

## Research on Real-Time Temperature Control of University Physics Laboratory Based on Wireless Probe

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**Abstract:** the Real-Time Test and Analysis of Experimental Data Play an Important Role in Experimental Education. through Real-Time Data Analysis, We Can Find out the Problems of Students' Experiments and Evaluate the Results Objectively. a Real-Time Test and Analysis System of Experimental Data Based on Wireless Lan Transmission Technology is Developed. the System Configuration Method and Main Functions of Data Transmission Interface, Data Receiving Interface and Data Analysis Interface Are Introduced in Detail. This System Can Solve the Problem That Students Can Not Check and Analyze the Experimental Data in Real Time, and Effectively Improve the Efficiency of Teacher Guidance and the Quality of Classroom Guidance.

### 1. Introduction

In the Experimental Class, Almost All Experiments Are Inseparable from the Measurement of Physical Quantities. the Completion of the Experiment is Usually a Process in Which Students Measure a Series of Experimental Data through the Specific Operation of the Experimental Instrument[1]. the Quality of the Measured Data Can Reflect a Lot of Information about the Experimental Students, Such as Whether the Experimental Design is Reasonable, Whether the Selection of Musical Instruments is Appropriate, Whether the Adjustment of Equipment, Whether the Operation is Correct, and Whether the Measured Value is Scientific. Therefore, It is Very Important to Check and Analyze the Experimental Data Measured by Students in Real Time. This Not Only Enables Teachers to Discover Problems in Time and Guide Them with Timely Methods, But Also Gives Objective and Fair Evaluation to Students' Classroom Performance. At Present, the Mainstream Teaching Method is That in Order to Measure the Experimental Data, Students Operate the Experimental Instruments in the Classroom, and Teachers Check the Final Measurement Results and Evaluate Them. This Method Has Two Disadvantages. on the Other Hand, Most of the Measured Physical Quantities Are Indirect Ones. This Requires Multiple Measurements to Make Multiple Direct Measurements[2]. When Checking the Final Result, It is the Time for the Teacher to Find out the Problem. Students Have Little Time to Revise in Class. on the Other Hand, When Teachers Evaluate Students' Operation Based on the Measurement Results, They Can See Whether the Experimental Data is Correct Qualitatively, But It is Difficult to Evaluate the Quality of the Experimental Results Quantitatively. There Must Be Subjective Factors in the Evaluation of Classroom Operation Performance. to Solve This Problem, This Article Uses Visual C - Cherchen "At At and Matlab". a Real-Time Detection and Analysis System for Experimental Data Based on Wifi Wireless Transmission Technology is Developed by Programming Language. Students Can Use This System to Send Directly Measured Experimental Data and Images to the Teacher's Computer, and Immediately Give Them on the Teacher's Computer. the Result of Error Analysis of Experimental Data is That Teachers Can Find out Problems in Students' Operation, Objectively Evaluate Students' Experimental Data and Find out the Main Error Sources of Experimental Data According to the Inspection and Analysis of Specific Experimental Data.

## 2. Unified Overall Design

The system includes temperature and humidity detection and display module, wireless transmitting module and wireless receiving and processing module. The temperature and humidity detection and display module is composed of dht11 temperature and humidity sensor, STC 89 C 52 RC, digital tube display, and infrared through 905 rdth RF wireless frequency chipset. The receiving and processing module consists of a group of netbus - 905 wireless data transceivers and a PC computer. The working principle is that after the temperature and humidity sensors collect data, it is input to a single-chip microcomputer, which displays the temperature and humidity of the field through a digital tube. Then, please use the radio frequency chip to send temperature and humidity data to the distance through the SPI communication protocol[3]. The remote wireless data transceiver chip receives temperature and humidity data and inputs it to PC computer for data processing, including data classification and comparison.

## 3. System Hardware Design and Performance Description

### 3.1 Single Chip Microcomputer

Stc89c52rc is used as the main control chip in this design. The chip is a high-performance CMOS 8-bit microprocessor with 4KB flash memory. The product has high cost performance and meets the design requirements of the system. In this system, the main control chip continuously outputs and displays the collected temperature and humidity signals and transmits the control data.

### 3.2 Temperature and Humidity Sensor

The design adopts the dht11 digital temperature and humidity sensor produced by Guangzhou Aosong Electronic Co., Ltd. This is a temperature and humidity composite sensor with calibrated digital signal output, with high reliability and stability[4]. As a new type of single bus digital temperature and humidity sensor, dht11 has the advantages of small size, low power consumption, fast response, strong anti-interference ability, simple control, high cost performance, and can be widely used in various fields.



Fig.1 Scenario of Using Data Transmission System in Students' Classroom and Scenario of Experiment Chapter

### 3.3 Wireless Transmission Part

In the design of wireless transmission, rf905rd-th chipset developed by Hangzhou Feituo Electronic Technology Co., Ltd. is used. Working in the ISM band of 433 / 868 / 915MHz, the chipset consists of a fully integrated frequency modulator, a receiver with demodulator, a power amplifier, a crystal oscillator and a regulator.

### 3.4 Wireless Receiving Part

In the wireless receiving part of the design, the PC wireless data receiving and transmitting chipset netusb-905 developed by Hangzhou Feituo Electronic Technology Co. Ltd. is used. Through USB 2.0 protocol, the chip communicates with PC computer at high speed to realize real-time and timely data transmission. Through the upper computer software, the data received can be seen directly on the PC computer, which is convenient for data analysis and processing.

### 4. Software Design

The main functions of this design are temperature and humidity measurement, display, wireless transceiver and so on. The design of software is also very important. The software components of the system adopt module design[5]. It is written in C 51 by the ttvision 3 compiler developed by keil. Including temperature and humidity detection and wireless transmission. Among them, temperature and humidity detection includes dhtll sensor initialization routine, dhtll sensor temperature and humidity acquisition routine, dhtll sensor operation temperature and humidity routine, digital tube display subroutine , etc. NRF 90 chipset send subroutine.



Fig.1 Scenario of Using Data Transmission System in Students' Classroom and Scenario of Experiment Chapter

### 5. The Interface Design of the Sending End of Students' Experimental Data

The interface design of the student's experiment data sending end is shown in Figure 2. At the end of data transmission, students need to input the student name, student number, Department category and experimental station number information. The software can collect images of students who are doing experiments. After inputting the necessary information, click the send data button, and the teacher's data receiving terminal will immediately receive the experimental data sent by the students, and give the analysis results of the data errors of the results[6]. At the same time, in order to train students' ability of designing data table independently, the software interface transmission terminal provides blank data table instead of fixed data table format directly. This requires students to design independent tables in the blank data tables, so as to give full play to their ability to design their own data tables. For various forms of data tables designed by students, many data analysis functions are added to data analysis. After many tests and improvements, in order to facilitate data analysis, necessary experimental data can be accurately extracted according to the needs. Follow up analysis. In addition, in view of the unforeseen situation such as computer conflict during data input, the pre input experimental data will disappear after the computer restarts. In order to avoid wasting time in software design, the data can be saved automatically in real time, the computer can be restarted, and the data that has been input in advance and the software interface used for data transmission can not be avoided.

## 6. The Interface Design of Teachers' Experiment Data Receiver

After the students send the experimental data at the data sending end, in the wireless LAN environment of the laboratory, the receiving end will immediately receive the experimental data sent by the students[7]. Shows the interface design of the teacher at the experimental data receiving end. After receiving the experimental data sent by the students, the corresponding number of the experimental station will change from light gray to red, so that the students can associate with the teacher of the experimental station who successfully sent the data. At the same time, students can automatically input the experimental data and image information into the corresponding tables on the receiving interface. At this time, click the number of the red experimental station, and the interface for analyzing the experimental data of students will pop up. Moreover, the receiving end can receive the experimental data sent by the same student many times. For example, when the teacher receives the experimental data sent by the students and finds that the experimental data of the students is obviously wrong, the students can modify it and send it again. This is the real-time display after the experimental station sends data again. This design allows students to send data to teachers in real time during the experiment. After obtaining some experimental data, it is not clear whether the experimental data is appropriate. You can input some data first, and then send the check to the teacher's receiver. The next measurement is performed after the error completes. Through real-time detection of students' experimental data, students' results after the experiment are avoided. Because all the results are wrong, we hope that students can complete the normal experimental time in a specific experimental time. Experimental content

## 7. Error Analysis of Test Data

After receiving the experimental data sent by the students, the teacher can click the corresponding number of the experimental station and pop up the experimental data error analysis interface. Fig. 4 shows an interface diagram[8]. The error analysis of experimental data not only provides the curve distribution of experimental data points, but also provides the uncertainty analysis of data corresponding to the comparison results of different algorithms. Through the curve distribution of experimental data points, we can see the distribution of data points, and also can find the abnormal situation of data points. For example, in the measurement of data points, the increase of the number is accompanied by the decrease of the measured value. There are irregular factors in the operation of students. The data is the random distribution of class a caused by the uncertainty of data points. In the data points of segmented code length, with the increase of the number of measurements, the data points are randomly distributed. The second data point and the fourth data point in the figure have the biggest difference and can be deleted directly at the interface of the data receiving end. Analyze the different data points, analyze the remaining experimental data, and determine the source of the main data points with big errors. In the uncertainty analysis of the experimental data, the type a uncertainty of the experimental data, the uncertainty of the final measurement results and the relative error are given. Using the results of these data, the correctness of the measured data is evaluated.

## 8. Use Effect and Student Feedback

This system is applied to experimental education. Figure 5 is a view of the student scenario and the entire laboratory using the classroom data inspection and analysis system. Through teaching practice, it not only brings great convenience to teachers' classroom guidance and performance evaluation, but also is very popular among students. Some students wrote in their experimental experience that "using more advanced data input analysis systems can quickly and easily determine the magnitude of experimental errors in a short period of time." The new data processing system inputs data on the tablet computer, the results are displayed on the terminal, the fairness of the results, and it is easy for teachers to achieve results, find problems, and prevent data problems, which is that you cannot deal with. The data processing of this experiment opened our eyes,

introduced a new data analysis system, and tested the quality of the experimental data. In addition, experimental scores, fair and fair system experience, in order to further understand and evaluate the system, the questionnaire was designed. According to the survey results of about 300 students, 98% of them have very good feedback to the system. I want to use this data analysis system in the experiment. I suggest that this is a good experimental classroom teaching method to promote all experimental projects.

## 9. Conclusion

Experimental teaching can not be separated from the measurement of experimental data. Therefore, in the limited time of classroom experiment, it is very important to analyze the experimental data measured by students quickly and scientifically[9]. A real-time test and analysis system of experimental data based on wireless LAN wireless transmission technology is established. Using this system, we can analyze the experimental data of students in real time, quickly and scientifically, find out the problems in the experiment, so as to prevent students from completing the experiment within the specified time. There is no necessary experiment content. At the same time, students' experimental results can be evaluated objectively and correctly. By analyzing the uncertainty of experimental data, students can understand the main causes of experimental data errors, and improve the strictness and standardization of students' experiments. In addition, the system will automatically back up the experimental data of students stored for a long time to the server. It is impossible to avoid the risk of students' experimental data loss and the completion of experimental reports. In addition, it is easier for various departments to start the analysis and analysis of students' experimental data. Target education is based on the characteristics of students in different fields.

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