Research on Visualization of Hardware P2P Network Communication Based on STM32

Cao Huiyuan[1], Ren Bin[2*], Yang Renhao[2]

[1]Department of Mechanical Engineering, Dongguan Vocational and Technical College, Dongguan China 523808

[2]School of Electronic Engineering and Intelligence, Dongguan University of Technology, Dongguan China 523808

[*]Corresponding author's e-mail: renbin@dgut.edu.cn

Abstract. This paper mainly studies the visual communication of P2P network based on STM32 microprocessor in the hardware direction. It illustrates the research on P2P network by many corporations and scientific research institutions. Besides, this paper points out that P2P network play an important role in the field of Internet or teaching. By designing circuit schematic diagram and PCB and selecting STM32 microprocessor, CC2530 chip, SIM800C chip, it puts up the hardware platform of this research. The other way, it uses KEIL software to write program and transplant the UCOSIII operating system, and realize the independent operation of each node. As for software, it builds the basic of P2P network communication by designing the ZIGBEE data packet protocol. In addition, it writes various data storage containers and designs trust, motivation, and encryption algorithms. Finally, the whole communication process of this research is displayed dynamically on the LCD screen in real time. In short, this study is of reference significance for future researches on P2P network at the hardware level.

1. Introduction

In recent years, P2P networks studied by major companies or universities are all based on the combination of large-scale computer computing power and various resources, which costs a lot of economic and human resources. In this regard, this paper studies the P2P network from the perspective of hardware communication, realizes the construction of trust model and incentive mechanism of P2P network by using self-designed programming algorithm. Through the independent operating system of each node, the data of communication process is displayed dynamically on the LCD screen in real time, realizes the visualization of the communication process of P2P network, and studies the P2P network. The research has a certain research value, and the cost of economic and human resources is less, and the cost is low.

This paper mainly studies the visualization of the hardware P2P network based on STM32. The Mesh (self-routing) network is composed of STM32 chip and Zigbee module as communication bridge. The trust model and incentive mechanism of the P2P network are constructed by using trust, incentive and encryption algorithms, and implemented by using UCOSIII programming system. Each node implements simultaneous multi-task scheduling, responds to requests from other nodes in the P2P network in real time, and dynamically displays the communication process on the LCD screen in real time. This paper studies the data of the P2P network hardware level by interpreting and analyzing the process data.

2. Hardware Platform Design

In this paper, the hardware platform is designed and developed independently. The main control chip is STM32F103RCT6. The minimal system consists of reset circuit, starting circuit and filter circuit. The peripheral device is equipped with SIM800C chip and its peripheral circuit to realize Gprs networking function. The system can communicate with the computer through TCP/IP communication protocol, and realize 2.4G channel networking communication with CC2530 chip, and display the working process of the system through an LCD screen. The power supply is powered by 3.7V lithium battery and its charging circuit is designed to ensure the continuous and stable operation of the system. The hardware platform is completed independently from circuit schematic drawing and PCB layout wiring to final debugging and welding.

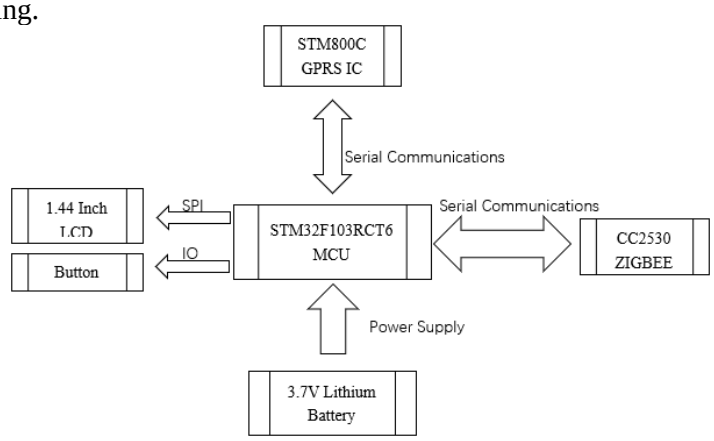

Figure 1. Overall block diagram of hardware platform

2.1 Power Circuit Design

The power supply circuit is responsible for providing the power supply needed for the operation of the whole hardware system. Considering the different working voltage and starting current of different chips, 3.7V 2500mAh lithium battery is selected as the power supply. Considering the working voltage range of each chip, LM1117 3.3V chip is selected as the voltage stabilizer chip, and 3.3V voltage is stabilized to provide voltage for each chip. Considering the exhaustion of lithium batteries, TP4056 lithium battery charge management chip is used as the charge circuit management chip, which is combined with resistance capacitor to form a lithium battery charging circuit to provide continuous power for lithium batteries.

2.2 Peripheral Circuit Design

The peripheral circuit mainly includes LCD screen circuit, Zigbee module circuit and SIM800C chip peripheral circuit.

LCD screen circuit is mainly composed of backlight circuit and SPI serial communication interface, backlight routing transistor, which is used to amplify current and maintain the normal operation of LCD screen [2]. Because Zigbee module is used this time, only serial communication interface is left for the connection of main control chip.

The peripheral circuit of SIM800C chips mainly includes startup circuit, radio frequency circuit and card slot circuit. The starting circuit is composed of a switch transistor and a resistance capacitor. It mainly provides pulse start for SIM800C chip. The RF circuit includes Bluetooth RF and Gprs RF. Bluetooth RF uses RF components, transmits 2.4-band signals, and Gprs uses 2.4-band antenna, so only one antenna interface is left. SMF05 anti-static chip and resistance capacitor are mainly used in the slot circuit to prevent the static effect caused by hand touching PCB board.

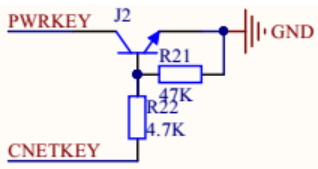

Figure 2. Start-up circuit diagram

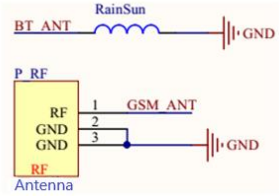

Figure 3. Radio Frequency Circuit

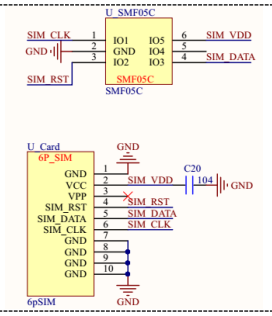

Figure 4. Chuck circuit

3. Software System Design

In software programming, UCOS III kernel files are transplanted to create different tasks, assign priority and stack space to various tasks, use kernel files to schedule and manage tasks, and use hook functions of idle tasks to detect system voltage and clear and refresh various flags.

Using C language structure, enumeration and other programming ideas, various structure containers are constructed to manage the relevant parameters in the process of P2P network communication, and related functions are written to realize data package, parsing, sending and receiving, forming a P2P network communication protocol layer, initially realizing P2P network peer-to-peer transmission [3].

Finally, software encryption algorithm is compiled to ensure the security and reliability of network communication. Software trust algorithm and incentive algorithm are designed and used to construct trust model and incentive model of P2P network respectively. The P2P network communication of this study is carried out. The process parameters and data are displayed by the prepared UI interface of LCD screen.

3.1 Program Task Management

In this paper, 11 tasks are created, including start task, Zigbee communication serial task, SIM800C communication serial task, main operation panel task, and so on. The corresponding priority is assigned one by one. In addition, there is a minimum priority idle task, which is mainly used for lithium battery voltage detection and interface display, P2P and Zigbee working status standard. Log detection and switching, etc. The following sections describe the other task management processes.

- Starting tasks are mainly used for system initialization, creating semaphores and message queues between other tasks and tasks, etc. They are suspended after they are created and used.
- The main function of Zigbee communication serial port task is that CPU and CC2530 chips configure instructions through serial port 2, send and receive Zigbee data packets, parse and generate corresponding actions, etc. The task is executed after interrupting the mark position in serial port 2.
- The main function of the SIM800C communication task is that the CPU communicates with the SIM800C chip through serial port 1 to configure different AT instructions in different working states, and to send and receive Gprs or Bluetooth data packets and generate corresponding actions. The task is performed after interrupting the position of the flag in serial port 1.
- The main panel operation task is mainly used to select and enter different function panels. The system performs the task after initialization.
- The key operation task mainly achieves four key functions by two entity keys and compiling key operation algorithm, and carries out different function operations of different function panels. The task is executed in real time.
- P2P communication panel, Zigbee panel, Gprs panel, Bluetooth panel and other four operation panel tasks are to achieve the interface operation of the corresponding functional panel, and perform different operation panel tasks after the selection of the main interface.

- The task of P2P communication panel serves the functions of data updating and network state switching during the execution of P2P network. It waits for the release of data updating semaphore, and performs the task when the right to use data updating semaphore is obtained.
- Network communication tasks are mainly used for the switching of network state and the execution of corresponding operations, which are suspended after the creation of the initial tasks and restored and executed when entering the P2P panel.

3.2 Software Algorithms

3.2.1 Trust algorithm. Because in the process of P2P network communication studied in this paper, it can not guarantee that each node can provide computing power and networking function for other nodes or the whole network at any time, there is selfish behavior, which affects the self-routing path planning of network architecture, so this paper studies and customizes a set of software trust algorithm, which is based on the credibility of each node in P2P network communication [4].

Give each independent node a fixed number of network operation resources, each time the network request or response network request resources are reduced by 1, the initial contribution value of each node group is 0, the credibility is 100%, and the selfishness is 0%[5].

3.2.2 Incentive algorithm. When each node responds to the network request, the contribution value of the node group is increased by 1, and the trust value is increased by 1. In the process of network request, if the node withdraws from the network request, the selfish value of the node is increased by 1 and the trustworthiness value is decreased by 1. According to the trust algorithm formula, the trustworthiness and selfishness of the node are calculated.

3.2.3 Encryption algorithm. In the process of P2P network communication, in order to prevent data leakage and external intrusion, encrypted bits and port numbers are added in the design of communication data package. When a node receives a data packet, it can only parse the data packet if the bit check is correct. At the same time, the source port number is the same as the receiving port number to respond to the request.

3.3 Construction of P2P Network

There are two layers in the construction of P2P network, namely protocol layer and algorithm layer. Based on Zigbee communication, the protocol layer adds request bit ReqFlag to the packet to judge the type of request. There are two types of request, one is to initiate REQACTION, the other is to successfully request REQSUCCESS. In order to prevent malicious requests from nodes, encryption bits are added to the packet to identify whether the requests from nodes are normal.

Algorithmic layer is mainly the programming of various data functions, including data packaging, data capture, data analysis and other functions. Data packing function is used to pack all kinds of scattered data into protocol layer-based data packages. In response to requests, the content of data packages is captured by data grabbing function and placed in the data container (which will be described in detail later). Then, various parameter data are parsed by data analysis function, and whether the correct request is accepted or not is judged.

4. P2P Network Communication Process and Result Analysis

The whole P2P network communication can be roughly divided into four processes: the node initiates the request and broadcasts the request through the network topology path, the other node receives the request and broadcasts the request, and one node successfully requests and broadcasts the network data which it requests back.

When a node broadcasts a request to the network through the Zigbee module, the request location is REQACTION. The local address, source port number, destination port number, request data type, encryption bit and request bit are put into the Zigbee packet manager. The request is sent out through the serial port and broadcasted through the P2P network.

When other nodes are out of idle state, they respond to requests on P2P network and resolve the source address, data type, port number, encryption bit, request bit and so on through packet parsing function. First, analyze whether the port number and encryption bit are correct, then proceed down. Then analyze whether the request bit in the data packet is REQACTION. If so, start the network to help it request data on the network. At the same time, broadcast the request again, let more idle nodes participate in the request activity.

When a node requests network data successfully, if it is not the request initiated by itself, the request location is REQSUCCESS, the network data is put into NetData, and its own address, request bit, network data are packaged into the P2P network for broadcasting, in turn, the successful request data is returned, and the request activity parameters are withdrawn.

LCD has many panels, among which, we choose the P2P working panel. When the node is in active state, the value of VolDisplayType will be taken out every time the network request is sent or received, and displayed on the LCD P2P working panel to update the data parameters.

Figure 5 Communication interface

Figure 6 Resource Interface

5. Conclusions

This paper studies the P2P network from the point of view of hardware communication, realizes the construction of trust model and incentive mechanism of P2P network by using self-designed programming algorithm. Through the independent operating system of each node, real-time and dynamic display of communication process data on the LCD screen, realizes the visualization of the P2P network communication process. In addition, on this basis, we can continue to explore in depth. We can make an effective breakthrough in practical application by adding FPGA (Field Programmable Logic Array), which greatly improves the computing ability from the hardware, supports a large number of data operations, and adds some intelligent identification parameters to enhance its intelligence.

Acknowledgments

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