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A Review-Cluster Computing Based Video Surveillance: Smart Hub

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Abstract. Security and surveillance are important and recent issues in computer vision world. Surveillance system means identify suspicious activity for the purpose of security such as prevention of crime, investigation of crime, protecting people or group or object. A video surveillance management system, not only able to find out what happened by viewing real-time video and searching video recordings but also the system must be stable and fault-tolerant. Capturing all of the video from a number of cameras to a centralized server is inherently unscalable and expensive. Distributed video systems scale much more effectively than centralized server system. A video surveillance system must meet different requirement such as availability, scalability, manageability, security. Current high-performance embedded cameras integrate video processing, video sensing, and communication within a single device which is called as smart camera. Today smart cameras are key components for video surveillance systems. This paper review different distributed video surveillance system framework.

Keywords: Video Surveillance System, Distributed Computing, Smart Camera, Events

I. INTRODUCTION

Visual surveillance has become one of the recent research areas in computer vision. Due to the growing importance of visual surveillance for surveillance and security purposes. The traditional video surveillance require continuous manual monitoring which is infeasible because of factors such as human fatigue and cost of manual labour.

It is virtually impossible to search through recordings for events such as finding suspicious activity in the past since that would require a playback of the entire duration of video recording. Hence there is a need of an automated system for video surveillance which can detect unusual or suspicious activities on its own.

Video surveillance system (VSS) has received a great demand as extremely active application-oriented research areas in computer vision. The early use of monitoring system was the tube camera. Used to broadcast and monitor the industrial processing. In recent decades expansion in automated video surveillance systems[7].These lead to inspire evolution in various prominent domains of technology such as: they are crime prevention through indoor and outdoor monitoring ,homeland security , traffic flow analysis, accident detection, traffic monitoring, controlling and airborne traffic management, maritime traffic control , counting moving object (vehicles), human behavior understanding, activity analysis ,motion detection[11].

There is also a growing demand for applications to support monitoring outdoor and indoor environments like shopping mall , train station ,parking lots, airport, and so on due to the development, availability, and low price of sensors and processors. Thus research in video surveillance areas are multidisciplinary field associated to image processing, embedded computing, and communication, pattern recognition, signal processing.

There are 3 generations of video surveillance system [1].Evolution of Video surveillance systems are summarizes in below table I.

1st Generation Techniques	Analogue CCTV systems
2nd generation Techniques	Automated visual/video surveillance system by combining computer vision technology with CCTV systems
3rd generation Techniques	Automated wide-area surveillance system

Table I: Video Surveillance Generation Techniques

A distributed system in which components located on same local area network. The distributed system component (computers) communicate and coordinate with each other by messages passing . The components interact with each other in order to accomplish a common goal.

The significant characteristics of distributed systems are independent failure of components and concurrency of components. There are two main architecture of distributed system: 1) Master slave, and 2) peer-to-peer.

1. Master-Slave: Master- slave architecture approach uses the Distribute Compute-Gather philosophy. In this approach, the master processing node splits the image data and distributes to the slave processing node. All slaves processing units work in parallel to achieve assigned objectives. Then master processing node gathers and accumulates all the image data back.

2.Peer-to-Peer: In peer-to-peer architecture ,partition the task between peers. Peers make a portion of their resources, such as network bandwidth, processing power,

disk storage directly available to other network participants. So there is no need of central coordination by servers in such system.

The video surveillance distributed system implements a unified concept for storage, management and video surveillance task. It builds a video network that implements simple and effective management of different subsystems in distributed environment.

Large areas can be covered only by numbers of cameras and analysis generally requires extracting information from several cameras. Pulling all of the video from a number of cameras to a centralized server system is expensive and inherently unscalable. Distributed systems scale more effectively than do centralized server system.

a) Processing all the data centrally have several problems.
b) Although data must be compared across several cameras to analyze video.

Manage the data transfer between processing nodes, it can make sure that data only go to the necessary nodes.

c) Availability of multiple points of computation that enables reconfigurations in case of failure.

Distributed VSS strongly rely on collaboration among the cameras. It require the distribution of control and data between processing nodes and cameras in effective manner. To process video data on Distributed processing nodes the camera network must be accurately adjusted in both space and time.

II.LITERATURE REVIEW

Research on the framework of large distributed surveillance systems mainly focus on video compression techniques, network and protocol techniques, distribution architectures and real time communications those approaches suffer from the problems of scalability problem and degraded quality-of-service (QoS).

Authors have developed a novel QoS aware video surveillance system based on overlay network, which is called as E-touch system[3].These system provides three-layers:

a. Underlying Networking Layer (UNL),
b. Overlay Service Network Layer (OSNL)
c. Application Layer (AL).

E-touch system can achieve better resource utilization and QoS provisioning than a traditional video surveillance system that uses fixed resource allocation scheme. Author's employ a load-balance service composition algorithm (LBQSC). LBQSC is used to find QoS-satisfied paths in the overlay traffic. The algorithm tries to allocate resources for tasks in such a way that the requirements are met and the load distribution of whole system is maximized. In case of overloaded system , new tasks will be refused. To avoid impact on services that accommodate already running tasks. With the development of network technologies, building a surveillance network consisting of thousands of sensors is possible. However monitoring surveillance networks through human scrutiny is expensive and remarkably ineffective because each sensor, especially camera, provides a huge quantity of information. Even trained operators would lose concentration and miss a high percentage of significant events. Wu Chao and Xin Ming Jun authors have proposed an intelligent distributed real-time video surveillance system framework based on the technologies of multi-agent and active blackboard [4].

It has two features:

(1) In these framework each surveillance terminal is designed as an agent, is responsible for processing of raw information from its according sensors and it ensures that processing all raw information is in the front-end of the system and it send only processing results over IP network.

(2) An active blackboard is the data exchange center among information processing and device control units. The system can give response to a surveillance event and avoid information loss. In theses system each terminal agent (TA) acquires and analyzes information from its associated sensors.

Then, the analysis results are referred to a multimedia information fusion and reasoning agent (MIFRA)[4]. MIFRA formats these analysis results with according weights and translates them into some facts which can be identified by knowledge reasoning engine. Finally, an active blackboard (ABB) share knowledge reasoning results and trigger a device management and controlling agent (DMCA) so as to control according hardware devices, such as entrance guard, LED, video wall, sound and light alarm. The task to be run in a surveillance system in traffic surveillance system includes stationary vehicle detection and video analysis algorithms such as wrong-way driver's detection, accident detection etc. Additionally, the tracking of objects among number of cameras is an important issue. Not all tasks can be allocated to a smart camera concurrently because of limited computing power of system

Authors have developed a resource aware task allocation system which distributes the surveillance tasks autonomously within groups of smart cameras[2],[5]. The task-allocation system works in a distributed manner based on mobile agent. The mobile agents are integrated into the task-allocation system. It provides the required infrastructure like resource monitoring, communication infrastructure. The tracking agents and the dynamic task allocation have been implemented on smart camera. Smart camera comprised of a network processor and several (DSPs) digital signal processors. It provides a complex software framework to reduce the resource usage. The tracking algorithm is only run on the appropriate smart camera as long as the tracked object is in its field of view. Therefore mobile agent decides based on the results when

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to migrate to the next smart camera[2].

P. Kumar, A. Mittal, A. Pande, A. Mudgal[6] has proposed framework for distributed multimedia processing using mobile agents in Distributed Video Surveillance(DVS) network architecture. Computational costs increased due to video processing tasks like object tracking and segmentation and are shared by the cameras and a local base station called as Processing Proxy Server (PPS) [6]. In a distributed surveillance application like traffic surveillance, where moving objects is tracked by multiple cameras.

The processing tasks needs to be dynamically distributed. In indoor surveillance applications, human motion analysis done. K. Srinivasan et al [8] presented an attempt to give an idea of human body tracking in area of monocular video surveillance system [8]. They have discussed various of background modeling techniques such as Adaptive background subtraction method, 2D and 3D human body tracking methods, Background Subtraction Method, Adaptive Gause Mixture Method etc. Human body modeling identifies the nature of the body, activities and positions in video frames.

W Yan, Declan F, Kieran, R. Jain [9] discussed event ,properties of event, classification of event and their relationship between them, techniques ,algorithm used in event detection in visual computing system[9].An event is defined as something that happens with respect to place and time. Events associated with media either video and audio or individually. The event detection algorithms are mostly based on recognition , statistical pattern, machine learning and artificial intelligence etc.

Table II: Techniques used in event visual computing

Event Detection Techniques	Pros	Cons
Dynamic Bayesian Network Hidden Markov Model (HMM)	good method of modeling temporal sequences,	difficulty in modeling long term temporal relationships in data
Finite / Continuous State Machine	robust in modeling temporal transition patterns	
Filtering Algorithms	provide optimal solution for many tracking and data prediction tasks.	limited in the quality and accuracy of the embedded Model
Support Vector Machine	the training involves nonlinear Optimization	

Table III: Tools and technologies used in parallel and distributed image processing

Tools and technology	Support for Parallel and/or Distributed Processing
MPI	Parallel processing Distributed computing on cluster(low latency)
Open MP	Parallel processing
CUDA	Parallel processing
Cilk	Parallel processing
MATLAB's PCT with MDCS	Parallel processing on multi-core processors and GPU Distributed computing on clusters

III.CONCLUSION

In this paper, we reviewed the different distributed video surveillance system framework and tools and technology used in distributed system. Also different approaches for task distribution in distributed VSS. Also we reviewed the use of prominent techniques based on machine learning, statistical pattern recognition and artificial intelligence for event detection. Also use of different features such as spatial, temporal, trajectories, audio-visual and others, for event detection. It is important that consider task distribution that optimizes the use of central, remote facilities and data communication networks.

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