Online Monitoring and Air Pressure Control System Plan for Air Separation Plant with Fuzzy Logic Method using Microcontroller

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Abstract. Air Separation Plant (ASP) using the air in the atmosphere as raw material to produce gases. The air is taken from the atmosphere using air compressor. Air from the atmosphere passed through the air filter for filtering dust and impurity from atmosphere. It is entering air compressor unit and compressed into certain flow rate and capacity. The plant is monitored from ASP control room. the parameter unit to be controlled is air flow capacity, the operator must to handle it manually in the local plant. Based on that problem, the researcher make a pressure control system plan and online monitoring for air compressor unit using fuzzy logic method which processed using arduino.

Keywords: Air Separation Plant (ASP), Air compressor unit, Arduino, Fuzzy logic, Online monitoring.

1 Introduction

In this research a system for controlling air pressure was designed for the air compressor using an air pressure sensor for detecting the amount of air pressure, used when the air compressor is working and a servo valve with the fuzzy logic method used to regulate the flow rate and air pressure for the production remains stable. By using the control in the form of a microcontroller that is connected online to monitor all existing processes. In 2014, Joyce, Sheeba conducted a simulation study of speed brushless DC motors with fuzzy logic controllers. In the article [1]. Using a hall sensor as a brushless motor speed control using a MOSFET driver for switching pulses. There are 2 inputs and 1 output to use as a membership function: large negative (NB), medium negative (NM), small negative (NS), zero (Z), small positive (PS), medium positive (PM), and large positive (P.B.). The result achieved is the simplicity of control, namely the fuzzy rule base or Fuzzy set can be easily modified. Improved simulation robustness fuzzy logic controller, using MATLAB to control the speed of a flexible BLDC motor.

In 2011 Abbas, M. with the title Autonomous room air cooler using fuzzy logic control system. For the room temperature control system using the fuzzy logic method and from the experiments that have been carried out the results obtained are by what the author wants. By

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using two inputs and three outputs as variables using the mamdani fuzzy logic method [2]. With the results achieved, the automatic air conditioning system with fuzzy logic control provides effective results during the simulation testing of various parts of the control system.

2 Materials and Methods

2.1 Fuzzy Logic Design

We will use fuzzy logic, with the Sugeno method. In creating a membership function to enter input and output parameter values. After finishing creating the membership function, continue to create rules that will be used in a system. The control system uses fuzzy logic with pressure sensor input. while for output, there are two outputs namely the servo valve, and the output valve. The fuzzy logic design that will be used is described in Table 1.

Table 1. Rule Base Fuzzy, description : SK(Very Small), S(Small), CK(Small-Medium), S(Medium), CB(Medium-High), B(High), SB(Very High), BSB(Open Very High), BB(Open High), BCB(Open Medium-High), BS(Open Medium), BCK(Open Small-Medium), BS(Open Small), BSK(Open Very Small).

Pressure Sensor	Servo Valve	Output Valve
SK	BSB	BSK
S	BB	BS
CK	BCB	BCK
S	BS	BS
CB	BCK	BCB
B	BS	BB
SB	BSK	BSB

In determining the Range of the Fuzzy Membership function then data from the Air Separation Plant, where the range when the air compressor operates is 0- 12,000 kPa, which will we reduce the range with a 1:20 scaling so that the working range from the compressor in this research becomes 0-600 kPa, and seven Fuzzy Memberships, which can be seen in **Figure 1**. below this.

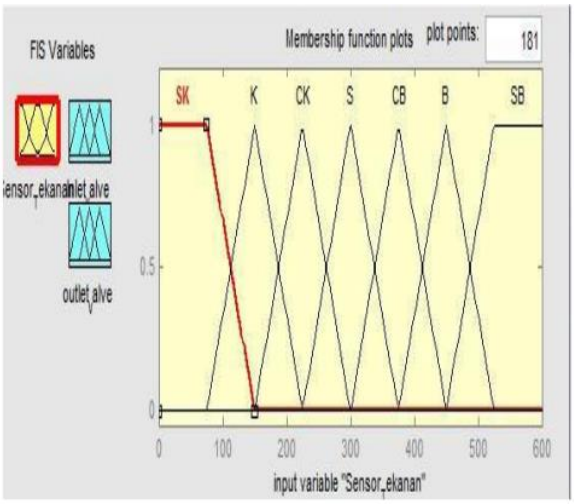

Fig. 1. *Fuzzy Memberships* for Pressure Sensor

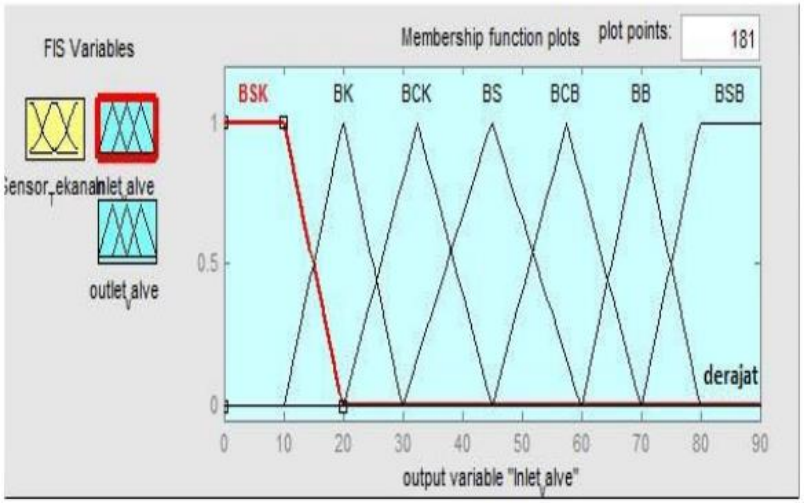

Fig. 2. *Fuzzy Memberships* for Inlet Valve

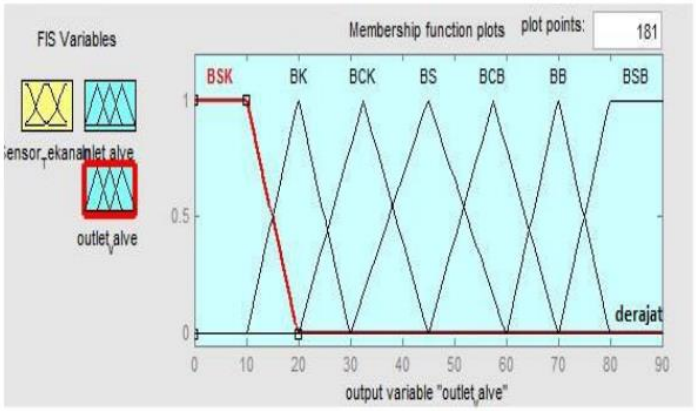

Fig. 3. *Fuzzy Memberships* for Outlet Valve

we can know From **Figure 2** and **Figure 3** in above. the inlet and outlet valve range has a value between 0-90 degrees, and has seven Fuzzy Memberships for each valve.

2.2 Online Monitoring

An online monitoring system is made with serial communication from Arduino to PC. Then from the PC to the local wifi using an independent web service built in the Java programming language. HTML Serial Monitor is a replacement for the standard serial monitor on the Arduino IDE. Using HTML serial monitor can be used to debug data from Arduino into HTML form and display it in a web browser. HTML serial monitor uses a browser to monitor the results of HTML debugging from Arduino. An Arduino library is available with some predefined functions to make it easier to program. In the system, communication is program med with Processing3 (java mode) which acts like a bridge that receives messages from the serial port and displays them in the browser by implementing a web server. How the HTML serial monitor works in the Arduino, we can enter HTML code or customize the properties of HTML elements with java script, HTML serial monitor receives data from Arduino and runs a web server browser which connects to the web server (Port8080).

3 Results and Discussion

After testing the air pressure sensor has an average error of 4.1%, and the fuzzy logic program on Arduino has an average error of 5.6%, due to a hardware error because the servo motor movement which does not correspond to output defuzzification. Pressure sensor calibration still has an average error of 1.62%.

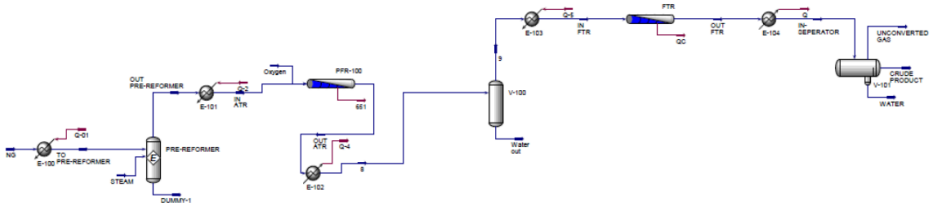

Fig. 4. Simulation Setup Property Package

The comparison between baseline simulation and the reference is provided in Table 11.

Table 11. Comparation baseline simulation and reference

Parameter	*Baseline* Simulation	Reference	Error (%)
Fraksi H_2/CO *syngas output* ATR	3.8	3.85	1.3
Actual Conversion ATR (%)	60.86	60.86	0
Actual Conversion Fischer Tropsch Reactor (%)	21.156	21.15	0
Mole Fraction C_9-C_{16}	0.13	0.135	0

From the results of the simulation comparison and the results on the reference [10]. It can be seen from several parameters that the resulting value is similar and close to the reference value and with a small error value. So that gas to liquid simulation modeling using equilibrium and kinetics data input is valid and can provide an accurate representation of the process.
Variations in the Ratio of Steam / Sales Gas to the ratio of H2 / CO of the resulting syngas. The feed sales gas used in this

4 Conclusions

From this research we get some conclusions below :
1. Setting the opening on the servo valve using PWM output on the the Arduino sent to the servo motor to control the opening angle of the servo valve.
2. The online monitoring system has a latency of a few seconds because of the speed of the internet connection between client and server.
3. There are only seven rules base because of the limitations of the bypass and outlet valve in the form of solenoid valves.

References

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