Integrated Surveillance System and Field Test in Urban Transit System

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Abstract

The security issue in urban transit system has been widely considered as the common matters in mass transition system. The safe urban transit system is highly demanded because of the vast number of daily passengers, and providing safety is one of the most challenging projects. We implemented a field model for integrated security system at subway stations and demonstrated its performance. This system consists of cameras, sensor networks and central monitoring software. We described the smart camera functionality in more detail. The proposed smart camera includes video analytics, video encoder and the server modules that transmit video and audio information. The video analytic functions in the system range from enter detection to crowdedness estimation, or fire detection. By the experiment, we obtained the high detection rate for tested events. We expect that the system would prove high performance at various events in our integrated intelligent surveillance system.

Keywords: *Video Analytics, Integrated Surveillance System, Smart camera.*

1. Introduction

The integrated surveillance system which covers the large area in metro subway environment saves the human resource and minimizes the non-surveillance spots. The smart network cameras with embedded video analytic algorithms and the video controllers which enable the conventional analog cameras to be smart are all combined into the integrated surveillance system. The proposed field model of integrated intelligent surveillance system consists of video analytic modules and various sensors. The sensors detect the status of temperature, dust, and smoke. The architecture approach has two types of cameras with regard to video analytics. Firstly, we employed the smart camera with internally embedded video analytic module. Secondly, we added the video analytic module to the conventional analog camera. The intelligent video analytic module detects the dangerous or unusual events, and sends information to the operators, by which the operator does not have to concentrate on monitors all the time.

This paper is organized as follows. Section 2 explains the difference between conventional surveillance system and our system. Also, we discussed the integrated intelligent surveillance system. Section 3 shows experimental results obtained at field test. Finally we concluded in section 4.

2. Security System at Urban Transit

2.1. Conventional Security System

We can find the conventional security system at urban subway stations as shown in Fig.1 even though it is installed not long before. People observe video inputs on the multi vision monitor from various cameras, and when suspicious situation occurs, they deal with it to keep safety.

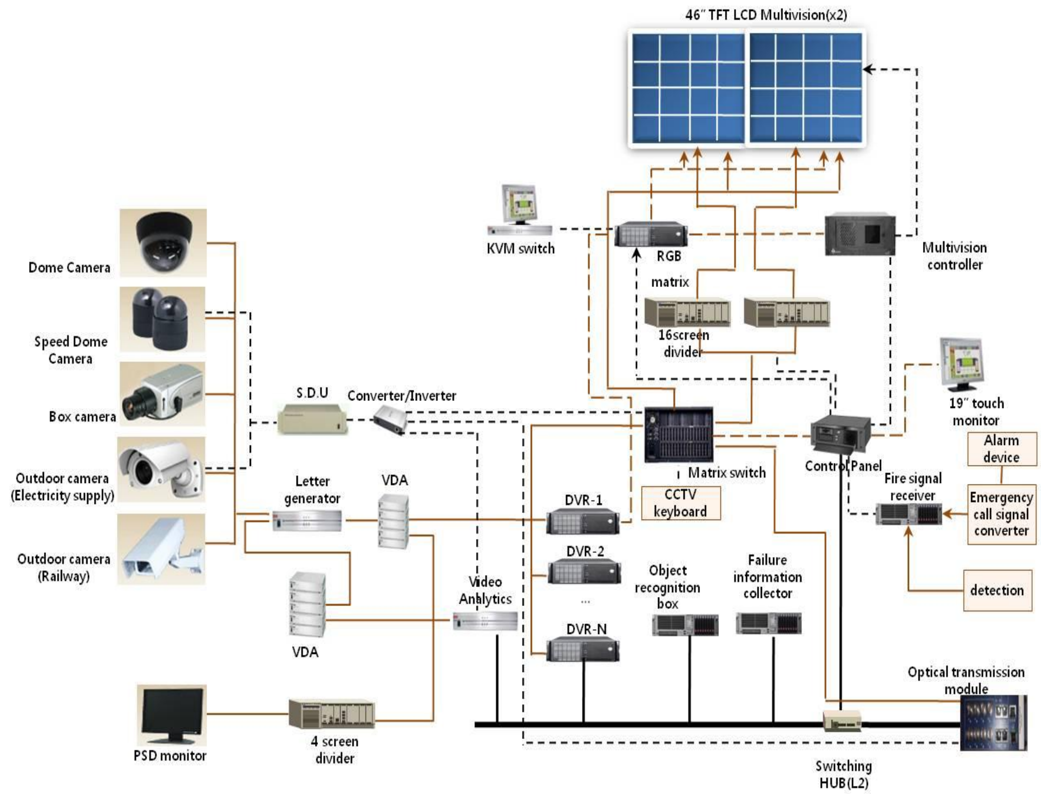


Figure 1. Conventional Surveillance System Installed at Urban Transit

People can't concentrate themselves on the monitors for a long time, and in this way they might miss the dangerous situations. When an emergent case occurs, reaction scenario must instantly begin, but under this system it is not very easy. At next section we introduced the intelligent system that overcomes this problem.

2.2. Integrated Intelligent Security System

The automatic and intelligent surveillance system integrates various sensor inputs and manipulates them to prompt adequate reaction scenario when security related events occur. As mentioned above, the system approaches in two ways with regard to video analytics. The architecture approach has two ways with regard to video analytics. Firstly, we employed the smart camera with internally embedded video analytic module. Secondly, we add the video analytic module to the conventional analog camera by which the old and conventional analog camera can be connected to the system.

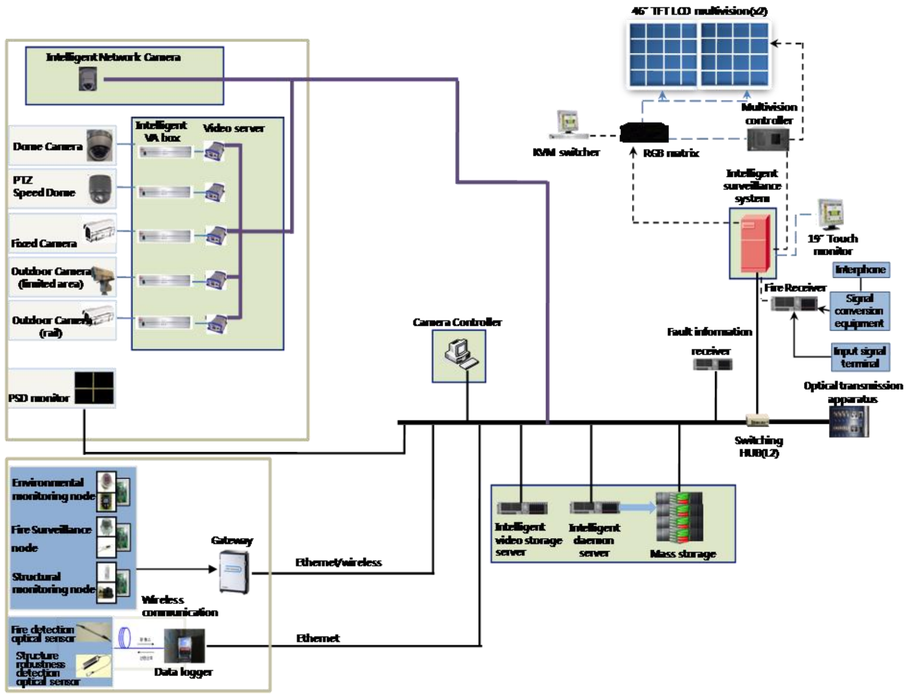


Figure 2. Intelligent Surveillance System Block Diagram

Table 1 shows some of the event processing scenarios embedded in smart camera in our system.

Table 1. Intelligent Scenario for Urban Transit Environment

Scenario	Role
Region of Interest	Free ride detection at ticket gate
Dangerous Area Monitoring	Detection of moving object at dangerous places. Observe near elevator
Fire detection	Fire detection at platform and at ventilation room
People counting	Counting people near transfer area
Crowdedness	Estimate crowdedness at platform

In order to perform the scenario task, eight functions were developed as shown in Table 2.

Table 2. Example of Developed Video Analytic Algorithms

Algorithm	Role
Motion Detection	Moving object detection in a video frame
Cross	Detection of object crossing virtual line
Enter	Detection of object entering the region of interest
Absent	Abandoned/stolen object detection in the region of interest
Auto Tracking	Object tracking by PTZ camera
DIS	Digital image stabilization for cluttering image
Loitering	Detect people hanging around in a region
Dehaze	image enhancement to reduce haze in smart camera
Fire detection	Fire detection at highly secure demanded area
Flow Monitoring	People flow crossing a virtual line and count the number
Crowd Monitoring	Density of people in an region of interest

Figure 3 shows the flow chart for loitering detection. A region of interest is initially set and moving path is defined. If a person is hanging around at the region with the highly matching pattern of defined path, then the system raises the loitering event alarm signal.

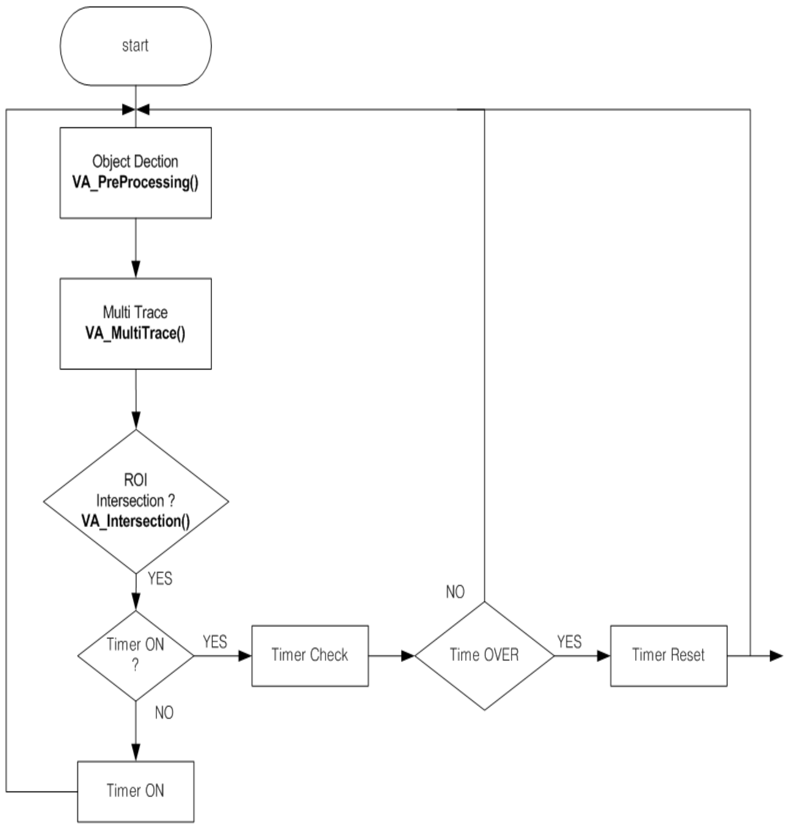


Figure 3. Flow Chart of Loitering Detection

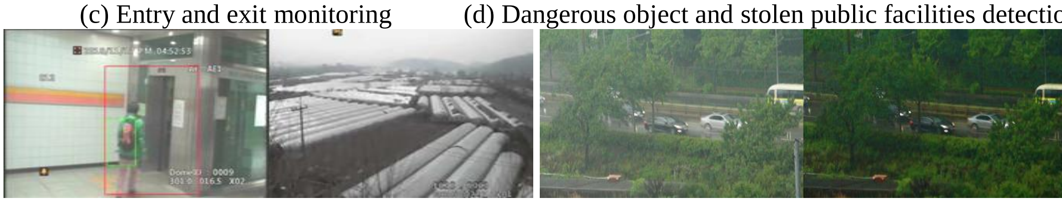
3. Experimental Results

We performed the field test of the proposed system installed at the real subway stations. Figure 4 shows the test results. In order to obtain quantitative results, we counted the number of successful detection out of fifteen times trial. We selected two enhancement and eight events which might occur at stations. In each experiment, we obtained 100% success in the event from Fig.4(a) to Fig.4(c), and 87% in (d). For the entering event as in (e), we achieved 100% success and obtained distinct enhancement in (e) and (f). For (g) to (j), the result shows 87% success.

(a) Intruder detection, auto tracking

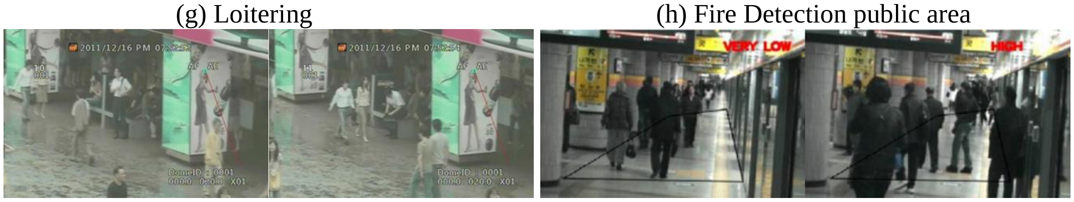
(b) Trespasser detection

(c) Entry and exit monitoring (d) Dangerous object and stolen public facilities detection



(e) Elevator entry detection and DIS (f) Dehaze Enhancement

(g) Loitering (h) Fire Detection public area



(i) Flow Monitoring in Field and sample video test (j) Crowd Monitoring

Figure 4. Result of Urban Transit Field Test

4. Conclusion

In this paper we proposed the integrated surveillance system which employs the video analytic cameras and evaluated the performance of the system by field test at subway stations. The result shows that the proposed surveillance system is well matched with the real subway station. In the future, system improvement at the smart camera and cooperation with various sensor outputs should follow to obtain the accuracy higher than 90%.

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