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An Efficient Algorithm for Real Time Moving Object Detection using GMM and Optical Flow

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ABSTRACT: Real time moving object detection is sensing the physical moment in given particular area. For detecting the motion in real time there are multiple methods are available like Background Subtraction, Gaussian Mixture Model, Inter Frame Differencing, Kernel Density etc. Here for proposed work used Gaussian Mixture Model and Optical Flow technique for the moving object detection. Gaussian Mixture Model is better extract the foreground object but it more time consuming and Optical Flow is faster for moving object detection but it is not more accurate so by using these two approaches design new approach for detect the moving object in real time.

KEYWORDS: Object Detection, Background Subtraction, Gaussian Mixture Model, Optical Flow, Video Surveillance.

I. INTRODUCTION

In real time moving object detection is nothing but detect motion for particular region. In now days there are different type of CCTV camera is available for detect an unusual activity but for more security this problem are still open. The principle sources of difficulties in the task of moving object detection are: 1) changes in appearance of the objects with viewpoint, illumination and articulation 2) partial occlusions of the target objects by other objects 3) Complexity of the background that is presence of waving tree leaves, waving of river water etc (4) environment changes [1]. In Fig 1 shown that the basic steps for the moving object detection.

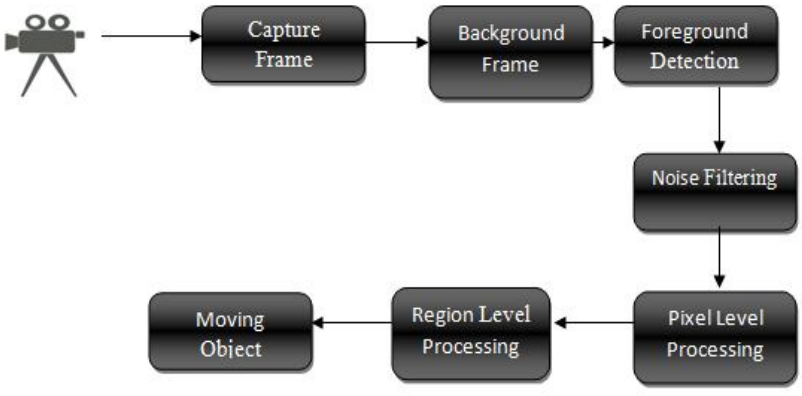

Fig.1. Basic Steps for Real Time Moving Object Detection

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II. RELATED WORK

In [1] paper author used Mixture of Gaussian Technique for moving object detection. For motion detection they convert frame of video into specified resolution i.e. 192x144 using three level Haar Wavelet Decomposition. This system can apply for colour and gray scale video imagery but high resolution converted into small resolution it is also disadvantage. Consider example moving object is small or far from video surveillance system than it is disappeared when it convert to small resolution. In [2] paper moving object detection is using Background Subtraction method. They remove noise from frame using Morphological technique and shadow removing using shape analysis but simple background subtraction is not apply directly to the outdoor system. In [3] paper author used RGB background modelling for the real time moving object detection and used morphology for removing noise and blob labelling for grouping real time moving object. Using this method predicts the velocity of moving object and detect moving object fast. They experiment on NVR camera and place it in different area for check robustness in different environment influences. In [4] paper author detect vehicle movement in high traffic area using Gaussian Mixture Model and using binary computation is draw the rectangular to detected object. In that they used the 150 train images to extract the vehicle part from the background. For noise removing some morphological operation is to be performed. For used this technique required more space to store the train images. In [5] paper author combine two methods one is background subtraction with Gaussian Mixture Model and second is inter frame differencing. In that they first consider the first frame is background and other frame is capture and compare with the background frame to detect the foreground object. In that if there is environment change or lighting change they used background update technique so improve the efficiency of algorithm. For the background update they used three inter frame differencing method. For noise removing they used the median factor and mathematical morphology operation. In [6] paper author used Optical Flow and Object Counter for moving object detection in video surveillance system. In that the optical flow method is used for detecting the moving pixel using two consecutive frames so that the motion part position can be identified. Object Counter is used for the extracting the moving object and define the actual object.

III. PROPOSED ALGORITHM

There are many methods for moving object detection: Background Subtraction Method, Inter frame differencing, Non- Parametric Kernel Density, Edge Detection based. Out of all of these methods the Gaussian Mixture Model is very efficient method for motion detection but it has also limitation that it requires more time for moving object detection. This limitation is overcome by the Optical Flow Method. Optical Flow is very fast and it calculates motion between two frames which are capture at time t and t+δt. Optical flow is noisy so this limitation is remove be GMM and at last get output from combination of GMM and Optical flow is more accurate but it also have some noise that can be removed by the morphology technique that can give an accurate result.

In Existing method it used every time background update technique that can consume more time for updating and also require more space for execution but in now a day's space is not an issue but time is more important factor. So in proposed method it is not required to background update so it's require less time for detecting and tracking moving object detection.

A. *Flow Chart:*

In fig 2 define the flowchart of proposed algorithm. In proposed method there are basic four steps for detect moving object in video surveillance.

- **Step 1: Capture Frame**
  In this step it simply capture frame from video surveillance system.
- **Step 2: Background Modelling & Foreground Extraction**
  In that it is also divided into subpart:
  a) Background Removing using Gaussian Mixture model
  b) Motion Detection using the Optical Flow and apply appropriate threshold value for complex image to binary image
  c) Detect actual moving object.

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- **Step 3: Filtering**
  In this steps noise is reduce using the Morphological Analysis method.
- **Step 4: Outline**
  Using the Blob Labelling method outline the moving object.

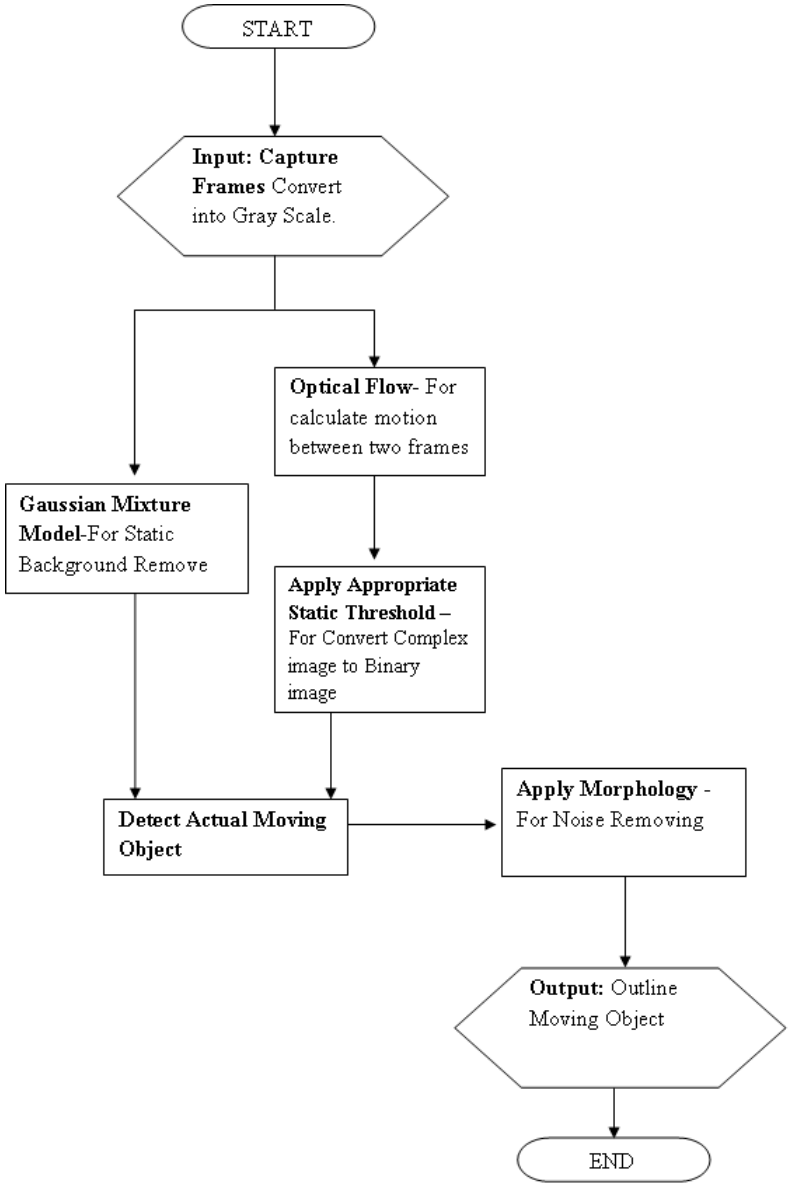

Fig.2. Flow Chart of Proposed Algorithm

B. *Experimental Parameter :*

For detecting the moving object the frames are captured from the video surveillance system. We will use Matlab R2014a instances as laptop computers with 2.0 GHz Intel(R) Core(TM) 2 Duo processor and 2 GB RAM having Windows 7 (32 bit) Operating system with webcam. For evolution of algorithm, we will use the TPR (True Positive Rate) and FPR (False Positive Rate) as evaluation parameter. Following is the equation of TPR and FPR.

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$$TPR=\frac{N_{tp}}{N_{tp}+N_{fp}},\ FPR=\frac{N_{fp}}{N_{fp}+N_{tn}} \qquad \text{eq. (1)}$$

WhereN_{tp}, N_{fp}, N_{fp} and N_{tn} are the number of objects identified as true positive, false positive, true negative and false negative[2].

IV. EXPERIMENTAL RESULTS

In this section define some experimental result of moving object detection using proposed algorithm and using this algorithm we found that the accuracy of proposed algorithm is 91.056%. This accuracy is calculated using eq. (1) and input taken from fixed camera. In fig 3 it is taken input from CCTV. In fig 4 it is extract foreground using Gaussian Mixture Model (GMM). For GMM first we have taken 150 frames as train frame and number of Gaussian is 3.

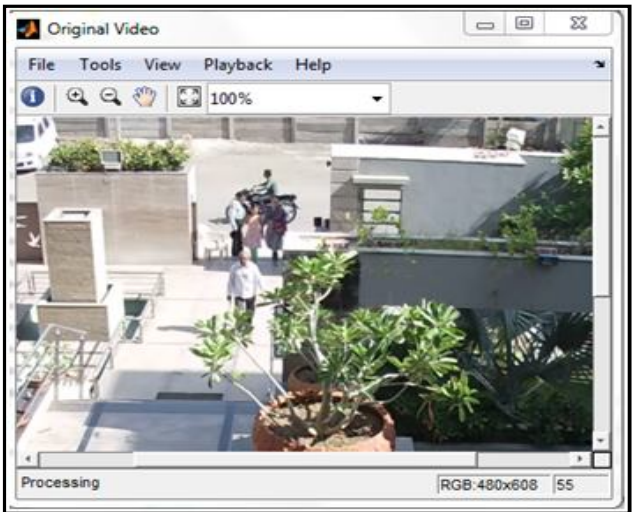

Fig.3. Original Input Frame

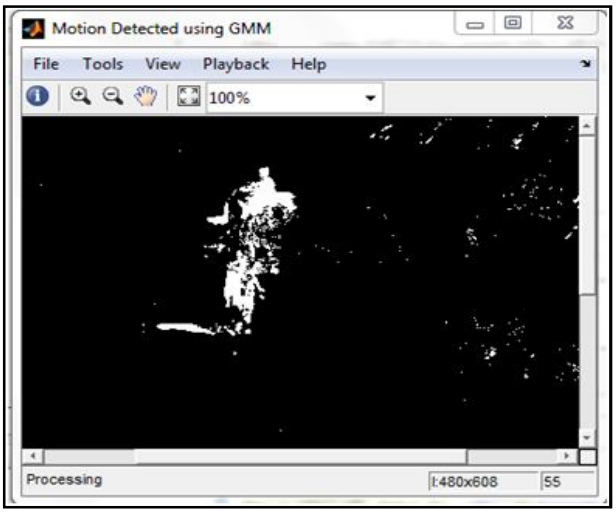

Fig. 4. Motion Detection using GMM

In fig 5 it is detect motion using Optical Flow method. In Optical flow method it output image is complex format so it is require to convert in binary format. In fig 6 it is detect motion using Gaussian Mixture Model and Optical Flow which is our proposed method.

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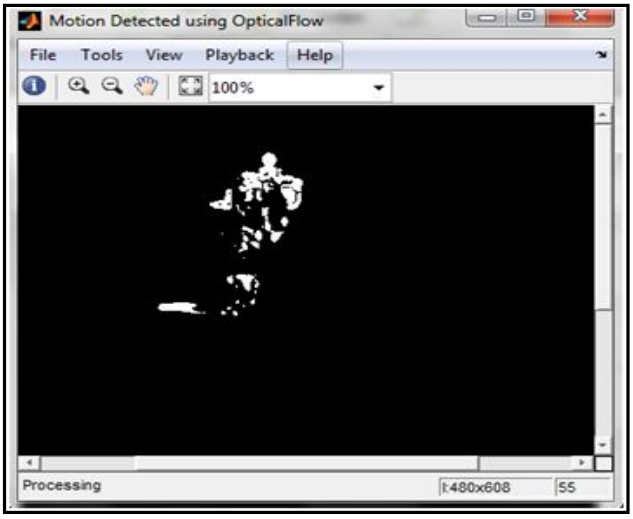

Fig. 5. Motion Detection using Optical Flow

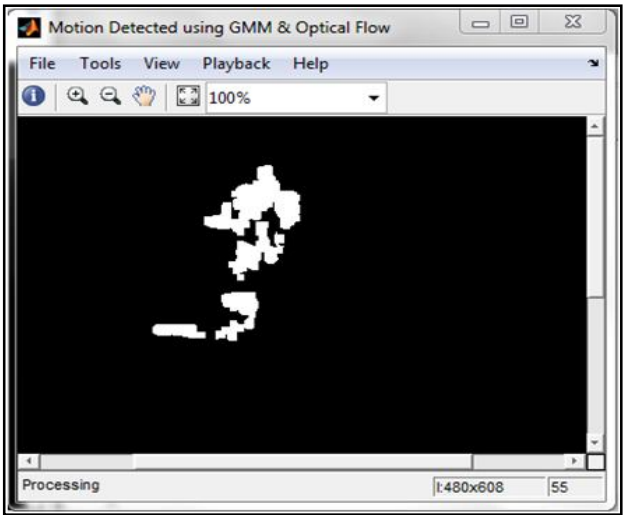

Fig 6. Motion Detection using GMM & Optical Flow

In fig 7 it is motion detection without noise, here noise is remove by morphological analysis using opening technique. In fig 8 it is track the moving object using blob analysis.

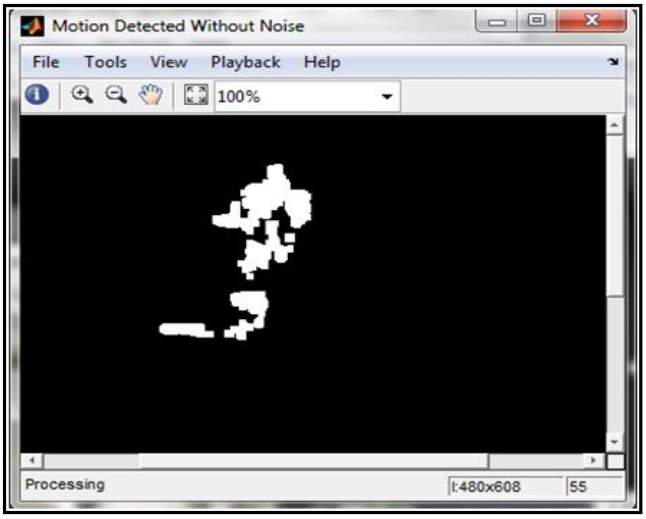

Fig. 7. Motion Detected without Noise

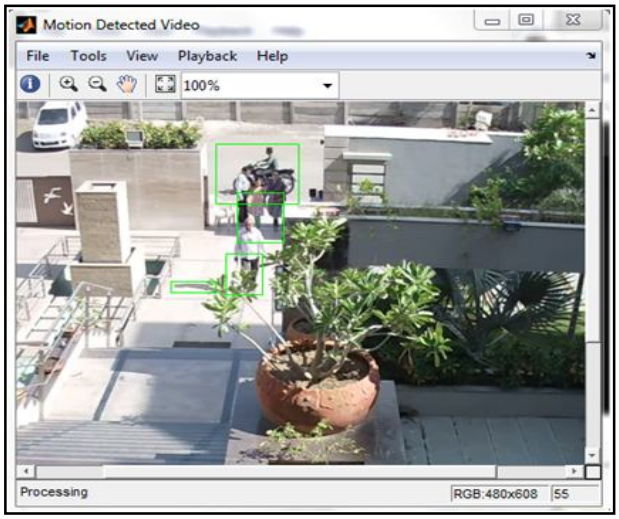

Fig 8. Output of Proposed Algorithm

V. CONCLUSION AND FUTURE WORK

According to literature survey finding that the simple background subtraction method is noisier for outdoor environment so that in proposed method used Gaussian Mixture Model and Optical Flow for tracking moving object. For noise removing morphology technique is used. At last after implementation of proposed method finding that it's require less time as compare to existing method. This algorithm is not applied when object and camera is moving, so that improved proposed algorithm that can be applied for this condition.

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