

Implementation of PLC Outseal as a Controller of Ammonia Gas Circulation in Chicken Coops with HMI Modbus Monitoring

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Abstract

Indonesia's population in 2022 is recorded at 275,361,267 people, significantly increasing per year which has resulted in an increase in food needs in the chicken meat sector, the high interest in chicken meat has not been accompanied by appropriate technology, this has made the quantity and quality of chicken breeders often experience crop failures the application of system technology for controlling and monitoring air quality in chicken coops based on PLC Outseal for ammonia gas is a technology used to reduce the death rate of chickens due to poisoning by ammonia gas produced from the chicken manure itself. The technology applied to chicken farms uses the Outseal PLC microcontroller as the design brain, Arduino nano as a sensor data storage communication, the MQ135 air quality detector by checking ammonia gas levels, monitoring through the HMI Modbus software on a bluetooth connection with control on a smartphone and removing dirty air by blowers. The parameter limit for the value of ammonia gas in the chicken coop is 20 – 40 ppm. The test result that the value of the ammonia gas content in the farm is above the specified value, the condition of the cage is excess ammonia gas and the automatic actuator functions to remove ammonia gas until the ammonia gas level value returns to normal.

Keywords: MQ-135; Outseal PLC; Modbus HMI; Ammonia Gas; Chicken Cage.

1. Introduction

Indonesia's population in 2022 is recorded at 275,361,267 (Setiawan, B. et al, 2022) experiencing an increase which has resulted in an increase in demand for food, one of which is consumed by chicken meat, high interest in consumption of chicken meat and high sales value foster business opportunities to establish chicken farms. The rise of broiler chicken farms has not been accompanied by the use of appropriate technology, therefore crop failure often occurs. Chicken deaths are caused by several factors, including disease from bad cage conditions, one example of poor air circulation is found in chicken manure which contains levels of ammonia gas which is lethal to chickens.

Ammonia is solid, liquid or gas that has a pungent odor. And including chemicals that are dangerous if exposed directly to the body's skin or inhaled for a long duration. From the chicken manure there is a high ammonia gas content which causes death in chickens. in the parameter of ammonia gas levels at 20 – 40 PPM (Part Per Million) which is a normal standard for ammonia gas in chicken coops, it is necessary to have a tool that is able to control and monitor the quality of ammonia gas in chicken coops when it exceeds the set levels (Rama et al, 2023).

To overcome this problem, the authors apply a tool that can monitor the quality of ammonia gas levels in the control of the blower in the chicken coop automatically and can be monitored via a smartphone. Which detects ammonia gas and is also equipped with Modbus HMI monitoring as a substitute for the HMI operator panel which makes it easier for farmers to see ammonia gas levels from smartphones. This tool can help chicken farmers improve the quality and quantity of efficient and effective chicken production.

2. Method

A. Research Method

The research method is a systematic stage of making the final project in order to obtain structured research results. The stages are made in the form of a Flow Chart which can be seen in Figure 1.

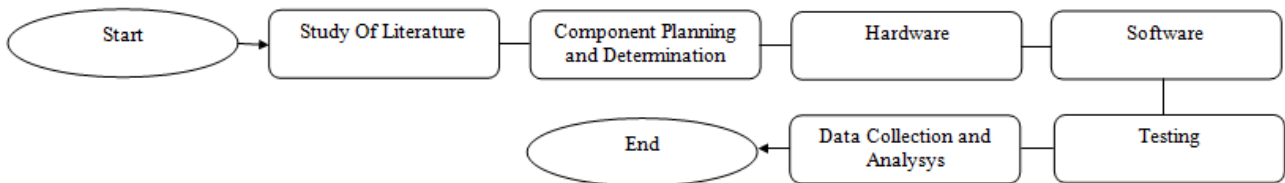


Figure 1 Flow Chart Research Method

B. Block Diagrams

The block diagram is a concept in the design of a prototype controller for circulating ammonia gas in a chicken coop based on an outseal PLC with Modbus HMI monitoring from smartphone software. How the system works as a whole can be seen in the block diagram figure 2.

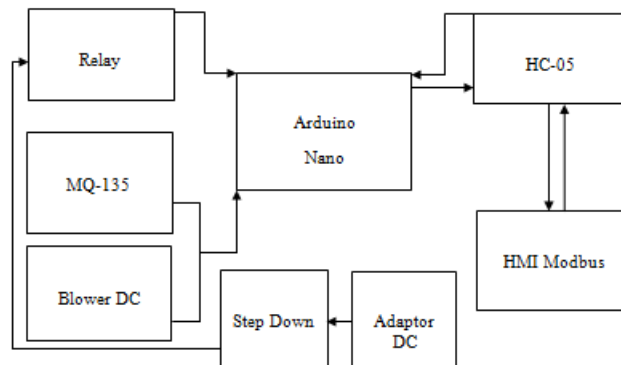


Figure 2 Block Diagrams System

1. Arduino Nano functions as sensor communication to the logic control program to store data ledger program.
2. MQ-135 functions as a detector for air quality, especially ammonia gas levels.
3. DC blower functions as a controller for dirty air disposal.
4. The relay functions as a load controller that works automatically.
5. The HC-05 functions as a Bluetooth wireless communication connector for incoming and outgoing connections Outseal PLCs and Modbus HMI.
6. The Modbus HMI functions as a monitoring value from the work of the MQ-135 gas sensor and automation notification of blower work through monitoring of the Android smartphone software.
7. Step Down serves to regulate the outgoing current from the adapter source
8. The adapter works as the mainline for using the accumulator

C. Block Diagrams Software HMI Modbus

The Modbus HMI software block diagram is a concept of monitoring the circulation of ammonia gas in a chicken coop based on a PLC outsele of smartphone software. How the system works as a whole can be seen in the block diagram figure 3.

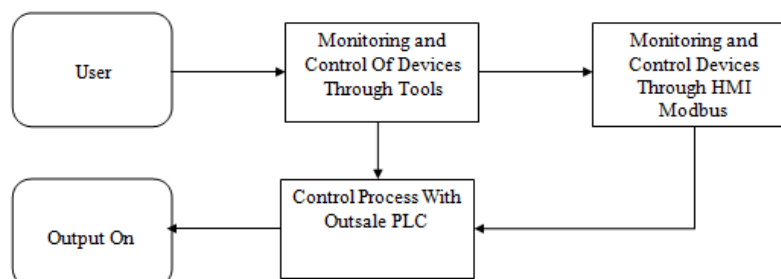


Figure 3 Block Diagrams Software HMI Modbus

Users monitor and control devices with outseal PLC via the Modbus HMI software.

D. Flowchart

Flowchart is part of the stages with certain blocks that explain the process steps of a system or method in a program or system. The flowchart can be seen in figure 4.

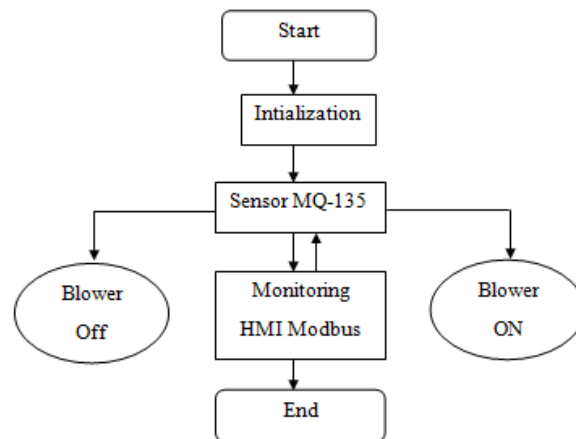


Figure 4 System Flowchart

The working principle of the system in the flowchart in Figure 3 is explained that the system is run at the preparation position, gas sensor (MQ-135), dc blower, HMI Modbus, PLC Outseal, and if the system is ready the system will start to the automatic stage using a push button, then control of the program that is ready in the outseal plc will be displayed on the Modbus HMI monitoring where the MQ-135 sensor gives a predetermined value of PPM (Part Per Million) ammonia gas levels if the value of ammonia gas exceeds the specified value the blower will automatically rotate faster and if the value of the ammonia gas is normal then the blower will spin normally again.

E. Electronic Design

Electronic design is part of making a system design which is carried out by determining component specifications, selecting the right components, making circuit designs, installing components can be seen in Figure 5.

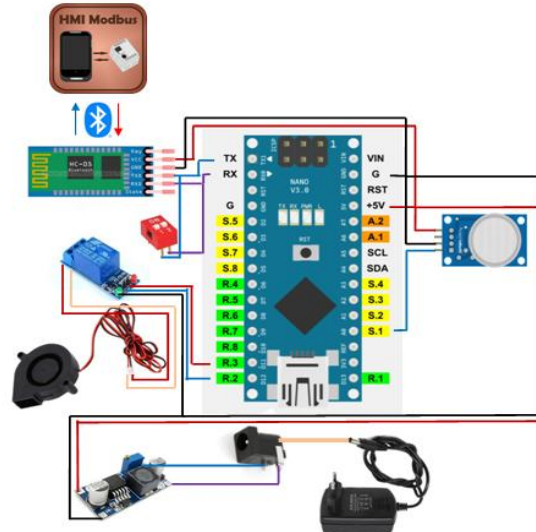


Figure 5 Electronic Design

3. Result and Discussion

In this research experiment, we will test the MQ-135 sensor on the Outseal PLC basis to see the levels of ammonia gas in Hj's chicken coop farm. Mustofah with the result that the value of the ammonia gas content in the farm is above the specified value, the condition of the cage is excess ammonia gas and the automatic actuator functions to remove ammonia gas until the ammonia gas level value returns to normal.

Testing	Time	Value rate ammonia	Blower
1	60 Second	140	ON
2	80 Second	142	ON
3	120 Second	142	ON
Total Avarage	142 ppm		

Table 1. Ammonia gas test

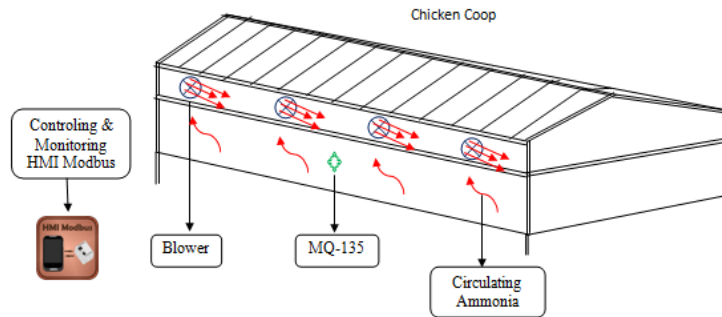


Figure 6 Design Architecture Implementation MQ-135 In Chicken Coop

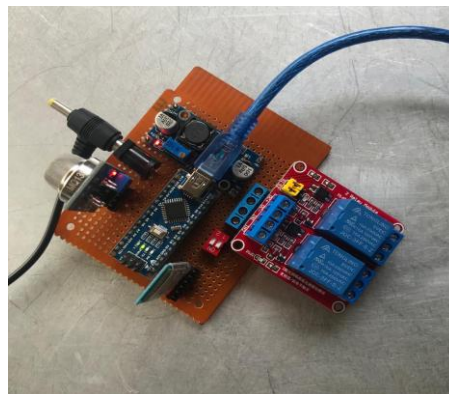


Figure 7 Hardware System

A. Software Design

Smartphone HMI Modbus is software that can be used as a replacement for the HMI operator panel. Several functions such as reading and writing different data types are provided. Modbus protocol and supported. To use Modbus it is necessary to have Bluetooth communication. The Modbus HMI software is based on the Drag and Drop principle, which can be seen in Figure 6.



Figure 8 Modbus HMI Software Design

Obtained from the study showed high levels of ammonia gas with an acquisition value of 142 ppm from the standard value of 20 – 40 ppm.

B. Coding PLC Outseal

To code the PLC outseal requires Outseal studio software to program the input and output where the system works as shown in Figure 7.

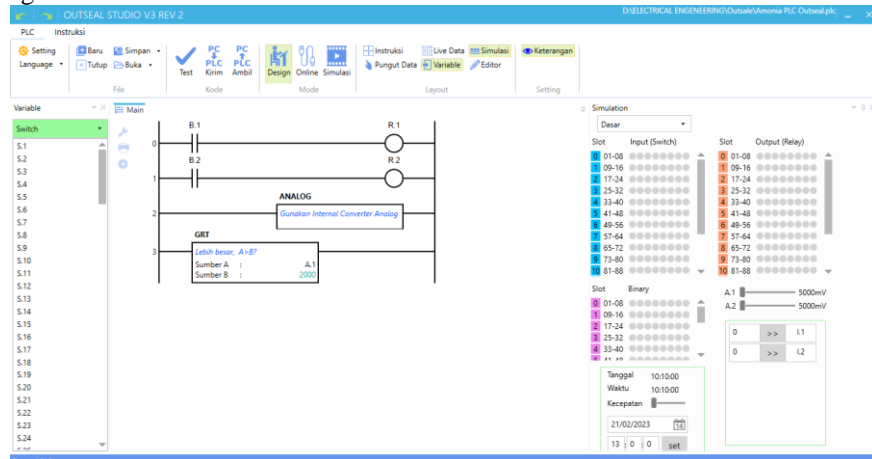


Figure 8 Ladder Outseal Studio

4. Conclusion

In the trial use of the Outseal PLC-based MQ-135 sensor it went well with the ammonia gas detection sensor being able to read and output data from a maximum standard value of 40 (PPM) Parts per Million seen from the Modbus HMI software as soon as the blower functioned because the value exceeded the set number. What is lacking in this study is that communication can only be reached 9 meters.

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