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MOVING OBJECT DETECTION USING BACKGROUND SUBTRACTION TECHNIQUES

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ABSTRACT

Now a day, Moving Object detection is becoming very popular, yet challenging vision task. Background subtraction is widely used for extracting unusual motion of object of interest in video images. The proposed algorithms have been used to identify moving objects from the sequence of video frames which contains dynamically changing backgrounds in the noisy atmosphere. There are many challenges in achieving a robust background subtraction algorithm in the external noisy environment. Background subtraction approach is used to separate the moving objects from the background. Many different methods have been proposed over the recent years. In this research work, three different methods studied and implemented by use of simple background subtraction algorithms. Different methods for detecting moving objects are worked out such as: Frame differencing, Mixture of Gaussian and Approximation median filter. It is clearly shown that frame difference method is very simple to understand and implement. It does the best job of subtracting out extraneous background noise but it is not suitable for complex applications. The second method, approximate median, gives us significantly increased accuracy with not much more computation. It had a little trouble with quickly changing light levels, but handled them better than mixture of Gaussians. And Mixture of Gaussians, the most complex of the methods, gives us good performance and reduce the problem of noise that have been studied in previous research.

KEYWORDS— Background subtraction, Frame differencing, Mixture of Gaussian, Object Detection.

INTRODUCTION (BAYESIAN TECHNIQUE)

Moving Object Detection is a process by which an object (a person, a car, etc) is detected from video or video sequences. The detection of an object in a video camera scene is a relatively new research area in computer science and, because of its broad applicability in real life this has been growing more and more. The CCTV is one of the main reasons for the growing interest and use of video in security systems. Moving object detection in a video stream is an essential step in video surveillance applications.. Detection of moving objects from a video scene is a challenging task in Video Processing and Computer Vision. Based on the movements of objects and background, video sequences can be categorized into two types.

- Moving objects with moving background
- Moving object with fixed background.

Moving Object detection algorithms usually take two consecutive images as input and return the locations where differences are identified. These differences can be caused by the intensity of color, changes in illumination or noise. The aim of such an algorithm is to locate only the changes that are due to color changes in the scene or an image, i.e. a object.

Moving Object detection and extraction from the fixed background in the analyzed scene is mostly done by simple subtracting the current image and background image .

Dynamic background subtraction in noisy environment for detecting object is a challenging process in computer vision. There are many challenges in achieving a robust background subtraction algorithm in the external noisy

environment. Identifying moving objects is a critical task for many computer vision applications. Background subtraction approach is used to separate the moving objects from the background. In some algorithms, the moving objects may become part of the scene when they come to a stop. Also the scene maybe affected by changes in the light, leaves swaying, cameras shaking, etc. Many algorithms for moving object detection have been proposed in recent years. These involve background subtraction, optical flow, temporal difference and many other algorithms for detecting moving objects. From these, the most widely used algorithm is background subtraction which has many algorithms such as frame difference method(FDM), approximate median method (AoM), Gaussian of mixture method (GoM).

BACKGROUND SUBTRACTION METHOD

It is particularly a commonly used technique for object detection in images [6][7][8]. It will detect moving regions by subtracting the current image pixel-by-pixel from a reference background image that is created by averaging images over time in an initialization period.

Algorithm	Advantages	Disadvantages
Temporal differencing	This method is simple and easy to implement. This is very adaptive to dynamic scene changes.	It generally fails in detecting whole relevant pixels of some types of moving objects. Additional methods need to be adopted in order to detect stopped objects for success of higher levels are computationally complex and cannot be used real-time without specialized hardware.
Background Subtraction	This method is simple and easy to realize, and accurately extracts the characteristics of target data.	It is sensitive to the change of external environment, so it is applicable to the condition that the background is known.
Optical Flow	It gives better performance under moving camera	this algorithm is very complex and complicated computation and also it needs special hardware support, so it is difficult to meet the requirements of real-time video processing.

Table 1: Comparison of algorithms.

In Table 1 we compare other existing methods with Background Subtraction method.

PROBLEM FORMULATION AND OBJECTIVES

In the past, a number of moving object detection algorithms has been developed specifically to suit the dynamic environment such as Background Subtraction Method, Temporal Differencing, Optical Flow etc. We are going to use Background Subtraction method and its techniques to detect moving object. Many techniques were proposed for detected moving object however there are few comparative studies carried out to verify their performance. In previous work there is a problem of noise in object detection which we try to reduce in our work using same methods.

In this research, we have implemented the background subtraction with three methods: frame differencing, approximation median and Gaussian. In this first method, we take the video and subtract current frame intensity from the previous one for the whole video and take the difference as object. Initially we have set the threshold value is 24. In the second method Approximation median we will take the median of the last three frames and take it as background. In this third method, we will implement the Gaussian method with different performance parameters.

Objectives for this research work are:

1. To optimize the performance of methods that are used in this thesis.
2. The main focus of this research is the real-time detection of objects in unrestricted environments monitored with static video cameras and to reduce the problem of noise in existing methods.
3. The objects of interest are moving as well as new static objects.
4. To analyze the background subtraction methods using various parameters.
5. To evaluate the performance of FDM, AoM, MoG.

RESEARCH METHODOLOGY

Background Subtraction Algorithms: The basic idea of background subtraction method is to initialize a background firstly, then by subtracting current frame in which the moving object present that current frame is subtracted with background frame to detect moving object. The three different methods studied using simple background subtraction algorithms, Frame differencing , Mixture of Gaussian and Approximation median filter .
In this research, we have followed the given steps to implement the research problem.

Step1: First to implement frame differencing method. In which we take any video and subtract the current frame intensity from the previous one for the whole video and take the difference as object.

Step2: Secondly we will implement approximation median method. In which took median of last three frames and take it as background and then subtract the intensity of the frame from the background one and then take the difference as object.

Step3: Finally, implement the Gaussian method for moving object detection. And analyze the results on basis of various parameters.

Input: - A video from which we want to detect moving objects.

Output: - Moving objects are detected and shown in white color and background is shown in black color.

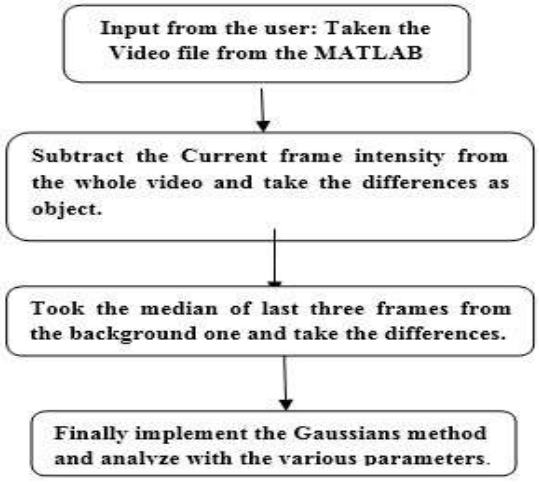

Figure1: Steps to implement the research problem.

Frame Difference Algorithm

Frame differencing is the simplest method in Background subtraction Techniques[6][7]. It is easy to implement and understand. Firstly consider first frame as background image and next frame as current image. Pixel value for each co-ordinate(x, y) for each color channel converted into gray scale. Now pixel value of background image is subtracted from the corresponding pixel value of the input current image. If the resulting value is greater than a particular threshold value, then that is a foreground pixel otherwise background. . The result of this method is mostly depends upon the value of threshold. As the threshold value is good the detected object shown is also good The flowchart of frame difference method is shown below:

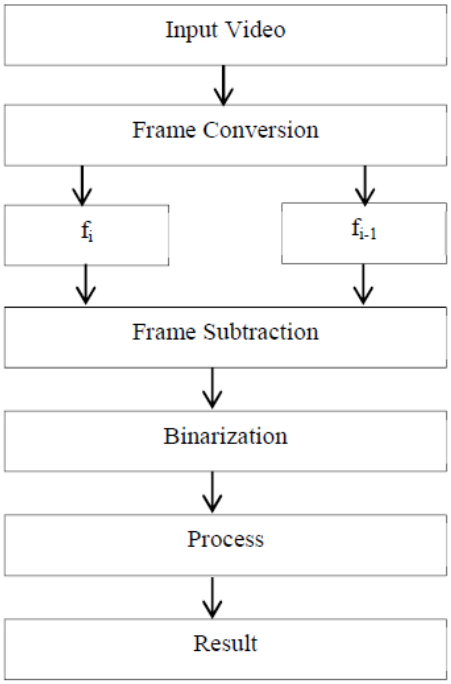

Figure: Flowchart of Frame differencing method

The algorithm of frame differencing:

1. Take a video as an input.

2. Consider the previous frames as background image and new coming frame as current image. 3. Convert both background image (bg_bw) and current image(fr_bw) from rgb to gray.
4. Perform frame subtraction to get an image fr_diff.
5. Convert the image fr_diff into bits 0 and 1.
6. if(fr_diff>thres)
Fg = fr_bw;
else
Fg = 0;
7. Output image is shown.

Approximation Median Algorithm
This method finds the difference of the current pixel's intensity value and the median of some recent pixel's intensity values[6][7][8]. It uses a buffer of size n, where n is the number of last frames whose pixel values are considered for calculating the median value for background model. Equation used is as follows. |I(i,j,k) - Med(i,j,k)|> Th then it is classified as foreground. The median value is updated for last n recent pixel values. 'I' represents the current frame and 'Med' is the median of last n frames. For each pixel (i,j), the difference of current frame pixel value with pixel value of median of last n frames decides whether it is foreground or background.

The Algorithm for Approximation median

1. *Take a video as an input.*
2. *Initially the first frame is considered as the background (bg).*
3. *For each pixel of the next input frame consider as current image (fr).*
4. *Convert bg and fr into grayscale.*
5. *Read the Sequences of video and channel of these sequences are created of size 3.*
6. *Then calculate the median of these frames (fmed).*
   Subtract the median value from the current image.
   Difference =fr- fmed
   IF(Difference> Threshold)
   fg = bg
   ELSE
   fg = 0
7. *For each pixel of the background*
   IF (fg > bg)
   bg=bg+1
   ELSE
   bg=bg-1
8. *Get the next input frame and Goto (Step 2).*
9. *Output shown.*

Mixture of Gaussian
This method uses first frame as Background image and convert it into gray scale and next frame as current image convert it also in gray scale[6][8]. Then calculate mean of previous frames and initialize variables and use Gaussian probability density function to evaluate the pixel intensity value. It finds the difference of the current pixel's intensity value and mean of the previous values. So it keeps a mean of the recent pixel values. If the difference of the current image's pixel value and the mean pixel value is greater than the product of a constant value and standard deviation then it is classified as foreground.

The Algorithm for Mixture of Gaussian Method

1. *Take a video as an input.*
2. *Consider first frame as background image.*
3. *Convert background image from rgb to gray scale.*

4. *Calculate no. of Gaussian components and background image components. Other variables are initiated.*
5. *Standard deviation (sd) method applied on each pixel value taking mean value.*
6. *Consider next frame as current image convert it into gray scale.*
7. *calculate difference of pixel values from mean*
8. *Update gaussian components for each pixel and other variables.*
9. *Match the component if component not matched creates new component.*
10. *Calculate foreground image.*
11. *Show output image.*

RESULTS AND DISCUSSIONS

As frame differencing is a simplest method as compared to other methods it gives good result but it is less useful in complex conditions. The result of this method is mostly depends upon the value of threshold because all the pixel values below threshold are considered as background object, shown as black color in output and all pixel values above the threshold value are considered as foreground object, shown as white color in output. If our threshold value is not correct then it will affect output.

Approximation median method gives better result with complex scene also. Here also we have to assume a threshold value.

And Mixture of Gaussian gives best results as shown in table 3 for particular values. This method reduces noise in detected object as compare to other methods.

INPUT	OUTPUT(Frame Differencing) Th = 24
	
	

Table 2: Output of Frame Differencing Method.

INPUT	OUTPUT(Approximation Mean) Th = 24

	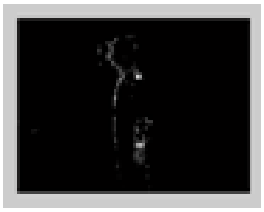
	

Table 3: Output of Approximation Median Method.

INPUT	OUTPUT(Mixture of Gaussian) $\alpha = 0.1$ and $Th = 0.23$
	
	

Table 4: Output of Mixture of Gaussian Method

CONCLUSIONS AND FUTURE WORK

I implemented the algorithms in Matlab described in methodology. The results shows that for the assumed threshold values although the frame differencing method is a simple to understand and implement gives good results but it can not detect objects properly in complex types of situations. Approximation Median algorithm shows better results than frame differencing. As shown above Mixture of Gaussian gives best result for these assumed values of threshold and reduce the problem of noise which had been faced earlier.

Future Work

Moving Object Detection is a vast concept and Background subtraction Method plays a very important role in Moving object Detection. There is a huge scope of improvement in this area. I have implemented only three methods, but there are still other methods that can also be applied. The performance of the given methods may also be increased.
For the Future work, I intend to evaluate new background models with updating capacity, which will allow the system to adapt luminosity changes or sudden scene configuration changes, shadow and camouflage. Till now I have used these three methods. In future, I will try to implement another object tracking and detecting method for videos.

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