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Object Motion Detection Using Background Matching Framework

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ABSTRACT: This document VIDEO surveillance systems have become widely available to ensure safety and security in both the public and private sectors due to incidents of terrorist activity and other social problems. In the previous systems motion is detected using static camera. This paper proposes a novel motion detection method with a background model module and an object mask generation module with moving camera. The moving camera captures monocular video of a scene and identifies those moving objects which are characteristically human. This serves as both a proof-of concept and a verification of other existing algorithms for human motion detection. We propose a self-adaptive background matching method to select the background pixel at each frame with regard to background model generation. Then the binary mask is generated using Cauchy distribution model. The quality of the proposed method is analyzed. The experimental results show that our proposed method has high accuracy and performance compared to previous methods using static camera.

KEYWORDS: Object motion detection, Cauchy Distribution, MTD, MSDE, Optical Flow.

I. INTRODUCTION

Nowadays, more and more moving cameras are used for different applications, such as unmannedaerial vehicle, driving assistant and wide-are avideosur veillance. Novel method to effectively detect moving objects from videos captured by a camera on a moving platform. The proposed method could be generally applied to detect moving objects with irregular camera movement and in complex environment . The surveillance system presented in this paper can detect and track moving objects ina video sequence, and is resilient against temporal illumination changes . In moving object detection, many approaches have been studied; e.g. back ground subtraction method, interframe difference method and the technique using the optical flow, which are well known as valid approaches in the image processing. Fast and accurate motion detection in the presence of camera jitter, known as a difficult problem. Because it is difficult to distinguish from the operating display jitter-induced errors in the statistical system. Motion detection has been used form any computer vision applications ,including recognition of traffic situations, visualizationof trafficflow, detectionandclassificationofhighwaylanes,driverassistance,facedetection.

Motion detection methods can be categorized into three major classes, i.e.,temporal difference, optical flow, and background subtraction. Optical flow methods generally show the projected motion on the image plane with good approximation based on the characteristics of flow vectors. Unfortunately, flow vectors of moving objects only indicate streams of moving objects, thus detecting asparse form of object regions. Moreover, the computational complexity of optical flow methods is usually too high to easily implement the motion task in the general video surveillance system. Out of these three categories, background subtraction methods received the most attention due to them oder ate time complexity and the accurate detection of moving entities.

In general, the existing background subtraction methods can detect moving bjects by estimating the absolute difference between each in coming video frame and the background model, which is applied to calculate the binary moving objects' detection mask with the object threshold function.[3]

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Optical flow methods generally show the projected motion on the image plane with good approximation based on the characteristics of flow vectors. Unfortunately, flow vectors of moving objects only indicate streams of moving objects, thus detecting a sparse form of object regions.[4] Out of these three categories, background subtraction methods received the most attention due to the moderate time complexity and the accurate detection of moving entities.[5] In general, the existing background subtraction methods can detect moving objects by estimating the absolute difference between each incoming video frame and the background model, which is applied to calculate the binary moving objects' detection mask with the object threshold function.[6]

Disadvantages of Existing System:

- The computational complexity of optical flow methods is usually too high.
- Background subtraction is inaccurate, it may produce wrong objects.
- The generated background model may not be applicable in some scenes.
- Poor performance.
- High cost.

II. MTD METHOD

Compared with the traditional temporal difference method, the Multi Temporal Difference (MTD) method holds several previous reference frames to reduce holes inside moving entities for motion detection [15]. As mentioned in [15], seven previous reference frames are used to calculate the difference image.[7]

$$\Delta_t(x, y) = \sum_{n=0}^{n_{max}} \left| I_t(x,y)-B_n(x,y) \right|$$

Δ_t - Absolute Difference Image
B_n -Reference frame

III. GAUSSIAN MIXTURE MODEL

Model the values of a particular pixel as a mixture of Gaussian distributions. Multiple adaptive Gaussians are necessary to cope with acquisition noise, lighting changes, and other natural occurrence. Pixel values that do not fit the background distributions are considered foreground.[8] This is a common method for real-time segmentation of moving regions in image sequences. Model Gaussians are updated using K-means approximation method. Each Gaussian distribution is assigned to represent the background or a moving object in the adaptive mixture model. Every pixel is then evaluated and classified as a moving region or as a background.[9]
Incremental model of Gaussian distribution is defined as

$$P(X_t)= \sum_{i=1}^{K} w_{i,t} n(X_t,\mu_i, \Sigma_{i,t})$$

X_t - Each pixel value of the *t*th image frame
$w_{i,t}$ - weight vector for the correspondingGaussian distribution.

A. MSDE Method

Basedonaconstantsignfunction,theMulti ∑-Difference Estimation (MSDE)methodgeneratesseveralreferenceimagestocalculateamixturebackground model[19].Ifthecurrentframeindextisamultipleofα_i,each referenceimageb^i(x,y)canbegeneratedasfollows:

$$b_t^i(x,y) = b_{t-1}^i(x,y) + \text{sgn}\left(b_t^{i-1}(x,y) - b_{t-1}^i(x,y)\right)$$

B. .Background Subtraction

In this method, the moving regions are detected by subtracting the current image pixel-by-pixel from a reference background image. The pixels where the difference is above a threshold are classified as foreground otherwise

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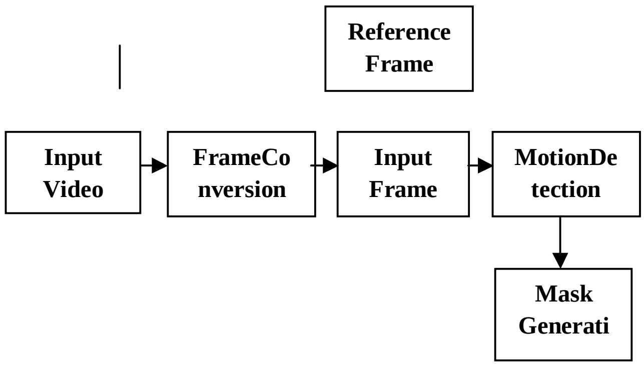
background.[1] Some morphological post processing operations are performed to reduce noise and enhance the detected region. [10]

IV. Proposed Method

A. Flow Diagram



B. Object Detection:

Detecting regions that corresponds to moving objects in video sequence plays a very important role in many computer vision applications.[11]

In simplest form, Object detection from video sequence is the process of detecting the moving objects in frame sequence using digital image processing techniques. Moving object detection is the basis of moving object identification and tracking.[12]

C. Cauchy Distribution Algorithm:

Cauchy Distribution Algorithm Based On Frame Difference and Edge Detection:

The edge difference image is obtained by computing difference between two images.[13] The smallest rectangle containing the moving object can be obtained. It is possible to get the exact position of the moving objects by calculating connected components in binary images, delete those components whose area are so small. The improved moving object detection algorithm based on frame difference and edge detection has much greater recognition rate and higher detection speed than several classical algorithms.[14]

$$f(\Delta_t(x,y);p,q) = \frac{1}{\pi}\left[\frac{b}{(\Delta_t(x,y) - p)^2 + q^2}\right]$$

$\Delta_t(x,y)$-Different frame

p , q – Location parameter

D. Moving object Detection Phase:

In order to detect a movement within a secured area, a surveillance camera is positioned to monitor the area. The detection of a moving object within the monitored area is the first phase. The movement detection uses a simple but efficient method of comparing image pixel values in subsequent still frames captured every two seconds from the surveillance camera.[15] Two still images are required to detect any movement. TheCaptured image size is 256x256 pixels. The first image is called “reference” image, represents the reference pixel values for comparison purpose, and the second image, which is called the “input” image, contains the moving object.[16]

The two images are compared and the differences in pixel values are determined. If the input image pixel values are not equal to the reference image pixel values, then the input image.[17] Pixel values are threshold and saved in a third image, which is called output image, with a black or white background. If the “difference” average pixel value isSmaller than a certain threshold value, then the output image background will be white (pixel value is 255); otherwise, the background will be black (pixel value is 0).[18]

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After tracking the moving object motion, the previous input image will now be used as a reference image, and a third image is captured and is called now the input image.[19] This process is repeated with the images being captured every two seconds, where the same comparison method is applied. If there is a difference between the reference and input images, then an output image is created. The obtained output image contains an object that will be extracted (in the second phase).[20]

E. Experimental Result

Original image (a)

Original image (b)

Result (a)

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Result (b)

V. Conclusion

Object tracking means tracing the progress of objects as they move about in visual scene. Object tracking, thus, involves processing spatial as well as temporal changes. Certain features of those objects have to be selected for tracking. These features need to be matched over different frames. Significant progress has been made in object tracking. Taxonomy of moving object detection is been proposed. Performance of various object detection is also compared.

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