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THE MODEL AND METHOD OF SCADA DIAGNOSTICS AS AN OBJECT WITH PARTIALLY DEFINED PARAMETERS

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Problem statement. Modern SCADA are widely spread all over the world to control technological processes in different industries such as power engineering, military, transport, etc. These systems have strict requirements to ensure their fault tolerance and reliability. Therefore, a very important problem is to perform real time self-diagnostics for mission critical SCADA. We propose a diagnostic model based on expert system methodology to solve this issue.

Analysis of publications on the topic research. We examined and analyzed the documentation on the most popular SCADA such as WinCC (Siemens, Germany) and RealFlex (BJ Software Systems, USA) which allows us to make the conclusion that SCADA operability can be maintained by using "hot" backup of backbone nodes in case of failures. SCADA software generates information flows which include different diagnostic codes. Companies need to keep highly qualified employees (process engineers, IT specialists, system administrators) who can work with such diagnostic codes. However, a great deal of diagnostic information causes processing issues for engineers of Enterprise Maintenance Services. Consequently, it is very important to develop an automatic "expert" by using the expert system methodology.

The aim of the paper is to consider the model for mission critical SCADA diagnostics using the expert system methodology and diagnostic method for detection and localization of system failures.

Main part. Consider the model of failure diagnostics in SCADA. Suppose we have a set of process control points, system diagnostic codes and types of SCADA failures. Our task is determining the dependencies between input data (Diagnostic Codes) and output data (types of SCADA failures) [1]. We can apply an expert system to determine the dependencies between system diagnostic codes and types of SCADA failures. The main components of the expert system are database, knowledge base and inference machine. The knowledge base accumulates data about all the processes in the system. SCADA generates diagnostic codes for a certain period of time Δt which come to the input of the expert system. The expert system uses its database, knowledge base and inference machine to derive a diagnosis and recommendations on recovery/self-recovery (in case of reversible failures) of the system.

Consider the diagnostic method for failure detection and localization in SCADA as an individual solution for determining system failures as part of the proposed model. These system failures can be caused by processes which are responsible for automatic data acquisition. The method is based on gathering the data from information flows which run through SCADA structural elements and hierarchy levels [2].

The set of controllable parameters is measured by smart sensors and is registered in specialized controllers (Remote Terminal Units) and then it is transmitted to the server. The controllable parameters can have one of three states at each hierarchy level: “Valid,” “Invalid,” “Absent.”

The states of controllable parameters can be described by using three-valued logic. We can generate a diagnostic matrix of controllable parameter validity based on the data which the system provides. The analysis of the diagnostic matrix allows us to detect and localize system failures.

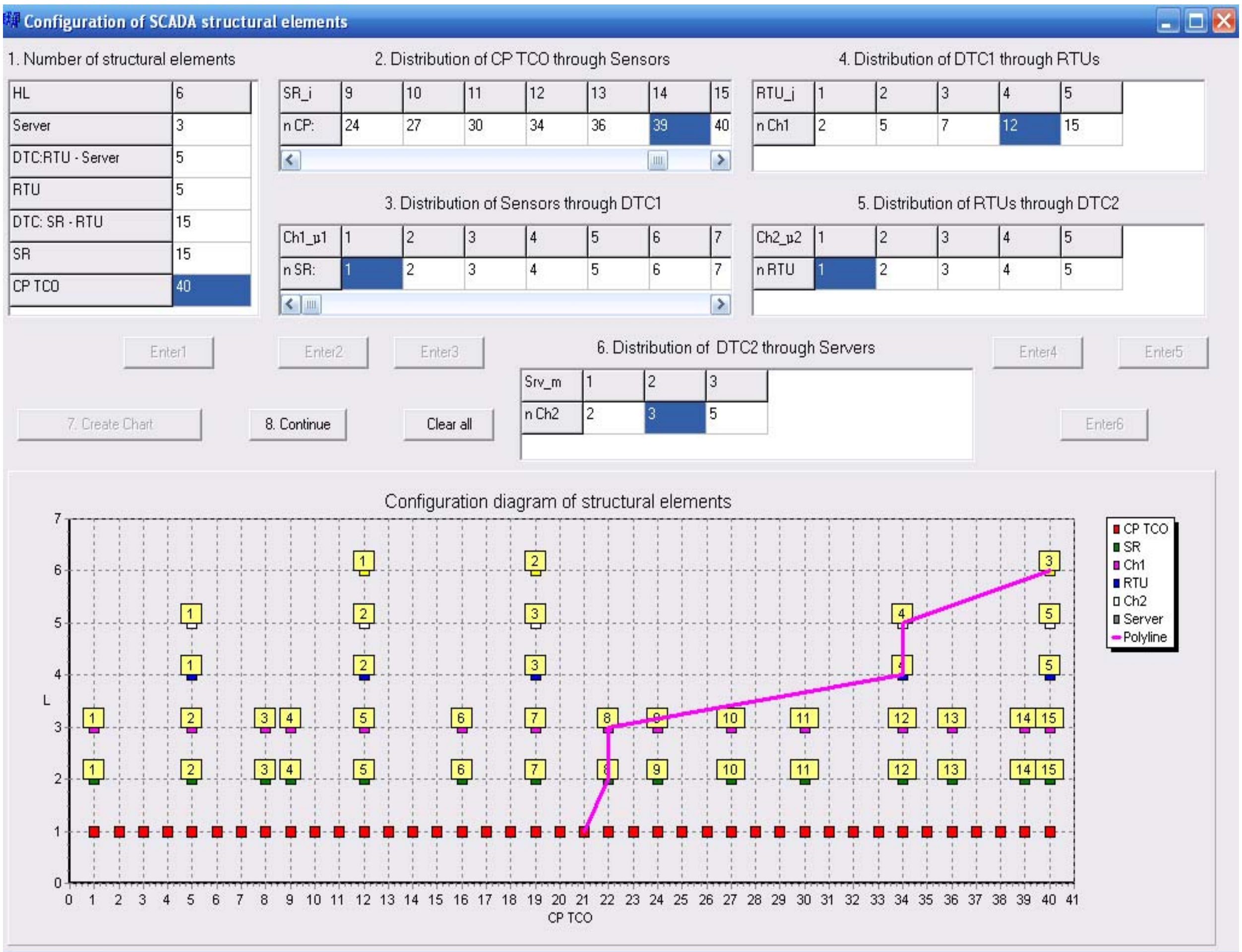

Figure 1. DgnMethod software interface

The method of automatic self-diagnostics in real time is based on monitoring the changes of controllable parameters when information flows run through SCADA structural elements and hierarchy levels. We also set patterns of failure detection/localization and form specific criteria and analytical dependencies to distinguish independent and secondary failures.

A specialized toolkit named “DgnMethod” (see Fig.1) was developed to conduct experimental research of the proposed method. A user can configure the structure of the system (e.g. number of servers, number of transmission channels, etc.). According to the input data, the toolkit forms the configuration diagram of structural elements (see Fig.1). Ordinal numbers of SCADA controllable parameters are shown on the abscissa axis. SCADA hierarchy levels are shown on the ordinate axis. Each square on the graph points to the ordinal number of the structural element in accordance with its hierarchy level. Left clicking with your mouse on the point of the graph displays the path of the controllable parameter you chose from the lower to the upper level.

DgnMethod uses the configuration information we entered in order to form and analyze the diagnostic matrix (see Fig.2). We used the random number generator to create the diagnostic matrix. The value function of failure detection in SCADA is presented in the analysis log.

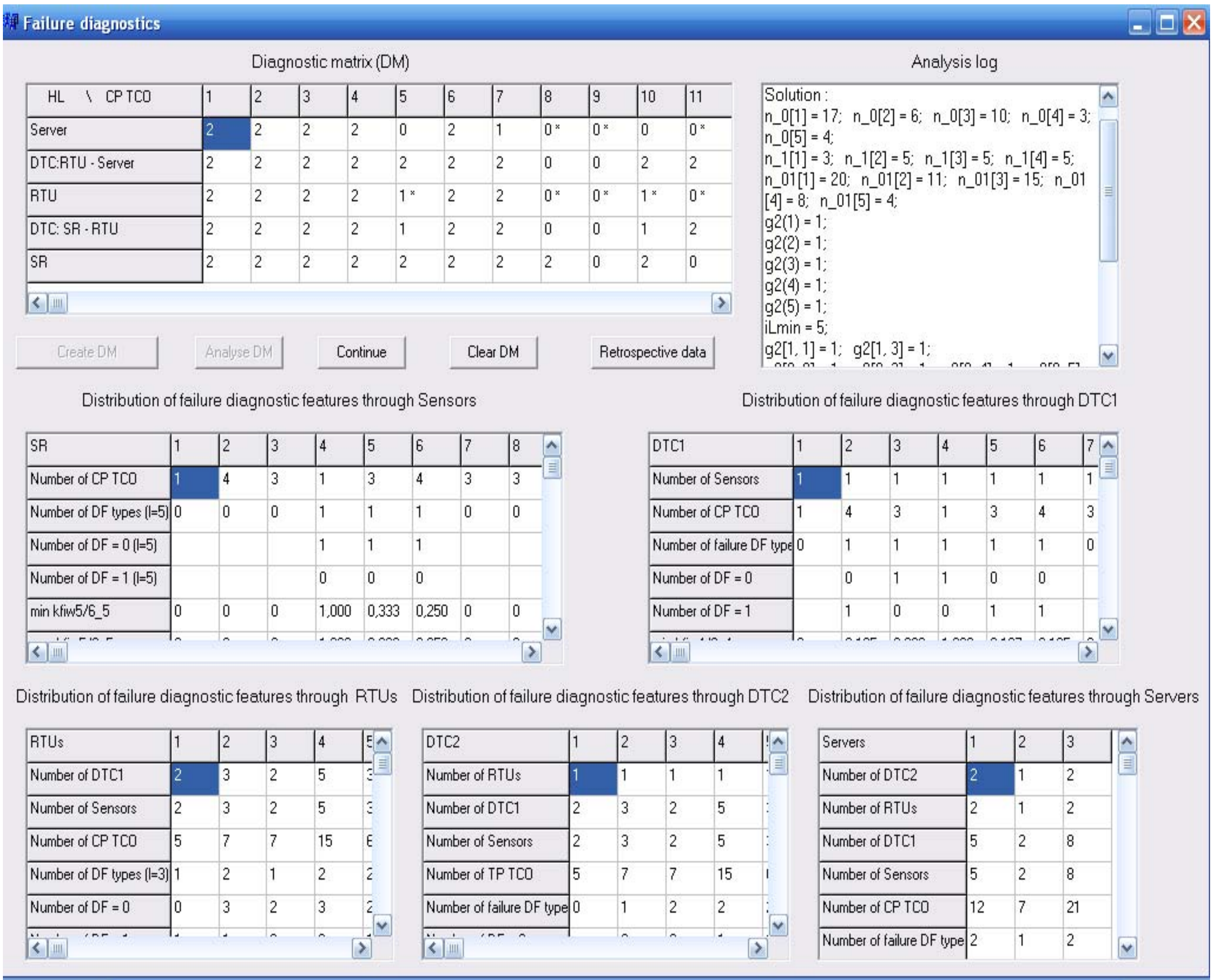

Figure 2. Results of diagnostic matrix analysis

Conclusions. The approach we suggested provides the efficiency of intellectual operations. It performs self-diagnostics of SCADA in real time and also reduces the time for system recovery. It is possible to apply this approach for any SCADA of any topology.

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