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SMART MONITORING CAMERAS DRIVEN INTELLIGENT PROCESSING TO BIG SURVEILLANCE VIDEO DATA

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ABSTRACT
Video surveillance system has become a critical part in the defense and resort system of modem cities, since smart monitoring cameras equipped with intelligent video analytics techniques can monitor and pre-alarm abnormal behaviors or events. However, with the expansion of the surveillance network, massive surveillance video data poses huge challenges to the analytics, storage and retrieval in the Big Data era. It suggests a novel intelligent processing and utilization solution to big surveillance video data based on the event detection and alarming messages from front-end smart cameras. The method includes two parts: the intelligent pre-alarming for abnormal events and rapid retrieval for evidence videos.

Keywords—*Big data, video surveillance, surveillance systems*

1. INTRODUCTION

Intelligent video surveillance systems have become popular day by day because of growing needs for monitoring and responding to situations in real time. Modern cities are generally exposed to emergency situations, such as traffic accidents, terrorist attacks and crimes. As a typical example, Paris terror attacks in 2015 left at least 129 people dead. In order to stop criminals and minimize social security dangers, a large number of smart monitoring cameras and surveillance systems have been widely deployed in urban areas storage capacities. Currently autonomous detection of alerts and abnormal situations is still at primitive stage. The smart monitoring cameras are able to automatically identify abnormal behaviors through the built-in intelligent process, greatly increase the performance of the surveillance system. The necessary reason is that the existing system only individually accepts alarm information from each front-end camera.

Some observations on criminal activities can help to improve intelligent processing of big surveillance video data. First, criminals watch various places in different time before committing crimes, which are captured by cameras located in different sites. Through temporally and spatially associative validation within camera network, false alarming can thus be ruled out. Second, video storage is mainly used for post-investigation, and so the video without unusual behaviors does not have to be preserved for long term.

2. PROPOSED WORK

2.1The Intelligent Pre-Alarming For Abnormal Events

These can be performed in three modules which are as follows:

Sensing: A sensor network containing smart surveillance cameras and other sensors (fire and movement detectors) is connected with the control center. Cameras run motion detection algorithms to transform the video stream into data packets .They transfer data packets in XML file which contain information about different moving object.

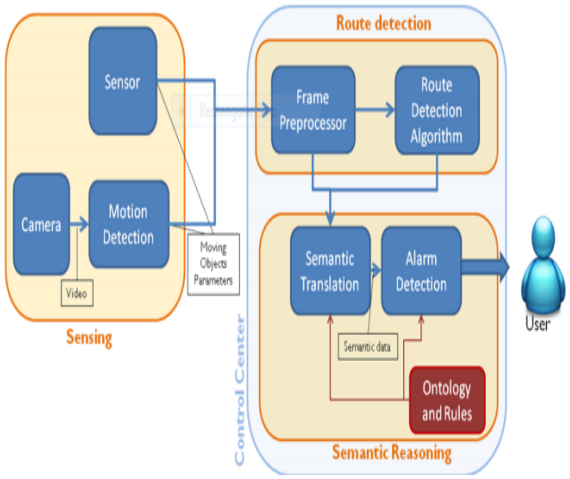


Fig.2.1.1 Basic scheme of the proposed surveillance system

Route Detection: When the XML file with the parameters of the moving objects is received, circumference and motion patterns of different objects are processed using an algorithm that builds for each camera. It has two internal sub modules. First, the frame preprocessor which receives XML file detected by camera , separates the integrated data in different

frame corrects the potential distortion using height and bent angle values by applying a simple Inverse Perspective Mapping , and reformats the information in a raw data matrix. From this raw data matrix, by using a set of routines ,the Route Detection Algorithm implemented in Matlab, determines the routes of the scene.

Semantic Reasoning: When Route Detection stage has finished and the route of the scene is determined. This stage translate the syntactic attribute of objects detected by the cameras and the Route Detection stage into meaningful semantic classes (car instead of object) and identify any alert situation going or not (For ex. a car is on the sidewalk) according to the ontology and semantic rule .Simply Semantic Translation translates the syntactic information into semantic data After the translation, the Alarm Detection sub module processes the ontology with a semantic data to find new properties about the objects in the image, and identify if an alarm situation is going on. If it is the case, it sends an appropriate XML Alarm.

Fig.2.1.1 Vehicle in wrong direction

2.2Rapid Evidence Video Retrieval Driven by Abnormal Events

Abnormal behaviors, which have a strong connection with specific events, not only refer to behaviors that influence the process of the event, but also represent those unusual actions which do happen after the incident. In the time of big data, typical behaviors can be summarized through data mining from massive historical cases, with the assistance of specific expert knowledge. Here are some typical associations between unusual behaviors and security events that have been verified:

a. Wandering outside or around the spot before bank robbery;
b. Running nearby after robbery;
c. Entering(or leaving) the community before (or after) burglary;
d. Gathering before group incidents such as riot;
e. Gathering before affray;
f. Moving against crowds after the violence;
g. Illegal parking in violence.

Therefore, establishing mapping relationship between typical events and abnormal behaviors that could be detected by smart monitoring cameras is indispensable. After occurrence of a case, by searching abnormal behavior database, all of unusual behaviors that have a strong correlation with the case according to event-abnormal behavior association table can be identified, including their occurrence time and spots. The meticulous analysis can be further performed with related snapshot images and videos captured by smart cameras. In this way, there is a significant decrease in data-analysis scale during the process of video investigation, and efficiency in finding evidences can be raised accordingly.

2.2.1 Event-abnormal Behavior Correlation Model

1. Definition of abnormal behavior set:
   A= {Regional invasion, Entering/Leaving the area, Wandering, Fast movement, fighting...}
2. With the increasing number of different types of abnormal behaviors detected by smart monitoring cameras, set A shall be enlarging correspondently.
3. With the expansion of abnormal behavior set A, cases or events which are closely related to newly added abnormal behaviors will be analyzed and added to the events set
4. For a given entry E_i in event set E, according to the historical case data, the frequency of associated abnormal behaviors will be counted and sorted as set S_1.
5. For a given entry E_i in event set E, according to expert's knowledge, all the relevant unusual behaviors are enumerated by priority and labeled as set S_2. Get intersection elements
   $$S=S_1 \cap S_2$$
6. Select the very first two behaviors in S, and record them into the correlation model table as the most likely associated unusual behaviors with a particular event

2.2.2 The Use of the Abnormal Behavior Database

Retrieval, statistics, analysis and other operations can be performed with respect to the abnormal behavior database, which thus can provide sufficient data for video evidence collection, social security situation census and security risk assessment.

Here are major functions of the abnormal behavior database.

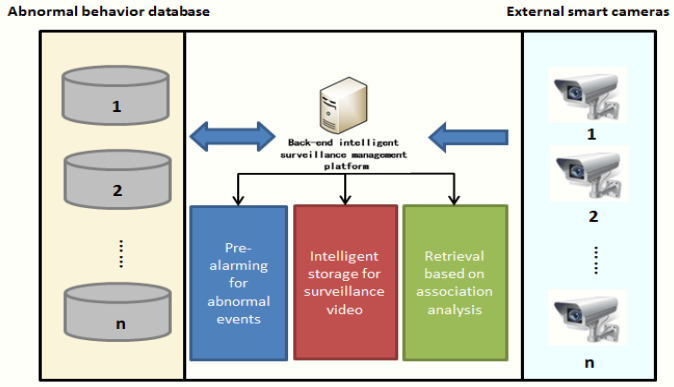
a. **Retrieval:** Abnormal behavioral constrained video forensics. Retrieve under types of behavior, site or time, and show retrieval image outcome along with time and site of the event.
b. **Statistics:** Survey of social security situation. The two dimensional statistics in terms of time and places, with a two-dimensional surface showing the number of abnormal behaviors occurred a year.
c. **Analytics**: The assessment of security risk. Cluster the spatial and temporal attributes of abnormal behavior, draw a security surface map. Try to figure

out spatial and temporal attributes of abnormal behaviors and predict their trends, find key nodes of security, and conclude information in favor of decision-making. For example, thieves are willing to steal at the end of a year or robberies are more likely to happen in a secluded place.

3. IMPLEMENTATION

Although smart cameras have gained popularity in recent years, there is no enough system software that can exert its features completely. Currently, there exist three major problems for using smart cameras: easy to produce false alarm, requirement for large storage and huge manual retrieval workload. These report designed the software to address the problems of pre-alarming, storage and retrieval. The framework of software is shown in Fig. 3.1 which consists of abnormal behavior database and three functional modules.

The alarm information of unusual behaviors, which is captured by front-end smart cameras, is used to construct the abnormal behavior database will provide the metadata for the subsequent analysis. The descriptive information provided by metadata includesthe type of monitoring site and unusual behavior, name of monitoring site, ID of smart camera, time of abnormal behavior index ofsurveillance video, snapshot or criminals usually cautiously observed environment video clip of associated behavior.



3.1 Software architecture.

As a kind of concrete realization, the abnormal behavior database has its own construction and method for accessing to information, which is shown as below:

1. The recorded type of abnormal behavior is exactly kept same as the type detected and labeled by smart cameras.
2. The name of monitoring site and the ID of smart camera show the specific geographic location.
3. Recording the time of abnormal behavior when it occurs and ends according to actual alarming.
4. Snapshot or video clip of associated behavior is regarded as a compressed result, which has already re-judge whether there are people staying for too long, and moved irrelevant frames from original video.
5. There are two methods to obtain snapshot or video clip: if smart camera has the function of delivering snap-shot, saves it directly. Otherwise, it needs to be long time in the spot but also behaved similarly in many done by back-end platform.
6. The index of surveillance video is created for locating videos quickly when case happens.
7. The remark includes some personalized information of behaviors, like the number of people who are wandering and direction of running.

4. ADVANTAGES

- Crime prevention-. It prevents crime.
- Use of surveillance information for marketing- By using advanced surveillance systems we can understands that where people spend most of their time, it is very helpful for marketing purpose.
- Public Safety- Surveillance cameras can be used to keep an eye out for any perpetration that are in progress.
- Evidence- In court, when video evidences are required these is very helpful technique.
- Prevent burglary by alarming .
- Surveillance systems are not easily damaged by dust, and severe climatic conditions.

5. DISADVANTAGES

- Visibility- Camera body and sensitive optics can be protected by replaceable, hard acrylic glass domes. In certain scenarios (e. g. ATMs) pinhole cameras can be used, which use only a tiny lens opening or are mounted behind a one-way transmissive aperture
- Risk of vandalism- blinking status lights and realistic lenses and controls. Even skilled staff will be unable to distinguish them from the original.

6. CONCLUSION

Comparing with the traditional video surveillance system, the proposed solution give full use of detected and alarmed events by smart monitoring cameras, which thus effectively improves the performance of intelligent surveillance system, It has the ability to danger pre-alarming, and rapid evidence video retrieval driven by abnormal events is possible. Meantime, the surveillance video data relevant to specific cases will be shelled down, which will greatly improve the efficiency for discovering valuable investigation clues.As the number of cameras to watch grows, several operators might be required, which increases the complexity and cost of the system. Automated surveillance systems solves this problem, autonomous interpretation of the scene is possible and the identification of alarm conditions is determined.

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