Based on the QT embedded data acquisition system design

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Abstract: The design of embedded data acquisition system based on QT is to use QT for embedded development, which can develop a data acquisition system with low cost, good effect and high practicability. This design is composed of temperature and humidity acquisition system module, camera acquisition module, buzzer alarm module, motor and fan module. The debugging and verification of the embedded system show that the data acquisition system has perfect function and stable operation. It can better meet the needs of practical application. QT based embedded data acquisition system has the advantages of high efficiency and reliability.

1. Introduction
In recent ten years, with the development of science and technology, embedded technology developed with QT application has played an increasingly important role. Embedded system has penetrated into many corners of people's production and life. Nowadays, with the rapid development of computer hardware and software technology, collecting data is becoming more and more important to life. It can be found in all aspects. However, in today's society with such developed science and technology, there are still many vegetables planted by farmers without temperature and humidity control, resulting in the most efficient output of crops. It seems not so cost-effective to buy large-scale measurement and control equipment for these small needs. Therefore, in order to solve this problem, an embedded data acquisition system based on QT is studied and designed, and a data acquisition system with high accuracy, high accuracy and cost-effective is designed. It can adapt to various complex environments, and can also carry out remote monitoring and monitoring. The data acquisition is also real-time and effective. In summary. This design is an embedded data acquisition system based on QT, which can not only improve people's living standards and work efficiency, but also improve the level of management automation, but also have important significance in promoting the development of social economy.

2. Related work
Generally speaking, this paper is mainly an embedded data acquisition system with raspberry pie 3B+ development board as the core[1]. This system can collect temperature and humidity data and video image data in the air, has certain monitoring and recognition functions, and the collected data can be displayed circularly through the LCD screen. When people need it, Timing automatic measurement or manual measurement can be carried out. The user can display the value of the humidity control panel in real time by pressing the red button, and the user can also set the value of the humidity control panel in case of exceeding the current temperature control range. When the user needs to display the value of the temperature control panel, the user can also set the value of the humidity control panel in real time. The system structure block diagram is shown in Figure1.
In terms of hardware, the system is mainly composed of raspberry pie 3B + development board, DHT11 temperature and humidity sensor module, LCD, etc. The raspberry pie 3B + development board is mainly used to process the data collected by the sensor, video image data and other logic functions\(^2\). The sensor is used to collect humidity and temperature. The display screen is used to display the collected data.

In terms of software, the data acquisition system is embedded development based on QT, which needs to be programmed with C++ language. It is necessary to collect the temperature and humidity in a specific area. The data collected by DHT11 is analyzed and processed, and then converted into digital signal to display the value of temperature and humidity on the screen\(^3\). It is mainly composed of LCD camera, temperature acquisition program, key input program, etc.

The air quality detector designed in this paper adopts liquid crystal display, which can automatically or manually display the actual values of humidity and temperature by pressing the key. In addition, the humidity and temperature will display its range, which can be manually changed to the safety range of humidity or temperature\(^4\). When the actual measured humidity and temperature are not within the safe range, the motor will be triggered to drive the fan for simulated cooling.

3. The method
The whole system design is based on raspberry pie 3B + development board, which is convenient for people to directly operate the data acquisition system. The whole system is based on hardware, and the hardware can collect data, which requires the matching of several modules. The matching of hardware modules provides a guarantee for the design of the following software. This chapter is divided into several parts: introduction of raspberry pie 3B + development board; Interface circuit design of temperature and humidity sensor; Design of camera module; Design of motor and fan module.

3.1. General design of DHT11 sensor system
The design block diagram of temperature and humidity data acquisition system is shown in Figure 2:
Firstly, set the interval time through the timer to collect data, and then display the collected data on the QT interface. Secondly, the standard limit value of temperature and humidity can be set manually. The temperature standard limit value of this design is that the temperature range is within 10 ~ 30 ℃ and the humidity is within 40 ~ 70% RH. When the actual measured temperature or humidity value exceeds the standard limit value in the design, the motor and fan module will be triggered to operate, and the buzzer will alarm through PWM pulse signal. When the temperature and humidity in the measured area reach below the standard value, all equipment will return to normal. Finally, the data is always stored in the cache, and the time can be set freely.

3.2. general design flow chart of video acquisition module

The overall design block diagram of video acquisition module is shown in Figure 3.

The video data acquisition module is first through IP camera. Based on the camera, it is divided into three plates. The first is PC display, which transmits data through the development version. The second is the display of the core QT interface of this design. Photos and videos will be stored in the cache and operated through the QT interface, which can play back or play the picture monitored by the current video. The third plate is the LCD, which can display the current temperature and humidity values through the development version.

3.3. software design

The whole design of embedded data acquisition system takes QT interface as the carrier, and the user can operate the system directly. The whole system is also divided into dhi11 temperature and humidity
data acquisition module, camera data acquisition module, motor and fan module. The data is collected through these hardware modules, then the data is displayed, and finally saved to the SQLite database required by the user. This chapter is divided into five parts: QT interface design and implementation, dhi11 temperature and humidity data acquisition module programming, camera data acquisition module programming, SQLite database loading and implementation, data acquisition function design and implementation.

Software design of camera acquisition. It mainly draws the video image collected by the camera in a module[6]. When collecting width and height data, it is necessary to keep the same proportion. The conversion of data can not only improve the efficiency of operation, but also facilitate the processing of graphics.

4. Experiment and analysis
DHT11 digital temperature and humidity sensor completes the bidirectional transmission of input and output through a single data pin port. The data is divided into two parts: decimal and integer. In the third chapter of hardware design, it has been pointed out in detail that the decimal part is designed as 0 for future expansion. Sensor data is output in binary, so all collected data should be processed separately to avoid confusion and data disorder.

4.1. Trigger DHT11 to collect data
Read, control and record the data of DHT11 sensor. It is necessary to control the timing of the sensor first. The timing includes: triggering DHT11 sensor data acquisition; Low level transmission; High level transmission.

First, when the bus is idle, it is high level. The processor is in the response phase waiting for the initial signal, and waiting for the initial signal of the sensor. The time waiting for the response phase must be greater than 18 milliseconds. In this way, the initial signal can be monitored. When the sensor receives the initial signal, the waiting phase becomes the response phase. The commissioning diagram of the whole control sequence is shown in Figure 4.

![Figure 4. Control sequence commissioning diagram](image)

4.1.1. Low level signal timing. When the DHT11 sensor outputs digital 0, the MCU reads the first low-level signal as 50 US, and then the read high-level signal as 26-28 us. As shown in Figure 5.
4.1.2. High level signal timing. When the DHT11 sensor outputs digital 1, the low level signal read by the processor is 50 US, and then the high level read is 70 US. As shown in Figure 6.

![Digital 1 signal timing debugging diagram](image)

**Figure 6. Digital 1 signal timing debugging diagram**

It can be seen from the above commissioning diagram. The difference between the sensor input number zero and the input number 1 is the time of high level. Therefore, this design is a temperature and humidity data acquisition system with high-level delay of 30us seconds.

4.2. Buzzer alarm and operation of motor and fan

This design selects 5V / 0.35A small DC motor control circuit for simulation. The PWM circuit for controlling motor speed is a PWM circuit with adjustable duty cycle. Adjust the frequency of PWM by adjusting resistance and capacitance. At the same time, adjust the comparator to have the same voltage as the input. The motor start is shown in Figure 7.
The duty cycle of PWM is indicated by a red line in the channel oscilloscope. At this time, the duty cycle is 55%. The yellow line represents the pulse signal, which is 6V at this time. After startup, if the time of compiling output high level is decreasing, the speed increases. The green line is rpm, and the speed voltage is 90V. The purple line is the output of the motor shaft. When stable, the voltage value of the speed is 190V. As shown in Figure 8.

4.3. Test results
The software part of QT based embedded data acquisition system shows the current temperature and humidity as shown in Figure 9.
The hardware part of QT based embedded data acquisition system design. The current temperature and humidity displayed by QT is shown in figure 10.

![Figure 10. Temperature and humidity diagram displayed on QT interface](image)

5. Conclusion
This design is the design of data acquisition embedded system. The system includes client and server. The development environment of client is QT, and the server control program is developed under Linux system. After hardware design, software design, debugging and other links, the measurable temperature range is 10 ~ 30 ℃, and the humidity range is 0 ~ 70% RH. When it exceeds the range, the motor will be triggered, and then the fan will simulate the air conditioner for cooling. Due to the DHT11 temperature and humidity sensor used, the temperature and humidity ranges are 0 ~ 50 ℃ and 20-90% RH respectively. It can better and more timely reflect the changes of temperature and humidity, which is conducive to timely adjustment and treatment in practical application. Because the design has low cost, accurate measurement data and good practical application, it has obvious advantages in temperature and humidity monitoring of greenhouse crops.

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