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# Moving Object Tracking using Gaussian Mixture Model and Optical Flow

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***Abstract—In this paper, we propose a new tracking method that uses Gaussian Mixture Model (GMM) and Optical Flow approach for object tracking. The GMM approach consists of three different Gaussian distributions, the average, standard deviation and weight respectively. There are two important steps to establish the background for model, and background updates which separate the foreground and background. This paper combines the GMM and Optical Flow object tracking. The advantages of Optical Flow are quick calculations and the disadvantage is a lack of complete object tracking. The advantage of GMM is complete results of the operation the disadvantage is not a complete object tracking, GMM result of the operation complete but disadvantages include computing for a long time with more noise. These two methods can complement each other and image filtering results in the successful tracking of objects. It has variety of uses such as video communication and compression, traffic control, medical imaging and video editing.***

***Keywords— Object Tracking, Gaussian Mixture Model, Optical Flow, Background Subtraction, Moving Objects***

## I. INTRODUCTION

Moving object detection is the first step in video analysis. It can be used in many regions such as video surveillance, traffic monitoring and people tracking. There are three common motion segmentation techniques, which are frame difference, background subtraction and optical flow method. Frame difference method has less computational complexity, and it is easy to implement, but generally does a poor job of extracting the complete shapes of certain types of moving objects. Background subtraction method uses the current frame minus the reference background image. The pixels where the difference is above a threshold are classified as the moving object. The Mixture of Gaussians method is widely used for the background modeling since it was proposed by Friedman and Russell. Stauffer presented an adaptive background mixture model by a mixture of K Gaussian distributions. Optical flow method can detect the moving object even when the camera moves, but it needs more time for its computational complexity, and it is very sensitive to the noise. The motion area usually appears quite noisy in real images and optical flow estimation involves only local computation. So the Optical Flow method can't detect the exact contour of the moving object, so we can conclude that there are some shortcomings in the traditional moving object detection methods:

- Frame difference can not detect the exact contour of the moving object.
- Optical Flow method is sensitive to the noise.

In this paper we combine GMM and Optical Flow method. GMM can be used in the context of a complex environment while Optical Flow can be used for quick calculation with simple background. GMM is not a complete object tracking while Object Flow provides complete computation tracking.

The rest of this paper is organized as follows, Section II describes the Gaussian Mixture Model contains background models and update method. Section III describes the Optical Flow Method. Section IV describes our proposed method. Section V describes results. Finally Section VI presents our conclusions.

## II. GAUSSIAN MIXTURE MODEL

The Gaussian mixture model is a single extension of the Gaussian probability density function. As the GMM can approximate any smooth shape of the density distribution, so often used in image processing in recent years for good results. Assuming the Gaussian mixture model consists of and the combination of Gaussian probability density function, the Gaussian probability density function of each has its own mean, standard deviation, and weight, the weights can be interpreted by the corresponding Gaussian model of the frequency, they more often appear in the Gaussian model the higher the weight. The higher frequency of occurrence, then find the maximum weight on the Gaussian probability density function, Finally, the Gaussian probability density function of the means pixel value is background image.[4]

### *A. Background model*

Background subtraction is one of the most common methods of object segmentation, this process contains two steps: background and update model.[8] The basic theory of the Gaussian mixture model is as long as the number of Gaussian

 

mixtures, an arbitrary distribution can be in any of the precision is mixed with a weighted average of Gaussian approximation

*B. Background update*

The known algorithms, if not updated, the step operation time will be very long, we must use the iterative method to update the mean, standard deviation and the weight to reduce the time required. New steps before must set the basic parameters, as the number of Gaussian components ,Number of background components are , Positive deviation threshold , learning rate between 0 to 1. Although the computational complexity of the GMM is high, but it can provide better results. If new entrants cannot be matched to any pixel of a Gaussian probability density function, update the pixel value of mean, then initialize the weights and the standard deviation. [1], [8].

## III. OPTICAL FLOW

Optical flow or optic flow is the pattern of apparent motion of objects, surfaces, and edges in a visual scene caused by the relative motion between an observer and the scene. The concept of optical flow was first studied in the 1940s and ultimately published by American psychologist James J. Gibsoas part of his theory of affordance. Optical flow techniques such as motion detection, object segmentation, time-to-collision and focus of expansion calculations, motion compensated encoding, and stereo disparity measurement utilize this motion of the objects' surfaces and edges. Sequence of ordered images allows the estimation of motion as either instantaneous image velocities or discrete image displacements. Fleet and Weiss provide a tutorial introduction to gradient based optical flow. John L. Barron, David J. Fleet, and Steven Beauchemin provide a performance analysis of a number of optical flow techniques. It emphasizes the accuracy and density of measurements. [2], [3]

The optical flow method try to calculate the motion between two image frames which are taken at times t and t+ δt at every position. These methods are called differential since they are based on local Taylor Series approximation of the image signal; that is, they use partial derivatives with respect to the spatial and temporal coordinates. [5]

## IV. PROPOSED METHOD

Combine the GMM with the Optical Flow method we can obtain the results of moving object tracking. We have to combine the advantages of GMM and Optical Flow. One of the key tasks in a tracking system is to update the object model. In most of the tracking scenarios, the underlying image data, the object, and the scene, evolve over time in a temporal sequence. In such scenarios, the assumption of a constant object or background model over the entire sequence will lead to an impoverished tracker which cannot handle photometric differences and occlusions. Hence it is essential to learn the object model and adapt accordingly.

- Input: captured with a fixed camera containing one or more moving objects of interest
- Processing goals: determine the image regions where significant motion has occurred
- Combine GMM and Optical Flow algorithm.
- Foreground extraction.
- Output: an outline of the motion within the image sequence.

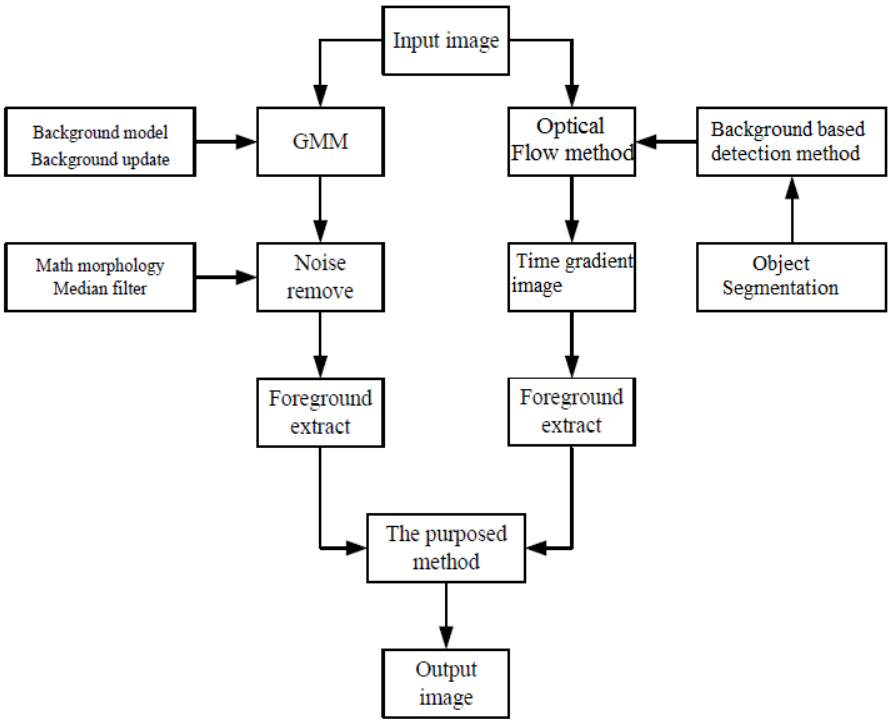


Fig. 1 Flow chart of the proposed object tracking

 

## V. RESULTS

In this section, we show experimental results of the proposed object tracking method. The proposed algorithm would be implemented in MATLAB 12. The object video sequences come from standard camera which is publicly available; the size of the video sequences is 480×320 pixels. Figure 2 show the original video and, figure 6 show the vehicle tracking results,


**Fig.2 Original Video**


**Fig.3 Motion Vector (Using Optical Flow)**

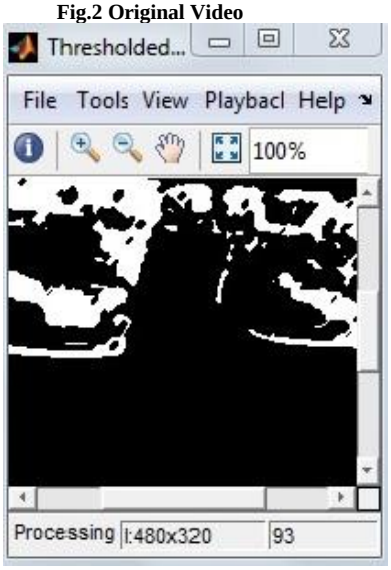


**Fig.4 Thresholding Video Frame**

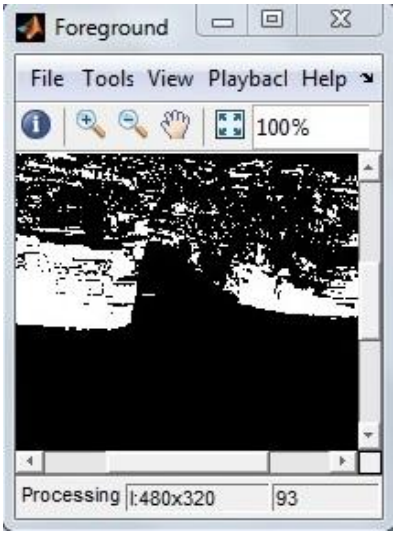


**Fig.5 Foreground Dtection (Using GMM)**

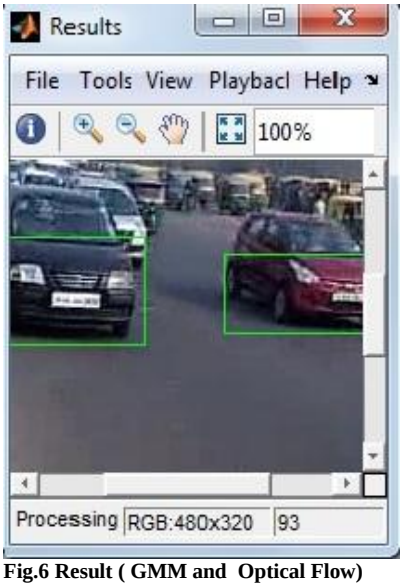


**Fig.6 Result ( GMM and Optical Flow)**


**Fig.7 No. of object count**

 

## VI. CONCLUSION

In this paper, we proposed the GMM and Optical Flow method successfully applied in a continuous image. We used the GMM approach as the main tracking algorithm, with morphological and median filtering to remove noise. The success of the foreground and background segmentation and found the object coordinates. On the other hand, we used the optical flow method to subtract successive images, also using morphological and median filters to remove noise. Due to Optical Flow method tracking object incompletely, supporting the main algorithm GMM, the proposed method there is still room for improvement. We can replace the Optical Flow method, fill the emptiness produced by the phenomenon of GMM, but the best algorithms in the future still need more testing to be able to get the perfect result.

## VII. FUTURE WORK

In future this method can be modified to differentiate different class objects in real time video. Later characteristics are extracted and applied to a Neural Network so that segmented objects are classified as vehicles and non vehicles and, in the case of vehicles, they will be classified according to the size of the vehicle as follows: large size, intermediate size, small size. With the help of Data Mining we can include a real database that could be helpful in Traffic Management.

## REFERENCES

[1] C.Stauffer, W.E.L. Grimson. "Adaptive Bacckground Mixture Models for Real-Time Tracking," in Proc. Computer Vision and Pattern Recognition Conf., vol. 2, Fort Collins, CO. USA, June 1999,pp.246-252.
[2] Object Tracking: A Survey, Alper Yilmaz, Omar Javed, Mubarak Shah.
[3] A. D. Bue, D. Comaniciu, V. Ramesh, and C. Regazzoni. Smart cameras with real-time video object generation. In Proceedings of the IEEE International Conference on Image Processing, volume 3, pages 429–432, June 2002
[4] Prakash Chockalingam. Non-rigid multi modal object tracking using Gaussian mixture model, The Graduate School of Clemson University, PhD thesis, 2009.
[5] Bhavana C. Bendale, Prof. Anil R. Karwankar. Moving Object Tracking in Video Using MATLAB, International Journal of Electronics, Communication & Soft Computing Science and Engineering.
[6] Qing Wanga, Feng Chena. An Experimental Comparison of Online Object Tracking Algorithms, aTsinghua University, Beijing, China
[7] Evandro Alves da Silva, Adilson Gonzaga. On-Road Automotive Vehicle Detection using Gaussian Mixture Model and NNs, University of São Paulo.
[8] Qi Zang & Reinhard Klette. Parameter Analysis for Mixture of Gaussians Model, The university of Auckland.

 