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Application of Digital Image in Communication Engineering

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Abstract

With the development of computer technology, image processing technology has also made great progress. In communication engineering, we can realize many different forms of information exchange through digital image processing technology, which is based on the combination of computer and network technology, based on computer network technology. This new communication system is an information exchange system that realizes the information exchange and sharing in multiple users and in multiple scenarios, and greatly reduces the potential network security risks. This paper mainly expounds the system scheme.

Keywords

Image processing; Computer network; Communication engineering

1. System Introduction

To address potential security risks in communications projects, we have designed a solution based on digital image processing technology. This solution utilizes the TCP/IP protocol as its core technology to enable the rapid and efficient exchange of various data and image information through a digital networked information transmission system. This system leverages its advantages in transmission, storage, management, security, and data management, ensuring real-time monitoring of various mobile data resources, network security, and other information resources, as well as various communications equipment, communication lines, and IP devices. The system comprises four components: a computer, a digital image processing platform, a security monitoring subsystem, and a communications subsystem. The system boasts a rational design, stable and reliable operation, and is well-suited for a variety of applications. It also features high software cost-effectiveness, strong system scalability, and easy maintenance. It represents an emerging multimedia communications architecture that integrates high cost-effectiveness, high security, and flexibility for mobile communications management systems and Internet management systems (Shangguan, 2022).

1.1 Computer

In this system, the computer primarily consists of a hardware platform and a software platform. The hardware platform, primarily composed of a processor, memory card, and network interface devices, enables the transmission of various information to the computer via a server or network interface (Ba, 2022). The software platform, primarily composed of the memory card, primarily comprises application development tools and a network support platform. The platform is equipped with a 32-bit hardware platform software library, including tools for multimedia content creation, multimedia content storage, multimedia file management, image and audio format conversion and image quality analysis, and video and audio editing.

Note: The article was originally published in *Advances in International Computer Science*, and this is an authorized translation of it.

1.2 Digital Image Processing Platform

The digital image processing platform includes a high-speed processing module, a high-speed image processing module, and a high-speed real-time image processing module. The high-speed processing module adopts a high-density memory, high-speed cache, and high-storage density design, which can realize multi-channel real-time image parallel processing and achieve real-time data processing of different categories of data objects and different types of data streams. The high- speed real-time image processing platform is interconnected with mobile networks and IP networks through high-speed video interfaces and recognizes images through software. The high-speed real-time image processing platform provides real-time digital image acquisition and processing functions, can realize rapid image acquisition and processing functions through FPGA and can set processing process parameters on the FPGA; provides image data storage functions through USB data cables and USB interfaces; provides graphical software tools to support graphical processing functions; and provides image acquisition and processing software and digital image processing platform interaction functions, making the platform a truly open system (Chen, 2021).

1.3 Security Monitoring Subsystem

In communications networks, the operational status of various electronic devices is a crucial indicator of the proper functioning of operator security management. In accordance with national laws and regulations regarding the production and use of electronic equipment, the mobile communications management system provides a new preventative measure. Various monitoring modules are installed on electronic monitoring terminals, enabling real-time monitoring of various communications equipment, network security information resources, mobile data resources, network service equipment, and IP terminal devices, and providing immediate alarm response in the event of a malfunction. This system primarily monitors user-related information or IP terminal status information in real time, implementing various alarm modules associated with user mobile phones (Wan, 2021). This system utilizes digital image processing technology, leveraging high-speed TCP/IP-based internet technology and image processing software stored in a high-performance, dedicated operating system, to monitor user data and traffic in real time. It also provides storage, analysis, display, and retrieval capabilities for the large amounts of collected data. Designed to ensure the security of various mobile communications devices and mobile network communications, this system incorporates a comprehensive suite of practical products and software (such as digital image processing and monitoring software) within its monitoring platform for mobile communications projects. These include digital image processing software, monitors, and digital image processing equipment.

1.4 Communication Subsystem

The communications subsystem primarily includes transmission equipment, terminal units, a network management center, business support systems, and a service platform. Transmission equipment primarily includes cameras, monitors, and switches. Terminal units primarily include smart terminals and multimedia terminals. The network management center primarily includes the mobile communications network management system, the internet information management platform, and the mobile terminal management platform. The service platform primarily includes smart terminals (including cameras), multimedia application software, and mobile apps (Cui, 2020).

1.5 Interpretation of Technical Indicators

Comprehensive technical indicators for communication systems include equipment reliability, stability, and availability. For example, in severe weather conditions, the monitoring system for existing mobile communication equipment remains unaffected by the weather, enabling real-time operational status monitoring. It also boasts large data storage capacity, capable of storing large amounts of information related to mobile communication equipment. Operation is stable, reliable, and highly repeatable, and it is easy to maintain. Furthermore, it offers flexible system integration and support for diverse applications. Comprehensive integration of all subsystems significantly enhances both integration and reliability (Zhang, 2021).

2. Digital Image Data Communication Network Architecture

In current communication network architectures, Ethernet is the primary transmission medium for image data communication networks. However, with the development of new systems and services, specialized IP-based networks

have emerged. This has provided more options and room for development in real-time digital image communication technologies. Among these, the VSTM digital image exchange network, represented by VDSLAN, is the most widely used and mature high-speed mobile information exchange system solution, based on IP networks, Ethernet as its core, and the coexistence of multiple hardware devices.

2.1 Business Structure

As the core of the VSTM digital service architecture, VDSLAN integrates multiple services, including video surveillance, video conversations, multimedia interactive terminals, and intelligent video surveillance terminals, providing users with a diverse multimedia interactive experience, including video calls and conference information. Currently, several well-known organizations have implemented private network applications based on VSTM digital image data communication technology, achieving excellent results (Han, 2020).

2.2 Data Transfer Rate

In image transmission, due to the use of a variety of coding technologies, transmission rates can reach gigabits to terabits across various frequencies, reaching as high as 10 Gbps. To ensure signal quality, signal transmission latency and delay must be considered when designing network transmission rates. The size of the bitstream is largely determined by the type and length of the bitstream channel. Therefore, limited bandwidth is an unavoidable issue. Based on the characteristics of VSTM, image exchange can be categorized into several different transmission types: IP transport (BGP), Ethernet transport (EER), Ethernet video (HVPA), and Ethernet MPLS.

2.3 Business Processing

Each node within VSTM runs a comprehensive suite of IP-based image processing software. Through the VSTM network, each node can use software to process real-time images on the same terminal. Currently, business processing at each VSTM node is primarily handled by the gateway (Ma, 2020).

3. System Application Solutions

This solution utilizes an embedded processing unit to convert SDI signals into digital signals. After loading and enhancing the digital signals, they are sent to the gateway via a URL, enabling the exchange and sharing of network-transmitted information data. The gateway utilizes an ARM architecture, offering excellent scalability. The gateway output signal, via SDI or SDI signal amplifiers, is sent to a computer terminal processing platform for decoding, compression, synthesis, demodulation, and filtering. The transmission rate matches the output rate of the acquisition port. The gateway can transmit data to the terminal processing platform via the control center and user-side switches.

3.1 Service Access

This solution provides a solution for accessing DVB system services from a URL connection, connecting DVB devices to a DVB software server. The DVB server acts as an RS232 interface, enabling access to an IP bridge (IP packets are transmitted via DVB to a computer terminal processing platform) and a PTZ interface (PTZ packets are forwarded via a network interface to the gateway). A DVB network is a digital switching network comprised of multiple data transmission channels, supporting transmission of different types and networking methods. To ensure service reliability and security, this solution combines two DVB interfaces (Mesh Wireless Device interfaces) with two PTZ interfaces (PTZ packets are transmitted via the network interface to the gateway), enabling bidirectional serial transmission with the gateway (serial data is transmitted bidirectionally via the network interface to the gateway).

3.2 Network Transmission

When a terminal requires real-time image and video data, it can be transmitted over a remote network, enabling the acquisition and processing of image information (video). Figure 3 shows the network connection diagram. Image processing software converts the data into image and video information, which is then transmitted to the control center via the network. Because SDI signals are not adjustable and are stored in a fixed format, this system uses dedicated SDI software and URLs for transmission.

3.3 Image System

An imaging system is a computer network device designed to acquire image data from a computer network and transmit image signals. The core of this system consists of two hardware components: a video capture module (SDI or SDI signal amplifier) and a video image processor (CCD or CCTV). The video capture module is responsible for capturing, storing, and decoding video signals. After the CCD and CCTV process the signals, they are sent to the gateway via a URL for data transmission and reception.

4. Conclusion

Traditional image processing systems are not only applicable to transmission lines, but also to various environments on-site. Digital image processing technology effectively combines these two aspects. This advanced technology enables many functions that are impossible to achieve on-site, effectively solving the problem of multiple application areas in engineering.

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