

Design of smart home virtual simulation laboratory based on IoT technology

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Abstract

In experimental teaching system of Internet of things , such as wireless sensor network (WSN), Zigbee principle and networking experiment and some experimental courses, requires a lot of hardware resources, or need more network nodes can well show the core content of experimental courses, in experiment teaching of IoT equipments general price is more expensive, the imperfection of the form a complete set of hardware and software, the Internet of things experiment teaching had a lot of challenges. In this paper, a set of smart home virtual simulation system is designed, and its working principle and mode are introduced, so that students can learn independently through the network, fully understand the principle and working process of the Internet of things, and achieve good teaching effect.

Keywords

IoT(Internet of things); virtual simulation; laboratory; smart home.

1. Introduction

As an interdisciplinary subject integrating communication, computer, electronics and other disciplines, IoT is also a subject based on engineering application and the comprehensive integration of existing advanced information technology. The cultivation of IoT major needs to strengthen the cultivation of experimental teaching, engineering skills and innovation ability. In experimental teaching system of Internet of things, such as wireless sensor network (WSN), Zigbee principle and network experiment, some experimental courses, such as cloud computing, need a lot of hardware resources, or need more network nodes can well show the core content of experimental courses, in experiment teaching of IoT equipments general price is more expensive, the imperfection of the form a complete set of hardware and software, the Internet of things experiment teaching had a lot of challenges. If the experiment courses by using the simulation software for the virtual experiment teaching, not only can save a lot of hardware resources, also can let students to pay more attention to the sensor application, engineering design, network, routing algorithm, etc. The core content of experimental teaching, so the virtual simulation experiment teaching the application and popularization of the Internet of things is necessary.

2. Design ideas

"Principles and applications of the Internet of things" is a professional basic course for the engineering major of the IoT. It is also an elective course for computer science and technology, network engineering, software engineering, information management and information system, logistics management and other majors. For the engineering major of IoT, the core courses such as "RFID principle and application", "sensor network", "wireless single-chip microcomputer and protocol development" have been equipped with supporting experimental equipment. Students can use these experimental equipments while learning these courses. The experimental equipment is expensive, because from different vendors, the correlation between each other is not very big, and the principle and application of "Internet of things" this foundation course, but lack the corresponding experimental method, when students learn only through the books on the theory of knowledge to understand the characteristics of the IoT, from the overall understanding of the IoT in the practice of working process.

In the data acquisition layer of the IoT, the simulation experiments of various sensors in the Internet of things were also considered. In this way, the three-layer structure of the Internet of things can be fully reflected in the virtual experiment, achieving the goal of building the virtual experiment of the IoT from the whole system. The construction scene of the virtual laboratory is set as the home scene. In the set home scene, all kinds of sensors have been installed. Students only need to click various sensors in the virtual experiment, and the interface will display the introduction of sensors, wiring diagram and communication node. Then continue to set the gateway, you can do "virtual and real", the interface will show the work of various devices after the work, lead students to understand the characteristics of the Internet of things work. Design of the virtual experiment content is close to the principle and application of IoT the teaching content of related courses, that can let the student practice and learning theory to get exercise and fully understand the overall development process of IoT technology.

3. The virtual experiment contents of smart home

Through the virtual simulation system, students can understand the development and design process of the whole IoT technology. Master the acquisition of data from the sensor, data transmission with short-range wireless communication technology, control its corresponding intelligent equipment in the application layer. Corresponding courses include principles and applications of the IoT, principles and applications of sensors, short-range wireless communication technology, web program development, machine learning, etc.

The virtual simulation system of IoT smart home can display the specific situation of the family from the first perspective. The following typical experiments design has been realized.

As shown in figure 1:



Fig.1 Virtual simulation of smart home

3.1 Introduction of typical experiments

3.1.1 Smart home environment monitoring

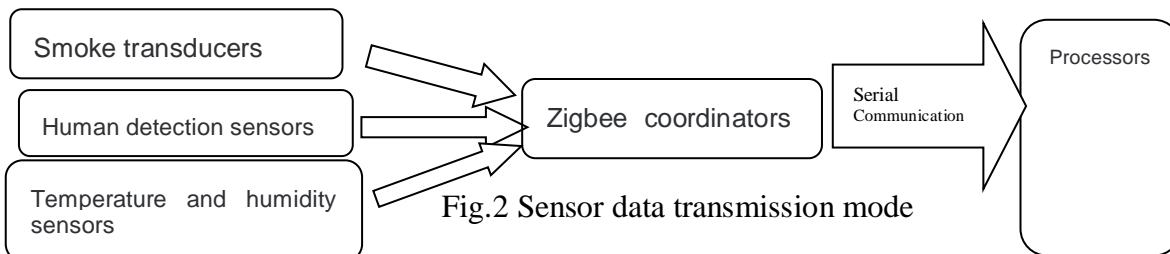
Experimental objective :to master how to use various sensors, to obtain field data and master basic switching logic .

Experimental principle: working principle of temperature and humidity sensor, working principle of light sensor, working principle of infrared sensor,

Experiment contents: real-time monitoring of the home environment, such as whether the device is online, illumination temperature and humidity, short address of the device, etc.

Through the device introduction button, you can have a simple understanding of the various sensors in the scene. When observing the scene, you can also click the corresponding sensor for further understanding. It includes introduction of sensor, wiring diagram and communication node. Students

can learn about the principles, wiring and equipment of the sensor they are using according to the pop-up interface. This experiment USES a number of node sensors, such as human body detection sensor, temperature and humidity sensor and smoke sensor, which collect data in real time and then send the data to the zigbee coordinator terminal through zigbee networking. Then the coordinator sends the data to the processor through serial port, and the processor does further processing. As shown in figure 2:



3.1.2 Smart light control

Experimental objective: to master the control APP communication function and understand the working principle of photosensitive sensor; Mastering the IoT transmission protocol and common principle of encoding and decoding. let the students learn how to through the wireless network upload data of each node to PLC, and then through the network to the server, learn to configure the gateway.

Experimental principle: Set up the network physical channel and PANID of the onboard ZigBee coordinator through the serial port protocol. Thus, after the launch of the ZigBee coordinator on the cortex-a8 smart gateway board, the network can be created. After the IMOTE remote node search with RFID module is successfully added into the network, the operation of the experimental function can be completed through the Qt application program. Click the yeelight admin button to search the device first. After searching out the device, clicking the manage button will bring up the operation UI of yeelight. The lamp must be connected before it can be operated. As shown in figure 3:

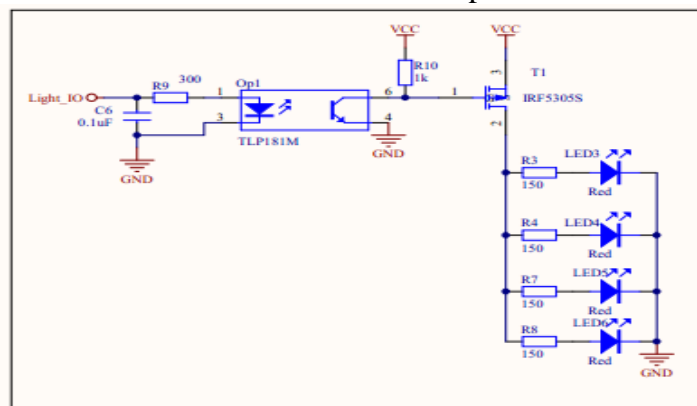


Fig3. LED dimming drive circuit

Use the client to access the smart light to the local area network, and open the "LAN control" interface function in the official application, the third party application can communicate with the smart light according to the API interface provided.

3.2 Laboratory equipments and software

The hardware of the main node of the smart home network controllers are mainly developed by ARM cortex-a8 MCU, CC2530, Zigbee wireless transceiver module, GSM module and STM32 development board. The sensors and hardware used are mainly temperature and humidity sensors, methane sensors, motors, bulbs, humidifiers, power supplies and drivers. Mobile terminal App is jointly implemented by Java and XML language. The design of mobile terminal mainly includes the realization of the communication with the wireless WiFi transmission module, and the design of friendly mobile terminal UI (user interface) in line with the habits of the public.

4. Teaching methods

4.1 Combination of theory and practice in classroom teaching

This course has strong practical requirements, and the explanation of traditional theoretical teaching methods often limits students' mastery of knowledge. However, if the classroom teaching method combining theory and practice can be adopted, many problems will be solved easily. For example, in the explanation of the sensor principle in this course, the sensor principle is complicated and difficult to understand, so it is difficult for students to grasp the key points of knowledge. If the teacher can make a brief theoretical teaching with accurate explanation, and then let the students practice with real (simulation) materials, the students can easily understand this problem. In the teaching, we use the real (simulation) method completely, has obtained the good effect.

4.2 Scenario simulation teaching

We design the smart home as a 3D simulation interface, which can move with first-person perspective to has a good sense of immersive. In the future, we may also consider adding 3D virtual reality technology and cooperating with 3D glasses. The design of this scene can enhance students' perceptual knowledge, stimulate students' learning interest and motivation to improve the teaching effect and achieve practical results.

4.3 Cases for practical training teaching

Each individual practical training is a case, the modern information technology is used by a variety of reasonable and effective means, fully using the network teaching and management, teaching outline, teaching arrangement, teaching plan, network courseware or video lectures, problem sets, experiment guidance, realizes the high quality resources sharing, convenient to students' autonomous learning.

5. Conclusion

This virtual simulation laboratory can demonstrate completeness and systematicness.

The IoT virtual simulation laboratory with complete functions can complete "full-function" experiments and practical training. The IoT is divided into three layers, information acquisition and information transmission, information processing and application. At present, the established laboratory of IoT engineering lacks an experimental platform for "information acquisition". The fully functional IoT laboratory will be able to carry out full-function experiments and training on the three-layer structure of the IoT.

After the construction of the IoT engineering IoT laboratory is completed, all practical courses including professional basic courses, professional compulsory courses, professional elective courses and engineering practical training can be provided for students majoring in the IoT major. Students of the IoT major can obtain systematic practical courses except theoretical ones.

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