Research on Integrated Control Platform for Intelligent Building Weak Current System

Changwu Li
School of Automation, Wuhan University of Technology, Wuhan 430070, China
932096717@qq.com

Abstract. The paper follows the industry norm standards currently promulgated by the state, uses advanced design theory to integrate design and management of the weak current system of intelligent residential quarters, and designs the structure of intelligent buildings and the principles and programming of software and hardware, and closed-circuit television for intelligent communities. The monitoring system, the home intelligent system and the three-meter remote transmission system are designed in detail, and the implementation organization of the weak electricity project is given. It is confirmed that the intelligent building integrated power system integrated control system can provide a safe, comfortable, convenient and energy-saving living environment for the community, and realize the purpose of community resource sharing, unified management and control.

1. Introduction
Intelligent building is an architectural art that organically integrates many new technologies (such as modern communication, multimedia, intelligent security, environmental monitoring, etc.). Its purpose is to design and build modern buildings that are safe, comfortable, efficient, energy-saving and convenient. With the development of computer network technology, information technology and control technology, people have put forward more requirements for the intelligence and adaptability of buildings. As a big construction country, the development of green and energy-saving intelligent buildings is an important measure for China to change the high consumption and pollution patterns of traditional buildings and achieve sustainable development. In order to meet the new demand for intelligent buildings, multi-purpose intelligent building equipment and multi-functional subsystems, such as power supply and distribution systems, water supply and drainage systems, central air conditioning and ventilation systems, and anti-theft alarm systems, etc. [1] In order to achieve integration of these self-control devices and achieve free communication between them, owners and managers urgently need open and interactive control technologies, and internal control systems require integration, networking and full distribution. Fully open control architecture [2].

By constructing an intelligent building weak current system integrated control platform based on LonWorks fieldbus technology, this paper interconnects the various subsystems, unified monitoring, control and operation management of electromechanical and security equipment, realizing resource sharing and information integration, and from multiple vendors. HVAC, lighting, fire protection, security, access control, water supply and drainage and elevators, as well as information, network and
other equipment integrated in this control platform, to reduce overall installation costs, improve system performance, save operating costs [3].

2. System overall planning and design of intelligent community

Generally, the residential community intelligent system can be divided into two parts: the property management subsystem and the information network subsystem. They are connected with each other and cooperate with each other to form a complete intelligent system. For the intelligent network subsystem, it can usually be divided into several intelligent subsystems, as shown in Figure 1.

![Figure 1. Intelligent community system structure.](image)

2.1. The composition of the intelligent subsystem of the residential community

2.1.1. Indoor Security Subsystem. The indoor security system uses industrial technology and fieldbus control technology. The equipment mainly includes intelligent terminals. Some manufacturers are called intelligent controllers or centralized controllers. Various security probes include window magnets, door magnets, glass breakers, infrared detectors, smoke detectors, gas leak detectors, emergency buttons, etc. Control equipment including electric curtains, lighting control, home appliance control and various intelligent devices mainly have network ports, video sharing ports, remote recording systems, etc., as shown in Figure 2 [3].
2.1.2. Intercom subsystem. The intercom subsystem mainly adopts image transmission technology and control technology, and generally adopts bus technology, and some manufacturers adopt technology. The intercom system generally has a management center machine, a door host, a decoder, a distributor, an indoor extension, a video line, and a control line. Some systems are also equipped with a computer, and can leave a message. The composition of the intercom subsystem is shown in Figure 3.

**Figure 2.** Indoor security subsystem.

**Figure 3.** Intercom subsystem.
2.1.3. Closed Circuit Monitoring Subsystem. The closed-circuit monitoring system consists of four parts: the front end, the transmission part, the control part and the display part. The front end is composed of a camera, a lens, a pan/tilt, a decoder, a shield, a bracket, a lightning arrester, and an optical transceiver. The transmission part is composed of a video line coaxial cable or an optical fiber, a power line, and a control line. The control part is composed of a matrix, a picture processor, and a hard disk. The display part of the video recorder is composed of a video wall, a plasma display, a display, and the like.

2.1.4. Perimeter protection subsystem. The perimeter defense subsystem mainly uses infrared radiation technology to prevent it, and also uses the vibration and buried cables, but the most used infrared radiation technology. The main manufacturers of the alarm host are Dingxin, which is owned by Tyco, Dickson of Bosch, and Andingbao of the United States. The manufacturers of infrared probes mainly include Ai Lifu, Japan St. Weir and Shenzhen Ai Lifu.

2.1.5. Patrol Subsystem. The electronic patrol system has online patrols, as well as off-line patrols with contact and non-contact. According to the author's experience, the most widely used patrol system in China is the offline contact patrol system, which uses patrol button technology and of course uses smart card technology.

2.2. System Control Solution Implementation

In order to realize the data collection and processing and control functions, an on-site energy node is established for each sub-network or subsystem control monitoring point for receiving and processing the sensor's acquisition signal, controlling the actuator operation, and the like. The intelligent node is based on the Neurom chip and can be used for peer-to-peer field communication with the monitoring PC and other nodes using the LonTalk protocol [4]. The structure of the distributed control system based on LonWorks technology is shown in Figure 4.

![Figure 4. Distributed control system structure of intelligent building fieldbus technology.](image)

The software programming of this system can be implemented in the development environment of EasyLon OPC Server and Visual Basic6.0. The on-site monitoring program can be developed by Visual Basic 6.0 or directly using the general configuration monitoring program with OPC interfaces function. Information can be exchanged between the EasyLon OPC Server and the LonWorks network.
variables, or the ADO data interface can exchange information with the database. The host computer communicates with the Lon intelligent node through the PCLTA-20 adapter card. The PC loaded with the adapter card serves as the monitoring host on the one hand, and also the server of the Lon network and database on the other hand[5].

The monitoring function of the monitoring host is realized by communication with the EasyLon OPC Server. EasyLon OPC Server writes the OPC client program according to the actual situation, reads and displays the real-time data, operating conditions and historical charts collected by the intelligent node, and realizes the data analysis and processing (discrimination, analysis and storage, etc.) in time, and simultaneously to the controlled device. Send data information to control the working state of each node. In the OnLon programming environment, the writing of the control algorithm can be done using the visual function block. Each function block has a package of I/O and configuration parameter interfaces, and the data flow of the control algorithm is represented by the connection between the function blocks.

The control function of the system controller can be realized by the on-site intelligent node. When the control algorithm corresponding to each function block in the configuration control platform is successfully compiled, it is downloaded to the field intelligent node through Visual Lon. The node will automatically call the corresponding algorithm function to control the output.

3. System testing and acceptance
The strict quality control by the quality supervisor, the installation of the equipment and the laying of the lines are strictly carried out in accordance with the design standards. During the construction process, the subsystems are constructed according to the national ISO9001 standard to ensure the stable operation of the system. Strengthen the inspection and acceptance of engineering equipment and materials to ensure that the equipment uses materials and materials of good quality, and unqualified products will never enter the market. According to the design requirements, nearly two months of careful construction completed the installation of the weak current system of Haobo Tianting Business Apartment. Immediately after the trial run, the problems found were adjusted and modified in time. For example, the setting of the road device in the network system, the adjustment of the switch parameters, the adjustment of the camera angle of the monitoring point in the monitoring system, the adjustment of the power amplifier of the public broadcasting and the background music system, and the continuity testing of all the cables of the integrated wiring. Or transfer rate test and so on. The system is in the best working condition, meets the design requirements, and passes the system acceptance once [6].

As shown in Table 1, the test results of the system in the network performance of 500~1000m communication distance and the total attenuation of the line is about 90dB.

| classification | Delay (S) | bandwidth (kbps) | Bit error rate |
|----------------|-----------|------------------|----------------|
| Test system    | 0.291867  | 9.5              | 2×10^{-3}      |
| PLCA-22        | 0.282317  | 9.6              | 1×10^{-3}      |
| Test system    | 0.780903  | 9.4              | 2.2×10^{-3}    |
| PLCA-22        | 0.791614  | 9.5              | 1.5×10^{-3}    |

It can be seen from the table that the real-time data transmission time and the control command transmission time of the system are both less than 1 second, and the linkage command transmission time does not exceed 1.5 seconds. In 5 seconds, the system can complete the refresh of the stored records in the database and update the dynamic data.

The installation of monitoring equipment in public areas guarantees the safety of public facilities, reduces man-made damage, and provides sufficient and effective evidence for the damage caused by some people, ensuring that there is a civilized environment shared by everyone in the building. The
setting of the host in the system is continuous recording during the day and alarming at night. Continuous video during the day guarantees that the parking lot, shopping mall, elevator, and apartment corridor are under monitoring and protection at any time. Any situation that occurs is recorded and monitored. In the event of an emergency, you can know and deal with it in time. It is also possible to reduce the loss by issuing timely notifications through the designed public address system and information distribution system [7]. Without the joint operation of these systems, it takes at least 10 minutes after the incident to process these events in such a large building, and more people are needed. The design of the linkage alarm at night is to more effectively utilize the resources of the system to reduce the storage space, reduce the workload of the monitoring personnel, and achieve the goal of high efficiency. In the working state of the linkage alarm, the images collected by each monitoring point are compared and processed in the host, and whether the previous picture is the same as the current picture. If someone invaders or moves the object to change the surveillance image, the DVR works immediately to record the situation at the time. When the screen is still for 10 seconds (can be set), the above DVR stops working, ensuring the minimum occupied space of the hard disk to prolong the recording time. At the same time as the DVR works, it triggers the sound and light alarm, reminds the security guards to pay attention to the monitor, and knows what needs to be handled in case of abnormal situation, so that the monitoring center is unattended at night. This security effect cannot be achieved without monitoring the regular duty patrol. Directly reduce staff and ensure the safety of property. From the usage situation, the system runs to the current night patrol, which can trigger the normal startup of the monitoring system and record the security patrol. There was no incident of property theft in the building.

The public broadcasting and background music system partitions the mall, the tea house club, and the apartment to play different music. From the daily use situation, the atmosphere of the community has been activated, enriching the life of the community, improving the different venues in the intelligent building, and the working and living environment of different people. The public broadcasting and information distribution system can immediately notify the handling of emergencies such as fire alarms, and often inform the owners to participate in community activities, to bring people closer, the distance between the company and the company, and to improve the relationship. The use of public broadcasting and information dissemination systems is the most convenient and direct way for building property communication owners.

4. Conclusion
At present, some weak current systems in China cannot be fully integrated into structured integrated wiring. Only by researching and producing a series of integrated wiring products that can meet various wire diameters and different transmission signal requirements can all the weak current systems be able to achieve the goal of structured integrated wiring. With the advancement of microelectronics technology, communication technology and the gradual promotion of the "people-oriented" design concept, the weak current system in intelligent buildings will inevitably appear to be increasing, so it will lead to a problem that cannot be ignored, that is, to choose different subsystem integration. Form different levels of intelligent buildings. Therefore, in the entire design process of intelligent building integrated wiring, overall planning will be particularly important. Only when planning is carried out, there is room for development during construction. Each subsystem is implemented step by step during the implementation; the system should reserve sufficient expansion interface for the piping and lines in the building, the outdoor pipeline, and the communication equipment room in the area. In order to make the weak electricity systems in smart residential areas an organic whole.

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