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Idle Object Detection in Video for Banking ATM Applications

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Abstract: This study proposes a method to detect idle object and applies it for analysis of suspicious events. Partitioning and Normalized Cross Correlation (PNCC) based algorithm is proposed for the detection of moving object. This algorithm takes less processing time, which increases the speed and also the detection rate. In this an approach is proposed for the detection and tracking of moving object in an image sequence. Two consecutive frames from image sequence are partitioned into four quadrants and then the Normalized Cross Correlation (NCC) is applied to each sub frame. The sub frame which has minimum value of NCC, indicates the presence of moving object. The proposed system is going to use the suspicious tracking of human behaviour in video surveillance and it is mainly used for security purpose in ATM application. The suspicious object's visual properties so that it can be accurately segmented from videos. After analyzing its subsequent motion features, different abnormal events like robbery can be effectively detected from videos. The suspicious action in ATM are many, such as using mobile phones, multiple persons trying to access the ATM machine in same time, kicking of each other, idle object and it shows event corresponding to Vandalism and robbery. In proposed system, idle object detection is used to identify by using PNCC algorithm with P-filter (Particle) and by extracting the features of the object in an enhanced way by using the curvelet based transformation.

Keywords: Cross correlation, detection, motion tracking, moving object, normalized, suspicious action

INTRODUCTION

Object detection and tracking has wide applications such as People tracking, Safety monitoring, Security and Biometrics, Traffic and road management, Web applications, Object recognition for Mobile Devices, Medical and biomedical, Sports analysis and others. Normalized Cross Correlation (NCC) algorithm is used to finding the cross correlation between two consecutive frames in an image sequence. Correlation is used basically to find the similarity between two frames. If the two consecutive frames are same, then the value of Normalized cross correlation is maximum. In that case, there is no moving object is detected. suppose if there is a moving object in the image sequence, then it means the two consecutive frames are not exactly same, with respect to the pixel positions and values. In that case the value of Normalized cross correlation is less than maximum value obtained. This concept of Normalized cross correlation is used to detect the moving object in an image sequence.

In the proposed approach, the input video streams are segmented into frames and background motion is subtracted, binary images are constructed by finding the difference image, which is obtained by calculating the intensity change in each pixel across the frames between image frame (k) and image frame ($k + 1$). Partitioning and Normalized Cross Correlation (PNCC) based algorithm is proposed for the detection of moving object. This algorithm takes less processing time, which increases the speed and also the detection rate. In proposed system, PNCC algorithm is used for moving object detection and tracking of idle object identification.

LITERATURE REVIEW

Moving object detection in a video is the process of identifying different object regions which are moving with respect to the background and in motion tracking method the movements of objects are constrained by environments. Daviest (1998) addressed the problem of detection and tracking of small, low contrast objects by using wavelet as well as Kalman filter, but it increases the processing time, as both wavelet decomposition and Kalman filtering is used for the detection and tracking of moving object. The main drawback of this method is that for longer wavelet filters the target becomes smeared over a larger region of the images and so locality of the target is lost. Elgamal *et al*. (2002), the kernel density function was used to model the color distribution of an object to help detect and track individual persons who start to form a group and occlude each other; Elena *et al*. (2000) suggests a video-based surveillance system for the automatic detection of abandoned objects in indoor environments. This surveillance system integrates an advanced real time detection method with video indexing capabilities in order to establish a logical correlation

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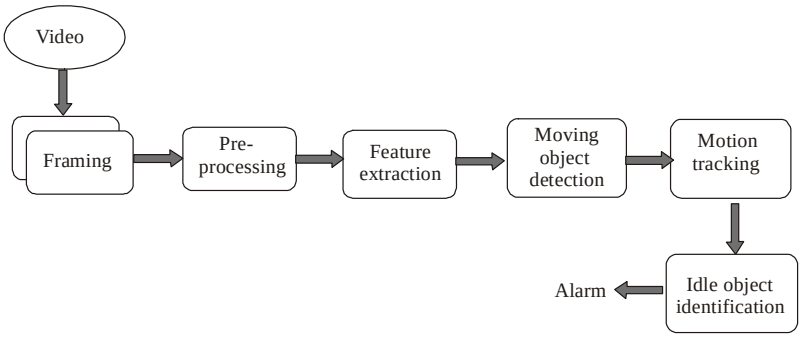


Fig. 1: Functional architecture for proposed system

between a suspicious object and the person who left it in a given environment by allowing the human operator to easily retrieve the image or the clip of interest while scanning a large video library.

Cucchiara *et al*. (2000) describes an approach for Moving Visual Objects segmentation in an unstructured traffic environment. It considers a complex situation with moving people, vehicles, infrastructures that have different aspect model and motion model. In this, a specific approach based on background subtraction with a statistic and knowledge-based background update is given. This approach allows a limited number of frames for the background update suitable for real time computation. Heisele *et al*. (1997) presents an algorithm for tracking moving objects in a sequence of colored images. In this object parts are determined by a divisive clustering algorithm, which is applied to all pixels in the first image of the sequence. For each new image the clusters of the previous frame are adapted iteratively by a parallel k-means clustering algorithm. This algorithm being complex requires more computational time. So there is a requirement to increase the speed.

METHODOLOGY

System architecture: A Partitioned and Normalized Cross Correlation algorithm is proposed to track the moving object and idle object detection for video surveillance of security purpose in ATM application.

The functional architecture for proposed system is given in Fig. 1 and has show the following modules:

- Moving Object Detection
- Motion Tracking
- Idle object identification

Video is taken as an input, video is converted into frames and the frames are consider as the image sequences. The image sequences are stored the extension of JPEG. The frames are undergone with pre-processing technique. Noise from the video is to be removed, done only by means of filtration. Isolated points and little blobs that remain after threshold filtration and it are removed by using particle filters. Random noises are removed by using median and Gaussian filtering. Feature extraction extracts the features such as color, shape-edges, optical flow and texture-curvelet. Based on the features extracted, the moving object is detected. The motion of the human is idle for some constant period of time, then it is said to be suspicious detection. The alarm is indicated for suspicious detection.

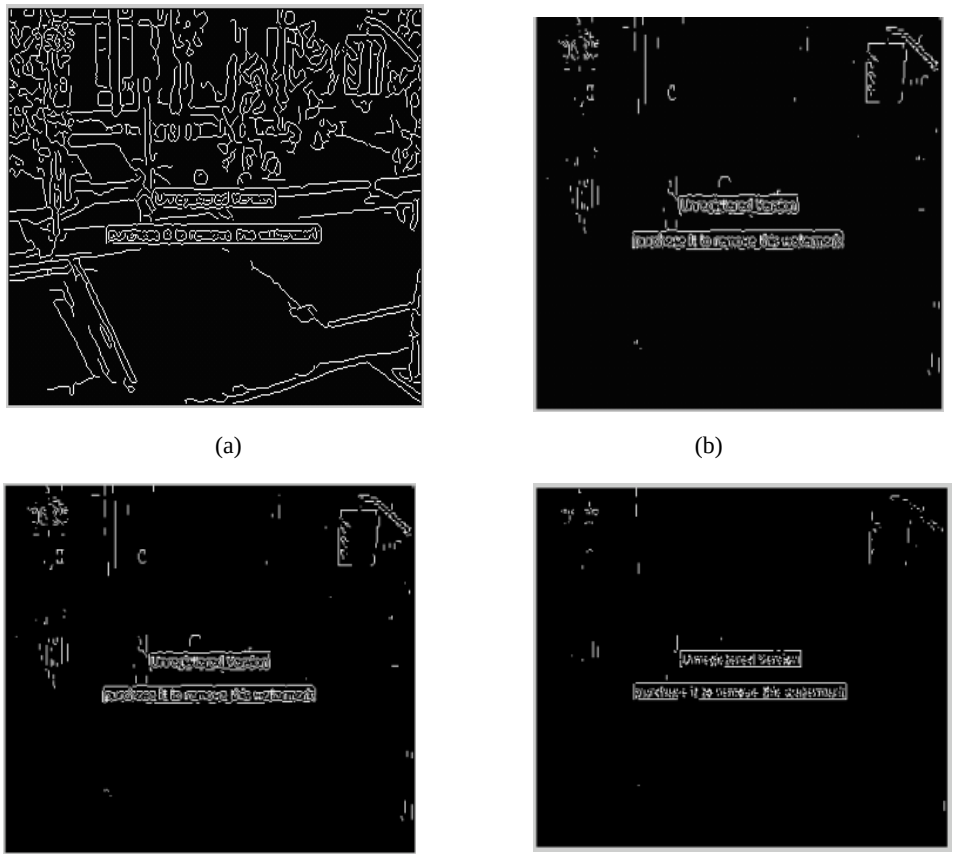
Pre-processing: The videos are converted into sequence of images. The images are stored in JPEG format. The image sequences are undergone with pre-processing techniques. P-Filter (Particle) is used to remove the blobs and to support the P-filter Kalman filter is used to for object tracking. The Kalman filter is a method of combining noisy (and possibly missing) measurements and predictions of the state of an object to achieve an estimate of its true current state based on position, velocity and size. Different types of filter techniques are applied and as show in Fig. 2.

Particle filters are sequential Monte Carlo methods that are used in several problems where time-varying signals must be presented in real time and where the objective is to estimate various unknowns of the signal and detect events described by the signals. Particle filter are used for denoising and for tracking the moving object. Particle filter provide the standard solutions for problems based on kalman filter or extended kalman filter. Kalman filter is used when the movement is linear and to overcome this problem particle filter focuses on both non-linear and non Gaussian signals. Particle filters are an alternative to the Kalman filters due to their excellent performance in very difficult problems including communications, signal processing, navigation, and computer vision. Particle filter is used to eliminate the noises in videos as shown in Fig. 2d and give better results for motion tracking as shown in Fig. 7 and 8.

Feature extraction: Shape and texture are the features extracted in the proposed system for tracking the moving object. By using the dataset, different edge based

(a) (b) (c) (d)

Fig. 2: (a) Median, (b) Mean, (c) Gaussian, (d) Particle



(a) (b)

(c) (d)

Fig. 3: (a), Canny, (b) Sobel, (c) Prewitt, (d) Robert

approaches Canny, Sobel, Prewitt, Roberts are compared, and the results are shown in Fig. 3. For texture based transformation curvelet is used.

Curvelet mainly extract the features from images and use to compute the similarity values between images so that efficient geometric shape structure-based image retrieval is possible. The curvelet based edge detection for the input image is shown in Fig. 4 and 5 the edge map is used to detect the sudden changes occur in the input image. Edge detection map is used to detect the edge features.

Moving object detection: Correlation is mainly used for measuring similarity between two images. It is useful in

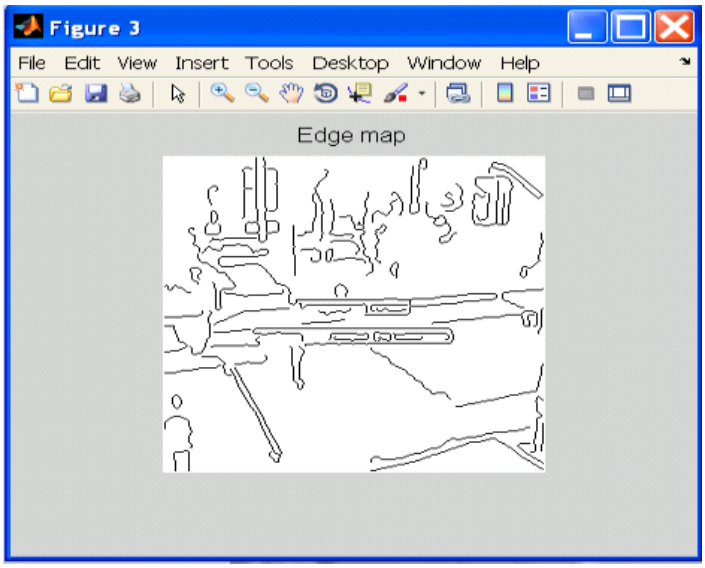


Fig. 4: Curvelet edge map

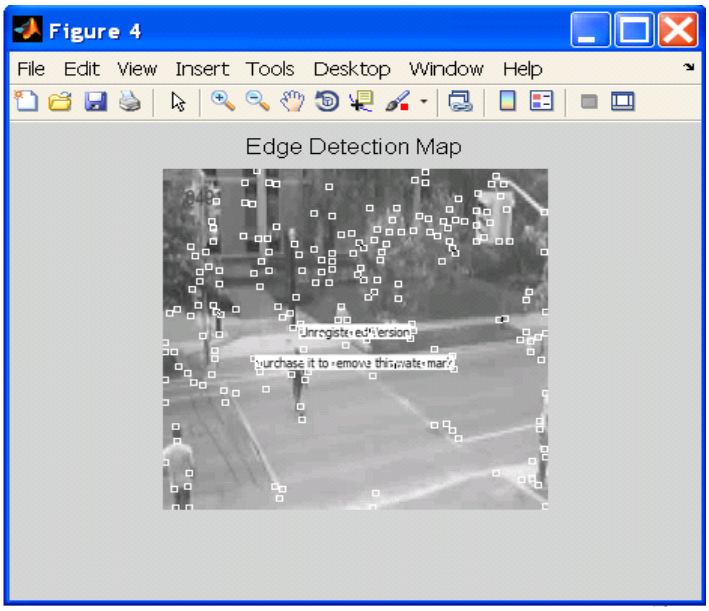


Fig. 5: Curvelet based feature detection

feature recognition and registration. Two consecutive frames from the image sequence are partitioned into four quadrants.

Then moving object detection takes place after finding Normalized Cross Correlation between two partitioned frames. Moving Object detection in video involves verifying the presence of an object in image sequence and possibly locating it precisely for recognition. After detecting the moving object, the location of the moving object is obtained by performing component connected analysis Based on the analysis of projection of 3D array the motion of objects, the information of motion field is exploited to make moving object detection more efficient. The discontinuities of motion vector field on the boundaries of moving objects enable us to detect the moving objects blocks in which the potential boundaries of the moving objects locate.

Motion tracking: In ATM application, the camera is fixed and that lighting does not change suddenly. Tracking of the detected moving object takes place by calculating the centroid of the detected moving object. Tracking means the detection of a target over time, thus establishing its trajectory. The aim of object tracking is to

(a)

(b)

Fig. 6: Sequence of motion tracking

establish a correspondence between objects or object parts in consecutive frames and to extract temporal information about objects such as trajectory, posture, speed and direction. The motion is tracked and it is shown in the sequence of frames in Fig. 6.

Theory of normalized cross correlation: The correlation between two images (cross correlation) is a standard approach to feature detection. It can be used as a measure for calculating the degree of similarity between two images. Normalized cross correlation is given by Eq. (1):

$$r = \frac{\sum_m \sum_n \left(A_{mn} - \overline{A}\right)\left(B_{mn} - \overline{B}\right)}{\sqrt{\left(\sum_m \sum_n \left(A_{mn} - \overline{A}\right)^2\right)\left(\sum_m \sum_n \left(B_{mn} - \overline{B}\right)^2\right)}} \quad (1)$$

PNCC algorithm for moving object detection and tracking: Partitioning and Normalized Cross Correlation (PNCC) based algorithm is proposed for the detection of moving object. In proposed system, PNCC algorithm is

Fig. 7: Input image

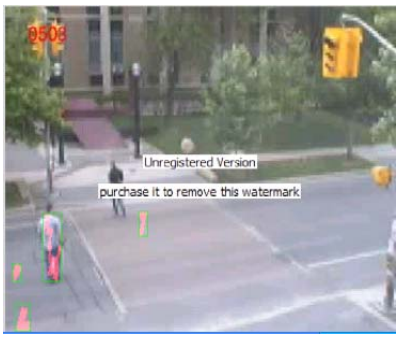


Fig. 8: Object detection

used for moving object detection and tracking of idle object identification and it is shown in Fig. 7 and 8.

Basic algorithm steps for the detection and tracking of moving objects are given below:

- Input data avi file to the system.
- Create frames from this file.
- Read two consecutive frames from the image sequence called as current frame and previous frame.
- Divide these frames into four quadrants.
- **For ex:** Current frame is divided into four parts called as a1, a2, a3 and a4. Similarly, previous frame is divided into four parts called as b1,b2, b3 and b4.
- Now find out the NCC of each sub image of current frame with the previous frame. After this there are four values of NCC, called as c1, c2, c3 and c4.
- Now find out the minimum value of NCC from these four values. To this minimum value of NCC apply the threshold.
- The threshold value is selected by taking average of four NCC values (i.e., c1, c2, c3 and c4).
- Suppose the minimum value of NCC is obtained at the first quadrant, it means that the moving object is present in that quadrant.
- Now operate in the first quadrant. Take the difference between the first quadrants of two consecutive frames. Partitioning of two consecutive frames.

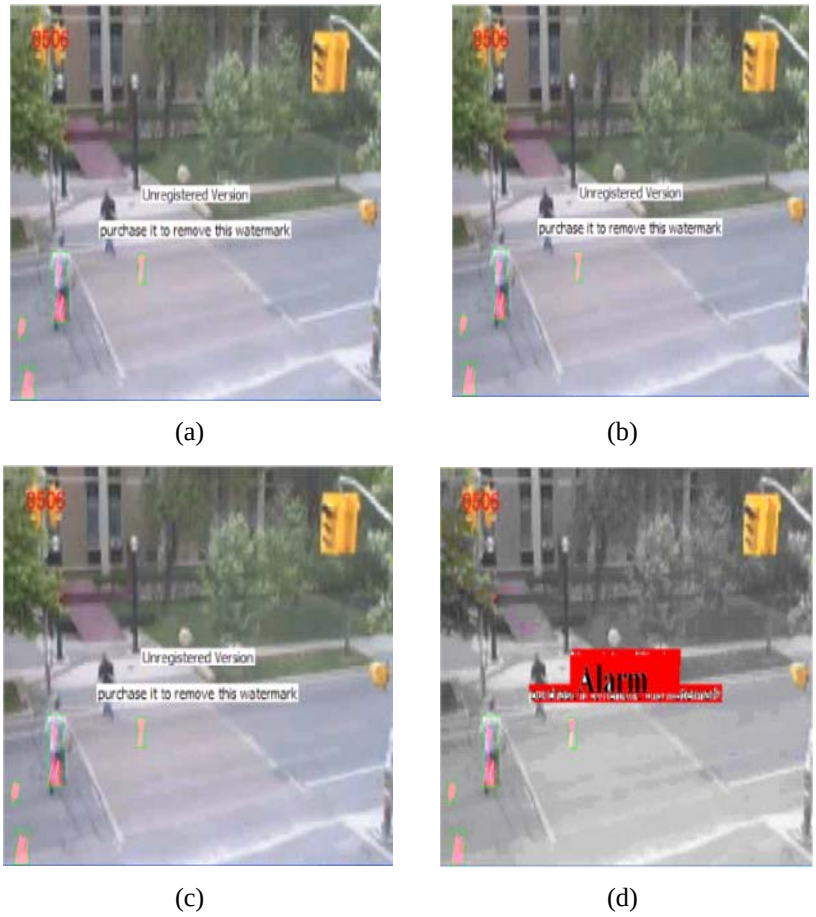


Fig. 9: Indicating alarm for idle object detection

- Then find the location of the moving object by performing component connected analysis and morphological processing.
- Centroid calculation is done for tracking the moving object.
- After this the second minimum value from the c1, c2, c3 and c4 is obtained. This is performed to check whether any other moving object is present in other part of the image.
- If the second minimum value is also greater than threshold then it means that the moving object is present in that quadrant. Now, identify the location of second moving object and track that object.
- Repeat the same procedure for the next frame.

This PNCC algorithm takes less processing time, which increases the speed and also the detection rate of moving object in video.

Idle object detection: A moving object is detected in a frame and the detected moving object is tracked based on the motion of the moving object. The motion of the moving object is constant for a particular period of time (constant in some sequence of frames) then it is idle, the idle action represents the object is doing suspicious action inside the ATM machine. Then Alarm is indicated for idle object identification as shown in Fig. 9 and the algorithm is as follows:

- Motion estimation for current and previous frame is calculated
- Location of the pixel value is identified based on the motion estimation of the object
- Pixel values are varying based on the intensity values of the moving object
- By comparing the pixel values of current and previous frame

If there is any variation in the pixel values then it is said to be moving Otherwise, the object is idle

EXPERIMENTS AND RESULTS

PETS 2001 dataset is used to evaluate the proposed system and it is compared with other edge based approaches like canny, Sobel, prewitt, Roberts. In

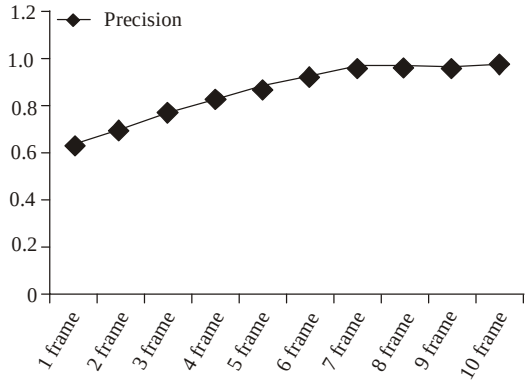


Fig. 10: Performance measure of precision

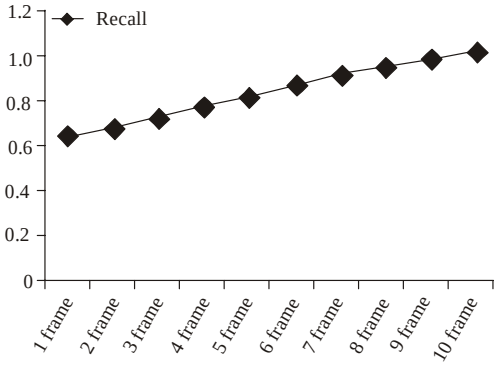


Fig. 11: Performance measure of recall

proposed system identifies the idle object detection by using curvelet based edge detection and it is compared with all other edge detection approaches. The results shown for all edge based approaches are given in Fig. 2. The curvelet based edge detection is shown in Fig. 3 and 4 and results are shown in Fig. 7 and 8. The performance measures of accuracy are calculated depend on the objects detected in the frame sequence of dataset and it is represented in graph as shown in Fig. 10 and 11. If number of objects are increased in the frame then the performance of the system remains stable.

CONCLUSION

Partitioning and Normalized Cross Correlation (PNCC) based algorithm is proposed for the detection of moving object. This algorithm takes less processing time, which increases the speed. The study presented a PNCC algorithm which takes less processing time, with increases the speed and also the detection rate for idle object detection by using tracking with P-filter and curvelet based edge detection transformation. The other suspicious actions such as using mobile phones, multiple persons trying to access the ATM machine in same time, kicking of each other which occur in ATM application are considered as future work.

REFERENCES

Cucchiara, R., C. Grana, M. Piccardi and A. Prati, 2000. Statistic and knowledge-based moving object detection in traffic scenes. Proceedings of Intelligent Transportation Systems 2000, pp: 27-32.

Davies, D.P., L. Palmer and M. Mirmehdi, 1998. Detection and tracking of very small low contrast objects. Proceedings of the 9th British Machine Vision Conference, 1: 599-608.

Elena, S. and S.R. Carlo, 2000. Real-time video-shot detection for scene surveillance applications. IEEE T. Image Process., 9(1): 69-79.

Elgamal, A., R. Duraiswami, D. Harwood and L. Davis, 2002. Background and foreground modelling using nonparametric kernel density estimation for visual surveillance. Proc of the IEEE, 90, No 7 (July 2002).

Heisele, B., U. Krebel and W. Ritter, 1997. Tracking non-rigid, moving objects based on color clusterflow. 1997 IEEE computer Society Conference on Computer Vision and Pattern Recognition, (CVPR'97), pp: 257.