International Journal of Engineering and Techniques - Volume 2 Issue 5, Sep – Oct 2016

RESEARCH ARTICLE OPEN ACCESS

Moving Objects Detection Using Fuzzy Color Difference Histogram Mechanism

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Abstract:

In the presence of dynamic background (such as camouflage, ripples in water) detecting of moving objects became the very toughest job. In order to subtract the background we are using three techniques in this paper i.e. CDH, FCDH, FCH. Initially the CDH (color difference histogram) technique used in order to remove the dynamic background so that it will help us to detect the moving objects by minimizing the false error occurred due to the non-stationary background. This paper proposes an algorithm FCDH (fuzzy color difference histogram) which uses the concept of fuzzy C-means clustering (FCM) and updates CDH for reducing the effects of intensity variations because of some fake motions. This algorithm tested with number of videos available in public.

Keywords — **Dynamic background, camouflage, fuzzy C-means clustering, color difference histogram, background subtraction, frame difference.**

I. INTRODUCTION

Security and video surveillance has become a growing marketplace. There will constantly be thieves and there will constantly be criminals. That is why there will usually be a huge call for of latest security cameras with superior safety generation to compete in opposition to the ever evolving approaches of crime those humans come up with. Surveillance system has become a crucial thing in security and a necessity to preserve right take a look at. There was a time when video surveillance becomes ordinarily used by the authorities and massive businesses. However, now the scenario has modified. Presently using surveillance digicam has expanded and it's miles growing more. Everywhere you look, whether or not it's a restaurant, workplace, academic institution or station, presence of video surveillance is almost obvious[1][2]. This is due to era being much more inexpensive and the attention of humans to take precautions to against the law than a treatment. However, the criminals are as aware as everybody else.

Now a day's detecting moving objects became common challenge in the application like security and surveillance, and also in the public traffic. The main challenges that are faced by detecting moving objects are as follows:-

- The changes like gradual and sudden, here gradual changes means passing of clouds over the moon and another sudden changes includes the situations like switching the light on and off simultaneously
- Having the dynamic background [3]-[5] such as waves in sea, water flowing etc.

In addressing the above challenges this paper introduce one technique for detecting moving objects in dynamic background from the static cameras, i.e. using background subtraction method is more robust technique. Different kinds of background subtraction [1], [2] methods have been even published in literature based on the procedures and technique in order to model the background.

This work makes use of fuzzy colour difference histogram algorithm having direct intension of modelling the background and finally make easy to detect the moving objects. Considering the literature survey there are many techniques have been published for background subtraction. Hence using these techniques are broadly classified into two types based on the features and the procedures that are used. The two types are as follows

1. Pixel based approach
2. Region based approach

Where, pixel-based approach [3]-[7] allows the programmer to look at scenes as processes of a set independent pixel.

While region based approach [8]-[13] deals with building a background model using an inter-pixel relations. Finally even it exhibits that this approach results in impressive results even when we handling non-stationery background. The earlier papers are mostly based on pixel (color) domain processing but this work proposes dynamic models in the difference domain.

A generic architecture diagram of moving object detection is as shown below Figure 1

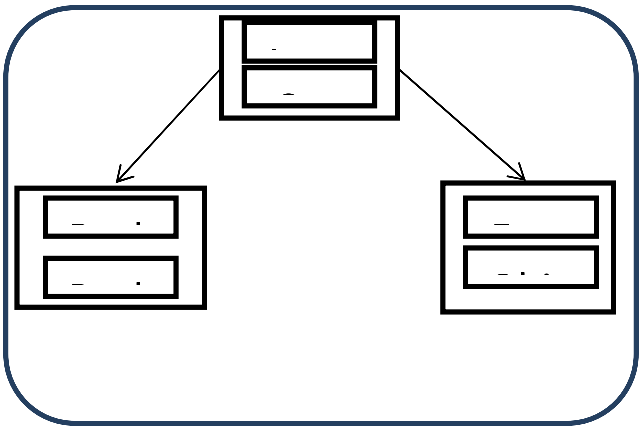

Figure 1: Architecture Diagram of Moving Object Detection

This paper is organized as follows. Section 2 describes the related work based on the object detection mechanism. Section 3 discusses the working principles Moving Object Detection and Tracking Using FCDH & Frame Difference. Section 4 presents the experimental setup and results of the proposed work. Section 5 concludes paper.

2. RELATED WORK

This section presents the information about the techniques, methods that are proposed earlier to detect the moving object in the various condition, some techniques requires two camera some techniques are based on some assumptions that results in false detection. The papers are given below.

B. Vachon et al [1] proposed several upgrades of the specific method advanced by the usage of over the modern years and the motive of this paper is to provide a survey and a genuine magnificence of these upgrades.

C. Stauffer et al [3] attempted to expand a visible monitoring system that passively observes shifting items in a domain and learns styles of pastime from the ones observations. For extended sites, the machine will require a couple of cameras. Consequently, key elements of the gadgets are camera coordination, activity type, and occasion detection. This paper, concentrate on recognition of movement tracking and display learn how to use observed motion to analyse patterns of interest in a website. Motion segmentation is primarily based on an adaptive background subtraction approach that fashions each pixel as a mixture of Gaussians and makes use of an on line approximation to replace the version.

The Gaussian distributions are then evaluated to determine that are maximum probably to result from a heritage method. This yields a strong, actual-time outdoor tracker that reliably deals with lighting adjustments, repetitive motions from muddle, and long-time period scene adjustments. At the same time as a monitoring device is ignorant of the identity of any object it tracks, the identification stays the equal for the whole tracking sequence. Our system leverages these records by way of collecting joint co-occurrences of the representations within a sequence. These joint co-incidence facts are then used to create a hierarchical binary-tree classification of the representations. This approach is beneficial for classifying sequences, in addition to character times of activities in a website.

W. Kim et al [11] proposed History subtraction mechanism for detecting moving objects from a still scene. For this, maximum of previous methods rely on the assumption that the historical past is static over quick time periods. but, dependent movement patterns of the background, which are unique from variations due to noise, are infrequently tolerated on this assumption and therefore nonetheless result in excessive-level fake superb charges while the use of previous fashions. They introduce a singular history subtraction set of rules for temporally dynamic texture scenes. specially, we endorse to adopt a clustering-based totally feature, called fuzzy color histogram (FCH), which has an capacity of greatly attenuating color variations generated through background motions whilst nevertheless highlighting shifting gadgets. Experimental consequences exhibit that the proposed technique is powerful for background subtraction in dynamic texture scenes compared to numerous aggressive strategies proposed within the literature.

So that from the related work, can analyse that the techniques used in this paper will work as per the user needs that is moving object detection in complex scenario, in camouflage scene. Existing approaches are not so accurate and efficient to solve this issue. We need to develop a system that recognizes motion of moving objects using proposed color histogram approach. The main objective of this paper is to detect moving objects using FCDH technique, and background subtraction using color difference histogram approach and tracking of an object.

3. MOVING OBJECT DETECTION AND TRACKING USING FCDH & FRAME DIFFERENCE

This section discusses the working principle of this paper that includes the techniques, steps involved in the detection of moving object.

In the presence of dynamic background (such as camouflage, ripples in water) detecting of moving objects became the very toughest job. In order to subtract the background we are using three techniques in this work i.e. CDH (color difference histogram), FCDH (fuzzy color difference histogram), FCH (fuzzy color histogram). Initially we use CDH (color difference histogram) technique in order to remove the dynamic background so that it will help us to detect the moving objects by minimizing the false error occurred due to the non-stationary background. To detect the moving object we use frame difference mechanism.

The proposed system consists of two modules background model and foreground model, the flow of implementation is as shown below.

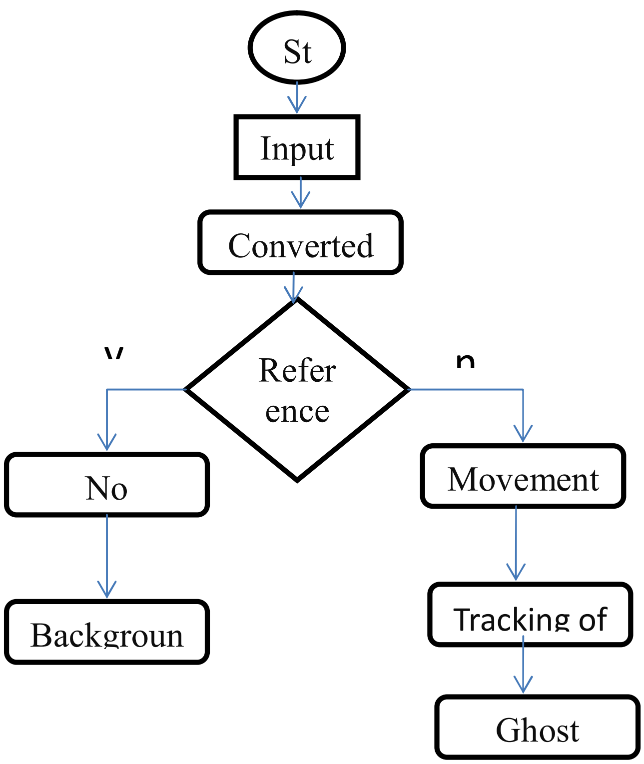

Figure 2: Flow chart for proposed system

The above figure 1 shows the flow of data where the input video will converted into frames then the frames will keep on checking whether they are related to background model or foreground model, if related to background model then those frames are maintains as a background model, and the changes in the frames referred to as foreground objects from that using the proposed mechanism we can detect the moving object.

I. Color Histogram: Here color histogram is also a histogram which even plots a graph of an image in terms of color distribution of that particular image. For a given particular color image consider the intensity level as *I (i, j, k,),* in which this intensity is computed in N levels, i.e., I € {0, 1... N-1} where (i, j) represents the location coordinates and k represents color channel.

At the location (i, j), thek^{th} color channel's intensity is denoted by *I (i, j, k,),* where *I (m, n, p)* is used to represent the intensity of pixel located in neighbourhood. By using these information's we can get the equation for color histogram *hg (m, n, ch)* that determines frequency of pixels in local region having size A × A where, centred location at (i, j). Is given as follows

$$hg\,(m,n,ch) = \sum_{i=0}^{A} \sum_{j=0}^{A} \delta((I\,(i,j,k,) - (m,n,ch))$$

$$\text{for } 0 \le m \le N\text{-}1, \text{ for } 0 \le n \le N\text{-}1, \text{ for } 0 \le k \le N\text{-}1 \text{ and } k = \{L^*, a^*, b^*\} \qquad 1$$

II. Color Difference Histogram: The way in which we can generate the equation for color difference histogram, which is most robust technique used for lowering the risk of getting false rates due the presence of illumination etc.., for non-stationary background.

The unique feature of color difference histogram is to detect uniform color difference in between minimum two pixels. Here the color difference is calculated in a region (B × B) with given a small local neighbourhood. Formula for this color difference histogram is as follows:

$$d(i,j) = \frac{\sqrt{\sum_{m=i-[\frac{B}{2}]}^{i+[B/2]} \sum_{n=j-[\frac{B}{2}]}^{j+[B/2]} (\sum_k (I\,(i,j,k,) - I\,(m,n,p))^2)}}{(B \times B)} \qquad 2$$

Where d is notation for color difference, which is fuzzified by Gaussian membership function. The membership function of Gaussian is as given below:

$$\mu_{d(i,j)} = e^{-1/2(d/\sigma)^2} \qquad 3$$

Where σ represents the standard deviation, now it's time to have function or formally the formula for CDH, consider a given region of size A ×A which is centrally located at the location (i, j) is as follows:

$$H\,(m,n,ch) = \sum_{i=0}^{A} \sum_{j=0}^{A} \mu_d(i,j)\, \delta((I\,(i,j,k,) - (m,n,ch))$$

$$\text{for } 0 \le m \le N\text{-}1, \text{ for } 0 \le n \le N\text{-}1, \text{ for } 0 \le k \le N\text{-}1 \text{ and } k = \{L^*, a^*, b^*\} \qquad 4$$

This above formula will allow us to compute the color difference histogram

III. Color Difference Histogram: In this proposed work an algorithm which uses the FCDH (Fuzzy color difference histogram) technique for background subtraction in order to identify the foreground objects i.e., clearly moving objects in foreground. This technique involves in converting snap shot which is taken by video or an RGB color image into the color space L*a*b*, which is done by using MATLAB image processing toolbox.

Fuzzy C-means clustering: Fuzzy C-means clustering is another kind of clustering algorithm, which is considered as the most robust and effective clustering algorithm. This kind of clustering assigns the membership value to each and every objects present in each clusters based on the distance between object and centroid point in cluster.

Formally the fuzzy C-means clustering [18] algorithm is mainly used to classify H bin (color) local histogram K= $\{k_1, k_2, \ldots k_H\}$ into C-clusters, each of them are centred at location l_i, here the bins along with membership will be assigned to each cluster. This process executes iteratively in order to minimize the cost function.

$$J_c = \sum_{m=0}^{C} \sum_{n=0}^{H} u_{mn}^{r} \, || \, k_i - l_j ||^2 \qquad 5$$

Where $|| \, k_i - l_j||^2$ is the Euclidean distance, between two clusters.

Finally using c × v dimensional membership matrix u, c-dimensional FCDH vector v is constructed. And for the color difference vector VC of M×1 dimension is as given below:

$$h_{c\times 1} = u_{c\times 1} \mathrm{VC} \, h_{M\times 1} \qquad 6$$

When there is overlapped data the technique fuzzy C-means clustering will produce best result then compare to K-means clustering.

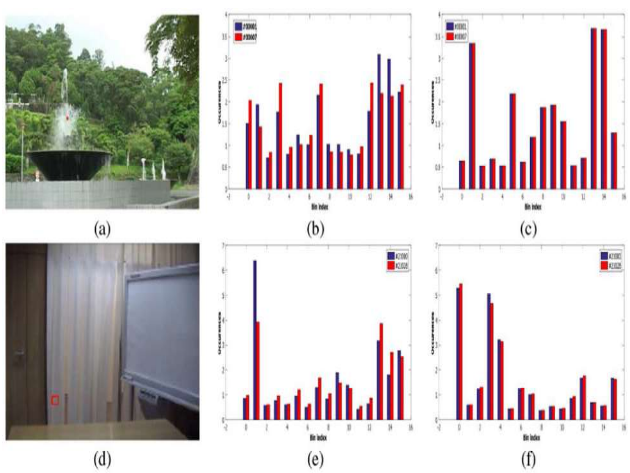

Figure 3 These Figures Gives the Difference between Two Histogram Techniques

Here (a) and (b) are the two images representing fountain [17] image and curtain image respectively. Here the images (b), (c) representing the FCH and FCDH for the image (a) respectively and images (e), (f) represents the FCH and FCDH for figure (d). The figure illustrated above will shows, the height of performance for both the FCH and FCDH. By looking at these figures only we can easily say that performance of FCDH is much better than the performance of FCH, because the FCH mainly based on color magnitude but the concept behind the FCDH technique based on color difference, having this feature.

IV. Background Subtraction

The main purpose of this work is to detect the moving objects in foreground. So the detection of moving objects itself requires a maintaining of background. Hence in this work, the proposed FCDH technique is used in order to subtract the background and help for the foreground moving object detection. Here camera is use for recording the situation, so after taking the video, then recorded video will get converted into frames. The very first frame taken from the video will be set to initialize background model. For this purpose the FCDH concept is used in order to check the similarities between those frames. Histogram intersection [19], use to measure the similarities one function is used which as follows:

$$\rho(c^b, c) = \frac{\sum_{j=0}^{h-1} \min(c_j^b, c_j}{\max(\sum_{j=0}^{h-1} c_j^b, \sum_{j=0}^{h-1} c_j)} \qquad 7$$

Where, ρ - is similarity, c^b represents the FCDH of frame which is modeled background and c represents the FCDH of current frame.

After calculating similarity function"ρ", it has to get binarized by having some appropriate threshold values *th*, since it having the responsibility of classifying pixels with rest to the background flags, *Bi* is the notation for binarized "ρ".

$$Bi\,(ti) = \begin{cases} 1, \rho(c^b, c) > th \\ 0, otherwise \end{cases} \qquad 8$$

The FCDH Background c_j^b will get updated by considering the new set of data and will be updating the bins for pixels, which is clearly labeled in background [3].

$$c^b\,(ti) = \begin{cases} (1-\beta)c^b(ti-1) + \alpha c(ti), pixel\ in\ background \\ c^b(ti-1), otherwise \end{cases} \qquad 9$$

Where β€ [0, 1] which is called as learning rate and *ti* is used for representing time index.

V. Tracking system: Moving object tracking is major application in security, surveillance and vision analysis. The implementation is performed by removing noise in image and separating foreground and background objects. The object is visualized and its centroid is calculated. The distance it moved between frame to frame is stored and using this velocity is calculated with the frame rate of video.

The steps involved in differencing the frame is as follows

Step 1: Distinction of two Consecutive Frames

The value of the xth frame in image sequences is Ix. The Ix+1 is value of the (x+1) th frame in image sequences. The absolute value of differential image is given below:

Ix (x, x+1) = |Ix+1 – Ix|

Step 2: Producing grey picture form absolute differential picture

The area of moving object detection which may contains holes and the outline of moving object is not recognized. To assist further operations, the grey image is produced by the absolute differential image. This operation is done by using the following formula

$Y = 0.299*R + 0.587*G + 0.114*B$

Step 3: Filtering and Binarizing

As explained in the above step 2 about the holes in area, frame differencing technique uses the Gauss low pass filter having an intention of removing the holes presented in the area.Ix1 is intensity of first image got by filtering. Founded Ix1 image is then subjected to binarized using the binary threshold and produced Ix2 (p, q) of binary image.

Where (p, q) - pixel coordinates in an image.

4. RESULTS AND DISCUSSION

The proposed technique is implemented in MATLAB, running on a 32-bit Windows7 platform with Intel Core i5-2400 CPU@3.10 GHz, 3.10 GHz and 4 GB RAM. The effectiveness of the proposed scheme is demonstrated on publicly available challenging video sequences. This paper demonstrate the techniques that are fuzzy color difference histogram mechanism in order to model the background as well as foreground, frame difference method is used to detect the moving object.

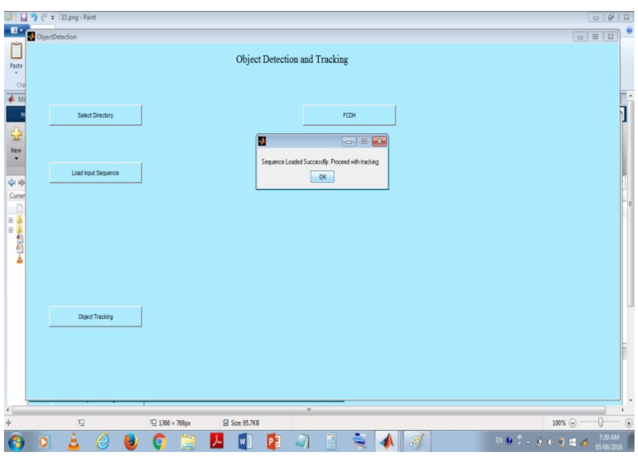

FIGURE 4

When the user selects, the video file it will get upload, then the Figure 2 is a dialogue box which will appear on the user interface in order to give the confirmation to the user that the video is successfully uploaded.

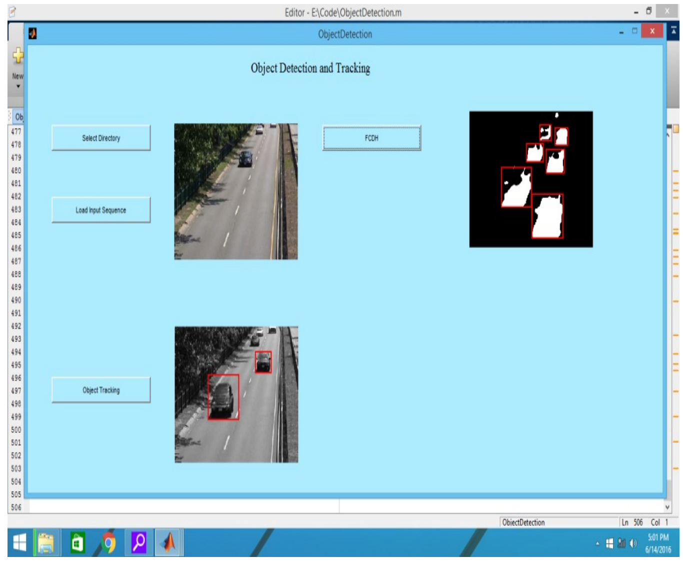

FIGURE 3

The above Figure 3 shows the final outcome of this work, where it include object detection and tracking of objects that are in moving condition. This interface includes 3 videos that are as displayed in the above screenshot gives the expected outcome that is in 1^{st} video represents the normal video 2^{nd} video represents the video where the system detects the moving objects, 3^{rd} video represents the video where it includes tracking and produce ghost appearance of moving object by subtracting the background i.e., making it one color black.

5. CONCLUSION

Detection of moving object in complex scene becomes more difficult so in order to detect the moving object in such a situation we proposed a robust mechanism that is, the use of CDH in background subtraction reduces the number of false errors due to the illumination variation, non-stationary background and even when pixel characteristics of the foreground and background objects are similar. Moreover, presence of a foreground object during the background initialization leaves ghost effect and also tracking of objects is done here. The future enhancement can made to this work is to detect shadow cast by the object as well as making it to work in dynamic cameras.

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