DESIGN AND MONITORING AUTOMATIZATION OF EXHAUST FAN THROUGH SMARTPHONE AT PT SEMEN TONASA

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ABSTRACT

Pfister coal feeder is an important piece of equipment in the development of the cement industry at PT Semen Tonasa, which if damage occurs will cause production to stop and result in losses. The pfister control panel is easily damaged at temperatures above 40oC. Because of that, an air conditioner was installed, the dusty factory conditions caused an AC error and delayed repairs resulting in a trip pfister coal feeder. To anticipate all of this, it is necessary to monitor factory temperature, so an exhaust fan is installed which can circulate clean air and remove dirty air. In addition to maintaining the temperature of the control panel so that it does not increase. PLC Allen Bradley helps to monitor temperature, which can be accessed via a smartphone so that temperature monitoring can be done anywhere. The research method used in this study is mixed research, which combines qualitative and quantitative research, in which the research design is based on assumptions as well as research. The results of this study are to use the Microsoft Windows 2000 operating system and RS link to produce images and exhaust fan automation to prevent coal feeder trip pfister due to high temperatures is to monitor via a smartphone to monitor the function of existing tools.

Keywords: *Automation, Exhaust Fan, Trip Pfister Coal Feeder*

1. INTRODUCTION

Pfister coal feeder is equipment that has a very vital role in every cement industry (Beguedou et al., 2023). This is because the coal feeder pfister is a tool used to weigh and control the fuel material that will be fed into the kiln burner so as to make perfect combustion and produce the best quality clinker material. The vital role of this tool is that there should not be a control failure that causes a trip on the coal feeder pfister and will stop the production process and cause losses.

Based on the results of monitoring and alarm indications on the pfister coal feeder, the cause of the pfister fault control can be seen from the history of the Pfister Variable Speed Drive and the dominant cause is the high temperature alarm indication (Guttikunda et al., 2023). The equipment on the pfister control panel is easily damaged at room temperature with temperatures above 40ºC so the pfister manufacturer installs a safety temperature and when it reaches the specified temperature a fault will occur (Agiantoro & Prasetyo, 2018). When a fault occurs, the pfister control will turn itself off so that all pfister activities will stop. This

happens to secure the vital parts of the pfister from damage due to high temperatures. To overcome this problem, an air conditioner is installed in the Pfister control panel room.

This is the background to the emergence of the idea of installing an exhaust fan to maintain the temperature of the control panel so that it does not rise. Exhaust fan or exhaust fan is a fan that has a function to suck air in the room which will then be discharged to the outside (Bivolarova et al., 2016). This tool helps in regulating indoor air circulation in both homes and industries (Turang, 2015). In the exhaust fan industry mounted on the roof of the production site. Often exhaust fans are used in special rooms for smokers where the air is polluted with cigarette smoke (Purwanto et al., 2019). The exhaust fan here will function to draw out air inside the control panel and enter new air from outside the panel. Air circulation can keep the temperature inside the panel from rising and tripping on the coal feeder pfister can be avoided. The exhaust fan installation is designed to be automated so that the fan starts only when it is needed and has an impact on energy efficiency.

With the formulation of the problem in the form of how to design an exhaust fan panel automation program pfister coal feeder using Allen Bradley PLC at PT Semen Tonasa; how to monitor the exhaust fan panel pfister coal feeder via smartphone; and what is the working principle of exhaust fan automation. With research objectives that will answer all the formulation of the problems that exist in this study.

2. THEORY
Pfister Coal Feeder

Pfister coal feeder is a device used to regulate and monitor the amount of material to be fed into the kiln burner (Ariyaratne et al., 2010); (Putri et al., 2021). Pfister is equipped with various sensors that assist in the measurement process, as well as using a blower to help feed the material into the kiln burner. The working principle of Pfister is that when the fine coal material is in the hopper, it is extracted into the prehopper. There is a rotary valve between the hopper and prehopper which functions as a channel to open and close the material output from the hopper.

If the prehopper is full, the rotary valve will be closed to prevent fine coal material from coming out of the prehopper. The fine coal material in the prehopper is extracted in the pfister through the rotary valve rotor weigh feeder. Then it enters through the inlet pfister and is forwarded to the weighing section. Then go to and enter the pneumatic delivery line, fired into the kiln burner to pass combustion. Pressurized air is used to shoot the material into the kiln burner which is produced by the blower (Smith, 2023). If the material that fills the segments on the rotary scale reaches the specified limit as input on the pfister, then the motor speed is slowed down. And conversely if the weight of the material has not met the set point, then the motor will rotate faster until the set point is met.

Exhaust Fans

The function of the exhaust fan is to suck air in the room. The inhaled air is then expelled outside the room (Munir & Erfianto, 2020). Meanwhile, exhaust fans are also able to draw in fresh air from outside and flow it into the room. In addition, the exhaust fan also acts as a regulator of the volume of air that will be circulated in the room (Baskara et al., 2023). The

goal is to keep the temperature in the room maintained. The selection of the exhaust fan is adjusted to the dimensions of the room and the volume of air needed to maintain the temperature of the room or panel. PT Semen Tonasa's Pfister control panel uses a fan with specifications of 0.5 A, 3 Phase, 1500 rpm.

Exhaust Fan Power Circuit and Control Circuit

In the operation of a 3-phase induction motor, it is equipped with an electrical panel, in which there is a power circuit and a control circuit (Bich & Le, 2022). The power circuit as a provider or supplier of power to electric motors. In this study the power circuit used is the Direct OnLine circuit. Control circuit to regulate the operation of the power circuit. The purpose of using power circuits and control circuits is for safety.

Automation Network

Automation is a process that automatically controls the operations and equipment of electronics as a substitute for humans in observing and making decisions (Zerilli et al., 2019); (Amiruddin, 2022). The working principle of the exhaust fan automation circuit is "the temperature sensor detects the ambient room temperature and sends a resistance signal to the transmitter, then the transmitter converts the resistance signal into a 4-20 mA electric current signal that can be received by the PLC. 4 – 20 mA signal is received by the PLC analog input and displayed on the monitor. The PLC gives an order to start the exhaust fan if the temperature value rises beyond the range limit and gives a stop command if the temperature drops below the value entered in the program. The goal of the automation system is to use the exhaust fan only when needed so that there is no wastage of electricity.

3. METHOD

This research was conducted from March 14 to April 8 2022 which was carried out at PT Semen Tonasa Unit 3 Pangkep South Sulawesi, using a mixed type of research, namely a combination of qualitative and quantitative. By using existing data at PT Semen Tonasa and the samples used were employees of PT Semen Tonasa. Data collection methods used include direct observation, interviews, and documentation. After that, the research results will be analyzed systematically to evaluate the success of the program.

4. RESULTS AND DISCUSSION

In this study using the operating system, namely Microsoft Windows 2000 and RS link to produce the image. After the realization of the exhaust fan automation design to prevent coal feeder trip filter due to high temperatures and monitoring via smartphone, it is therefore important for us to carry out trials to identify weaknesses and limitations in the system that has been designed or made. In addition, the purpose of this test is also to understand how to condition this tool so that it can be used optimally.

Tool Design

Designing an exhaust fan automation tool using Allen Bradley PLC requires tools: plus screwdriver, minus screwdriver, cutting pliers, combination pliers, cable stripping pliers, test pen, L key set, hacksaw, cutting grinder, drilling machine, contactor, breaker, overload relay, relay, start – stop button, PT 100 sensor, INOR R330 transmitter, 4 × 1.5 cable of 15 meters

and control cable (Cross, 2020). Automation of the exhaust fan circuit functions to monitor the temperature on the pfister control panel (van Weteringen et al., 2023). This automation uses the PT 100 sensor to detect temperature, sequential control functions and plant monitoring. designing monitoring using the Human Machine Interface program with PLC is a computerized system that is used to automate electro-mechanical processes, such as machine control on factory assembly lines.

Network Design

The design of the power circuit and control of exhaust fan automation involves several components and steps that need to be taken to regulate and control the operation of the exhaust fan automatically (Bloch & Singh, 2009). First, is the design of an automation circuit that aims to regulate the operation of the exhaust fan based on a certain temperature or humidity. This circuit involves a temperature sensor or humidity sensor which will measure the conditions around the exhaust fan and provide a signal to the control circuit.

Next, is the design of the INOR 330 transmitter which functions to transmit temperature or humidity data from the sensor to the control circuit (Wallage et al., 2017). These transmitters need to be connected wired or using wireless communication, depending on system requirements. The design of the fan motor PLC program is needed to regulate the operation of the exhaust fan motor. This program must match the temperature or humidity conditions received from the sensor and the instructions given from the control circuit. The PLC program must ensure that the fan motor will rotate or stop according to the specified setting.

The design of the analog input PLC program also needs to be done if there is use of a temperature or humidity sensor that produces an analog signal (Feng & Wang, 2022). This program must be able to convert analog signals into digital information that can be received by the PLC. In addition, the interlocking program also needs to be designed to avoid operating conflicts between the protection system or other safeguards and the exhaust fan. In this program, the standby conditions and operational conditions of the exhaust fan must be determined, as well as the interlock mechanism that will be implemented.

The design of the HMI (Human Machine Interface) program is an interface between the user or operator and the control system (Ardi et al., 2020). Through the HMI, users can visually monitor and control exhaust fan operation. HMI can be a touch screen or control panel with buttons or data display as required. Furthermore, monitoring via smartphone is an additional feature that needs to be designed and implemented. This allows the user to remotely monitor and control the operation of the exhaust fan via a smartphone application connected to the control system. After the entire design is completed, the implementation of the design is carried out. Implementation includes installing and setting up all components, as well as testing and evaluation to ensure the system functions properly.

TESTING

In this study, to find out whether the system is working properly or not, it is necessary to design an exhaust fan automation tool which is carried out through two stages of testing, namely circuit testing and response testing. At the circuit testing stage, all components connected to the exhaust fan circuit are checked, such as switches, relays, temperature sensors, and motors.

This aims to ensure that all components work optimally and according to specifications. After the circuit testing is complete, proceed with response testing.

Table 1. Temperature Test Table

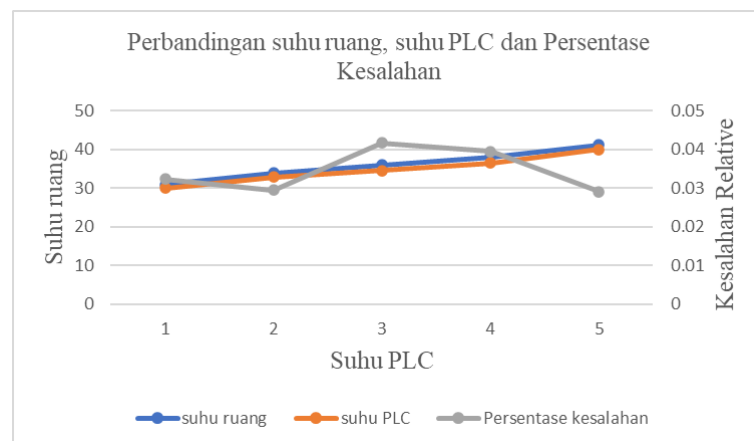| No	Temperature Room (ºC)	Sensor measurement (ohms)	Transmitter measurement(ma)	Designation on PLC (ºC)	Error value (ºC)	Relative Error (%)
1	30.95	112	13.54	29.95	1	0.032
2	33.90	113,14	14,43	32.90	1	0.029
3	36	114	14.76	34.50	1.5	0.041
4	38	114.7	15,42	36.50	1.5	0.039
5	41,2	116	16.5	40	1,2	0.029
			Error average			0.034

Figure 1. Room temperature, PLC and error percentage

In order to prevent tripping, the researchers carried out 2 improvements, the first was a modification, namely exhaust fan automation, the second, the researchers installed an application to monitor temperature and monitor exhaust fan work. So researchers can monitor the temperature conditions, whether the temperature rises or falls and the condition of the exhaust fan is started or stopped. If the temperature rises to 35ºC the exhaust fan is working or not, the researcher can monitor it using the RD Client application which can be operated via a smartphone. So the monitoring function via smartphone researchers do not need to go to the location or to the factory to see whether the temperature is rising or not, the equipment is working or not.

5. CONCLUSIONS AND RECOMMENDATIONS

There are several steps taken to install the exhaust fan, namely the first is to choose the type of exhaust fan that suits your needs, after the exhaust fan is suitable, the next is to choose the installation location, for security when installing is to remove the electrical fuse, first read the installation manual, if you experience difficulties then ask for help from other members or technicians who are competent, draw an outline according to the size of the exhaust fan, make holes in the measured point, set the air duct connector, install the frame, attach the exhaust fan to the frame, connect it with the connector, and finally close the exhaust fan. Next, all you have to do is program the RD Client application so that it can be accessed via a smartphone.

The exhaust fan panel pfister coal feeder functions to monitor temperatures so that the temperature remains stable, and anticipate production failures that cause losses. So that it can be known the working principle of monitoring the exhaust fan panel pfister coal feeder via smartphone is checking the temperature which can be done using a smartphone with the RD Client application. Thus smartphones can access company PCs and all data can be monitored as a whole without the need to go to the office.

SUGGESTION

If currently the researcher only uses exhaust fan automation only on coal pfister panels, it is hoped that in the future exhaust fan automation can be applied to other equipment that requires a stable working temperature. In addition, in the future it is hoped that it can be carried out to several PTs or other research sites so that it will prove that it can be used commercially.

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