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Research on Fault Monitoring Method of Information System Based on Machine Learning

Jianchao Guan*, Jun Lu, Wei Wang
State Grid Anhui Electric Power Co., Ltd. Information and Telecommunication Branch, Hefei, China
*guanjc3016@ah.sgcc.com.cn

***Abstract*—A monitoring system based on machine learning has been established to achieve real-time early warning and positioning. By using MSP430F149 single chip microcomputer and FPGA, we form a communication cable fault detection system with high speed and variable collection rate. The combination of DTMF FM single-chip microcomputer MT8888 and MSM7512 single-chip microcomputer realizes remote alarm and data transmission. The process of program management and serial communication in Windows system is analyzed. The real-time communication corresponding to the serial port is realized by using low-level software design methods such as process injection and API hooking based on the serial port. Based on the network operation mode under the SNMP mode, the polling and reporting information under the network operation mode is analyzed. An alarm probability model based on SNMP mode is proposed. The actual test proves that this method is practicable, and provides a practicable method for the analysis of communication protocol mechanism and communication fault analysis.**

Keywords—Machine learning algorithm, communication information failure, fault monitoring, network monitoring

I. Introduction

Monitoring and control are the two most important jobs of network management. Network monitoring information is the most widely used, its role is to analyze the performance of the network and the network fault. On the one hand, network monitoring provides a method to ensure the normal operation of the network, and the traffic of monitoring information is overlapped with the normal network traffic, which brings greater pressure to the network. Especially in wireless AD hoc networks with limited bandwidth such as mobile AD hoc networks (MANET), how to reduce the sending load of monitoring data through reasonable monitoring schemes to ensure the normal operation of network services. There are many kinds of communication cable faults, and the most representative one is the line breaking fault. Therefore, it is necessary to monitor the fault of communication cable in real time. This paper studies an online monitoring method on a local telephone line, so that it can send an alarm quickly when the line is broken, and can detect the blocking points on the line more accurately [1].

II. Design of Communication Information Fault Monitoring System

A. System Architecture

The system consists of three modules: control module, mobile phone communication module and acquisition circuit. The control module takes STC89C51 as the core, assembler language as the control program of the system, and uses the interrupt system function of the single chip to monitor the level trigger signal sent by the sampling circuit in real time. The communication system of the mobile communication system is produced by Siemens, Germany, dual-frequency 900/1800 MHz highly integrated GSM communication system, with small size, low power consumption, easy integration, support data, SMS, voice and other functions [2]. It is the intermediate terminal for data interaction between mobile terminal and MCU. The sampling circuit connects the signal that is likely to have an error at a certain position of the transmitter to the interrupt end of the MCU in a high-level form through level transformation. When the transmitter has some error, the sampling circuit sends a signal from a high level to a low level to the interrupt end of the MCU. And the MCU is in an interrupt warning mode by the mode of level trigger. The architecture of the communication information Fault monitoring system is shown in Figure 1 (the image is quoted from Recent Advances in Fault Localization in Computer Networks).

Through the analysis of the network, it can be found that the whole network is divided into three levels: field layer, monitoring center layer and remote fault center layer. The system consists of communication server, database server, Web server, fault server and so on. The collected real-time monitoring information is transmitted to the monitoring system through the communication server. The database server is a platform for data access to analyze and report on data. The web server can browse the web information [3]. The monitoring center software can use the collection point of the monitoring center to obtain the operation data of the monitoring terminal and the monitoring center, and judge whether the monitoring system is abnormal and whether there is a potential fault based on these operation data. If something unusual happens, the expert system is triggered.

In the field layer, that is, the remote monitoring terminal station, it mainly includes communication, fault information data collection, data processing and so on [4]. The remote diagnosis center is composed of diagnosis server, data analysis server and Web server. The Internet is used to connect to the monitoring center level of the client. Get data from a monitoring center level server. Trend comparison and historical process playback are analyzed. In this system, decision makers can view real-time curve, historical curve, report, alarm and other information on IE. According to this information, the operation of the monitoring terminal is analyzed and judged in detail.

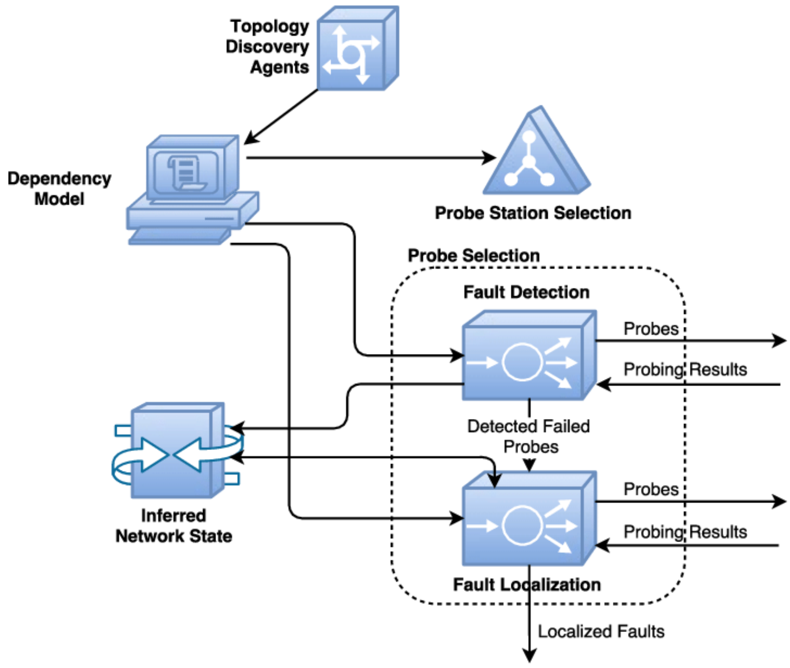

Fig. 1. Architecture of communication information fault monitoring system

B. System Software Architecture

The system has three layers of B/S architecture, namely, customer layer, business logic layer and data layer (Figure 2 is quoted in FMS: A computer network fault management system based on the OSI standards). As a human-computer interaction interface, the client is responsible for interacting with the user and presenting it to the user through a friendly interface [5]. The Web browser simplifies the user's various applications, making it a normal browser like Internet Explorer, Firefox, Safari. The browser converts the HTML code into a page with certain interactive functions, which allows the user to input the information in the application form provided by the page to the Web server at the second layer, and then put forward the processing request. An object-oriented business logic structure is proposed. Its role is to implement various application policies and package various application programs. The business object uses EJB to complete the data processing logic, and analyzes the background data of the system, including the user information data, the graphic configuration information data and the on-site real-time data information. This information is converted into the corresponding Java object and then fed back to the client. The data layer is the lowest of the three layers and is used to define, maintain, access, update data, and process and process various data requirements.

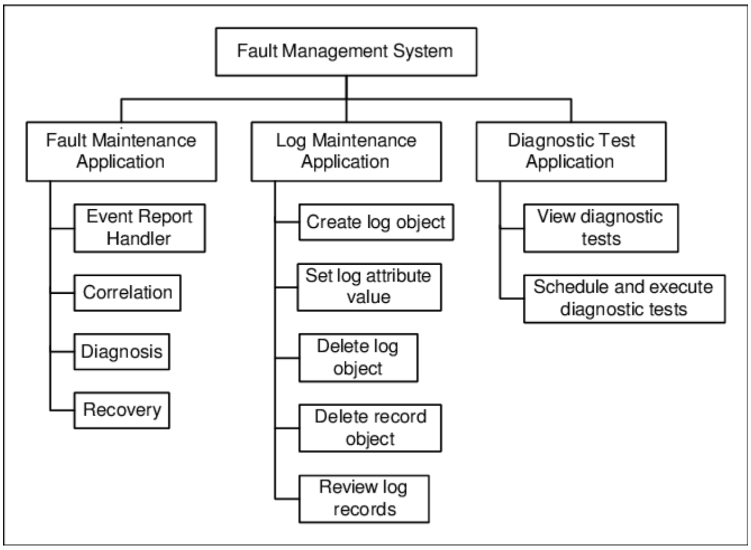

Fig. 2. B/S structure of monitoring center software

C. System hardware design

1) Selection of microprocessor

The MSP430 is a 16-bit microprocessor, and its power consumption is already in the milliampere order, so we chose the MSP430F149. The software uses a 16-bit CPU, uses RISC commands and is equipped with 16 quick response interrupts to deal with all kinds of emergencies in real time [6]. The system has built-in 64 K flash read-only memory and provides JTAG interface for software debugging and download. 2 sets of 16-bit timers, with the ability to capture/compare, can handle event counting, timing, PWM and many other situations. So, using MSP430 series MCU for long-distance transmission is a good choice.

2) Implementation of monitoring function

The power supply voltage of the communication line is generally -48 V or -60 V, and when a fault occurs, it can be determined whether a fault occurs according to whether the power supply voltage exists. During the operation of the system, the MCU always keeps in the inspection state.

3) Line disconnection fault detection circuit

When the detection loop detects a broken cable, the detected cable is connected to the detection loop, and the location of the breakpoint is detected by the pulse reflection detection loop. Figure 3 shows A block diagram of A probe device that has a high-speed A/D chip for generating a probe pulse, a high-speed A/D chip for detecting the pulse, and an asynchronous FIFO for buffering A/D sampled data. With MAX125 as the core chip and FPGA as the core, the asynchronous FIFO, clock control and pulse generation modules are designed.

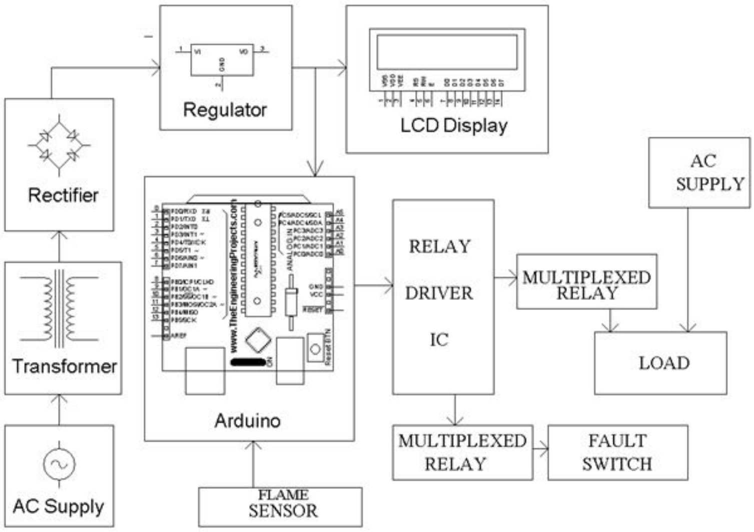

Fig. 3. Block diagram of line break fault detection circuit

4) Call Lines

The MT8888 is connected to a microprocessor to control how it sends, receives and operates. This paper introduces a communication mode based on MT8888 and MCU, and gives the realization method of the communication mode [7]. Its receiving components use single-ended inputs, including R201, R202, and C201, with an input voltage gain of R201/R202=1. The control component comprises R203 and C203. In addition, because the IRQ end is an open output, it is necessary to use a pull-up resistor R204 connected to the P3.5 pin of the MCU to monitor and calculate the number of square waves of signal tones in the telephone loop, and C203 is a decoupling capacitor. DTMFIN and DTMFOUT are connected to the interface of a phone. Figure 4 shows the MT8888C dial-up circuit (image cited in Detector Suara DTMF Dengan IC MT8888).

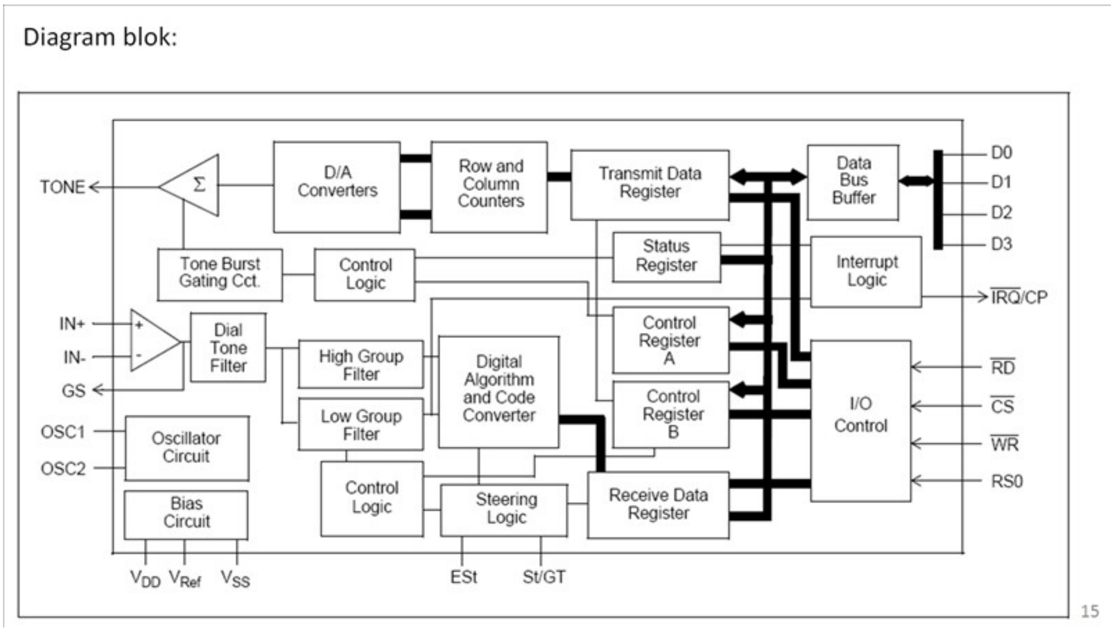

Fig. 4. MT8888C dial circuit

5) Communication interface circuit

The output communication of FSK signal is realized by MSM7512 single chip computer. MSM7512 is a low cost, low power consumption and excellent performance modem developed by Japan OKI company. A half-duplex modem based on FSK is proposed, which has 1200 bps communication speed, low power consumption, good stability and application prospect. The MSM7512B features a TTL level and is able to easily connect to most MCUS. The DTMF single chip transmitting and receiving device MT8888C is connected with the device, which makes it a kind of remote communication module with strong flexibility.

After the breakpoint fault of a cable is detected, the MODEM is set to FSK transmitting mode by the lower computer using MOD1 and MOD2, the control port of the relay is set, and the MODEM is combined with the public telephone network number, and then the MODEM connected to the remote PC is called by MT8888C. After receiving a ring, the remote MODEM will enter a "handshake" state, and the lower machine will detect the CD pin of the MSM7512B and determine whether there is a carrier.

III. SYSTEM ALGORITHM DESIGN

In the network management system, the time set of the network status sampling is $T_c = \{t \mid t = t_i, i = 1, \cdots, j\}$, and the time set of the CH polling agent is $T_p (T_p \subseteq T_c)$. A CH obtains the status of n managed objects in its cluster subnet at the same time at polling time. $X_t = \{x_{1,t}, x_{2,t}, \cdots, x_{i,t}, \cdots, x_{n,t}\}, x_{i,t}$ indicates the status value of managed object i at time t. f_t is defined as an alarm function, which is related to the state X_t of the managed object at time t. To simplify the discussion, a weighting factor $c_{i,t} = 1, f_t = \sum_{i=1}^{n} (c_{i,t} \bullet x_{i,t})$ is set, for example, to represent the relationship between the traffic emitted by each node in the subnet and the traffic emitted by the entire subnet.

On the CH side, the manager can perform regular polling for A fixed period, which starts as soon as it receives an exception notification from agent A. There are two triggering mechanisms for event notification. One is that agent A sends event notification to CH when the status value $x_{i,t}$ of the managed object at time t exceeds the corresponding threshold specified in the MIB. The other is to send event notification to CH when the state value change $(x_{i,t} - x_{i,t-1})$ of the managed object at time t exceeds a certain threshold [8].

In the algorithm combining polling and event notification, after receiving a trap from the agent, CH immediately triggers the CH to poll all monitored objects in the whole subnet, obtains the $f_t = \{x_{1,t}, x_{2,t}, \cdots, x_{n,t}\}$ value at time t through polling, and determines whether to send an alarm message based on the alarm function f_t. The alarm condition is to determine whether the alarm function exceeds the alarm threshold. Set the alarm function $f_t = \sum_{i=1}^{n} x_{i,t}$ to have an alarm threshold of T. When $f_t \geq T, CH$ reports the alarm message to the management personnel or the upper-level management. If $f_t < T$, the managed objects of the cluster subnet are normal.

Set t as the last polling time, if at time $t'(t < t' < t_m)$, the change quantity of a managed object Δ_i exceeds the threshold. The formula for determining t_m is $t_m = t + \left\lfloor \left(T - \sum_{i=1}^{n} x_{i,t} \right) \backslash \sum_{i=1}^{n} \delta_i \right\rfloor$. In this paper, a new network status monitoring polling strategy is proposed, which uses the status value of the managed object obtained at the last polling time at CH and the updated status value of a managed object sent by this trap to determine the next polling interval [9].

Let t be the last polling time to obtain $x_{i,t}$, and let $t_m = t + \left\lfloor \left(T - \sum_{i=1}^{n} x_{i,t} \right) \backslash \sum_{i=1}^{n} \delta_i \right\rfloor$, if CH does not receive an event notification during time period $[t, t_m]$, wait until polling begins at time t_m, which is the same treatment as in literature. If during time period $[t, t_m]$, such as time $t'(t < t' < t_m)$,CH receives a trap containing the status value $x_{i,t'}$ of a managed object J, then the value of $T - \sum_{i=1}^{n} x_{i,t} - (x_{j,t'} - x_{j,t}) - (t' - t) \bullet \sum_{i=1, i \neq j}^{n} \delta_i$ is calculated. If $T - \sum_{i=1}^{n} x_{i,t} - (x_{j,t'} - x_{j,t}) - (t' - t) \bullet \sum_{i=1, i \neq j}^{n} \delta_i > 0$, the deferred polling time is $t' + m'$, where $m' = \left(1 \backslash \sum_{i=1}^{n} \delta_i \right) \bullet \{T - [x_{j,t'} + \sum_{i=1, i \neq j}^{n} [x_{i,t} + (t' - t) \bullet \delta_i]\}$;

When CH receives an event notification, it also receives A status update value $x_{j,t'}$ in the trap Then, on the basis of the status values of other managed objects obtained in the latest polling, according to the worst case of these state changes, increase their state changes to the maximum upper limit to determine whether an alarm is possible. As long as there is a possibility of an alarm, all states are immediately polled. If there is no possibility of an alarm, wait for a time to poll again in this way Ensure that the number of polling times is reduced without missing information. The following is to prove the correctness of the algorithm, that is, to prove whether the algorithm can meet the above purposes.

IV. SYSTEM INSPECTION

Collect data on the real Internet, collect the data throughput between 64 bytes and 1518 bytes, collect once in

10 seconds, use 24 hours of service as the simulation data source, and conduct simulation based on the collected data from 10 distribution points. Figure 5 is a comparison of our proposed approach with the published article (image cited). The status change of the monitored object in the MIB database is Delta. Take the method used in the Delta-Delivery model as the vertical axis. Using our method for network polling monitoring under the same data source can reduce resource consumption. It can effectively reduce the management cost of the system and improve the operation efficiency of the system.

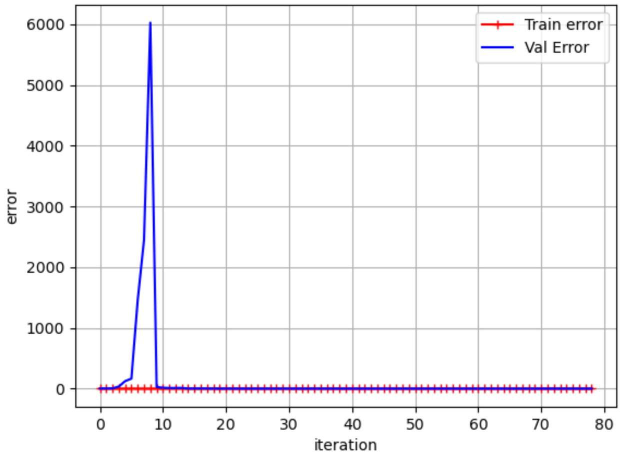

Fig. 5. The algorithm's improvement to polling in this paper

V. Conclusion

This paper uses some basic software development methods, such as process injection and API hooks based on serial interfaces. The synchronization of data acquisition and monitoring is realized in the daily operation of the device. It will not interfere with the internal communication process between the relevant intelligent device and the superior monitoring platform, so that the monitored data is reliable and accurate. Compared with the traditional way of obtaining serial information by adding extra hardware, the design of this paper is more convenient and faster. This method is of great significance for analyzing the mechanism of serial communication protocol, analyzing the communication fault and improving the communication quality.

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