The prototype of SCADA application in the school building

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Abstract. The complexity of electrical installation in a building will depend on the function or operation of the building in question. On the other hand, power supply is very important to support the building operation. However, it is very often difficult to locate which point in the power distribution system that experience electrical fault. This study attempts to solve such problem by designing a prototype of monitoring and controlling system of power distribution in school buildings. To this end, we use Arduino-based system and Wonderware InTouch for the user interface. This study resulted in a power monitoring system consisting of voltage sensor and electric relay connected to Arduino ATMEGA 2560. The system can be configured, monitored and controlled through a computer software.

1. Introduction

In an electrical distribution system, electrical equipment is often installed at a distant location far enough from the center of control, so a system that can carry out a remote supervision and control is needed. The system must be able to perform data acquisition, data analysis, and electrical supervision and control. However, it is very often that the system is restricted by low quality of electric power so that the electrical equipment cannot operate normally, and this in turn leads to poor performance of electrical equipment [1].

An electrical distribution system is expected to be able to maintain the continuity of reliable, economical, effective, and efficient electricity supply [2,3]. This paper describes a design of Supervisory Control and Data Acquisition (SCADA) system in an electrical distribution network that can be used by the operator to supervise, control, configure, record the system performance in real time, and remotely solve permanent or temporary fault from the control center.

2. Method

The designing of the prototype follows the following procedures:

2.1. Equipment preparation

We identify some hardware and software required to implement the prototype of SCADA system in a school building. The required hardware are as follows:

- An Arduino Mega 2560 to be used as remote terminal unit (RTU).
- Two units of SRD-05VDC-SL-C single 8 micro relay module to be used as the actuator.
- Six LC Technology’s ACS712-5 current sensors to be used as the electric current measuring instrument.
Two ZMPT101B voltage sensors to be used as the voltage measuring instrument.

One Kraus & Naimer’s 3-position selector switch CA10 to be used as the changeover switch.

Two Schneider Electric’s miniature circuit breakers C60H, C2A, 240/415 VAC to be used as safety voltage sensor for the overcurrent in the module circuit.

One Schneider Electric’s miniature circuit breakers C60H, C2A, 240/415 VAC to be used as safety control unit for the circuit overcurrent

Two ABB’s miniaturized switch breakers S282 UC, K16A, 440 VAC to be used as the miniature of generator sets and distribution transformers.

The required software are as follows:

- Arduino IDE 1.6.13 to be used for making programs in the Arduino ATmega 2560 microcontroller.
- Arduino OPC Server 1.9 to store data SCADA program.
- Wonderware InTouch 10.0 including Wonderware FGateway DA Server and ArchestrA System Management Console for SCADA human machine interface (HMI).

2.2. SCADA system prototyping

The designing of SCADA miniature for electrical distribution system in this study is divided into two main parts:

- Interconnected hardware as illustrated in Figure 2.
- The designing of software including main programming and subroutine program embedded into the Arduino ATmega 2560 microcontroller to monitor the equipment status, acquire data from current sensors and voltage sensors, and subroutine program for circuit breaker control. Communication between microcontroller and main terminal unit (MTU) is facilitated by Arduino OPC and Wonderware InTouch 10.0 [4].

![Figure 1. SCADA prototype block diagram.](image-url)
3. Results
The SCADA prototype to monitor electric equipment in school buildings has been successfully designed as shown in Figure 3. All switch indicators (on-off) has been tested and met the requirements. Indicators of voltage and current values have also been tested and verified with standard devices.

![Figure 2. Results of main distribution system test.](image1)

Real time condition of electric equipment can also be monitored online as illustrated in Figures 3 and 4.

![Figure 3. Results of real time monitoring system test.](image2)
The operator can see the history of system failures and take initial action to overcome the problems. Building management policy makers can also check the fulfillment of power requirements in campus buildings by reading data records from the system.

![Figure 4](image_url)

**Figure 4.** Results of alarm monitoring system test.

Changes in system configuration for both addition and subtraction of devices and connection in the system, can be accessed through the available menu. The menu display is not displayed in this paper. The limitation is only a licensing problem, in the research of student licenses used

4. Conclusion
The whole system works as expected. Digital input and output function correctly and accurately. In general, the results of test show that analog and digital parameter values, both those produced by sensors and read by microcontrollers or displayed in the Human Machine Interface (HMI), have been aligned. The prototype needs approximately 400 mWatt to start from the standby system and 5.620 watt in the full load system, during full operation.

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