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A System for Video Surveillance

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Abstract- More than ever before, it is important to maintain the safety and security of citizens, public infrastructure, buildings. This paper is concerned with video surveillance systems. With the growing quantity of security video, it becomes vital that video surveillance system be able to support security personnel in monitoring and tracking activities. In this paper is described new video surveillance system.

I. Introduction

Video surveillance systems are widespread and common in many environments. Video surveillance has been a key component in ensuring security at airports, banks, casinos, and correctional institutions. More recently, government's agencies, businesses, and even schools are turning toward video surveillance as a means to increase public security. With the proliferation of inexpensive cameras and the availability of high-speed, broad-band wireless networks, deploying a large number of cameras for security surveillance has become economically and technically feasible [15].
Several important research questions remain to be addressed before we can rely upon video surveillance as an effective tool for crime prevention, crime resolution, and crime protection [10,11]. Much of the current research in video surveillance focuses on algorithms to analyse video and other media from multiple sources to automatically detect significant events [9].
The remainder of this paper is organized as follows. Section 2 describes video surveillance system and applications of visual surveillance. In section 3 is describes change detection. In section 4 is represented our new video surveillance system. Example sequences in which people are recognition are reported in section 5.

II. Video surveillance systems

Video surveillance is an active area of research. Object detection and tracking in video surveillance systems are commonly based on background estimation a subtraction. The primary focus of today's video surveillance systems act is the application of video compression technology to efficiently multiplex or store images from a large number of cameras onto mass store devices (video tapes, discs) [5].
From the perspective of real-time threat detection, it is well know that human visual attention drops below acceptance levels, even when trained personal and assigned to the task of visual monitoring [17]. On the other side, video analysis technologies can be applied to develop smart surveillance systems that can be aid the human operator in real-time threat detection [1]. Specifically, multiscale tracking technologies are the next step in applying automatic video analysis to surveillance systems.
Applications of visual surveillance include car and pedestrian traffic monitoring, human activity surveillance for unusual activity detection, people counting, etc. A typical surveillance application consists of three buildings blocks: moving detection, object tracking and higher level motion analysis.
Multimedia systems can provide surveillance coverage across a wide area, ensuring object visibility over a large range if depths and can be employed to disambiguate occlusion. Techniques that address handover between cameras, in configurations with sheared or disjoint views, are therefore becoming increasingly important. Events of interest identified as moving object and people must be coordinated in the multiview system and events of special interest must be tracked throughout the scene [16].
Several video surveillance products are available on the market for office and home security as well as remote surveillance. They monitor a home, an office, or any location of interest, capturing motion events using webcams or camcorders and detect abnormalities [12]. In the case of webcams, the visual data is saved into compressed or uncompressed video clips, and the system trigger various alerts such as sending an e-mail.
The necessarily of working with complex scenes characterized by high variability, requires the use of specific

and sophisticated algorithms for video acquisition, camera calibration, noise filtering and motion detection that are able to learn and adopt to changing scene. Working with scenes characterized by poor structure requires the use of robust pattern recognition and statistical methods.
The video surveillance system comprises the function of object detection, tracking, recognition and classification. The problem of object detection has been tackled using statistical models of the background image [6,12,13], frame differences techniques or a combination of both [7]. Several techniques have also been used for object tracking in video sequences in order to cope with multiple interacting targets.
Object recognition and classification is performed using statistical Pattern Recognition and neural network. Several features, which explore the specific condition of the problem, can be used. These include geometric features such as bounding box aspect ratio, motion patterns and colour histogram [12,13].

III. Change detection

For the surveillance application considered, video cameras capture images of a static scene, with illumination changes, most of the time. The entrance of an intruder into the scene can thus be detected by the changes it causes. A change detection segmentation algorithm can be used, with the changing areas typically correspondent to intruders. The change detection algorithm implements a statistical hypothesis test to decide whether a given pixel has changed, or not, like in [2], and, additionally, the thresholding step makes extra considerations about the differences between the changed and unchanged areas' variations, and on the size of the changed area, to achieve a better behavior for the thresholding operation [8].
The main modules of the proposed change detection segmentation are:

- *Thresholding* – Classification of pixels as changed or not results from the thresholding of the difference between consecutive images. The threshold value is automatically computed, according to the video sequence characteristics, without any manual configuration.
- *Combination with memory* – The thresholding output is combined with the segmentation masks from a memory, to make the change detection results more stable. This improves segmentation results when the motion of a given object temporarily stops.
- *Smoothing* – Isolated pixels are removed and small holes in objects are filled to make the change detection segmentation result smoother.
- *Memory update* – The final step consists in the automatic adjustment of the memory contents, according to the observed sequence characteristics. The memory stores information about the changed areas detected in past time instants, being essential to keep track of objects even when they temporally stop moving, to ensure a better temporal continuity of change region. However, using a long memory may have the undesired effect of creating segmentation masks for the moving objects that are much larger than the actual objects. The algorithm memory length control parameter represents the number time instants in which the pixel's classification as changed should be kept [8,14].

IV. Video surveillance system architecture

Tracking accessibility of people into the rooms, where is enter for the employees only. At airports, stations, schools and etc., the security is very important for prevention of employees and non-employees.

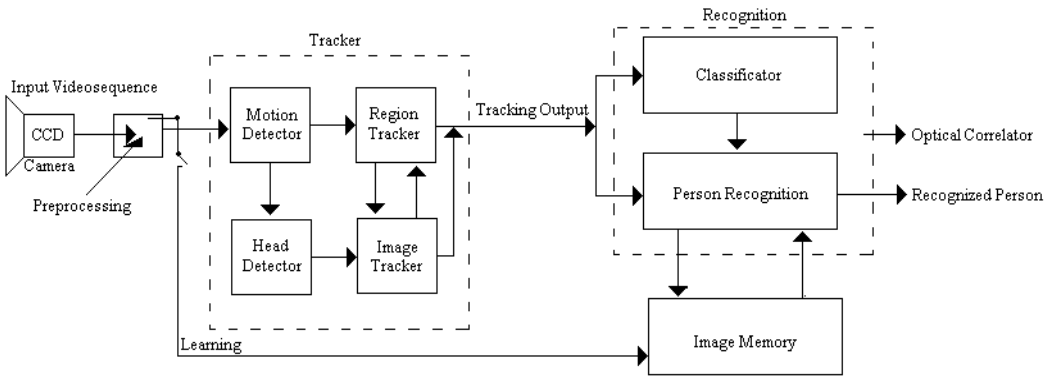

Figure 1. The architecture of video surveillance system

The designed system architecture is on Fig. 1. We have video output from CCD camera. This video output is divided to video sequences that are input for process called pre-processing. To recognition moving objects on the background, head detection and luggage detection we using the tracker. Tracker contained following blocks: Motion Detector, Head Detector, Image Tracker and Region Tracker. Tracking output is recognized in recognition block. Recognition block contained two blocks: Classificator and Personal Recognition. Data from recognition output are compared with data from Image Memory. Image memory is database containing a list of known faces, that have guarded enter to this room (employees faces). Learning is a process of personal identities creation.
First task of the optical correlator is linking together person with his luggage, bag, package, etc. and if this person leaves guarded room with the same luggage, bag, etc.
Second task is performed with an optical correlator which compare faces from tracker with database of known faces, that have guarded enter to this room.

V. Experimental results

A new method for a robust and efficient analysis of video sequences is presented; it allows the extraction of foreground objects and the classification of static foreground regions as abandoned or removed objects.
On Fig. 2 is shown face detection with recognition system. The face detection and recognition system utilizes a video camera and a PC with optical correlator to perform the person identification task. It should:

1. Detect faces from the still images (or video sequences). There is no restriction to the background and the number of faces.
2. Handle the varying conditions in a consumer environment.
3. Recognize faces by comparing the captures face images to a database of known faces. A decision is then made about the identity of the person (either one of the faces in the database, or not belong to the database at all).
4. Enable that the face detection and recognition stage can take place at different locations.

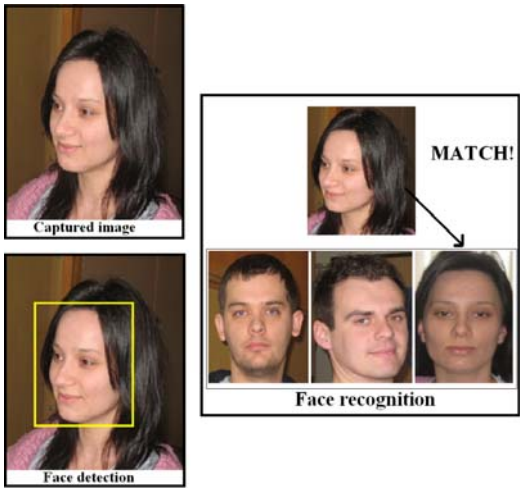

Figure 2. Face detection and recognition system

VI. Conclusions

Surveillance systems significantly contribute to situation control. Such systems transform video surveillance from a data acquisition tool to information and intelligence acquisition systems. Real-time video analysis provides surveillance systems with the ability to react to an activity in real time, thus acquiring relevant information at much higher resolution [4]. The long-term operation of such systems provides the ability to analyze information in a spatial-temporal context.
Despite the importance of the subject and the intensive research done, background detection remains a challenging problem in applications with difficult circumstances, such as changing illumination, waving trees, water, video displays, rotating fans, moving shadows, inter-reflections, camouflage, occasional changes of the true background, high traffic, etc. Simplistic, static-background models cannot solve such problems. Some are

very computationally extensive and cannot be used in applications requiring real-time operation [3].The problem of remote surveillance has received growing attention in recent years, especially in the context of public infrastructure monitoring for transport applications, safety of quality control in industrial applications, and improved public security. The development of a surveillance system requires multidisciplinary expertise, including knowledge of signal and image processing, computer vision, communications and networking pattern recognition and sensor development and fusion [4].
Our system is preventing before entering forbidden person and leaving the suspicious luggage into the guarded room. In this luggage or package could be bomb, gun, drugs, etc. On the other side, big task is checking if some person steals the luggage, package or the other things. Our system could increase security employees and the other people in schools, stations, airports, etc.

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References

[1] ARAKI, A. - MATSUOKA, T. - YOKOYA, N. – TAKEMURA, H.: *"Real-Time Tracking of Multiple Moving Object Contours in a Moving Camera Image Sequence",* IEICE Trans. Inf. &Syst., vol. E83-D, no. 7, pp. 1583 – 1591, July 2001.
[2] BAR-SHALOM, Y. - FORMANN, T.: *"Tracking and Data Association"*, Academic Press, 1988.
[3] BERAN, V. - HEROUT, A. – ŘEZNÍČEK, I.: *„Video-Based Bicycle Detection in Underground Scenarios“*, In: Proceedings of WSCG'09, Plzeň, CZ, p. 4, 2009.
[4] BHARGAVA, M. – CHEN, CH. - RYOO, M. S. - AGGARWA, J. K.: *„Detection of object abandonment using temporal logic“*, Springer Berlin, pp. 271-281, January 2009.
[5] BOJKOVIČ, Z. - SAMČOVIČ, A. – TURÁN, J.: *"Object Detection and Tracking in Video Surveillance systems"*, COST 276 Workshop, Trondheim, Norvegia, 113 – 116, May 25 – 26, 2005.
[6] BOULT, T. - et al.: *"Into the Woods: Visual Surveillance of Noncooperative and Camouflaged Targets in Complex Outdoor Settings",* in Procceding of the IEEE, vol. 89, no. 10, Oct. 2001.
[7] COLLINS, R. - et al.: *"A System for Video Surveillance and Monitoring"*, CMU-RI-TR-00-12, 2000.
[8] CORREIA, P. L. – PEREIRA, F.: *"Change Detection – Based Video Segmentation for Surveillance Applications"*, VIAMIS, 2004.
[9] CUCCHIARA, R.: *"Multimedia Surveillance systems",* Proc. ACM Workshop on Video Surveillance and Sensor Networks, pp. 3 -10, 2005.
[10] DIMITRIJEVIČ, Z. - WU, G. – CHANG, E.: *"A Multi-Sensor Fusion and Mining System"*, Proceeding of the 2nd Usenix FAST, March 2003.
[11] EBRAHIMI, T.: "*Image and Video Analysis: Trend and Challenges Position Statement"*, VIAMIS, Lisbon, April 2004.
[12] HARITAOGLU, H.: *"Hartwood and Devis, W4: Real Time Surveillance of People and their Activities"*, IEEE Trans. Pattern Anal. Machine Intell., vol. 22, no. 8, pp. 809 – 830, Aug. 2000.
[13] McKENNA, S. - et al.: *"Tracking Groups of People",* CVIU 80, pp. 42 - 56, 2000.
[14] PAULO, F. C. – CORREIA, L. C.: *"Automatic detection and classification of traffic signs"*, VIAMIS, 2007.
[15] RANGASWAMI, R. - DIMITRIJEVIC, Z. - KAKLIGIAN, K. - CHANG, E. – WANG, Y. F.: *"The SfinX Video surveillance system"*, 2003.
[16] RAO, K. R. - BOJKOVIČ, Z. S. – MILOVANOVIČ, D. A.: *"Introduction to Multimedia Communications: Applications, Middleware, Networkin*g", Wiley, 2005.
[17] RAO, K. R. - BOJKOVIČ, Z. S. - MILOVANOVIČ, D. A.: *"Multimedia Communication Systems: Techniques, Standards and Networks"*, Prentice-Hall PTR, New Jersey, 2002.