

Environmental Chicken House Monitoring

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Abstract — with the system, which is based on the Internet of Things technology, the data is mainly transferred to the cloud for processing, which reduces the real-time performance of the system and increases the load on the cloud data center. With the increasing number of smart devices and rapid data growth, network bandwidth is also increasing. In view of the above problems, this article proposes a method to apply edge computing [1~2] to the Internet of Things. The main idea of is to use the functions of the edge nodes closest to the data source in the agricultural environment monitoring system based on the Internet of Things technology. Processing occurs at the edge nodes. After experimenting, the data can be processed in real time, reducing the load on the cloud data center.

Index Terms— *Internet of Things; edge computing; real-time; Modbus protocol*

I. INTRODUCTION

If we can process and analyze data at the edge of the network, then this kind of computing model will be more efficient and robust, because data will not be uploaded to the cloud, which adds privacy protection. we found that in the development of the Internet of Things, cloud computing is not always so efficient, we need to solve the bandwidth and delay problems, so we proposed edge computing, which the edge is not absolutely the edge of the geographic location, but it is arbitrary computing and network resources between the cloud computing center and data source, compared with the edge of the cloud computing center, the edge computing model migrates data processing tasks to the edge of the network, reducing the pressure on cloud computing and increasing the system's real-time. Based on the above ideas, the self-learning energy saving system based on the Internet of Things in literature, the various types of data collected by the classroom terminal nodes are uploaded to the cloud for processing, the above problems will occur, in this

paper, edge computing is applied to the environment monitoring system of farm chicken house based on Internet of Things. The temperature, humidity and light intensity data of the house collected by the terminal node are transmitted to the STM32 gateway through the ZigBee network, and the gateway is used as an edge node to process data, and the fan and the illumination level are controlled according to the temperature, humidity and the light intensity, and the command is given in real time. Then upload the data you want to save to the cloud. Processing data closer to the data source reduces bandwidth requirements during transmission, reducing network latency and increasing privacy.

II. OVERALL SYSTEM DESIGN

The system mainly consists of ZigBee module, STM32 gateway, Wi-Fi module and wit Gizwits. The ZigBee network is used to transmit the terminal node data to the gateway. The gateway uses STM32F103RCT6 as the microprocessor to process the data collected by the terminal node. STM32 as an edge node, performs edge calculation, and sends the calculation result to the terminal control node through the ZigBee network. STM32 parses the data according to the Modbus protocol and assembles the packet to transmit it to the Gizwits platform through ESP8266, and displays the node data Gizwits mobile APP. It can also send data to terminal node through the Gizwits mobile APP. System block diagram shown in Fig.1. A. Design of environmental data acquisition terminal node The CC2530 module is used as the core chip for collecting environmental parameters of the terminal. This chip is a single-chip computer which supports ZigBee protocol launched by TI Company. The CC2530 microcontroller uses an industry-standard enhanced 8051 core internally, which is connected to the sensor and mainly senses the temperature and

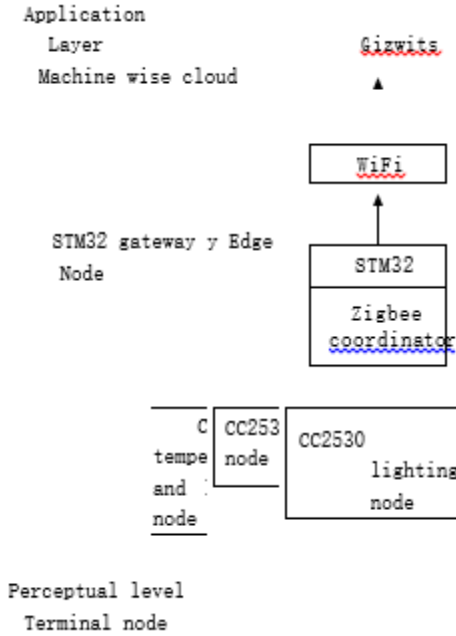


Fig.1. Overall system block diagram

The control unit receives the signal from the gas detector, sensor and then send signal to solenoid valve Drive unit and then activate an alarm. Should also LCD screen. From the humidity of the house environment, light intensity and fan status. They are transmitted to the STM32 gateway through the ZigBee network. The ZigBee coordinator node is connected to the serial port 4 of the STM32 to send data to STM32. After the coordinator creates the network successfully, the terminal device joins the network and allocates an address to realize communication between the nodes in the network. After the sensor node of the system joins the network, the environmental parameters of the chicken house are transmitted. The temperature and humidity sensor adopts DHT11, which is a temperature and humidity composite sensor with calibrated digital signal output and adopts simplified single bus protocol, and the light intensity measurement is performed by BH1750FVI. The sensor is a digital light intensity sensor integrated circuit for two-wire serial bus interface, which can accurately detect light intensity ranging from 1 lx to 65535 lx. The fan node adopts an ordinary DC motor, and it is turned on after power-on. The terminal node periodically collects and sends environment parameters.

B. STM32 gateway design

The gateway hardware includes STM32F103C8T6, ESP8266, and ZigBee coordinator node. The gateway is a data switching center and communication medium, which converts the protocol sent by different modules into a unified interface protocol, which is a bridge connecting the wireless sensor network and the Internet. STM32 is the core of the whole gateway. It is the ARM processor based on Cortex-M3 core produced by ST. The main function of the gateway is to receive the terminal environment parameters which are transmitted by the ZigBee network in the uplink data transmission, and send it to STM32 through the serial port. STM32 parses the serial port data according to the Modbus protocol, then upload the analyzed temperature and humidity and light intensity to the Gizwits. In downlink data transmission, ESP8266 receive instructions which are sent by Gizwits and transmitted them to STM32 through serial port. There is an event processing function in STM32. The received data is packaged according to Modbus protocol and sent to ZigBee coordinator. The ZigBee network realizes instruction sending, and turns on and off fans and lights. The gateway data transmission communication chart is shown in Fig.2.

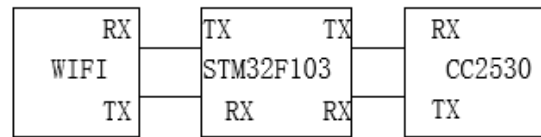


Fig.2. Serial Port Connection Diagram of Gateway

C. Cloud platform design

Gizwits mainly provides developers with self-help development tools for Internet of Things devices, back-end technical support services, remote control and management of devices, data storage analysis, third-party data integration, hardware socialization and other technical services. It shortens the development cycle of intelligent hardware products to half a day at the fastest, and realizes intelligence quickly. First of all, we need to download the Gagent firmware on the Gizwits official network and download it to ESP8266 to realize the docking between the Wi-Fi module and the Gizwits. Then

create products in the Gizwits and establish data nodes, such as temperature display, and finally generate MCU SDK that select the hardware development platform for STM32F103C8X to develop. The automatically generated MCU SDK code realizes the parsing and encapsulation of Gizwits communication protocol, the conversion logic of sensor data and communication data, and encapsulates it into a simple API. When the device receives the data from the APP, the program converts the data into corresponding events and notifies the application layer. The developer only needs to add the control function of the sensor in the corresponding event processing logic to complete the product development. SDK is transplanted to STM2 module to realize the access of Gizwits.

III. SYSTEM SOFTWARE DESIGN

The system software design includes terminal node environment data acquisition, STM32 gateway program. Provisions of Transport Protocol.

A. Edge calculation platform

We define edge computing as: "edge computing is a new computing mode, which unifies the resources close to users in geographical distance or network distance, and provides computing, storage and network services for applications." The edge calculation of this paper means that analysis of temperature, humidity and light intensity data in STM32 gateway. The environmental standard of the house is set to [7]: 13.0~27.0°C, 50%~70% [8] is suitable humidity, It is 10 to 30 Lx for the brooding period and 10 to 12 Lx for the laying period. it is suitable for light intensity. When the temperature and humidity values and the light intensity are not within the proper temperature range, the STM32 gateway will send commands to the terminal node to switch the fan and the light.

B. Modbus protocol

The communication protocol of this system is based on Modbus-RTU transmission protocol, which is a serial communication protocol, which is really used in industrial fieldbus protocol, The communication protocol format of this document includes packet header, data length, data offset, device address,

network type, sensor address, data field which has 1~255 byte, CRC8 check, etc. Two frame data interval is no less than 3.5 characters, 1.5 characters between bytes, communication process is shown in Fig.3.

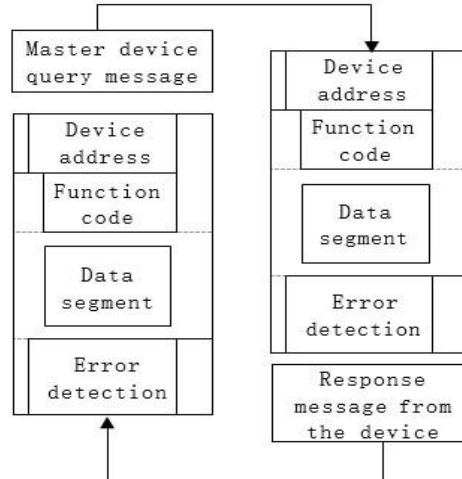


Fig.3. Communication process

C. Program design of ZigBee module

The terminal environment data acquisition node joins the network after the ZigBee coordinator establishes the network. A network address is assigned by the Z-Stack protocol stack. After the network is established successfully, the event pointer polls the event table. If an event occurs, it finds the corresponding event handling function, completes the processing, and continues to access the next item in the event table. In the protocol stack, the data transmission mode is selected as afAdder 16 bit, which is 16 bit short address point-to-point transmission mode. The ADC is initialized, Converting ADC value to voltage value to determine sensor type, The sensor type, the sensor node address, the data field length, and the sensor value collected in the event task processing every 5 seconds are encapsulated into the ModBus protocol, and finally the wireless transmission interface is called to send the sensor data, if the ZigBee coordinator receives command sent by the STM32 gateway, ZigBee coordinator send it to the ZigBee child node. If ZigBee coordinator receive the data from the child node is received, the data is sent to the embedded gateway. The program flow chart of the coordinator is shown in Fig.4.

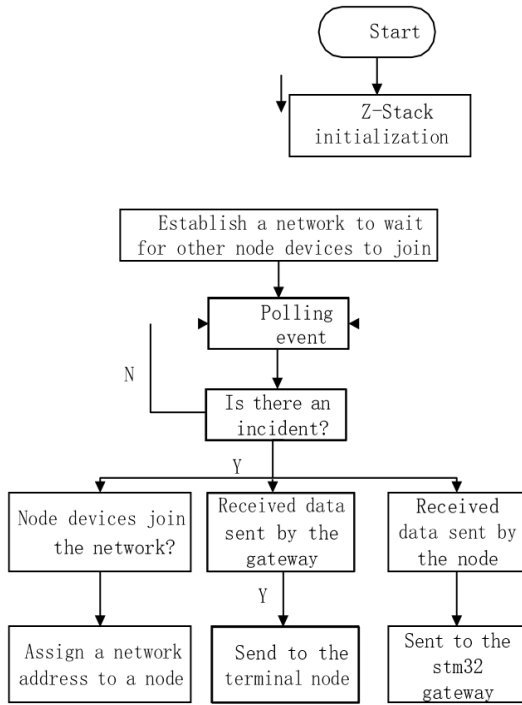


Fig.4. Coordinator program flow chart

D. Gateway programming

The MCU SDK code is generated on the Gizwits platform, uart4 is initialized in the uart.c file, message queue store the serial communication data in the serial port interrupt processing function, the data of the ZigBee coordinator node is received, and the received data is stored in message queue buffer, cyclically read the data in the message queue, and judge whether it is empty. If it is not empty, when the packet header is detected, all the data in the buffer area is stored in the valid data buffer, and then the CRC check is performed. If the verification is successful, it is a complete package of data, then protocol analysis, find the sensor type in the valid data buffer, read the corresponding data field, and parse the data to the data point. The Gizwits firmware will automatically determine whether the data point is change, if there is a change, perform Gizwits reporting task and automatically send the data to the Gizwits. When the upper layer sends a command to the terminal node. In the STM32 project, there is an event task processing function, which calls the uart4 sending interface to send the instruction. The program flow is shown in Fig.5.

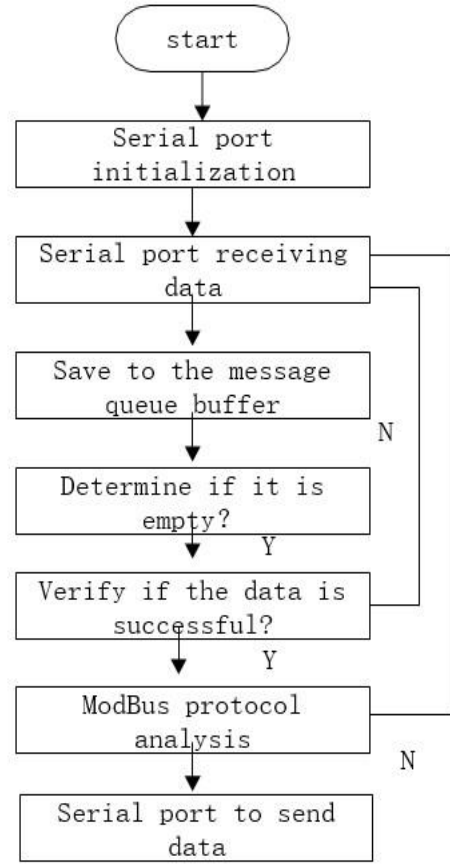


Fig.5. Gateway program flow chart

IV. CONCLUSION

The rapid development of Internet of Things technology has made many hardware devices more and more intelligent, which has brought great convenience to our production and life. This paper designs the environment monitoring of Internet of Things chicken house based on edge calculation, which makes the feeding environment more scientific and greatly saves the labor cost. The proposed edge calculation also improves the real-time performance of the system command and reduces the cloud computing center burden.

VII. REFERENCE

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