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SIMULATION AND DETECTION OF MOVING OBJECT FROM VIDEO SEQUENCE

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ABSTRACT: In moving object detection problem, more n more researchers from computer vision community has been propose more solution to the said problem with a great amount of effort in recent years, either in real time or offline. recently, moving object detection algorithms have been developed to identify moving object in videos. The aim of this research is to implement a system to detect moving object & count the number of detected on one of those algorithms. Here, in this propose work, our aim is to detect the moving object based on background subtraction model-based algorithm and then count the total number of moving object and show as the output. If we see the process of detecting moving object, most commonly used algorithm is background subtraction. So, whole process is divide into three steps. In first step is to take input offline video for detecting moving object, here we have to read a from input video and perform pre-processing task to remove noise, to enhance the quality of video. Second step is finding moving object from current frame. To detect moving object from current frame of input video, a background subtraction method is required in initial phase of the system development. Here, we maintain the background scene by its edges only, and then we use the adaptive single gaussian model. background subtraction method is used for modelling the background scene for given input video. After detecting moving pixel for current frame, third step is to remove noise from foreground image using morphological operation. After that we will get foreground mask. By applying foreground mask, we can separate moving object from the current frame. Propose algorithm of background subtraction, tested on different test video data-set. Result of propose method is gives improvement over frame difference, it cannot better than Mixture of gaussian. If we compare the execution time of propose method, it is executing faster than MOG. And slower than frame difference method.

Keywords: Moving object detection, background subtraction, frame difference, gaussian mixture model, morphological processing,

I. INTRODUCTION

The goal of computer vision is to enable computer to intercept motion and understanding of human vision. Visual object tracking has been emerged as important and challenging subject inthe field of computer vision. The core of visual object tracking is to estimate the motion of the object in each frame of the input sequence of video frame (i.e. image). Object can be defined as region of interest which can be used for further analysis. For example, boat fish, vehicle, planes, etc. Tracking is defined as to follow the motion of an object moving under the action of given forces.
One of the applications of object tracking is video compression. For example, Video object tracking is applied in banks, parking lots, residential areas, malls for monitoring human activities. Object tracking is also used for hand gesture recognition in human-computer interaction applications. It is difficult to project 3D world into 2D image. This may cause loss of information. Various methods are used for tracking purpose. In our proposed research work, our aim is automatically detecting and count the number of moving object in an offline video in a constrained environment. In the object counting system, first step is to detect the foreground objects in the video, and then finally classify the objects and count the total number of object of same type. There should be an automation system in that, input parameter is the name of the offline video, and an outcome is the total number moving object of similar type in the video. Background subtraction is often one of the preliminary tasks in any machine vision applications. So, it is most difficult task of the system. The out-come of background subtraction is provided as an inputto a higher-level module, for example, tracking of detected moving object.The efficiency of background subtraction is mainly depending on the background modeling techniques used to model the background. Natural scenes required to face many challenging tasks for background modeling because they are dynamic in natureincluding illumination changes, swaying vegetation, rippling water, flickering monitorsetc.
An efficient background modeling algorithm, easily handle the situation where newstatic objects are enter into background scene and/or old static objects are removed from the background scene. Additionally, in the video, shadows can be seen either for moving object or static object into the scene. Because there may be objects are moving in-front of light source can cause a problem. Moreover, in a stationary background scene, changes can occur because of noise and jitter effect.

II. TECHNICAL BACKGROUND

Basic Concept
Moving Object can be defined as a thing of interest which can be used for further analysis. Tracking is defined as following the motion of an object moving under the action of given forces. Firstly, identification of the interest region is must. For this moving objectdetection algorithm is used. Objects have different color, shape and texture. Therefore, fixed camera environment is assumed. Image is divided into set of pixels. First set consist pixels of foreground object and

the second set contains the pixels of background object. Foreground objects are moving objects which we want to track for example people, boat, cars, etc. The basic steps for video data processing are,Object representation, Moving Object detection, Object tracking [2].

ObjectRepresentation
Here one of the most critical question is how to represent the object? we can give simple answer to this question is, Objects can be represented by their features. So, object is nothing but a simply we can say that it is a region of interest which required further analysis.For example, in a traffic video, there are so many moving objects, but if we are interested in vehicle counting than vehicles are our moving object, for pedestrian, walking man is a object. Similarly, fish in an aquarium, boats on the sea, planes, etc.,So, there are different types of representations are mostcommonly used for object tracking. Object can be describe by variousmethods,using these methods the objects can be represented e.g., ellipse, contour, point,etc. Mainly objects are represented by Shape and appearances. Methods of object representation are point, primitive geometric shapes, object silhouette and contour, articulated shape modes and skeletal models.

- Points: The object is represented by a point, that is, so region of interest is represent by the centroid(in Figure 2.2 (1)), or it is represented by a set of points (in Figure 2.2(4)). This representation is suitable for tracking objects that occupy small regions in an image.
- Primitive Geometric Shape: Object Shape is represented by a rectangle, ellipse (in Figure 2.1 (3), (4)), etc. Object motion for such representations is usually modeled by translation, or projective holography transformation. These are more suitable for representing simple rigidobjects. They are also used for tracking non-rigid objects.
- Object Silhouette: The boundary of a region is defined by the contour representation(in Figure 2.2 (7), (8)).The region inside the contour is called the silhouette of the object. These are suitable for tracking complex non-rigid shapes.
- Articulated Shape Models: Articulated objects are composed of body parts that are held together with joints(in Figure 2.1 (5)). Forexample, the human body is an articulated object with torso, legs, hands, head, and feet connected by joints. The relationship between the parts is governed by kinematic motion models, for example, joint angle, etc.., Articulated shape model simply represented by connected component like line and circle for detected moving object.
- Skeletal Models: Object skeleton can be extracted by applyingmedial axis transform to the object silhouette(in Figure 2.1 (6)). Thismodel is used as a shape representation for recognizing objects. Medial axis transformation can be done using morphological operation.

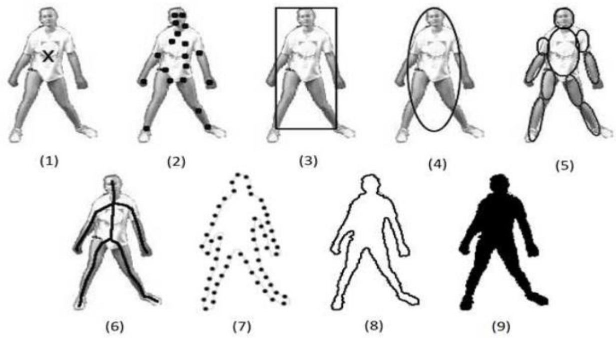


Figure 2.1: Object Representation
Object Representations. (1) Object Represent using point, (2) Group of points, (3)& (4)Object represent as rectangular/elliptical box, (5)Part based geometric shape, (6) Object as a skeleton, (7)Complete contour, (8) Object as a contour control points, (9) Object silhouette.

There are so many ways to describe objects based on some appearance features.shape and appearance feature of object can be mixed together for object tracking [3,4]. There are some appearance base representations of object which can be useful in tracking andcan be define as following:

Probability density estimation of object appearance:PDF can find the location of an object based on shape feature and use parametric methods like, Gaussian density function and GMM base function and non-parametric methods like, histograms.

Templates: Templates can be created using silhouettes or using simple geometric shapes. It gives both appearance and dimensional information of object. This is suitable only for objects whose location does not change rapidly during the tracking.

Active appearance models: The appearance models created by modelling shape and appearance of an object. Shape of object can be represented by some set of features. Each feature vector is stored by various features of image like texture, color or gradient magnitude.

Multi-view appearance models:This model gives different approaches to encode the different view of the object. One of the approaches is to generate subspace based on the provided view to describe different views of object.

Moving Object Detection
Moving object detection algorithm is applywhen the object first appears in the video. Once the objects are describe using any of the defined method,nextstage is to detect moving object in the sequence of image frame. Moving object is detected when the object first appears in the frame of video. The time base information of the object in the first frame is separated to detect it. Some of the basic moving object detectionmethods are discussed below:
Frame Difference Method:The moving object is detected by calculating absolute pixel value difference between two

consecutive frames of video. This method has ability to adapt with different type of dynamic environment. It is difficult to get complete boundary of moving object.

Optical Flow Method: In this method for image frame optical flow field is calculated and clustering processing is performed as par the optical flow distribution characteristic. This method gets the complete movement information and detects the moving object. This method is very responsive to noise.

Background Subtraction Method: In Background subtraction first reference frame is created which is called modelled background. Background Modeling preferred to be sensitive so as to recognize objects. Background Modeling gives a reference background frame. This reference frame is used in background subtraction. In background subtraction each video frame is compared to the reference frame to detect possible variation. The variations between current video frames & reference frame in terms of pixels difference to find moving objects. [2,3].

Table 2.1: Comparative study of object detection methods

Object detection Technic		Efficiency	Execution Time	Remarks
Background Subtraction	GMM	Medium	Medium	+ Low memory required
				- it is difficult to adapt with multimodal background.
	Approximate Median	Low to Medium	Medium	+ sub sampling is not required for creating an adequate background model.
				- For computation, requires memory with the latest pixel values
Optical Flow		Moderate	High	+ It can give the complete movement pattern.
				- More computation time for calculation
Frame Differencing		High	Low to Moderate	+ Simple Method. Efficient for static Background
				- Reference background w/o moving object is required

Object Tracking

After the successful detection of the object of interest, object tracking methods are applied on it. Tracking can be specifying as the problem of rough estimation of the path of an object in the image frame as it moves in the scene [4].The techniques of object tracking are point tracking, kernel tracking and silhouette.

Tracking objects can be complex due to:

- Loss of information caused by projection of the 3D world on a 2D image,
- Noise in images,
- Complex object motion,
- Non-rigid or articulated nature of objects,
- Partial and full object occlusions,
- Loss complex object shapes,
- Scene illumination changes, and
- Real-time processing requirements.

Background Subtraction Method

The common problem of all computer-vision systems is to separate people from a background scene (determine the foreground and the background).Many methods are proposed to resolve this problem. Background subtraction is used in several applications to detect the movingobjects in a scene as in multimedia, video surveillance and optical motion capture. Background subtraction consist of steps, like Background modeling, Background initialization, Background maintenance and Foreground detection shown in Figure

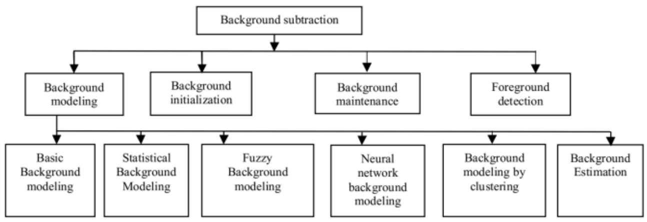


Figure 2.2 Classification of Background Subtraction

Background subtraction is used to detect foreground object by comparing two different frames and will find the difference and create a distance matrix. Basically, it will compare the value of the difference with the threshold value. Now a threshold value is not predefined but it will calculate the threshold value by using first few frames that you have given. So, the main scenario is that if the difference is greater than a threshold value than it is marked as a moving object otherwise it will take it as a background image [4].

Now the challenges that have to be face during background subtraction is that background is changes frequently because of illumination changes, motion changes and changing in background geometry. So a simple inter frame difference is quite weak solution to detect a moving object accurately.

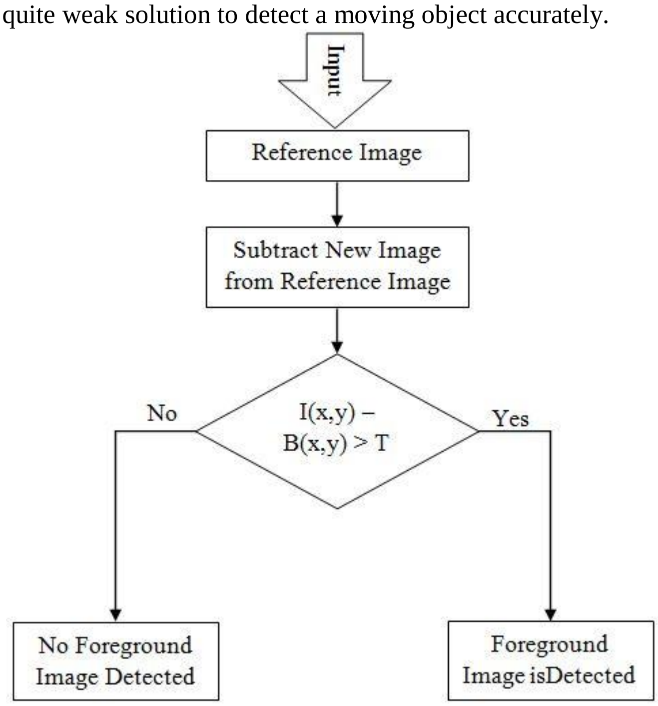


Figure 2.3: Flowchart of background subtraction method.

The efficiency of these applications is dependent on the performance background subtraction algorithm depends on how it will adapt to change into illumination, little movements of background elements (e.g. leaves of trees), the movement of background object (e.g. background object changes its location) or moving object becomes stationary in the background (e.g. parked car), and shadows by moving objects. Computational time is also of high priority.

The common standard for performing background subtraction is to develop an external model of the background. After that, moving objects are then identified by taking the pixel value difference between the current image frame and this reference background image frame. Finally, a binary segmentation mask is then constructed by dividing any pixel as being from a moving object when the absolute difference is above a threshold. Background subtraction algorithms classify in how they create and update the reference background frame.Even though the success enjoyed by background subtraction algorithms, it is very clear that post-processing is required in order to improve their efficiency. This post-processing work can range from shadow detection algorithms to connected component labelling. The results of post-processing steps can be used to improve the quality of the segmentation.In the same way we get efficient foreground mask & feedback into the background subtraction algorithm, in order to make it more intelligent updating of the background model.

Background subtraction, although being simply defined as a difference between the background image without objects of interest and an observed image, has many difficult issues to overcome, making it a problem that has inspired a wealth of research. For instance, somesituation, it is necessary to solve many problems and a background subtraction algorithm that works well in one situationit is not necessarily work well in another.As this is an important phase of the project and has a significant impact on the outcome of the project, this report primarily focuses on background subtraction. This report looks at background subtraction with respect to videos, comparing an obtained background image to video frames, as opposed to background subtraction for still images.

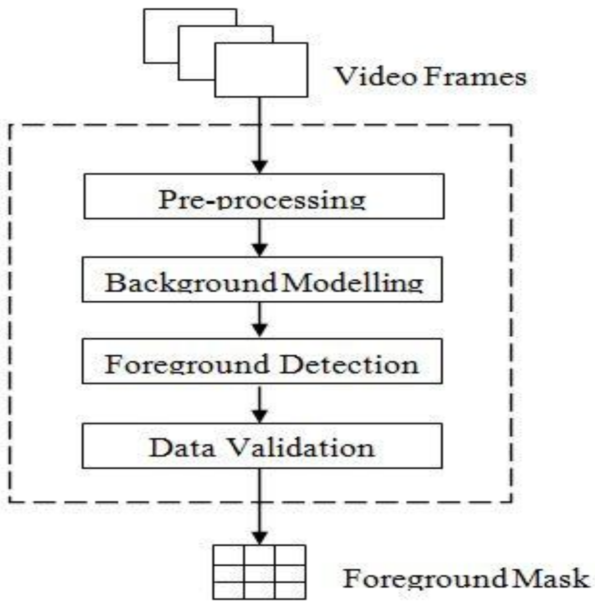


Figure 2.4: Basic Outline of Background Subtraction Algorithm.

Although there are many algorithms for background subtraction, they all follow a general pattern of processing as shown in Figure 2.4,hereimage frames captured from a camera are input to the background subtractor. In Pre-processing stages involves filtration &change the input video to a process-able format. Background modelling then uses the observed image frame to calculate and update the reference background frame. Foreground detection is where the pixels that show a major difference to the corresponding pixel of the background model, are referred as a foreground. validation is used to checkweather detected objects are valid or not.In the post processing, any false detected object is eliminated. After thatfinal foreground mask is prepared & can be used to segment the foreground objects.

III. GAUSSIAN MIXTURE MODEL

The simple pixel-based background subtraction as we seen in previous section, we have static image of background scene and this backgroundimage is subtracted from each selected frame at specific interval and based on threshold value we classify a pixel value is fore ground region of image or background region of image.

Here problem is when we have to estimate the background of the scene, then it is difficult to maintain the background scene, i.e. when there are some minor changes occurs into background then it is going to detect the false pixel into foreground. So simple background subtraction method is not adaptive to rapid change into background.So, when we estimate the background of the scene, then we have to estimate the threshold value every time to come up with the changes occurs into the background scene. We signify the vector characterize the value of a pixel at time t by $\underset{X}{\rightarrow}(t)$. Hereelements of the vector are generally RGB pixel values, Gray values. The PDFmodeling a pixel is $f\left(\underset{x}{\rightarrow}\right)$. The pixel is denoted as background if its new value$\underset{X}{\rightarrow}(t+1)$is well characterized by its density function, usually:

$$f\left(\underset{x}{\rightarrow}(t+1)\right) > Th$$

WhereTh is a threshold value.

Here main problem is estimating the density function from thedata set. There are different ways that can be divided into the parametricand the non-parametric ones. However, there are some requirements specificfor the background subtraction task.

Time and Memory Efficient

Background subtraction algorithm is the first step for most of the moving object detection base application. So, background subtraction algorithm is uses less memory and execute faster. For a parametric approach, direct towards thefast-recursive algorithms. Recursive algorithms are also memoryefficient because only the parameters of the model are saved per pixel andchanges for every new data sample.

Adaptive

The difficult part of the background subtraction task is themaintain the background model. The illumination in the scenecan change moderatelye.g. during daytime and weather conditions in an outdoorscene, or suddenly such as switching light in an indoor scene. A new objectcould be entering into the scene or aexisting object removed from it.The background subtraction model should be adapting quickly to such changes occurs into background scene. The density estimates mostly depends on the recent data. At time t the effect ofthe older samples at time k is reduced by$(1 - \alpha t - k\ (K \leq t)$. Where the constant α denotes the adaption rate or learning rate.

Gaussian Mixture Background Model

Gaussian Mixture model is the extended version of single gaussian model. As we know in single gaussian model, we try to fit a single gaussian curve to all the data points of given data-set. But in reality, it is impossible to find a single gaussian curve for given normal distributed data. So instead of finding the single gaussian curve for given input data, here data set are divide into sub set which is fit to gaussian curve in naturally, so here we cluster the data into k-different data set which is fit to k- number of different gaussian curve. Since subset assignment is not known, it is a form of unsupervised learning.

For example, we have given a data set of children's height data who are study into class x, if we try to find a model forgiven data-set, height of children, for each gender (boy or girl) data-set followed as a normal distribution. For boyapproximately, average height is 4'5'' and for girl's average height is 4'1". So, in above data set its only given a height data without assignment to each child, data-set distribution of heights of all the children follow the sum of two different variance and different mean base normal distributions. So above given model is the example of GMM.Simple we can say that, when our data set is a multimodal then it best suited for gaussian mixture modeldistribution, in other words we can say that in our data set if there are more than one "peak" then we try to fit this data set into unimodal distribution then it gives poor results. To improve the result, we have to follow the mixture of gaussian model to fit the multi-model data. Same we can realize with given figure 2.6. In left image, we try to fit the given data set with the single gaussian distribution, and in right image, same data set best fitted with gaussian mixture model with 2 components.

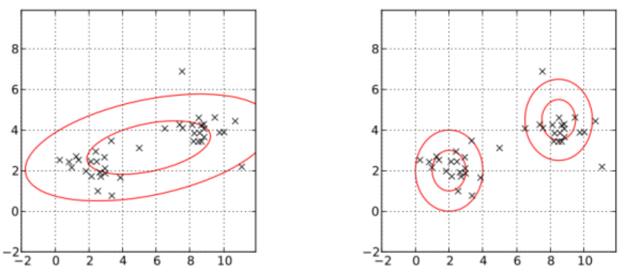


Figure 2.6: Data fit with single Gaussian distribution(left), Data fit with gaussian mixture model with 2 components.

GMM is defined by two types of values, first is the mixture component weights and second component are mean & variances/covariances for each component. In GMM with K- components, for each component μi&σi are mean and variance of ith component (1 ≤ I ≤ K), which is stored in a co-variance matrix, mixture component weights are defined as ΦKfor component CKwith the constraint that $\sum_{i=1}^{K} \Phi i = 1$. So here if we does not know the weight of mixture component then, initially we assign equal weight for each mixture component.[9].

Learning the Model for GMM

Model based on GMM is generally follow the unsupervised learning. So here if we know the number of components, EM algorithm is the best technique that is most frequently used to derive the GMM's parameters.

Expectation maximization (EM) is a numerical base technique use for maximum likelihood estimation. Expectation maximization is an iterative process and has the user-friendly property that it is guaranteed to approach a local maximum point.

IV. PROPOSED WORK

The goal of this research work is to automatically count the number of moving object in an offline video in a constrained environment. Here in first stage,find the foreground objects in the video, and then classify the objects & count the number of object. There should be an automation system,whose input an offline video, and an output of the system is number ofobject count in the video.

Organization of Work

The project work is divided into three major phases. The initial phase consists of Pre-processing of the input video. Once we get input video, first off all we concert a video into sequence of frames i.e. images.

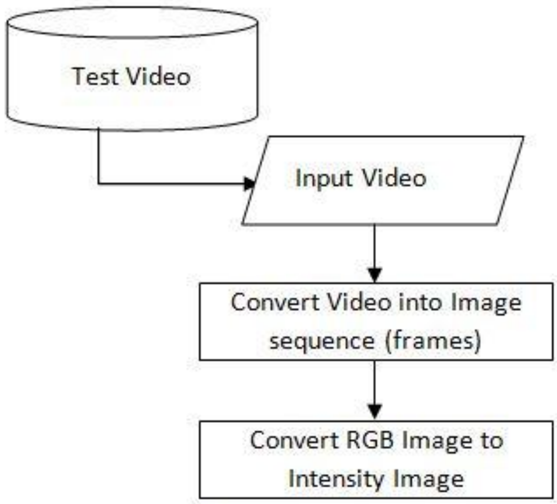


Figure 4.1 Pre-processing of Video Frame

Once we convert video data into sequence of images, we have to convert RGB – image into gray image or intensity image. We also apply the noise removal filter to remove noise from the images. After this, sequence of images given to next phase – called background subtraction.

In this phase, we separate background and foreground by using background model for background subtraction method. Efficiency of background subtraction algorithm mostly depends on three factors, first factor which affect the performance on the background subtraction algorithm is the threshold value. Threshold value is a constant defined such as it separates the foreground with background. So, choosing a appropriate threshold value is necessary detect the moving objects from the current frame. If threshold value we choose is too small than part of the background is also detected along with the moving object it consists the noise and if we choose threshold value too high than part of the moving object is note detected properly. So here, first problem is to decide the appropriate threshold value for detection moving object is necessary.

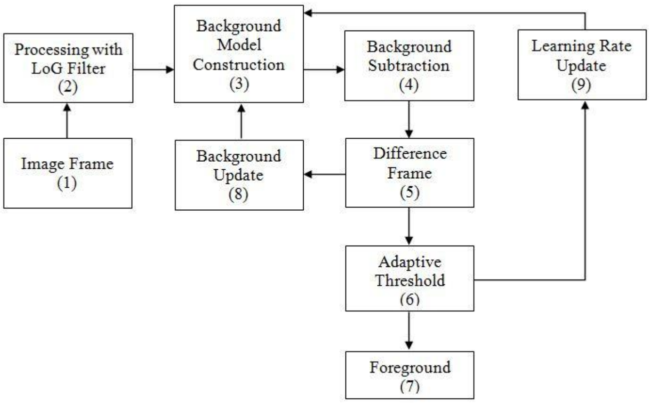


Figure 4.2 Propose Background Subtraction Based on Gaussian Averaging Method

Next problem is computation complexity & storage requirement of background subtraction algorithm, here it is also impact on the performance of the background subtraction. So, here background subtraction method, these two parameters are also affecting the performance of the background subtraction algorithm.

Last problem is post processing work on foreground mask, once we use background subtraction method, as a result we will get the fore-ground mask which consist a noise i.e. some pixels of the background are detected as fore-ground object. So we have to remove this pixels from the fore-ground mask.

Finally, once we apply the fore-ground mask on the current frame it will gives us the moving object, which can be segmented as a separate object using blobs. and it can be further processed.

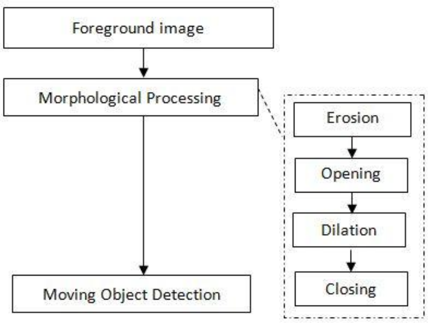


Figure 4.3 Moving Object Segmentation Using Morphological Operations

So, here propose system for moving object detection is divided into three phases.

V. PROPOSED ALGORITHM FOR BACKGROUND SUBTRACTION

Background subtraction is the heart of any computer vision application. So, detection of moving object is mainly depends on the efficiency of the background subtraction algorithm. As we discuss in literature review that any background subtraction algorithm main perform 4 tasks like –background modelling, background initialization, background Maintenance and fore ground detection.

In my propose algorithm, I try to overcome the deficiency of the frame difference background subtraction method by exploiting the temporal pixel clustering of previous data available in observe frames previously. Another deficiency of any background subtraction algorithm is the global threshold value to differentiate background pixel to foreground pixel. So here I try to find a adaptive threshold method which is change from frame to frame to improve the performance of the background subtraction method.

So, here during the training phase as the number of frames processed to understand the seen, in which each pixel is classified as a foreground or background. We use the all these previous frame data in which pixel is already classify. So we predict a background for the next frame from all the observe frame.

Proposed Method for Background Subtraction

Step 1: Initialize the first video frame after the applying mean filter as reference background frame initial learning rate 0.01.

Step 2:Start with frame It=2 to N.

Step 3 :Apply the log filter on current frame It(x,y).

Find the mean frame Mt(x,y). and find the σt(x,y) using following equation

$$\mu_t(x,y) = \alpha I_t(x,y) + (1-\alpha) \quad \mu_{t-1}(x,y)$$

$$D_t(x,y) = |I_t(x,y) - \mu_t(x,y)|$$

Step 4 :Evaluate threshold value for current difference frame $D_t(x,y)$ using otsu threshold.

Step 5:Adjust the learning rate based of threshold value difference of current difference frame and previous difference frame.

Step 6 :Based on new learning rate αt update the mean image and sigma image for the next cycle.

Step 7:Based new sigma image, detect the foreground pixels.

Step 8:Morphological Operation on $FR_t(x,y)$ for Object Segmentation.

VI. IMPLEMENTATION AND RESULT

This section provides various tools and technology that are required and used for implementing the proposed system.

About Tool

MATLAB is a programming language developed by MathWorks. It started out as a matrix programming language where linear algebra programming was simple. MATLAB (matrix laboratory) is a fourth-generation high-level programming language and interactive environment for numerical computation, visualization and programming. It allows matrix manipulations; plotting of functions and data; implementation of algorithms; creation of user interfaces; interfacing with programs written in other languages, including C, C++, Java, and FORTRAN; analyze data; develop algorithms; and create models and applications. It has numerous built-in commands and math functions that help you out in mathematical calculations, generating plots, and performing numerical methods.

Dataset Used for Experimental Purpose

Data Set 1: Bootstrap

- This Dataset contains 5898 images of resolution 160x120.
- Ref.: Dataset was taken from computer vision dataset website. www.cvpapers.com/datasets.html. (in indoor scene section)
  Description: Bootstrap - 12.5 minutes looking toward Building 31 cafeteria condiment bar(00000 – start, 03054 – end). Frame no. 00299 to be Evaluate.
- .bmp file format

Data Set 2: Waving Trees

- This Dataset contains 286 images of resolution 160x120.
- Ref.: Dataset was taken from computer vision dataset website.
  www.cvpapers.com/datasets.html. (in foreground/background section)
  Description : Moving tree in background(Frame no. 00000 - tree moving
  Frame no. 00242 - John enters scene). Frame no. 00247: to be Evaluate
- .bmp file format

Data Set 3 : Moved Object

- This Dataset contains 1747 images of resolution 160x120.
- Ref.:Dataset was taken from computer vision dataset website. www.cvpapers.com/datasets.html.(in foreground/background section)
- Description : Moved object in background in conference room (00000 – start, 00637 - John enters scene, sits, telephones, 00891 - John leaves scene with chair and phone moved, 01389 - John re-enters, sits, telephones, 01502 - John leaves scene with chair and phone moved, 01744 – end). frame No.00985: to Evaluate (100 frames after chair moved)
- .bmp file format

Result

Six sample videos are used as a input to test the propose method from above dataset.

Waving tree: This video consists a dynamic background in which leaves of tree are continuously waves, so here every time your background is changing. And after some time a man is entered into the scene, that is the fore ground object.

Camouflage: This video consists a sequence in which illumination is change continuously, and size of moving object is consisting more than 50 % of area.

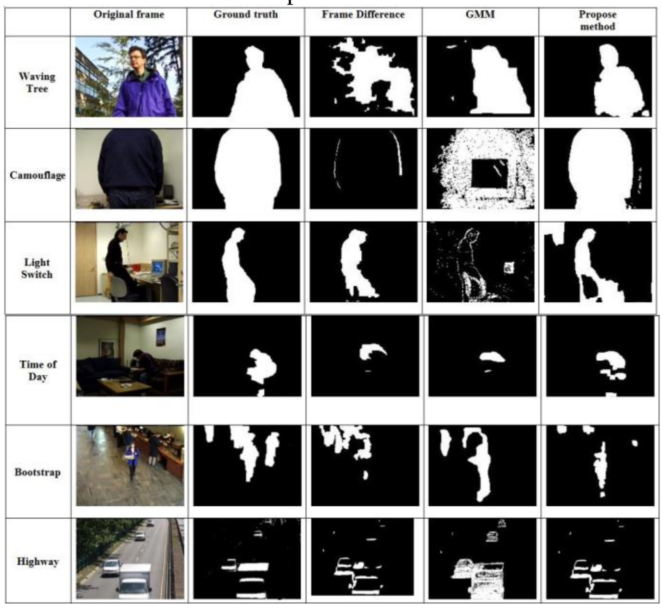
Light switch: this video consist a sudden illumination change into sequence of frame. After some time a person moving his chair.

Time of day: this video consists a sequence of frame which consist a illumination change.

Bootstrap: This video consists a fast-moving object i.e. more than one person in a video are moving fast. So, it creates a complex scene in which more than one object are occluded.

Highway: This video consists a outdoor sequence of images which consist a number of vehicles are passing on the road.

Table 6.1 Analysis of Different Video for Frame Difference, GMM and Propose Method Methods



Moving Object Detection Comparison

Table 6.2: Comparison Results of Object Detection for Different Video

Video Frame	Evaluation	Different Detection Algorithm		
		Frame Difference	GMM	Propose Method
Waving Tree	Similarity	0.07	0.69	0.72
	Recall	0.07	0.85	0.80
	Precision	0.57	0.79	0.88
Camouflage	Similarity	0.005	0.52	0.95
	Recall	0.24	0.73	0.97
	Precision	0.005	0.63	0.97
Light switch	Similarity	0.009	0.34	0.10
	Recall	0.57	0.45	0.11
	Precision	0.009	0.54	0.46
Time of Day	Similarity	0.02	0.20	0.51
	Recall	0.03	0.21	0.60
	Precision	0.09	0.76	0.78
Bootstrap	Similarity	0.27	0.33	0.27
	Recall	0.36	0.45	0.31
	Precision	0.51	0.54	0.72
Highway	Similarity	0.26	0.41	0.26
	Recall	0.30	0.67	0.30
	Precision	0.63	0.50	0.63

VII. CONCLUSION&FUTURE WORK

Presently, there are different algorithm propose for background subtraction based on object features. Real time use of the such algorithm requires more accurate with less complexity. Because of this problem still open and needs significant research. In propose method, Gaussian average method is modified. In Gaussian average background subtraction technique with the use of edge-based background model construction, adaptive thresholding for learning rate adaptation. Our propose method was able to show promising result both in terms of low computational complexity and less presence of noise with respect to traditional frame difference and mixture of Gaussian model. In the future research work, I will focus on designing a more robust moving object detection algorithm to overcome the existing problems

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