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A Real Time Object Tracking System for Visual Surveillance

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ABSTRACT: Recent investigations have shown the advantages of keeping multiple hypotheses during visual tracking. In this paper we explore an alternative method, which presents the concepts of histogram matching technique and absolute frame subtraction to implement a robust automated object tracking system. The object is later tracked using discrete kalman filter technique. Such a tracking system reduces the computation time by a factor of 10 w.r.t. using other methods of segmentation.

Keywords - Object tracking, absolute frame subtraction, and histogram matching, discrete kalman filter.

I. INTRODUCTION

The complexity of physical protection systems has increased to address modern threats to national security and emerging commercial technologies. A key element of modern physical protection systems is the data presented to the human operator used for rapid determination of the cause of an alarm, whether false or real. Alarm assessment primarily relies on imaging technologies and video systems.

Thus visual surveillance in dynamic scenes, especially for humans and vehicles, is currently one of the most active research topics in computer vision. It has a wide spectrum of promising applications, including access control in special areas, human identification at a distance, crowd flux statistics and congestion analysis, detection of anomalous behaviors, and interactive surveillance using multiple cameras, etc. The word “surveillance” is the French word for "watching over". Visual surveillance in dynamic scenes attempts to detect, recognize and track certain objects from image sequences, understands and describes object behaviors. The goal is to accomplish the entire surveillance task as automatically as possible.

The cost effectiveness of behavior detection systems to transit agencies depends on independent verification. Surveillance cameras can be a far more useful tool if instead of passively recording footage, they can be used to detect events requiring attention as they happen, and take action in real time. Several authors in the past tried to develop a robust real time tracking system [1-3], Most of them worked on the principle of combining foreground image [4], N-cut technique [5], Background Subtraction Method [6] followed by tracking. Video Surveillance is described as the task of analyzing videos to detect certain unusual activities. There are two categories of video surveillance: semi-autonomous [7] and fully-autonomous [8].

Classical image segmentation used Magic Wand, or edge information, like Intelligent Scissors which were user-interactive [9-11]. But the drawback of such techniques is that these are user driven and also very slow. To overcome these two problems background subtraction method (BSM) was been considered widely [12]. It made the processing fast as well as automated. But in this also there was addition of excessive noise due to either change in the position of objects in the reference frame, or sudden change in the luminosity of the light. This problem was solved by applying a certain threshold which removed smaller particles of noise and certain morphological operations like erosion which reduced the non connected parts smaller in size. But as noise was removed there is a loss of essential information i.e. certain part of the object gets eroded while applying erosion.

Hence here a method is proposed to detect an object (when appeared in the frame) by absolute Histogram subtraction of frames and track using discrete kalman filter technique respectively. The outline of the paper is as follows:

Section II & III describes the algorithmic approach to extract the object once it appears in the frame. Section IV describes the tracking of the object using Kalman Filter followed by result and conclusion in section V & VI respectively. The framework of the proposed approach is shown in Fig. 3.

II. OBJECT DETECTION

A Histogram function is defined which gives the frequency of the pixels within a range of 20 or more. Like for eg. as shown in the Table 1. Then absolute subtraction of the histograms of consecutive frames is taken to analyze the appearance of the object.

Add the absolute difference in the frequency of the pixels. If the obtained value is greater than threshold value (that should be obtained after testing), it indicates that the object has appeared in the frame. This threshold helps in overcoming the problem of change in light intensity and any small insignificant changes in the background. This technique is used to save time and memory by avoiding the excessive processing in those frames that restrain a significant object.

Table 1. Range of colors and its pixels

Color range	Number of Pixels
0- 20	300
20-40	400
40-60	0
60-80	10
80-100…	25

IV.OBJECT EXTRACTION

As soon as the object is detected, then go for further processing i.e. extraction as shown in figure 2 and figure 3 which the processing framework. For extraction here the absolute difference of the current image from the ref. image is taken. This can give a better output than regular background subtraction method. The resultant image is then converted into a binary image using global image threshold [13]. This threshold image is used to convert gray level image to a binary image. The normalized intensity value should lie in the range [0, 1]. The threshold is chosen such as to minimize the intra class variance of the black and white pixels.

Then smoothening is done to connect the small non connected parts. This effectively removes the small particles by connecting them into one and also helps in connecting the disconnected components of the objects. The connectivity can be done in two ways:

a) 4-connectivity
b) 8- connectivity

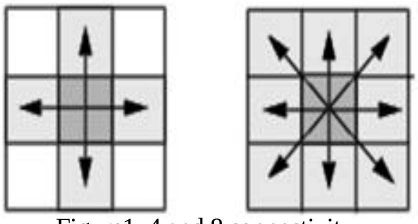

Figure1. 4 and 8 connectivity

Thus after connectivity the pixels labeled 0 can be treated as the background image. The pixels labeled 1 make up one component. The pixels labeled 2 make up a second component, and so on. The components with max label assigned have max area which corresponds to the object. This component having max area has some id or label assigned to it. Through that label, extraction of the pixels of the object can be done very easily and thus can calculate the centroid of the extracted object. If two objects are very close to each other they are treated as one and tracked together. The centroid calculated is used in tracking to calculate the further states by using Discrete Kalman Filter.

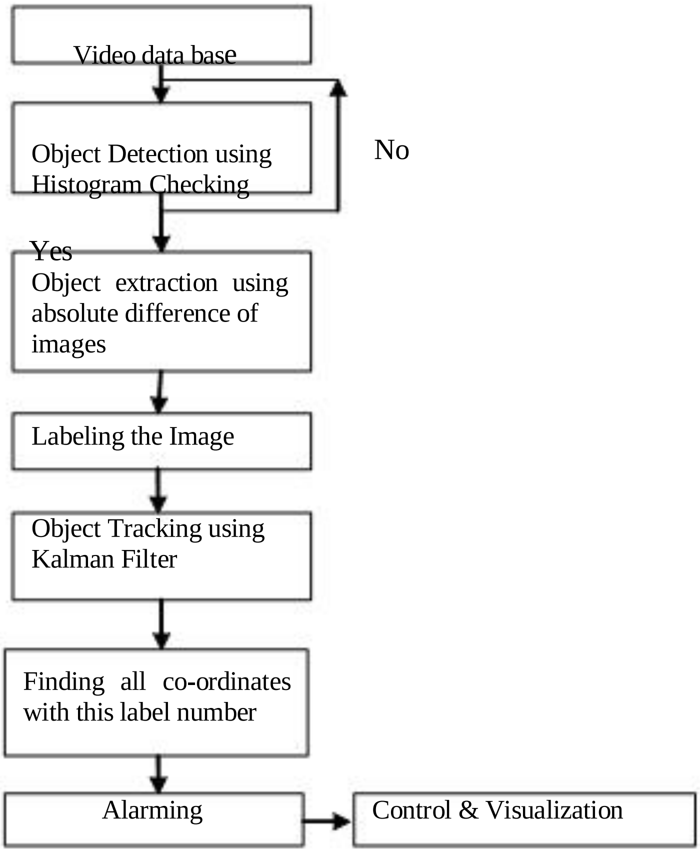

Figure 2. Block diagram of the proposed work.

IV. OBJECT TRACKING

Discrete Kalman filter technique is to be used to track the detected object [14]. It is a recursive method to predict the object using present and past state. Kalman filter is a set of two mathematical equations which first predict the state of object before the object makes its next move and then corrects this prediction using Kalman gain.

Prediction equation or time update equations are used to predict the object on the basis of past state.

Correction equations or measurement update equations are used to correct the prediction. This will give the previous set of equations and give a better estimate to track the object. In Discrete Kalman filter first the process function is defined and then the measurements function.

The process function can be defined as follows:

= A + B +

Where A (nxn) is a state transition matrix, B (nxl) is a matrix used to relate the control input to the current state, where (u_{k-1}) is a control input.

The measurement function is defined as follows:

= H +

Where is our actual measurement, H (mxn) is a matrix which relates the state x at time step k to the measurement function.

In the above equations, w and v are the process and measurement white noises respectively. They are independent of each other with normal probability distribution as follows:

p(w)~N(0,Q) and p(v)~N(0,R) ,

Q is called the process noise covariance while R is called the measurement noise covariance. As it is quite difficult to measure the values of process noise w and measurement noise v at each time step, first estimate the state function and measurement function without them as:

= A + B

= H

Where is a priory state estimate at step k which gives us the knowledge of the process prior to step k and is a posteriori state estimate at step k which gives the knowledge of the process given measurement is the predicted measurement. First calculate the prediction for the moving object using Discrete Kalman filter prediction equations.

From above equations it's clear that to calculate a priory estimates for state k the $(k-1)^{th}$ stage must be known. The Discrete Kalman filter measurement equations are used to calculate and incorporate a new measurement in previously obtained a priory estimate to obtain an improved a posteriori estimate. Here the values of centroid location are used which should be calculated in the first part of algorithm as actual measurement. After a gap of 10-15 frames a new value of centroid location can be achieved. Then calculate a new prediction using above equations.

The Kalman gain gives less weightage to the actual measurement and more to the predicted measurement. It can also be seen that as the number of times the steps increases, in other words as the object moves more distance without deviating from its path a better prediction can be done which continuously increases. This is because of calculation of a priori state estimate in which the residual of previous time step to get a better a posteriori state estimate is incorporated.

In the whole process use of different matrices is done which change at each time step but for user convenience it is assumed that each matrix is constant during the whole tracking process. After using the Kalman filter the object should be successfully tracked.

V. RESULTS

Fig. 4(a) - 4(d) shows 4 selected frames from a real time video. It shows the outputs when we use the Absolute Background Subtraction method followed by Kalman tracking respectively. It's clearly visible from the figures that the moving object is clearly distinguishable from the background when we apply absolute background subtraction method to our tracking algorithm. It gives us an accurate extraction which can be seen in Fig. 4(c) & 4(d). The red rectangle is the estimated position of the object obtained using Kalman Filter.

VI. CONCLUSION

It is seen that this method save computational time and processing steps, as we try to implement the absolute frame subtraction instead of normal frame subtraction and histogram matching technique. Also the processing time is saved since the algorithm starts working only when the object is detected and comes in the vicinity of the camera.

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Fig.4(a)Input image

Fig.4(b)Background image

Fig.4(c)Tracked image

Fig.4(d)Detected image

REFERENCES

[1]TP Chen and Haussecker et al., "Computer vision workload analysis: case study of video surveillance systems," Intel Technology Journal, vol. 9, no. 02, 2005.

[2]F Porikli and O Tuzel, "Human body tracking by adaptive background models and mean-shift analysis," IEEE Int. W. on Performance Evaluation of Tracking and Surveillance, 2003

[3]P.F Gabriel, J.G Verly, J.H Piater, and A Genon, "The state of the art in multiple object tracking under occlusion in video sequences," Advanced Concepts for Intelligent Vision Systems,pp. 166-173, 2003.

[4]Jaime Gallego, Montse Pardas, Jose-Luis Landabaso, "Segmentation and tracking of static and moving objects in video surveillance scenarios," In Proc. IEEE International Conference on Image Processing (ICIP), San Diego (California, USA), October 2008.

[5]Jianbo Shi and Jitendra Malik, "Normalized Cuts and Image Segmentation," IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 2000

[6]A. Elgammal, D. Harwood, and L. Davis. Non-parametric model for background subtraction. In ECCV, pages 751-757, 2000

[7]Carsten Rother, Vladimir Kolmogorov, Andrew Blake. "GrabCut" -Interactive Foreground Extraction using Iterated Graph Cuts, In proceedings SIGGRAPH 2004

[8]Kar-Han Tan, Narendra Ahuja, "Selecting Objects With Freehand Sketches," In Proceedings IEEE Computer Society Conference on Computer Vision and Pattern Recognition. 2001.

[9] Eric N. Mortensen1, William A. Barrett2, "Intelligent Scissors for Image Composition." Proceedings of the 22nd annual conference on Computer graphics and interactive techniques, pages: 191 - 198,

[10]E. N. Mortensen and W. A. Barrett, "Interactive Segmentation with Intelligent Scissors," Graphical Models and Image Processing, Vol. 60, No. 5, pp. 349-384, Sept. 1998.

[11]E. N. Mortensen and W. A. Barrett, "Toboggan-Based Intelligent Scissors with a Four Parameter Edge Model," in Proc. IEEE: Computer Vision and Pattern Recognition (CVPR'99), Vol. II, pp. 452-458, 1999.

[12]A. Monnet, A. Mittal, N. Paragios, and V. Ramesh, "Background modeling and subtraction of dynamic scenes". In CVPR, 2003.

[13]Otsu, N., "A Threshold Selection Method from Gray-Level Histograms," IEEE Transactions on Systems, Man, and Cybernetics, Vol. 9, No. 1, 1979, pp. 62-66.

[14]Greg Welch and Gary Bishop, "An Introduction to the Kalman Filter" presented at ACM SIGGRAPH 2001.