Research on Simultaneous Transmission of Signal and Energy for Wireless Video Transmission

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Abstract: With the rapid development of wireless mobile services and video compression methods, the technology of using wireless network to transmit real-time video streams has attracted people's attention. Limited by the capability of wireless communication technology, wireless video signal and energy simultaneous transmission technology, especially mobile-based wireless video, has not been effectively applied. Especially in the wireless transmission environment, the video transmission rate is low, and the motion characteristic data is the main proportion in the code stream. The forward prediction mechanism of the existing rate control technology can not effectively track the changes of object motion in video sequences. Combining relay technology and cooperative communication technology, this paper studies the interruption performance of the wireless network with energy collection and double relay cooperative transmission. The solution proposed in this paper can overcome the existing problems, and combine the wireless broadband network and video signal with each other.

1. Introduction

With the rapid development of mobile communication technology and Internet technology, as well as the widespread popularity of intelligent mobile terminals, people's demand for communication services gradually changes from a single voice call to a hybrid multimedia service, such as video, data, files, etc. [1]. However, in wireless network communication, there will inevitably be insufficient bandwidth, network congestion, packet loss, packet disorder, and delay and other problems, which directly lead to the loss of the smoothness and clarity of video playback at the receiving end [2]. The simultaneous transmission of wireless video signals is mainly achieved through microwave communication (MMDS or LMDS). Microwave communication can provide effective transmission bandwidth and sufficient transmission distance, and its limitations are mainly: it does not support mobile capabilities, only provides point-to-point or point-to-point Multi-point fixed connection; does not support public protocols, and products of different manufacturers cannot communicate with each other [3]. Therefore, in the face of massive video data, it is one of the key issues in the field of multimedia communication to study efficient compression algorithms. Video image coding and transmission technology for wireless communication has become the forefront of information science and technology.

2. Wireless Video Transmission Technology

The basic idea of video coding is to effectively remove redundant information in video sequences through prediction, transformation and statistical coding, so as to achieve the purpose of compressing data. It is a video coding standard specially used for low bit rate video communication, and has a high compression ratio, so it is especially suitable for wireless video transmission. Its

main theoretical idea is to load the original data stream into thousands of sub-carriers in segments [4]. In this way, the symbol period of the information is several times of the previous one, so that it is converted into a relatively low-speed subcarrier data stream for processing. When the mobile terminal sends data, the main energy-consuming components work at the same time, and its power consumption will increase sharply. Tasks can only run if they get the necessary resources, such as CPU, memory, I/O devices, and some specific events and messages. Broadcast the coded data. After receiving the coded data sent by relay, users and base stations can decode according to their prior information to get the information sent by the other party [5]. A virtual local area network is composed of a plurality of wireless communication networks and a server, so that the uplink bandwidth can be multiplied in theory to achieve real-time transmission of video data.

Coding control is a kind of high-level control, and its purpose is to coordinate the work of video acquisition, coding, packaging and transmission, and the bottom layer transmission, so as to avoid task blocking and give full play to the performance of the processor, thus improving the coding efficiency [6]. Fig. 1 is a schematic diagram of the control relationship.
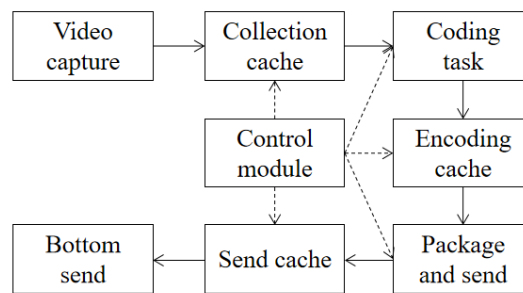

Figure 1 Schematic diagram of coding control relationship

Wireless broadband technology realizes QoS classification and scheduling functions in MAC layer of air interface, and meets QoS requirements of different bearer services through four different scheduling types. According to the different directions of information flow at relay end, relay transmission modes can be divided into unidirectional relay transmission mode and bidirectional relay transmission mode. In addition, the modulation method of the signal should have certain adaptability to channel fading. An important design concept in anti-fading technology is to achieve reliable transmission by increasing a certain degree of system redundancy, such as diversity sending/receiving technology, spread spectrum technology and error correction coding technology; It can be seen that there is a sharp contradiction between the needs of video signal transmission and the characteristics of wireless environment, so wireless video transmission is facing great challenges. Traditional multi-carrier modulation needs multiple non-overlapping signals with limited bandwidth, which must rely on a large number of oscillators and filters [7]. On the other hand, network coding can improve the throughput of wireless networks, thus reducing the number of data transmission, saving network resources, and further reducing the network transmission energy consumption. The ready task with the highest priority in the system will get the CPU and enter the running state. When multiple ready tasks have the highest priority, they will use the time slice rotation method to occupy the CPU fairly.

3. Video Quality Improvement in Wireless Broadband

3.1. Channel Characteristics of Wireless Broadband

Traditional video signal and energy simultaneous transmission is carried out on wired network. There are many differences between wireless broadband network and wired network. The packet headers in the transmission process are all with time stamps and serial numbers, so that the data can be easily reassembled according to the packet headers after being transmitted to the server. One of the key points in the design is to realize the integrated control of various wireless modules, and to meet the requirements of flexible configuration and upgrade of the system. By designing effective

communication protocols and resource allocation methods, bandwidth resources can be used reasonably and the transmission power of mobile users can be reduced. The interval between channels must be much larger than the transmission bandwidth of symbols to ensure the effectiveness of oscillator and filter operation. Undoubtedly, a large amount of frequency bandwidth is lost, which greatly reduces the effective utilization rate of frequency band. It can also play the role of fault tolerance by adopting certain technologies to utilize these residual redundancies at the decoding end. The wireless channel is usually represented as a transmission system with memory [8], which is also helpful to the design of fault-tolerant mechanism at the decoding end. Therefore, in order to improve the speed of encoder, the efficiency of motion estimation algorithm must be improved first.

3.2. Video Quality Improvement Scheme

The software of the wireless terminal runs on the real-time operating system. The quality and stability of system performance depend on the design and optimization of software modules, multi-task scheduling and synchronous communication, and the implementation of state control strategy. When two networks are online at the same time, send a heartbeat packet to each module every 5 seconds to test the online status and signal strength. If the network is online, determine the amount of data carried by each module according to the returned signal strength. For example, users near the base station can communicate directly with the base station without relay cooperation. Each sub-carrier differs from its adjacent sub-carriers by one period, and each sub-carrier has integral multiple complete periods, which ensures the mutual orthogonality among the sub-carriers. Fast motion estimation algorithm accelerates the search process by reducing the search space.

If the video compression technology is not adopted, the existing network transmission simply cannot carry such a huge amount of data. The energy required by the relay node will increase with the distance between the relay node and the center point, so the outage probability of the system will also increase.H.264 compression standard is adopted and some error resilience tools are added to adapt to the high error rate characteristics of wireless broadband channels. Using large data packet transmission will cause a large number of data packets to be lost. Determining packet size also becomes an important aspect in transmission. Table 1 shows the test results of different packet sizes.

Table 1 Packet loss rate and transmission rate of different packet sizes

Packet size/byte	200	300	400
Packet loss rate/%	0.552	0.371	0.842
Transmission rate /kbs^{-1}	12.403	6.482	10.776

In addition, when transmitting data on the mobile network, the packet size of data packets directly affects the transmission efficiency. Using smaller data packets for transmission can effectively reduce packet loss, but the efficiency is too low; Task is the basic unit to participate in resource competition, including system task and user task. User tasks are applications written by users running in the system. Each task is assigned a priority. The base station and the mobile user send their own data to the relay respectively. In the second and fourth stages, the relay decodes the received data from the base station and the user respectively, and then encodes them and forwards them. Accuracy can also meet the needs of many applications, so they are widely used. Generally speaking, the standards developed in the later period are easy to accommodate more advanced coding technology in grammar and semantics, and convenient for the network transmission and application of video. Processing the data that will enter the encoder: its purpose is to eliminate noise and weaken the influence of illumination (the video with simultaneous transmission of video signals is an image with natural illumination), reduce the burden of the encoder and reduce the coded code stream. In this way, the corresponding signal value can be obtained at the maximum amplitude of each subcarrier during demodulation, that is, the information contained in each subcarrier can be obtained without mutual interference.

3.3. Optimized End-to-end Wireless Video Transmission Mechanism

The purpose of signal transmission research on reliable channel is to make full use of channel bandwidth resources. For unreliable channels, the focus of transmission research is to make full use of bandwidth resources to achieve reliable transmission, that is, fault-tolerant transmission technology. In addition, the video coding algorithm has strong parallel processing potential, so people have studied the parallel computing capability of the coding algorithm, which further ensures the real-time implementation of the coding algorithm. This multi-carrier modulation technology is based on using a large number of subcarriers with different frequencies, and it must rely on a large number of subcarriers to achieve the purpose of loading information. Users can exchange information directly with the base station through direct link mode, and can also transmit information bidirectionally with the base station through the assistance of decoding, forwarding and relaying. Each task works in a cooperative state, so the key of software control lies in priority arrangement, task scheduling, synchronous communication between tasks and between tasks and interrupts. The receiving end responds and returns a data packet, and the time taken when the sending end receives the feedback packet. Frames transmitted on the channel will be affected by errors. If the delay of channel transmission is short enough, the influence can be limited to the acceptable range.

4. Conclusion

In this paper, the technical difficulties of video signal and energy simultaneous transmission in wireless broadband network are analyzed. When using mobile communication network for video transmission, the idea of multi-channel signal and energy simultaneous transmission is innovatively put forward, and a simple and practical retransmission mechanism and packet size control method are proposed according to its characteristics. Especially in the wireless transmission environment, the video transmission rate is low, and at this time, the motion feature data is the main proportion in the code stream. The forward prediction mechanism of the existing rate control technology can't track the change of motion in the bit stream. The further work is the combination of RTP/RTCP real-time transmission and system error-resistant measures, such as real-time error concealment technology, to further improve the video transmission quality. Therefore, strengthening the research in this field now is an opportunity to enhance China's scientific and technological strength and will play an important role in China's future communication field.

References

[1] Hu, Xun., Zhou, Yuanping. Android mobile terminal wireless video transmission based on WebRTC. Microcomputer and Application, no. 019, pp. 83-85, 2015.

[2] Lei, Yang., Jin, Jing., Su, Linglei. Wireless video transmission based on Socket communication. Electronic Technology and Software Engineering, no. 21, pp. 40-40, 2016.

[3] Huang, Tianhai., Luo, Cheng., Zhu, Fengjie. Application of wireless video transmission

technology based on WHDI in surgical relaying. China Medical Equipment, no. 009, pp. 151-153, 2015.

[4] Zhao, Chuang., Zhang, Hua., Wang, Jiu. Embedded wireless video transmission unit based on X.264 and its optimization. Journal of Southwest University of Science and Technology, no. 01, pp. 63-68+97, 2015.

[5] Zhong, Tao. Application of wireless video transmission technology in security monitoring. Electronic Technology and Software Engineering, no. 005, pp. 28-28, 2016.

[6] Yang, Yutuo., Zhang, Xiaoling., Liang, Wei. Fifty-first lecture of long-distance wireless video transmission system based on WIA-FA protocol. Instrument Standardization and Metrology, no. 003, pp. 24-27,45, 2015.

[7] Jiang, Haihan. Application of 3G communication system in wireless video transmission. China New Communications, vol. 21, no. 07, pp. 92, 2019.

[8] Zhang, Zeqiang. Analysis of the design and implementation of wireless video transmission based on RUDP. Computer Fans, no. 008, pp. 170, 2018.