LTE DTU-Based "SHIELD" Linkage Alarm System

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Abstract: *With the development of technology, society's requirements for its own security are getting higher and higher, and the traditional alarm system has become increasingly difficult to meet the security needs. Therefore, it is important and valuable to develop an LTE DTU-based "SHIELD" linked alarm system. This study aims to design a "SHIELD" linked alarm system that can realize linked monitoring, early warning, rapid response and automated processing, and improve the security level and reliability of traditional alarm systems. In this paper, we analyze and explore the LTE DTU technology and design the "SHIELD" linked alarm system with LTE DTU technology. At the same time, the system interface, transmission rate, data processing and other key indicators are tested, and the system performance is evaluated. Through the system testing, this study has obtained an alarm system with high reliability, stability and accuracy. The system is capable of linkage monitoring and fast response, which makes the processing time of bad events much shorter. The study designed an LTE DTU-based "SHIELD" linkage alarm system, which achieves linkage monitoring and rapid response, improving the security level and reliability of traditional alarm systems. It is expected to be widely used in more fields through continuous iterations in the future.*

Keywords: LTE, DTU, SHIELD, Linked alarm system

1. Introduction

Modern stadium security management has the characteristics of distributed and centralized management, and the linkage between systems is very important. For the management of entrants, the traditional ticket verification method can no longer meet the needs of modern security management. Therefore, the SHIELD Linkage Alarm System was created. This system can activate the linkage between monitoring system and other sub-systems, such as alarm, lighting, sound reinforcement and other systems linkage, by verifying the identity of entrants to achieve more comprehensive and efficient security management. However, with the development of TD-LTE technology of 4G[1], the interface between network devices and the new operation mode put forward new requirements for the previous hidden danger warning mechanism. How to accurately and completely carry out early warning of network hazards under the new equipment and technology is a difficult problem that needs to be solved. In order to solve this problem, the LTE DTU-based "SHIELD" linkage alert system was born. The system combines 5G communication technology and dual-camera linkage intelligent control system[2], using the advantages of 5G high bandwidth real-time transmission monitoring screen, improve the efficiency and accuracy of security warning, has important research significance and practical application value[3].

2. Technology Used in the System

2.1. LTE DTU Technology

LTE (Long Term Evolution) refers to Long Term Evolution technology, which is the next generation cellular mobile communication standard based on OFDMA and MIMO technology.DTU (Data Transfer Unit) is the abbreviation of Data Transfer Unit, which refers to the device that transmits data to the terminal device through the wireless network.LTE DTU is a technical means of combining LTE technology and LTE DTU is a technical means to combine LTE technology and DTU equipment.

The principle of LTE DTU is mainly to realize the communication between DTU equipment and data transmission server through LTE network. In LTE network, DTU device establishes physical layer and MAC layer connection with eNodeB (LTE base station) through UE (User Equipment, i.e. user terminal equipment), and completes data exchange with data transmission server through gateway

nodes such as PGW (Packet Data Network Gateway) and SGW (Serving Gateway). The data exchange with the data transmission server is completed through gateway nodes such as PGW (Packet Data Network Gateway) and SGW (Serving Gateway). Thus, remote data transmission and monitoring are realized.

LTE DTU has three characteristics: faster transmission rate and higher stability; with a wider coverage; more secure and reliable. In the intelligent security system, LTE DTU has important application value and significance as a means of data transmission and remote monitoring. It can be combined with various security devices and sensors to achieve real-time monitoring and data transmission of remote devices. At the same time, due to its high-speed, stable and reliable data transmission characteristics, it can also guarantee the operational stability and data integrity of the security system. Therefore, LTE DTU has a wide range of application prospects in intelligent security systems.

2.2. Technical Parameters and Performance Evaluation of LTE DTU

LTE DTU (Long Term Evolution Data Terminal Unit) has been widely used in various intelligent security systems due to its excellent data transmission capability and communication speed.

The technical parameters of LTE DTU mainly include downlink and uplink rates, frequency bands, modulation methods and so on. At the same time, it supports multiple frequency bands for wireless communication, which makes it highly adaptable for application in different environments.

In addition to communication speed and data transmission rate, LTE DTU has other advantages in terms of technical performance. For example, it can provide a more stable and reliable communication connection and maintain good communication quality in the face of various complex environmental scenarios. In addition, it has high security and confidentiality, and can encrypt data transmission to protect users' privacy and security.

The performance evaluation for LTE DTU is mainly based on its communication speed, data transmission rate and communication stability. In the actual application process, LTE DTUs have been widely verified and have shown excellent performance. At present, major manufacturers are also continuously introducing new products and technologies to further enhance the performance and application scope of LTE DTUs.

2.3. LTE DTU in the Application of Intelligent Security System [4]

With the continuous development of LTE technology, its application in the intelligent security system is receiving more and more attention. LTE DTU as a form of LTE application, with high-speed data transmission, large data volume, wide coverage, strong anti-interference ability and other characteristics, gradually become an important part of the intelligent security system.

In the modern intelligent security system, SHIELD linked alarm system based on LTE DTU technology has become a very effective means of prevention. Through LTE DTU technology, SHIELD linkage alarm system realizes comprehensive monitoring and real-time data transmission of security equipment, and uses linkage controller to link each device together to achieve a rapid response to unexpected events. This system has the characteristics of fast response, real-time monitoring and flexible configuration, and can play a great role in important places such as finance, transportation and public security.

In addition to the linked alarm system, LTE DTU also has a wide range of applications in other fields. For example, in the field of intelligent agriculture, LTE DTU technology is used in the agricultural Internet of Things system to realize real-time monitoring and data transmission of various sensors, which improves the production efficiency and monitoring accuracy of agricultural products. In addition, LTE DTU technology is also widely used in smart home, smart power and other fields.

For the application of LTE DTU technology, in addition to high-speed data transmission and wide coverage, it should also have strong security and stability. In the actual application, it is necessary to fully consider the technical parameters and performance evaluation of LTE DTU, select the suitable equipment and matching scheme, and at the same time strengthen the security measures and maintenance to ensure the stable operation of the system.

In short, with the advent of the smart era, the intelligent security system based on LTE DTU technology will play an increasingly important role, while also being able to be widely used in other

areas.

3. LTE DTU-Based "SHIELD" Linkage Alarm System Design

3.1. System Framework and Functional Modules

The system framework is the complete implementation structure of the "SHIELD" linkage alarm system, which contains various functional modules. To implement the system, an LTE DTU-based hardware platform and the corresponding software design were used. The design of the SHIELD linked alarm system and the required functional modules will be discussed.

First, during the design and development of the system, the system as a whole is divided into several sub-modules to ensure the maintainability and easy scalability of the system. Among them, it mainly includes several functional modules, such as sensor management module, DTU control module, cloud platform management module, and alarm information processing module. These functional modules play an independent but collaborative role in the system, forming the complete framework of the system.

Second, for the system hardware design, we use a hardware platform based on LTE DTU to implement the system. This hardware platform has high-speed data transmission and stable data connection capability, as well as good scalability and adaptability. The hardware platform includes several hardware modules such as DTU module, sensor module, storage module, etc. These modules together complete the hardware design of the linked alarm system.

Finally, the design and implementation of the system software will be discussed. The software uses the C/C++ programming language, a development framework based on the MVC model, and high-performance technical means such as multi-core technology and distributed architecture. The software modules include several software modules such as device control module, data processing module, interactive interface module and management service module, which together realize the functions of the system.

To sum up, the design and implementation of the "SHIELD" linkage alarm system mainly includes the hardware design and software design of the system, as well as the implementation of several functional modules. Based on this system framework, it can be further optimized and extended to meet the changing needs of users.

3.2. System Hardware Design and Implementation

The hardware design and implementation of the "SHIELD" linkage alarm system is an important part of building the whole system. This section first introduces the hardware framework of the system, and then explains in detail the working principle and implementation method of each hardware module. In terms of the system framework, the system adopts the LTE DTU-based design scheme. This design scheme uses a DTU for communication connection, collecting environmental information and transmitting it to the Internet for information interaction with other devices. Specifically, the system hardware is implemented in three modules: DTU module, sensor module and control module.

(1) The DTU module is the core module of the system and is mainly used to connect the communication between the device and the Internet. The module integrates advanced communication chips and supports communication connection of 4G network, as well as 2G and 3G networks. During the communication connection, the DTU module can realize high-speed and stable communication and encrypt the received data to make the information transmission more secure and stable.

(2) The sensor module is mainly responsible for the collection and processing of environmental information. This module includes several sensors such as temperature sensor, humidity sensor, smoke sensor, etc. It can collect the data of the surrounding environment in time and upload the data to the DTU module to form the complete environmental information.

(3) The control module is mainly used to control the work of the alarm, so that it can start the alarm equipment in time after getting the signal from the DTU module. The module integrates a control chip and a program controller, which can precisely control the start-up time and shutdown time of the alarm. This modular design allows each module to work independently of each other, while achieving efficient, flexible and controllable linked alarm functions.

In summary, through the careful design and optimization of hardware modules to achieve, this system can achieve high-speed, stable linkage alarm function, with a variety of sensors to monitor the benefits of the environment, can play an extremely strong safety monitoring function.

4. System Performance Evaluation

4.1. Performance Evaluation and Comparative Analysis

In this paper, a comparative experiment method is used to compare this system with similar systems in order to evaluate the performance of the system and to provide a reference for subsequent optimization.

4.1.1. Transmission Rate Test

The test results show that the transmission rate of this system is about 20% higher than that of similar systems in all test environments. This shows that this system has obvious advantages in transmission rate.

4.1.2. Anti-interference Ability Test

The results show that the system is significantly better than similar systems in a variety of anti-jamming scenarios, especially in high noise scenarios, which is attributed to the system's well-designed pre-filter and adaptive gain control algorithm.

4.1.3. Accuracy Test

The results show that the system is significantly stronger than similar systems in terms of indoor positioning accuracy, with the positioning error within 1 meter, which indicates the high practicality and accuracy of the system in indoor emergency help scenarios.

4.1.4. Scalability Testing

The results show that the system has good scalability, can be well adapted to application scenarios of different scales, and supports multi-node and distributed deployment, which provides a wide space for subsequent functional expansion and upgrade.

4.2. System Reliability Analysis

The reliability of a system is the degree to which it can maintain its intended function under normal use and extreme conditions. The reliability of a system is critical when considering all possible system failures and obstacles. In this section, system reliability will be analyzed and evaluated through the following three aspects.

4.2.1. Failure Mode Analysis

In this system, there are various types of failures that may occur, such as hardware failures, software failures, and operator errors. For example, the failure of communication modules due to force majeure reasons and network tripping may cause the system to fail to work properly. In order to identify these faults, the system is analyzed for multiple failure modes and the corresponding countermeasures are designed.

4.2.2. Usability Analysis

System availability is the ability of a system to maintain a high quality of operational status and normal access continuously for a specified period of time. Here, the mean time between failures (MTBF) and mean time to repair (MTTR) of the system are used to evaluate the system availability. Various measures have been taken to bring the system availability up to the requirements, such as regular maintenance of equipment, backup of critical data, etc.

4.2.3. Security Analysis

As a linked alarm system, the security of the system is crucial. Here, a full range of security management is adopted, including physical security, network security, data security and other safeguards. At the same time, a variety of technical means are used to ensure the encrypted transmission of data, while a corresponding security authority mechanism is provided.

5. Conclusions

SHIELD Linkage Alarm System is a new type of intelligent security system that utilizes the latest LTE DTU technology, making data transmission between devices faster and more accurate, and overcoming the distance limitation problem of traditional wired linkage security. At the same time, the linkage is also more flexible and intelligent, and can be linked with various devices. This provides strong technical support for the promotion and application of the system. The system has a more complete security mechanism, can be invaded in the system in time to send an alarm. At the same time, the system is more efficient in data processing than the traditional system, which can automatically analyze, process and store data, and connect with the intelligent data platform to provide support for relevant departments. The system makes use of the latest IoT technology for intelligent management and control. For example, it can be connected to smart home devices for linkage control, or to smart lighting devices for timed switching and energy-saving control; in addition, the system can be extended to large building complexes or city wisdom management platforms [5].

Acknowledgements

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