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SCADA SYSTEM FOR NEXT-GENERATION SMART FACTORY ENVIRONMENTS

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ABSTRACT

Today, in factories, production is spread into a wide area and became complicated. Complicated production requires a better monitoring and control system to improve efficiency. For this purpose, SCADA systems are used. SCADA systems allow industries to monitor, control and access to real-time data and data logging. Nowadays, all large-scale industries have SCADA systems. The cost of the SCADA system makes it unreachable for small and medium-size industries but a SCADA system that is designed by using C# programming language would be cheaper and could perform the same. In this study, a SCADA system has been developed to monitor and control the smart model factory system in AFSUAM. SCADA interface is created by using C# programming language and the communication between PLC and the SCADA is set by using Mitsubishi MX Component tool. With the developed SCADA system, the process of a product entering the factory as raw material, going through several processes and becoming a product from the supply chain to the distributor has been modeled on a sample marble factory model, and a graphical user interface has been created considering the purposes such as real-time monitoring, controlling, data logging and preventing errors in the context of this model.

Keywords: Control systems, SCADA, PLC, Data, Industry, Remote control, C#.Net

1. INTRODUCTION

Production lines in the industry have become complicated with the developing technologies. Complicated production lines required sophisticated control and monitoring of the process. Supervisory Control and Data Acquisition (SCADA) is an integration of software and hardware components facilitating supervision and control of industrial or any processes easily and more conveniently reducing manpower and improving production efficiency (Aghenta, 2019; Mackay and Park , 2003; McDonald, 1993). Even though SCADA systems have benefits for industries, such as increased reliability, reduced cost, improved worker safety, and efficiency, they are not cheap enough for small and medium industries. A SCADA system involves data logging, process handling, and supervisory control which helps industries in production. However, the installation cost of this system makes it unreachable for small and medium scale industries (Phuyal et al. 2020).

In this paper it is aimed to design a SCADA system for smart factories. Therefore, a Human Machine Interface (HMI) software with Graphical User Interface (GUI) representing subcomponents to enable computerized controlling and monitoring of different parts in factories is developed. SCADA system is designed by using C#.net to reduce the cost of system.

2. MATERIALS AND METHOD

A SCADA system provides a higher level of system control than that provided by the normal programmable controllers and is particularly suitable for “big picture” monitoring and control of large systems like electricity generation, transmission, and distribution networks. SCADA enables data to be gathered from and supervisory control to be performed for a large-scale industrial process from one or more centralized location(s) rather than having large numbers of individual operators (Anh and Chau, 2010). SCADA system allows industries to transmit reports, alarms, and general information to personnel. For instance, maintenance staff can be alerted if a process is taking more or less than it should take. SCADA system improves operating efficiencies by automating some controls and gives access to remote control of a system, allows preventative maintenance actions to reduce the possible and speeding diagnosis.

Mitsubishi Fx5U-32M PLC is used as the controller of the smart factory located in İzmir Katip Celebi University Smart Factory Systems Applications Center. The factory models a marble factory.

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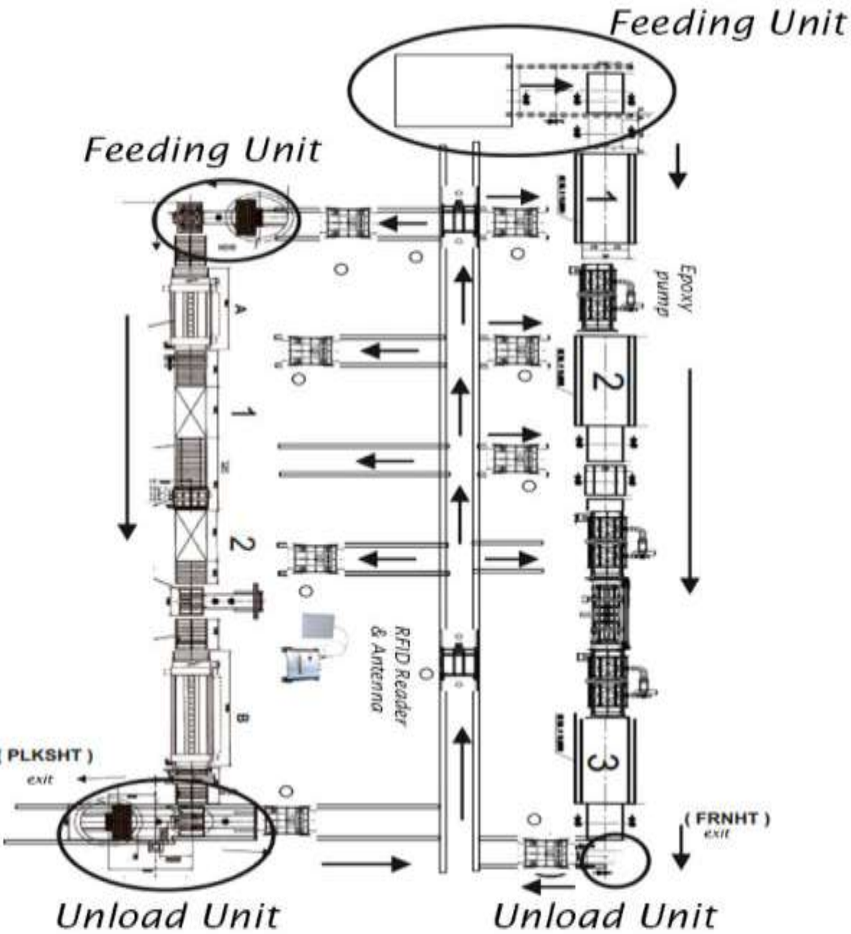

Figure 1. Model of Smart Factory

HMI component contains the real-time animation of the production process, alert system for possible errors, data logging and remote controls of the process. The SCADA interface is created by using C#.net. Serial communication protocol is established with the Mitsubishi PLC by using Mitsubishi MX Component. Mitsubishi MX Component is a tool that allows user to communicate with Mitsubishi PLCs.

The production process at the feeding unit, a vacuum lifter lifts the marble block and places it to the tray on the conveyor belt to be processed. The belt moves and the marble block goes to first heat process. Since there are a few types of marble to be processed, first the marble block is identified by a camera. According to the marble type, temperature of the heat process is adjusted. After the heat process is done the marble block goes through an epoxy application unit. Then the marble again heated to the desired value and finally lifted by a robot arm and placed on the storage area. From the storage area marbles are transferred to the quality control. Every marble block is checked with a gloss sensor and if the product passes the quality control, it goes to unload unit. The process keeps cycling.

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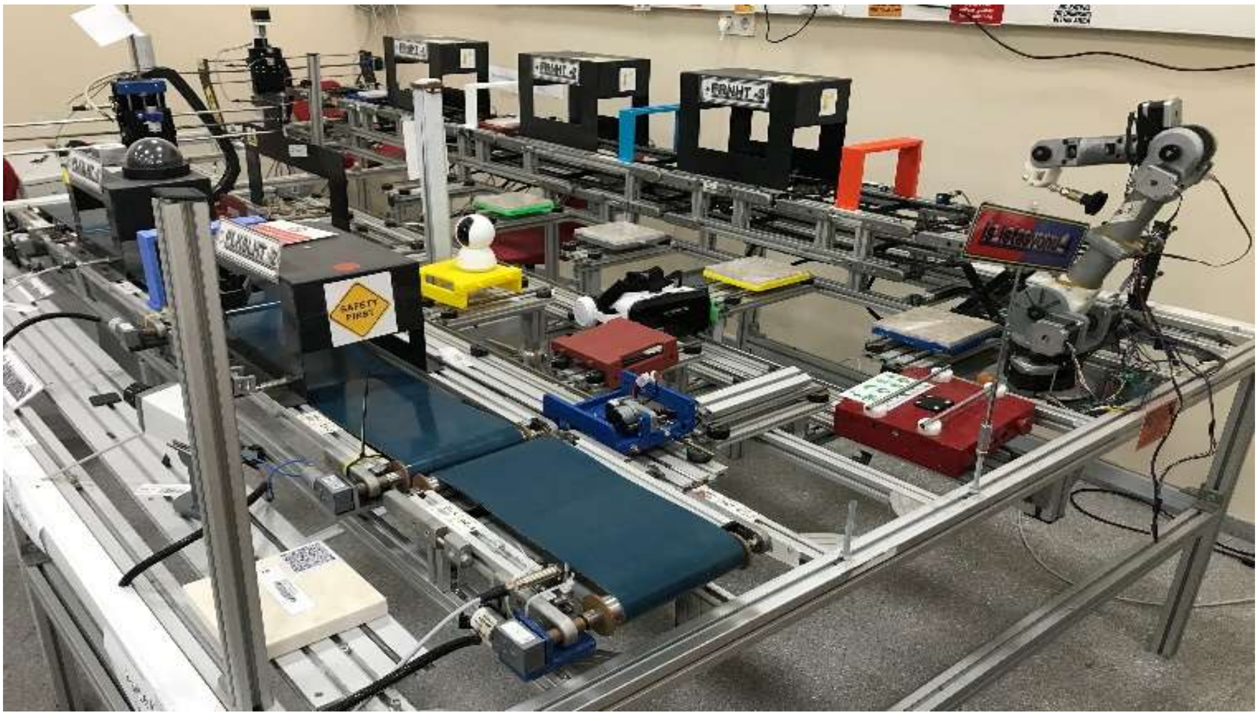

Figure 2. Smart Factory Model (AFSUAM)

Animation of the conveyor belts and heat process is shown on the SCADA interface.

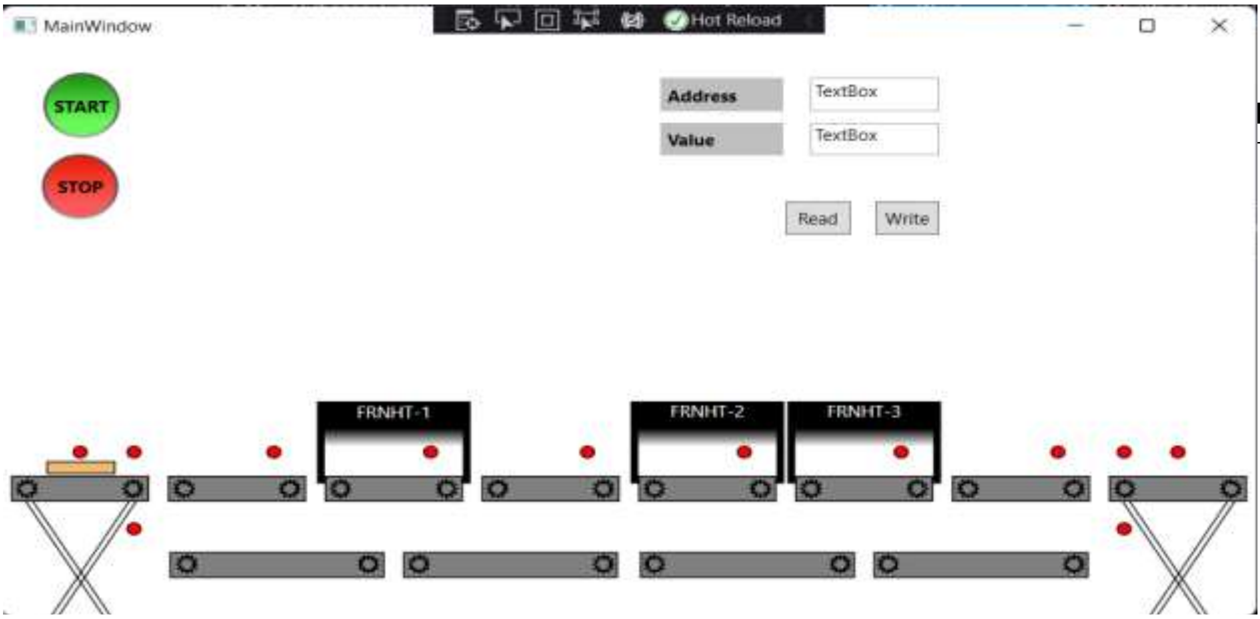

Figure 3. SCADA interface

Every conveyor belt has a sensor attached to it and the sensors are activated when the marble block is arrived on the conveyor belt. The SCADA system measures the time between conveyor belts. The measured time values are stored in a database and used for detecting deviations and if there is a deviation more than it should be, the system gives a warning to the operator for possible errors.

3. RESULTS

The SCADA system that is designed in this paper shows improvements in production efficiencies in ways such as possible breakdown detection, advanced monitoring of the factory, remote control, and data logging. The SCADA interface s created with using C# via Visual Studio and Mitsubishi MX Component. These are publicly

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available, and this makes the system cheaper than the competitors and allows medium and small sized industries to increase their production efficiency.

The system will be improved by adding more features. Temperature values of the heat process will be collected and again stored in the database for graphical presentation of previous values and current temperature value of the oven. Fully remote control of the system via SCADA interface and automated controls of the motors in the system in case of error.

4. DISCUSSION

This paper shows the potential to increase the efficiency of the production by integrating SCADA systems to industries. The SCADA system in this paper is designed for marble factories. However, this system is easily customizable for other industries.

5. CONCLUSION

In this paper it is aimed to improve the production efficiency of a next generation smart factory by designing a low-cost SCADA system. System that is designed allows user to monitor the factory in real-time and control at any time. The system is designed to warn in case of a possible error by collecting real-time data and checking constantly for deviations in the collected data. The collected data is also presented in a graph for better monitoring. These benefits of the SCADA system make it crucial for industries.

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