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Efficient Object Detection Techniques: A Review

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***Abstract*: This paper basically emphasizes on different methodologies that have been proposed from past few years on object detection. Research on detection has widely covered applications such as artificial intelligence, robotics, security surveillance, identification, face recognition, detection of vehicles in traffic and many more .These applications led to untiring efforts for further techniques yet to be proposed. This paper enlightens us about numerous techniques that have extensively being used for detection in videos.**

***Keywords:* Background subtraction, adaptive means filtering, adaptive median filtering, Eigen backgrounds, simple Gaussian method, Mixture of Gaussian.**

I. INTRODUCTION

Earlier used traditional systems which employed manual methods of detection were based on subjective analysis and judging that resulted in low accuracy and sometimes wrong results. The idea of computer vision brought many techniques which integrated various other technologies[1] .The detection of any object is done on the basis of color, detection through edges, detection through corners detection through shapes, detection though face.

In this paper various methods for detection under illumination variation and its tracking has been addressed. Various techniques of background subtraction for detection of moving objects are discussed. The sub sections mentioned provides the detailed description.

Background subtraction: Background subtraction has been extensively used for detection and tracking of objects in a video from a static camera. Many techniques exist and many algorithms have been designed for the same. The techniques proposed for subtraction should be robust under change in illumination and intensities. Also the effects of dynamic changes such as shadow, unwanted movement etc should not be encountered and the desired region should be easily detected. The techniques of background subtraction can broadly be classified as recursive and non-recursive techniques. Some techniques and their brief discussion are mentioned in the upcoming sections.

II. METHODS OF BACKGROUND SUBTRACTION

A simple thresholding based background subtraction technique segments the object under the condition of illumination variation. A method called thresholding extracts the relevant information from the frame and the rest is discarded as is denoted by a value ‘0’.

Second method is frame differencing method. In this method of background subtraction the value of the captured frame is compared with the previous frame .Meanwhile the values of the frames are also updated. Every time the captured current frame is compared with a previous frame and the difference of the two gives the detected region as every time the value will differ on intensity basis and that too by the variation of pixel by pixel.

F_n(i, j)-F_{n-1}(i, j) >T

The major disadvantage of this technique is in terms of speed .If the speed of moving object is almost negligible then the difference of the two values of frames will not be easily identified which will not be able to detect objects properly [1]

Another method of mean filtering extracts the foreground using equation

| I(x,y,t) - B(x,y,t) | > T .....ref[2]

Where the background is calculated by taking into account the value of mean of last n frames[1].

$(B(x, y, t) = 1/n \sum_1^{n-1} I(x, y, t - i)$

. The foreground can thus be detected by

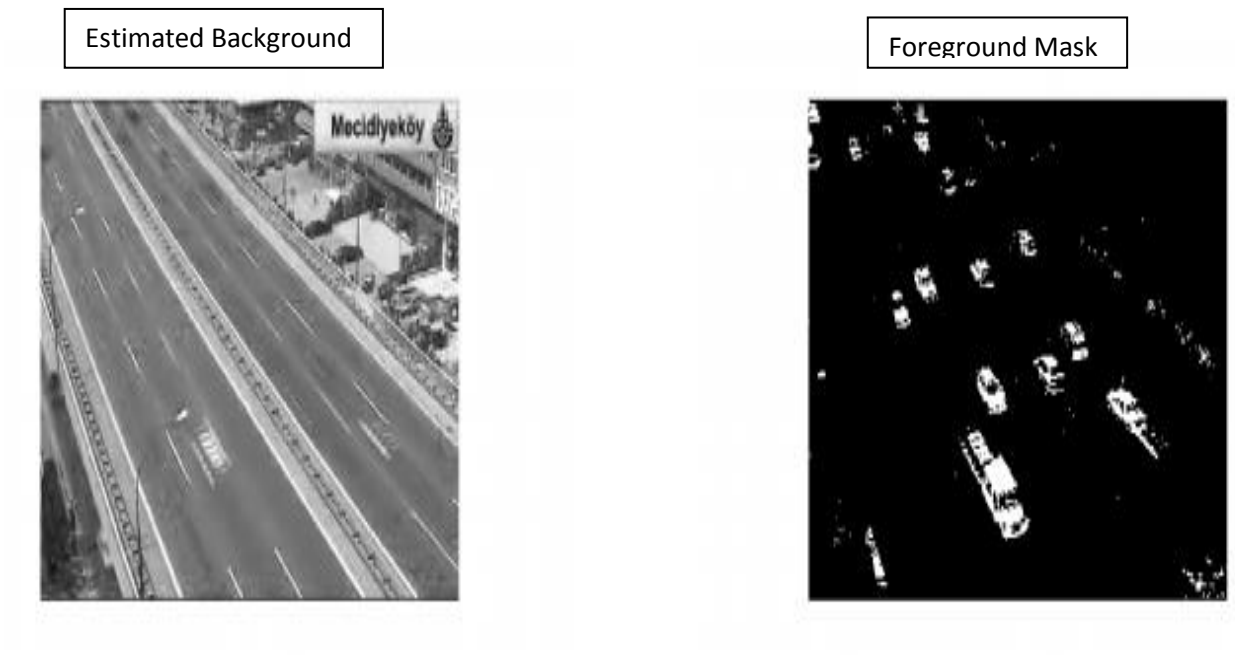
| I(x,y,t) - B(x,y,t) | > T

N. McFarlane and C. Schofield, presented Method of median filtering. In this the background pixel is modeled with adaptive median filtering technique .The background is calculated with the same method as that of mean filtering and the value of background is given by:

B(x,y,t) = median{I(x,y,t − i)}

|I(x,y,t) − median{I(x,y,t − i)}| > Th where

i ∈ {0, . . . , n − 1}.
the results are shown by using previous and frames where n=10[10]



Detection (Image courtesy of ref[9])

The above method come under the category of non recursive techniques and provides an ease because their implementation is easy and also they provide faster speed. But the memory requirement for its implementation is high and accuracy is also a varying factor [1]

The other method of motion-Based Background Subtraction using Adaptive Kernel Density Estimation is a technique for modeling the dynamic scenes. Utilization of optical flow is done. To take into account the uncertainties in the features a novel Kernel based multivariate density estimation technique has been proposed that adapts the bandwidth according to the uncertainties in the sample measurement [8]. The effect of undesired movement of tree has been fairly reduced.

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Results without undesired movement, image courtesy of ref[8]

The algorithm using w4 technique is designed to compute moving objects. Its implementation is done on gray scale images. The background is modeled and constructed using a training sequence without any information of vehicles or persons. Estimation of three values which are: minimum intensity (Min), maximum intensity (Max), and the maximum intensity difference between consecutive frames (D) [2], is done for each pixel by taking into account the training sequence. Moreover the computation of foreground objects is carried out in steps by performing thresholding first, noise cleaning by erosion, fast binary component analysis[2] followed by elimination of small regions. Modification of thresholding in this algorithms done to avoid any significant level of misclassifications [2]. We classify a pixel I(x, y) as a foreground pixel if

$|It(x, y) < Min(x, y)| \_ |It(x, y) > Max(x, y)|) \wedge |It(x, y) - It{-}1(x, y)| > D(x, y)$

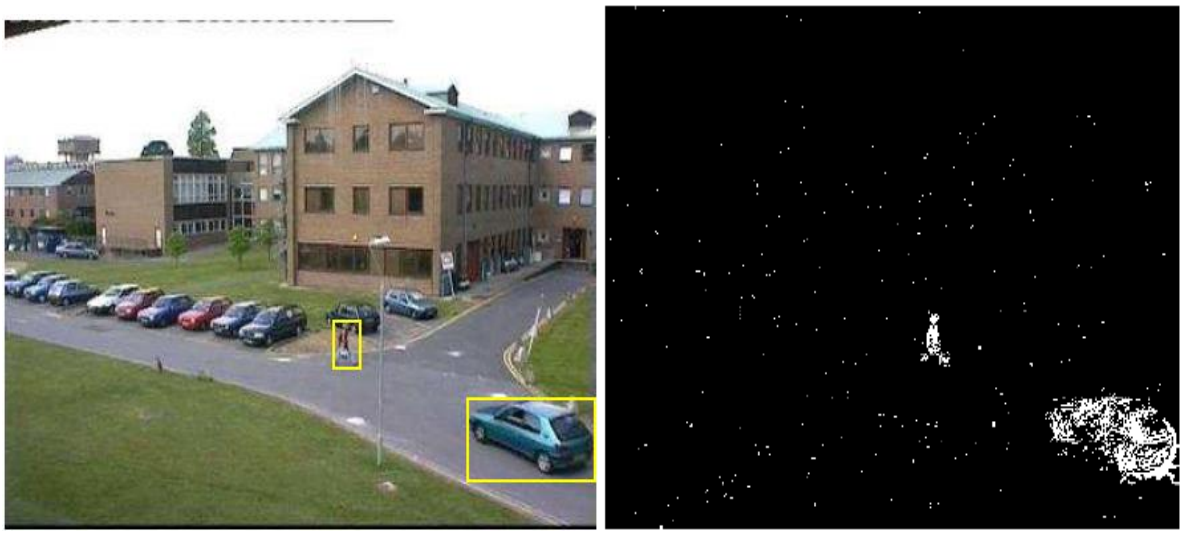

Image courtesy of ref[2]

Wren et al proposed a sample Gaussian method. In this the information in this method is collected in the form of vector [Y, U, V] T, which is beneficial in defining the information of color and intensity of every pixel[2]. This method is used to detect moving objects in which there is a static background having a controlled lightning effect on it or if there is a change in scene which is very slow. The value of mean μ(x, y) and covariance _(x, y) can be recursively updated [2] for each pixel as follows

$\mu t(x, y) = (1 - \alpha)\mu t{-}1(x, y) + \alpha It(x, y)$, [2]

$\sum^{t} (x, y) = (1 - \alpha)\_t{-}1(x, y) + \alpha(It(x, y) - \mu t(x, y))(It(x, y) - \mu t(x, y))T$..[2]

Once the background is updated, the binary classification into foreground or background of the pixels is done which clusters the foreground pixels into blobs [2]. The comparison of the pixels in the current frame is done with the background which measures the likelihood of log in the color space and then the pixels are assigned either to background or foreground.

This technique is however affected i.e. obtaining a low value will enhance the detection but makes the model sensitive to noise. Also the variance of noise will set the minimum value of variance for this model [3]. Higher values are advisable for videos having noisy image.

Stauffer and Grimson proposed a method of mixture of Gaussian. The method of GMM is more preferable as the pixel's color distribution model is built, according to the distribution [4] which is useful in achieving the goal of modeling background. Shiwen Chen etc, offers the formula of GMM [4]. The pixel of the background image is modeled by co-Gaussian model of K Gaussian distributions, namely[4]

$$P(X,t) = \sum_{i=1}^{k} \omega_{i,t} * \eta\left(X_t, \mu_{i,t}, \Sigma_{i,t}\right) \qquad [4]$$

η represents Gaussian distribution probability density function [4]

Oliver, N.M.; Rosario, B.; Pentland, A.P presented Eigen backgrounds method. This method thresholds the difference image which is between the reconstructed background and the video frame. By this background is reconstructed by the eigen backgrounds which are selected, trained and then updated with constructed virtual frames. The proposed method says that if foreground objects are not present in video frames, background model obtained will be better. The problem of acquisition of clean pixel can be sorted by GMM using EM algorithm[5].The Gaussians are sorted in descending order of w/delta and the first b ones are used as a clean Gaussian [5].When a pixel matches at least one of these clean Gaussians, it is determined as a clean pixel [5].The background model is updated after that and then again reconstructed.

III. BACKGROUND SUBTRACTION USING INTERFRAME CORRELATION

A large number of techniques exists but the problem in detection is addressed when the reference frame is not present. Also if the speed of the object is too slow then temporal segmentation introduces some cavities. So to make it more effective a spatial- temporal frame work based method has been introduced. The computation of correlation is carried, the probability that a pixel belongs to background is high, if the correlation is high.Histogram of the correlation matrix is built to make (Tcor) more adaptive. Thresholding is done by Ostu method and then the computation of inter frame correlation is done using grey scale equivalent. The final results are obtained by merging the three segmented planes using a logical union operartor.[7]

Original frames Results, ref [7]

Background subtraction using Xoring is also a method of background subtraction the updation of reference frame is of prime importance. The reference frame is compared with the next frames in a fixed time interval .Logical xor operation has been used as the detection will be done when there will be change in values which will be denoted by 1 and when the object is static then there will be no change in values which by the process of xoring gives 0.

IV. CONCLUSION

In this paper, various algoritms of background subtraction have been discussed. A very good idea about various techniques used Background Subtraction method is shown in this paper. As per study non recursive methods are simple in terms of implementation but they lack in terms of accuracy. Accuracy can be achieved by recursive techniques. Speed is also a major factor.The techniques which are mainly affected by it are dicussed in this paper.

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