

Research Article

Design of Indoor Lighting Control System for Human Body Signal Acquisition Based on Internet of Things

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The improvement of microelectronics innovation, programmed control innovation, and correspondence innovation has brought human culture into a universe of electronic data, and different electronic control frameworks are applied to each edge of life. Among them, the intelligent and energy-saving living environment has become more and more popular, and the development of electronic technology has greatly facilitated people's lives. This paper aims to study how to analyze and study indoor lighting control based on the Internet of Things technology and describe the acquisition of human body signals. This paper puts forward the problem of indoor lighting control, which is based on the Internet of Things technology, then elaborates on its related concepts and related algorithms, and designs and analyzes a case of indoor lighting control system. The experimental results showed that 100 orders are normal, and the intelligent lighting node can correctly receive and process the order information and respond accordingly. During the brightness reduction process, the sensitivity and smoothness of the touch screen slider are good, and the brightness reduction is successful.

1. Introduction

The Internet of Things is an emerging technology that, although still being in its infancy, is already being used in various industries. Traditional lighting systems use switches and knobs to control light switches and light levels. With the development of electronic technology, human voice and light control have been widely used in our daily life. But these lighting systems not only are complex to operate, but also consume a lot of energy. By improving people's living standards, people's lives have become more intelligent, and traditional lighting control has been unable to meet people's needs.

Using a smartphone to control home appliances is an advancement of the times, because the remote-control mode of the mobile terminal is no longer limited by the type of remote control. Traditional home appliance switches require corresponding remote controls to operate efficiently. When mobile phone remote control technology is available, the

remote controls for all home appliances can be flipped to the side, significantly improving ease of operation.

The innovation of this paper is as follows: (1) this paper combines human body signal acquisition with indoor lighting control and introduces the theory and related methods of Internet of Things technology in detail. It mainly introduces incremental kernel fuzzy clustering algorithm and support vector machine algorithm. (2) In the face of indoor lighting control, after each command is sent 100 times, the number of successful times is recorded and analyzed.

2. Related Work

Indoor lighting has an inseparable relationship with people's lives. With the ceaseless improvement of individuals' expectations for everyday comforts, it is a quest for singularity, beauty, and intelligence in life and work, and the requirements for indoor lighting are also constantly improving. Tan

et al. proposed a sensor-driven human, on top of it lighting framework [1]. Ayaz et al. proposed the plan and execution of another savvy sunshine-based lighting control framework to furnish energy reserve funds in open structures with ordinary lighting frameworks [2]. Karapetyan et al. studied that the Internet of Things (IoT) brings a new paradigm of integrated sensing and actuation systems for intelligent monitoring and control of smart homes and buildings [3]. Mahbub et al. centered around the plan and execution of an insightful independent lighting and ventilation framework that empowers energy-mindful independent lighting, observing temperature, mugginess, carbon dioxide (CO₂) fixation, and exhaust cloud [4]. Beccali et al. analyzed the outputs of several artificial neural networks in relation to different sensor placements by using the measurements in an experimental setup [5]. Jain and Garg examined the presentation and attainability of different sunlight determining techniques and their application in controlling blinds and incorporated lighting frameworks [6]. Kim et al. proposed a characteristic light multiplication framework that gives the sunshine cycle attributes of regular light to keep up with circadian rhythms [7]. Singh et al. have studied developing a complete proof system that requires the development and integration of various technologies that can be used to develop smart homes [8]. However, the insufficiency of these studies is that they do not consider multiple factors and cannot solve the multilevel situation well, so the problem needs to be considered from multiple aspects.

3. Human Body Signal Acquisition Method Based on IoT

3.1. Internet of Things. The Internet of Things is a significant piece of the new age of data innovation and an augmentation of Internet applications. It is the result of the profoundly incorporated advancement of data innovations like sensors, the Internet, and communications. In short, the Internet of Things is the Internet of things connected. The key technologies in the application of the Internet of Things are as follows: sensor technology, RFID technology, and embedded system technology. At present, a large part of the signals processed by computers are digital signals. For analog signals, the computer is not easy to identify; it needs to be converted into digital signals. This can be done by using sensors, so sensors are key in computer applications. Lately, embedded technology has been widely used in smart products [9].

What really drives the rapid development of the Internet of Things is the premise of continuous technological innovation. In the process of developing the Internet of Things, its key technologies include radio frequency identification technology (RFID tag), barcode technology, communication technology, remote sensing technology, and intelligent information equipment.

Usually, the architecture of the Internet of Things is divided into three layers, from bottom to top, the perception layer, the network layer, and the application layer. The overall architecture of the Internet of Things is shown in Figure 1.

The discernment layer is at the lower part of the IoT design. Its principal objective is to interface things to the IoT organization and measure that gather and cycle related state data. It handles these things through sent savvy gadgets like RFID, sensors, actuators, and so forth and sends data to upper layers through layer interfaces [10].

The network layer, also known as the transport layer, is in the middle of the IoT architecture. Devices (hubs, switches, gateways, cloud computing implementations, etc.) as well as various communication technologies (Bluetooth, WiFi, LTB, etc.) are integrated at this layer. Therefore, the network layer is the most important layer in the IoT architecture, and its main function is information transmission.

The three-level engineering is the underpinning of IoT, and it has been planned and executed in numerous frameworks. In any case, the capacities and tasks in the organization layer and application layer are different and complex [11]. To fabricate a general and adaptable IoT multifacet engineering, a help layer ought to be created between the organization layer and the application layer to give information administrations in IoT.

The Internet of Things is widely used in smart industries, smart homes, intelligent agriculture, intelligent management, intelligent transportation, intelligent network, intelligent environmental protection, intelligent security, intelligent medical, etc. It can also be used in many fields such as personal health and government work. The Internet of Things is of great significance to future economic development, social progress, and technological innovation [12].

3.2. Radio Frequency Identification Technology. Radio Frequency Identification (RFID) is a noncontact automatic identification technology that does not require manual operation. It includes three basic devices, a tag, a reader, and an antenna.

3.2.1. Overview of RFID Technology. RFID technology was first used in World War II. Although China started late in RFID technology research, it has begun to catch up. By actively promoting government and related services and businesses, it can independently develop the integration of electronic tags and card reader systems. The technology has been applied to China's "Railway Car Number Automatic Identification System" and has the intellectual property automatic remote identification of a completely independent technical system. In addition to long-range applications, China also applies RFID technology to short-range applications [13, 14].

3.2.2. Working Principle. The reader sends a signal to the tag through the antenna, and the communication electromagnetic response is completed between the reader and the electronic tag through scattering coupling. When the tag receives the electromagnetic wave signal, an induced current will be generated to activate the power switch, and at the

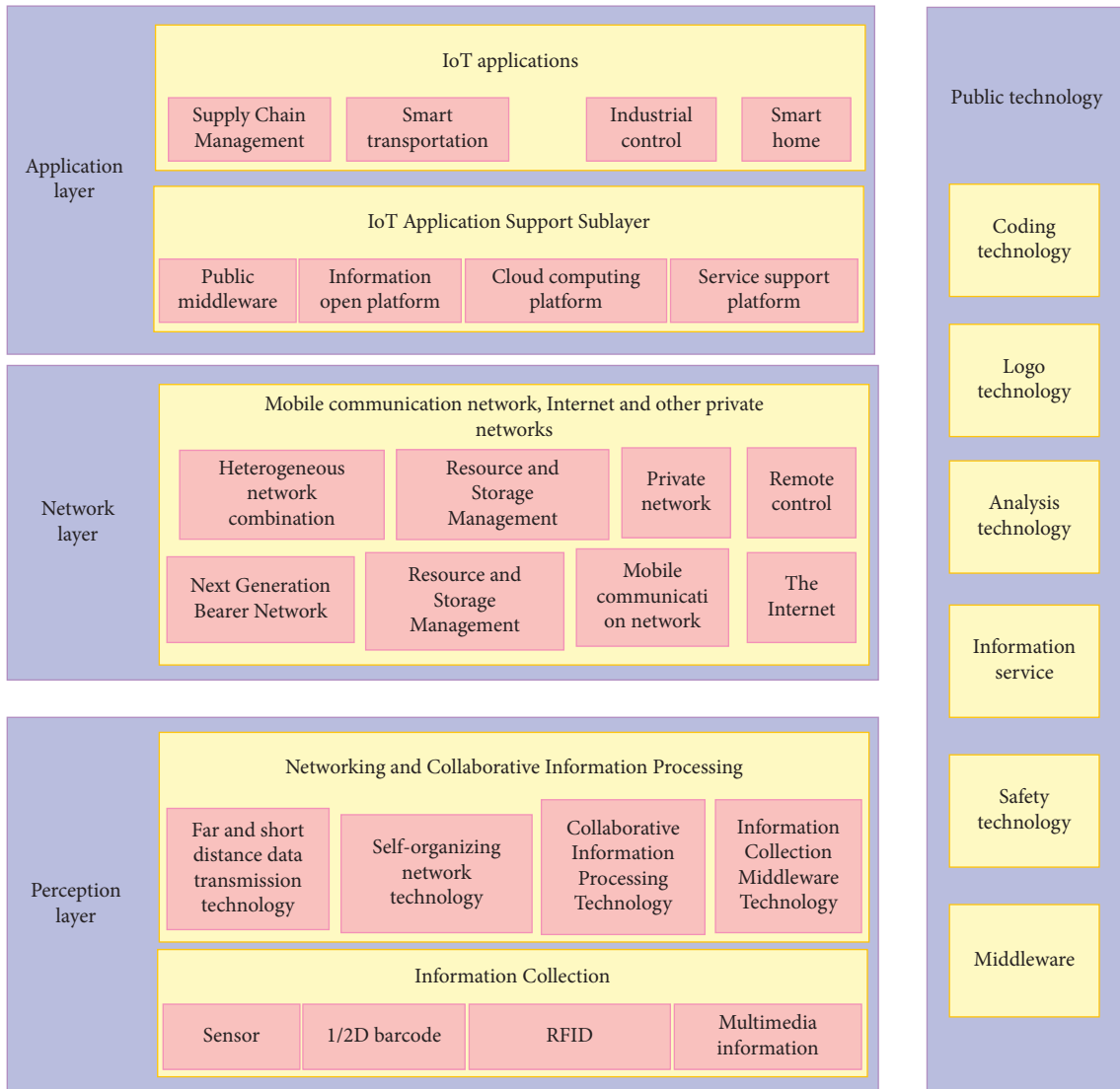


FIGURE 1: The overall architecture of the Internet of Things.

same time, the encoded information will be sent to the reader, enabling two-way communication between the reader and the tag.

The working principle is shown in Figure 2.

3.2.3. Application of RFID Technology in the System. A device worn on the wrist collects human physiological data and transmits the data in real-time to a nearby RFID reader via integrated RFID. The reader uploads the data to the cloud through the Internet network. An experienced cloud system receives the data and processes it and analyzes the human body based on the results of the data analysis state monitoring [15]. The working process is shown in Figure 3.

3.3. Data Mining

3.3.1. Related Concepts. Data mining is a multistage process, or a step-by-step data mining process, as well as a modeling process. A complete data mining process includes six steps:

problem formulation and understanding, data understanding, data preparation and preprocessing, model establishment, model evaluation and optimization, and program implementation, as shown in Figure 4.

3.3.2. Related Algorithms. Information mining incorporates an assortment of insightful strategies to mine and investigate informational collections, then get designs, and apply them. Among them, characterization involves a spot, and the order strategy has additionally been notable by individuals. The most effective method to appropriately group the information will straightforwardly influence the exactness and standard productivity of mining results. Utilization of characterization incorporates a wide assortment of issue spaces, for example, text, mixed media, long-range interpersonal communication, and organic information. Besides, various issues can be experienced in a wide range of situations, characterization is a genuinely different subject, and the basic calculations are intensely reliant upon the

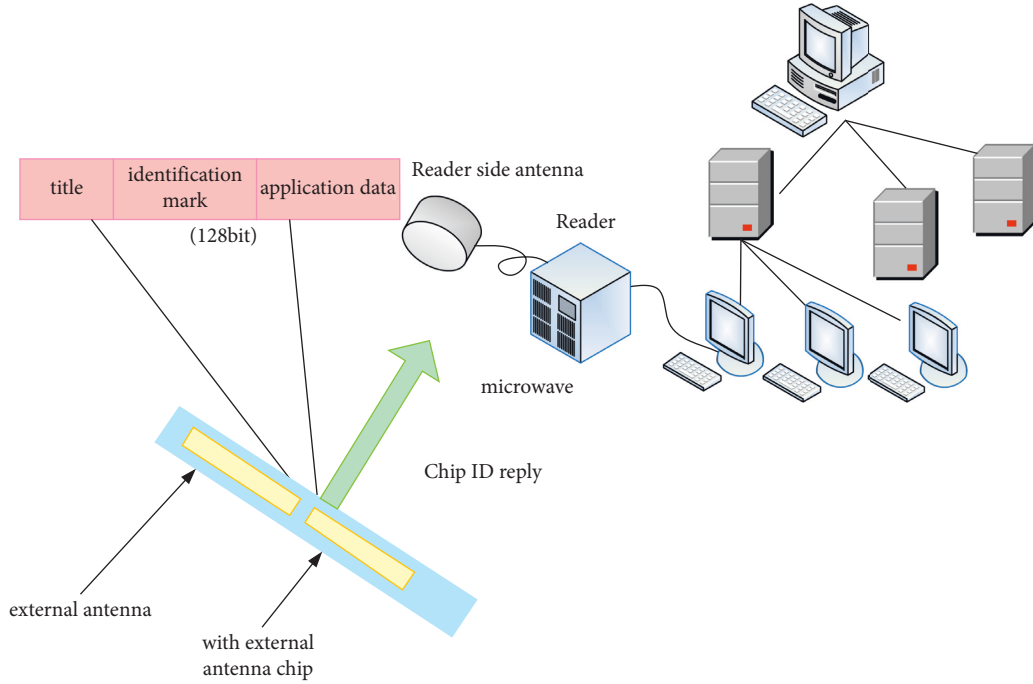


FIGURE 2: How RFID works.

information area and issue situation. Grouping calculation is additionally one of the significant fields of examination in varying backgrounds [16].

(1) *Incremental Kernel Fuzzy Clustering Algorithm.* wFCM is one of the most commonly used fuzzy clustering algorithms. For a given dataset $Z = \{z_1, z_2, \dots, z_n\}$, let γ_a ($a = 1, 2, \dots, n$) be the weight of data point z_a . The wFCM method initially randomly selects x different initial cluster centers and calculates the participation of each data point in the cluster center according to formula (1); then, it updates the cluster center according to formula (2) and obtains a new cluster center; and finally, it restarts the process. Repeat until convergence.

$$d_{ca}^2 = \sum_{c=1}^x \left(\frac{d_{ba}^2}{d_{ca}^2} \right)^{-1/m-1}, \quad (1)$$

$$v_b = \frac{\sum_{c=1}^n \lambda_a \eta_{ba}^y z_a}{\sum_{c=1}^n \gamma_a \eta_{ba}^y}, \quad (2)$$

$$d_{ba}^2 = \|z_a - v_b\|^2. \quad (3)$$

There are three convergence criteria:

All u_{ba} are no longer changed; all cluster centers v_b no longer change; satisfy $|B^{e+1}(U, V) - B^e(U, V)| < \epsilon$, where ϵ is the convergence accuracy, e is the number of iteration steps, and $J(U, V)$ is the criterion function.

$$J(U, V) = \sum_{b=1}^x \sum_{a=1}^n \gamma_a \eta_{ba}^m d_{ba}^2. \quad (4)$$

The definition of the kernel function is as follows:

$$x(s_a, s_b) = \theta(z_a)^T \theta(z_b), \quad (5)$$

where θ is the mapping function, and $x(z_a, z_b)$ is abbreviated as x_{ab} .

The definition of distance is shown in

$$d_{ba}^2 = \|\theta(z_a) - \theta(v_b)\|^2 = x_{aa} + x_{bb} - 2x_{ba}, \quad (6)$$

in which

$$x_{aa} = \theta(z_a)^T \theta(z_a), x_{bb} = \theta(v_b)^T \theta(v_b), x_{ba} = \theta(z_a)^T \theta(v_b). \quad (7)$$

Substituting formulas (6) into (1), the calculation formula of the membership degree in the wKFCM algorithm can be obtained, such as

$$u_{ba} = \sum_{c=1}^x \left(\frac{\|\theta(z_a) - \theta(v_b)\|^2}{\|\theta(z_a) - \theta(v_c)\|^2} \right)^{-1/m-1}. \quad (8)$$

And the update formula of the cluster center is

$$\theta(v_b) = \frac{\sum_{a=1}^n \lambda_a \eta_{ba}^m \theta(z_a)}{\sum_{a=1}^n \lambda_a \eta_{ba}^m}. \quad (9)$$

Incremental kernel fuzzy clustering is to use the wKFCM algorithm to perform clustering on the data block Z_t and the clustering result V_{t-1} of the $t-1$ th step when clustering at the t ($t = 1, 2, \dots, N$) step. The incremental clustering model is simple, and a core step is the utilization of the clustering results of existing data blocks, and some improved algorithms are also carried out for this problem. In the general incremental clustering algorithm, when clustering at the t -th step, the clustering center at the $t-1$ step is directly used for subsequent clustering [17, 18].

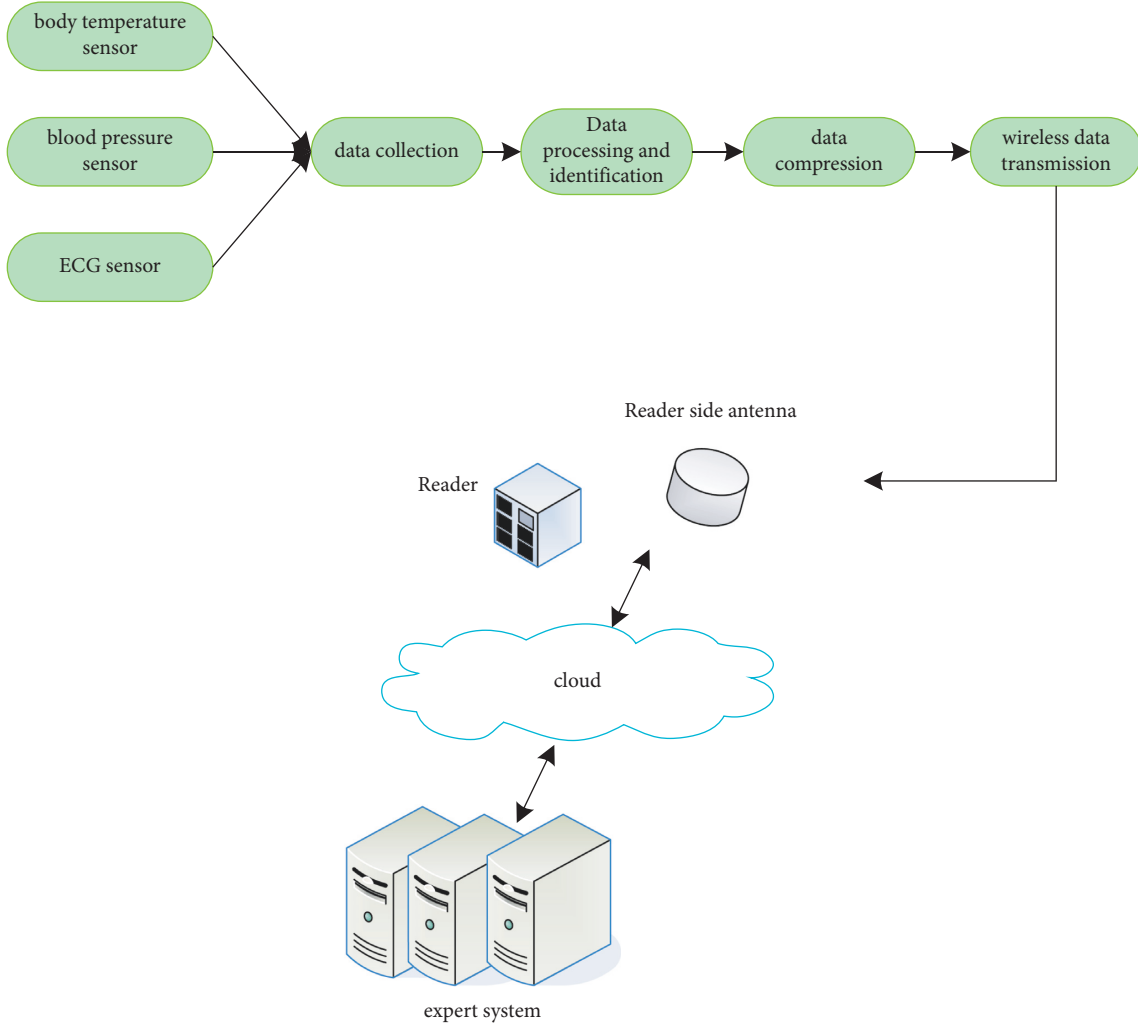


FIGURE 3: RFID data transmission and processing system diagram.

Let $R_t = \{r_1^t, r_2^t, \dots, r_x^t\}$ represent the set of mapped points from the result of clustering at time $t-1$, and let $r_b^t = \sum_{a=1}^{n_t} \alpha_{ba}^t \theta(z_a^t)$. Since R_t is V_{t-1} obtained by mapping, then it can be obtained by solving the optimization problem shown in

$$\min \|\theta(v_b^{t-1}) - r_b^t\|. \quad (10)$$

The cluster centers obtained by the t -th step clustering are expressed as equations (11) and (12).

$$\theta(v_b^t) = \sum_{c=1}^{n_t} q_{ac}^t \theta(z_c^t). \quad (11)$$

Among them,

$$q_{ac}^t = \frac{\gamma_c^t (u_{ac}^t)^m + \sum_{z=1}^n \alpha_{sc}^t \gamma_s^{(t,\alpha)} (u_{as}^\alpha)^m}{s \sum_{z=1}^{n_t} \gamma_s^t (u_{as}^t)^m + \sum_{s=1}^x \gamma_z^{(t,\alpha)} (u_{as}^\alpha)^m}. \quad (12)$$

For data point $z_a^t \in Z_t$, its weight value is generally set to 1, that is, $\gamma_a^t = 1$. The calculation of the weight value $\lambda_b^{(t,\alpha)}$ for

the transfer point 3 can be obtained by the following formula:

$$\gamma_b^{(t,\alpha)} = \sum_{a=1}^{n_t} \eta_{ba}^t \gamma_a^c + \sum_{s=1}^x \eta_{bs}^\alpha \gamma_s^{(t-1,\alpha)}. \quad (13)$$

And the membership degree η_a^t of data point z_a^t is calculated as the following formula:

$$\eta_a^t = \sum_{c=1}^x \left(\frac{\|\theta(z_a^c) - \theta(v_b^t)\|^2}{\|\theta(z_a^t) - \theta(v_c^t)\|^2} \right)^{-1/m-1}. \quad (14)$$

The calculation method of the membership degree $\eta_b^{(t,\alpha)}$ of the transfer point r_b^t is as the following formula:

$$\eta_a^{(t,\alpha)} = \sum_{c=1}^x \left(\frac{\|\theta(r_b^c) - \theta(v_b^t)\|^2}{\|\theta(r_b^t) - \theta(v_c^t)\|^2} \right)^{-1/m-1}. \quad (15)$$

The incremental kernel fuzzy clustering algorithm is a process of continuously reclustering new data blocks and

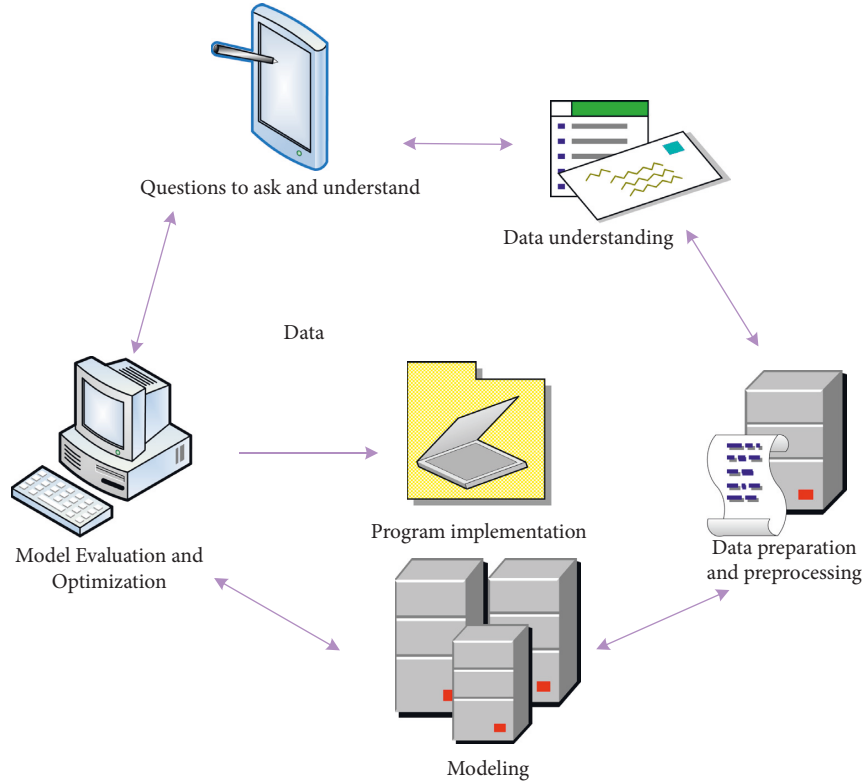


FIGURE 4: Data mining flowchart.

existing clustering results, and each step of the clustering is the same.

(2) *Support Vector Machine*. Solving the optimal separating hyperplane is the basis of SVM, so that the training data can be divided correctly, and the geometric spacing is maximized. For linearly separable data sets, the basic idea and the formalized convex quadratic programming problem are shown in formulas (16) and (17):

$$\begin{aligned} & \max_{wb} \delta \\ & \text{s.t. } y_i \left(\frac{w}{\|w\|} \cdot x_i + \frac{b}{\|w\|} \right) \geq \delta, i = 1, 2, \dots, N, \end{aligned} \quad (16)$$

$\delta_{i=1,2,\dots,N} y_i (w/\|w\| \cdot x_i + b/\|w\|)$ defines the geometric space of the hyperplane relative to sample point (x_i, y_i) , and $\delta = \min_{i=1,2,\dots,N} \delta_i$ is the minimum value of the geometric space of the hyperplane at all sample points.

$$\min_{\alpha} \frac{1}{2} \sum_{i=1}^N \sum_{j=1}^N \alpha_i \alpha_j y_i y_j (x_i \cdot x_j) - \sum_{i=1}^N \alpha_i, \quad (17)$$

$$\text{s.t. } \sum_{i=1}^N \alpha_i y_i = 0 (0 \leq \alpha_i \leq C, i = 1, 2, N), \quad (18)$$

where the penalty parameter $C > 0$, the most E solution:

$$\alpha^* = (\alpha_1^*, \alpha_2^*, \alpha_N^*)^T. \quad (19)$$

For nonlinear classification, the interinstance inner product can be turned into a kernel function. For x, k in any input space, we have

$$Z(x, k) = \varphi(x) \cdot \varphi(k). \quad (20)$$

Support vector machines have been widely used in neuroscience and bioinformatics because the algorithm can handle high-dimensional data well. Its main disadvantage is the large amount of calculation and easy overfitting.

3.4. Human Body Signal Acquisition. There are various physiological signals in the human body. According to the nature of electricity, it can be divided into electrical signals, such as ECG, EMG, and EEG, as well as nonelectrical signals such as respiration, invasive blood pressure, noninvasive blood pressure, blood oxygen saturation, respiratory carbon dioxide end point, body temperature, heart rate, and pulse. Since the human body is a complex living body, various physiological signals are affected by various factors such as the human body and the external environment. Therefore, they have features that are not generally marked:

- (1) The signal is weak.
- (2) The motivation behind why the commotion is solid is that the sign of the human body itself is exceptionally feeble and is effortlessly upset by the clamor. For example, the electrocardiogram of the fetus is mixed with strong noise. On the one hand, the interference

from the electromyogram and power frequency becomes noise.

- (3) The recurrence range is by and large lower, then again, actually, the unearthly components of the heart sound sign are marginally higher, and the range of other electrophysiological signals is for the most part lower.
- (4) Human physiological signals have strong randomness, not only random, but also immovable.

According to the instability, nonlinearity, and probability characteristics of human physiological signals, different detection methods should be used for different physiological parameters. Since the human body system is very complex and rich in information, human body signal detection technology is very important.

4. Design Experiment of Indoor Lighting Control System

4.1. System Solution Selection. In the mainstream system development in the world today, there are two commonly used software system architectures, namely, CIS structure and B/S structure. The two structures have their own characteristics and are suitable for different system designs. The following is an analysis of the design of intelligent lighting control systems based on the two structures.

The CIS function, the client\server function (Client-Server), is a simple software system architecture. This function allocates system tasks reasonably, makes full use of the advantages of client and server hardware resources, and saves the consumption of data communication in the system. Because CIS distributes many tasks to the client for processing and submits them to the server after processing, reducing the workload of the server. Therefore, the function can fully utilize the processing power of the customer and has a higher response speed. At present, the server mainly completes the functions of information coordination and database management. Using this mode of operation, a local fast response network system can be built. The structure of the CS-based smart lighting system is shown in Figure 5(a).

B/S mode is browser\server mode. In this mode, users can access the Internet network through a web browser and exchange information such as text, data, images, and sounds, while a large amount of information data on the network is stored in the server database. In addition to supporting the Web browser function, the client usually does not need any user program and only needs to obtain information from the local Web server. This process is mainly that the browser sends a request to the web server, and the web server obtains relevant information by analyzing the request and communicating with the database, then returns to the browser, and then returns to the user. In B/S mode, almost all software code development and data information processing tasks are completed on the server side. The server is the heart of the system, and its requirements are lower than the server on the client side. The customer development under the B/S mode is mainly web interface development and data communication development, with low customer utilization rate and

simple operation [19, 20]. The structure of the intelligent lighting system based on the BS function is shown in Figure 5(b).

In C/S mode, the entire indoor lighting system forms a wireless Wi-Fi local network, and smart devices are wirelessly connected to the system server through Wi-Fi. The user conveys the intention to operate on the server by operating the application software on the electronic device, and the server analyzes and processes it and sends commands to the lighting control terminal.

In B/S mode, the client can be any smart device that supports browsers, and the client communicates with the system server by accessing the Ethernet. The system server communicates with the light control terminal through Wi-Fi wireless, and the server is the bridge connecting the client and the light control terminal.

Through the above comparison, the comparative analysis of the indoor intelligent lighting system in CIS and B/S mode is as follows:

- (1) The CIS function is a two-layer structure, and the mobile terminal and the server are directly connected and communicated through WF, and the response speed is fast. B/S is a three-tier architecture. The mobile phone connects to the Internet via Wi-Fi or 2G/3G and exchanges data with the server. It has low speed and long latency.
- (2) In CIS mode, the smartphone client provides full functionality for its powerful data processing capabilities. It makes full use of the hardware resources of Android phones and servers to undertake data processing tasks. In B/S mode, a complex server needs to be deployed to take over most data processing tasks, and the processing power of the mobile phone is not fully utilized, which will increase the difficulty and development time.
- (3) In C/S mode, a simple, reliable, and secure independent wireless LAN is created. In B/S mode, the server must be connected to the Internet network. Real-time access to the Internet generates a large amount of data traffic in the process of information transmission and interaction, which undoubtedly increases the consumption cost of home lighting applications.

This system is based on home application and should fully consider the needs of simple design, reducing the difficulty of development and maintenance and saving resources. After comparing different modes, choose C/S mode to design the system, which can meet the needs of home lighting.

4.2. System Scheme Design

4.2.1. Hardware Design of Intelligent Lighting Node. The intelligent lighting node provides lighting for the home environment and is the basic part of the system, and its design is related to the realization of the lighting function of the system. This part of the single-chip microcomputer has

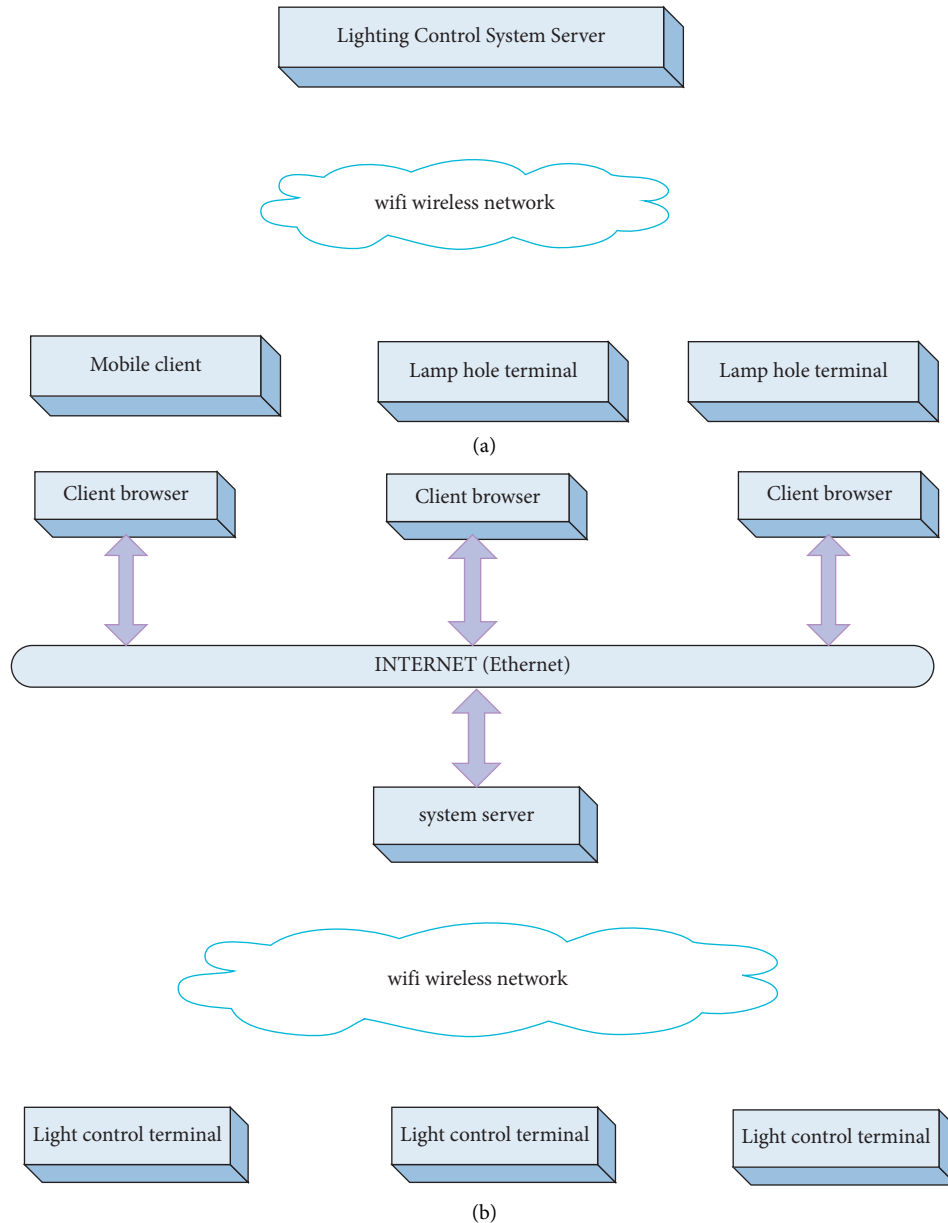


FIGURE 5: Structure of an intelligent lighting system. (a) System structure diagram based on C/S mode. (b) Structure diagram of intelligent lighting system based on B/S mode.

640 bytes of EEPROM, which is enough to store the ID and status of the lamps and lanterns. It is not necessary to install the EEPROM memory chip of AT24C64. The hardware design block diagram of the intelligent lighting node is shown in Figure 6.

4.2.2. Overall Structural Design. The system is designed with CIS functionality to create a home WiFi lighting network. Develop mobile application software aimed at controlling and implementing home lighting via mobile phone. The general schematic graph of the framework is displayed in Figure 7.

4.2.3. System Function Design. The system takes the home as the background and the central control as the goal and evenly manages the home lighting through electronic equipment, which solves the traditional constant on-off control and the inability to reduce the brightness of lamps. The overall realization function of the system is divided into control function and management function.

(1) Control Function. The control function is performed by sending control commands to the AP server through the mobile phone client software, and the AP server sends the control commands. The details are shown in Figure 8. The specific control functions are as follows:

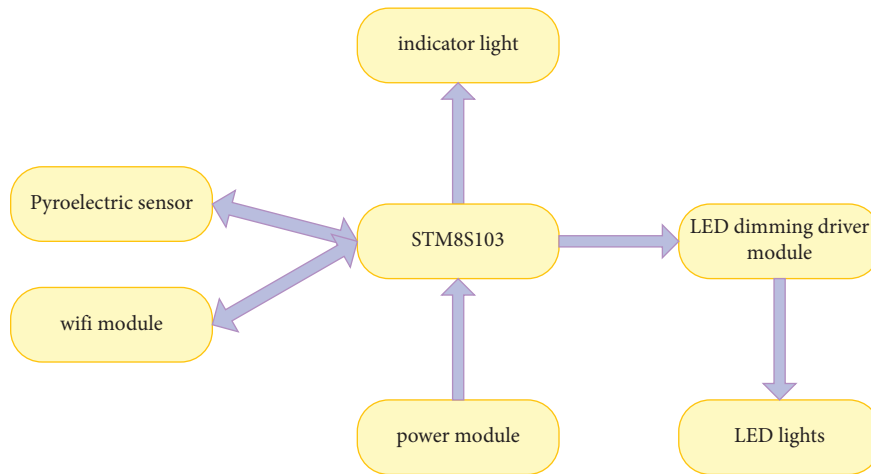


FIGURE 6: Block diagram of smart lighting node design.

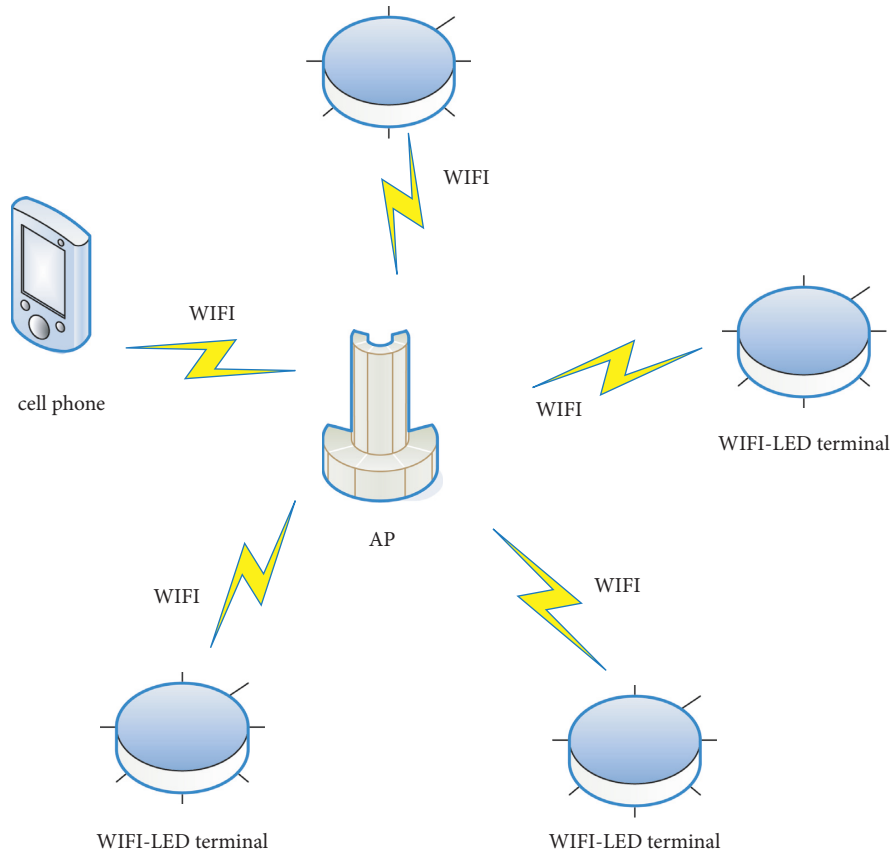


FIGURE 7: Schematic diagram of intelligent lighting system based on human body signal acquisition.

Switch light function: through the mobile client software, you can turn on and off a single light, turn on and off the group where the light is located, and turn on and off all lights.

Dimming function: this system can reduce the brightness of LED lights through PWM waves. It adjusts the brightness of the WiFi LED light from 20% to

100% and continuously adjusts it from 20% to 100%. When the light is off, the brightness can be preset to decrease, and the preset brightness is displayed when the light is on.

Status refresh function: after the client software exits, the current lighting information of each lamp will be maintained.

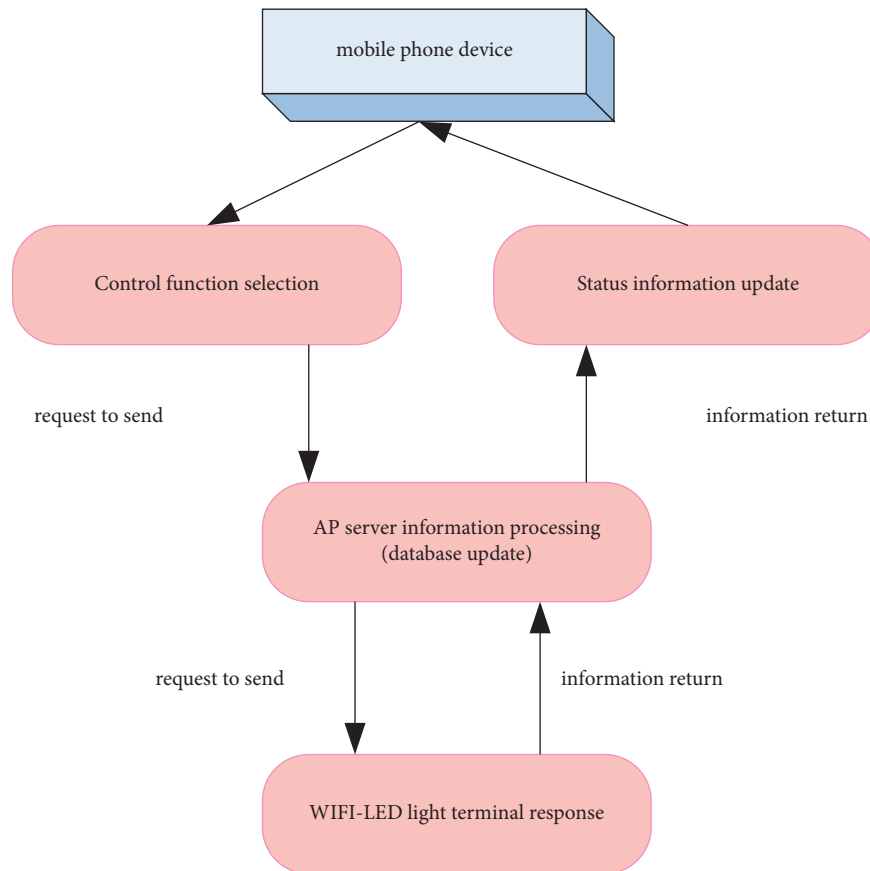


FIGURE 8: Control function realization flow chart.

(2) *Software Design of Lower Computer.* Each smart lighting node has its own ID and has the functions of switching lights on and off, adjusting lights, and storing light information. After the system is initialized, first turn on the WiFi module to check whether the WiFi module is working normally. After the module is started, it is connected to the AP server. At this time, the LED light will indicate whether the AP is turned on. After the system starts to work, it first receives information, analyzes and processes the information, and then sends the returned information. The software flow chart of the intelligent lighting node is shown in Figure 9(a).

The AP server receives the information of the intelligent lighting node and the mobile phone control terminal, processes and relays it accordingly, and stores the information of the LED light node at the same time. The information processing flow chart is shown in Figure 9(b).

Infrared pyroelectric sensor: when people enter the detection range, the device outputs a high level to turn on the indoor LED lights. When people leave the detection range, the LED lights go out. The PA3 port is the input end of the HC-SR501 sensor.

4.3. Overall Test of Intelligent Lighting System. In this test, a smartphone was used to send commands to the number and group of lights and then to change and turn off the lights of individual lights, recording the corresponding data. There are three types of lamps, that is, A, B, and C, and lamps A and B are

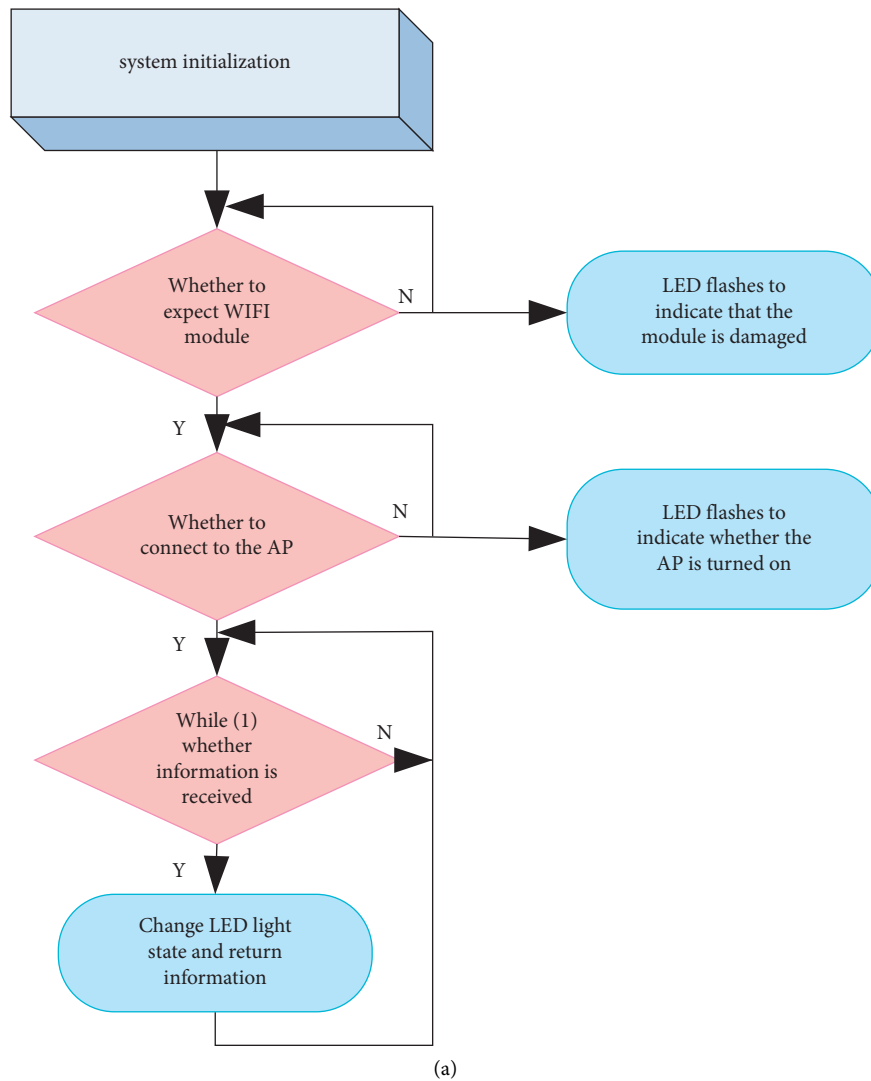
defined as a group. After each command is sent 100 times, the number of successes is recorded, and the test data records are shown in Table 1. In the brightness reduction test, the brightness of the two lamps was 35% and 75%, respectively, and the corresponding PWM waveforms are shown in Figure 10.

Test analysis: after the test is completed, 100 times of commands are issued normally, and the intelligent lighting node can correctly receive and process the command information and respond accordingly. During the brightness reduction process, the sensitivity and smoothness of the touch screen slider are good, and the brightness reduction is successful. When a group of lights is turned on and off, the C light is not in the group, and the display data is 0, indicating that the group switch is working properly.

Test results: the intelligent lighting system basically realizes sending and receiving commands, intelligent lighting nodes with light switches, group light switches, and all lighting switches and dimming functions of the lamps meet the design requirements.

5. Discussion

The study analyzed how to research the indoor lighting control based on the human body signal acquisition based on the Internet of Things technology. The technical concepts



(a)
FIGURE 9: Continued.

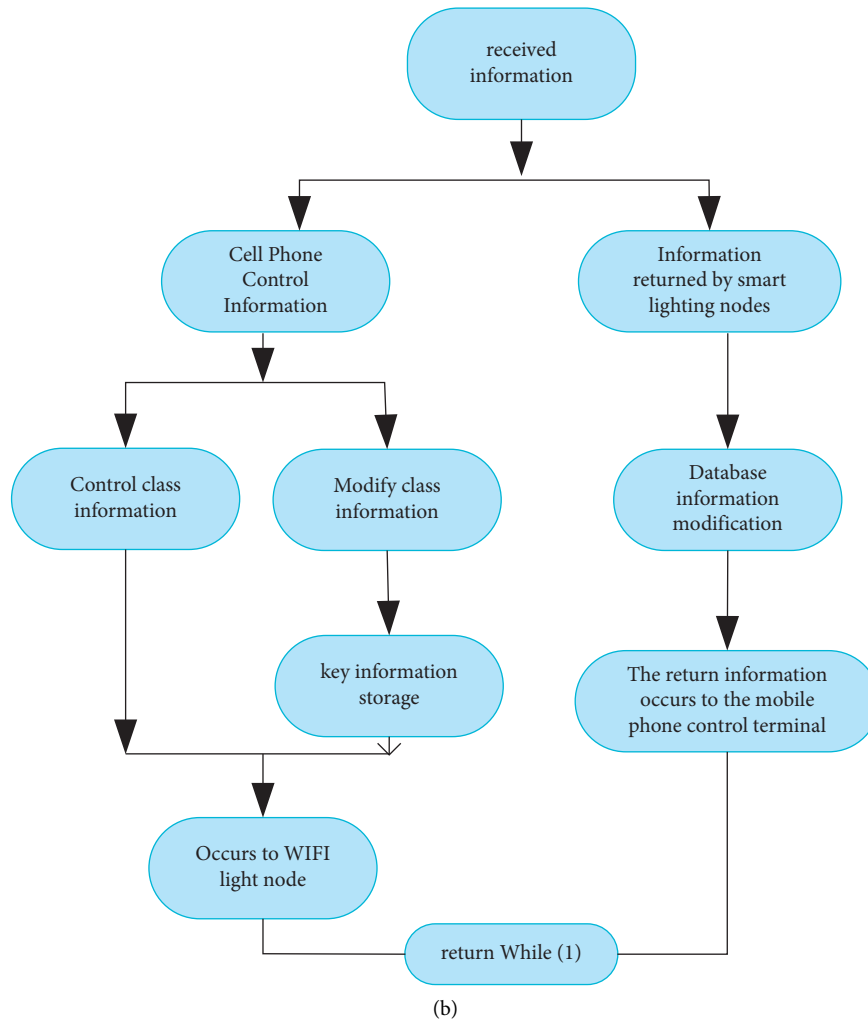


FIGURE 9: The software flow chart of the lower computer. (a) Flow chart of intelligent lighting node software. (b) Information processing flow chart.

TABLE 1: Overall test data recording form.

Test content	Single light on	Single light off	Dimming	Group open one group	Group off one group	Fully open	All closed
A lamp (one set)	100	100	100	100	100	100	100
B light (one set)	100	100	100	100	100	100	100
C lamp	100	100	100	0	0	100	100

and algorithms of the Internet of Things are expounded, the incremental kernel fuzzy clustering algorithm is studied, and the support vector machine is explored. It also analyzes the applicability of IoT technology in indoor lighting control system through experiments.

Most of the traditional indoor lighting control systems build a lighting network by laying wires and use fixed switches for control, which increases the complexity and difficulty of construction. In addition, there are problems such as chaotic wiring and unsightly overall effect, which seriously affects the application of lighting systems. With the advancement of science and technology, various wireless transmission technologies have developed rapidly, and technologies such as

infrared and WiFi have become increasingly mature and widely used.

Through experimental analysis, this paper shows that when the pyroelectric infrared sensor is activated, it will simulate a person entering this state. When someone enters, the light will be automatically turned on, and when no one enters, the light will not be turned on. When the infrared pyroelectric sensor is off, the light cannot be turned on whether or not someone enters. In addition, the control end of the pyroelectric sensor designed in this paper adopts two ways: inside the door and outside the door. After the test, when only one pyroelectric induction unit senses someone, the light will not be turned on, and only two pyroelectric

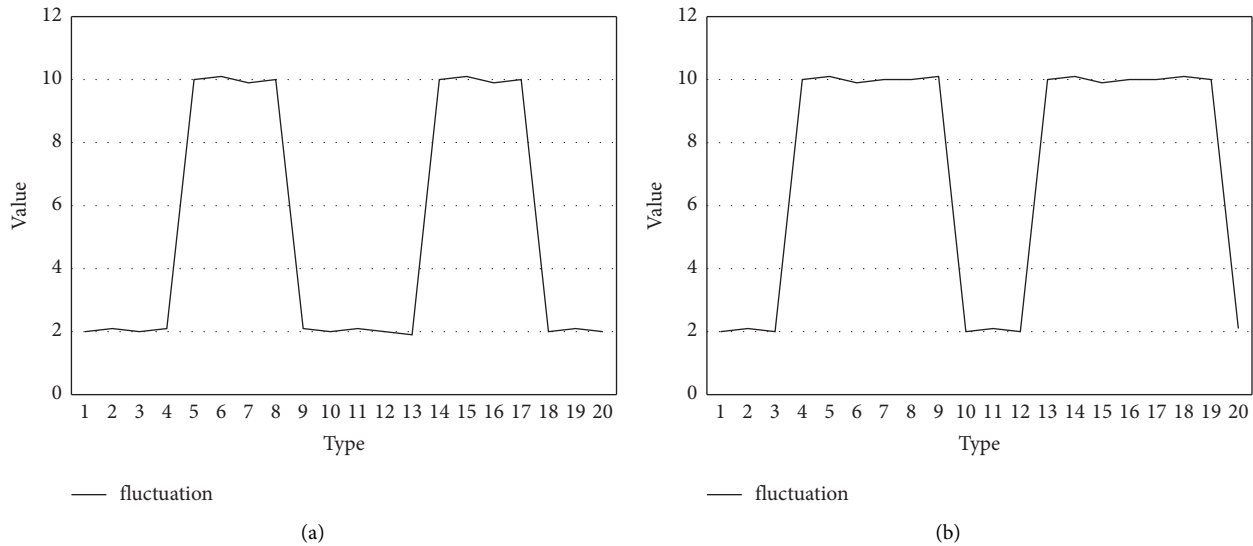


FIGURE 10: PWM waveform diagram. (a) Brightness 35%. (b) Brightness 75%.

induction units will light up continuously. After the induction ends, the light is turned on. The test results meet the design requirements and achieve the design goals.

6. Conclusions

The Internet of Things combines various information detection equipment, computing equipment, objects, and people with the Internet to establish a large-scale operation network. The connection between people, machines, and things can be interconnected anytime and anywhere. In this paper, a uniform light environment distribution model for indoor lighting is established, and the output stability of intelligent control of indoor lighting uniformity is analyzed to improve the softness of indoor lighting. It adopts the optical background extraction method to realize the intelligent control of indoor lighting uniformity. The smart home lighting system contains a variety of modern technologies, and the design and learning process is difficult. Due to the limited research time and the lack of own experience, the system design work can be improved and perfected.

Data Availability

No data were used to support this study.

Conflicts of Interest

There authors declare that there are no potential conflicts of interest in this study.

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