Design and Realization of Modern Smart Home System Based On Multimedia Network Technology

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Abstract. With the development of science and technology and the progress of multimedia network technology, various intelligent electronic products are more and more widely used in people's lives. High-tech and intelligent technology have moved from intelligent buildings to residential home users, and home intelligent technology has become a cutting-edge technology topic. In this regard, the purpose of this article is to study the design and implementation of modern smart home systems based on multimedia network technology. This article first studies the development status of domestic and foreign multimedia network technology and smart home technology, and conducts a questionnaire survey on some residents to understand the current status of smart home. Finally, based on this, this article uses high-level programming language to code the system. According to the method and technology of test theory, the function and performance of the software system are tested completely, and compared with the traditional smart home system. The experimental results show that the modern smart home system using multimedia network technology is more recognized and loved by residents, and the residents' preference for smart home has increased by about 20%, which has played a significant role in increasing the utilization rate of smart home systems and is a multimedia network the future development of smart home systems provides an important reference.

Keywords: Multimedia Network Technology, Modern Smart Home System, Questionnaire Survey, Comparative Analysis

1. Introduction
With the continuous development of the times and economy, people have new requirements for the improvement of the quality of life, and as an important life factor of people, the quality of home has become an important indicator [1-2]. Under the background of this new era, the concept of smart home was proposed, and the smart home system has also been developed [3-4]. It provides users with the most convenient, efficient and comfortable intelligent lifestyle [5]. With the rapid development of multimedia network technology, more and more smart home products use multimedia network technology. The development of smart home systems using multimedia network technology has provided a lot of fun in people's lives, and has gradually become a new way of life, with great development prospects [6-7].
At present, with the continuous development of multimedia network technology, researches on the use of multimedia network technology to transform smart home systems have emerged [8]. In foreign countries, Dwairi M has realized the networking automation and informationization of indoor home equipment for residential users, and has also developed biotechnology for authentication and realized automatic door system identification [9]. In China, Lei and Du combine wired and wireless on the basis of traditional products, and smart home products are connected through sensors and network equipment terminals. In order to realize the intelligence of the home, it can identify the interconnection of the smart home security system, digital information and multimedia, and realize the real network sharing [10].

Based on multimedia network technology, this paper studies the design and implementation of modern smart home systems. This article first studies the home multimedia network technology and smart home technology to understand the current situation of smart homes. Then, this article introduces the key technologies related to the multimedia network smart home system, solves these technologies and problems, and specifies the requirements of the media network smart home software design in the early stage of the system design. Finally, this article uses high-level programming languages to code and test the system. The latest smart home system incorporating multimedia network technology is widely recognized and loved by residents, and provides an important reference for the future development of multimedia network smart home systems.

2. Technical Research on the Design and Implementation of Modern Smart Home System Based on Multimedia Network Technology

2.1. Multimedia Network Technology

The so-called multimedia is a kind of human-computer interactive information exchange and dissemination that integrates two or more media. The media plays the role of a pipeline in the process of information transmission. There are many types, including text, images, graphics, animation, and audio, Video, etc. With the development of multimedia technology and network technology, the development of the future network towards multimedia is the general trend. Looking at the current situation of education in our country, it is not difficult to find that multimedia and networking are increasingly closely integrated. The application of multimedia technology and network technology to education is the two major global hot spots of today's educational technology and will bring about major historical changes in education and teaching.

(1) Resource sharing

The so-called resource sharing means that the same resource can be browsed or downloaded by more users at the same time. It has become the world's largest shared resource library, connecting the world's educational resources into a vast ocean of information. The multimedia system based on the network, the multimedia and network communication technology are closely combined to greatly expand the functions of a single multimedia system. It not only has a variety of information processing and human-computer interaction functions, but more importantly, it realizes the transmission and sharing of online multimedia information resources.

(2) Extensibility of time and space

The smart home system under the multimedia network technology has great freedom in space and time. For example, you can use the smart home anytime and anywhere at home according to your actual situation, skip the manual control process, and directly issue related commands to the smart home system, thereby greatly improving the efficiency and effectiveness of use.

(3) Multi-directional interaction

Under normal circumstances, intelligence controls the home equipment through direct contact with gloves. Although some ordinary smart homes now use some basic intelligent control methods, due to the weak interaction, users can only passively receive information, and cannot independently choose to control the content and progress. Realize the interaction between user and machine, user and user, machine and machine interaction. Due to the formation of an interactive atmosphere, the smart home
under the multimedia network fully embodies the creativity of the user in the communication with the user, so that its personality can be fully displayed.

(4) Learning collaboration

Users continue to communicate, coordinate, and cooperate closely with smart homes, and gradually form collaboration, so as to better realize the use of smart homes. Through collaborative learning, users have a deeper understanding of smart homes and gradually form their own ways of using them.

(5) Autonomous and selective

In traditional homes, some fixed operating methods are often used as the only information sources, and users have no free choice. However, free choice is the prerequisite and key to autonomous control. In the multimedia network environment, users can no longer be led by the only information source, they can choose a wealth of materials from a wide range of network information sources, and design and arrange use according to their actual conditions, thus becoming the main body of intelligent control.

2.2. Design and Algorithm of Multimedia Network Technology in Modern Smart Home

(1) Basic functions

1) Conducive to the user's autonomous control

It can meet the individual requirements of users. Since traditional household equipment cannot provide multiple household functions at the same time, users cannot use them according to their actual conditions. The multimedia network is flexible and diverse, and users have greater autonomy. They can choose the content and process of use according to their personal goals, personal needs and level, design use methods, construct effective individual control structures, and optimize the construction process.

2) Conducive to increase interest in use

It also stimulates the user's learning interest, emotional experience and the influence of beauty. In the use of multimedia network technology, the user's multiple senses participate in cognition, which stimulates interest in use and cultivates emotions. The multimedia network also reproduces many real situations, brings the colorful phenomena in life into the use process, and promotes their pleasure of use. Through the large amount of original materials provided by the multimedia network, users have widely absorbed various natural and social knowledge, and deepened the inner experience in many aspects. At the same time, the multimedia network can also express the content of home use in the form of art, so that users are influenced by the aesthetics in the process of use, and cultivate their sentiment in the atmosphere of beauty.

3) Facilitate interaction and cooperation between users and smart homes

The smart home system under the multimedia network technology has a good interactive atmosphere, and can easily expand the information exchange between the user and the machine, the user and the user, and the machine and the machine. At the same time, the relationship between the user and the machine has also undergone subtle changes—because the user no longer appears as a mere controller or user, but becomes an active participant in the entire use process.

(2) Design and Algorithm

1) Design of lighting control module

The lighting control module sends instructions and data to the lamps through the Internet of Things network to realize the adjustment of indoor and outdoor lighting effects. The lighting control module can adjust the lighting effect and lighting duration of a certain area indoors and outdoors according to needs, and adjust the lighting control for comprehensive lighting needs and energy-saving considerations.

\[ L^* = 116(Y / Y_0)^{1/3} - 16 \]  

(1)

\[ a^* = 500[(X / Y_0)^{1/3} - (Y / Y_0)^{1/3}] \]  

(2)
\[ b^* = 200[(Y / Y_0)^{1/3} - (Z/Z_0)^{1/3}] \]  \hspace{1cm} (3)

Among them, \( X, Y, Z \) are the tristimulus value of the object; the tristimulus value of the \( X_0, Y_0, Z_0 \) CIE standard lighting body; \( L^* \) represents the mental brightness; \( a^*, b^* \) are the mental chromaticity.

2) Access control recognition design

The composition of the access control system recognition includes hardware devices such as cameras, voice intercom devices, fingerprint recognizers and image processing software, voice processing software, etc. The key to access control recognition is the collection and processing of user identity information. The algorithm of face image collection is as follows:

\[ \text{gray} = 0.39*R + 0.50*G + 0.11*B \]  \hspace{1cm} (4)

Among them, the meaning of gray is the gray value, \( R, G, B \) respectively represent the value of the red, green, and blue components of the color image pixel value.

3) Fire alarm and fire protection design

The core of the fire alarm function design is to determine the detection method of fire occurrence. At present, fire sensors commonly used in engineering generally collect information such as temperature, humidity, smoke, and combustible gas concentration in the monitoring site, and then analyze and determine whether a fire has occurred through signal processing. The threshold comparison method is often used to analyze and judge the detected signals.

\[ F_0(X_1, X_2, \ldots, X_n) \]

Means the characteristic data extracted from the fire data (a random process with multiple dependent variables), remember the data collected by the sensor at time \( T \) as \( F_r(X_1, X_2, \ldots, X_n) \), then the differential \( \frac{dF_r}{dt} \) of the collected data is judged by the following expressions:

\[ P[x_2(t)] = \begin{cases} \frac{dF_r}{dt} \leq \frac{dF_0}{dt} \\ \frac{dF_r}{dt} > \frac{dF_0}{dt} \end{cases} \]

Among them, 0 means normal state and 1 means fire has occurred.

3. Experimental Research on the Design and Implementation of Modern Smart Home System Based on Multimedia Network Technology

3.1. Experimental Data

This paper randomly selects 200 residents of two communities A and B as the research objects, with 100 residents in each community. A questionnaire survey was conducted on these residents, and the data of the questionnaire survey was collected. In order to ensure the validity and representativeness of the research, this paper adopts an anonymous method when conducting the questionnaire survey. A total of 200 questionnaires were distributed and 200 questionnaires were returned, including 190 valid questionnaires.

3.2. Experimental Process

This article issued a questionnaire survey to 200 residents of these two communities to understand their expectations of modern smart home systems based on multimedia network technology. Then, based on the results of the questionnaire survey, this article allows the A community to use a modern
smart home system incorporating multimedia network technology, while the B community uses a traditional smart home system for one month. Use the data statistics during the experiment, and comparative analysis to analyze the effect of the modern smart home system incorporating multimedia network technology.

4. Experimental Analysis of the Design and Realization of Modern Smart Home System Based on Multimedia Network Technology

4.1. Community Residents' Views on Modern Smart Home Systems Based on Multimedia Network Technology

In order to study the status of multimedia network technology and modern smart home system, as well as residents' views on this, this paper uses big data analysis system to classify and count the selected representative data. As shown in Table 1 and Figure 1.

**Table 1.** Relevant views of community residents

| Survey items       | A district | B district |
|--------------------|------------|------------|
| High intelligence  | 95%        | 93%        |
| Good optimization  | 98%        | 96%        |
| High efficiency    | 93%        | 90%        |
| Multiple functions | 94%        | 98%        |
| Good multimedia effect | 99%    | 93%        |

**Figure 1.** Relevant views of community residents

It can be seen from the survey data that the residents of the two communities A and B are quite satisfied with the modern smart home system based on multimedia network technology. The support of each survey item has reached more than 90%, which shows that the integration of multimedia modern smart home system of network technology can meet the needs of most residents for various functions of the home, and can get their support. This is because the network-based multimedia system is a close combination of multimedia and network communication technology, which greatly expands the functions of a single multimedia system. It not only has a variety of information processing functions and human-computer interaction functions, but more importantly, it can also transmit and share online multimedia information resources to meet people's needs.
4.2. Actual Effects of Modern Smart Home Systems Incorporating Multimedia Network Technology

In order to further verify the actual effect of the modern smart home system that incorporates multimedia network technology, this article allows the A community to use the modern smart home system that incorporates multimedia network technology, while the B community uses the traditional smart home system. The use time is 1 month. Then the changes in the use effect of these residents are visually expressed, and curve fitting is performed according to the mean value. As shown in Table 2 and Figure 2.

Table 2. Comparison of the effects of two smart home systems

|       | 5 days | 10 days | 15 days | 20 days | 25 days | 30 days |
|-------|--------|---------|---------|---------|---------|---------|
| A district | 50%    | 59%     | 66%     | 76%     | 84%     | 91%     |
| B district | 50%    | 54%     | 57%     | 62%     | 68%     | 73%     |

Figure 2. Comparison of the effects of two smart home systems

It can be seen from the experimental data that the actual effect of the modern smart home system incorporating multimedia network technology has reached a theoretical level, and the degree of preference among the residents of Community A that uses the smart home system has increased over time. Very fast, much higher than the residents of Community B using traditional smart home systems. This shows that modern smart home systems incorporating multimedia network technology can effectively improve people's use effects and truly realize smart homes. Moreover, the modern smart home system integrated with multimedia network technology has formed three interactive use atmospheres. The smart home under the multimedia network fully embodies the creativity of users in communicating with users, so that its personality can be fully displayed and used the user experience is very good.

5. Conclusions

Based on multimedia network technology, this paper studies the design and implementation of modern smart home systems. This article first investigates the development status of multimedia network technology and smart home technology at home and abroad to understand the current situation of smart home. Next, this article introduces the key technologies involved. In this article, following the technology of software engineering design, the requirements of media network smart home software design are analyzed in detail in the early stage of system design, and the system is coded using high-level programming languages. Then this article carries out a complete test on the function and performance of the software system according to the method and technology of test theory. The modern smart home system using multimedia network technology has been widely recognized and
loved by residents. The real realization of smart home will serve as an important reference for the future development of multimedia network smart home systems.

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