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Design and Realization of Video Collection and Transmission System in Wireless Multimedia Sensors Network

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Abstract: Wireless multimedia sensor networks, as a new type of processing and information retrieval technology. It is based on the existing wireless sensor network to construct and develop. This technology has the multimedia information awareness. In the commercial, civil and military and other fields it has been widely applied. Wireless multimedia sensor networks can be combined with multimedia technology, it has not only the character of unattended, self-organization that the traditional wireless sensor network (WSN) has, but also has rich media awareness, multitasking ability, network capacity and faster transmission speed. In this paper, we took the basic characteristics of the wireless multimedia sensor networks as a starting point to discuss the design and implementation methods of video collection and transmission system. *Copyright © 2013 IFSA.*

Keywords: Wireless, Multimedia, Sensor network, Video collection, Transmission system.

1. Introduction

In 2003, the international famous journals in IEEE, by Holman et al. First of all, on the coast by using video sensor network environment monitoring in detail in this paper, the problems. After that, the international academic circles have published a related video sensor network research. In IEEE conference series of ACM series appear a series of key research. EURASIP applied signal processing (EURASIP) magazine in 2006, successively carried out video sensor network research project. Since 2003, ACM also organizes international symposium (ACM) video monitoring and sensor network communication related research results. After 2003, the Iowa state university, university of Massachusetts, Carnegie Mellon University, the University of Virginia, Oregon Health & Science University and other famous universities also started the video sensor network research work, and set up a video sensor networks group and start the relevant research plan. Institute of computing technology, Chinese Academy of Sciences and National University of Defense Technology University also look at the video sensor network technology has carried on the corresponding research. In the node hardware structure, the WMSN is quite different from that of traditional WSN mainly embodied in WMSN is adopted which has the function of image and video acquisition sensor and processor has stronger processing function. Most interface design USES extensions of connected sensor nodes, to

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increase the versatility of platform. By the processor, the nodes can be domestically also attaches great importance to the research of video sensor network technology, institute of computing technology, Chinese academy of sciences and the national defense university of science and technology and other units also began in the field of study. WMSN and traditional WSN in the node hardware structure of different lies in WMSN adopted with images. Video capture function such as sensor and processor has stronger processing function. Most interface design USES extensions of connected sensor nodes, to increase the versatility of platform.

2. Wireless Multimedia Sensor Networks

2.1. The Network Structure

First, center control network. Center set controlled only by a central control node in the network of other ordinary nodes for management and coordination, the control points should be connected with ordinary node, through the central control node flow control, routing and data forwarding and access, ordinary nodes cannot be directly connected to each other. This kind of network structure with center control node processing power is stronger, but the equipment setup is more complicated, and ordinary node equipment is relatively simple, and the entire network control method is simple and clear structure and other significant advantages. As shown in Fig. 1.

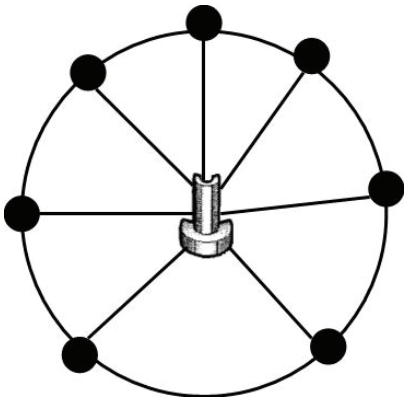

Fig. 1. Diagram of the center controlling network.

Second, a distributed network. All nodes are distributed in the network can play out the same function in the entire network, each node has the function of network routing and communication terminal at the same time, with equal flow management, routing and network control function, which is usually referred to as the structure equation [1]. The normally no bottlenecks exist, the structure and network structure is more perfect. Destination node usually has multiple paths between source node selection, help to select optimal routing and load balancing implementation. If distributed network mobility strong, however, and the number of nodes is bigger, often cannot to effective control and management of networks, each node in a distributed network routing should understand all of the other nodes, and to be able to effectively control the dynamic changes of the information [2]. As shown in Fig. 2.

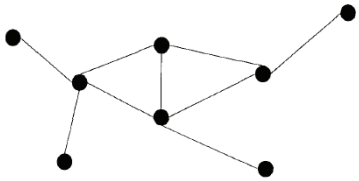

Fig. 2. Diagram of the distributed network.

Third, hierarchical network. Hierarchical network is usually divided into one or more clusters, each cluster consists of a cluster member to a cluster head. In more advanced network, all the cluster head to and then clustering, together constitute the more advanced network. Cluster nodes in the hierarchical structure, the main role is to forward data between clusters, either from the nodes, through the clustering algorithm to form, can also be specified in advance. In order to have effective communication between cluster heads and should provide support for each gateway node. Gateway nodes and cluster heads together form a higher level of network, and thus also known as a virtual backbone network. As shown in Fig. 3.

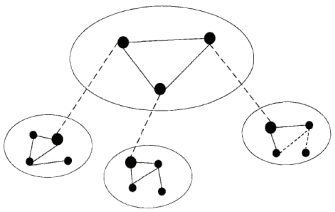

Fig. 3. Diagram of hierarchical network**.**

2.2. Nodes Structure of Wireless Multimedia Sensor Network

Software platform and hardware platform is a wireless multimedia sensor node architecture of two major components, among them, the operating system layer consists of power management, embedded file system, embedded network system and the embedded kernel and so on several parts; as attached directly to the hardware driver layer of a layer, able to provide power needed for the application and operating system support. Application is a software platform, operating system and driver layer of three main components.

2.3. Hardware Platform of Nodes in Wireless Multimedia Sensor Network

Peripheral devices with the core platform is the hardware platform of two major components, among them, the key link in the process of the core platform for the node system, mainly include all kinds of connecting device interface, FLASH, embedded CPU, RAM and combine to make the better performance of embedded CPU, as well as the high speed large capacity RAM and FLASH, so more in line with the large capacity of storage and video processing need [3]. All external interface to connect with other nodes, and the wireless network CARDS, camera top equipment under effective control. As shown in Fig. 4.

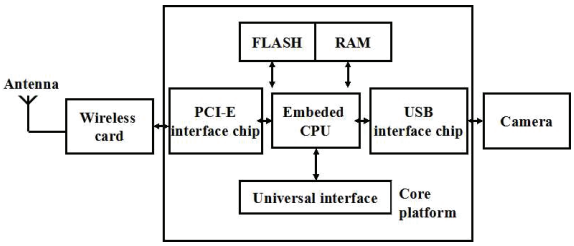

Fig. 4. Structure of hardware platform.

2.4. Software System of Nodes in Wireless Multimedia Sensor Network

2.4.1. Nodes Driver in Wireless Multimedia Sensor Network

For associated directly with the hardware device driver layer, the initialization of the wireless network interface card and video acquisition card after equipment, test and adjustment on the basis of the hardware of image processing, transformation, equipment of closed and open as well as the operation of the equipment and other related hardware capabilities. The equipment details some of functions with strong concealment quality, provides the same interface for the use of different equipment, on a special device file mapping equipment [4]. The same as the other documents, the upper file applications to control operation of the device. Associated with application software and related to system software, and board level initialization program is the layer of the three main types.

2.4.2. Nodes Operating System of Wireless Multimedia Sensor Network

Operating system to provide support for the video collection transmission software, embedded system should have the relevant key features include: First, to be able to control and drive video should scheduling in the process of collection and transmission equipment, to provide users with the interface and image; Second, better real-time performance of task scheduling and task of support is high, has better performance such as reliability, throughput, response time; Third, embedded systems often lack a clear difference between application software and system software, should not be in the realization of the function of the complex and design, so as to guarantee the security of system, reduce system operating costs [5]; Fourth, because of the embedded system is mainly used in wireless multimedia sensor node, the system resources are limited, therefore, compared with the original operating system, has good operational system kernel [6].

2.4.3. Nodes Application Module of Wireless Multimedia Sensor Network

To different types of sensing tasks, different applications can simultaneously applied to the application layer, mainly related to corresponding task monitoring based applications, necessary in the process of the running software and application software support. With other software, the software is not only needs to accord with stability, security and accuracy of the actual application needs, but should also maximize the system optimization at the same time, to reduce hardware costs, reduce system resource consumption [7]. VTSN video collection and transmission system is refers to the transmission, processing and collecting video image as the main target, based on the Gstreamer framework to develop multimedia, which is based on operating system and hardware platform, operating in the application layer of one with video long-distance display, transmission, acquisition and processing software system, thus further extend and enhance the function of wireless sensor network (WSN) [8].

2.5. Main Technology of Video Collection and Transmission System

2.5.1. Requirements and Characteristics of Video Transmission

Video technology belongs to a kind of very important multimedia video technology, video information is redundant, strong real-time performance, more basic characteristics such as large amount of data. Because video information compared with the normal data has high specificity, video collection transmission system in the network system, should meet the need of the following several aspects: First, the smaller packet loss rate. The occurrence of packet loss can lead to video playback quality degradation occurred due to lack of data. Second, the stability is good. Is the video

doesn't happen too often in the process of transmission jitter, and thus able to maintain stability for a long time. The main reason is that the number of video data generated to follow a particular code rate, in order to ensure the quality of the video playback. Third, the time delay is small. Video transmission need to keep certain timeliness, so it needs at a particular time, avoid video information. Fourth, the minimum transmission rate. In order to further improve the quality of video playback, should gradually reduce the transmission of video transmission rate, thus ensuring the specific amount of video data transmission in unit time complete [9].

2.5.2. Video Coding and Compression

H.261 video coding standard. H.261 belongs to the integrated services digital network (ISDN) in ITU-T two-way audio-visual business, its rate is 64 KB/s integer times. Can only handle QCIF h. 261 and CIF two image mode, and each frame needs to be macro block (MB) layer, macro block group (GOB) layer, image processing. Originally H.261 is applied to image compression in the process of moving, and formulate the detailed video coding, each part is mainly related to the office of motion compensation coding, quantitative, DCT transform, interframe prediction, and channel rate control with fixed rate [10].

H.263 video coding standard. Initial H.263 used in low bit rate video coding standard of ITU-T, belongs to a kind of less than 64 KB/s narrowband communication channel set of ITU-T video coding standard. Its development in H.261, on the basis of CIF, 4CIF, CIF or QCIF or 16S-QCIF 4:2:0 color and sample images for the main standard input image formats. Compared with h. 261, H.263 half pixel of motion compensation, at the same time has 4 more optimized compression coding patterns.

H.263 video compression standard version 2.H.263 standard version 2 of the ITU-T in H.263 after revision, not formally named H.263+ standard. Its not only keep the H.263 standard original core semantics and syntax, and on this basis, adding more options, which broke through the traditional H.263 standard limits in terms of image input format, the compression efficiency, is no longer just limited to five kind of source video format. H.263+ standard has a greater range of image input format, as well as the image of a custom size, greatly expanded the standard scope, make its can be based on the Windows wide-screen image, high frame frequency and computer image processing image sequence.

H.263 video compression standards. Starting from H263+ base, H263++ added three new options, the basic goal is to enhance coding efficiency, bad code to improve the performance of flow resistance error on the channel, the three options include: W: options based on H263+ code flow, increase the supplementary information, so as to guarantee for the enhanced backward compatibility. Option V: data can also be referred to as shading, have stronger ability to resist error, by putting the DCT coefficients and motion vectors in video stream data first separated, with reversible coding method to protect the motion vector. Options: U can also be referred to as the enhanced reference frame and its regeneration ability strong channel errors and higher coding efficiency, and must have more buffers for reference frame image storage.

H.264 video coding standard. H.264 video compression standard belongs to a new generation of application in the low bit rate transmission of video compression standard, compared with the traditional coding method, at the decoder side H.264 did not see significant changes, the basic difference is that the details of the different function blocks, and image content forecast, obviously improve the encoding efficiency is achieved. Compared with the original video compression standard, H.264 has much more advanced technology, mainly for the size of the block of the interframe prediction technology, multiple reference frames, 1/4 pixel accuracy motion estimation, airspace frame prediction and 4×4 integer transform, etc.

3. Design of Video Collecting System VTSN

VTSN for wireless multimedia sensor network video transmission system mainly includes two parts of receiving end and sending end, among them, the receiver the main role is to implement the corresponding reverse operation, including read the RTP packet header information, UDP receives, decompression and display the received data in different places. Send the original video of the hardware of the basic function is to read data frame, after corresponding processing and adjust the compression coding, again through the wireless network video transmission effect is good in the RTP protocol, and encapsulate the data to the wireless network transmission through UDP function of system. Video acquisition system VTSN process as shown in Fig. 5.

Because the transmission is based on the connectionless UDP protocol, according to the needs of the client requests data, system used at the receiving end program should start prior to sending as in:

$$\begin{pmatrix} Y \\ U \\ V \end{pmatrix} = \begin{pmatrix} 65.481 & 128.553 & 24.966 \\ -37.797 & -74.203 & 112 \\ 112 & -93.786 & -18.214 \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix} + \begin{pmatrix} 16 \\ 128 \\ 128 \end{pmatrix} \quad (1)$$

In order to realize the above functions, we need establish Gstreamer to be the basic pipe, as shown in Fig. 6.

Gstreamer pipeline module selection and construction is the foundation of all system functions mentioned above, and send the basic design is the

same at the video acquisition, Gstreamer plug-in module library provided in receiving server-side implementation according to the main basis, to provide gasket type compatible plug-ins, and meet the relevant requirements. This part of the components of receiving and selection process, the system can provide more information, so need to add some callback control mechanism based on the system, to feedback for video data width, transfer time and related information.

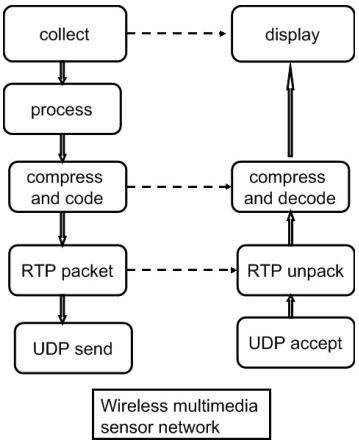

Fig. 5. Design decision of video collection system VTSN.

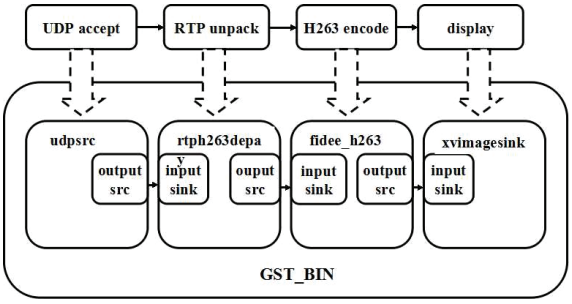

Fig. 6. Structure of Gstreamer system.

4. Conclusions

The research of wireless multimedia sensor networks is now a very hot topic in related fields. People have become more and more familiar with the sensor networks. However, we need solute a great number of problems to carry out this technology, at meanwhile, with the enlargement of the scale of the deployment of sensor networks and the types of diversification, web application development design should also take into account balance and scalability. For wireless multimedia sensor network design are discussed in this paper analysis, realized a highly efficient and practical video collection and transmission system, namely VTSN, solved a series of problems in practical application. VTSN use modern development framework and development mode, in fully meet the balance of the application development and scalability requirements, on the basis of meet efficiently complete wireless video acquisition in a network. On this basis, according to the characteristics of the wireless multimedia sensor network, from two aspects of system parameter adjustment and system framework to optimize VTSN, embodies the design based on buffer system and the thinking characteristics of compulsory multithreading. In both the rationality of the design and the realizability of at the same time, we need further improve the smoothness of video transmission. The improved VTSN in video transmission has further improved the stationarity.

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