

Design of intelligent greenhouse automatic control system based on C language

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Keywords: Greenhouse automatic control; greenhouse; intelligent; temperature and humidity; light

Abstract: The greenhouse can effectively improve the yield per unit area of land, out of season limits the growth of plants, based on this, puts forward a set of intelligent greenhouse automatic control system based on C language design, through the system can be realized in to carry on the accurate control of the greenhouse environment and effectively improve the degree of intelligent greenhouse environment control, increase production of greenhouse cultivation has very important significance.

1. Introduction

From the point of greenhouse technology development situation in China and abroad, greenhouse control technology development can be divided into three stages, 1st stage is manual control stage, use the traditional instrument and meter to monitor the environment, then manual adjust the relative equipment to control the environment^[2-5].

But see from the existing greenhouse automation control system design, most of the control system is designed in a centralized way^[9], the intelligent level is low, the greenhouse environmental parameters monitoring is not comprehensive. Considering this background, this thesis propose a design of intelligent greenhouse automatic control system based on C language.

2. Basic structure of intelligent greenhouse system

Greenhouse automatic control system is mainly to maintain the greenhouse environment balance, keep the environment within the setting target and the error of the allowed range^[13], please refer to illustrator 1, which show the normal design structure of automatic greenhouse, which normally includes heating equipment, carbon dioxide producing equipment, humidification equipment, ventilation control cabinets, lighting and temperature control cabinet and the central control cabinet etc.

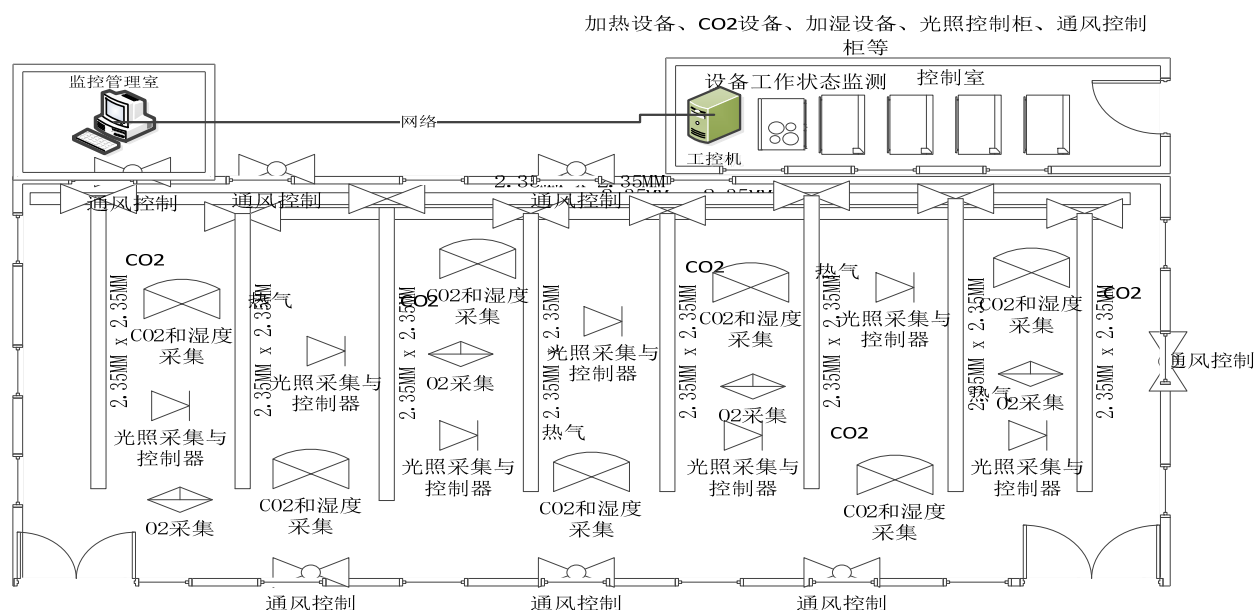


Illustration 1 Design structure of automatic greenhouse

加热设备	heating equipment,carbon dioxide producing equipment, and the central control cabinet etc.
CO2 设备	carbon dioxide producing equipment
加湿设备	humidification equipment
光照控制柜	lighting and temperature control cabinet
通风控制柜	ventilation control cabinets
监控管理室	Monitoring and control room
网络	Network
工控机	Industrial personal computer
设备工作状态监控	Equipment working condition monitoring
控制室	Control room
CO2 和湿度采集	CO2& humidity acquisition
光照采集与控制器	Lighting acquisition
通风控制	Ventilation control

3. Intelligent greenhouse automatic control system hardware structure designs

Based on above analysis of greenhouse automation design structure, we can conclude that the greenhouse automatic control system structure as shown in illustrator 2,take industrial controller as the core, through the RS485 highway and greenhouse environment data acquisition sensors, control room equipment control network inside the greenhouse to acquire the environment parameter.

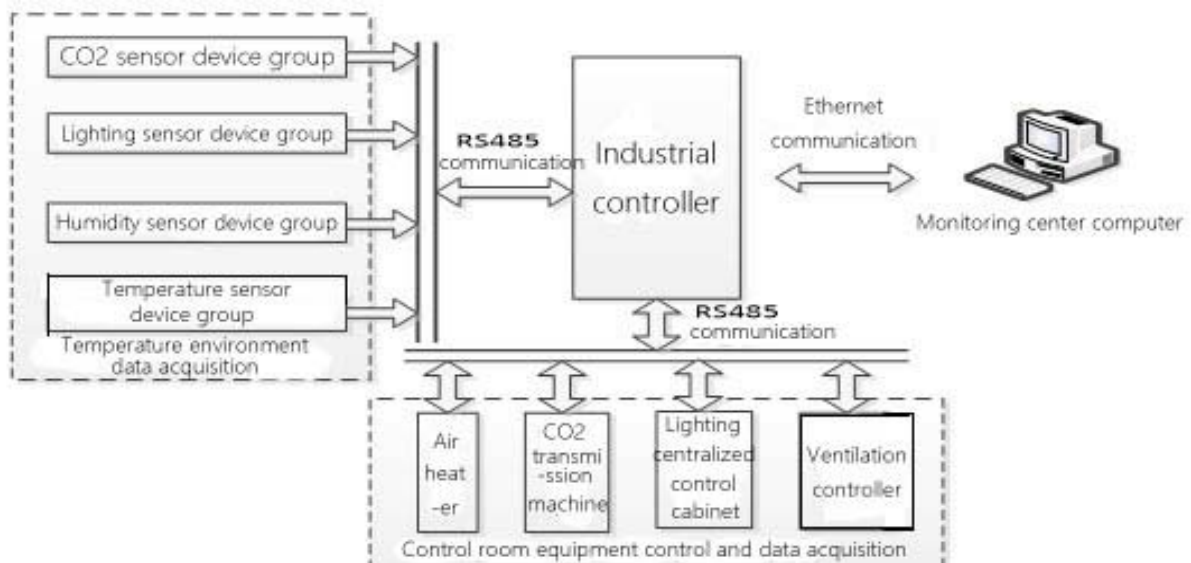


Illustration 2 Intelligent greenhouse automatic control system hardware structure design

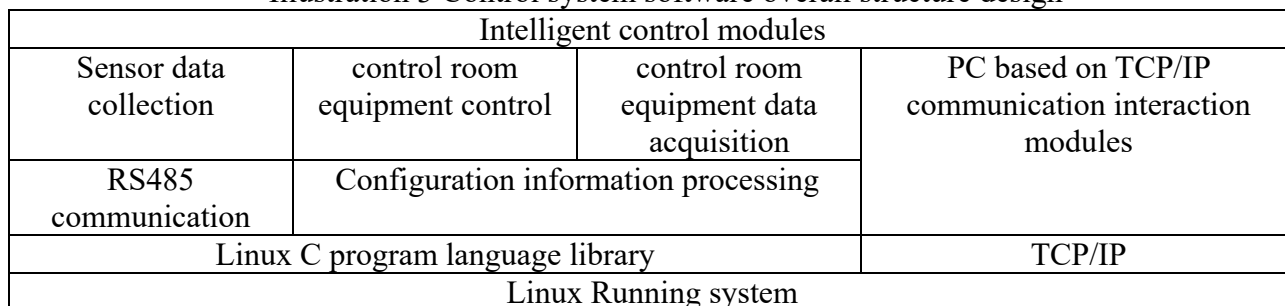
CO2 传感器设备组	CO2 sensor device group
光照传感器设备组	Lighting sensor device group
湿度传感器设备组	Humidity sensor device group
温度传感器设备组	Temperature sensor device group
室温环境数据采集	Temperature environment data acquisition
工业控制器	Industrial controller
监控中心计算机	Monitoring center computer
热风机	Air heater
CO2 输送机	CO2 transmission machine
灯光集中控制柜	Lighting centralized control cabinet
通风控制器	Ventilation controller
控制室设备控制与信息采集	Control room equipment control and data acquisition

4. Intelligent greenhouse automatic control system software overall structure design

According to above analysis of intelligent greenhouse automatic control system hardware structure, we can have the conclusion of this thesis, the design of the intelligent greenhouse automatic control system based on C language software design mainly needs to implement seven modules as RS485 communication, control room equipment acquisition, control room equipment control, sensor information collection, intelligent control, PC based on TCP/IP communication interaction and configuration information processing. System builds on the Linux operating system and the C program language, the whole software system structure as shown in illustrator 3.



Illustration 3 Control system software overall structure design



5. System core module design and implementation

According to above greenhouse automatic control system software overall architecture design we can concluded that the system should include RS485 communication, control room equipment

acquisition, control room equipment control, sensor information collection, intelligent control, the main function module of system implementation, this section will introduce these two big module design in details.

5.1 Intelligent control module design and implementation

Intelligent control module is the core module of the intelligent greenhouse automatic control system based on C language, it calls information acquisition, equipment control and PC based on TCP/IP communication interface module to coordinate the whole system to realize the greenhouse environment controlling, guarantee the greenhouse will run smoothly according to various preset environmental parameters, the entire module running processes show as illustrator 4.

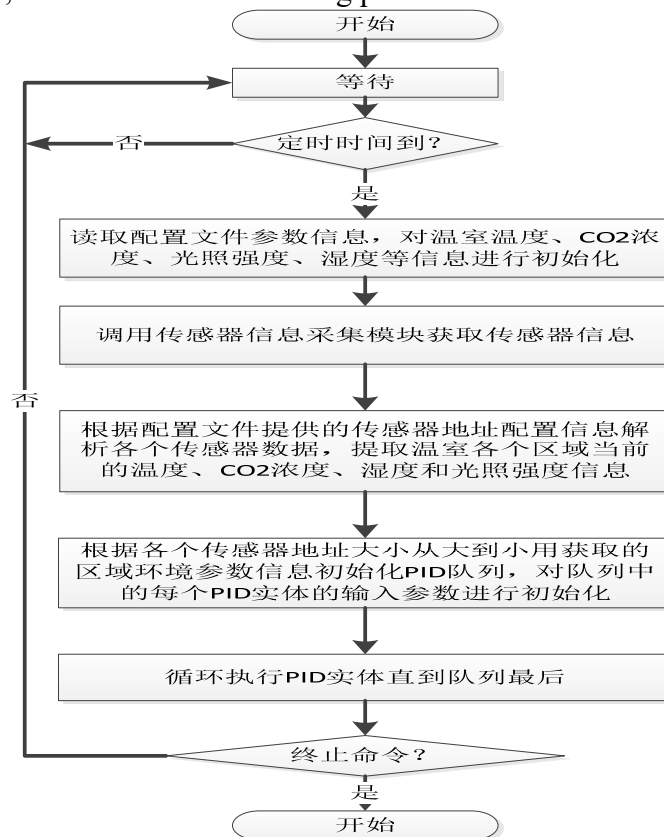


Illustration 4 Intelligent control module design and process

开始	Start
等待	Waiting
定时时间到	Time for Timing
读取配置文件参数信息，对室温，CO2 浓度，光照轻度，湿度等信息进行初始化	Reading configuration files parameter information, Initialize the room temperature, CO2 concentration, lighting, humidity
调用传感器信息采集模块获取传感器信息	Call the sensor information acquisition module for sensor information
根据配置文件提供的传感器地址配置信息解析各个传感器数据，提取温室各个区域当前的温度，CO2 浓度，湿度和光照信息	According to the configuration file for sensor address configuration information for each sensor data analysis, extract the greenhouse temperature, CO2 concentration, humidity and light information
根据各个传感器的地址大小从大到小用获取的区域参数信息初始化 PID 队列，对队列中的每个 PID 实体的输入参数进行初始化	Arrange Region parameter information from big size to small size based on the address from each sensor to initialize the PID queue, initialize each parameter of PID entity in the queue.
循环执行 PID 实体直到队列最后	Loop PID entity queue until the last one
终止命令	Terminate the command
结束	Finish

5.2 PC based on TCP/IP communication interaction and control module design and implementation

The principal computer machine based on TCP/IP communication interaction and control module is the interaction control core of the system, and is also the basis for greenhouse system management, the module including two parts, the subordinate computer running on the IPC and the principal computer running on a monitor computer. The subordinate computer is responsible for the reception the control from the principal computer and feedback the whole greenhouse environmental information and equipment operation information to the principal computer. The illustrator 5 as below shows the subordinate computer work process.

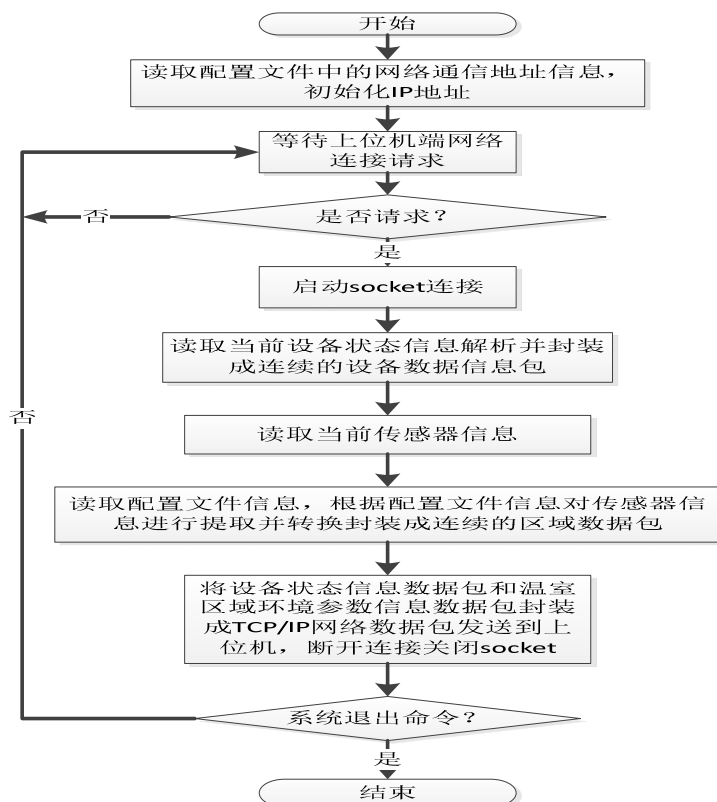


Illustration 5 Subordinate computer with PC based on TCP/IP communication interaction and control module design and implementation

开始	Start
读取配置文件中的网络通信地址信息, 初始化IP地址	Read network address information in the configuration file , initialize the IP address
等待上位机端网络连接请求	Waiting for principal computer network connection requests
是否请求	Request or not
启动 SOCKET 连接	Start SOCKET connection
读取当前设备状态信息解析并封装成连续的设备数据信息包	Read the current equipment state information analysis and encapsulated into the continuous data packets
读取当前传感器信息	Read current sensor information
读取配置文件信息, 根据配置文件信息对传感器信息进行读取并转换封装成连续的区域数据包	Reads the configuration file information, according to the configuration file to read and convert sensor information packets encapsulated into a continuous area data package
将设备状态信息数据包和温室区域环境参数信息数据包封装成TCP/IP网络数据包发送到上位机, 断开连接关闭 SOCKET	The equipment state information packet and greenhouse environment parameter information encapsulated into a TCP/IP network packets sent to the PC, disconnect and close the SOCKET
系统退出命令	Terminate the command
结束	Finish

There are two kinds of design for proposal computer program. 1st one is sending the updated data command to the subordinate computer regularly, request the subordinate computer to feedback the greenhouse environment parameter information and equipment running condition, realize the real-time monitoring. Another design is setting in the program, after setting, the program will

connected to the subordinate computer to call the initial function to initiate the user interface.

6. Conclusions

Greenhouse automatic and intelligent control will improve the greenhouse management efficiency, increase the productivity and also greatly increase the industrialization development of greenhouse cultivation. It is a trend for greenhouse technology development in the future. So the proposal in this thesis is about design of intelligent greenhouse automatic control system based on C language. Regarding current intelligent greenhouse design, raise up the hardware and also software structure, explain the design and implementation process of some core module in detail, through testing implementation, proves the intelligent greenhouse automatic control system will realize the centralization management of the greenhouse and automatically control the equipment to maintain the greenhouse environment in a constant condition according to the pre-set parameter, which have very important significance to improve the greenhouse intelligent level and management efficiency.

Reference

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