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Literature Survey on Video Processing Techniques

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Abstract:

Visual analysis of human motion is currently one of the most active research topics in computer vision. It concerns the detection, identification of region of interest and recognition of object behaviours from image sequences. The applications of object detection and Motion detection are farming, military, transportation, civil, security and for commercial use. Detection of moving objects in video streams is the first step of information which is then followed by tracking. Tracking is the process of finding object of interest within a sequence of frames, from its first appearance to its last. Thus, object behaviour can then be recognized using various algorithms. This paper presents a brief overview of video processing techniques and algorithms required for object detection, tracking and recognition of object behaviour. The objective is to study different methodologies of motion analysis and identify future research directions.

Keywords — **Object detection, motion analysis, edge detection.**

I. INTRODUCTION

Video processing indicates the processing on video frames which are taken as an input and results in a set of related parameters based on images in video. In this paper, we have reviewed different methodologies to process video in order to obtain different parameters to get expected results. Usually, to evaluate video processing algorithms, a set of video sequences is collected together and after that different steps are carried out like object identification, object segmentation, identifying region of interest and motion detection. Object detection is performed to check existence of objects in video frame and to detect that object. Edge detection algorithm is used to identify the region of interest and then region of interest is tracked in subsequent frames using motion detection algorithm. This paper is structured in the following way:

Section I gives introduction to object detection, object segmentation, identifying region of interest and motion detection, section II provides brief explanation on several object detection, object segmentation, edge detection and motion detection methods, section III provides comparison of those methods and section IV provides conclusion.

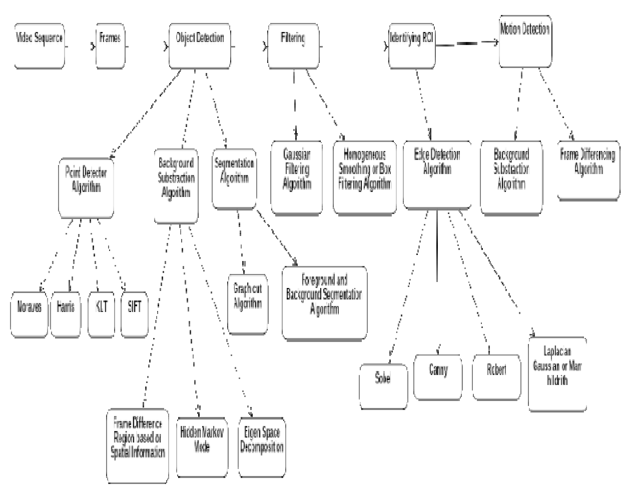

Fig. 1. Classification

II. BRIEF DISCRIPTION

OBJECT DETECTION

Object identification is the task (within computer vision) of finding and identifying objects in an image or video sequence. Segmentation algorithms are used to identify the objects in the video frames. There are few common object detection methods described below.

1.1 Point Detectors[11]

Point detectors are used to find interesting points in images which have an expressive texture in their respective localities. Commonly used interest point detectors include:

1) Moravecs Detector

This is one of the earliest corner detection algorithms and defines a corner to be a point with low self-similarity. The algorithm tests each pixel in the image to see if a corner is present, by considering how similar a patch centered on the pixel is to nearby, largely overlapping patches. The similarity is measured by taking the sum of squared differences (SSD) between the corresponding pixels of two patches. A lower number indicates more similarity.

If the pixel is in a region of uniform intensity, then the nearby patches will look similar. If the pixel is on an edge, then nearby patches in a direction perpendicular to the edge will look quite different, but nearby patches in a direction parallel to the edge will result only in a small change. If the pixel is on a feature with variation in all directions, then none of the nearby patches will look similar.

The main problem with this operator is that it is not isotropic: if an edge is present that is not in the direction of the neighbours (horizontal, vertical, or diagonal), then the smallest SSD will be large and the edge will be incorrectly chosen as an interest point.

2) Harris Detector

Harris and Stephens improved upon Moravec's corner detector by considering the differential of the corner score with respect to direction directly, instead of using shifted patches.

3) KLT Detector

Kanade Lucas Tomasi (KLT) feature tracker is an approach to feature extraction. It is proposed mainly for the purpose of dealing with the problem that traditional image registration techniques are generally costly. KLT makes use of spatial intensity information to direct the search for the position that yields the best match. It is faster than traditional techniques. For the KLT algorithm, it is necessary to implement all operations in a sub-pixel precision.

4) SIFT Detector

Scale-invariant feature transform (or SIFT) is an algorithm in computer vision to detect and describe local features in images. SIFT key points of objects are first extracted from a set of reference images and stored in a database. An object is recognized in a new image by individually comparing each feature from the new image to this database and finding candidate matching features based on Euclidean distance of their feature vectors. From the full set of matches, subsets of key points that agree on the object and its location, scale, and orientation in the new image are identified to filter out good matches. Object matches that pass all these tests can be identified as correct with high confidence.

1.2 Background Subtraction[7]

Object detection can be achieved by building a representation of the scene called the background model and then finding deviations from the model for each incoming frame. Any significant change in an image region from the background model signifies a moving object. The pixels constituting the regions undergoing change are marked for further processing. This process is referred to as the background subtraction. There are various methods of background subtraction as follows:

1) Hidden Markov models (HMM)

A hidden Markov model (HMM) is a statistical Markov model in which the system being modelledis assumed to be a Markov process with unobserved (hidden) states. A HMM can be presented as the simplest dynamic Bayesian network.

A hidden Markov model can be considered a generalization of a mixture model where the hidden variables (or latent variables), which control the mixture component to be selected for each observation, are related through a Markov process rather than independent of each other. Recently, hidden Markov models have been generalized to pairwise Markov models and triplet Markov models which allow consideration of more complex data structures and the modelling of non-stationary data.

2) Eigen Space Decomposition

A non-pixel-level method was proposed by Oliver that uses an Eigen space to model the background. The key element of this method lies in its ability of learning the background model from unconstrained video sequences, even when they contain moving foreground objects. While previous approaches use pixel-level statistics, Eigen takes into account neighbouring statistics. It thus has a more global definition on background, which, hopefully, makes it more robust to unstable backgrounds.

Algorithm

1. A sample consisting of images from the scene is acquired, mean background image is calculated and mean normalized images are organized as the columns of a matrix.
2. The co-variance matrix is calculated.
3. By means of this co-variance matrix, the diagonal matrix of its Eigen values and the Eigen vector matrix is calculated.
4. The Eigen vectors, having the largest Eigen values (Eigen backgrounds), is kept and these vectors form the background model for the scene.
5. If a fresh frame, first projected on the space spanned by Eigen vectors and the recreated frame is acquired by using the projection coefficients and the Eigen vectors.
6. The difference is calculated. Since the subspace made by the Eigen vectors well denotes only the still parts of the scene, consequence of the difference will be the wanted alteration mask comprising of the moving objects.

1.3 Segmentation

The aim of image segmentation algorithms is to partition the image into perceptually similar regions. Every segmentation algorithm addresses two problems, the criteria for a good partition and the method for achieving efficient partitioning.

1) Foreground and Background Segmentation

Foreground and Background Segmentation algorithms assume that foreground of the picture is the moving objects while the background is the static object. Therefore, object segmentation is done by moving region detection.

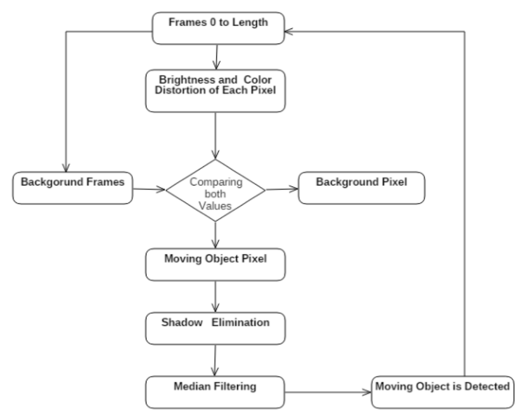

Fig. 2. *Foreground and Background Segmentation*

2) Graph Cut Algorithm

Graph Cut Algorithm can be employed to efficiently solve a wide variety of low-level computer vision problems, such as image smoothing, the stereo correspondence problem, and many other computer vision problems that can be formulated in terms of energy minimization. Such energy minimization problems can be reduced to instances of the maximum flow problem in a graph (and thus, by the max-flow min-cut theorem, define a minimal cut of the graph). Under most formulations of such problems in computer vision, the minimum energy solution corresponds to the maximum a posterior estimate of a solution. Although many computer vision algorithms involve cutting a graph (e.g., normalized cuts), the term "graph cuts" is applied specifically to those models which employ a max-flow/min-cut optimization (other graph cutting algorithms may be considered as graph partitioning algorithms)

Filtering Algorithms

Noise contained in an image can be remove by using different Filtering Algorithms.

1) Homogeneous Smoothing or Box Filtering

Homogeneous smoothing or box filter is one of the simplest filters. It does smoothing by sliding a kernel (filter) across the image. Each pixel value is calculated based on the value of the kernel and the overlapping pixel's value of the original image. Convolution operation is done on an image with a kernel. The kernel applied to the image makes difference to the result of the smoothing. In this filter an average values of a pixel's neighbors is assigned. Appropriate kernel size need to be selected. If it's too large, it may blur and remove small features of the image. But if it is too small, noises of the image may retain.

2) Gaussian Filter

Noise contained in image is smoothed by convoluting inputimage with Gaussian filter.

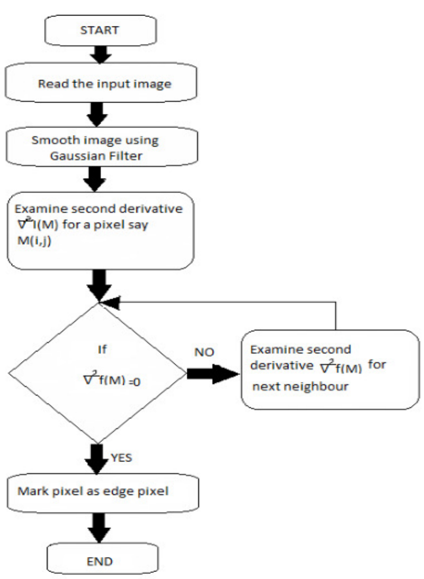

Fig. 1 :Gaussian Filter

Edge Detection[4]

An edge is the boundary between an object and the background and indicates the boundary between overlapping objects. This means that if the edges in an image can be identified accurately, all the objects can be located, and basic properties such as area, perimeter and shape can be measured.

1) Sobel Edge Detector

Sobel edge detector is a gradient based method based on the first order derivatives. It calculates the first derivatives of the image separately for the X and Y axes. The operator uses two 3X3 kernels which are convoluted with the original image to calculate approximations of the derivatives one for horizontal changes, and one for vertical changes.

2) Laplacian of Gaussian or Marr Hildreth Edge-detector

The Marr-Hildreth edge detector was a very popular edge operator before Canny proposed his algorithm. It is a gradient based operator which uses the Laplacian to take the second derivative of an image. It works on zero crossing method. It uses both Gaussian and Laplacian operator so that Gaussian operator reduces the noise and Laplacian operator detects the sharp edges.

3) Canny Edge Detector

Canny edge detector is an algorithm derived from the previous work of Marr and Hildreth. It is an optimal edge detection technique as it provides good detection, clear response and good localization. It is widely used in current image processing techniques with further improvements.

Algorithm

1. Smoothing: Blurring of the image to remove noise.
2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.
3. Non-maximum suppression: Only local maximal should be marked as edges.

4. Double threshold: Potential edges are determined by threshold.
5.Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

MOTION DETECTION [2]

1) Background Subtraction

Background subtraction method uses the difference between the current image and background image to detect moving targets. The basic idea is the 1st frame image stored as a background image. Then the current image f_k with the previously stored background image B subtraction, and if the pel difference is larger than the bound threshold, then it determines that the pixel to pixel on the moving target, or as the background pixel. The choice of threshold of the background subtraction to achieve the success of motion detection is very important. The success of motion detection is very important. The threshold value is too small will produce a lot of false change points, the threshold choice is too large will reduce the scope of changes in movement. The appropriate threshold request adapts, the changes of light conditions, so the choice of the dynamic threshold should be selected. The method formula is shown as-

$$R_k (x, y) = f_k (x, y) – B(x, y) \quad (1)$$

$$D_k (x, y) = 1 \quad \text{background } R_k(x, y) > T \quad (2)$$

$$= 0 \quad \text{Target } R_k (x, y) > T \quad (3)$$

Background subtractions used in case of the fixed cameras for motion detection. Its advantage is easy to implement, fast, effective detection, can provide the complete feature data of the target. The shortcomings are frequent in the moves of the occasions may be difficult to obtain the background image. The immovable background difference is particularly sensitive to the changes in dynamic scenes, such as indoor lighting gradually changes.

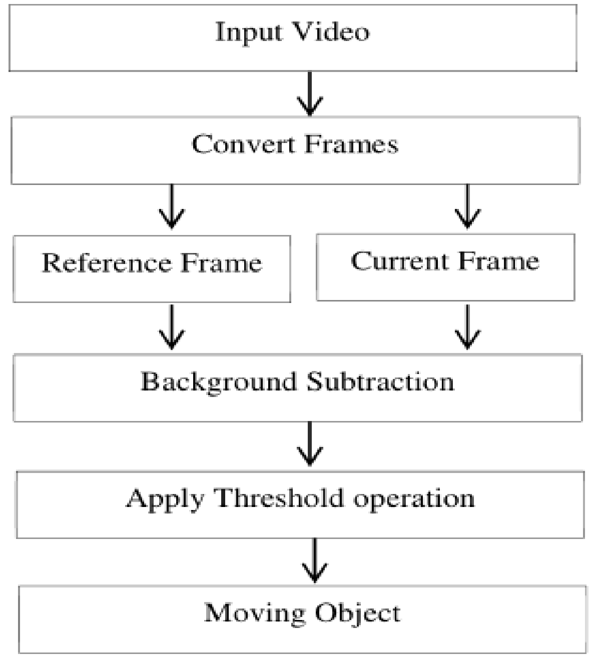

Fig: Background Subtraction

2) Frame Difference

Frame difference method, is also known as the adjacent frame difference method, the image sequence difference method etc.it refers to a very small time intervals t of the two images before and after the pixel based on the time difference, and then threshold to extract the image region of the movement. The specific method of calculation of difference image D_k between the k^{th} frame images f_k with the k_1 the frame image f_{k1} is differential, the negative differential and fully differential, the corresponding formula is as follows -

Differential:

$$D_k = f_k – f_{k-1} \quad \text{if}(f_k – f_{k-1}) > 0$$
$$= 0 \text{else}$$

Negative Differential:

$$D_k = | f_k – f_{k-1} | \quad \text{if}(f_k – f_{k-1}) <0$$
$$= 0 \quad \text{else}$$

Fully Differential:

$$D_k = | f_k – f_{k-1} |$$

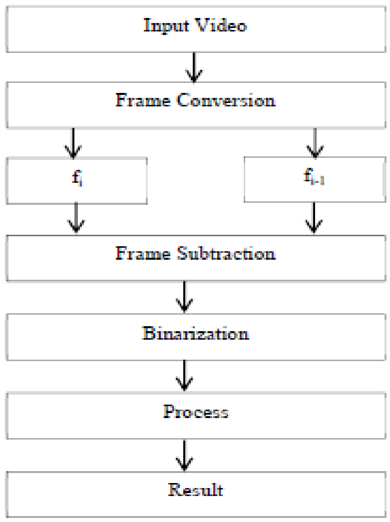

Fig:Frame Difference

III. COMPARISION OF ALGORITHMS [1, 2]

Property	Background Subtraction	Point Detector
Object	Part of Background	Interested part
Recovery	Fast	Slow

***Table 1.** Object Detection Algorithms*

Property	Homogenous Smoothing or Box Filter	Gaussian Filter
Computations	Simple	Complex
Time Required	Less	More
Adaptively	Adaptive	Not Adaptive
Probability of finding errors	Low	High
Noise	More sensitive	Less sensitive

***Table 2.** Filtering Algorithms*

Property	Sobel Edge Detector	Laplacian of Gaussian(LoG)	Canny Edge Detection Algorithm
Computations	Simple	Complex	Complex
Time Required	Less	More	More
Edge Orientation	Detects	Cannot Detect	Detects
Accuracy	Low	Low	High
Noise	More sensitive	Less sensitive	Less sensitive

Table 3. Edge Detection Algorithms

Property	Frame Differencing	Foreground and Background Subtraction
Computations	Simple	Simple
Background	Static	Static
Accuracy	Low	High

Table 4. Motion Detection Algorithms

IV. CONCLUSION

We have reviewed different methodologies to process video in order to obtain different parameters to get expected results. This paper analyses various object detection,Segmentation,region of interest(ROI) identification andMotion detection methods and algorithm.It is identified fromthe survey that video to video and purpose to purpose proposemethods are to be selected and hence every method and algorithms are having their own advantages and disadvantages oftheir use.It is suggested that combination of different methodsand algorithms can improve the accuracy and performancedepending on the application.

References

1. Rupesh Kumar Rout (National Institute of Technology Rourkela) A Survey on Object Detection and Tracking Algorithms.

2. Asad Abdul Malik, Amaad Khalil ,Object Detection and Tracking using Background Subtraction, International Journal of Computer Applications Volume 75, August 2013.

3. Rashmi, Mukesh Kumar, Algorithm and Technique on various Edge Detection Techniques, Signal and Image Processing:An International Journal (SIPIJ) Vol.4 , June 2013.

4. Raman Maini, Dr. Himanshu Aggarwal, Study and Comparison of Various Image Edge Detection Techniques.

5. T.Deepika 1, Dr.P.Srinivasa Babu, Motion Detection In Real-Time Video Surveillance With Movement Frame Capture And Auto Record, Volume 3, Special Issue1,January 2014.

6. Tripty Singh, Ph.D ,Sanju S, A New Algorithm Designing for Detection of Moving Objects in Video Internationa,l Journal of Computer Applications Volume 96 No.2, June 2014.

7. Stalin Alex, Dr. AmitabhWahi, BSFD : Background Subtraction Frame Difference Algorithm For Moving Object Detection And Extraction, Journal of Theoretical and Applied Information Technology, 28th February 2014. Vol. 60 No.3.

8. Payal Panchal, Gaurav Prajapati, Savan Patel, Hinal Shah and Jitendra Nasriwala, A Review on Object Detection and Tracking Methods.

9. Web reference:wikipedia.com/Point Detectors

10. Aseema Mohanty,Sanjivani Shantaiya, A Survey on Moving Object Detection using Background Subtraction Methods in Video, National Conference on Knowledge, Innovation in Technology and Engineering (NCKITE 2015)