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Application Software for the Cabinet Operator Module of the Reactor Protection System

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1. Introduction

A reactor protection system (RPS) plays the roles of generating the reactor trip signal and the engineered safety features (ESF) actuation signal when the monitored plant processes reach predefined limits. A Korean project group, so-called KNICS (Korean Nuclear I&C System), is developing a new digitalized RPS and the Cabinet Operator Module (COM) of the RPS which is used for the RPS integrity testing and monitoring by equipment operators. A flat panel display (FPD) with a touch screen capability is provided as a main user interface for the RPS. This paper shows the application software developed for the COM FPD. Equipment operators can monitor the status of the RPS and carry out various tests to verify system functions by means of the application software. A qualified hardware and software development environment are used to develop the application software.

2. Implementation Environment

2.1 Cabinet Operator Module

The figure 1 shows the COM (Cabinet Operator Module) for the KNICS RPS.

Figure 1. Cabinet Operator Module

The COM satisfies the Class 1E grade requirements and consists of the followings;

- Power Supply 1 & 2
- Processor Module
- ICN Module 1& 2 : Profibus FMS Electric Driver
- Ethernet Module 1 & 2
- CompactPCI Bus
- CD-ROM
- Serial port
- Rack
- Pointing Device & Keyboard
- Hardware Control Switches

2.2 Programming Environment

- QNX4.25 Operating System

The QNX is a kind of real time operating system and recently stands a spotlight for embedded operating system with uITron, Linux. The QNX4.25 has been qualified the safety for using in reactor system and has advantage in adaptation and upgrading partly since possessing micro kernel architecture property rather than integrity architecture [1, 2]

- PhAB (Photon Application Builder)

The QNX provides graphic user interface called Photon micro GUI. The Photon micro GUI version 1.14 is graphical user interface (GUI) environment of the QNX 4.25. In addition, the Photon Application Builder (PhAB) for the programming on the photon graphic environment is provided, which includes several widgets similar with controls in Visual C++ with callback function [3, 4, 5]. PhAB is a graphical integrated development environment (IDE).

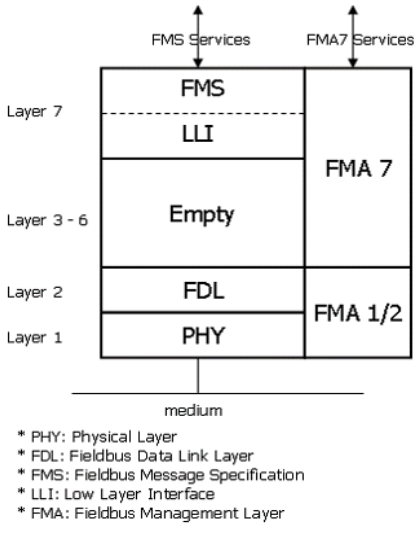

Figure 2. Profibus-FMS protocol architecture

- Profibus-FMS Protocol

The Profibus-FMS protocol is used for communicating with other processor modules such as ATIP(Automatic Test and Interface Processor), BP(Bistable Processor), and CP(Coincidence Processor).

The Profibus belongs to a fieldbus category and is used for transferring messages between industrial devices such as PLC, CNC, RC, sensors, actuators, and so on. The Profibus-FMS satisfies the real time constraints and follows the protocol architecture depicted in figure 2 [6].

As shown in figure 2, the protocol architecture has 4 layers for data transmission (FMS) and 2 layers for network management (FMA). CIF50-PB and CIF80-PB Profibus-FMS network cards are used for implementing the COM.

3. Application Software

The application software mainly consists of two parts: the GUI program and the file database. The GUI program is interfaced with the file DB through the database_API and the file DB is interfaced with the Profibus driver through the profibus_API.

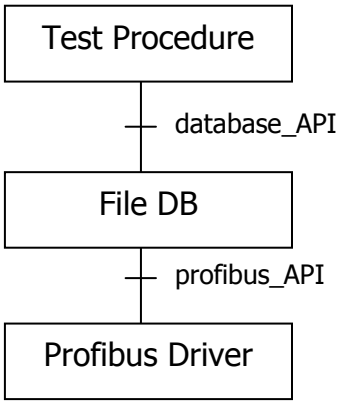

Figure 3. Elements of Monitoring Program

3.1 GUI program

The GUI program is used by equipment operators to check the status of the RPS and to perform four function tests: Manual Test, Manual Initiated Automatic Test, Automatic Periodic Test, and Integrity Surveillance & Diagnosis. Actually the GUI program shows information on System Parameters, Bypass Parameter, Process Parameter Setpoints, Initiation Circuit Status, System Alarm & Event, and Test Data & Test Results.

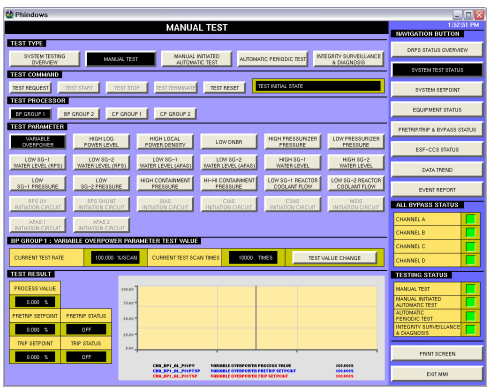

Figure 4. Snapshot of the GUI program

3.2 File Database

The file database manages and stores the whole transit signals from/to the COM. It receives signals from other modules in specified frequency and stores current status/alarm information of the COM and other modules. Because of hardware constraints and simplicity of the COM, we adopt a file database instead of traditional DBMS.

4. Software Test

In order to verify the application software, we prepared one QNX machine (COM), one Window machine and a notebook for capturing packets on the cable as shown in figure 5.

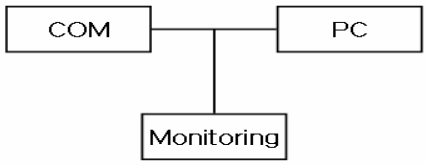

Figure 5. Software Testing Environment

The PROFIcard2 v.1.00-softing AG is used as the capturing device.

5. Conclusion

In this paper, we show the application software for the COM of the KNICS RPS. The software was developed on the basis of qualified software development environment such as QNX 4.25 and Profibus-FMS protocol. Currently the application software passed basic module tests. To confirm the interfacing functions with ATIPs and other systems, integrated test and system test were planned and carried out soon.

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