An Efficient Background Updating Model for Motion Detection

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***Abstract*— In transit system, military, residential area and restricted area video surveillance system is getting more popular for motion detection and object extraction. Background updating process is the most important feature for motion detection in video surveillance system. In this paper, we proposed a novel algorithm for updating the background and therefore detection the motion of an object for a fixed video surveillance system. In our proposed method video frames are taken from a surveillance camera and then for updating background previous 40 frames from the video frames are used. Here pixel wise comparison is done for the previous frames so that maximum common pixel values are stored to get a temporary background. When the temporary background is obtained then it is compared to the last frame's pixel values and the common pixel values are stored as the permanent background. The pixel values which are not common to the both frame then these values are taken from the previous permanent frames which are common with the last frame. Now again if there is any mismatched pixel value remains then the temporary background's pixel value is stored as permanent background for this position. Finally we get the permanent background as an updated background. And now for motion detection, the next frame's pixel values are subtracted with the permanent background, if the value goes beyond a threshold value then there the object motion is detected. We have applied this method for different video datasets and obtained interesting and promising results.**

Keywords-background modeling; motion detection; video surveillance; object detection.

I. Introduction

Motion detection is very common in real time video analysis. In many places where the area is restricted or secured there is a great application of motion detection. Video surveillance systems are used for detecting, observing and analyzing a moving object or human being. The intelligence sector and military uses the surveillance camera for observing the suspicious activities or movements. This is also used in identification of the human activity [1], air flow control, detection of motion from the airborne video [2], monitoring of traffic [3], abnormality detection and behavior recognition [4], analysis of a busy environment [5], 3D scene capture [6], image change detection [7] and many more. Motion detection mainly extracts the moving object from a series of image frames. It is comprised with motion segmentation and object classification. Also now-a-days almost all the existing surveillance systems use 2D data for motion analysis.

Background subtraction, temporal differencing and the optical flow are three methods for object segmentation or motion detection. Among them background subtraction is one of the most popular method in where the foreground object is extracted when there is a significant difference between the past image and present image. Already there have been applied many method and improved method on background subtraction [8], [9], [10], [11]. Another method for motion detection is temporal differencing [12]. In this method the video frame is separated in a definite time scale. After that they compared to find the differences if there any. Optical flow is a vector based method which finds motion in video using point based analysis on multiple frames [13]. In many work, after motion detection, the object classification is done for behavior recognition [14], [15]. So the primary requirement for further analysis of an object is to detect first. If the object detection can be done perfectly then it is possible to make any kind of analysis of that object. And for this purpose background modeling is the main feature.

In our proposed method, the background modeling is compared not only with the previous frames but also with a temporary background and previous permanent backgrounds. For updating a temporary background, a pixel based comparison is done to a number of frames. Only the maximum common pixel values which are same at a certain position for all frames are taken as the temporary pixel values. When the temporary background is obtained then for obtaining the permanent background this is compared with the last frame and where there is a match of pixel values in the same position, this is stored for permanent background. And where no common pixel value is found then the last frame is compared with the previous permanent frames and if it finds a match then stores this for permanent background. Again there may some value which does not match. For this the temporary pixel value is stored as the permanent pixel value and by this way finally we get this updated permanent background. Now for motion detection the updated background is compared with the present frame, if there is a remarkable difference between pixel values in any region of the frames then there the object motion is detected. This work has a great advantage over where only subtraction with two frames is done to detect the motion of an object or where the updating is done by only subtraction of frames. Our proposed method is highly applicable where the movement of object is very fast like road traffic surveillance system. This method shows promising results for two different datasets.

The rest of the paper organized as follows. Section II briefly overviews of our proposed framework. Section III describes the proposed algorithm of our method. Experiments and result analysis are described in Section IV. We conclude the paper and future research directions in Section V.

II. OVERVIEW OF OUR FRAMEWORK

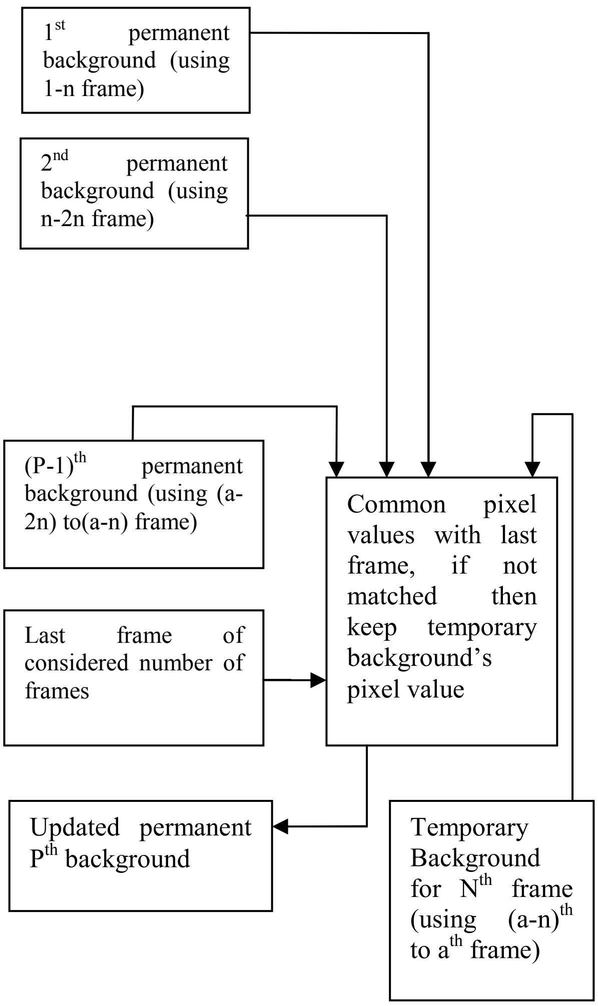

Figure 1. Block diagram for background modeling

Fig. 1 describes the block diagram of the background modeling process of our proposed method. Temporary background is created by a certain number of frames which we want and the maximum common pixel values are used to create the temporary background. Here by maximum common pixel values we mean the mode of the pixel values. Then the last frame of the selected number of frames is compared with the previous permanent backgrounds as well as with the temporary background. Now the modes of these pixel values are considered for updating of the present permanent background. If there remains any mismatched pixel value then chose the temporary background pixel for the permanent background on that position. So a complete updated present background will be obtained.

Now to detect an object from motion the difference of a frame with the permanent background is found. If there any difference presents then a moving object is detected.

III. ALGORITHM OF OUR PROPOSED METHOD

1. Select a certain number of frame after that we update our background.
2. For updating background:

   Step 1) Make a temporary background by using last n number of frame

   Step 2) Compare last frame of considered frames with temporary background

   Step 3) Common pixels are considered for permanent background for the next upcoming frames

   Step 4) Compare last frame of considered frames with all pervious permanent background one by one (except those pixel bits which are already fixed by **step 3**) last to first.

   Step 5) Common pixels are considered for permanent background for the next upcoming frames

   Step 6) Updated background

3. When the background is updated then for motion detection we have to select a threshold. Then if any frame has a difference with the permanent background frame value more than the threshold a motion is detected.

IV. EXPERIMENTAL STUDY

A. *Acquisition of Image*

The acquisition of video image was performed with the camera sth-dcsg-9cm. The STH-DCSG is a revolutionary stereo head with a global shutter specially designed for machine vision tasks of scenes with motion, Pre-calibrated so it is plug-and-play, Global shutter, low-noise, high-sensitivity CMOS imager, Color or monochrome, uncompressed video at VGA resolution (15 fps), Includes miniature lenses and SRI Small Vision System software for real-time stereo analysis, Offering high performance and low power with motion capture in a compact package. Here the camera is interfaced with a video surveillance system. When the camera is calibrated, it will produce dynamic video images.

Figure 2. Pictorial view of a STH-DCSG – 9CM camera

B. *Experimental Results*

1. *Indoor small object:*

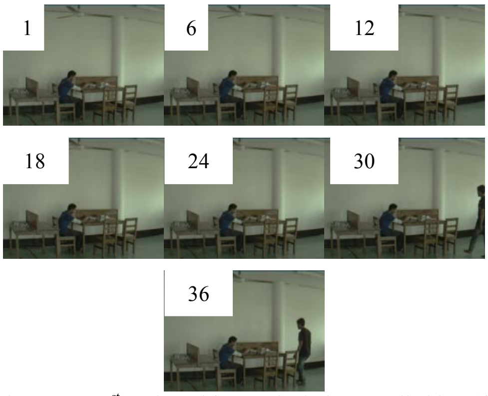

Figure 3. 1st packet of frames for indoor small object (frame1-40)

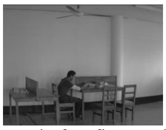

Figure 4. Background after first packet of Frames

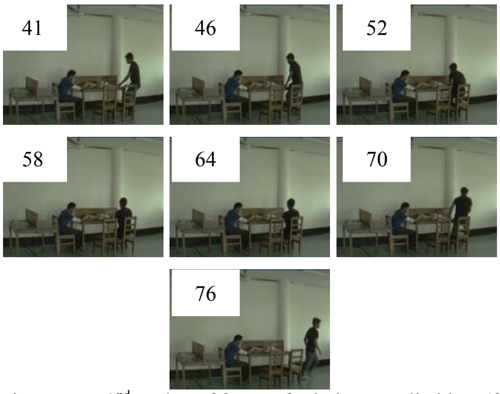

Figure 5. 2nd packet of frames for indoor small object (frame41-80)

Figure 6. Detected background and last frame of 2nd packet

Figure 7. Temporary background and previous updated background

Figure 8. Updated background for packet 3

Figure 9. Sample frame of packet 3 and detected motion using simple subtraction method

Figure 10. Sample frame of packet 3 and detected motion using our proposed method

The experimental data through Fig. 3 to Fig. 10 describes for the indoor small object background updating and motion detection results. Fig. 3 shows the initial 40 frames and an object is entered on frame 30. From these frames an initial background is detected which is shown on Fig. 4. Now the next 40 frame is considered and then the temporary background is defined. Also then the last frame is considered for comparison with the temporary background and previous updated background to update the present background. From Fig. 5 to Fig. 8 the present background is obtained. Now this updated background is applied for motion detection. In general subtraction method the motion is detected for frame 117 is erroneous. Here the temporary background object is also detected as a moving object though that object was not present on the frame 117. But when we used our proposed method then it detects accurately the moving object on the frame 117. So our proposed method outperforms than the general background subtraction method.

2. *Indoor large object:*

Figure 11. 1st packet of frames for indoor large object (frame1-40)

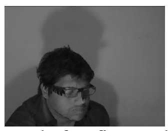

Figure 12. Background after first packet of Frames

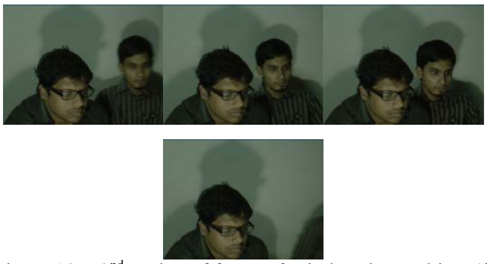

Figure 13. 2nd packet of frames for indoor large object (frame41-80)

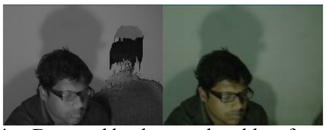

Figure 14. Detected background and last frame of 2nd packet

Figure 15. Temporary background and previous updated background

Figure 16. Updated background for packet 3

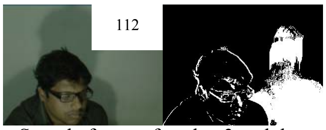

Figure 17. Sample frame of packet 3 and detected motion using simple subtraction method

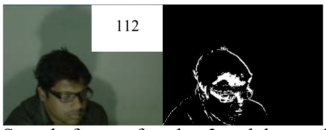

Figure 18. Sample frame of packet 3 and detected motion using our proposed method

Fig. 11 to Fig. 18 describes for the indoor large object background updating and motion detection results. Here in the similar way the background is updated and then Fig. 17 and Fig. 18 shows the motion detection performance of general background subtraction method and our proposed method. In this case frame 112 is used for detection of motion if there any. Our proposed method outperforms than the general method in case of indoor large object also.

3. *Outdoor very small object:*

Figure 19. 1st packet of frames for outdoor very small object (frame1-40)

Figure 20. Background after first packet of Frames

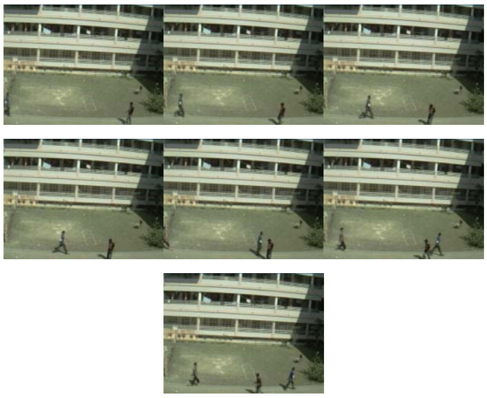

Figure 21. 2nd packet of frames for outdoor very small object (frame41-80)

Figure 22. Detected background and last frame of 2nd packet

Figure 23. Temporary background and previous updated background

Figure 24. Updated background for packet 3

Figure 25. Sample frame of packet 3 and detected motion using simple subtraction method

Figure 26. Sample frame of packet 3 and detected motion using our proposed method

Fig. 19 to Fig. 26 describes for the indoor large object background updating and motion detection results. Here in the similar manner the background is updated and then Fig. 25 and

Fig. 26 show the motion detection performance of general background subtraction method and our proposed method. It is very interesting that for this small object motion the general background subtraction method detect a false object for frame 116. In frame 116 there only two moving objects were present but general method presents three moving objects. But our proposed method detects the moving object accurately because of accurately updating the background. So all the cases our proposed method outperforms than the general background subtraction method.

V. CONCLUSION AND FUTURE WORK

In our proposed method we described a new approach for updating the background. If the background is updated properly then it becomes very easy to detect the motion of an object. Our proposed method does not compare directly with previous frames to update background. It first creates a temporary background with the maximum common pixel values among the frames then the last frame is compared with this temporary background and with the previous permanent frames if any to update the present background. But in some conventional background method only the difference of frames is considered to update the background. Our method also removes the noise which is present in the conventional method. Also the background updating process of this method compared with the general subtraction process results with high accuracy. In general process there remains errors on the background but our proposed method is capable to avoid that errors. So for motion detection of an object this almost error free background is used and thus motion can be detected perfectly. It is also notable that our experimental results show better performance in noisy and open air environment.

We are interested to detect the gesture from human body motion, object identification and abnormality detection from motion as our future work.

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