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Research on Green Ecological Interior Space Design Based on FPGA and Embedded System

Zhu Lingyi, Tang Yuhe, Li Xiang, Zhang Xinyi, Sun Xiaomeng*

School of Art and Design, Xijing University, Xi'an, China
SXM15319959753@163.com
**Corresponding author*

Abstract: *At present, with the development of FPGA technology, FPGA has become an indispensable part of various systems. Based on the idea of modular and standardized design, a simple and standardized design method is found for the construction of FPGA design system. With the attention paid to environmental protection, interior space design also began to pursue green ecology. This paper briefly describes the concept and technical advantages of FPGA and embedded system, analyzes the concept of green ecological interior space design, and introduces the application of FPGA and embedded system in interior space design with examples. Different types of indoor home systems will have different technical applications. FPGA and embedded system are the technical means that interior designers need to learn and understand, Wireless communication technology and Internet of things technology are also of great significance for green ecological interior space design.*

Keywords: *FPGA, Embedded, Green ecology, Space Design*

1. Introduction

Social development and progress promote the improvement of people's living standards. The concept of environmental protection has also been deeply rooted in the hearts of the people in recent years. People pay more and more attention to indoor space design and put forward higher and higher requirements for the living environment. The dual enjoyment of material and spiritual life is pursued by more and more people. In today's increasingly serious environmental pollution, how to design a more healthy, environmental friendly and comfortable indoor space is a hot issue for interior designers. Under the general trend of indoor ecological design, interior designers and space users attach great importance to how to meet the visual aesthetics and create a more environmentally friendly and healthy indoor space, and put forward the design concept of ecological aesthetics to meet the dual needs of contemporary people for aesthetics and environmental protection. With the development of science and technology, how to make better use of science and technology to help the design of interior space is also a key research issue for interior designers. This paper explores how to better design green ecological indoor space based on FPGA and embedded system, in order to provide reference and reference for the design in the industry, so that man and nature can coexist harmoniously, and the coordinated development among man, environment and architecture can be realized.

2. Concept of FPGA and Embedded System

The full name of FPGA is field programmable gate array, which is translated as "field programmable gate array". It is a programmable logic device (PLD) based on look-up table structure in the field of special integrated circuits. The essence of display look-up table (LUT) is random access memory (RAM). Data is written in RAM in advance, and the address input is realized through input signal and look-up table is carried out. When the user forms a logic circuit, The development based on FPGA can automatically calculate according to the design content, and record and store all possible logic results generated in the table. Different input contents will correspond to different outputs in the logic circuit [1]. Such components were invented and put into use in the 1970s. After more than 40 years of development and progress, the internal structure, manufacturing process, power consumption, production scale and application speed of components have been significantly improved. The single-chip FPGA has developed from thousands of integrated gates to hundreds of thousands and millions of gates. The I / O ports of the chip have also increased to thousands. The increase in the

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number of gate circuits has led to better development of FPGA, It also effectively solves the shortcomings of customized circuits. FPGA has programmable characteristics, and can be combined with the user-defined IP core for unlimited programming and greater creativity. At present, FPGA is widely used in the field of communication, which helps to improve the level of science and technology [2].

Early embedded systems generally took general processor or circuit breaker as the core. The peripheral circuits included memory, power driver, communication interface, display interface, human input interface and other peripheral interfaces. After adding application software and some plug-in operating systems. Form a complete system. With the development of microelectronic technology, SOC has replaced the traditional architecture centered on single chip microcomputer in many applications, integrating many peripheral devices and memory into one chip. The consumption and volume of the system are smaller and smaller, but the function is more and more powerful. At the same time, FPGA is a component that realizes multiple functions through logical combination, and can carry out almost all kinds of processing. In general digital signal processing, some FPGAs provide DSP modules to speed up the speed. The parallel processing structure of FPGA is very suitable for operation intensive applications such as image processing and digital signal processing. When any chip cannot meet the requirements, you can also use the sealed FPGA chip with the same capacity to provide higher processing power and maintain the compatibility of its attractive pin, so there is no need to modify the PCB. The programming possibility of FPGA can enable design engineers to modify the design at any time, and even correct design errors after product configuration. FPGA can not only complete various functions of MCU and DSP, but also generate new functions according to requirements, or allocate resource proportion among various functions, so that the same hardware circuit design can meet different application requirements. FPGA can use the existing processor core to directly generate software processor and execute the operating system.

The design of embedded system is developing towards system on chip (SOC). Programmable system on chip (SOPC) based on FPGA is favored by designers because of its flexible design, tailorability, software and hardware programmability and other characteristics and advantages. However, there is relatively little research and application in related fields in China, so the research on programmable system on chip is of great significance. The so-called embedded system is an application-oriented software and hardware system based on computer technology. It can meet the multiple requirements of function, cost, energy consumption and volume, and can be tailored with high reliability. It belongs to a special computer system. The embedded system includes two parts of software and hardware, which can operate independently. The hardware mainly includes storage module, communication module and signal processing module. Its storage capacity is limited. EEPROM and other storage media are mostly used. The software includes operating environment and operating system, and takes API interface as the core of the development platform [3]. At present, embedded systems are widely used in medical treatment, transportation, aviation, industrial control, exploration and other fields. The breadth and depth of their applications are developing, and the types of products involved are also increasing. The characteristics of multi scene applications provide more possibilities for the application of embedded systems in green ecological indoor space design.2 green ecological interior space design.Green ecological design has many functions. 1. Ecological function. The organic combination of various natural elements in urban green space can effectively protect the urban ecological environment, and has the ecological functions of purifying air, saving water, protecting biodiversity and so on. 2. Aesthetic function. Modern cities are surrounded by high-rise buildings made of reinforced concrete. The natural landscape is less and less, more and more precious. Urban green space is an important part of the city. Different from other gray spaces, it makes people living in cities feel green and natural beauty. The different green spaces with regional characteristics built in each city also have certain aesthetic characteristics. 3. Leisure and entertainment functions. The rapid development of modern cities has accelerated the pace of people's life, increased the usual work pressure, and has higher and higher requirements for spiritual life. Urban residents hope to get close to nature, meet their spiritual needs and alleviate the pressure of life. Urban green space has such a function.

2.1. Green Ecological Concept

People's pace of life is faster and faster, the pressure is also greater and greater, the mood is depressed and nervous, making people feel tired. There are more and more high-rise buildings around. People live in such an environment and lack a natural living environment. With people's pursuit of higher and higher quality of life, people also have higher requirements for ecological greening

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environment. Green environment makes people happy physically and mentally. Since ancient times, the idea of conforming to nature and the unity of heaven and man has been deeply rooted in people's hearts. Building a green natural ecological city must be an important direction of urban development. In the landscape environment design, we should take the green ecological concept as the first element of the design, ensure the harmonious coexistence between man and nature, and pay attention to the common development of man and all kinds of creatures in nature. Secondly, we should make a comprehensive analysis from the aspects of visual landscape, ecological environment and people's behavior habits. Designers should not only consider the role of greening, but also meet people's spiritual and spiritual needs, ensure the survival of nature, make people feel beauty and truly return to nature. With the worsening trend of the safety of natural environmental pollution, people have higher and higher requirements for the safety protection of the ecological environment, and people's awareness of protection has been gradually improved. Enhancing the technical concept of modern green ecological decoration design is mainly to meet the inevitable environmental needs of modern society and economic and social development, and derived into an important design technical component and link part of modern interior decoration design in China. By using the modern green interior decoration design concept, It can promote the practical application speed in the practice of modern green interior decoration design in China. Interior decoration designers further explore how to apply the green ecological interior space design that residents rely on to ecological aesthetics. Ecological aesthetics is a higher-level aesthetic form compared with traditional aesthetics, advocates the concept of the coexistence of visual beauty and spiritual enjoyment, and emphasizes the harmonious coexistence between man and nature, which is a topic that interior design must face when it develops to a new stage. Ecological aesthetics requires both green environmental protection and individual beauty, which puts forward higher requirements for modern interior design. Designers should not only ensure ecological environmental protection, but also ensure certain aesthetic ability. Under the guidance of ecological aesthetics, modern interior design will develop in a more green and intelligent direction and realize the harmonious coexistence between man, nature and Architecture [4].

2.2. Application Principles of Green Ecological Design in Indoor Space

2.2.1. People oriented

Humanist humanism is not only a concept of environmental protection, but also a design principle. The direction of modern interior design should follow the design concept of green environmental protection and provide residents with a green, healthy, warm and comfortable indoor environment, so as to meet the needs of indoor environmental quality and the desire of residents to be closer to nature as much as possible. The application of environmental protection design concept in interior design requires designers to follow the people-oriented principle, take into account people's use needs, psychological, emotional and spiritual needs, and make interior design more humanized. Nowadays, people-oriented design concept is becoming more and more popular. Its application in interior design promotes the innovative development of interior design, makes interior design present the new characteristics of modern society, and creates a green, healthy, safe and comfortable space environment for people. It is also a demonstration of the improvement of contemporary designers' awareness of ecological and environmental protection and their courage to bear social responsibility. People-oriented green ecological design will become the mainstream of interior design. Contemporary designers should constantly innovate the design language and promote the good development of people-oriented green ecological interior design.

2.2.2. Energy saving

With the increasingly serious ecological and environmental problems, it is imperative to strengthen environmental protection. As an effective measure of environmental protection, energy conservation and emission reduction, energy conservation and consumption reduction has gradually attracted more and more attention. Modern interior design should also keep up with the development trend of the times to realize energy conservation and energy-saving design. In the renovation, some old and non reusable decoration materials often become construction waste and are discarded at will, resulting in a certain degree of environmental pollution. In addition, due to the weak awareness of environmental protection, some designers often can not take ecological environmental protection as the starting point in the application of decorative materials and the selection of furniture products. Ignoring the ecological environment protection of interior design is naturally easy to cause indoor environmental pollution, but also brings great health risks to people. The application of green ecological design concept in interior design requires designers to adhere to the principle of energy-saving design, use green and renewable environmental protection decoration materials as much as possible, and advocate

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the recycling and rational use of materials. This can not only avoid excessive consumption and waste of resources, but also create a green and healthy space environment.

2.2.3. The nature of the unity of man and nature

"Unity of heaven and man" is a concept often mentioned in ancient China. It emphasizes the harmonious coexistence between man and nature, and emphasizes the unity of heaven and man, the unity of heaven and man, and the unity of heaven and man. It aims to express that nature, like our hands and feet, is closely related to human beings. However, with the modernization, people's desire for Industry and technology has accelerated the destruction of resources, resulting in a large number of plundering and destruction of nature. If the alarm is not sounded, the living environment on which we human beings depend will be affected, and then human health will be affected. Based on the concept of ecological aesthetics, everything is constantly changing and developing. The development of things has no certain direction, but will be in dynamic balance. There may be some factors causing imbalance in the development of things, but it is overall balanced for the development of the whole ecosystem. The survival and development of human beings depend on nature and ecological environment. The selection and utilization of materials in nature also need to follow the dynamic balance of ecology and achieve controlled utilization. For green ecological interior space design, it is necessary to reduce the pollution load index in the design process, and make the interior space design get a benign ecological cycle based on the concept of sustainable development. The high-quality living environment pursued by modern mankind reflects the closer contact between man and nature. In order to prevent the unlimited demand for nature, the spirit of "environmental protection" should be implemented in the construction of natural green ecological space to avoid the bad situation of polluting the environment. Officially, because green represents hope, in this context, more and more residents actively demand a living environment in which man and nature coexist harmoniously. The designer requires to implement the concept of green ecological interior design, which involves more or less the construction of new ecological buildings that are more environmentally friendly, healthier and green. In order to create a good ecological environment, protect and promote the sustainable development of the environment, residents from all walks of life are eager to contribute to the natural dynamic balance [5].

3. Design of Indoor Temperature Intelligent Wireless Control Based on FPGA

In order to greatly improve the heating rate of indoor air conditioning temperature control and realize the wireless temperature measurement control of smart phone and the automatic temperature adjustment of Android smart phone, an indoor air conditioning temperature control and heating system based on temperature sensor and intelligent FPGA is designed. Android intelligent wireless integrated control temperature measurement system can control the air conditioning temperature and window switch status in the room with appropriate environment through the wireless integrated technology of Android intelligent studio. It basically realizes the automatic control and adjustment of the minimum temperature of the mobile phone, the automatic alarm of the maximum air conditioning temperature and the comprehensive control and temperature measurement function of the automatic control and setting of the mobile phone temperature. FPGA processes the temperature control data of the mobile phone through the smart phone computer motherboard and the wireless port of the controller data center at the same time, transmits the temperature information data to the Android smart phone and uses it in the mobile computer terminal and Android smart phone terminal, simultaneously controls the central air conditioner in the room through the infrared control port, and simultaneously controls the curtain and window switch of the mobile terminal through the motor port. The development of electronic information technology promotes the progress of indoor design related technology. Indoor temperature control technology has gradually developed into automatic control, intelligent control, wireless control of mobile device terminal and other control types from the initial manual control. The monitoring and control of temperature and humidity are widely used in production and life, and are most used in agriculture and industry. The application of wireless transmission and distributed measurement technology helps to realize the real-time temperature and humidity monitoring of multiple observation points, and the accuracy of monitoring data is high.

In recent years, WiFi communication has become the mainstream wireless communication technology and began to be applied to data transmission in more fields. ZigBee is a short-distance data transmission protocol, which is characterized by low speed, low consumption, low complexity and low cost. It can safely and reliably support a large number of online nodes. Its application is earlier than WiFi, but there is a gap between the current popularity and WiFi. It shows obvious disadvantages in bandwidth, transmission distance and anti-interference, and is not suitable for application in the design

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of this product [6].

In this study, the method of WiFi to serial port and FPGA transmission temperature measurement is selected for home distribution measurement and wireless transmission design. Taking advantage of the wide coverage of WiFi, the control terminal equipment can be placed in non fixed places, and the distance of temperature data transmission and control commands can be longer. According to the received temperature monitoring data, users can manually or automatically turn on the air conditioner, open or close the curtains and windows to intelligently adjust the indoor temperature.

The design also develops an app application, which covers the display of indoor temperature monitoring, setting the target temperature, controlling the air conditioner and other functions. Based on the transparent transmission after data acquisition through WiFi to serial port module, the mobile device terminal carries out wireless communication with FPGA chip, and the FPGA main processor collects and receives the temperature from various measurement points in indoor space in real time, The data received by the serial port is processed, converted into the corresponding control signal and sent out. After the temperature is triggered and the critical value is set, the automatic control of the air conditioning switch is realized through infrared, and the curtain switch is controlled by controlling the motor to better control the indoor temperature.

FPGA serial port is connected with WiFi to serial port module. After receiving the signal transmitted from FPGA, mobile device terminal will convert it into WiFi signal and send control command to FPGA. Set the WiFi to RS 232 serial port server to AP mode to provide wireless access services that allow other devices to access. Other WiFi modules are set to sta mode and do not receive wireless access. You can connect AP mode WiFi. Serial port plug and play can reduce the difficulty of users as much as possible, and transparent transmission does not do any analysis. The maximum transmission distance under this application can reach 400m, which is enough to meet the requirements of indoor equipment control and temperature information reception [7].

4. Design of Indoor LED Intelligent Lighting Energy Saving System Based on Embedded System

With the application of Internet of things technology and embedded system more and more widely. LED lighting products have the advantages of energy saving, environmental protection, stable performance, economic reliability and so on. Therefore, they play a very important role in smart home and community lighting systems. Based on the application of mobile Internet of things and other embedded intelligent technologies, the structure of energy-saving management system is formed by using indoor and outdoor LED intelligent lighting. The overall functional structure, hardware and software verify the scientificity and feasibility of the system. Embedded technology and mobile Internet of things are directly combined into two LED chips, driver and communication technology, and the system hardware is designed by using sensors. This part of the system includes indoor and outdoor line intensity detection sensor, thermal radiation infrared intensity sensor, human body internal infrared intensity detection control module, storage module, GSM control module, LCD, voice intelligent prompt control module, button automatic control, power supply module, wireless communication control module, fluorescent lamp power drive control circuit, LED fluorescent drive control circuit and a main control system computer. The monitoring system can effectively monitor the status of indoor power lighting resources and power lighting equipment in real time, and transmit the remote lighting command control data and on-site power lighting equipment status control data in real time through the indoor GSM / GPRS wireless network, so as to realize the remote real-time automatic monitoring of indoor power lighting and improve the comprehensive utilization efficiency of indoor power lighting resources.

In addition to more applications of FPGA in interior design, embedded system is also widely used in interior design, which is of great significance for green ecological interior space design. Taking the indoor LED intelligent lighting energy-saving system as an example, the construction of wireless network communication environment can remotely monitor the user interface service rate. Through the application integration of embedded system and Internet of things technology, the wireless module is taken as a part of the embedded system, give full play to the advantages of wireless communication network technology, and realize the remote control of LED lighting equipment by mobile device terminal, so as to better reduce lighting energy consumption.

Based on the application of embedded system and Internet of things technology, the maintenance and management of LED lighting system in the later stage becomes easier. While it is convenient for operation and management, it can better meet the diversified and personalized lighting needs of users,

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so that users can get a better space living experience. The design of indoor LED intelligent lighting energy-saving system is also of great significance for later function expansion. It not only reduces the energy consumption of equipment, but also prolongs the service life of equipment, and plays an important advantage in energy conservation and environmental protection [8].

Unlike the indoor temperature intelligent wireless control system with control terminal equipment installed in non fixed places, the equipment of indoor LED intelligent lighting energy-saving system is wired with fixed circuits, and the software part can use ZigBee wireless sensing technology with cost and energy consumption for wireless network communication. The terminal node collects information and intelligently controls the LED lamps for intelligent regulation through the obtained data; The network coordinator constructs a wireless network, receives the status data and transmits the data to the host computer, and uses the system terminal node data acquisition module to intelligently control the indoor lamps.

5. Conclusions

The intelligent wireless control design of indoor temperature based on FPGA and WiFi technology can monitor the indoor temperature through transparent data transmission of serial port, trigger the temperature and set the critical value, and then automatically control the air conditioning switch and curtain switch, so as to better control the indoor temperature. The combination of embedded system and Internet of things technology is applied to indoor LED intelligent lighting energy-saving system, which can effectively save energy, ensure reasonable lighting brightness and reduce power consumption cost while facilitating users' operation. The integration of green ecological concept into landscape environmental design is not only in line with modern ecological concept and aesthetics, but also in line with the principles of landscape design. Combined with local historical and cultural characteristics and local customs, landscape design is carried out according to local conditions. Landscape design techniques are used to help urban ecological development, promote the healthy development of the city, and reflect the development concept of urban green ecological civilization. It effectively promotes the harmonious coexistence between man and nature. FPGA and embedded system still have many applications in green ecological indoor space design. In the future, they will play a greater role in promoting indoor space design to the direction of environmental protection and sustainable development.

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