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An Improved Approach for Video Surveillance Using Kalman Filtering and Frame Rate Optimization

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***Abstract*— Object detection and tracking are essential and challenging obligations in plenty of device vision packages equal to surveillance, car navigation, and self-maintaining robot navigation. Video surveillance in dynamic surroundings, mostly for humans and cars, is, genuinely, one of the important, rigorous topics in computer vision. It's a key technology to combat in competition to terrorism, crime, public protect and for green control of visitors. The model entails designing of the capable video surveillance machine in complex environments. In video surveillance, detection of transferring items from a video is necessary for object detection, target tracking, and conduct. The proposed model deploys a Kalman Filtering approach for object tracking and frame rate optimization to improve the quality of performance.**

***Keywords*—** video surveillance, object tracking, mean square error

I. INTRODUCTION

Detecting and tracking of human body parts is the main in understanding human movements. Sensible and automated protection surveillance techniques have grown to be an active study area in up to date time because of a growing demand for such programs in public places similar to airports, underground stations, and mass routine.

After learning the literature, it is observed that detecting the things from the video sequence and likewise monitoring in various articles that, it is a relatively complicated as an undertaking. Object tracking is usually a time drinking procedure due to quantity of knowledge that is contained in the video. From the literature survey it's determined that there are many background subtraction algorithm exist which work efficiently in each indoor and outdoor surveillance system. In [1] has proposed a background modeling process and used another algorithm to notice shadowed vicinity.

But the shadow removing system is an overhead for object tracking algorithm. It will be better if the shadow will also be removed at the time of the foreground object detection algorithm via designing an efficient algorithm, which is able to classify adequately the foreground object and background taking away false foreground pixel from detection. Then there will no extra computation wanted for shadow detection and removal.

Video surveillance is essentially the most energetic study matter in machine vision for people and vehicles. Right here the intention is to enhance an intelligent visual surveillance method through re-inserting the age ancient classical method of monitoring via human operators. The inducement in doing is to design a video surveillance approach for movement detection and object monitoring.

Segmentation algorithms generally involves satisfying some homogeneity property in some image features over a large region or detecting abrupt changes in image features within a small neighborhood [2]. Threshold selection is the major step in the segmentation algorithms. Various threshold selection techniques are well known in the literature, e.g., histogram method, busyness measure method and entropy measure based methods [3].

II. OBJECT DETECTION AND EXTRACTION

The histogram display of subsequent image sequences was subtracted consecutively and averaged out. The resultant peak at a certain region of gray level indicates that the new coming foreign object has gray scale in that particular range. The thresholded image either from RGB plane or single gray plane must first of all be converted into a binary image. Then morphological operations of image labeling [4] can be used to detect the number of objects in the image. Before this process, the extracted object image should be filtered with a low-pass filter [5] to eliminate up any noise in the image, as noise is a high-frequency component, low pass filtering will eradicate it, resulting a more elegant view of foreign objects. The labeling information of the number of objects can be used as the primary parameter to initiate Kalman filtering approach discussed later on. The detection of the foreign object in consecutive frames is shown in the figure below, where it can be seen that foreign object has a gray value of represented range. The gray values at which peak occurs gives a precise idea about the gray characteristic of the foreign object. After object detection, the system got automatically triggered on and preceded further to stages of object extraction and tracking.

A. *Image Thresholding*

Various well known threshold selection techniques mostly used are cluster based, histogram based and global threshold based algorithms[6].

B. Clustering Methods

This technique works on the statistical method of clustering the datasets. Initially, some clusters are assumed arbitrarily in function point area, and pixels of the frame are assigned to those clusters primarily based on distance dimension along with Euclidean or Mahalanobis calculation [2]. Then recompute new cluster center through averaging

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pixels at every cluster and constantly repeat it until a few smaller predefined parameter is reached.

C. Histogram-Based Method

The histogram is opportunity representation of various gray stages in a given aircraft of three-dimensional images. Thus thresholding has been a process of subdividing the complete photo into elements foreground item and history of the object[7].

Histogram plays an essential function in assessment of threshold fee. There needs to be straight forward valley inside the histogram to without problems calculate the brink value of gray level to subdivide our photographs. However, this can no longer be the case for always, as many instances, noise degrades the deep valley as shown in parent below. In this type of case, Otsu approach [2] may be used to extract object inside the photograph.

D. Information Theoretic Approach

In this subsection, we speak the distinct entropy measures [3], which may be used for comparative benefit information of in picture segmentation issues. The technique of image segmentation the use of the gray level co-prevalence matrix and Shannon entropy measure is discussed in [9]. Researchers make bigger this technique using the co-occurrence matrix with no- Shannon entropy measures (paying homage to Renyi, Havrda-Charvat, Kapur and Vajda entropy) on color photographs. The fundamental steps of the algorithm are reproduced properly here for the sake of comfort [15]:

i. First of all, the co-occurrence matrix C_{m_1,m_2} of the image to be segmented computed for each color channel.

ii. The probabilty distribution $p_{m_1,m_2} = C_{m_1,m_2} / MN$ is calculated from its co-occurrence matrix C_{m_1,m_2} .

iii. Entropy function for each entropy definitions, as defined below, are then calculated for each $t \in [0,1,2,....,L-2]$ for a given image to be segmented using the probabilty distribution p_{m_1,m_2} .

iv. The numbers of minima points are determined from the entropy function versus gray level (t) plot. The gray level corresponding to the smallest minima may be taken as a threshold.

E. Histogram thresholding technique.

In this technique, the method observed in the sort of manner that, for every viable price of the threshold, the histogram get subdivided into classes. Then total picture variance, within the elegance variance and among the class variance turned into used to evaluate the maximum exact value of the threshold[4].

III. OBJECT TRACKING

In an order to track the moving objects, discrete version of Kalman filter was used. Kalman filter [3] is basically an estimator to perfectly follow system response irrespective of input or output and any other inherent system noises. The filter predicted the next movement of object depending upon parameters of previous and present state. Then it measures variation of the observed value from predicted one.

A.Understanding the Kalman filter

As this model is primarily targeting goal of movement evaluation. The idea of Kaman Filtering may be deployed here to estimate the kinematic parameters of object actions. The paintings should base totally on two styles of errors estimates, priory nation estimate, and posterior estimates. Priory estimate is the prediction of subsequent parameters, the use of the statistics of preceding behavior before the actual procedure is going to take place. Posterior estimate refers to nation estimation as soon as the real manner or measurement has were given finished.

Now transfer up to understanding the working of a Kalman Filter, for this first of all it have to skip via the derivation of a Kalman filter out, in which the input is a scalar quantity. Fig.1 depicts the structural block diagram of Kalman filter.

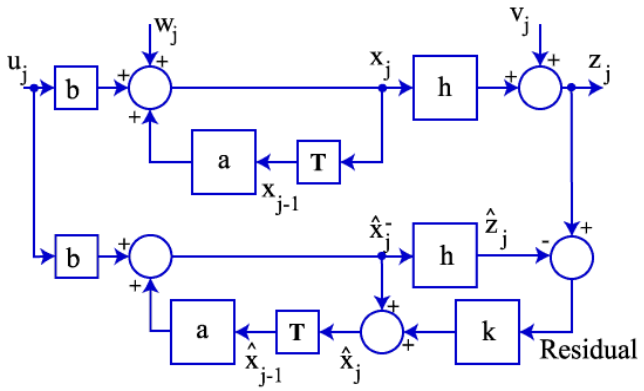


Figure (1): Kalman Filter Structure

IV. EXPERIMENTAL TOOL & RESULTS

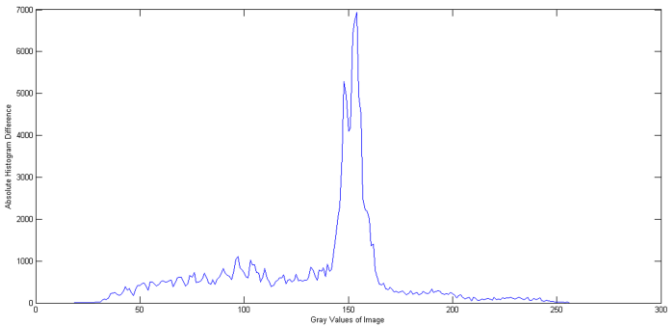
Matlab is a mathematical "Matrix Laboratory" package deal which operates as an interactive programming surroundings. It is a mainstay of the Mathematics Department software lineup and is also to be had for PC's and Macintoshes and can be discovered on the CIRCA VAXes. Matlab is nicely tailored to numerical experiments because the underlying algorithms for Matlab's built-in functions and furnished m-documents are primarily based on the usual libraries LINPACK and EISPACK. Matlab program and script files usually have filenames finishing with ".M"; the programming language is particularly sincere on account that nearly every data object is believed to be an array. Graphical output is to be had to complement numerical outcomes. Below is listed some prominent features of this tool.

ops	Operators and special characters.
Lang	Programming language constructs.
Strfun	Character strings.
Iofun	File input/output.
Timefun	Time and dates.
Datatypes	Data types and structures.

The MATLAB operating surroundings presents us the set of equipment and centers to paintings because of the MATLAB user or programmer. It consists of facilities for coping with the variables in the workspace and importing and exporting statistics. It also includes gear for developing, managing, debugging, and profiling M-documents, MATLAB's programs. The operating surroundings features are placed in a single listing.

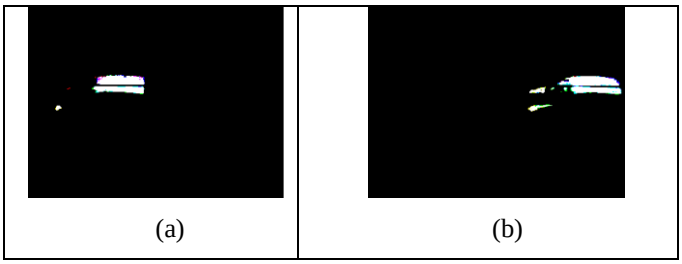
A. *Simulation Results:-*

The object detection result taken for the video file "video_frames.mp4" from VISOR database, represented in Fig(2) , here the peak constitutes the detection of foreign body and the gray cost at which this height takes place gave an inference of gray regions of foreign item.



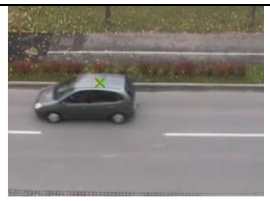
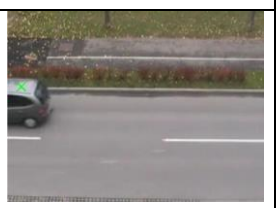
Figure(2):Gray level versus absolute histogram difference for object detection.

Subtract consecutive frames and extract the outside item using Otsu's thresholding approach as shown in Fig (3):-



Figure(3): Segmentation result for object extractions at two frame sequences.

The sequence of images taken by static camera when passed through Kalman Filtering structure as in Fig(1) gave out following sequences of images. Here the kinematic parameters of obkect locations and velocity are estimated for the continuous flow of frames and it estimate the forthcoming parameters by tuning its Kalman Gain parameter as shown in Fig. (4).

Frame Instances	Investigated frame flow rate $dt = 1$	Investigated frame flow rate $dt = 100$
1.		
2.		
3.		
4.		

Figure(4):The motion tracked frame sequence for two distinct frame rates, lower (left) and higher (right).

V. CONCLUSION

In this thesis, we modeled the Kalman Filtering based technique for Real-Time Object Detection, and Tracking. The system version became evolved making the usage of the kinematics equations associated with pace and accelerations. It became shown that appropriate strategies for object detection have been successive histogram subtraction, for object extraction carried out by means of Otsu's method of photo thresholding and for item tracking Kalman proves to be milestone realization. This article provides a giant outline for any further learning in this zone.

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