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Moving Object Detection Methods in Video Analysis: A Review and Comparative Evaluation of AGMM and MCSHM

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Abstract*:* Moving object detection is very essential task in various computer vision applications. Moving object can be detected by various methods i.e. Background subtraction, frame differencing, optical flow method etc. All these are traditional methods which are widely used.. Some of these traditional methods are based on stable background; and hence they cannot be applied to dynamic background. Multiple color space histogram model is a great solution to this problem. Also Adaptive Gaussian Mixture Model is applicable to the dynamic scenes. In this paper we discuss these two methods. And results of both the models are compared here.

Keywords— Moving object detection, Multiple color space histogram model, Adaptive Gaussian Mixture Model.

I. INTRODUCTION

Moving object detection can be done by various methods like Background subtraction, frame differencing, optical flow method etc. All these are traditional methods which are widely used for moving object detection [1]. Some of these methods are based on assumption that background is stationary; and hence they can't be applied to dynamic background i.e. changing background, whose background images change over time. Here we are comparing two methods which are used for moving object detection. i.e. Multiple color space histogram model (MCSHM) and Adaptive Gaussian Mixture Model (AGMM) using Background Substraction. Traditional background Substraction is based on assumption that background is stationary but here this improved AGMM can also be applied to detect objects in changing background too. Also MCSHM is based on dynamic background. i.e. changing background. But MCSHM is a fast and simple algorithm, which combines histograms in multiple color spaces with the superposition principle of statistical histogram, called Multiple Color Space Histogram Model (MCSHM) is used. MCSHM first calculates statistical histograms of many color components in multiple color space and then use the variations of statistical histograms to find out whether there is an object. Thus, the computational complexity becomes very low[2-3]. MCSHM is briefly discussed in [2].

Whereas AGMM is the model is being designed for background substraction to detect moving object. The primary step for background subtraction is background modelling. The reference model is accomplished by utilizing the background modelling. The reference model is valuable in background substraction. In this process each frame in every video sequence is compared with reference frame to determine whether there is any possible change in the background or not. In terms of pixels, if there are any changes between current video frames and the reference model, then it can be said that moving object is detected [4].Generally GMM model is widely used for background subtraction. But there is still error in between an estimate of the image with stable objects and the current image.

There are various ways to solve this problem. AGMM is one of the most suitable methods used to update the model. To find out the result, the Gaussian distributions of the adaptive mixture model are then calculated. Every pixel is classified according to its Gaussian distribution, which represents each and every pixel most effectively and is considered as a part of the background model. The number of components of the mixture and the parameters are perseveringly adjusted for each pixel. By picking the number of components for every pixel in an on-line procedure, this method can automatically completely adapt to the scene. This exhibits a stable system which reliably manages with lighting changes, repetitive motions from clutter, and long-term scene changes. This system runs almost continuously in any weather [5-6].

This paper includes methodology of AGMM and compares it with MCSHM.

II. METHODOLOGY

A. GMM Model

A general strategy is applied and the scene model has a probability density function for every pixel independently. A pixel from another image is viewed as a background pixel if its new value is well illustrated by its density function. For a stable background the simplest model might be just an image of the scene without the interfering objects. Along these lines, to gauge suitable qualities for the changes of the pixel intensity levels from the picture since the fluctuations can differ from pixel to pixel. This is the GMM model proposed for background subtraction. Conventional strategies dependent on backgrounding techniques are not ready to deal with these general circumstances. Consequently to make a solid, versatile following framework which is adaptable enough to deal with varieties in brightening, moving scene clutter, multiple moving objects and other discretionary changes to the observed scene. The resultant tracker is essentially equipped towards scene-level video observation applications. Thus improved adaptation of GMM is proposed [5-6].

B. AGMM Model

AGMM is an updated version of GMM. It incorporates the parameters as well as the number of components of the mixture is always adjusted for each pixel. By picking the number of components for every pixel in an on-line procedure, this method can automatically completely adapt to the scene. Actually, the brightening the scene could change dynamically (daytime or climate conditions in an outside scene) or all of a sudden (exchanging light in an indoor scene). A new object can be brought into the scene or a present object expelled from it. So as to adjust to transforms we can update the training set by including new examples and disposing of the old ones [6].

C. Flowchart

First of all a static camera is used to capture video frames. Thus captured video is then applied to the model. Then number of frames is separated and so image sequences are created. Background modelling is an essential step hence the reference model is obtained by the background modelling. At that point the reference model which is useful in background substraction is compared with reference frame i.e. current frame image is compared with background image frame to find whether there is any change in the background or any moving object appears or not. If there are any changes between current video frames and the reference model in terms of pixels, it can be said that moving object is detected. The flow diagram given below describes the scenario explicitly.

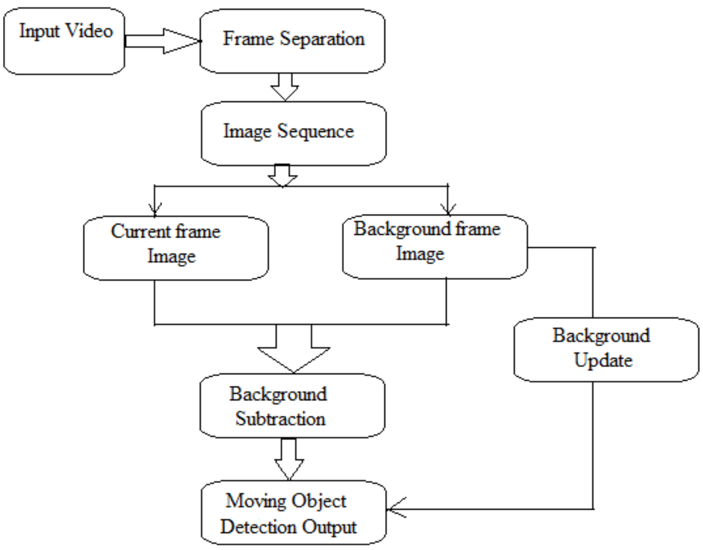

Figure.1. Flow chart of AGMM Model

III. EXPERIMENTS AND RESULTS

To analyse the performance of both the algorithms i.e. MCSHM and AGMM we used two scenes as input video frames. We use true positive (TP), true negative (TN), false positive (FP), false negative (FN), accuracy, precision, recall and f-measures to examine the performance of the algorithms. Here true means the correct classification and false is the false classification. Also in our experiment positive means there is moving object in the scene and negative means there is no moving object in the scene. We compared the MCSHM with AGMM.

A. Moving car: We use 'Moving car' to analyse the performance of both the algorithms. AGMM is updated version of GMM hence it has the problem that is holes inside the target. This problem is caused due to update process. Fig2 and 3 shows the results of both the algorithms MCSHM and AGMM respectively. The result exhibits that our method precisely depicts the influence of the moving object on the background. Also it determines whether there is moving object in the scene or not.

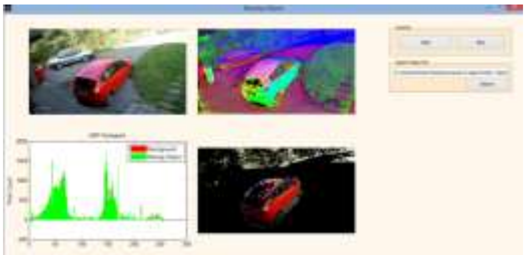

Figure 2: Moving object detection using MCSHM

Figure 3: Moving Object detection using AGMM

Table1: Evaluation Results for 'Moving Car' for both algorithms

Method	TP	TN	FP	FN	Accuracy (%)	Precision	Recall	F-measures
AGMM	382	41	6	19	94.41	0.9845	0.9526	0.9647
MCSHM	368	73	3	4	**98.43**	**0.9919**	**0.9892**	**0.9849**

Table 1 shows the performance parameters for both the algorithms i.e. AGMM and MCSHM. It presents that AGMM has accuracy (94%) less than that of MCSHM. Table 2 exhibits that our method surpasses the AGMM for precision, recall and f-measures.

B. Static scene: We assess the adaptability of both the algorithms to static scene on 'Office' as shown in fig 4 and 5. Table 2 shows that MCSHM gives the better accuracy rate than AGMM. It can be interpreted as MCSHM shows very good adaptability to static scenes for example 'Office'.

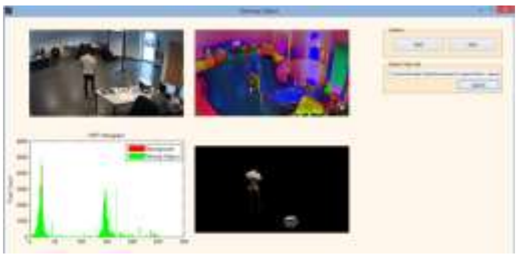

Figure.4 Office-Moving object detection using MCSHM

Figure.5 Office-Moving object detection using AGMM

Table 2: Evaluation Results for 'office' for both algorithms

Method	TP	TN	FP	FN	Accuracy (%)	Precision	Recall	F-measures
AGMM	311	46	4	61	84.59	**0.9873**	0.8360	0.905
MCSHM	172	191	3	56	**86.01**	0.9828	0.7543	0.85

ROC Curve: Figure 6 &7 shows ROC for 'Moving Car' for MCSHM and AGMM and ROC for 'Office' for both the algorithms respectively.

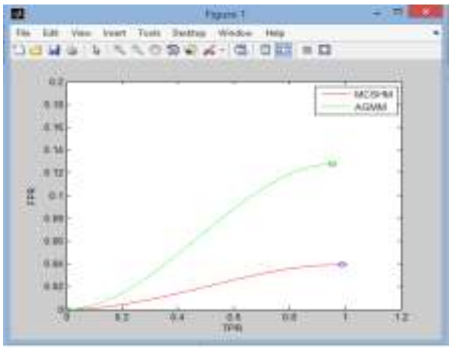

Figure 6. ROC for Moving Car

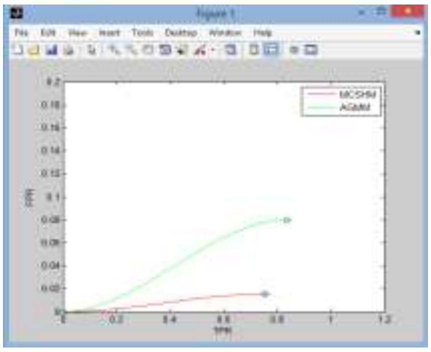

Figure 7. ROC for Office

As compared to the AGMM algorithm, MCSHM focuses on whether there is a moving object in the scene or not and do not care about the location of the object. Output of MCSHM is a Boolean value, true or false whereas output of AGMM is the binary images. When an object appears suddenly on a static background, an abrupt flux arises in the curve. As the object fades away, the curve i.e. histogram is synchronized to restore the previous state. It shows that our method i.e. MCSHM can precisely describe the influence of the object on the background and can determine whether there is an object in the scene or not.

IV. CONCLUSION

In this paper we compared the two methods to detect moving objects. After taking into consideration both the methods for both the cases i.e. for 'Moving car' as well as for 'Office', results exhibit that MCSHM gives 92 % accuracy whereas AGMM gives 89% on an average. Also this algorithm is different than pixel level modelling hence computational complexity of MCSHM is very low as compared to AGMM. Flexibility of our method leads to give better results than any other algorithm. And choosing proper color components boost the strength of MCSHM. This demonstrates that our technique is more proficient than AGMM.

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