Automatic Information Scheduling System of 5G Intelligent Terminal Based on Internet of Things Technology

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Abstract. It is difficult to extract accurate feature data in conventional automatic scheduling system, which leads to large automatic scheduling error. Therefore, 5G intelligent terminal information automatic scheduling system is designed based on Internet of Things technology. In the design of hardware system, the bus circuit, 5G intelligent network management node system and 5G mobile communication chip based on Internet of Things are designed. In the design of software system, the initial solution of automatic scheduling is calculated, the automatic scheduling characteristics of 5G intelligent terminal based on Internet of Things are extracted. Experimental results show that the average scheduling error is 0.1604 and 0.2632 lower, the absolute error is 0.0503 and 0.0568 lower, and the data obtained by the two methods are smaller than those by the conventional methods. Therefore, the system has a more accurate 5G intelligent terminal information automatic scheduling capabilities.

Keywords: Internet of things technology · 5G · Intelligent terminal · Information automatic scheduling system

1 Introduction

With the rapid development of information technology in the 21st century, the information released through 5G intelligent terminal has become an important pillar of people's daily interaction, so the scheduling of such information has become an important method of production, operation and management of enterprises [1]. But in the actual process, some unexpected events often occur, this kind of event has great damage to the accuracy of program scheduling, which may cause great error. So this paper analyzes how to reduce the error of 5G intelligent terminal information scheduling system. Document [2] Coding of communication information by establishing a standardized unified system enhances the integration of the system and the sharing of information. Document [3] Obtaining the network server address for TCP/IP through an application in the client and controlling the security of the server using standard Internet technology [2, 3]. However, in practical application, the scheduling characteristics of 5G intelligent terminals are not accurately extracted, which leads to a large error in the automatic scheduling of 5G

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intelligent terminals. Therefore, this paper proposes to design an automatic scheduling system for 5G intelligent terminal information by using the Internet of Things technology. The bus circuit of the system is designed through zero group grounding, which makes the grounding line anti-interference. The parameters of bus and gateway nodes are designed, and the hardware part of the system is built with the core chip. The objective function is constructed, and standard frequency, initial frequency, optimal frequency and fundamental frequency are used to identify the automatic scheduling characteristics of 5 G intelligent terminal information samples.

2 Design of Hardware for 5G Intelligent Terminal Information Automatic Scheduling System

2.1 Design Bus Circuit

In the design of the bus circuit of the system, a portion of the power output condition is provided by the power division module shown in Fig. 1, where the output device uses a 3.0V standard voltage.

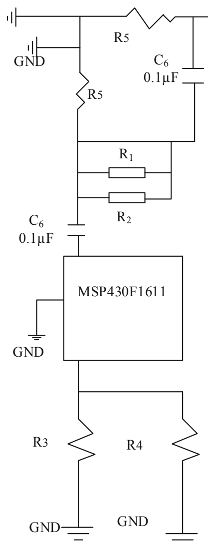

Fig. 1. System bus circuit design

However, after some time of testing, it is found that the overall design of the circuit as shown in Fig. 1 needs to achieve the purpose of grounding anti-interference through zero group, so different power line numbers are needed to make these grounding lines bypass interference and complete the automatic scheduling of the whole system module [4]. In this process, two 30Ω resistors can be used as the matching resistors of the smart terminal transmission module, and five grounded power supplies can be connected as the output of line impedance.

Controller STM32F207VE internal integration of the powerful CAN controller, CAN communication module design only need to design the interface circuit between the microprocessor and the driver [5]. In the system design, the master node and the child node adopt the same driving circuit, the driver adopts the whole encapsulation technology, the internal integration of the power isolation, electrical isolation and CAN transceiver circuit, isolation voltage up to DC2500V, simple interface, easy to use, can be a good CAN-BUS bus between the nodes of the complete isolation and independence of electricity. The TXD, RXD pins of the module are fully compatible with the CAN controllers of 3.3V and + 5V, and no external components are needed. Compared with the existing design scheme, the DC-DC power module, optocoupler module and ESD protection circuit are simplified, and the stability and security of the node are improved.

2.2 Design of 5G Intelligent Gateway Node System

The design of 5G intelligent terminal information gateway node is the key node of the whole automatic scheduling system. The gateway node realizes the automatic scheduling of information by setting the parameters of CAN bus and its sub-nodes [6]. Among them, the main function of each sub-node is to collect field information and transmit it to the information gateway node of 5G intelligent terminal through CAN bus. When there is any problem at the production site, the on-duty personnel shall be alerted by means of LCD display and sound and light alarm. The on-duty personnel may learn the information of each node in detail from the control platform, and issue control commands to the sub-node through the control platform or keyboard [7]. The 5G intelligent terminal information gateway node communicates with the control platform through TCP/IP and LTE to ensure the effective control of the scene. 5G intelligent terminal information gateway node circuit mainly includes CAN transceiver circuit, Ethernet interface circuit, LTE communication circuit, keyboard circuit, LCD display circuit and acoustooptic alarm circuit, the specific structure is shown in Fig. 2.

Considering that the data processing capacity of the 5G intelligent terminal information gateway node is required to be high, the 32-bit processor STM32F207VE based on the ARM Cotex-M3 core is selected. The chip uses the latest 90-nm process to produce a new generation of STM32 products, which can achieve the processing capacity of 150DMIPS at a high speed of 120 MHz, up to 512k bytes of on-chip flash memory and 128k bytes of SRAM, and the adaptive real-time flash memory accelerator enables the on-chip flash memory to execute the code with a high-speed zero wait of 120 MHz [8]. The chip carries 1 way 10/100M 5G intelligent terminal interface, 2 CAN channels, 6 UART interfaces, in addition to ADC, DAC, USB, PWM and other peripheral equipment. In this way, 5G intelligent terminal information automatic scheduling system can communicate with TCP/IP and CAN bus stably, and it can be ensured to be included in the running module of automatic scheduling system.

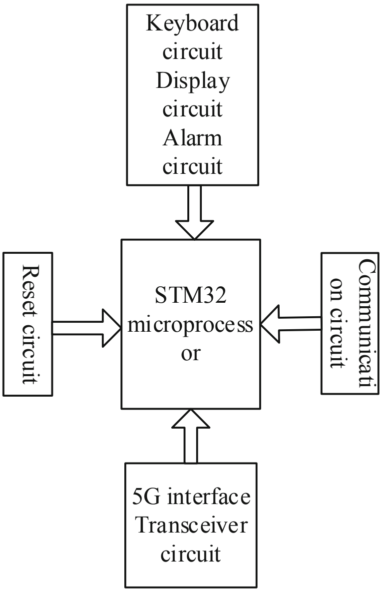

Fig. 2. 5G smart terminal gateway node system architecture

2.3 Design of 5G Mobile Communication Chip Based on Internet of Things

In the design of communication chip of 5G intelligent terminal information gateway node, in order to realize the remote transmission of data, expand the communication bandwidth and improve the communication compatibility. The MAC chip of STM32F207VE integrates special DMA inside and provides MII or RMII for Ethernet communication. The PHY physical layer control chip adopts DP83848CW to simplify the circuit design diagram of the hardware as shown in Fig. 3. The PB11 of STM32 is connected with TX _ EN to enable the sending of pins [9]. PB12, PB13 connect with TX _ DO, TXD _ 1, send data. PD9, PD10 connect with TX _ D0, TXD _ 1, and receive data. The X1 provides a clock signal for receiving and sending data. DP83848CW is connected with network transformer socket J0011D21BNL to realize the differential transmission of TCP/IP digital signal.

LTE5G intelligent terminal information gateway node communication chip USR-LTE-754 as the core, can easily achieve high-speed communication with the LTE network. The USR-LTE-754 is a compact, feature-rich M2M product that can be easily and quickly integrated into the design system. The chip software has complete functions, covers most common application scenarios, supports custom sign-up packets and heartbeat packets, supports 4-way Socket connections, and supports transparent cloud access with high speed and low latency [10]. The UARTTX and UART-RX pins of USR-LTE-754 are connected with PC11 and PC10 of STM32 respectively to realize the bidirectional data transparent transmission from serial port to LTE network. The chip has integrated the function of SIM card and connected with the corresponding pins of SIM card base in design. CSI _ CLK, CSI _ RST and CSI _ D pins are connected in parallel with the capacitors around 47pF to filter the interference of RF signal. The chip provides switch

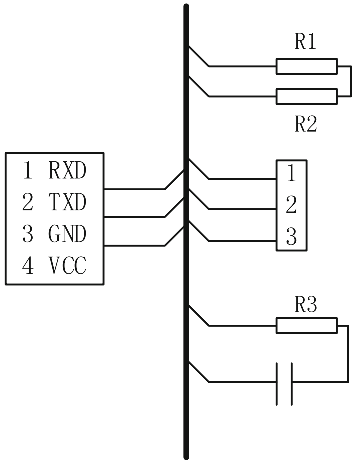

Fig. 3. 5G mobile communication chip

RES and POWER _ KEY pins to control the switch of STM32. Through the LED status display chip working state. The indicator pins of the chip are LinkA, LED _ W and LED _ N, which indicate the network connection, the chip operation and the specific network status respectively. The pin level is 18V, and the driving indicator needs to match the level and drive the indicator through the triode.

3 Design of 5G Intelligent Terminal Information Automatic Scheduling System Software Based on Internet of Things Technology

3.1 Initial Solution of Computational System Automatic Scheduling

Suppose an automated scheduling schedule has three machines in progress, m_1, m_2, m_3, respectively, generating, encapsulating, and transporting jobs. The number of methods of intelligent terminal information automatic scheduling is n_1, and the number of schemes formed by the method is n_2, and then the number of initial solutions is n_3 [11]. Where $m = m_1 + m_2 + m_3$ and $n = n_1 + n_2 + n_3$ for transshipment. In order to facilitate the calculation and reduce the computational efficiency problems caused by too many variables, the varieties of the three initial solutions are calculated separately and the following objective functions are established:

$$c = \sum_{i=1}^{m} \sum_{j=1}^{n} X_{mn} D_{mn} \tag{1}$$

In the expression, the constraint of the objective function, the number of intelligent terminal information automatic scheduling methods and the number of intelligent terminal information automatic scheduling schemes are expressed. In this process, the system calculates the number of methods and schemes [12], and calculates the implementation coefficient matrix of 5G intelligent terminal information automatic dispatching through ArcGIS:

$$X = \begin{pmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{pmatrix} \quad (2)$$

The objective value function obtained from matrix calculation is as follows:

$$X' = \left(2324 \; 1956 \; 3817\right)^T \quad (3)$$

Using the program of simple form method and two-stage method, the scheduling value can be obtained after the calculation of standard type, initial type, optimal type, basic type, iterative type, etc.

3.2 Extracting Automatic Scheduling Characteristics of 5G Intelligent Terminal Based on Internet of Things

Before extracting the automatic dispatching features of 5G intelligent terminal, it is necessary to calculate the automatic dispatching features first, and to recognize the effects of various automatic dispatching features in the 5G communication process [13]. In this process, there are several parameters which are inevitably affected. This paper uses standard frequency, initial frequency, optimal frequency and fundamental frequency to identify the automatic scheduling characteristics of a 5G intelligent terminal information sample.

First is about the standard frequency change, in eliminates in the standard frequency the process, often appears the signal overload the question. In order to eliminate the influence of this kind of signal, filter eliminator is usually used to reduce the signal frequency. If the short-time framing coefficient of a signal is set to $f(n)$, the adaptive function of the signal can be obtained:

$$f(n) = \sum_{n=1}^{N-K} W_x(n)(n+k) \quad (4)$$

In the formula, N indicates the number of frames in the signal, K indicates the time parameter for signal elimination, and $0 \leq k \leq n$, usually the value of k is between 50 and 100 Hz, and $W_x(n)$ indicates the range of change in the window function of the signal.

The initial frequency is usually used to reflect the frame amplitude of a 5G smart terminal information sample, which plays a key role in the expression of 5G smart terminal information. When calculating the initial frequency, the weighted squared sum of the sampling points can be obtained by calculating the average energy of the information data of a specific 5G intelligent terminal [14]. The specific calculation formula is as follows:

$$E = \sum_{i=1}^{N} A_x^2(\alpha) \tag{5}$$

In the formula, E represents the numeric value of the initial frequency, with the unit of kJ; N represents the frame length of the information of a segment of 5G intelligent terminal; i represents the frame number of the information of the segment of 5G intelligent terminal; A represents the average value of the information of the segment of 5G intelligent terminal; and α represents the electric energy calculation parameters of the segment of the information of the segment of 5G intelligent terminal. Because the 5G intelligent terminal information will be averaged in the process of this calculation, the data are not less than zero integers. The specific parameters of energy summation can be obtained in the open form in daily calculation.

The optimal frequency is usually due to a short period of time in a 5G intelligent terminal information changes 5G intelligent terminal information, there is a short zero-energy phenomenon, such phenomenon can obviously lead to a large difference between 5G intelligent terminal information data, and this kind of phenomenon usually exists in the 5G intelligent terminal information with large emotional fluctuations. The method of extracting the optimal frequency is very simple, and can be determined directly by the change of the symbol, namely:

$$\theta = \frac{1}{2} \sum_{i=1}^{N} |\mathrm{sgn}(\beta) - \mathrm{sgn}(\beta - 1)| \tag{6}$$

In the formula, N represents the frame length of the information data of the 5G intelligent terminal with the phenomenon of short-time zero-crossing; i represents the frame number of the information of the 5G intelligent terminal; and β represents the frequency coefficient of the information of the 5G intelligent terminal. Of these, sgn is typically a symbolic function that has a value of 1 at $\beta > 0$ and a value of 0 at $\beta \leq 0$.

Most of the basic variable frequencies are based on the analysis of the functions of 5G intelligent terminals. If the computing capacity of 5G intelligent terminals is linearly and positively correlated with the information of 5G intelligent terminals, the information frequency of 5G intelligent terminals in this section is lower; if the computing capacity of 5G intelligent terminals is unable to be correlated with the information data of 5G intelligent terminals, the information frequency of 5G intelligent terminals in this section is higher. When a frequency filter is constructed based on this concept, it can be concluded that the frequency calculation formula for the information data of the 5G intelligent terminal is as follows (4):

$$f(x) = 3325 \ln(1 + \frac{f(v)}{700}) \tag{7}$$

In the formula, $f(x)$ represents the value of the frequency filter function, and $f(v)$ represents the calculation function of the frequency. The cosine transform parameters of the

5G intelligent terminal information data can be obtained by logarithmic analysis of the function value. By accurately extracting the information features of the four kinds of 5G intelligent terminals, the accuracy of the identification system can be directly optimized, so the accuracy and reliability of the parameters should be paid attention to. However, it is very difficult to determine these four kinds of parameters perfectly only by 5G intelligent terminal information, and its accuracy is very difficult to guarantee. Therefore, other algorithms can be introduced to test the results of these four kinds of parameters to ensure the accuracy of 5G intelligent terminal information automatic scheduling system.

3.3 Designing Optimization Algorithms for Automatic Scheduling Systems

In order to get more accurate 5G intelligent terminal information automatic scheduling system, the 5G intelligent recognition is classified as a calibration reference in the scheduling algorithm, which is shown in Fig. 4.

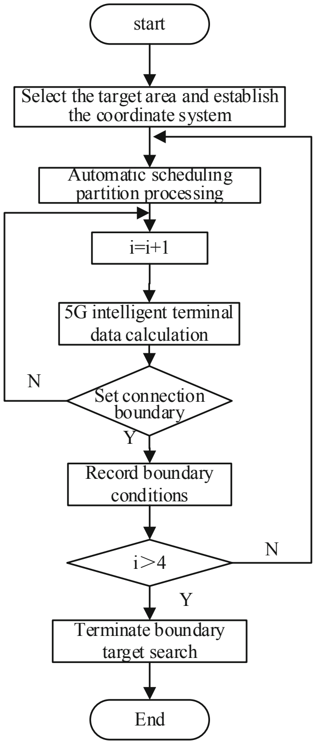

Fig. 4. Automatic scheduling optimization algorithm

As shown in Fig. 4, you first need to set four boundary conditions to schedule partitions through intelligent terminal computing devices. When all the four boundary conditions are satisfied, the boundary target can be terminated and the search can be stopped, so that the input data and parameter can be obtained in the automatic scheduling.

Then, according to the data obtained from the automatic scheduling search, converted to the above parameters, become another vector of the automatic scheduling features, so as to achieve the optimization of this algorithm.

4 Experimental Research

4.1 Experimental Preparation

This system mainly uses Eclipse as the JAVA language development tool; the database aspect uses PL/SQL to develop the SQL statement, the view, the stored procedure and so on; the development work mainly carries on under the Windows XP, the temporary application server chooses Tomcat 5.0; uses Microsoft Visual SourceSafe 6.0 as the version control tool. The software environment on the database server is mainly divided into two aspects, namely, the operating system software Solaris and the database software Oracle 9i. The software environment on the application server includes the operating system software UNIX and the application server software Websphere. The operating system software needs to choose the version of Win2000 or above and the IE browser is IE6 or above. SUNV4900 is used for the database server, SUNV490 for the application server and PC for the client machine in the hardware environment.

According to the above conditions, the data simulation test environment is built, and the same 5G intelligent terminal information database is tested by using this system and several traditional dispatching systems. Data monitoring network is the core of the database, and the best scheduling feature is selected by 5G intelligent terminal. The best component model is obtained by reducing the dimension of the original data. The final parameter of the database is 45 by default. When one sample is a training dataset, the other sample can be verified by cycling until all the data are traversed, and the best model parameters can be obtained. In general, the accuracy of the algorithm needs to be tested more than 5 times in order to get more accurate values. In order to determine the superiority and accuracy of the system design method in this paper, this method is tested separately with the conventional three methods, and its superiority is analyzed through the comparison of accuracy.

4.2 Scheduling Error Test

The validity of the 5G intelligent terminal information automatic scheduling system based on Internet of Things technology is verified and tested according to the above experimental environment and parameter settings. The average and absolute errors in the process of automatic dispatching shall be calculated separately, and the calculation formulas are as follows:

$$\begin{cases} \alpha = \frac{1}{|\delta|} \sum\limits_{\tau_i \in R} \left| \tau_i - \tau_i' \right| \\ \beta = \sqrt{\frac{1}{\delta} \sum\limits_{\tau_i \in R} \left(\tau_i - \tau_i' \right)^2} \end{cases} \tag{8}$$

In the formula: α represents the average error of the dispatching result; β represents the absolute error of the dispatching result; δ represents the actual number of dispatching scoring items; τ_i represents the true rating of the automatic dispatching of 5G intelligent terminal information; τ' represents the forecast rating of the system; R represents the scoring set. The smaller the values of α and β are, the smaller the error of the scheduling result is. Based on the above calculation, any 10 sets of data in the data set are selected, and the data set is trained and tested according to the ratio of 8:2. According to the above formulas, the performance evaluation results of different systems are obtained, as shown in Table 1 below.

Table 1. Comparison of scheduling errors

Test set	The system in this paper		Conventional system 1		Conventional system 2	
	α	β	α	β	α	β
1	0.1534	0.2267	0.3886	0.3794	0.2568	0.4596
2	0.2367	0.9657	0.4685	0.4752	0.7456	0.6935
3	0.4587	0.1145	0.1426	0.5544	0.1459	0.4756
4	0.1544	0.0112	0.4455	0.1452	0.6357	0.3247
5	0.5556	0.1214	0.4425	0.6895	0.4582	0.2476
6	0.1445	0.5214	0.1144	0.2448	0.9634	0.1475
7	0.0112	0.3145	0.3514	0.2569	0.7851	0.5475
8	0.1123	0.2552	0.5527	0.1456	0.2447	0.1474
9	0.1145	0.4425	0.4752	0.3697	0.1448	0.4256
10	0.0221	0.4425	0.1455	0.2578	0.2145	0.1145
Mean value	0.1963	0.3016	0.3527	0.3519	0.4595	0.3584

As shown in Table 1, the average error of the system used in this paper is 0.1963, 0.1604 and 0.2632 lower than the two conventional systems, 0.3016 in absolute error, 0.0503 and 0.0568 lower than the two conventional systems, both absolute error and relative error are lower than the two conventional systems. Therefore, the average error and absolute error of the system designed in this paper are lower, and it has more accurate effect for the automatic scheduling of 5G intelligent terminal information.

5 Concluding Remarks

In this paper, an automatic scheduling system of 5G intelligent terminal information is designed based on Internet of Things technology. The bus circuit of the system is designed through zero group grounding, which makes the grounding line anti-interference. Taking standard frequency, initial frequency, optimal frequency and fundamental frequency as objective functions, the scheduling characteristics of 5G intelligent terminal information samples are extracted, and the automatic scheduling of 5G intelligent terminal information is realized. Through the above three experiments, it can be found that the 5G intelligent terminal information automatic scheduling system based on Internet of Things technology has better performance, and can reduce errors in the automatic scheduling process. Due to the limited conditions, the method studied in this paper is verified in the simulation environment, but has not been applied in practice. In the future research, it needs to be applied in the actual environment to meet the actual needs and improve the application performance of the design system.

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