Ghost detection and elimination in moving object detection: A Review

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Abstract: Ghost may occur in background when object start or stop moving. Detection and eliminating ghost is a very challenging task in object tracking, event analysis, video monitoring etc. This paper presents a review of various aspects regarding of ghost detection and removal methods for improving background subtraction modeling. Their performance analysis is also presented to regulate the most suitable background subtraction algorithm for the specific application or situation of video surveillance systems.

Index Terms **- Ghost detection, Background subtraction, Surveillance system**

I. INTRODUCTION

Segmentation of foreground objects is an important and an essential task for many systems that aim to carry out motion tracking, object classification, event detection and used in applications such as traffic monitoring and analysis, access control to special areas, human and vehicle identification and detection of anomalous behavior (yin et al , 2008) Segmentation is challenging task when object start to move or stop to move in background in such case unseen object appear in background is called 'ghost'. The ghosts seriously effects on background modelling and background updating.

In past decades some researcher have been proposed methods on detection and elimination of ghost for updating and modelling of background. Abdelli A et al.(2017) proposed three and from frame differencing methods, improvement in precision is due to the elimination of the ghost problem by considering more pertinent temporal information .Cucchiara et al. (2003) proposed a method which combines statistical assumptions to detect moving objects, apparent objects (ghosts), and shadows with the object level knowledge of those from previous frames. They used optical flow to differentiate between moving objects and almost static 'ghosts'. However, optical flow is computationally expensive for real-time processing, also stationary objects may be inaccurately classified as ghosts (Cucchiara,2008). The paper presents a review of various aspects regarding of ghost detection and removal methods for improving background subtraction modelling including performance analysis. The rest of the paper is systematized as follows. Section II presents methodology in which ghost detection and removal techniques is illustrated. Section III present state- of–art of ghost detection and eliminating. Performance analysis is described in Section IV. Conclusion

II. GHOST DETECTION AND REMOVAL METHODOLOGY

This section comprises some of the literatures used for ghost detection and removal techniques developed by various researchers using twice, thrice and four times frame difference methods with their importance.

Ghost detection methods are based on motion detection in the exposures sequence. Basically, we can identify two type of motions in a dynamic scene: (i) a moving object on a static background, e.g. moving people or cars; (ii) a moving background with static or dynamic objects, e.g. windblown leaves or waves (Srikantha, 2012)

A. Four times frame difference: Moving objects detection can be performed using simply Two-frames differencing with explicit handling of ghosting (Saleemi et al, 2013), however, this method suffers from false negatives (missed detections). An improved approach proposed by (Xiao et al, 2010) and followed by (Keck et al, 2013) (Basharat et al ,2014), is to use three-frames differencing. This technique is robust to sudden illumination changes and very efficient hence Abdelli et al., (2017) has proposed four times frame difference.

Using four frames, we can get 6 difference maps, however, we found that 3 difference maps are enough to robustly separate the foreground from the background, In fact, our Algorithm uses an additional difference map in comparison to three-frames differencing technique to eliminate the ghost problem, and a different algorithm to extract information from these maps , as illustrate in Fig.1.

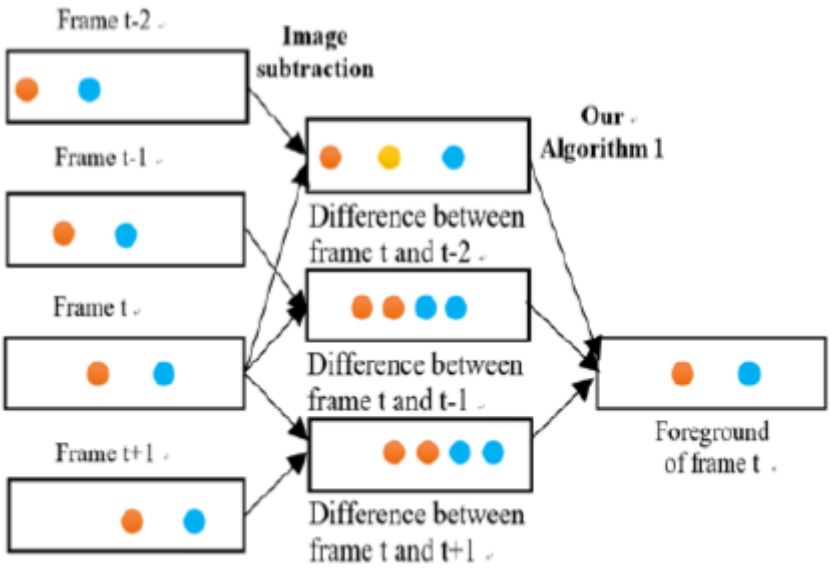

Fig.1 four frame difference method (Abdelli et al.,2017)

Algorithm: four frame differencing

Input: video frames (frame1, frame2,……..frame t) with moving object
Output: foregrounds (foreground1,foreground2 ,…….foreground t)

```
1. for each frame t in input video:
2. {
3.       for each pixel P in foreground t;
4. {
5.       If  (|I_{t-1} - I_t| <T )   or ( |I_{t-1} + I_t| <T )
6.              foreground t(P)=0  // Background
7.       else
8.            {
9.      If  (|I_{t-2} - I_t| <T )   or ( |I_{t-1} -  I_t| <T )
10.           foreground t(P)=0  // Background
11.    else
12.           foreground t(P)=1  // foreground
13.          }
14.  }
15.  }
```

Fig.2 algorithm: Four frame differencing (Abdelli et al , 2017)

B. Variance based ghost detection: This method detects ghost regions based on a weighted variance measure. First, the camera response function is estimated and the radiance maps are computed. Then, a Variance Image (VI) is generated by evaluating the variance of radiance values at each spatial location (u; v): As regions affected by movement exhibit high variance, the VI can be used as a likelihood measure for intra-image movements. Regions where this local variance measure is above a defined threshold are detected as ghost regions: the threshold is set to 0:18 for the normalized VI. For color images, the VI is calculated as the maximum over the three color channels and morphological operations (erosion and dilation) are applied to remove outliers, false detections and to obtain closed and well defined structures (Srikantha,2012)

C. Entropy based ghost detection: A local neighborhood based entropy map is computed for each LDR image. For each pixel (u; v) in L k, the entropy is calculated from a local histogram computed in the window of size (2r + 1) (2r + 1) around (u; v) An Uncertainty Image (UI) is then derived from the weighted difference of the pre-computed entropy images, is used to find ghost regions based on thresholding. (Srikantha, 2012)

D. Edge Histogram Contrast for ghost detection and removal: The moving target and ghost in moving video can be distinguished according to histogram contrast, average change rate and object similarity, which has verified the effectiveness and feasibility of the algorithm shown in Fig. 3. (Jiangfeipeng, 2015)

Algorithm: Edge Histogram contrast

Input: video frames (I1,I2,……..In) with moving object
Output: ghost detection and removal background
1. F(x,y)= |I(x,y)-B(x,y)|, where I(x,y) –frames
B(x,y) –background
2. Avg change rate| F(x,y)| =M(x,y) a m
3. G(x,y)=|M(x,y)+E(x,y)+ H(x,y)|, E(x,y)- edge deteciton, H(x,y)- histogram analysis,G(x,y)-ghost detection
4. GMM is used for change B(x,y)
5. G(x,y) is illiminated.

Fig.3 Edge Histogram contrast algorithm (Jiangfeipeng, 2015)

E. Edge Comparison based ghost detection and removal: Yin et all have developed ethod based on edge comparison for ghost detection and removal during tracking. Ghosts mainly appear in two cases. (Yin et al, 2008) In 1st case when a moving object becomes stationary and when it starts to move again sometime later, there will be a ghost. In 2nd case an existing object that belongs to the background starts to move (e.g. a parked vehicle) and will also cause a ghost problem.

III. STATE -OF- ART

Various survey of ghost detection and removal in background can be found in literature, only none of them address an overall review in this area. This review enables readers to do a comprehensive study about the complexity of the different methods and can effectively assist them to select the most adapted methods for a specific application.

Table 1. Comparison of ghost detection and removal methods

Methods	Advantages	Disadvantages
Four Frame Difference	➢ Improvement in precision ➢ To improve the robustness against camouflaged objects.	➢ Manual Thresholding
Edge Histogram contrast	➢ Effectively detect and remove the ghost and remnant ➢ It is beneficial to tracking object ➢ It is useful in crowed also.	➢ Time consuming method
Edge based	➢ No computational cost to the surveillance system	➢ Cannot recognize individual objects in crowd scenes

Here, various methods of ghost detection and removal presented its merit and demerit in Table 1. which gives the idea about which method is suitable for next application.

IV. QUANTITATIVE ANALYSIS

Numerous metrics are available for evaluating the correctness of ghost detection results. Most of the authors use Per-pixel accuracy, ghost Detection Rate, and ghost Discrimination Rate was used.(sasi et al, 2014). These metrics are computed using the number of True positives (TP), True negatives (TN), false positives (FP), and False negatives (FN). TP and TN indicate the number of correctly classified ghost pixels and non-ghost pixels, respectively. FP is the number of non-ghost pixels misclassified as shadow, and FN is the number of shadow pixels misclassified as non-ghost. The formula to compute each of the metrics is given below:

$$Pre\ pixel\ accuracy = TP+TN/N \quad (1)$$

$$Ghost\ detection\ rate, \eta = TP/TP+FN \quad (2)$$

$$Ghost\ discrimination\ rate, \zeta = FN/TP+FN \quad (3)$$

Where, N indicates the total number of pixels in the image.

V. CONCLUSION

Ghost are phenomenon that appears in a background due to dynamic background, moving object move to stop and stationary object start to move. Since their presence may cause complications in image vision applications, the detection and elimination of ghost have become an important topic of research. Ghost detection and removal is considered as an image enhancement technique and is therefore included in such pre-processing stage of computer vision applications as object detection and video examination. This makes it necessary to develop techniques that can detect and remove ghost accurately in very limited time. The paper presented survey of methods of ghost detection and removal with merit and demerits which is helpful in computer vision applications.

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