Zigbee Technology in Intelligent Electric Leakage Protection System Applied Research

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Abstract

Aiming at inconvenient wiring and low flexibility of current wired sensor network an implementation method for real-time monitoring system based on ZigBee wireless network is proposed in this paper. in view of existing selective earth leakage protection device of low sensitivity, poor reliability problems, proposed one kind based on the zero sequence current feature selectionSelective leakage protection and line selection method; analysis of power supply system leakage fault branch of zero-sequence current logical relations, introduced based on the zero sequence current featuresVolume selective leakage protection principle and the realization method of fault line selection. As a Zigbee wireless sensor technology, it is application to the grid. Analyze leakage protection system in relation to the past system of superior performance and favorable conditions, and its features and system design of a simple program to explain the analysis and application of specific measures.

Keywords: r wireless sensor, leakage protection, system design, zero-sequence, ZigBee

1. Introduction

All the time since, in the power supply system of accident, the highest percentage than the leakage fault generated. Leakage failure caused many, affect the range is very wide, as long as the electricity may spread to the. With the development of technology, the ZigBee technology to the electric leakage protection system, can effectively make up for the traditional system of complicated route problem, the traditional protection system is a failure to get information is transmitted to a control center, the center to obtain these information data is then concentrated processing [1]. The transmission processing mode so that the information processing time, many problems can not be timely solved, once at the time of transmission interference or temporary interruption protection system will lead to errors of judgment. If the center of control lines or equipment failure, will make the whole protection system paralysis be unbearable to contemplate the consequences. In view of the above problems, the use of wireless sensor network is imperative under the situation.

2. ZigBee Wireless Sensing Technology

The traditional power supply monitoring system using a wired connection mode. When the monitoring node is large, there is difficulty in installation, wiring is tedious and inconvenient maintenance problems. Based on the ZigBee technology wireless sensorNetwork to establish the power supply monitoring system, can solve above all problem. Introduce the working principle of ZigBee technology and real-time monitoring systemSystem design. The ZigBee protocol stack structure is composed of physical layer, MAC layer, networkLayer and application layer. The ZigBee standard, all ZigBee the network nodes are divided into Coordinator, Route, End Device 3Type. Regardless of the ZigBee network topology, networkAutomatically according to the protocol of ZigBee algorithm to select better routing paths for a data transmission channel, in order to improve the communication efficiency. Using the current leakage protection function can not completely meet the desired safety production standard, the information transmission is used in the wired mode, which means that network wiring complex, have limitations, not flexible networking, the system function is not perfect. Select ZigBee to replace the traditional leakage protection system is actually earth leakage protection system to realize wireless transmission to replace the cable transmission technology updated logo, leakage

protection system is the inevitable trend of further development. ZigBee technology is applied to the electric leakage protection system, on one hand can make the node layout become more simple and flexible, stronger practicability, not easy to damage, and the system operation more accurate positioning of. And replacing the information transmission link, so that each node can be independent of monitoring information and rapid fault judgment, the judgment result data and high accuracy, fast positioning. On the other hand, wireless sensor network using a 2.4GHz, anti interference ability, does not need the transmission cable, its cost and energy consumption compared with the traditional electric leakage protection system to [2]. ZigBee wireless sensor wireless sensor nodes arranged in a grid of each branch, thus forming an autonomous multi-hop network system, can not only avoid laying cable trouble, can also according to the different situation to adding or deleting node, if a node fails to no other node and the whole system to produce an effect.

3. ZigBee Leakage Protection System Design

Protection system consists of two parts, namely, the sensor node and the coordinator node. The system each branches and each bus will corresponding sensor node. The effect of fault information and the position of timely warnings, advantages of independent work of the sensor node in the leakage judgment information transmission frequencies are not too much, save energy. When a node leakage can work independently, and timely analysis of the accuracy of fault, to avoid the traditional transmission and centralized processing time and interference problems. The coordinator node, wireless communication module and a processor is composed of two parts, whose role is to deal with the sensor node in the work of the detection of a branch appears leakage failure phenomenon, specifically to the detected fault and sends location information to the coordinator node, coordinated by the node to analysis these information, and then transmits to the user terminal, convenient to view and control terminal, at the same time the data will revert to the coordinator node, and through its transmission to each sensor node. This will achieve information exchange control, avoid because of long transmission distance and leads to information data interference or multiple data have focused on addressing the traditional malpractice, can make the final test data faster and more accurate [3].

Selective leakage protection power supply system is the one of important protection. At present, the selective leakage protection device used in power supply system. The fruit is not ideal, all based on the steady and transient parameters of line selection methodIs not entirely reliable, leakage protection device maloperation, misoperation occurs. Especially for low voltage power supply system, due to the parasitic parameters is small, low selective leakage protection device of pressure sensitivity is very low, resulting in protection device the reliability of difference. Therefore, study on the high reliability and high sensitivity selective leakage protection method, to ensure safety of power supply and reduce leakage failure has important significance. Current leakage protection method of fault line selection based on zero sequence power and main current amplitude, the current party to the characteristics of the fault diagnosis method based on the method, the additional signal method, based on morphological or energy method, based on transient characteristics syndrome, using the wavelet analysis algorithm for line selection method. Above line selection method limitations mainly displays in: (1) as a result of underground power supply line fault condition is changeable, may beStability failure or intermittent fault line selection method, some criterion with universal, prone to error; (2) the small fault current, protection setting is difficult and prone to misoperation. When the fault current is less than the current transformer lower range, the letterAcquisition difficulties, some can not judge the fault line selection method; (3) because of the electromagnetic interference effect and the transient zero sequence circuit amplification effect, low signal noise ratio, causing some dependent transient route selection method for line selection accuracy is low. These limitations affect the selective earth leakage protection device performance. Therefore, this paper presents a method based on zero sequence current characteristic quantity selective leakage protection and line selection method.

3.1. Sensor Node Hardware Structure

The sensor node is an important component part of the microprocessor, the sensor node is in the core status, mainly on the routing protocol, data operation and processing,

program management and plays a role in the overall management responsibility, to ensure the accuracy and security of communication network, the wireless communication module, its task is to pass wireless communication with other nodes, receiving and transmitting data information, exchange control tasks, signal detection processing section, the system power and other peripheral part [4]. As shown above. It is mainly composed of zero sequence current and zero sequence voltage detection part of channel two:

　　　1) Zero-sequence current detection channel.Its composition roughly by the filter circuit, signal processing, A/D converting circuit. Through each outlet of the zero sequence current transformer two measurement can be zero sequence current signal data. If the line problem, fault current is always positive, if it is a fault line current will appear negative or zero in the case of.

　　　2) The zero sequence voltage detection channel. On the bus the sensor nodes will set the zero sequence voltage detection, the signal is derived from each bus zero sequence voltage transformer triangular openings. In the zero sequence voltage transformer with two windings, the output voltage signal of up to 100V, and then through the filter circuit and signal processing, finally by A/D conversion circuit eventually transferred to the processor. The power supply module role is not only to supply, but will be based on node type provided with corresponding power supply mode, if the terminal node needs only two 1.5V batteries, then Coordinator on the use of USB connection or directly using alternating current [5].

3.2. Processor Options

　　　Wireless sensor network node, from processors have the following two aspects: one is the low end type, the node controller using 8/16 bit single chip computer most. Its drawback is that when processing data will be unstable phenomenon, and processing of information data capacity is low, has the advantages of energy consumption is relatively low, small power. So most use front-end acquisition node. Is a high-end processors, which is based on the ARM processor as the representative, relative to the lower end of the processor, the tremendous energy, but relatively powerful processing ability, general support for dynamic voltage regulation or dynamic frequency regulation, suitable for high volume of data business. As the application of image, the majority of the gateway node or the coordinator node uses high-end processor. Therefore, in choice of processor issue should be whether meet the system requirement of processing capacity in the first place, then consider the issue of energy consumption of [6].

3.3. IEEE 802.15.4 Definition

　　　The definition of ZigBee standard is defined on the basis of the IEEE 802.15.4, based on the physical layer and medium access control based on the network layer, application layer, and layer of security definition. This technique was used by 2.4 GHz ISM working frequency, ZigBee can have such a strong resistance to interference of the same frequency is mainly due to the ability to achieve IEEE 802.15.4 standards and the following mechanism:

　　　1) The clear channel assessment. In collision avoidance mechanisms, IEEE 802.15.4 physical layer can provide the spatial channel assessment, refers to when the other equipment occupied the channel at the same time, can let its transmission to exit.

　　　2) Channel algorithm. If the network responsive to the interrupt, or in its initialization time, ZigBee will all be loaded channel table parameters among the channel for the collective scanning, is designed to select the best channel.

　　　3) Dynamic channel selection.In ZigBee network, the coordinator will automatically scan each channel then automatically select a proper PAN into, rather than creating a new PAN. The function of benefit is not increased in the same frequency band the PAN number, which greatly reduces the possibility of interference. If there is interference and its source is found in the channel, then the coordinator will be scanned and used again in the upper channel algorithm, searching for another channel. The ZigBee protocol standard also has the advantage of having network self organization ability,can at any time in the network or node, makes the data transmission rate, low power consumption, low accuracy is more advanced characteristic [7].

3.4. Fault Slip under the Zero Sequence Current Characteristics

　　As shown in the following illustration. When No. 2 for the fault line, then you can use the representative from A out of the current, then the No. 2 line through the zero sequence current can be expressed as:

$$3 - I_{02} = (-I_{A2}) + (-I_{B2}) + (-I_{C2}) = -[(-I_{B1}) + (-I_{C1}) + (-I_{BG}) + (-I_{CG})]$$,

That is, the effective value: $3I_{02} = 3U\,\Phi\,\omega(C_{0\varepsilon} - C_{02})$ 。

Its characteristic is when single-phase grounding occurs, the system will have zero sequence voltage phenomenon, fault lines, zero sequence current value for the whole system in normal operation of zero sequence current is the sum of the parts, and the value of capacitance to ground and its current value, roughly for: detection approach the zero sequence current of I0 and other tuning IX numerical comparison. In general, the whole system a line capacitance current numerical than would be the setting value IX to small. At this time, when the detection occurs when IX is greater than I0 situations, this line is normal. But when IX than I0 hour on this line problems, so there may have been a failure. This method is relatively simple, which measure the zero-sequence current is positive is a fault line, instead of zero or negative, says the line normal fault [8-10].
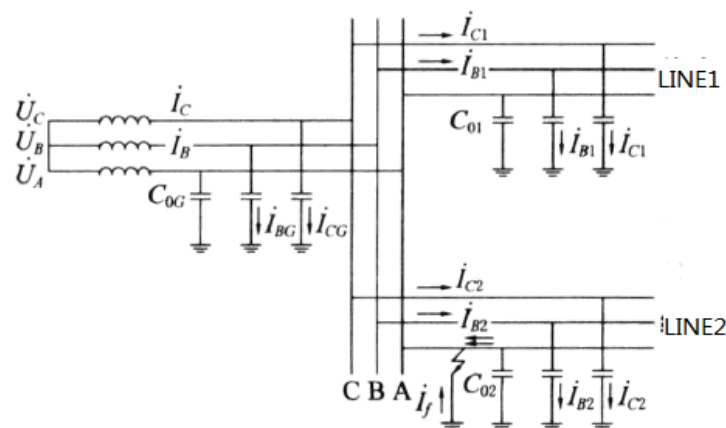

Figure 1. Zero-sequence Circuit

3.5. System Realizing Method

In the whole system, the first step is to detect the bus zero sequence voltage value, namely the use of zero sequence current transformer, access bus routing node detection. The detected voltage data to be transmitted to the processor after processing, for the moment the monitoring function, when the system lines without exception will automatically jump to the sleep mode. Leaving only the processor when necessary for zero sequence current monitoring, monitoring the voltage has reached the action value standard to. When it reaches the action value, then this line leakage fault condition, the wireless communication system will be to all branches of the routing node sends a signal and inspect. Each branch of the routing node will be on zero-sequence current of numerical magnitude and its current trend detection, the obtained data and information will be in the each other between nodes transmit and focus judgment, avoid the occurrence of miscarriage of justice [11-13]. When the final location of leakage fault slip is a which, the line's branch node processor will take control measures, immediately cut off the line, and with the fastest speed of the fault information and data, the specific location and fault alarm information is transmitted to the coordinator node, coordinator node receiving the information data timely analysis and then sent to the user terminal.

4. Knot Theory

Traditional leakage protection system using a wired network, the utility model has the advantages of technology has been more mature, the cost price is cheaper also, between the network noise small, network communication speed. However, relative to the wireless sensor network, the traditional electric leakage protection system has wiring complex, poor flexibility of malpractice. If the room has been decorated, to use a wired network sensing device must want

to once again laying out a special network, it is very troublesome [14-16]. If the line cloth, but because the network topology has been fixed, so to meet the need to increase the network node will be unable to join the system status. When the network more will make the cable number, complex lines, in addition to affect the appearance but also to repair caused great difficulty.

4. Conclusion

Zero sequence current features of selective leakage protection of line selection methodAnalysis criterion of obvious characteristics, with reference to electrical quantity pure, strong anti interference capability,High sensitivity, small power supply system can effectively solve the problem of selectiveLeakage protection of low sensitivity, bad reliability technical problems.Based on the Zigbee leakage protection system design of the main purpose and mission is to make the ZigBee wireless network in leakage protection system of data transmission to achieve better results, and make its node positioning more accurate, stable, reliable, precise leakage protection system, which not only has the practical significance, but also for the wireless network in power protection system in the development of help.

Acknowledgements

References

[1] Meng Xiangzhong. Modern power supply technology. Tsinghua University press. 2010.
[2] Dong Tingting, sand, etc. Based on the CC2420 wireless sensor network node design of. *Computer and automation technology.* 2009.
[3] Shu Hongchun. Distribution network fault line selection. Mechanical industry press. 2009; (8).
[4] Tang Yi. Principle of selective leakage protection. China Coal Industry Publishing House. 2010.
[5] Li Wenzhong, A Zhaoyu. ZigBee wireless network technology with the actual entry. Beihang University press. 2011.
[6] Li Bing. ZigBee based wireless embedded equipment design and implementation. Beijing University of Posts and Telecommunications. 2007; (3).
[7] Peng Yan. ZigBee based wireless sensor networks to study. *Modern electronic technology*. 2011; (6): 120-127.
[8] Wang Chen. Intelligent campus ZigBee network performance simulation and reliability improvement path. Shandong University. 2010.
[9] Wu Chengyu, Sun Yunqiang. ZigBee technology based on short distance wireless data transmission system. *Instrument technique and sensor*. 2008; (5): 101-109.
[10] Edric H, Jean S. iPhone Security Model &Vulnerabilities. United States: HITB SecConf. 2010.
[11] Jean-Baptiste B, Jean S. iPhone Data Protectionin Depth. United States: HITB SecConf. 2011.
[12] Stefan E. Exploiting the iOS Kernel. UnitedStates: Black Hat. 2011.
[13] Dino A, Dai Z. Apple iOS Security Evaluation:Vulnerability Analysis and Data Encryption. United States: Black Hat. 2011.
[14] Egele M, Keruegel C, Kirda E, et al. PiOS: Detecting Privacy Leaks in iOS Applications. United States: NDSS. 2011.
[15] Jonathan Z. iPhone Forensics. United States: O'Reilly. 2008: 144.
[16] Sean M. iOS Forensic Analysis. United States: Apress. 2010: 317.