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Video Surveillance over Camera Network Using Hadoop

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ABSTRACT: Object detection and tracking are two fundamental tasks in multi - camera surveillance. This paper proposes a framework for achieving these tasks in a no overlapping multiple camera network. A new object detection algorithm using mean shift (MS) segmentation is introduced, and occluded objects are further separated with the help of depth information derived from stereo vision. The detected objects are then tracked by a new object tracking algorithm using a novel Bayesian Kalman filter with simplified Gaussian mixture (BKF-SGM). It employs a Gaussian mixture (GM) representation of the state and noise densities and a novel direct density simplifying algorithm for avoiding the exponential complexity growth of conventional Kalman filters (KFs) using GM. When coupled with an improved MS tracker, a new BKF-SGM with improved MS algorithm with more robust tracking performance is obtained. Furthermore, a monitoring-based object recognition algorithm is employed to support object tracking over non overlapping network. Experimental results show that: 1) the proposed object detection algorithm yields improved segmentation results over conventional object detection methods and 2) the proposed tracking algorithm can successfully handle complex scenarios with good performance and low arithmetic complexity. Moreover, the performance of both monitoring and training-based object recognition algorithms can be improved using our detection and tracking results as input.

KEYWORDS: Image Processing; Computer Vision; Histogram matching; Motion Detection; Surveillance; Hadoop.

I. Introduction

Object detection and tracking are two fundamental tasks in multi - camera surveillance. The most important technique of this multi-camera related technique is to track and analyse objects within the images. The core technology of multi-camera analysis is used in detecting, analysing, and tracking the object's motion [1]. In addition, it is difficult to trace the object when the light's colour or direction changes. Firstly, we should use the block based algorithm for detecting the change in scene. In video, once the changed scene is detected then video is stored on the server for further analysis. Once the video is stored in the server, they are divided in to chunks and send to different nodes for analysis using map reduce technology of Hadoop. For detecting object, we applied the object tracking algorithm using a novel Bayesian Kalman filter with simplified Gaussian mixture (BKF-SGM).Using Hadoop we minimized the analysis time. Finally, we have drawn the graphs in which we have shown the number of objects to be detected and time required for analysis and stored the analysis result into a database for security purpose[2].

Visual object detection and tracking are important components of video analytics (VA) in multi-camera surveillance. We have developed a system for achieving these tasks in a multi-camera network. The system configuration used, is different from existing multi-camera surveillance systems and utilize common image information extracted from similar field of views (FOVs) to improve the object detection and tracking performance. However, in practice, such camera setup may not be easily achieved because of economical concern, topology limitation, etc. Therefore, we focused on the non-overlapping multi-camera scenario in this system, and our main objective is to develop reliable and robust object detection and tracking algorithms for such environment.

Automatic object detection is usually the first task in a multi-camera surveillance system and background modelling (BM) is commonly used to extract predefined information such as object's shape, geometry etc., for further processing. Pixel-based adaptive Gaussian mixture modelling (AGMM) is one of the most popular algorithms for BM where object detection is formulated as an independent pixel detection problem. It is invariant to gradually light change, slightly moving background and fluttering objects [3]. However, it usually yields unsatisfactory foreground information (object mask) for object tracking due to sensor noise and inappropriate GM update rate, which will lead to holes, unclosed shape and inaccurate boundary of the extracted object. Furthermore, important information of the object such as edge

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and shape are not utilized in such method. Therefore, the performance of subsequent operations such as object tracking and recognition will be degraded [4].

II. LITERATURE SURVEY

2.1. Multi-tasking smart cameras for intelligent video surveillance systems (2013):

We demonstrate a video surveillance system comprising passive and active pan/tilt/zoom (PTZ) cameras that intelligently responds to scene complexity, automatically capturing higher resolution video when there are fewer people in the scene and capturing lower resolution video as the number of pedestrians present in the scene increases. Till now, we have developed behavior based controllers for passive and active cameras, enabling these cameras to carry out multiple observation tasks simultaneously. The research presented herein is a step towards video surveillance systems consisting of a heterogeneous set of sensors that provide persistent coverage of large spaces, while optimizing surveillance data collection by tuning the sensing parameters of individual sensors (in a distributed manner) in response to scene activity [5].

2.2. Moving Object Detection by Detecting Contiguous Outliers in the Low-Rank Representation (2013):

Object detection is a fundamental step for automated video analysis in many vision applications. Object detection in a video is usually performed by object detectors or background subtraction techniques. Often, an object detector requires manually labeled examples to train a binary classifier, while background subtraction needs a training sequence that contains no objects to build a background model. To automate the analysis, object detection without a separate training phase becomes a critical task. People have tried to tackle this task by using motion information. But existing motion-based methods are usually limited when coping with complex scenarios such as non-rigid motion and dynamic background [6]. In this paper, we show that the above challenges can be addressed in a unified framework named Detecting Contiguous Outliers in the Low-rank Representation (DECOLOR). This formulation integrates object detection and background learning into a single process of optimization, which can be solved by an alternating algorithm efficiently. We explain the relations between DECOLOR and other sparsity-based methods. Experiments on both simulated data and real sequences demonstrate that DECOLOR outperforms the state-of-the-art approaches and it can work effectively on a wide range of complex scenarios.

2.3. New Object Detection, Tracking, and Recognition Approaches for Video Surveillance over Camera Network (2015):

Object detection and tracking are two fundamental tasks in multi camera surveillance. This paper proposes a framework for achieving these tasks in a non-overlapping multiple camera algorithms for such environment. Automatic object detection is usually the first task in a multi-camera surveillance system and background modeling (BM) is commonly used to extract predefined information such as object's shape, geometry and etc., for further processing. Pixel-based adaptive Gaussian mixture modeling (AGMM) is one of the most popular algorithms for BM where object detection is formulated as an independent pixel detection problem [7]. It is invariant to gradually light change, slightly moving background and fluttering objects. However, it usually yields unsatisfactory foreground information (object mask) for object tracking due to sensor noise and inappropriate GM update rate, which will lead to holes, unclosed shape and inaccurate boundary of the extracted object. Furthermore, important information of the object such as edge and shape are not utilized in such method. Therefore, the performance of subsequent operations such as object tracking and recognition will be degraded.

III. EXISTING SYSTEM

Manual systems emphasize on people to be accurate in all details of their work at all times, the problem being that people make mistakes. With manual systems the level of service is dependent on people and this puts a requirement on management to run training regularly for staff to keep them motivated and to ensure they are following the correct methods. Otherwise there is inconsistency in data entry or in hand written orders made by people. Reporting and checking that data is robust can be time consuming and expensive [8]. This is an area where significant money can be saved by automation.

Another impact of manual systems is on customer service. Customer queries can be difficult to respond to as information is stored in different places and may even require that you find the right person before being able to respond. Large ongoing staff training cost is the major disadvantage of this manual system [9].

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IV. PROPOSED SYSTEM & ARCHITECTURE

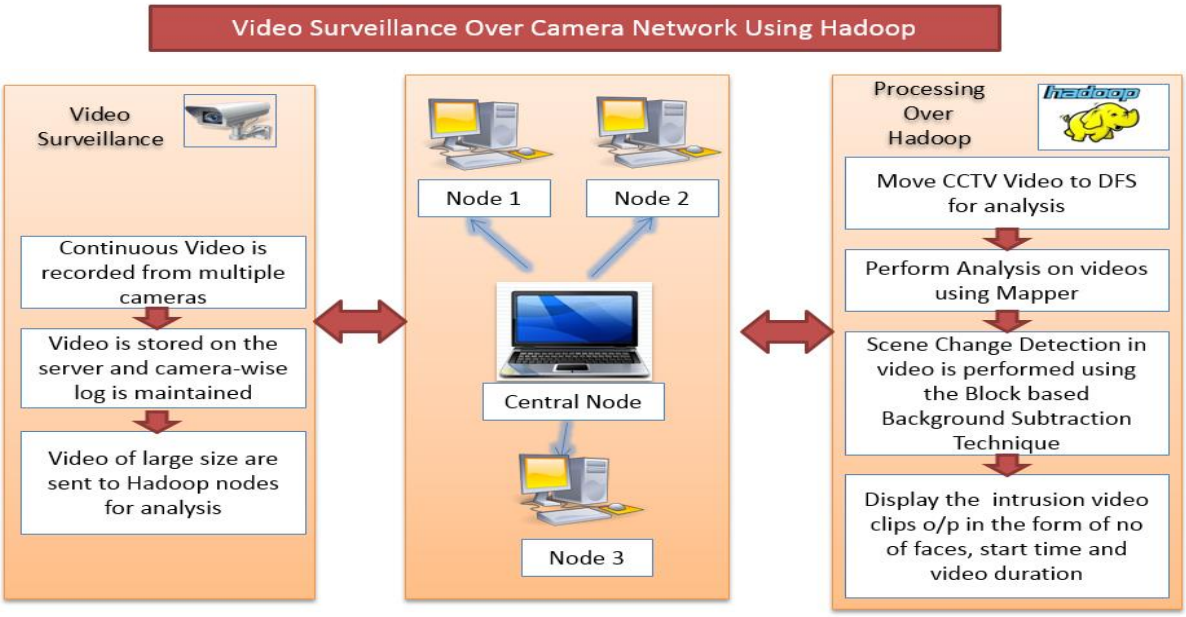

Figure1: Overall Design.

This project makes use of Open CV library to capture camera images and detect intrusion using comparison- block based motion object detection method [10]. Once the comparison is done and an intrusion is found, it saves the streamed video on server. After that video analysis is performed using Hadoop technology.
Application consist of following modules

4.1. Video Recording:
Video recording takes place using Open CV. Image capturing and comparing with template image takes place. Once the difference between template image and current image found then it means that intrusion is detected. Finally the intruded video is stored on the server for analysis [11]. Analysis is performed using Hadoop technology.

4.2. Historic CCTV Video:
We can apply the Hadoop technology on Historic CCTV Videos which is large size. For analysis these video take long time on single machine so overcome this problem we use Hadoop technology.

4.3. Analysis on videos using Mapper:

a. **Scene Change Detection:** Scene Change Detection is performed using the block based background subtraction image .Compare the current image and template image if the current image and template image difference is found then Scene change is happened [12].
b. **Pedestrian Detection:** Pedestrian Detected using novel Bayesian Kalman filter with simplified Gaussian mixture (BKF-SGM).Once the pedestrian is detected in the intruded video is stored on server for analysis of video over Hadoop.

4.4. Processing Over Hadoop Node:
For analysis using Hadoop the map Reduce concept is used. A Map Reduce job usually splits the input data-set into independent chunks which are processed by the map tasks in a completely parallel manner. In our project we analyses the video and slit the video in to number of chunks then it proceed to the different nodes for analysis [13].

4.5. Generate output with faces and change timing:
Generate a graph and how much time is required for the analyzing video

4.6. Save the analysis logs into the database:
Analysis logs like timing of each node for analysis, number of objects to be tracked, timing etc. is stored into the database for security purpose.

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Advantages:

- Less time is required to analyze the large video as Hadoop technology is used.
- The entire system can be implemented in a very low cost.
- High security is provided.
- Alarm system is used when any kind of intrusion is detected.

Applications:

In high security areas such as,

- Banks
- Malls
- College premises
- Jewelers shop

V. METHOD

5.1. Color histogram:

A histogram is nothing but graphical representation of the distribution of numerical data. We are considering these colors. Alfa, Red, Green, Blue with range 0-255.We will get gray-scale image by taking the mean of those values. Thresholding is a popular technique for the process of image segmentation as it is widely applicable to other areas of the digital image processing[14]. All we have to do is, set the thresholding value as constant and comparing those values between frames. This software is going to detect all the changes in the video. Color histogram distributes the color in an image. When we take photos from our camera, some cameras have an ability to display the 3 color histograms.

5.2. Bayesian Kalman Filter:

This filter is used to find the state of physical system in an accurate environment Here the physical state could be velocity and readings may not be continuous. These filters uses inference algorithm. Kalman filter uses one kind of algorithm which receives various measurements which are observed. They contain noise which is represented by unknown variables sensor models are expressed by linear Gaussian distributions. Let the current state be Xt. For calculating the next state linear function will Xt+1. If we have taken the X co-ordinate of the object of which we have to specify the position and let us say Δ be the interval between the observations. Also the velocity will be constant. Then the updated position will be given as, Xt+Δ = Xt+XΔ

5.3. Mean Square difference:

In this paper, two images are taken. Then, both the frames are resized into 300X300 sizes. The next step is to divide it further into 5X5 matrix [15]. Then the average of each matrix block is calculated. Average of the first image is represented as r,g,b. The average of the another block is represented as r1,g1,b1 . After this, the summation of each of the matrix block will be calculated. One threshold value is set. Then the summation with this threshold value will be compared. So with this mean square algorithm, the frames of the video are divided into the matrix form. Then each block means square, is compared to the very next frame and the change will be detected.

5.4. SSIM Algorithm

It is Structural Similarity Index. In SSIM, the similarity between any two given images is measured. It predicts the perceived quality of the digital images as well as videos.

$$\mathrm{SSIM}(x,y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

with

- μ_x the Average of x;
- μ_y the Average of y;
- σ^2_x the variance of x;
- σ^2_y the variance of y;
- σ_{xy} the covariance of x and y;

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VI. Conclusion

New approach for object detection in camera network has been presented. A novel object detection algorithm using Color Histogram, Mean square Deference Structural Similarity Index. The segmented objects are then tracked by BKF-SGM-IMS; the computation is carried over Hadoop which reduces the time and also storage space. The output of the system is shown in the form of Intrusion Video duration, start time, end time. Alert is shown on screen in the form of pop-up box.

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