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REALIZATION OF A BUILDING AUTOMATION SYSTEM USING PLC AND SCADA

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ABSTRACT: Building automation systems are inevitable in every building in order to make life easier, decrease work load, and create safer and higher quality environments. Today's automation technology generally makes use of computer enhanced automation. PLC and SCADA Systems are the most commonly preferred systems. With the developments in technology, various equipment and procedures are found to be in use in this field. In the present study, a system has been implemented in order to monitor and remotely control the parameters of a building automation system and to gather data. The system is a PLC and SCADA based system. The proposed system was applied in Tekirdağ Namık Kemal University Vocational School of Technical Sciences Control and Automation Technology laboratory.

Keywords: Building Automation, PLC, SCADA.

1. INTRODUCTION

Building automation systems are used for several reasons including the safety of residents and physical assets in the building, air quality and comfort, quality and sustainability of energy transmission [1-2].

Expectations of individuals from building automation systems can vary. While the expectations of comfort are high for those who live or work in the building, concepts such as the ability of control and productivity would be among the top expectations of those who manage the building [3]. A building automation system is expected to meet this kind of expectations [4]. New generation building automation systems are designed according to both the residents and building managers' expectations.

Building automation systems can be carried out by classic remote systems of PLC based automation systems. PLC-based automation systems are frequently preferred in building automation designs due to its high security levels, easy set-up, being less affected by bad environment conditions, taking a small space, ability to monitor data received from field workers, and easy tracking.

SCADA is used to monitor and control processes real-time. This control can be automated or manual. Information received from the sensors in the field are evaluated by PLC [5]. The results

are, then, sent to components connected to the PLC output. This process can be monitored through SCADA software's and controlled remotely.

PLC and SCADA systems should have the desired components in building automation systems. PLCs and SCADA systems include a central station, field station, communication system, and PLC and SCADA software's. The central station controls the system and stores the data. Building automation components can be controlled via the software installed in this central station. Field station audits the data obtained by field components through PLC systems and sends the data to the central station. Communication system provides communication between the central station and others. Software controls all the data and stores the data for the central station.

A literature search was conducted and resulted in finding systems built by using PLC and SCADA. The commonality of these studies is that buildings and industrial environments equipped with sensors are controlled and monitored through PLC and SCADA [6]. In building automation systems, PLC and SCADA-based applications such as control and monitoring of heating-cooling systems [5], sustaining energy transmission system and productivity [7], safety precautions against physical attacks [8] and pressure control were found. There are also control studies that used PLC and SCADA in industrial environments [9-10].

In this study, a multi-purpose automation system, called "Model System," was designed by using PLC and SCADA. This system was applied in the Control and Automation Laboratory in the Vocational School of Technical Sciences at Tekirdağ Namık Kemal University. SCADA software was used to control the Model System real-time, and to obtain, evaluate, and command data continuously.

2. MATERIAL AND METHOD

The designed model system for a building automation by using PLC and SCADA is presented in figure 1. The system consists of two components that are, hardware and software.



Figure 1. Overview of the study.

The hardware of the Model System is a Wago 750-852 model PLC, PT 100 type heat sensors, DWYER RHP-3W44-LCD heat and humidity sensor, and differential-pressure sensor.

The PLC and SCADA softwares developed for real-time process monitoring and remote control of the system, operation of the Model System through PLC according to the developed algorithm, are monitored through the main computer connected to the system. To program the Wago 750-852 PLC which is used in the Model System, Codesys (Controller Development System) 2.3 editor was used.

Codesys, developed by the company named 3smart, is a programming editor with an open source coding. It is the common PLC software development editor for companies producing PLC such as Wago, ABB, Schneider, Beckhoff, and Mitsubishi. As it supports several PLC programming language, has access to many training materials, being an open source software and other benefits abovementioned contributed in choosing it for this thesis.

The PLC software in the Model System consists of heating-cooling automation (HVAC) software, dampening automation software, alarm system automation software, and main software controlling this sub software's. The PLC software operating the heating and cooling control is shown in figure 2, the PLC software for humidity control is shown in figure 3, and the alarm PLC is shown in Figure 4.

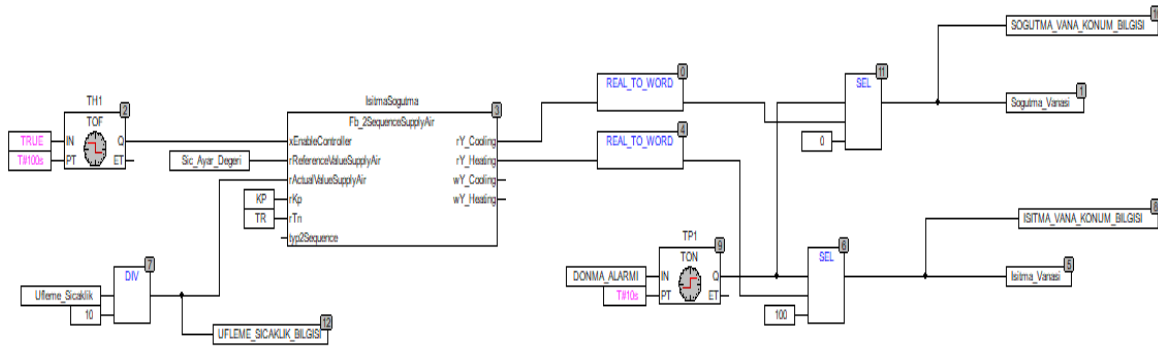


Figure 2. PLC subprogram for heating and cooling control

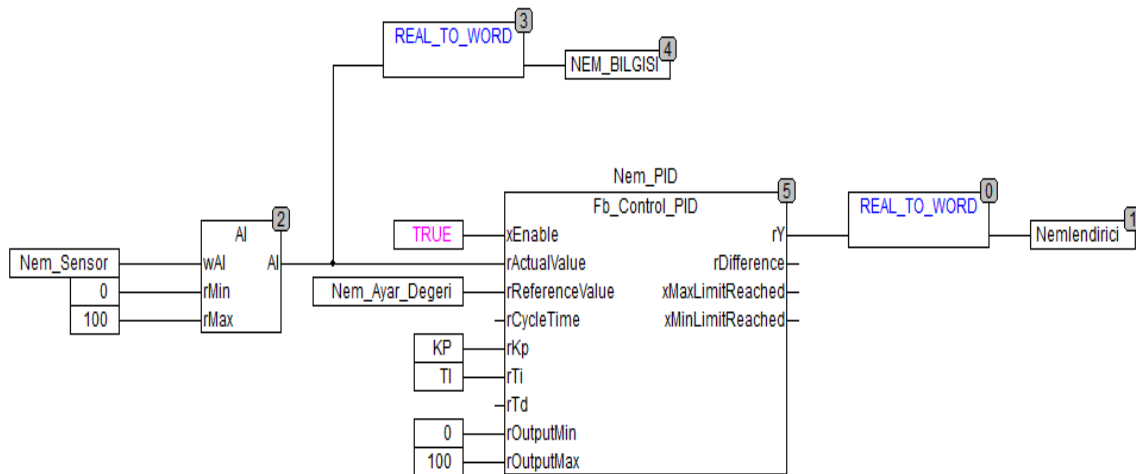


Figure 3. PLC subprogram created to measure moisture information and set humidity level to desired value

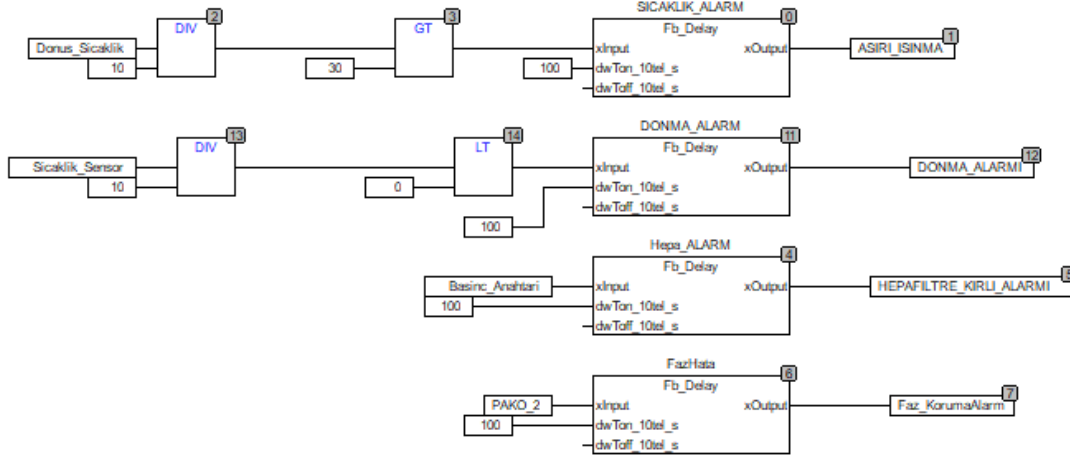


Figure 4. PLC subprogram created for overheating, freezing condition, hepa filter pollution information, phase failure

A SCADA software was developed to control the developed model system real-time, to collect, evaluate, and command data continuously and real-time. This software was developed by using Visu + Scada editor.

In the software developed with Visu + Scada editor, first the points used in the model system as seen in Figure 5 were created according to the Modbus protocol.

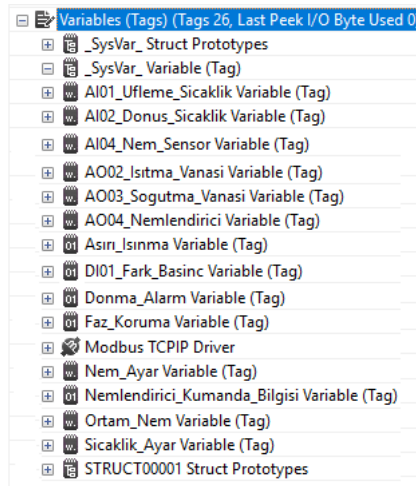


Figure 5. ModBus SCADA points

The SCADA software of the Model System consists of 3 pages. In Figure 6, the introduction page, in figure 7, the HVAC page in which heating and cooling functions are performed, and in figure 8, the alarm page is presented.

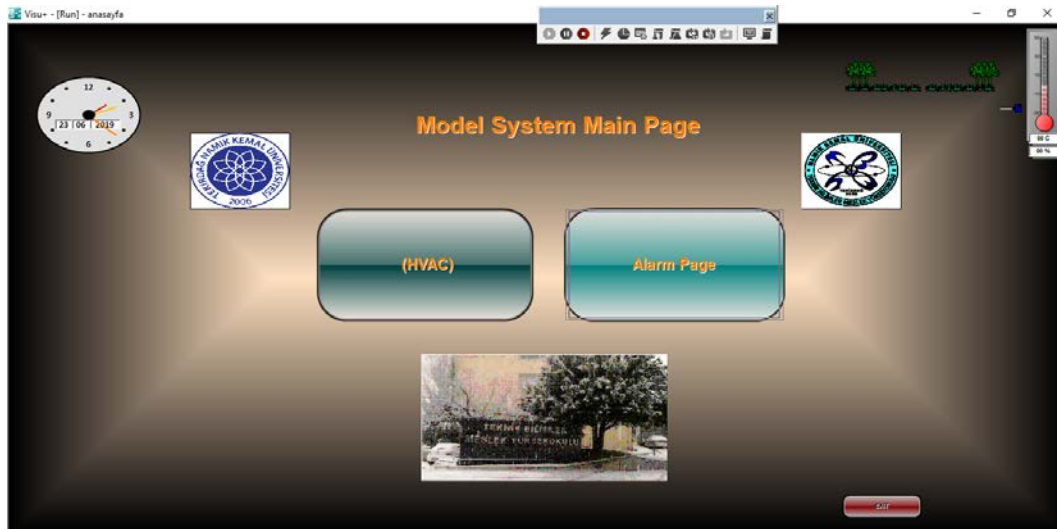


Figure 6. SCADA page

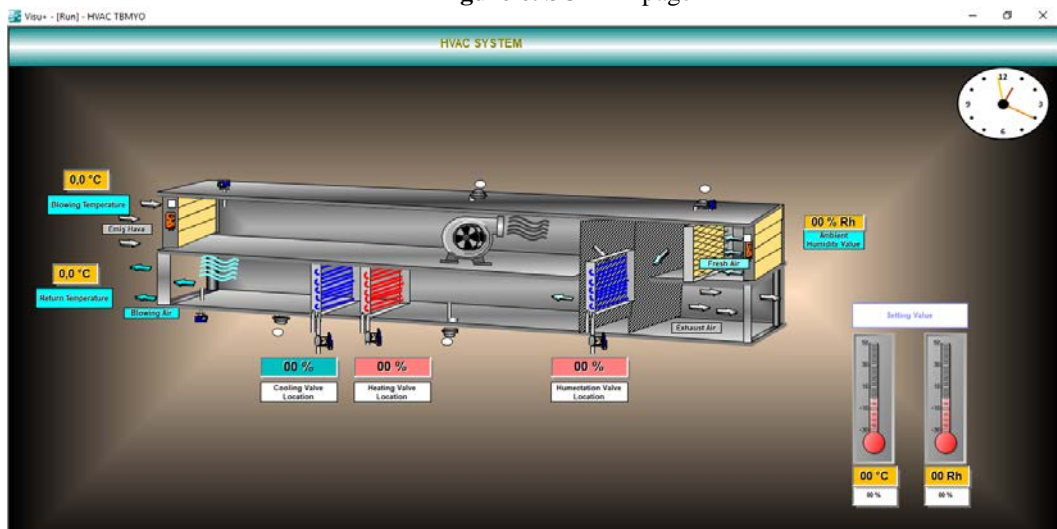


Figure 7. HVAC



Figure 8. Alarm Page

3. FINDINGS

Building automation refers to monitoring-commanding, and controlling systems such as lighting, elevator, fire, alarm, and security, in a system. Taking precautions against pre-determined emergency scenarios, energy saving, increasing life quality, providing air quality and comfort, and increasing security level to the highest are the fundamental goals of building automation systems. Research in the literature show that as there is a need for multiple points in big building, PLC systems are preferred. For the control of these systems and management by the user, certain visual applications are needed. Therefore, SCADA systems were developed.

Within the scope of this study, a system called the “Model System” was designed. This system was applied in the Control and Automation Laboratory in the Vocational School of Technical Sciences at Tekirdağ Namık Kemal University.

The hardware of the system consists of PLC and input and output elements connected to PLC that are humidity sensor, heat sensor, differential-pressure key and relays.

The software of the Model System consists of two components; PLC software and SCADA software. CodeSys editor was used for the Wago 750-852 PLC software used in the Model System. The reasons for preference of this editor include being open-source coded, supporting multiple PLC programming language, and having access to many training materials. The model system consists of heating-cooling automation software, humidity automation software, and the main software controlling this sub software's.

4. RESULTS AND RECOMMENDATIONS

In this study, a building automation system, called the Model System, that allows real-time monitoring and controlling of data by using PLC and SCADA was used. The Model System provides controlling and monitoring of functions such as heating cooling, dampening, and alarm system. The significance of the study is that the control structures are provided together. With PLC and SCADA programs, the system has a feature of remote monitoring and control.

As the Model System was designed in a module at structure, it is easy to add sub-systems and to increase the number of points. Thus, the planned additions in future studies are listed below:

- By adding a camera to the system that has a virtual laboratory characteristic due to its web interface to provide real-time visual control,
- To provide communication with other electronic devices,
- Adding a fire alarm system,
- Controlling and monitoring security camera system remotely,
- Adding graphics to SCADA software's,
- Creating an infrastructure for energy transmission and auditing system.

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