SCADA Control System Through Servomotor with PLC Monitored by Software Application on Automatic Rolling Door

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Abstract: Automation is a basic technology in the digital era especially in industrial revolution 4.0 so as a human is a shared responsibility between the workers and engineers who are specifically authorized to maintain the stability of the technology. For example, a rolling door in an industrial warehouse is a way to make the distribution possible from inside to outside the room or vice versa. But the implementation of the industrial warehouse rolling door is still operated manually. So this study aims to create a control system for the industrial warehouse rolling door like a Supervisory Control and Data Acquisition (SCADA) and it's controlled automatically through Servomotor with Programmable Logic Controller (PLC) and also to monitor the system to inform certain conditions by using a software application. The purpose making of the automatic rolling door for industrial warehouses with monitor software application itself is to construct everything from the loading distribution to the shipment automatically without doing it manually and also at the same moment can be monitored every time.

1 INTRODUCTION

The increasing need for automation in every life aspect has made a lot of industry to develop many automatic standards and implementations. The engineer and the workers have a challenge so that it meets the technical requirements as regulated by each of the tools and component manual. The vehicle should be considered first if it fits the regulation to pass the rolling door and made it through the room for loading. The automatic rolling door opens when the door controller receives an activation signal from the sensor and activates the gear motor to drive the belt and pulley. When no one is detected inside the activation area, the door starts closing after a designated period of time. An automatic rolling door operator is a set of driving devices and controllers that opens/closes the door. It includes components such as a gear motor and door controller. The power to the door operator can be turned on/off easily during the maintenance of the door. Activation sensors are used to activate the door's openings and closings by sending a signal to the door operator. The software application is connected to every component of the automatic rolling door so it can be controlled through Human Machine Interface (HMI) and monitored in a device such as a personal computer or laptop. The challenges of the applied systems using this technology have already been reported in some early research. And some techniques used have been considered useful candidates for the vehicle-to-infrastructure context. Our paper proposed the implementation of a basic rolling door controller as a fixed infrastructure automated by common distribution and transition vehicles used such as pick-up trucks or cargo trucks.

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2 MANUSCRIPT PREPARATION

2.1 Literature Review

2.1.1 SCADA

SCADA (supervisory control and data acquisition) is a category of software applications for controlling industrial processes, which is the gathering of data in real-time from remote locations in order to control equipment and conditions. SCADA provides organizations with the tools needed to make and deploy data-driven decisions regarding their industrial processes (Peter Loshin, 2021).

2.1.2 Servomotor

A servo motor is an electromechanical device that produces torque and velocity based on the supplied current and voltage. A servo motor works as part of a closed loop system providing torque and velocity as commanded by a servo controller utilizing a feedback device to close the loop. The feedback device supplies information such as current, velocity, or position to the servo controller, which adjusts the motor action depending on the commanded parameters (Kollmorgen Experts, 2020).

2.1.3 Authors

A Programmable Logic Controller is a small industrial computer originally designed to perform the logic functions executed by electrical hardware (relays, switches, and mechanical timer/counters), as defined by The U.S. Department of Commerce National Institute of Standards & Technology (NIST). PLCs have evolved to control complex processes and are used in supervisory control and data acquisition (SCADA) systems and Distributed Control Systems (DCS). PLCs are used in almost all industrial processes. PLCs have user-programmable memory for storing instructions for specific functions, including I/O control, logic, timing, counting, three mode (PID) control, communication, arithmetic, and data and file processing. Unlike SCADA and DCS, PLCs usually do not have a central control server and HMI and, therefore, they “primarily provide closed-loop control without direct human involvement.”. This kind of automation allows engineers with a limited knowledge of computers and computing languages to operate the systems easily, as PLCs are generally considered intuitive (Cristina Tuser, 2022).

2.2 Research Method

In the process of making a prototype, it is necessary to design and flow to be able to know the development and progress of the prototype as follows

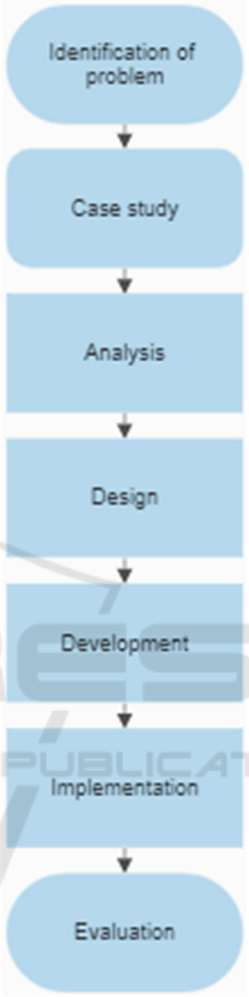

Figure 1: Flowchart.

2.2.1 Identification of Problems

To start the method, first we should know the industry need how the efficiency must be and how practically could be of the use of rolling doors automatically. Measure the width of the sensor placement and also where the control panel should be placed. And then configure the placement of the wiring how to connect the control panel to the object.

2.2.2 Case Study

Based on the majority of user requests, this case requires various actuator sensors and control systems

to run automatic rolling door systems such as load cells, relays, mini-circuit breakers, motor drivers, power supply, PLC, and HMI.

2.2.3 Analysis

The step requires designing a series of automatic rolling door control systems, system design, design a set of supporting tools, control panel design, and diagram wiring. Also, there is an analysis of non-functional requirements. Hardware: Personal computer (PC/Laptop), communication cable, control panel. Software: EasyBuilder Pro application for HMI designing and connecting HMI to the program, PANATERM application for monitoring the Servomotor, FPWIN GR application for the PLC programming, and AutoCAD application for various designing (Sutrisno, 2019).

2.2.4 Design

A hardware design from control panel.

Figure 2: Control panel wiring.

The control panel contains a 24VDC power supply, 6A mini-circuit breaker, Panasonic PLC FP0R, PLC CPU, and terminals. The mini-circuit breaker to turns on the power source. The Power supply supplies the DC current to the PLC. Terminals to connect various wiring.

Picture of one of the HMI design windows.

The HMI is designed to make it easier to control and monitor the object. There are many various windows included in the HMI display like parameter window, monitor window, input window, and many others.

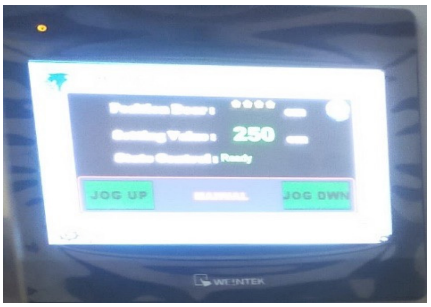

Figure 3: HMI Display.

2.2.5 Development

Hardware and software development as follows: Determine which components to use, designing wiring, make ladder program on PLC FP0R, creating HMI display for operator convenience, trial run of the entire automatic rolling door system such as checking servomotor, PLC, and also HMI.

2.2.6 Implementation

At this stage, testing of the tool and a trial run of the servomotor through the PANATERM application is carried out by running for several hours to ensure that the servomotor is safe. Checking the program if it connected with sensor & actuator. If all the requirement is ready and safe, the simulation can be started. The vehicle will drive through the near edge of the door. And if the sensor detected, the servomotor will work which means the rolling door is open (Sutrisno, 2014).

2.2.7 Evaluation

This evaluation stage where the author sees the success rate of the simulation after passing the trial and will be used to develop the next automatic rolling door process.

2.3 Program Logic Ladder

The following figure shows the program used to program the PLC FP0R.

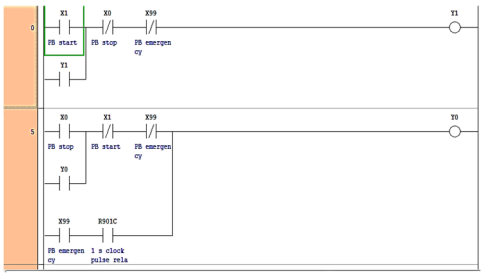

Figure 4: Command button rung network.

The created program is centered on a pushbutton from start button, stop button, emergency button, and reset button.

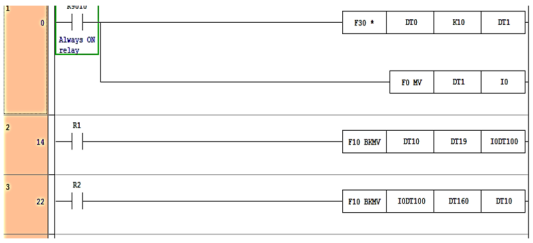

Figure 5: Indexing data rung network.

In the indexing data program, the use is for saving and loading data when the simulation is working including the day, time, and date. The data can be also removed or reset to make new data. The data will be displayed on HMI itself.

2.4 Alarm Display List

Alarm display list can be viewed in PANATERM application. The alarm list contains various past machine error from the servomotor so we can monitor and know the problem what causes the error. This is the alarm list from the recent simulation.

Model name: MDDLN45SG011

Print Date: July 27, 2022 13:44:27

Serial No: 18050079

Table 1: Now Error.

Protect Function	Error CD
Encoder communication disconnect error protection	21.0

Table 2: Now Warning.

Protect Function	Error CD
Encoder communication warning	A4

When the simulation start and the device/laptop is connected to the control panel via a communication cable, we can open the PANATERM application to monitor and look at the alarm list history from the past to the present. The monitor displays from the now error, now warning, and past error history. With the alarm list, we can see why and how the simulation work or maybe there is an error so we can find the problem from the list and find the solution to make it work again like running a jog in a trial run.

Table 3: Past Error History.

Hist.	Protect Function	Error CD	Power Of Time[h]
1	Encoder communication disconnect error protection	21.0	12926
2	Over-load protection	16.0	12926
3	Encoder communication disconnect error protection	21.0	12926
4	Encoder communication disconnect error protection	21.0	12926
5	Over-load protection	16.0	12926
6	Over-load protection	16.0	12926
7	Overload protection	16.0	12926
8	Over-load protection	16.0	12926
9	Over-load protection	16.0	12926
10	Over-load protection	16.0	12926
11	Over-load protection	16.0	12926
12	Encoder communication disconnect error protection	21.0	12926
13	Over-load protection	16.0	12926
14	Overload protection	16.0	12926

3 CONCLUSIONS

With the simulation that has been cleared and how the system work, the level of security and effectiveness in an industrial warehouse can be further increased and allows the industrial product distribution to become fastly automatic and also can be reliable. Because this system can facilitate the warehouse worker and distribution transition allowed it to be more practical in these day technology and has very minimum of failure and work accidents. Meanwhile, when using this system, the message can be maintained until the situation is under control and all of the workers are ensured. This system could be implemented to Society 5.0. Where all working activities can be improved effectiveness and efficiency with the control system more precisely and quickly than before.

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