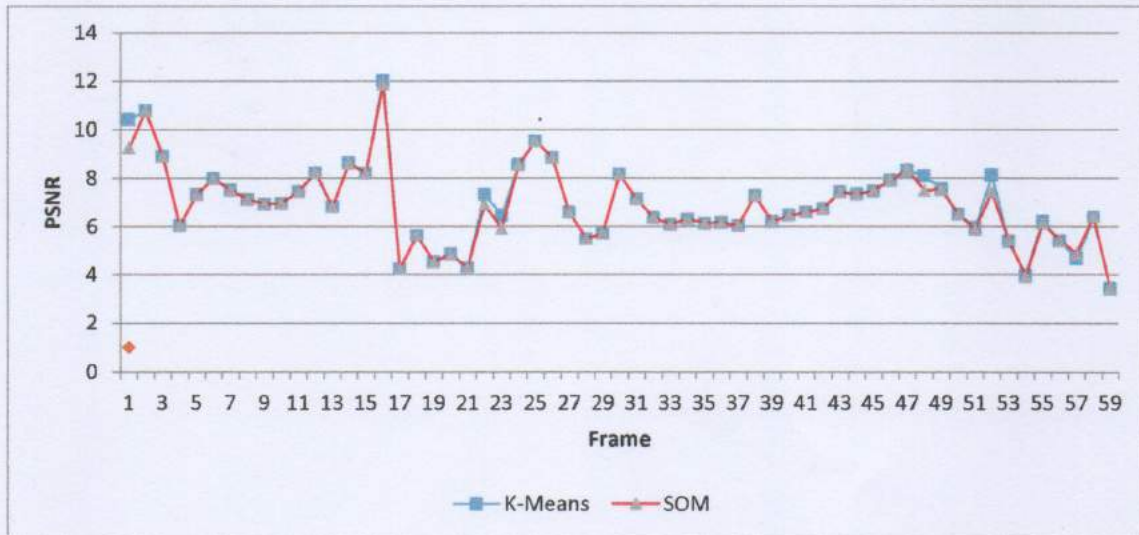


Figure 6. PSNR of Walk1 Dataset using K-Means, SOM

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.

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