A Method for Background Establishment Using Accumulate Histogram for Detection of Object Trajectory for Video Tracking Applications

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الخلاصة

هناك الكثير من التحديات التي تواجه عملية تعقب الأهداف المتحركة، خاصة عند استخدام الكاميرات الثابتة أو المتحركة، لذلك فان هناك حاجة لإيجاد حلول مناسبة لحل هذا النوع من هذه المشاكل. ان عملية تتبع الأجسام المتحركة تصبح أسهل عندما تكون الخلفية ثابتة (أي ساكنة) من أجل التمييز بين الأجسام المتحركة من الأجزاء الثابتة بواسطة عمليات مختلفة.

في هذا البحث، نحاول الاستفادة من تقنية لبناء قالب خلفية لمشهد معين، وهذا النموذج يستبدل عندما يتغير الوقت الذي سببه شدة احوال الطقس أو تغيرات الإضاءة.

تم إستخدام الرسم البياني التراكمي لكل كتلة من إطارات الفيديو لحساب قيمة خلفية تلك الكتلة. وبالتالي، المتوسط الاكثر احتمالا للكتلة سيعتمد كخلفية للقيمة المتوسطة، وهذه القيمة يمكن أن تطرح من قيم البكسلات المنتمية إلى تلك الكتلة. يتم استخدام القيم الوسطية التي تم حسابها لجميع الكتل (البلوك) في الصور الفديوية المتعاقبة للحصول على أكثر قيم متوسطة مكرره لكل بلوك تم تحديده في الصور لتكوين الخلفية التي سيتم استحدامها.

لغرض تحديد الأجسام المتحركة، وفصلها عن غيرها من الأجسام أو الثوابت في خلفية المشهد نطبق طريقة تنامي المنطقة "تمثل طريقة فصل الاهداف المتحركة عن الثابتة" .

بعض الميزات مثل (مركز أي كائن) تم استخراجها، واستخدمت لتحديد مسار الكائن التي تم تحديدها من خلال تتبع التغيرات في مركز حركة الجسم من صورة إلى أخرى باستخدام قانون المسافة الإقليدية.

الكلمات المفتاحية

الرسم البياني التراكمي، نموذج الرسم البياني التراكمي للخلفية، التتبع الفديوي، المسار المنحني.

Abstract

There are a lot of challenges facing the process of tracking moving targets, particularly when using fixed or moving cameras, so there is a need to find appropriate solutions to solve the kind of problems. The process of tracking moving objects becomes easier when the background is fixed (i.e., static) in order to distinguish the moving objects from the static parts by different operations.

In this research, we attempt to utilize a technique for building a background template for this scene, and this model replaces when time changes are caused by weather adversity or dynamic illumination.

We use the accumulative histogram for each block of the video frames to compute the background value of that block. Hence, the most probable mean of the block will be adopted as the background mean value, and this value can be subtracted for the values of pixels which belong to that block. The mean values of all corresponding blocks which lay in the taken successive block are used to get the most redundant mean which is adopted as the background value of that block.

For the purpose of identifying the moving objects and separating it from other objects as well as the background we apply the method of region grown. Some features like (the center of any object) are extracted, and they are used to fix the trajectory of the identified object by tracking the changes in position coordinated from frame set to other set by using Euclidean distance metric.

Keywords

Accumulate histogram, Accumulative histogram Background model, video Tracking, Trajectory.

1. Introduction

Computer vision is a branch that studies ways for getting, processing, analyzing, realizing images and, in common, high-dimensional information from its nature so that it can produced symbolic and digital mathematic information.

• For several ages, video monitoring has been developed fast in various application contexts, for like cars, buses, boat, the old, ill persons and shopping.

• In my point of view, the aims of a video monitoring system are as follows:

➢ Detection of a limited target such as: (person or vehicles).

➢ Extraction information of statistic for example: (Average no. of vehicles or people).

➢ Detection of limited events (accident, unmoved vehicles, .. etc.).

Broad set of techniques are used in video based behavior understanding and the fast progress in this area.

The ability of tracking and classifing the many of targets is a challenging and a significant task within a computer vision [1].

A histogram is a graphical representation of the distribution for numerical data [2]. Histogram is a technique of graphical information analysis for briefing the organizational data of a variable. The response variable can be classified into equivalent limited intervals (bins). We can compute the response variable for each bin by number of occurrences. The contents of histogram are [3]:

Axis of vertical = frequencies or proportion frequencies;

Axis of horizontal = the response variable (the middle-point for each interval).

The accumulative histogram can better describe the object moving characteristics in comparison with case of using the histogram. The accumulative histogram can reflec the link between distance in axis of color and the likeness of color distributions; and its use offers better opportunities for distinguishing colors more accurately [4].

In this paper, a model for the static background of the image is build using a collection of successive frames of the analyzed video. The established background model can be illustrated in the moving targets using a subtraction method. An idea of using accumulative histogram is improved by using the mean of each area of the frame, then using the frequency of occurrence of the mean of blocks assess the mean of the background existing in that block.

The segmentation of foreground is the operation of splitting a scene into two kinds: foreground and background. The foreground contents are any targets that are motion or are expected to motion, like: animals, persons and vehicles. The background contains any targets that belong to the static environment, like: trees, roads, traffic signs, buildings,… etc. [5].

2. Related Work

In this part some research related to the proposed method has been briefed below:

Israa Hadi and Mustafa Sabah [6], this represents the new approach to deal with the trajectory by using function of curve fitting and extract best features (intersection point,slope) to convert the trajectory points into approximation function.

The function of curve fitting will be an essential element of any interface of mathematical. The

procedure involves approximation a function such that the total squares of differences between the actual and approximation function.

Qingzhang CHEN et al. [4] this represents an enhanced particle filter target tracking algorithm instituted on particle position adjustment and accumulation histogram. The particle filter applies accumulation histogram to explain the object motion characteristics instead of the common histogram. The accumulation histogram part reflecting the link between distance in axes color and the likeness of the color distributions,separates colors more accurately.

Bharti, TejinderThind [7] this represents the chief algorithms used to detect the foreground target with its demerits and merits. The background subtraction classified into non-parametric and parametric background subtraction. The model of background can be divided into dynamic or static. The model of dynamic background is one in which the background of scene may contain motiontargets in outside environment, block and pixel-based are two main types of approached are for the background Subtraction. The non-parametric statistical Modeling of pixel process is used to build a statistical representation of the background scene.

R. Manikandan, R. Ramakrishnan, [8]a new algorithm to identify players depended on the background subtraction. The updating of background model is established. The algorithm of dynamic optimization threshold is used to get a more complete behaviour of tracking and motion player. In a video stream, studied the motion player and trackingand its velocity is detected. The centroid of target is calculated to use in the analyses of the location of the motionperson body.

K. Onoguchi, [9] in the weather, the visibility changes quickly in the short time and the intensity of every pixel changes hard for each frame. To solve these problems, the proposed algorithm splits an input image into grid regions, computes a cross correlation between two histograms whose accumulated number of images are various. The short accumulated histogram, created from accumulating a few number of images, changes rapidly whenever motion targets go into the region.

3. General Accumulation Histogram

One of the most essential color features is color histogram, which indicates the occurring possibility of many colors in the frame (image). In common color histogram, the value of color is the abscissa, and the color occurring frequency in the frame (image) is the ordinate. Let the function Sum (A, z_i) stand for to the number of pixels of feature informationz$_i$ in the image A, and N indicates the aggregate number of pixels in the frame (image)A. Then, the commoncolor histogram of the frameA is presented as equation 1:

$$H(A) = (h_{z1}, h_{z2}, \ldots..,h_{zi}, ,h_{zn}) \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Accumulation histogram is utilized to characterize the object motion features instead of the public histogram. The histogram of accumulation reflecting the link between distance in axes-color and the likeness of color distributions, separates colors closely and more accurately [10].

Where $h_{zi} = \frac{Sum(A,\ zi)}{N}$, ……..…..……(2)

i, N are all integers.

Assuming the public color histogram of several feature data H(A) = (h_{z1},h_{z2},….., h_{zi}, …., h_{zn}) of

frame A is recognized, its accumulation histogram is displayed as follows:

$\lambda(A) = (\lambda_{z1}, \lambda_{z2}, \ldots, \lambda_{zi}, \ldots, \lambda_{zn})$ ……..(3)

Where $\lambda_{zi} = \sum_{j=1}^{i} h_{zi}$ ……..(4)

i, j are all integers.

λ_{zi}: The summation of all values of λ_{zi} from 1 to I

While Euclidean distance is utilized as likeness measurement, accumulate histogram has the benefit over public color histogram that it makes two points with large distance less likeness in the coordinates than that with small distance [11].

4. Subtraction

The approach of background subtraction is appliedto find the motion target from the background. This approach is sensitive to changing unimportant movement and illumination of the background [12].

To find the foreground targets from the background as the absolute of difference between the current frame and an image of the scene's static background we applied equation below [13]:

$|frame_i - background_i| > Th$ ……..(5)

$Fame_I$ = current incoming video frame.

$Background_I$ = Reference image.

Th = Thresholding.

The background model can be divided in to two types of background model:

A. Static background: the background-based target detectors work mostly with static cameras [14].

B. Dynamic background: one of the background scene is dynamic and contain motion objects in outside environment.

The background subtraction is further classified into non-parametric and parametric background subtraction [14]. The quality of a background subtraction method correlates with three significant steps: modeling, thresholding and data validation.

• Background modeling: it is the backbone of the Background Subtraction process. The model of background defines the kind of model selected to signify the background.

• Thresholding:it is a process that removes an unwanted range of pixels in the scene with respect to certain threshold values.

• Data validation:it is involved with the collection of methods to decrease the misclassification of pixels.

5. Segmentation Algorithm

They contain partitioning a frame into meaningful and a set of homogeneous regions, such that the pixels in each partitioned region possess an identical set of attributes or properties. These groups of properties of the frame may contain contrast,gray levels, textural, or spectral values properties. The end result of segmentation is a number of regular regions, each having a single label. An image (frame) is thus distinct by a set of regions that are linked and non-overlapping.

Region growingis assigned to the process that collection pixels or sub-regions into larger regions. Beginning with a set of seed points,

the grawth of regions starts from these points by including to each seed point those neighboring pixels that have likeness attributes such as color,

gray level texture, intensity, intensity, etc.[15].

The best issues in the growing of region are:

• Selection: represents initial seeds.

• Growing: represents the pixels and depends on certain properties of the frame.

• Similarity: refer to the minimum difference in the gray level observed between two spatially adjacent pixels.

• The minimum area threshold is connected with minimum region size in pixels.

6. Trajectory of Object Detection

The conception of trajectory is rooted in the evolving location of some target traveling in some space through a given time interval. Thus, a trajectory is by meaning a spatio-temporal concept.

Continuous trajectory: It is a tuple (x, y, t) where t is the time and (x, y) are the spatial coordinates associated.

Trajectory is a list $\{(t_0, x_0, y_0), (t_1, x_1, y_1), (t_2, x_2, y_2) \ldots (t_N, x_N, y_N)\}$, with $t_i, x_i, y_i \in R$ for i= 0,1,2,..N and $t_0 < t_1 < t_2 < .. < t_N$, where t_0 is the instantaneous when the target begins the travel and t_N is the instant when the travel ends [16].

Area of a n target: The area of a binary target is computed by

$$A = \sum_i \sum_j T[i,A] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where **T[i,j]** represents the target pixels (binary 1).

- Location of object: The position of the target is usually specified by the center of mass and is computed as [17].

$$X_C = \frac{\sum_i \sum_j [iT(i,j)]}{A} \qquad Y_C = \frac{\sum_i \sum_j [jT(i,j)}{A} \quad \ldots\ldots\ldots\ldots (7)$$

After applying the method of region growing to identify moving objects in each frame, then the area of each moving object is determined, also its position is calculated using equations (6,7).

The object is determined by using Euclidean distance metric that represented by equation (8); which determines the closest distance between the centers of the same moving object identifies in the two consecutive frames, then the trajectory of the moving object is identified over all film frames.

$$Distance = \sqrt{(X_1 - X_2)^2 + (Y_1 - Y_2)^2} \quad \ldots\ldots\ldots\ldots (8)$$

X_1, Y_1: Center of object in last frame.

X_2, Y_2: Center of same object in current frame.

7. Proposed Method

Proposed method consists of five major modules:

i) Input video

ii) Background Model

iii) Subtraction

iv) Segmentation

v) Trajectory

Fig. (1) shows the proposed method steps

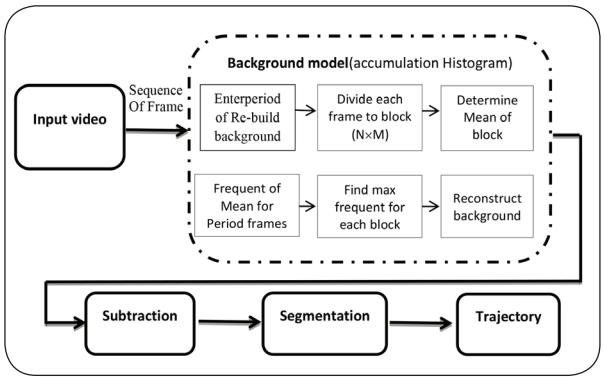


Fig.(1): Block diagram of Proposed Method

I. Input Video: Convert video to Sequence of frames.

II. Background model: We can divide constructing background model to two parts as shown below:

A. General Accumulation Histogram

It is explained in paragraph 3.

B. Blocks of Accumulation Histogram

In this research, we improve the idea modeling of accumulated histogram by the mean or rate for a certain area or dividing images to blocks (U×V) and calculate the mean value of their blocks and rounded to nearest whole number, then calculating the number of repeat this block for a certain number of images(frames) to approve is this part of the block or fixed rear part of the moving target, its improve accumulation histogram is shown in equations 9, 10, 11 below:

$$Mean(C,D) = \frac{1}{N \times M} \sum_{I=0}^{N-1} \sum_{J=0}^{M-1} Block(I,J) \quad \ldots\ldots\ldots(9)$$

I, J: dimensional of small blocks.

M, N: dimensional of blocks.

C, D: dimensional total numbers of mean value for each block.

After the mean of block is determined for a certain set of images (i.e., for specific period of time of the film) then most frequent mean values is calculated; it represents the mean value of the background belong to that block. After assigning the most frequent mean for all frames, then the background model is established.

The updating processes are continually applied to the established background model for a certain number of images, and repeated again after each period of time; this period is pre- defined, and its value should depend on the nature of the application and the relevant effects.

$$Frequent\ of\ Mean = \sum_{I=First}^{Last} round(Mean(C,\ D)) \quad \ldots\ldots\ldots\ldots(10)$$

Background Image Model = Max Frequent of repeat Blocks. ..... (11)

We are applying above equations on the example (Frame 4´4) below:

Frame 1
8 7 3 2
6 5 2 1
3 1 5 2
4 4 5 4

Frame 2
5 6 3 2
8 7 2 1
2 2 4 3
5 3 4 5

Frame 3
6 5 6 4
3 7 3 3
3 2 3 4
5 4 7 2

Frame 4
5 5 4 4
4 6 2 2
5 5 2 2
5 5 2 2

Mean 1 | Mean 2 | Mean 3 | Mean 4

2=4/(2+3+1+2)

7=4/(7+8+5+6)

4=4/(2+5+4+5)

3=4/(1+3+4+4)

7 2
3 4

7 2
3 4

5 4
4 4

5 3
5 2

Max of frequent

7 2
3 4

Output: Background Image Model

5 6 3 2
8 7 2 1
3 1 5 2
4 4 5 4

Example 1: It is represented (4 Frames of size (4´4)) to produce Background image model.

III. Subtraction

Explain in paragraph 4 and used to isolated background about foreground and it is applied to find the motion target from the background.

IV. Segmentation Algorithm

Discuss in paragraph 5 and used region growing to isolation or segmentation to each object about another objects.

V. Trajectory of Object Detection

Describing in paragraph 6 and using Euclidean distance metric among frames to find the trajectory for any object.

8. Algorithm to Detection of Object Trajectory

8.1. Main Algorithm to build system

Step 1: Input video and convert to sequence of frames.

Step 2: Build background model by accumulation histogram algorithm.

Step 3: Use Subtraction model to isolate background about foreground.

Step 4: Isolation or segment of each object from another object using region growing.

Step 5: By equations (6,7) to find the area and center of any object, then use Euclidean distance metric that represented by equation(8)among frames to find the trajectory for any object.

8.2. Algorithm to build background model

Algorithms of Build background is consists of six steps:

a. Enter period of re-build background: It is represented one back-ground model which is dealing with number of fixed sequence frames.

b. Divide each frame to block (N´M): Each frame is divided into to a small block (N´M), N is a row and M is a column.

c. Determine Mean of Block: Find mean to each block (N´M)in order to improve accumulation histogram that leads to reduce consume time.

d. For frequecy of mean for period frames: determine the repetition of block mean for the same location of sequence frames.

e. Find max frequent for each block: Find maximum or most frequent block mean in the same location for all frames and this represents best block to construct background model.

f. Reconstruct background: After testing all blocks and find best or most blocks which depend on value mean after that we use all best blocks to construct background model.

9. Experimental result

To test the performance and efficiency of process, we have executed the module with several data sequential. In example one, the video sequence used as an illustration in Fig. (2) consists of time (50) second and (1270) frames of (640×360) pixels with rate of (25.4) (frame/sec) with static camera.

Fig.(2): The film is taking from website avenue dataset [18].

Fig. (3): Illustrates samples of frames (640 ×360) which obtained from the process of converting the movie film into sequence of frames.

Fig. (4): The Images of Frame after Applying Segmentation and Tracking.

Fig. (5): Image background after run mean accumulate histogram.

In example two an illustration in Fig. (6) consists of time (50) sec and (1262) frames of 720´576 (pixels) with rate of (25.4) (frame/sec) with moving camera and fast moving object.

(a) Film

(b) Frame 1 (c) Frame 50 (d) Frame 100 (e) Frame 150

Fig. (6): Illustrates samples of frames (720´576) which obtained from the process of converting the movie film into sequence of frames.

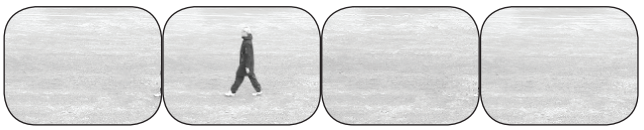
(a) Binary 1 (b) Binary 50 (c) Binary 100 (d) Binary 150

Fig. (7): The Images of Frame after Applying Segmentation and Tracking.

Fig. (8): Background Build with each step by 50 frames.

In example three an illustration in Fig. (9) consists of time (16) second and (324) frames of (160×120) pixels with rate of (20.25) frame/sec with static camera and slow moving object.

(a) Film



(b) Frame: 1 (c) Frame: 50 (d) Frame:100 (e) Frame:150

Fig. (9): Illustrates samples of frames (160 ×120) which obtained from the process of converting the movie film into sequence of frames.

(a) Binary 1 (b) Binary 50 (c) Binary 100 (d) Binary 150

Fig. (10):The Images of Frame after Applying Segmentation and Tracking.

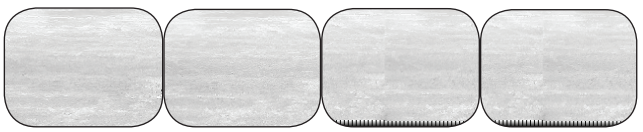


Fig. (11): Background Build with each step by 50 frames.

Table (1): Comparison among build improve accumulation algorithm to various films.

Attribute / No. example	Camera type	Speed object	Number build background	Accuracy	Frame size	Complexity scene
1	Static	Slow	Less	High	360×640	High
2	Moving	Fast	More	Low	576´720	High
3	Static	Medium	Less	Medium	120×160	Low

Table (2): Comparison among detection object algorithm to group of attributes.

Detection Object / Attributes	Sobel Filter	Canny Filter	Accumulate Histogram	Mean Accumulate Histogram
(Speed (run time	Medium	Low	Fast	Very Fast
Effective Points	Medium depend on) (Threshold	Low (Outer Frame)	High depend on built) (background model	nearest High depend on built) (background model
Science Variation	Poor	Medium	Strong	Strong
Accuracy	Medium	Less Medium only Shape of ob-) (ject	Very high	High
Shape	Medium	Very High	High	High

10. Conclusion

From Table (1) listed in paragraph (experimental result), it is clear that the proposed way to improve the accumulate histogram is characterized by a high speed in implementation and high precision in determining the effective points of moving object. Also, it is robust to the changes may occur on the scene (such as, illumination). Also, it is leading to better accuracy in determining the outdoor framework of the moving object.

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