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Hybrid Method For Moving Object Exploration In Dynamic Scene: A Study

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Abstract

Moving object exploration in dynamic scenes is a widely applied technology in computer vision and photogrammetry. It is extensively used in video surveillances and target identification system. Object exploration usually involves frame by frame comparison in the video with that of the object to be searched. Several researches have been carried out by professionals and scholars to identify an object efficiently in dynamic scenes. Still researches are being carried out in computer vision for moving object exploration. Each proposed method has its own benefits and limitations in accordance with time and space complexity as well as reliability in matching the object. A Hybrid Method encompassing of image filtering and matching can be proposed for detecting the object in dynamic scene. Methods like optical flow, frame subtraction, background difference and color correlation are some proposed by research scholars to enable object search in a dynamic scene. This paper investigates on different image matching algorithm and image filtering algorithms. This study paper guides the researchers to choose the best image matching and image filtering algorithm for hybrid method of moving object detection.

Keywords: image filtering, image matching, object search

1. Introduction

Video Surveillances are widely used in private and government organizations to monitor the activities of the people or object under surveillance. Surveillance videos are videos with low resolution, noise and blurriness, stored in very large databases. Detecting an object in such a dynamic scene (i. e.) under video surveillance is a crucial problem in computer vision. Video Surveillances has both indoor and outdoor applications. Nowadays researches are being carried out for monitoring vehicular motions, rail-road safety and aerial surveillance also. Moving Object detection is usually carried out by background subtraction, frame difference, color correlation. This paper studies about a hybrid method for detecting a object in motion under surveillance.

The first level in moving object detection is denoising the video i. e. the frames. Filters are applied to remove noises in the frames. Videos quality is usually affected due to acquisition of the video signals when they are transmitted. Thus in case of detecting an object in a video surveillance better matching cannot be obtained unless and until the video is denoised. The key frames are put through filters for denoising thereby restoring the image. Video Denoising are of three types a) spatial filtering: Filtering is done for each and every frame separately this may cause blurring at some spatial points due to high level of noising. b) Temporal filtering: Filtering is done between frames and not individually. c)spatio-temporal filtering is a blend of spatial filtering and temporal filtering. Video noises can be classified into analog and digital noise. These noises can be removed by filters.

Local features matching play a crucial role in state-of-the-art systems. The main problem is to compute the correspondence between the object to be searched and the sub region of the key frame captured. The sub-regions with higher value of matching score imply that the object is detected. Many research works are being done on object search in a video surveillance. Various methods are proposed for object search such as spatial context search, bag of visual words, text retrieval approach. Object search in video or dynamic scenes has a wide range of applications. This study paper guides the research scholars to choose the suitable technique for a hybrid method of searching an object in dynamic scene.

2. Overview of Methods

Detecting a object in a dynamic scene is a wide research topic in computer vision and photogrammetry. Image matching algorithms are commonly used to detect objects in a video surveillance. To denoise the key frame filters are implemented. Denoising ensures better matching strategy.

2. 1. Denoising:

Filtering videos is the level one process in detecting an object in a dynamic scene. Video denoising usually decreases the computation time in moving object detection. Digital recordings are susceptible to noise. There are different type of noises such as Gaussian noise, Salt and pepper noise, speckle noise. Norbert Wiener in 1949 proposed the Wiener Filter[13] which follows a statistical approach. Wiener Filter is

suitable only when prior knowledge about the spectral properties of the original video signal and the noise are known. Later Mean Filter[5] which works on the principle of replacing the pixel in an image with the mean value (average) of the neighbor pixels, unrepresentative pixel can affect the surrounding pixels. Mean filter might also blur the edge. This problem is overcome by the median filter.

$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$
$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$

Fig. 1. Mean Filter.

Unlike mean filter the median filter[7] takes only the pixels with representative values and replaces the pixel with the median of the pixels. Median filter preserves the edges as it takes into account only the representative pixels. The problem with median Filter is that it is expensive and complex in terms of computation.

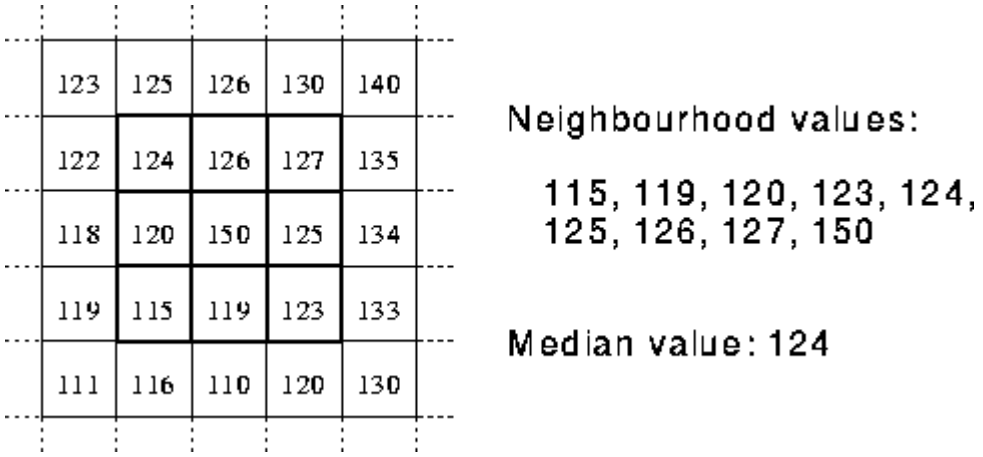

Fig. 2. Median Filter.

Yet another filter is Gaussian filter[4]. Gaussian filter uses the 2D-Gaussian function for denoising.

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} \tag{1}$$

The kernel of the filter is the Gaussian function Eq. (1) where σ is the standard deviation. The Gaussian filter is a low pass filter having fast computation as its kernel is separable but the filter does not promise to preserve the brightness of the image. Bilateral Filter[3] unlike other filters is a non-linear filter. In bilateral filter the intensity of the pixels is replaced by the weighted average of the neighbourhood pixels. The weight of pixels is based on Gaussian distribution. The bilateral filter loops through the pixels for preserving the sharp edges but sometimes bilateral filter might also tend to create false edges

2. 2. Feature Detection:

Detecting robust features and image matching are research works being carried out for several years in computer vision field. Recognizing objects in motion in dynamic scene is the most challenging problem in computer vision. The first feature detection technique is Harris Corner Detector[6] proposed by Harris and Stephen in 1988. Since, Harris Corner Detector only focused on detecting the corners. Reliable matching was not obtained (i. e.) it did not concentrate on the feature point connectivity of the objects and surfaces. Later Trajikovic and Hedly proposed FAST(Features from accelerated segment test), concentrating both on corners and edges. After decades of research Modified Harris, SUSAN[16] and WANG[18] were proposed but when compared with FAST it was still the best in those times. In 2010 Fraser et. al., modified the original FAST and improvised the algorithm by adding a filter like Wallis Filter[19]. Thereby increasing the computational speed and high point detection reliability.

Feature based algorithms work accurately only when the objects have distinguishable corner or edges (i. e.) suitable only for matching planar surfaces and planar objects in the image given. The feature based algorithms perform poorly when the images are put through scaling, rotation, illumination variation or affine transform variation. Later texture based algorithms were introduced by David Lowe in 1999[11] for reliable matching of images with cluttered background. Texture based algorithms match features irrespective of the lack of planar surfaces and edges. Later in 2004 David Lowe[12] as a continuation of his previous work i. e. feature based algorithm, proposed SIFT(Scale Invariant Feature Transformation) constituting of four stages containing filters at each and every stage. Even though SIFT seemed to be appealing in those days it was relatively expensive for 128 dimensions descriptor vector. Later to reduce the cost of Lowe's SIFT various researches were carried out to improvise SIFT. PCA-SIFT[8] in the same year was proposed by Ke and Sukthankar which involved the reduction in dimensionality by Principal Component Analysis. SIFT had wide areas of applications.

Later in 2006 SURF[1] was proposed by Bay H. who suggested Hessian matrix trace to increase the matching speed significantly. The algorithm was widely used because of invariant nature towards scaling and rotation changes. SURF(Speeded Up Robust Features) was comparatively faster to other image matching algorithms. But Still SURF and SIFT were not idle for systems with low resources. Later researchers developed image matching algorithms like ORB[14] built up on FAST and BRIEF(Binary Robust Independent Elementary Features) descriptors. When

ORB(Orientated BRIEF and Rotated FAST) tested with SIFT and SURF produced an optimized result in matching. BRIEF is a feature descriptor that makes use of the binary tested values between the pixels of smoothened images. BRIEF is almost like SIFT in many aspects like robustness to lighting and blur. BRIEF does not resolve in case of in-plane rotation. Whereas ORB is resistant to noise and it is rotation in-variant. Though many image matching algorithms are proposed the suitable algorithm for object search in a video sequence would be the algorithm which works faster and it is reliable

3. Discussion and Conclusions

Object search has a wide application in intelligent surveillance, video monitoring and searching for a person under a surveillance. Many techniques have been proposed for object search such as frame difference, background subtraction, optical flow method. The study of various Image matching algorithms and filtering algorithms have been done among which surf and bilateral filtering algorithm is the most suitable for object search as it involves fast computation and best in terms of accuracy compared to others. But both SURF and bilateral filtering algorithm has their own disadvantages like cost of computation and resource requirement, hence an improved version of SURF in which computation time is reduced further can be deployed and FBF(Fast Bilateral Filtering) where the overall cost is reduced. This study paper will guide the researchers working in the field of computer vision and enabling them to choose the appropriate algorithms in their work.

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