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Application of Intelligent Control Method in Power Supply and Distribution System in Forestry Engineering

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Abstract:

The efficiency and reliability of power supply and distribution system in forestry operation have a great impact on the quality of forestry operation. This paper studies the intelligent control method in power supply and distribution system. From the load calculation, power supply voltage, three-phase load balance, material, cross-section and path of power supply wire, power factor of power supply and distribution system, reasonable adjustment of seasonal load and other aspects related to the design of power supply and distribution line, this paper discusses the energy-saving problems in building electrical design. Based on the current situation of parallel operation of power supply system and user load control system, this paper proposes an intelligent monitoring system for power supply and distribution demand side. In this paper, by using various effective information of power supply system and load control system, the resources of both supply and demand sides are reasonably allocated through control strategy. This paper analyzes the problems in the start-up and operation of the existing equipment, and proposes a dynamic scheduling strategy with W load power and load level as the core to control the operation of the equipment. By dynamically adjusting the start and stop of the equipment in the system, the stable operation of the system can be ensured, and the power consumption cost of users can be reduced under the agreement power.

***Keywords**: Forestry Engineering, Power supply and distribution system, intelligent control, load calculation, power factor.*

I. INTRODUCTION

With the continuous reform of the national power system and the gradual improvement of the power market theory, the research of power distribution strategy based on energy conservation and environmental protection is becoming more and more mature [1-2]. For enterprises with high energy consumption, the State Grid in some regions has implemented the policy of power agreement. According to the reasonable needs of users, a fixed amount of power is allocated to users, and a high punitive price is implemented for the part of power exceeding the fixed power, which will bring great economic burden to enterprises [3]. At the same time, the internal power supply system and equipment control system are two independent systems, and there is little information exchange between them. The power supply system is only responsible for power supply, but it can not provide

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personalized power supply according to the operation characteristics of the equipment; The control system monitors the operation process of the equipment, but it can't control the operation of the equipment according to the state of the power supply system. As a result of the above problems, two results often appear in the power supply of enterprises: one is that the power supply capacity of the power supply system is far greater than the demand of users, which makes the efficiency of the power supply system decline and its own loss increase. Second, due to improper start-up, the required power of the system exceeds the agreed power, which leads to the punishment of the superior power supply department or the need to increase the power supply capacity, resulting in the increase of one-time investment. Demand side management is usually used to improve the reliability and energy-saving efficiency of power grid, but the traditional demand side management has poor real-time control, which has been unable to meet the needs of users.

II. DESIGN SCHEME OF INTELLIGENT MONITORING SYSTEM FOR POWER SUPPLY AND DISTRIBUTION DEMAND SIDE

2.1 Overall structure of intelligent monitoring system for power supply and distribution demand side

The overall architecture of the intelligent monitoring system on the demand side of power supply and distribution is roughly divided into three parts: remote intelligent distribution terminal layer, communication transmission layer and intelligent management layer [4-5].

(1) Remote intelligent distribution terminal layer

The remote intelligent distribution terminal layer mainly includes collecting and transmitting the power consumption data of the equipment and executing the upper control command. Remote intelligent distribution terminal layer can be divided into core terminal layer and peripheral auxiliary equipment layer, which can have various forms of structure. The core terminal layer is mainly responsible for the packaging and forwarding of relevant data, and timely response to the command of the host computer. The core device of the peripheral layer is the power parameter acquisition device, which provides the original data support for the whole system.

(2) Communication transport layer

Communication transmission layer is to build a communication bridge between intelligent management layer and remote intelligent distribution terminal, and adopt the most reasonable communication transmission mode according to different production environment. The main communication channels are: can bus, Internet of things, MODBUS bus, GPRS / CDMA wireless public network, etc.

(3) Intelligent management

Intelligent management layer is the core content of the system, which includes database, business applications, etc. It has the functions of data storage and processing, operation control of distribution transformer, load start-up control strategy, issuing instructions and information, and human-computer interaction.

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Power supply and distribution demand side intelligent monitoring system uses remote intelligent distribution terminal to collect power consumption data, guide users to use electricity intelligently and distribute power reasonably, so as to make the transformer operate reasonably and the power of the system maintain under the agreement power [6-7]. The intelligent monitoring system manages the electric equipment through the remote intelligent distribution terminal, and manages all the information related to the remote intelligent distribution terminal and the electric equipment.

The overall framework of intelligent management system is shown in Figure 1, including integrated application layer, data management layer and communication layer.

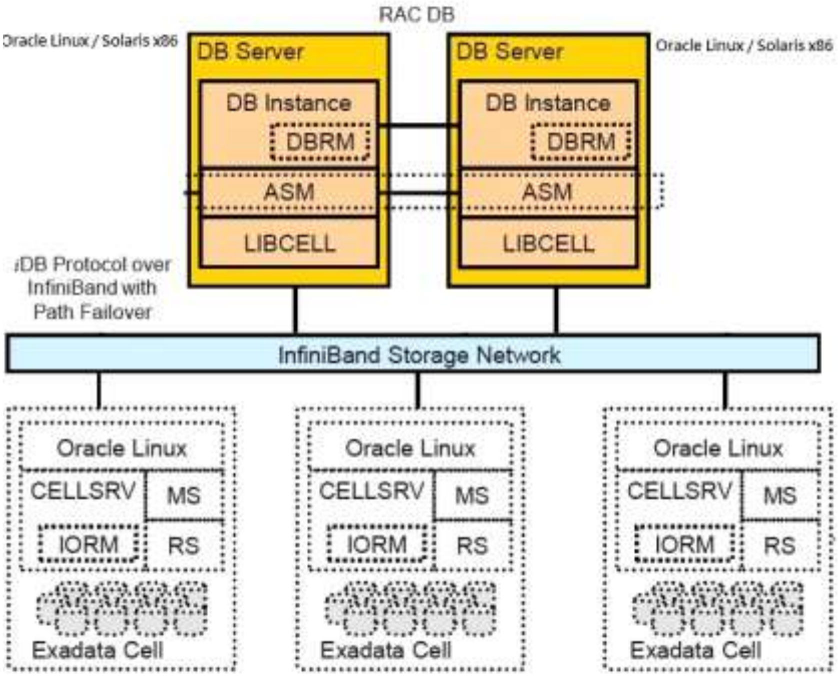

Fig 1: Software architecture of power supply and distribution demand side monitoring system

The comprehensive application layer is to develop application software to support the comprehensive application of data according to the business needs of users, including system management, data query, load forecasting, equipment management, help, dynamic sorting and transformer operation management.

The data management layer processes and stores the collected data such as power consumption, self consumption and equipment information. It also stores the power consumption priority of equipment and relevant information of users. It provides data support for the management of the whole system.

The communication layer accesses various types of terminal equipment in various communication modes, and transmits data in two directions according to the specified

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communication protocol.

2.2 Other requirements of intelligent monitoring system on demand side of power supply and distribution

The demand side intelligent monitoring system of power supply and distribution must meet the following performance requirements [8-10]:

(1) High reliability: the intelligent monitoring system of power supply and distribution demand side is required to have high adaptability and be able to face a variety of natural or man-made interference, including temperature, humidity, electromagnetic interference and lightning.

(2) High real-time performance: the intelligent monitoring system on the demand side of power supply and distribution must be able to collect the relevant power data in real time, calculate and forward the data in time, quickly execute the instructions of the upper computer, and report the equipment situation to the upper computer in time.

(3) Multiple communication modes: due to the different basic conditions of each site, the intelligent management system of power supply and distribution demand side should integrate multiple communication modes to meet various environmental requirements.

(4) Scalability: because the fixed function system can not meet the needs of users for a long time, the intelligent monitoring system on the demand side of power supply and distribution will reserve some software and hardware interfaces for secondary development on the original basis.

(5) Modular design: power supply and distribution demand side intelligent monitoring system should be composed of functional modules, so that once a part fails, it can not only better adapt to various needs, but also easy to maintain and reduce costs.

At the same time, the relevant technical indicators of the designed intelligent monitoring system must meet the national power industry standards.

III. DESIGN OF REMOTE INTELLIGENT DISTRIBUTION TERMINAL

3.1 Design scheme of remote intelligent distribution terminal

Remote intelligent power distribution terminal is a combination of intelligent control chip and high-level measurement and control circuit. The remote intelligent distribution terminal mainly works with the upper computer, provides data support for the control strategy of the upper computer and executes the upper control command. According to the above requirements, the structural design is shown in Figure 2.

The development and design principle of the remote intelligent distribution terminal is mainly

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completed by the power acquisition system and the core control module. The functions of related modules are as follows:

(1) The core control module is mainly responsible for the management of peripheral equipment, so that each module can work in the system.

(2) The power module is mainly responsible for the power supply of all hardware devices;

(3) The button has three functions: device start, stop, device power priority adjustment;

(4) Communication interface is the transmission of auxiliary data;

(5) The core of power acquisition module is the real-time acquisition of power related data;

(6) Liquid crystal display module: it displays the power consumption information of the current device;

(7) Alarm module: when the remote intelligent distribution terminal fails, it will send out a fault reminder and record relevant information at the same time;

(8) Data storage module: mainly responsible for the storage of relevant data parameters;

(9) Relay: mainly to perform the physical operation when the equipment is opened or stopped;

Only when all the modules work together, can the intelligent monitoring system of power supply and distribution demand side run normally.

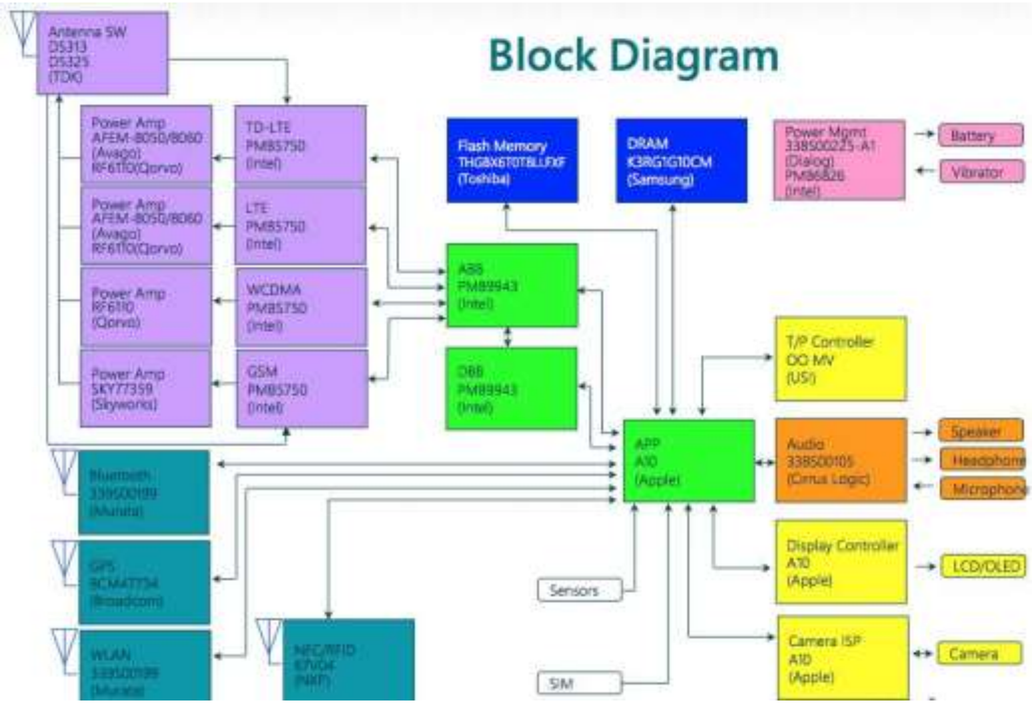

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Fig 2: Overall scheme block diagram of remote distribution terminal

3.2 Hardware design of core control module

(1) Design of power supply circuit

The remote intelligent distribution terminal is powered by USB. The USB interface inputs 5V DC power. The voltage of LPC2138 chip is 3.3V which is normally operated by spx1117m-3.3. 3 to reduce voltage of 5V. SPX 1117m-3.3 chip is a ldpo chip produced by Sipex company, which has the characteristics of high output current, high output voltage precision and high stability. The performance of power suppression ratio and static loss is very outstanding in the same products, with the maximum output current of 800rna, and the current limit and overheating protection function.

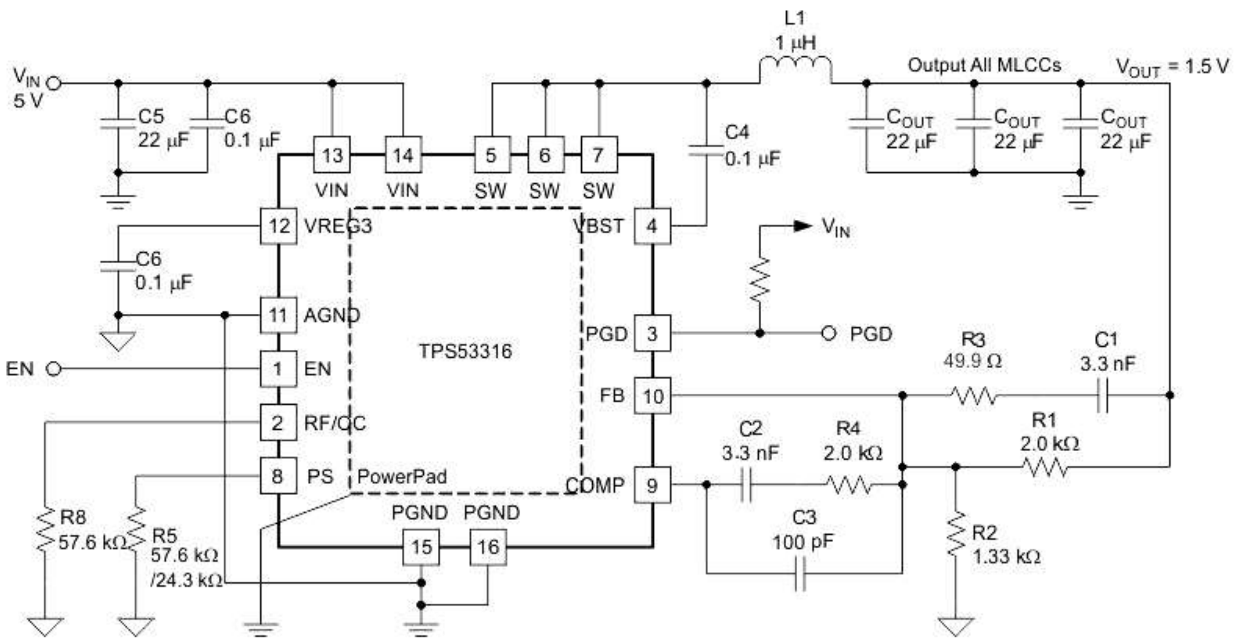

Fig 3: System power circuit

The power supply circuit is shown in Figure 3. In the circuit design, in the input, by adding an inductor to prevent transient current sudden damage to the circuit, the functions of capacitors C3 and C5 are filtering. At the output end, the analog power supply and digital power supply are isolated from each other through inductor L2 and L3, and the noise and error probability are effectively reduced to meet the requirements of LPC2138 microcontroller for power supply and signal. In addition, a capacitor is needed to improve transient response and stability. When the circuit is working properly, LED indicator D9 will be illuminated.

(2) JTAG interface circuit design

The core control module directly uses the standard 20 pin JTAG interface of LPC2138 processor as the simulation debugging interface. The hardware circuit design of JTAG simulation debugging interface is shown in Figure 4. In order to facilitate simulation debugging, by connecting a 4.7K pull-

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down resistor under the rtck pin, its JTAG interface can be enabled directly after the system is reset.

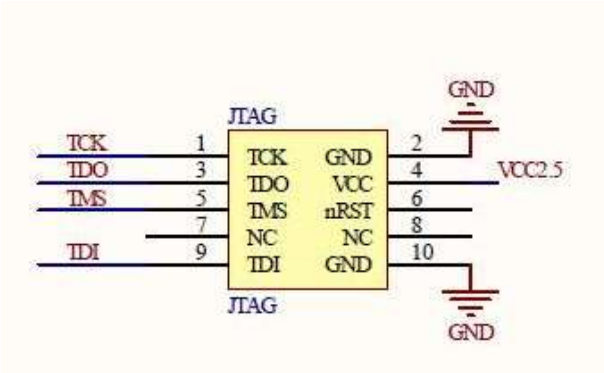

Fig 4: JTAG interface circuit

(3) Design of data storage circuit

The stored data needed by remote intelligent distribution terminal are the corrective parameters of power acquisition module, the relevant information of equipment and the initial priority of equipment power consumption. Because the amount of data is very small, the EEPROM integrated on CAT1025 is adopted. Before using it, it is necessary to write relevant data information in EEPROM in advance, and use the characteristic that EEPROM data will not be erased when it loses power to permanently save relevant information. When the system works, the related parameters in EEPROM are read through I2C interface, and then packaged and transmitted to the upper software together with the real-time data in SDRAM. I2C bus is a two-wire serial bus, which is a common bus form in data transmission. It has the advantages of few occupied pins, simple communication control and high transmission rate. The I2C interface must be at high potential when it is idle, so pull-up resistors must be added to both wires to work normally. The related circuit is shown in fig. 5.

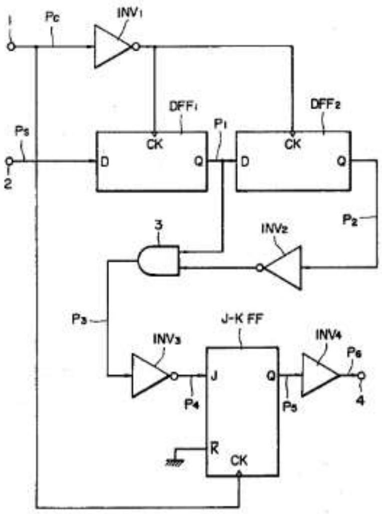

Fig 5: Data storage circuit

3.3 Communication module design

The communication module of remote intelligent distribution terminal needs to integrate a variety of communication methods to meet the needs of different users, mainly using serial port and wireless

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communication. Wireless communication technology has the characteristics of small space, no wiring, flexible configuration and strong scalability, so it is increasingly used in industrial control and power industry. Therefore, the communication mode is mainly wireless, and CC2420 chip is used as the core of the communication module. CC2420 adopts ZigBee technology, which is a short-distance wireless communication technology. Although its transmission speed is relatively low, it has short delay time, low power, low price and convenient networking communication.

CC2420 chip is connected with LPC2138 chip through SPI interface, which not only integrates physical layer and partial MAC layer, but also provides many hardware supports including data caching, message processing, data encryption, channel selection and so on. We need to add a power amplification module in front of the antenna to increase the transmission distance to ensure better data transmission in the network.

The working voltage of CC2420 is 1. 8V, which consumes very little energy. therefore, in some battery-powered equipment, the working voltage of external I/O interface is 3. 3V, which can be shared with LPC2138. a voltage regulator is integrated on CC2420, which is mainly responsible for finally converting the 3. 3V voltage into 1. 8V voltage. CC2420 uses differential mode to transmit and receive RF signals, and adjusts impedance matching circuit based on the most differential load. The circuit is shown in Figure 6 below.

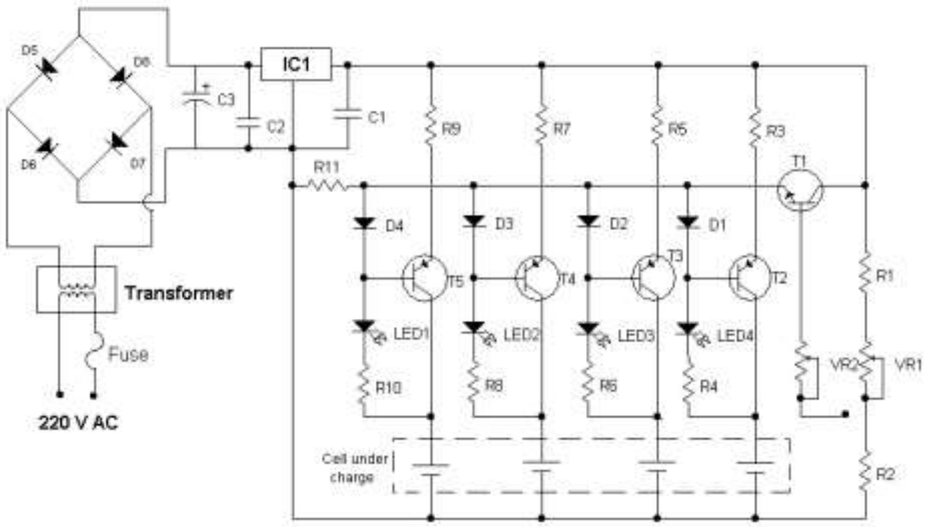

Fig 6: Wireless transceiving circuit

V. CONCLUSION

All along, the research of demand side management has received great attention and investment all over the world. Our government, enterprises, research institutes, universities and other units carry out the research of demand side management technology. With the protocol power policy proposed by the State Grid in some regions, the demand for power consumption of users is higher and higher, and the traditional methods can not meet the needs. In this paper, many research results of DSM on power load coordination control technology are absorbed. On this basis, the power supply system and load control system are combined to maintain the total power of the whole area under the power of the agreement, reasonably control the number of transformers, reduce the power cost of users, and

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improve the stability of the power supply system.

With the rapid development of science and technology, the software and hardware systems of power system are more and more abundant, which can meet the different needs of different users. The intelligent monitoring system of power supply and distribution demand side will also develop towards a more intelligent and information-based direction.

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