Application and research in small current grounding system based on ARM

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ABSTRACT

The fault current in single-phase grounding is so small that it is very hard to detect, single-phase grounding protect problem have no very effectual solution as yet. According to fault line selection problem of small current grounding power system, the paper gives a new real-time monitoring and fault diagnosis device based on ARM S3C2440.It not only can really monitor system status, but also can measure some elementary power parameters, such as the three-phase voltages, current, power, frequency etc. Eventually, the design realize many function such as real time detection, fault phase selection, fault line selection, fault recording, device satisfies the practical requirement. Operation results show that this device computing speed quickly, strong anti-jamming capability, stable operation, is very application in the small current grounding.

Key words: Small current grounding power system, fault line selection, S3C2440, ARM

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INTRODUCTION

At present, Middle voltage distribution power systems in our country are almost ineffective grounded systems (NUGS), which include isolated neutral networks (NUS) and networks grounded with the neutral compensator coil (NES). The coefficient of single phase-to-ground fault is very high in NUGS, but the faulty current is so small, the signal is weak, three-phase voltages remain symmetrical, so load power does not produce bigger impact, the longest continuous operation does not exceed 2 h. When the fault occurs, Healthy phases is hoisted relative to the earth of voltage ,so long time running will cause serious influence to earth insulation, may cause short-circuit fault breakdown insulation. Therefore, fast locating the fault line for safe operation of the power is of great significance.

Previous line selection method is not strong due to the ability to adapt so as to the election line unit operation falls far short of the requirements of the site. General microprocessor system is far from competent to deal with such a large number of operations, and mutations in the signal duration is very short, in front of the data processing part to be completed in a short time, which made the pace of work on the processor for a high demand. At present, conventional microprocessor instruction cycle is longer, computing power is limited, so these rapid demands for conventional MPU system are difficult to achieve. So it is necessary to search for a new fast processing chip specifically for data processing to meet demand. As the hardware technology continues to evolve, fast ARM chip, the emergence of the implementation of complex algorithms to provide a hardware support. Based on ARM technology for a new type of fault detection hardware devices and software programming language carry out in-depth research and development [1].

THE MAIN PRINCIPLE AND CHARACTERISTICS OF DEVICE
The main principle of device

First, confirm that you have the correct template for your paper size. This template has been tailored for output on the US-letter paper size. If you are using A4-sized paper, please close this file and download the file for "MSW A4 format". Judging the malfunction is device of start-up: From the upon fault analysis, Whether isolated neutral

networks (NUS) or networks grounded with the neutral compensator coil(NES), zero sequence voltage will mutate and amplitude rise greatly. According to the characteristics of the fault, malfunction start-up process of the device cicely judge zero sequence voltage of variety, When the zero sequence voltage level exceed, set failure identification and start-up system fault record, at the same time, carry through the fault route computation.

Isolated neutral networks (NUS) route criterion: For the power system for ungrounded, According to the size of zero sequence current changes, Choose all lines of capacitive current which change the biggest 3 line as a selection object, then ground lines in bus bar zero sequence voltage as a benchmark, calculate the zero sequence reactive power Q, if Q>0, circuit happened grounding, If Q<0, line is not grounded.

Networks grounded with the neutral compensator coil (NES) route criterion: For networks grounded with the neutral compensator coil (NES), when one-phase ground fault occurs, inductive current compensates for the fault of the capacitive current. When the system is excessive compensated, capacitive current flows from the line to bus bar no longer, but from the bus lines to line like the other bus, so the fault line has not been judged from the zero sequence current variance. This device according to the zero sequence current wave on the size of the active components carry though if or not grounding, when the active power is bigger than setting value, the line is grounded, whereas the line is not grounded.

THE FUNCTIONS AND CHARACTERISTICS OF THE DEVICE
Conventional "four control function": The device is based on ARM device of floating-point calculations, in normal operation system; monitor the real-time voltage, current, active and reactive power, and power factor, so on basic electricity and frequency. In order to realize dispatching automation RTU remote measure, remote communication, remote control, adjustable functions. Filter the fault: After the fault occurs, record the dynamic process of the fault, protection device and other automation equipment of the actions, to analyze the reason of failure analysis, to reduce the probability of failure, to ensure the safe and reliable operation of the power the safely and reliably.

Fault diagnosis: Power system due to the different ways of neutral-point grounding, the fault feature will have greater difference. In the small current grounding system (not directly grounded system), due to the big zero sequence impedance equivalent, after the failure, the changes of zero current is small, so it is difficult to effectively solve the fault location. For low resistance grounding system, Due to the smaller zero sequence impedance equivalents, After the failure, the changes of zero current is large, so relay protection device or other automation equipment can work reliably, and ablate the fault line quickly to avoid rapid expansion of the accident. This device mainly studies the small current grounding system power of single-phase grounding route.

THE HARDWARE DESIGN OF THE DEVICE
The Hardware Structure of Device
The device uses plug-in type of hardware structure, structure diagram as follows shown in figure1. The signal of system is changed as low voltage signal by the high transformer, then transform to the ARM main board, ARM motherboard answers for the signal of collection and filter, and judges the system state. When the failure occurs, the information of fault is delivered by photoelectric isolated remote, and startup the printer to put a seal on the fault statement, and LCD display the fault line and voice alarm. When the device operates, crystal display information can be delivered to the control centre room by Ethernet. Operation parameters of the device can be modified and software maintenance by Modem distance, by the device on the keyboard on-site modification.
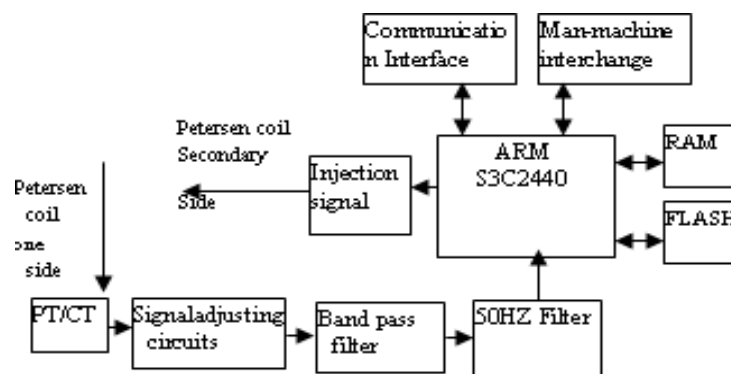

Fig. 1: The device structure

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THE DESIGN OF HARDWARE
Power real-time monitoring and fault diagnosis device of hardware is shown in figure 2, including the data processing units (ARM), Data acquisition unit (A/D converter), Man-machine interface unit (MMI module), Input/output switch quantity unit and upper monitor unit (industrial control) etc.
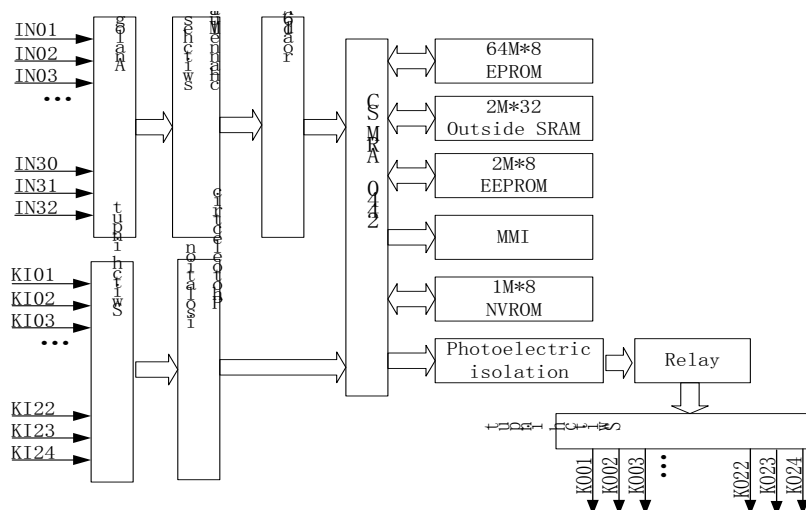

Fig.2: The structure of hardware

Data processing unit: Data processing unit adopts S3C2440, and the working frequency is 66MHz .This product is designed to provide hand-held devices and general applications with cost-effective, low-power, and high-performance microcontroller solution in small die size. To reduce total system cost, the S3C2440X includes the following components separate 16KB Instruction and 16KB Data Cache, , NAND Flash Boot Loader, System Manager (chip select logic and SDRAM Controller), Touch Screen Interface etc. The S3C2440X offers outstanding features with its CPU core, a 16/32-bit ARM920T RISC processor designed by Advanced RISC Machines, Ltd. Data acquisition unit: Data collecting unit in A/D chip adopts A 16-bit LTC1608 chip, the inside of chip contains sampling/ keep. Analog signal firstly passes the first-order RC filter and sample, and then passes the multi-channel analog switch and amp decay ratio, and then is transferred data cache, uses the interrupt mode in the A/D conversion end response to an interrupt, through setting channel selection registers successive to sample multi-channel analog quantity.Human-machine interface (MMI module) unit: The development of MMI unit is based on RCM2000 chip. RCM2000 which is produced by Rabbit semiconductor company is the eight microprocessors, The working frequency is 22.1 MHz [3], There are forty parallel the I/O port, 4 CMOS compatible serial port, 13 address channel, eight data channel, Within the chips with 256 K Flash and an SRAM 512 K, Built-in calendar|, clock, the watchdog, timer, multi-level interrupt, double the DMA channel. The function of MMI mainly includes LCD display, keyboard response and communication processing, the hardware composition as shown in figure 3.
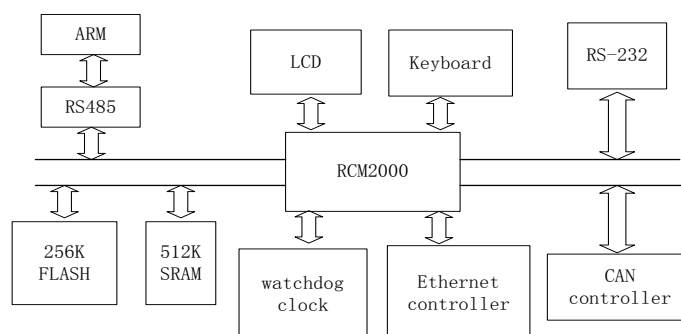

Fig.3: MMI hardware diagram

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THE DESIGN OF SOFTWARE
The design of system software contains three parts, Including ARM software, MMI software and upper monitor software. Each part of the software design relatively is independent of each other, data exchange between each other relays mainly on communications to complete.

The design of ARM software: The design of ARM software uses the C programming language. Among them, sampling interrupt service routine is used to clear watchdog timely, data acquisition, data analysis, calculation of voltage and current wave as well as fault start tape-recorded; Serial interrupt service routines can be used to receive the serial communications; The main programming is used to check oneself cycle, communication system, frequency calculation, PT disconnection judgment, digital filter, fault acquaintance 、 fault location calculation module, the event log so on processing tasks. The software uses modular structure programming, can according to customers' demand easily add or delete all sorts of functions.

The design of MMI software: Rabbit2000 microprocessor software design uses a Dynamic C language. Dynamic C is integrated C compiler, editor, the link editor, loader and debugger, contains many standard C library and the specific function board of peripheral drive and chip board peripherals equipment source code, Support a simple、 effective and easy-to-use Macro/OS - II real-time operating system and support Ethernet chip TCP/IP protocol stack. The man-machine exchange is embedded real-time operating system - II OS, so make LCD display, data communication, keyboard response function can be operated independently and safely.

The design of the upper monitor software: Upper monitor machine commonly used industrial control machine or commercial computer, so the design of upper monitor software is based on Windows XP operation platform, adopt the integrated development system of object-oriented, Visual Basic programming language, It is simple, efficient, easy to use, In object-oriented design, process visualization, event-driven, dynamic data driven and other advanced software technology, has the strong data access features and network function. The design of upper monitor software design mainly includes three parts: communication, the user interface, and database. Communication program mainly deals with the data exchange with MMI unit, when testing or debugging devices, the data exchange through RS232 communication, during normal operation, the monitoring center or distant data center through the Ethernet or RS232 and Modem dialing carry out the data communications. The master program flowchart is shown in figure 4.
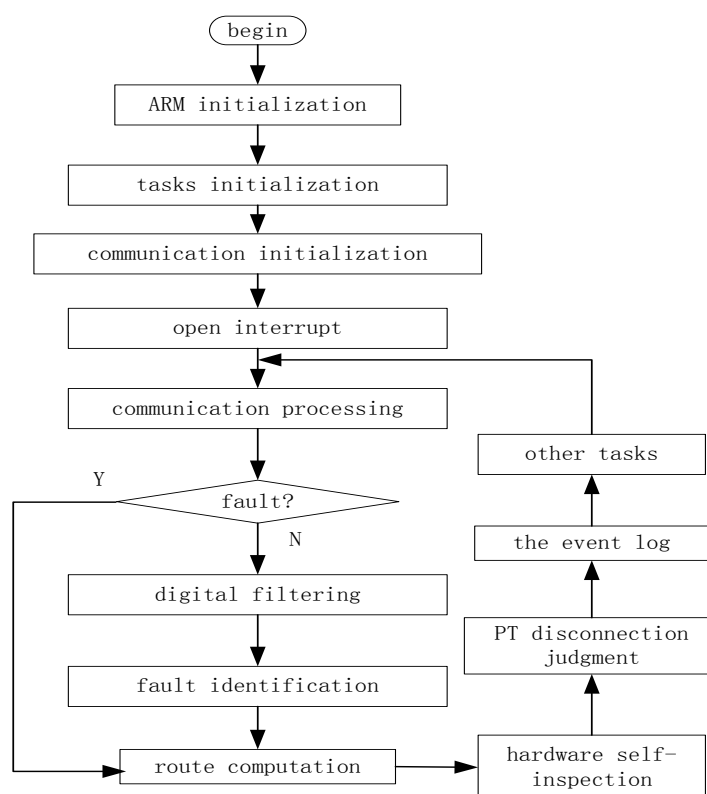

Fig.4: The master program flowchart

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CONCLUSION

At present, ARM has been widely used to relay protection, electric power quality, and electromagnetic measurement so on electric field. Based on the development of the Samsung company S3C2440 one-phase ground fault diagnosis device, a lot of simulation experiments and dynamic simulation experiment is carried, Experiments show that device in normal operation, can quickly and accurately measure the zero sequence current and voltage of system, and can quickly and effectively volt in the fault lines, and avoid the further development of fault to insure the power supply reliability of electric distribution network. In addition, this device can operate multiple concurrent, composite an independent small system, in order to meet different requirements of substation.

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