

Monitoring System Based on Wireless Sensor Network

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Abstract. With people's safety awareness improves, more and more security and monitoring system is need in society. The security and monitoring system designed in this paper is based on the wireless sensor network. The system can record audio, video, alarm and other signals, and the signals can be stored for future inquiry. The system designed has the advantages of security, flexibility, intelligence and so on, it can be used widely.

Preface

With society's development, people's security awareness is growing. Traditional security and monitoring measures can not meet people's need today. In addition, security and monitoring system is widely used, that almost every field will use the system, the residential area, industrial area, commercial area and so on. Almost every corner of the city will have a security and monitoring system. Security and monitoring system can associate with other protection and alarm system, making the system more powerful. The system's peripheral equipment can be controlled through auxiliary communication interfaces. The security and monitoring system designed in this paper is based on the technology of wireless sensor network(WSN for short). WSN is thought to be one of the most influential techniques in the 21st century. It is also thought to be the second network after internet. It will produce profound impact in people's future life. The research on the WSN and its application in China has become the world's leading technology in the world in the information field.

Introduction of Wireless Sensor Network

The wireless sensor network includes wireless sensor node, sink node, and management node. The wireless sensor node consists of many stationary and moving sensors, processor, wireless communication modules and power. The sensor is responsible for collecting and converting the object's information; the processor controls the operation of the entire node, stores and processes the data collected by itself and other sensor nodes; wireless communication module realize the communication between sensor nodes, sensor node and user node, management control node, receive and send data. Multiple sensor nodes are deployed in the monitoring area, forming the multi-hop wireless ad hoc network.

Sink node gathers the information collected by wireless sensor nodes, and then sends the information to management node through wireless communication. The sink node plays the role of intermediate connection. The data collected by wireless sensor nodes is transmitted along other nodes. In the transmitting, the data can be processed by multiple nodes, after multi-hop to the sink node, arrives the management node via the internet or satellite. The architecture of the WSN is shown in figure 1.

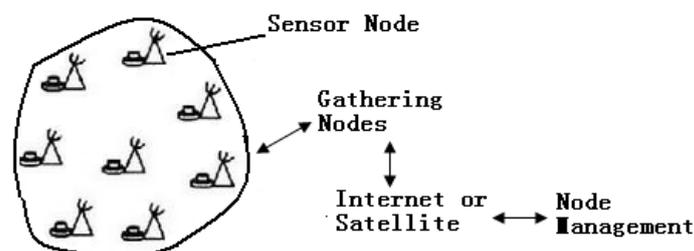


Figure 1. Architecture of the WSN

WSN acquires, processes and transmits the monitored information in the areas where the network covered, then the information or data is reported to the users. Many sensor nodes of WSN detecting data, gathering the nodes, and send the data to users through other network.

The Structure of Security and Monitoring System

There is a security and monitoring system based on WSN for a residential quarter. The host of the system is a multimedia computer. As for the monitoring system of WSN, it is made up of high performance Industrial Personal Computer(IPC), all the devices(video matrix switch card, audio matrix switch card, video card, audio card, communication card, etc) are inserted into the chassis of the IPC, this makes the system easier to be integrated, and have higher stability. The whole system of the sub-control terminal also is a multi-media computer, under the network environment, every sub-control computer can communicate with host directly according to the protocol, and the sub-control computer authorized can control the whole monitoring system.

The whole system can be divided into two blocks: hardware and software. The hardware platform equipped with high performance multimedia computer; video and audio matrix switcher, Industry Standard Architecture(ISA) bus; talkback monitor card for talking with the monitoring site bidirectional; Input/output card, providing the system's input and output; video capture card, completing A/D conversion of the signal; digital video compression card, completing the compression of video image, facilitating the system's storage and transmission. The software includes processing software and monitoring software. Running the monitoring system based on WSN needs corresponding controlling software, these software can implement the function of switching, for example: video signal matrix switching, audio signal matrix switching, alarming control, PTZ camera control, auxiliary control and so on. In addition, the system has signal processing function, for example, the layout arrangement of the control system is displayed in the form of graphic, real-time image is displayed in serial port mode, the image displayed in the window can be stored and printed and so on.

The entire system can be divided into two parts from another aspect, monitoring site and monitoring center, as shown in figure 2, the figure shows the architecture of the monitoring system. The core equipment on the monitoring site is on-site processing equipment; the equipment can perform A/D conversion, compression and coding for the following signals: the video images that camera captured, audio information collected by the monitor and the information captured by the alarm probe. After composite processing, the signals are sent to the monitoring center through WSN, according to different situation, taking different compression methods for the signals, it maybe MPEG-1、MPEG-2, MPEG-4 or H.264.

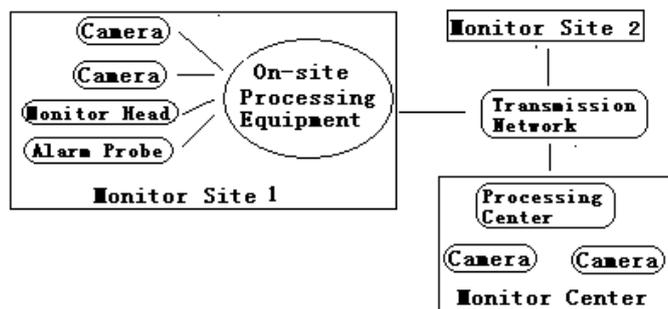


Figure 2. The Architecture of the Monitoring System

The centre architecture of the monitoring system based on WSN composed of centre control system and front-end equipment. Centre control system has multimedia computer, video and audio controller, switching devices and so on. The front-end equipment has camera, lens, PTZ and so on. The lens can be full-duplex mode or fixed mode. The centre of the monitoring system compress and process the signal of digital flow, finish the processing of video signal, audio signal and alarm signal. The centre also sends the audio control signal to the monitoring site, complete the controlling of monitor equipment. The centre has to deal with lots of audio video and image signals, so it needs large-capacity storage devices to store images of the video information. The centre can

combined with geographic information systems and management information system, providing more flexible management for the system.

In the working process of matrix switchers of the system's host, the front-end equipment take the camera as the center with some auxiliary equipment, the back-end equipment are displayer, controlling and recording equipment. The transmission part is connected to each other by means of optical cable, electric cable or microwave. In the Camera, transmission, controlling and display recording parts, every part has concrete equipment or parts.

A Security and Monitoring System Based on Wireless Sensor Network for Residential Quarter

There is a concrete example of a residential monitoring system based on WSN. The system composed of four parts, the front-end of the monitoring site, the transmission network and controlling, remote controlling centre, remote client terminal. The architecture of the system is shown in figure 3

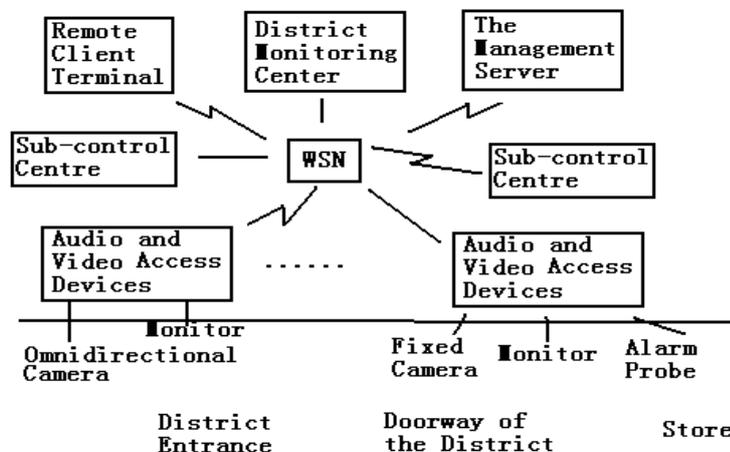


Figure 3. A Monitoring System of a Residential Quarter

As shown in figure 3, cameras (omnidirectional and fixed) captures video and audio signals, alarm probes collect alarm signals. The captured signals are analogue, The controlling unit convert the analogue signals into digital signals, then compress and code the signals, the core of the controlling system is the microcomputer unit(MCU), the processed signals access to local area network through WSN. In addition to the hardware, the system needs software to implement various functions: PTZ control, camera control, video storage and remote control switch, database query and remote control, system management, such as work log, the system power on and power off at the same time everyday, implement all of these functions depends on the software.

The whole system is based on WSN, the WSN technology can ensure the quality of the signal in the transmission. Classification of the remote client at all levels of the monitoring center, authorization and the control of video audio signals transmission, all these jobs are finished by the management server of transmission. The limit of authority is distribute according to the need by remote monitoring center, the monitoring signals is sent to the center through WSN, the center pick the key signals to monitor according to the need. Every monitoring center of the residential quarter has its own limits of authority and control range, the authority and range can be adjusted according to the need and situation. The monitoring center also can be connected to the bureau of public security, this can ensure the security of residential quarter better.

Summary

In the monitoring system based on WSN, the video image can be stored, captured and displayed multi-screen, it is compressed with multiple methods to meet different needs; through the WSN, the system can realize point to point, or point to more network monitoring. This system can establish different security level to meet the need of large community's security need; depend on the management software's powerful function, the system can record, track, analyze and store the

monitoring signal automatically, achieve automatic management.

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