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Background Subtraction Techniques- A Survey

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Abstract

Recent research in computer vision has increasingly focused on building systems for observing humans and understanding their appearance, movements, and activities, providing advanced interfaces for interacting with humans, and creating realistic models of humans for various purposes. Background subtraction approach is used to detect the moving object from background. Different methods have been proposed to detect object motion by using different background subtraction techniques over recent years. Each technique has its own benefits and limitations such as some techniques can only applied for static background and some for dynamic backgrounds. In this study paper provides different methods of subtraction techniques as a literature survey.

Key words: Background subtraction and Gaussian distribution

1. Introduction

Background subtraction could a technique within the fields of image processing and computer vision whereby an image's foreground is extracted for more process (object recognition etc.). Typically an image's regions of interest are objects like humans, cars, text etc. in its foreground. When the stage of image preprocessing which can include image denoising etc. object localisation is needed which cancreate use of this technique. Background subtraction is a widely used approach for detecting moving objects in videos from static cameras. The explanation within the approach is that of detecting the moving objects from the difference between the current frame and a reference frame, often called “background image”, or “background model”. Background subtraction is mostly done if the image in question is a part of a video stream.

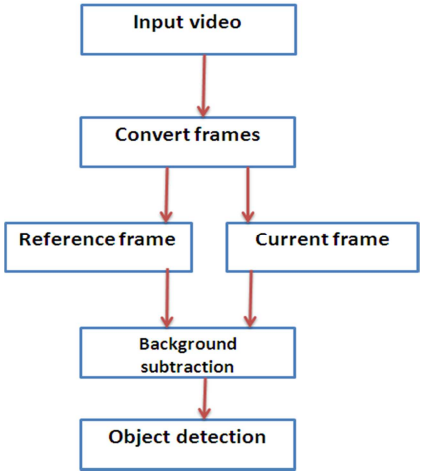

Figure1. Background subtraction

Gives the sequence of steps followed during this survey. The primary Step is that the input video taken for pre-processing. The pre-processing consists of color and frame conversion, which is represented in the consecutive blocks. After that, this frame is compared with the reference frame by considering the intensity variation. Then the Background Subtraction technique is implemented, after which the object is detected by using the Techniques like Frame Difference Algorithm, Approximate Median and Mixture of Gaussian method. The object detection method is used in numerous applications within which moving object detection is required.

Applications of background subtraction

- Optical Motion Capture
- Human Computer Interaction
- Content based Video Coding
- Video Surveillance

2. Literature Survey

MahmoodAmintoosi, et al. [1].proposed QR decomposition is technique of linear algebra in which they split the image into tinyl blocks and according to the R values they choose the background blocks with the weakest contribution. This technique can distinguish the foreground object from background object with the scene having moving object during initialization. In this technique, N totally different blocks are obtained by splitting the input image frame. Now to identify the background part in image we apply QR decomposition method on each block.

Wren et al. [2] presented a real-time system for tracking and interpretation of people by adopting a Maximum A Posteriori Probability (MAP) approach. It runs on a standard SGI Indy computer and has performed reliably on thousands of people in many different physical locations.Pfinder has been used as a real-time interface device for information spaces, performance spaces, video games, and a distributed virtual reality populated by artificial life. It has also been used as a pre-processor for gesture recognition systems, including one that can recognize a forty-word subset of American Sign Language with near perfect accuracy.Thismethod is stable enough to support real applications as well as higher-order vision techniques.

DorraRiahi, et al. [3] described an approach to background subtraction based on rectangular regions (blocks). In this particular principle is to successively split the image into blocks and detect foreground pixels based on the color histogram and the variance between pixels of the blocks. The process of this method as follows: Divide the image iteratively into rectangular regions (blocks), modeling each of them using a color histogram and a texture measure. Compare the blocks from the coarsest scale to the finest scale using the MDPA (Minimum Difference of Pair

Assignments) histogram distance. This gives coarse foreground detection at the scale of the smallest block and Apply Gaussian Mixture Method (GMM) to detect the foreground at the pixel level for each foreground block. Thus this approach reduces false positives by filtering noise coming from small motion as it is based on groups of pixels instead of on individual pixels.

Beleznai et al. [4] proposed the intensity difference between an input frame and a reference image as a multi-modal probability distribution, and mode detection is performed by using mean shift computation. The mean shift computation is performed in a fast way using integral images or summed area tables, which gives the method real-time performance in a manner which is independent of the size of the window used. The mode detection procedure is able to locate isolated humans, but for separating partially occluded and grouped humans, a model-based validation process is used. The human model is very simple and consists of three rectangular regions. Within each cluster of humans, a maximum likelihood configuration of humans is identified.

Haga et al. [5] outlined a moving object is classified as human based on the spatial uniqueness of the image motion (called criterion F1 by the authors), temporal uniqueness of the human motion (F2), and the temporal motion continuity (F3). First, the moving object is detected by background subtraction, and then F1, F2, and F3 are evaluated.The spatial uniqueness of image motion is a measure of uniformity of local motion within a region. Temporal uniqueness is correspondingly defined in the time direction. A linear classifier separates human and non-human data in the F1-F2-F3 space, and is used to classify new input data.

Eng et al. [6] proposed a combination of a bottom-up approach based on background subtraction and a top-down approach incorporating a human shape model as a solution to the problems of detecting a partially occluded human and multiple overlapping humans. First, a region-based background model is constructed under the assumption that each region has a multi-variateGaussian probability distribution over the colors. The background models are constructed in a simple manner using a set of background frames which is separated into square blocks using a k-means algorithm. Pixels in a new input image are compared with this background model and classified as foreground or background. The missing foreground parts are added by using color-based head and body detection. Then, a bayesian formulation is applied based on a simple model of the head and body as two ellipses, and all head and body pairs are determined based on the maximum a posteriori. The experiments presented in this paper deal only with a specific domain involving surveillance of a swimming pool.

Lee et al. [7] discussed a shape-based approach for classification of objects is used following background subtraction based on frame differencing. The goal is to detect the humans for threat assessment. The target intruder is classified as human or animal or vehicle based on the shape of its boundary contour. The system classifies the contour of the object into different categories using the following procedure. The data points on the contour are reduced by a curve evolution technique which uses a relevance measure to remove vertices from the contour. By this method, the contour is reduced to 60 data points, which basically amounts to a polygon approximation expressed as bend angle vs. normalized length. The similarity between contours is measured using the L2 norm.

Zhou et al. [8] presents a method to detect and track a human body in a video. First, background subtraction is performed to detect the foreground object, which involves temporal differencing of the consecutive frames. After this step, the classification of the object is based on two approaches: the first is a codebook approach, and the second involves tracking of the object and if the object can be tracked successfully, it is considered to be a human. For the first approach, the size of foreground blob is normalized to 20x20, and then a shape feature vector of the forefront object is formed. In order to create the shape vector of object, the mask image and boundary of human body are created. The distance from the boundary of human body to the left side of bounding box is used as feature vector. This is compared against the feature vectors of the human images in the codebook. The minimum of all distortions for the all the features vectors in the codebook is found, and that if that is less than threshold, then the object is classified as human. Tracking is based on color histograms, motion and size of the foreground blob. False alarms due to static oscillatory motions are also detected and removed, to handle objects like shaking trees. Other features of the technique includeshadow removal.

Lucia Maddalena et al. [9]projected a model which allows capturing structural background variation due to periodic-like motion over a long period of time under limited memory; it is based on self-organization through artificial neural networks, applied in human image processing systems and in cognitive science.

Liyuan Li, Weimin Huang et al. [13] structured a method for detection and segmentation of foreground objects from a video which contains both stationary and moving background objects and undergoes both gradual and sudden "once-off" changes. A Bayes decision has applied in order to classify background and foreground objects. The drawback of this method it is prone to absorb foreground objects if they are motionless for a long time.

3. Conclusion

Background Subtraction is one among the necessary image process steps for video surveillance and plenty computer vision issues like recognition, classification, activity analysis & tracking. During this paper we have presented the review of various Background subtraction techniques. Each of above mentioned techniques has its own merits and demerits.

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