Optimization Of Frame Rate In Real Time Object Detection And Tracking

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Abstract: The paper focuses on the development of the optimization of real time object system which uses a static camera to capture the video frames and track an object. The work proceeds as: Matching of the histograms created for the frame, Absolute frame subtraction to build an optimized automated object tracking system. As the location of the object is detected, it is tracked by using discrete Kalman Filter Technique. Identifying the object entering the viewing range of the camera, this is done by histogram matching algorithm. To recognize the object OTSU segmentation is used. Since the frame occurrence rate is increased it can be used in automatic licensed number plate system recognition.

Index terms: Absolute Frame Subtraction, Automatic Licensed Number Plate, Histogram matching, Kalman Filter, OTSU, Object Detection, Object Tracking.

1. INTRODUCTION

Security is one of the major issues which are to be better day by day. Many authors have worked on Real Time Tracking System. A large numbers of algorithms have been proposed in the field of image segmentation which is important part of Image Detection. To detect unusual activities Video Surveillance System is built, so the Video Surveillance System can be categorized into two:-

1. **SEMI AUTONOMOUS:**
   It involves human involvement along with the video processing.

2. **FULLY AUTONOMOUS:**
   In this, the only input is video processing without human involvement.

Image segmentation is a fundamental part of object detection. Image segmentation is done on different parameters such as Edge (contrast) Information or Texture (color) Information. For ex: the user or the operator marks the specific area in order to detect/track the object. The disadvantage of this type is it is operator driver and the processing time is very slow in this fast moving world. To overcome the above mentioned problem the Background Subtraction Method is taken into account. It is automated as well as fast in processing but nothing comes free of disadvantages i.e. excessive noise due to the change in the position of the object in the referenced frame.[8] For ex: change in the intensity of light and the above. This problem is solved by applying correct threshold which removes small particles and morphological operations like remove to reduce the noise. Thus, here we present our approach to optimize the frame rate occurrence to detect the object in the frame. If the object is seen, we used Absolute Image Subtraction to extract the object by Kalman Tracking of the object.

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2. HISTOGRAM MATCHING TECHNIQUES FOR OBJECT DETECTION

The algorithm deals with the color adjustment of two images in the Image Histogram Acquisition of images at the same location, illumination at the same atmospheric condition can be normalized by Relative Calibration Technique. The results are used by histogram used to analyze the appearance of the object by the absolute subtraction of two frames. If the 'hist' value is greater than the certain threshold, then it indicates that the object has appeared in the frame. Threshold helps to save the time memory by avoiding too much processing in those frames.

3. OTSU ALGORITHM FOR OBJECT DETECTION

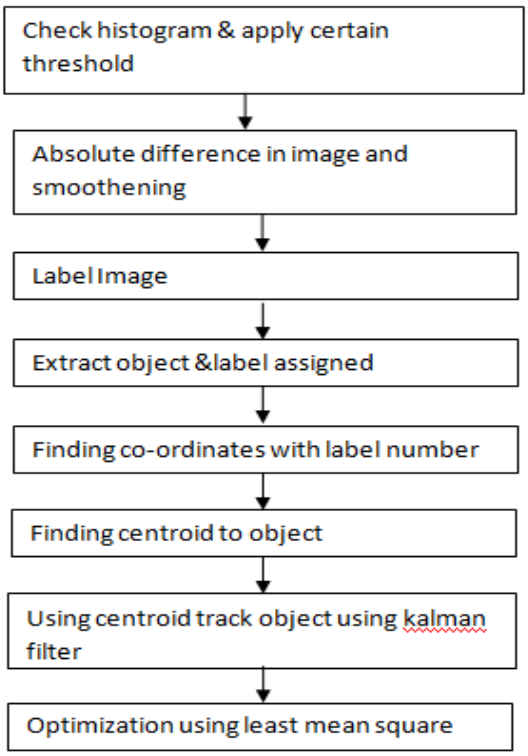
After object detection is done comes object tracking which is done by OTSU algorithm. For the extraction of the object we require absolute difference in the successive frames. The resulted image is now converted into a binary image using OTSU's algorithm. OTSU algorithm is a very simple idea. It searches the threshold that the weighted within class variance. It minimizes the intra-class variance and maximizes the inter-variance for black and white pixels 0/1. Smoothening is done in order to remove the noises and to prepare the histograms for further processing. Smoothening is helpful in connectivity. The connectivity of the pixels can be done into 4-way connectivity and 8-way connectivity. Connectivity with 0 is the background and with the 1 is the component. Label the component which has maximum area with some id. We can extract the co-ordinates of the object from labeled area. Now find the centroid of the object. Using this centroid track the object with the help of Kalman Filter.

4. OBJECT TRACKING USING KALMAN FILTERING

This filter has lot of application. Some of common applications of Kalman filter are for navigation and control of vehicle, aircraft, spacecraft, and guidance. It uses sequence of measurements observed; time filled with noise and other inaccuracies. [8]It has set of mathematical equations such as PREDICTION EQUATION which predicts the object based on past state and TIME UPDATE EQUATION which updates the time when the object displaces its position. Since the object to be tracked is in real time so the position of the object is changing with respect to time. The velocity of the object also changes with respect to time.

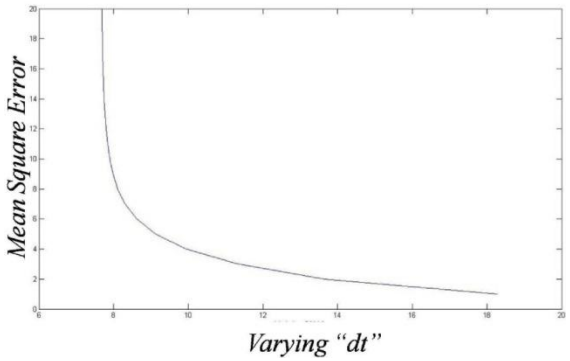
5. Optimization Of Frame Occurrence Rate

To make tracking perfect we optimize the frame occurrence rate using Least Mean Square Algorithm. There are sets of equations out of which most of the equations are unknown."Least Square" means it minimizes the sum of squares of errors in each equations result. When the frame rate is increased from 1-100, the tracking of object becomes better and better. Figure 5.1 defined below:



6. Result Analysis

It seen that higher the frame occurrence rate better is tracking. Figure (6.1): Mean square error representation as a function of varying frame rate (dt)

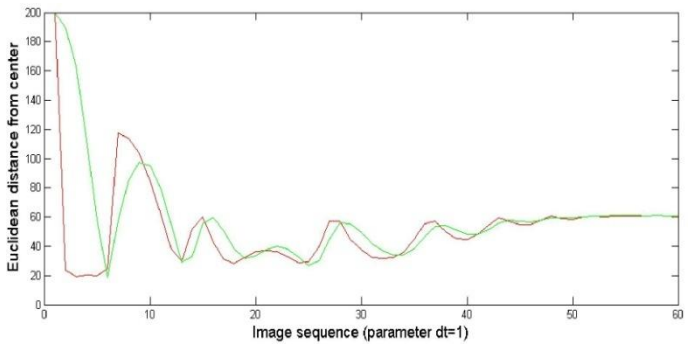


The sequence of images taken by static camera when passed through Kalman Filtering structure as in Fig (6.2) gives out following sequences of images. Figure (6.2): Kalman Filtered image sequences for different values of frame occurrence rate dt, the object motion is tracked by green square.

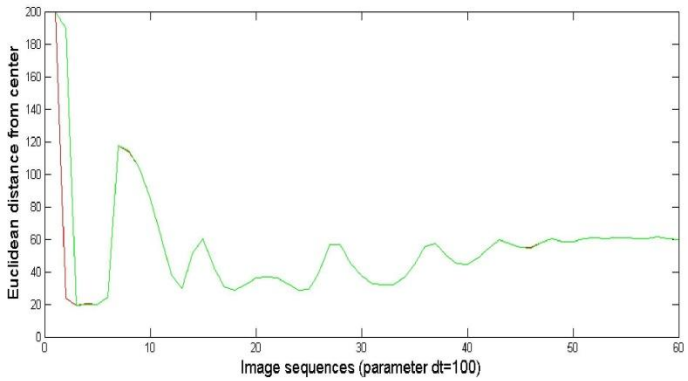
Image Sequence	Frame Occurrence Rate (dt = 1)	Frame Occurrence Rate (dt = 100)
1.		
2.		
3.		
4.		

Where , "red" cross represents the object coordinates and "green square" represents the structure developed around Kalman filter resulted object centroid, this green square is centered of Kalman measurement showing estimated centre of moving object done by proposed technique. The Euclidean distance method represents a distance measuring technique in any coordinate system. For any two arbitrary points, it is simply the root summation square of the margin between the pair of coordinates [8]. To retrieve the response of proposed method, one reference point is taken at the centre of given image and other point is represented by central coordinates of the moving object. The representation of Kalman estimated and observed value of object movement is figured as below:

Figure (6.3): Response of proposed algorithm with shift of object coordinates (dt $\equiv$1).



Same as previous representation, the red line represents the extracted object centre, while green line represents the Kalman Filter estimated object centre. Figure (6.4): Response of algorithm with shift of object coordinates (dt =100)



7. CONCLUSION

It can be concluded that to save computational time and the processing step we use absolute background subtraction instead of background subtraction. The processing step is reduced because of threshold function used for the separation of foreground objects and background pixels. The black pixel (0) represents background and the white pixel (1) represents objects. When the frame rate i.e. dt =100 the tracking becomes better. It start tracking object at the early stage in the case of when the dt (frame rate) = 100 and when the frame rate (dt) =1 it starts tracking after 50 frames has already passed.

8. FUTURE WORK

We can use genetic algorithm for the optimization of the frame occurrence rate. It uses probabilistic approach not deterministic. The time duration taken by it is less than the other algorithm.

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