

Design of smart learning environment monitoring system based on multi-mode

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Abstract. The traditional smart campus pays attention to improving the management efficiency and neglects to improve the learning effect. This paper studies that the physical factors of smart learning environment affect students' learning effect, and designs a monitoring system of smart learning environment. The sensor is used to sense the temperature, humidity and air quality of the learning environment. The microcontroller system processes the sensing information of the sensor, and the server analyzes the data and generates the physical environment report and equipment control information to build a multi-mode multi-user smart learning environment monitoring system.

1 Introduction

On the basis of the Internet of Things, cloud computing and ubiquitous network technology, the smart learning environment adds new capabilities such as real-time situational awareness and automatic analysis to intelligent education, including online virtual environment and offline physical environment. It is an important part of the smart campus. At present, the mainstream smart campus management system manufacturers include Microsoft, Lenovo, Tencent, etc., which mainly solve the problem of how to improve management efficiency through smart means, but ignore that the main purpose of smart campus is to achieve smart education and promote learning effects.

Smart learning environment is an integrated online learning space that serves students. It provides learning resources, collaboration tools, learning evaluation tools, etc., supports students to carry out richer learning activities inside and outside the curriculum, provides students with personalized and intelligent learning services, and promotes a new talent training model [1]. Based on ThingSpeak IoT open source platform [2], this paper designs a smart learning environment physical condition monitoring system, which collects various physical factors of learners' environment through various sensors, such as (light, temperature, humidity, air quality, noise), improves learners' learning efficiency by monitoring and improving the learning environment, and provides different students with personalized learning services, It is a functional supplement to the current mainstream smart campus products.

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2 Physical factors of smart learning environment

Smart learning environment is the "basic guarantee" for smart learning. Smart learning environment is a set of conditions that support learners to carry out constructive learning, including physical environment, technical environment, resource environment and emotional environment [3].

The tidy, beautiful, elegant and spacious smart learning environment makes people feel comfortable, full of vitality and vitality, improves the level of brain activation, and can reduce or eliminate fatigue; However, if the natural environment is untidy, dirty and narrow, it will make people feel depressed, irritable, dull and unhappy, affect the interest and efficiency of students' learning activities, and also affect their physical and mental health [4]. To create a good natural environment for college students is to create a good learning and living environment. The classroom is the main place for students to study. The lighting, ventilation, temperature, etc. of the classroom directly affect the learning efficiency [5]. The lighting in the classroom should be sufficient and uniform to reduce students' fatigue, improve students' attention, and reduce tension and anxiety. The indoor temperature and humidity should be moderate, such as too high or too low temperature, too wet or too dry humidity, which makes people feel uncomfortable, emotional instability, or upset, or depressed. Air quality and noise level also affect people's mentality and mood [6].

2.1. Temperature

Research shows that staying indoors with high temperature for a long time will not only affect people's study and rest, but also easily lead to irritability and irritability, as well as adverse effects on cardiovascular system, nervous system, digestive system and other systems [7]. However, the efficiency of brain use can be improved by 20%~35% when working and learning in a suitable environment. The overheated or too cold classroom environment will affect the work and learning efficiency to a certain extent [8].

2.2. Humidity

It has been found that high humidity environment is not conducive to lowering the body temperature through heat conduction, which is likely to cause physiological dysfunction, affect the heat balance of the human body, increase the body temperature, and make the emotion sensitive, unstable and impulsive. In a high humidity environment, due to low air pressure, people will feel depressed, excited or listless, inattentive, upset, and also prone to increase blood pressure and heart rate. High temperature and humidity are not conducive to people's mental health, and even suffer from mental diseases [9]. The humidity that the human body feels comfortable is: the relative humidity is lower than 70%.

2.3. Air pollution

Air pollution does not seem to cause physical pain like natural disasters, crowding or noise, but its impact on psychology and behavior is also quite serious. The most obvious signs of air pollution are the dust, smoke, haze we can see and the odor we can smell. However, air pollution is not always detected by us. Sealed residential or teaching buildings have more pollution than outdoor buildings. Long term air pollution will lead to air pollution syndrome, with headache, fatigue, insomnia, depression, irritability, eye inflammation, gastroenteritis and other symptoms [9]. Under the background of low CO₂ concentration, it has the highest accuracy, the shortest reaction time and the highest learning efficiency.

3 Smart learning environment monitoring system

The smart learning environment monitoring system considers the impact of the main physical environment factors (temperature, humidity, CO₂ concentration) of the intelligent learning space on learners. Based on ThingSpeak Internet of Things open source platform, data fusion technology and intelligent learning algorithm, it designs a learning emotion evaluation system for the smart learning environment based on multimodal physical factors, which is capable of automatically collecting the physical environment data of the intelligent learning space. The function of integrating analysis data and intelligent judgment of environmental comfort can affect learners' learning mood and improve learners' learning efficiency by adjusting environmental comfort.

3.1. Thingspeak

Data processing and sharing at the computer end, combined with the latest Internet of Things technology Thingspeak, allows customers to conduct online testing and process data. Sensor data can be transferred to ThingSpeak from Arduino, Raspberry Pie, BeagleBone Black and other hardware. ThingSpeak can use MATLAB to analyze and visualize the data, and use MATLAB to perform relevant processing to reduce the difficulty of compilation, while helping to achieve more technologies. Thingspeak enables the edge node to communicate with the data aggregator through line connection. The data aggregator establishes a connection with the PC and communicates with each other, thus realizing data transmission, analysis and communication, and realizing an interactive system from "things" to "networks" and from "networks" to "people".

3.2. Description of smart learning environment monitoring system

The smart learning environment monitoring system consists of three parts: sensor, microcontroller and server. Its system structure is shown in Figure 1.

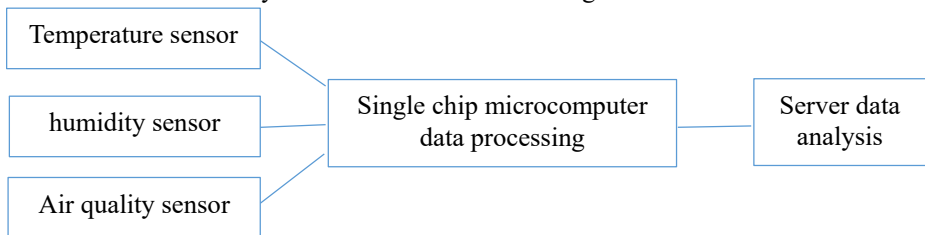


Fig. 1. Smart learning environment monitoring system.

The smart learning environment monitoring system is developed based on Thingspeak platform. The sensor collects data and transmits it to the microcontroller for processing, and then stores it in the server for data analysis. The microcontroller with high cost performance ratio is used to drive the micro sensors of various parameters, collect the temperature, humidity, oxygen content, light and other physical parameters of the learning environment, digitize and send them to the corresponding server through the network interface in the microcontroller. The server runs the corresponding application program to get the comfort evaluation report of the learning environment according to the algorithm of the relationship between specific human feelings and various environments.

3.2.1 Sensors

① Temperature and humidity sensor

DHT11 digital temperature and humidity sensor is a temperature and humidity composite sensor with calibrated digital signal output. As shown in Figure 2 [10].

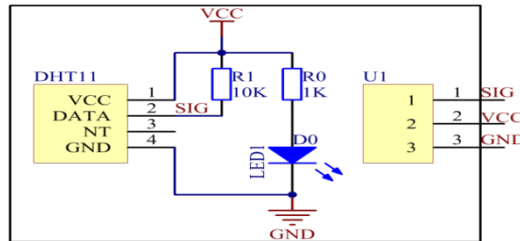


Fig. 2. Working principle diagram of DHT11 digital temperature and humidity sensor.

DHT11 digital temperature and humidity sensor applies special digital module acquisition technology and temperature and humidity sensing technology to ensure high reliability and excellent long-term stability of the product. The sensor consists of a capacitive humidity sensor and a NTC temperature sensor, which are connected to a high-performance 8-bit microcontroller.

② Air quality sensor

The gas sensing material used in MQ135 air quality sensor is tin dioxide (SnO_2) with low conductivity in clean air. When there is polluted gas in the environment where the sensor is located, the conductivity of the sensor increases with the increase of the concentration of the polluted gas in the air. The change of conductivity can be converted into the output signal corresponding to the gas concentration by using a simple circuit.

3.2.2 Single chip microcomputer

Using a cost-effective microcontroller to drive the micro sensors of various parameters, you can collect the temperature, humidity, oxygen content, light and other physical parameters of the learning environment, digitize them, upload them to the server through the network interface of the microcontroller, and get a learner's comfort evaluation report through the algorithm processing of the relationship between human perception and various environments. Users can easily view the user's learning environment comfort report through the app or related websites. At the same time, users can control various devices through their mobile phones to make themselves always in their own learning environment, or submit personalized customization through the app to control the microcontroller to fine tune various controllable environmental factors, so that the physical learning environment can reach the best state.

3.2.3 Server

The server side program uses the thread pool model to handle multi-user and highly concurrent access to the server, and provides standard interfaces for corresponding App access and computer side access.

The server receives the physical environment parameter data (temperature, humidity, noise, CO_2 concentration, etc.) sent by the microcontroller, analyzes the data, and generates

the physical environment status report according to the human comfort and the dynamic season model of each parameter.

3.3 Working mechanism of smart learning environment monitoring system

3.3.1 Sensor sensing data

The sensor has rich digital I/O ports, analog I/O ports, and supports serial communication. Through a variety of sensors to perceive the environment to perceive the physical environment (temperature, humidity, noise, CO₂ concentration, etc.) information, and send the sensing information to the microcontroller.

3.3.2 Single chip processor processing data

The mcu receives the sensing information of the sensor, and processes the sensing information with data. using the added network module, ip packets are used to transmit the data to the server. The server transmits the results of data analysis to the microcontroller, and the microcontroller controls the background servo system to change the physical environment parameters.

3.3.3 Server analysis data

The server side uses the thread pool model to deal with multi-user and highly concurrent access to the server, and provides standard interfaces for corresponding App access and computer access. After the server receives the environment message sent by the SCM, it starts the corresponding application to analyze the physical parameters (temperature, humidity, noise, CO₂ concentration, etc.) in the environment message, and generates the physical environment report and equipment control information according to the human comfort and the dynamic season model of each parameter. The SCM or App makes various micro controls on the equipment according to the received equipment control information.

4 Conclusion

The main purpose of smart learning environment is to improve learners' learning efficiency. The physical conditions of smart learning environment are important factors that affect learners' learning effect. In this paper, a multi-mode multi-user intelligent learning environment monitoring system is designed, which uses sensors to sense the temperature, humidity and air quality of the learning environment. The microcontroller system processes the sensor's perception information, and the server analyzes the data and generates the physical environment report and device control information, which realizes the adaptive adjustment of the physical conditions of the smart learning environment and has a positive impact on the learning effect of learners.

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