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Motion Detection Based Interactive Surveillance Systems for Mobile Clients

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Abstract. Surveillance systems provide the capability of collecting authentic and purposeful information and forming appropriate decisions to enhance safety. In a general video surveillance system, video streams from cameras are sent to a control center and operators monitor the videos. But human operator monitoring of the views every moment of every day is almost impossible; Mobile video surveillance represents a new paradigm that encompasses, on the one side, video acquisition and, on the other side, especially at the same time image viewing, addressing both computer-based and mobile-based surveillance. It is based on JPEG 2000 still image compression format is attractive because it supports flexible and progressive access to each individual image of the pre-stored content, It supports still image creation on the basic of motion detection technique which enables efficient utilization of resources. The paper is concluded with concise summary and the future of surveillance systems for public safety.

Keywords: Web-based Surveillance System, Usage of PDA and cellular phone as GUI, conditional replenishment (CR), JPEG 2000, video server.

1. Introduction

Security is one of the most important problems all over the world. From the point of view on keeping security efficiently, it seems to be natural and essential to apply ICT (Information and Communication Technology) into a field of security. In order to be secured of safety with ICT, it is useful to realize and manage smart surveillance system combined with image processing techniques. It is an application scenarios for which a client typically a human controller behind a PC or a wireless PDA remotely accesses pre encoded content captured by possibly multiple (overlapping) surveillance cameras, to figure out what happened in the monitored scene at some earlier time.

These functions are necessary for autonomic monitoring, which is provided by our surveillance system. This paper presents related works and problems of our previous surveillance system, at first. An overview of the new version of our surveillance system and its functions are described in the next section. Additionally, services from our new surveillance system are illustrated and brief evaluation about our system with cellular phone as its client is also reported. To address the above requirements, we have decided to build our system on the JPEG 2000 compression standard JPEG 2000 indeed provides a natural solution to support the required Access flexibility, through low complex manipulation of pre- encoded bitstreams without the need for computationally expensive transcoding operations—i.e., decompression followed by compression.

Recently, in addition to the employment of the incessantly enlarging variety of sensors, the inclination has been to utilize more intelligence and situation awareness capabilities to assist the human surveillance personnel. The most recent generation is decomposed into multisensor environments, video and audio surveillance, wireless sensor networks, distributed intelligence and awareness, architecture and middleware, and the utilization of mobile robots. The prominent difficulties of the contemporary surveillance systems are highlighted. These challenging dilemmas are composed of the attainment of real-time distributed architecture, awareness and intelligence, existing difficulties in video surveillance, the utilization of wireless networks, the energy efficiency of remote sensors, the location difficulties of surveillance personnel, and scalability difficulties.

System Configuration

Capture Module

At first, by means of image processing for monitored data, it is illustrated whether remarkable changes between continuous sampled images happen or not. Secondly, through comparison of a series of monitored image from network camera, detection of dynamic changes from the previous image to no one is performed so that the signal for homing of camera's platform can be computed and sent to camera for controlling its platform. It is used to read data from an output Data Source of a Processor. It creates a processor and hook up the output. Instantiate and set the frame access codec to the data flow path. Get the output Data Source from the processor and hook it up to the Data Source Handler. It reads from camera and display information of each frame of data received. It uses the Java Media Framework to detect image capturing device. It locates the Locator = vfw://0 to detect capture device using plugins.

Motion Detection Module

Image processing has been done with the following procedures; two target images extracted from database are divided into fourth or ninth pieces of sub image, corresponding two pieces of sub image are compared with pixel-wise operations, and detection of dynamic changes can be performed based on the result whether compared two sub images are different or not.

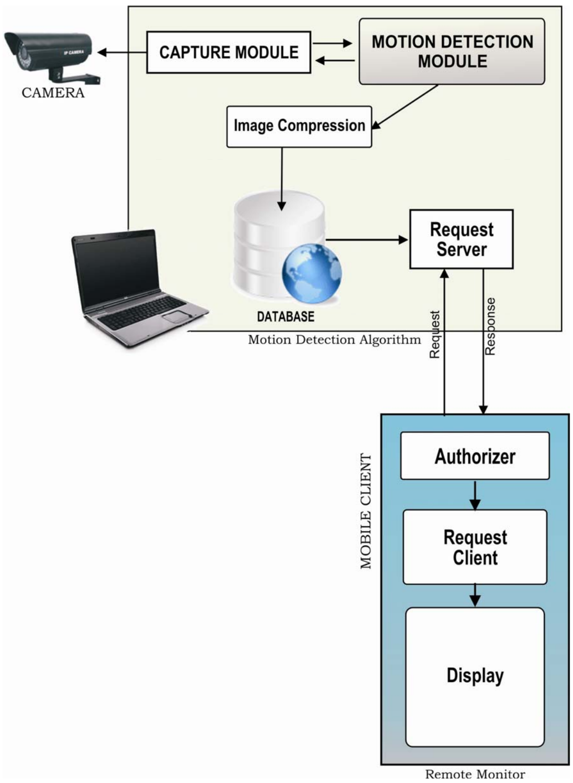


Fig. 1. Overall Architectural diagram.

Motion Detection Control

It is get implemented along with the image capture to manage and to control the way of capturing the images from the video frames. It will set the threshold value to a certain limit and it will check for the change in the value. The Max and the Min threshold value have been set. By comparing this frame capturing has been initiated. The integrated server of our surveillance system has been implemented on a Linux machine and almost all of its application software is written in Java. Such software may be divided into some modules, which were designed based on the way of server-client computing model. Modules for server are written as stand-alone applications of Java, while others for clients were implemented as Java applets as well as Java application programs for mobile computing devices Our surveillance system employs Java applet for client software construction because of its capability to be constituted for different kinds of clients, transferred from server to each type of client through HTTP connectivity Almost all software of our surveillance system has been written in Java programming language, because of easy and powerful description of GUI as well as network Programming. We have decided to develop Java-based Web server software (Java Web Server, JSW) with several functions written in pure Java language. With this JSW, the major part of software for our surveillance system can be efficiently realized so that prototype of our new surveillance system has been developed in a short period. And it is very much easy to customize and build in many applications and execution modules as external subroutines and/or threads of JSW. Image processing function has been also implemented as an external thread of it.

Motion Detection Effect

According to the detection and position of dynamic changes direction of controlling camera platform can be computed in order to realize automatic homing. And then the event concerned with start of automatic homing can be informed into the specific client as emergency contact by means of e- mail services as described in the next subsection. The information of such a situation for clients are sent with a warning message including the URL expression which contains Java Applets for PC browser and/or a special CLDC-based Java applications for some kinds of cellular phone. The clients that have received the above information can download the suitable Java Applets or CLDC-based Java applications through wide area network so that they can enjoy personalized (or privacy-based) remote monitoring by means of the location-independent way. Enhancement of our monitoring system can be realized and supported with the above structure and method.

Image Compression

The JPEG 2000 standard describes images in terms of their discrete wavelet coefficients. An important question raised by conditional replenishment of JPEG 2000 coefficients is related to the granularity of refreshment of those coefficients. Specifically, one needs to understand to which extent it is possible to define the resolution, the subband, the position and the reconstruction accuracy of the coefficients that are refreshed. That issue is directly related to the JPEG 2000 format, which can be summarized as follows. According to the JPEG 2000 standard, the subbands issued from the wavelet transform are partitioned into *code-blocks* that are coded independently. Each code-block is coded into an embedded bitstream, i.e. into a stream that provides a representation that is (close-to-) optimal in the rate distortion sense when truncated to any desired length. To achieve rate-distortion (RD) optimal scalability at the image level, the embedded bitstream of each code-block is partitioned into a sequence of increments based on a set of truncating points that correspond to the various rate-distortion tradeoffs defined by a set of Lagrange multipliers. A Lagrange multiplier _ translates a cost in bytes in terms of distortion.

It defines the relative importance of rate and distortion. Given, the RD optimal truncation of a code-block bitstream is obtained by truncating the embedded bitstream so as to minimize the Lagrangian cost function L(_) = D(R)+_R, where D(R) denotes the distortion resulting from the truncation to R bytes. Different Lagrange multipliers define different rate-distortion trade-offs, which in turn result in different truncation points. For each code-block, a decreasing sequence of Lagrange multipliers {_q}q>0 identifies an ordered set of truncation points that partition the code-block bitstream into a sequence of incremental contributions. Incremental contributions from the set of image code-blocks are then collected into so called quality layers, Qq. The targeted rate-distortion tradeoffs during the truncation are the same for all the code-blocks. Consequently, for any quality layer index l, the contributions provided by layers Q1 through Q1 constitute a rate-distortion optimal representation of the entire image.

It thus provides distortion scalability at the image level. Resolution scalability and spatial random access to the image result from the fact that each code-block is associated to a specific subband and to a limited spatial region. Although they are coded independently, code-blocks are not identified explicitly within a JPEG 2000 codestream. Instead, the code-blocks associated to a given resolution are grouped into *precincts*, based on their spatial location , Hence, a precinct corresponds to the parts of the JPEG 2000 codestream that are specific to a given resolution and spatial location. As a consequence of the quality layering defined above, a precinct can also be viewed as a hierarchy of *packets*, each packet collecting the parts of the codestream that correspond to a given quality among all code-blocks matching the precinct resolution and position. Hence, packets are the basic access unit in the JPEG 2000 codestream.

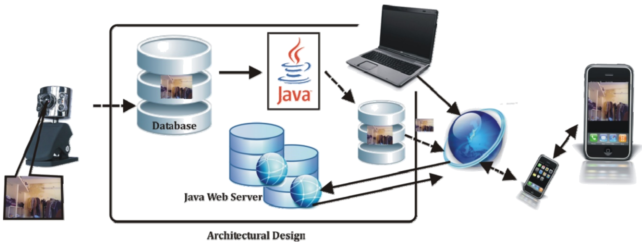
Request Server

A series of JPEG image file can be periodically taken by network camera, transmitted into JWS, and accumulated with simple image resizing procedure in the storage of that server. Request to obtain the buffered image in JWS causes transmission of such image into the browser of client PC, process of Java Applet for downloaded images, and display images on the browser in the manner of stationary picture and/or quasi-moving picture. It will response to the request from the client and respond periodically depending upon the client request. Depending on the client request the image has been sent to the client side from server.

Mobile Side Evaluation

User Authorizer

To avoid unwanted access and to restrict unauthorized users we have to set a sequence of user authorization on the basics of user name and password verification. The user name and the password have been sent to the server side for verification. After verification the user can login to access the image from the image server. We may set any number of users depending upon the need.



Request Client & Display

Here JWS has prepared such a Java applet on its homepage, delivers it into clients' cellular phone according their requests, and communicates it for transmission of monitoring images. As there are some constraints on the image data size, which cellular phones can accept at the one time, for both of transmission and display of it, then JWS must reduce JPEG images from network camera into a suitable size for cellular phones and accumulate these images in its storage for request of image delivery from cellular phones. With Java applet, clients can browse monitoring quasi-moving image obtained from network camera on their browser of PC through JSW. But it has seemed to be more effective and convenient for clients to browse such images with their cellular phones, because almost all people of Japan always carry their cellular phones together with them. One of various Java technologies, for example CLDC (Connected Limited Device Configuration) of Java 2 Micro Edition, allows us to utilize relatively small sizes of Java program (or Java application) on the specific cellular phones, and then it can be downloaded from JWS and perform a mobile communication based on HTTP connection between it and cellular phones. With Java applet, clients can browse monitoring quasi-moving image obtained from network camera on their browser of PC through JSW. But it has seemed to be more effective and convenient for clients to browse such i mages with their cellular phones, because almost all people of Japan always carry their cellular phones together with them. One of various Java technologies, for example CLDC (Connected Limited Device Configuration) of Java 2 Micro Edition, allows us to utilize relatively small sizes of Java program (or Java application) on the specific cellular phones, and then it can be downloaded from JWS and perform a mobile communication based on HTTP connection between it and cellular phones.

Brief Performance Evaluation

JWS has prepared such a Java applet on its homepage, delivers it into clients' cellular phone according their requests, and communicates it in order to transmit monitoring images and allow cellular phones to browse them. There are some constraints on the image data size, which cellular phones can accept at the one time, for both of transmission and display of it. JWS must reduce JPEG images from network camera into a suitable size for cellular phones and accumulate these images in its storage for request of image delivery from cellular phones. Transmission times of not only an image but also a control signal are described as a trial evaluation of our system. First of both transmission times is the case of transmission time of an image. An image is obtained at network, stored in Server, and transmitted into a mobile phone, according to a request of a client. We measure 10 times of response time of an image, from pushing a button of phone to getting image on the display of the phone as transmission time of an image. The result of performance is shown in Table 1. The average of transmission time of an image is 5,089 milli-seconds (about 5 seconds). Maximum time is 7.10 seconds and minimum one is 2.06 seconds. Amount of image is 2.2-kilo bytes in that case A size of image to be transmitted is normal and almost constant in our system because such a monitoring image is obtained at network camera, periodically accumulated in JWS, and reduced suitably for cellular phones. Due to Wide Area Network of cellular phone service, transmission times range, for example, from 2,060 milli-seconds to 7,100 milli-seconds. In almost case, however, clients of our surveillance system will be able to obtain the monitoring image and take a look at the display of cellular phone about under 10 seconds of response time.

2. Conclusions

We have described design and tentative implementation of a Web-based surveillance system. Our surveillance system contains several kinds of servers; JWS is designed to play an intensive role to instruct and integrate its subsystems by means of network connectivity. Mobile computing devices, especially, wireless portable PC's and/or cellular phones are useful for client users to communicate with monitoring and database server at any place as well as at any time. In order to realize such monitoring and controlling, it is available for constructing a Web-based surveillance system.

This paper also considers remote interactive browsing of JPEG 2000 content captured by still cameras. Rather than transmitting each frame independently to the clients as it is generally done in the literature for JPEG 2000 based systems, our proposed streaming server adopts a conditional replenishment scheme to exploit the temporal correlation of the video sequence. As a first contribution, we propose a rate-distortion optimal strategy to select the most profitable packets to transmit. As a second contribution, we provide the client with two references, the previous reconstructed frame and an estimation of the current scene background calculated at the server side, which significantly improves the transmission system rate-distortion performances. As a third and significant outcome, we describe a post-compression rate allocation mechanism, which enables the server to adapt in real-time the content forwarded to heterogeneous –both in terms of resources and interest- clients using a single pre-compressed version of the sequence.

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