Approaches for Video Surveillance Using Hadoop

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Abstract: *We have studied the core technology of multicamera analysis which is used in detecting, analysing and tracking the object motions. In addition when the light colour or direction changes, it is difficult to track the object, it also require huge amount of time for analysis. These paper propose a framework for achieving this task in less amount of time using Hadoop technology. Firstly we use block based algorithm for detecting the scene change in video, if the change is detected then video is stored on the server. Stored video are divided into number of chunks and send to different nodes for analysis using map reduce technology of Hadoop. For detecting object we apply the object tracking algorithm using a novel Bayesian kalman filter with simplified Gaussian mixture (bkf-sgm). Using Hadoop we minimize the analysis time. Finally we draw the graph which shows that number of object detected and time required for analysis. Analysis result is stored into database for security purpose.*

Keywords: *Object Detection, Tracking, Recognition, Image Processing etc…*

1. INTRODUCTION

The traditional technology is incapable for handling huge amount of data. So to overcome this drawback new technology is emerging which is Hadoop. Today's Hadoop is most popular technology for processing huge amount of data. Which is combination of both unstructured and structure data available in huge volumes. Hadoop provides way to utilize multiple computing resources for executing particular task. The core component of Hadoop is -

1.1 HDFS (Hadoop Distributed File System)

HDFS is an effective, scalable, fault tolerant and distributed approach for storing and managing huge amount of data using clusters.

1.2 Hadoop Map Reduce

Map reduce is a computational framework used in Hadoop, it performs the mathematical computations. It is based on the parallel and Distributed implementation that provide high performance. Hadoop clusters are created from racks of community machines. Tasks are distributed across this machines which is also known as nodes, which are allowed to work independently and provide their response time to the central node. Also it is possible to add or remove nodes dynamically in a Hadoop cluster on the basis of varying workloads. Hadoop has ability to detect changes in the cluster and adjust to them, without causing any interruption in the system. Hadoop perform its operations by dividing the tasks into subtasks that are handled by individual node with the help of the Map reduce model, which is work using two functions mapper and reducer. The mapper function is responsible for mapping the subtask to the different nodes, and the reducer Function is responsible for reducing the response from compute nodes, to a single result. Hadoop enables businesses to run the application on thousands of nodes involving many thousands of terabytes of data. Hadoop also offers a cost effective storage solution for businesses. Hadoop distributed file system that basically maps data whenever it located on a cluster. The tool for data processing are often on same server where the data is located, resulting in much faster data processing.

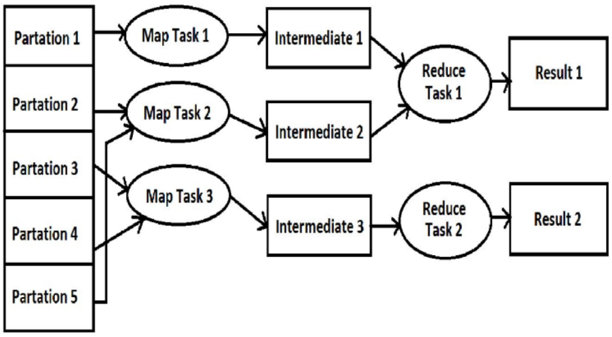

Fig 1: *Working of Map Reduce*

In this Paper, we present approaches for video surveillance using Hadoop technology. In traditional video surveillance detecting , analysing and tracking the motion require more time for processing .In addition when light colour or direction changes, it is difficult to trace the object . Firstly we use the block based algorithm for detecting the change scene in video, if the change is detected then video is stored on the server for further analysis. Once the video was stored on the server, Stored videos are divided in to chunks and send to different analysis using map reduce technology of Hadoop For detecting object we apply the object tracking algorithm using a novel Bayesian kalman filter with simplified Gaussian mixture (bkf-sgm). Using Hadoop we minimize the analysis time. Finally we draw the graph which shows that number of object detected and time required for analysis. Analysis result is stored into database for security purpose.

2. SYSTEM ARCHITECTURE

This system makes use of OpenCV library to capture camera images and detect intrusion using comparison - block based motion object detection method. 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

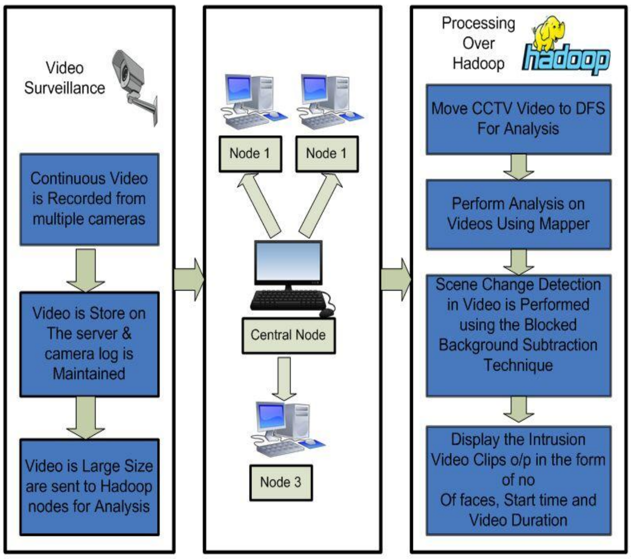
Video Surveillance
Continuous Video is Recorded from multiple cameras
Video is Store on The server & camera log is Maintained
Video is Large Size are sent to Hadoop nodes for Analysis
Node 1
Node 1
Central Node
Node 3
Processing Over Hadoop
hadoop
Move CCTV Video to DFS For Analysis
Perform Analysis on Videos Using Mapper
Scene Change Detection in Video is Performed using the Blocked Background Subtraction Technique
Display the Intrusion Video Clips o/p in the form of no Of faces, Start time and Video Duration

Fig 2: *System Architecture*

2.1 Video Recording

Video recording takes place using OpenCV. 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. Analysis is performed using Hadoop technology.

2.2 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.

2.3 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.

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.

2.4 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 analyse the video and slit the video into number of chunks then it proceed to the different nodes for analysis.

2.5 Generate output with faces and change timing

Generate a graph and how much time is required for the analyzing video

2.6 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.

3. ALGORITHMIC DETAILS

3.1 Motion detection using block based background subtraction image

a) Motional Region Detection Structure

The new motion detection method we proposed uses a technique like BSM. That is, it uses the subtraction between the current frame image and the background image. The background image used at this time is not a background image prepared in advance. However, it creates the background screen in real-time when video shooting. The motion detection method proposed in this study can divided into three steps:

a) Blocking the input image and pre-processing the image by block zoning

b) Obtaining the difference image between the background image and block zoning

c) Updating the background image

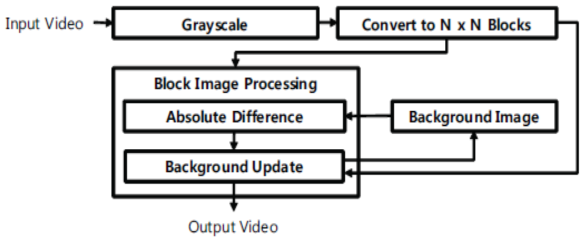

Fig 3: *Motion Detection algorithm structure*

In Figure, the initial input image is a TV input method proposed in the NTSC standard. This is the YIQ method. It is converted to greyscale using following formula. Herein, F represents the frame image, and r, g, b indicates Red, Green, Blue value, respectively, to the pixel corresponding to the position of x and y.

$$\begin{aligned} G(x,y) &= 0.299 \times F_r(x,y) + 0.587 \times F_g(x,y) \\ +| &\ 0.114 \times F_b(x,y) \end{aligned}$$

The images obtained after converting to greyscale are segmented into the square block with the entire number of pixels, *N*. Subsequently, the absolute difference image of the block is divided in the front using formula.

$$D_n(x,y) = \begin{cases} 1, & |W_n(x,y) - B_n(x,y)| > t_T \\ 0, & otherwise \end{cases}$$

$$(x, y{=}0,1,2,\ldots\ldots,N\text{-}1 \qquad N\text{: window block size})$$

In above formula, *n* represents the number of blocks, *W* the block corresponding to the current image, *B* the block corresponding to the background image, and *D* the value of the absolute difference between *W* and *B*.

b) Background Image Update

Step 1: One-dimensional array is declared to store each difference image luminance change rate by block R(n), and initialized to 0. This step is performed only once during the first run.

Step 2: Integer variable C to calculate the degree of change for the entire block is declared and initialized into 0. Here in, C represents the number of blocks with a change. For the block difference image (Dn). Steps 3 and 4 are performed repeatedly.

Step 3: The number of pixels that have 1 as a value within the block difference image (Dn) is put together. At this time, the sum of pixels represents the change in the luminance within the block. If it is equal to or greater than t, it is considered to have a change in the movement in the block, and the value of R(n) increases by 1. In addition, the value of C increases by 1. Conversely, if the sum of the pixels is less than t we consider there is no change, the value of R(n) reduces by 1,and all the values of Dn are initialized to 0. The image with no change in the luminance value in the block is initialized into0 to eliminate noise. Herein, t uses an arbitrary threshold value i.e. block size N.

$$R(n) = \begin{cases} R(n)+1, & C = C+1, \ \sum_{k=0}^{N^2} D_n(k) > \Delta t \\ R(n)-1, & D_n = 0, \ldots, 0., \ \ otherwise \end{cases}$$

Step 4: In above formula, if the value of *R*(*n*) is less than '-1',the background image of the block is updated. Otherwise, it is not updated and remains as the previous background image.

3.2 Object tracking algorithm using a novel Bayesian Kalman filter with simplified Gaussian mixture (BKF-SGM)

A Kalman filter is used to estimate the state of a linear system where the state is assumed to be distributed by a Gaussian. Kalman filtering is composed of two steps, prediction and correction. The prediction step uses the state model to predict the new state of the variables:

$$\bar{X}^t = DX^{t-1} + W$$

$$\bar{\Sigma}^t = D\Sigma^{t-1}D^T + Q^T$$

Where and are the state and the covariance predictions at time t. D is the state transition matrix which defines the relation between the state variables at time t and t − 1. Q is the covariance of the noise. Similarly, the correction step uses the current observations to update the object's state:

$$X^t = \bar{X}^t + K^t\left[Z^t - M\bar{X}^t\right]$$

M is the measurement matrix, K is the Kalman gain. Note that the updated state is still distributed by a Gaussian. Kalman filter, the extended Kalman filter assumes that the state is distributed by a Gaussian.

4. FUTURE SCOPE

This Project can be used in Bank Security System where security has prime importance it will be helpful to detect frauds and robberies in the banks. It can also be used in ATM systems to get to know about suspicious withdrawals from users account. It will be used in detecting robbery of vehicles in parking slots and to find criminals who are responsible for whose robberies. It records criminal activities which can act as a important proof for investigators.

5. CONCLUSION

Hadoop is a most popular technology to analyse large amount of data through which we can process data in less amount of time.

Our implementation uses Hadoop technology for analyzing large amount of video data and detecting the objects. Existing system requires more time and cost to analyze data but the system which we are developing will be having reduced cost and time to do the same and also it will provide greater security as compared to the existing systems.

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