DESIGN OF MONITORING SYSTEM TEMPERATURE CONTROL USING ONLINE AND WIFI

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ABSTRACT

Proportional control system design, hardware in the form of temperature control systems using Wifi, to control the heater. In this system made the system interface and device temperature control system for reading the same data records with the reading of stored data and graphical visualization using Borland Delphi.

To maintain a stable temperature of the reactor need to be made primarily on monitoring and temperature control systems that work online using Wifi, the result is that the actual temperature control system and can monitor the temperature of it online.

This study uses a temperature sensor type LM 35 which is a type of semiconductor that has an integrated signal conditioning part of it. Using the internal ADC 10 bits of mikrokontrol AVR ATmega 8535, as an interface. To perform wireless data communications that have used Wifi 802.11g specification. Wifi injected data from a computer using a standard protocol TCP / IP. By doing a set of IP addresses allows the data on a computer can be accessed by another computer around it.

Validation test was done by comparing the temperature readings by the sensor LM35 with Thermo standard test equipment 300, the test results obtained device temperature control system that can work in accordance with the principles of control on the basis of proportional control theory, with errors less than 2%.

Keywords: temperature control, proportional control, Wifi

INTRODUCTION

Most industries require a transition from conventional devices that still use the switch to automated equipment. The use of completely automated equipment, in addition to be able to obtain results more efficient and effective manner, is also able to suppress the error that comes from humans (human error), so it takes a computer-based tool which, from the information system can provide an accurate and just in time to be able to give the reports required in order to increase production with the effective and efficient.

Research carried out an actual temperature control system and can monitor the temperature of online.
The design of monitoring and temperature control system online using Wifi 802.11g specifications. To control the temperature of the liquid to be more stable inside the chemical reactor using a temperature sensor type LM 35, using mikrokontrol as an interface between the reactor with the server by using mikrokontrol ATMega 8535. Type of batch type stirred reactor which can access via a server or client, in making the setting point and temperature monitoring. The obtained data recorded and stored in the form of Microsoft Excel.

Control Systems

The existence of controllers in a control system has a major contribution to the behavior of the system. In principle it can not be transformed due to the constituent components of the system. That is, characteristics of the plant should be accepted as is, so that changes in system behavior can only be done through the addition of a sub-system, namely the controller.

Proportional controller

Proportional controller having an output that is proportional / proportional to the size of the error signal (difference between the desired quantity with the actual price) [Sharon, 1992].
The relationship between control signal and the error is:

$$u(t) = K_p e(t)$$

Where:
Ut: Output proportional control
Kp: Proportional gain
e (t): The error at the time 't', ie

$$e(t) = SP - PV$$

SP: Set point
PV: Process variable

In the proportional control algorithm, the controller output is proportional to the error signal, namely the difference between set point and process variable. In other words, the output of proportional controller is the result of multiplication of the error signal and the proportional gain.

Figure 1 shows a block diagram illustrating the relationship between quantity setting, the actual magnitude proportional to the amount of output controller. Keasalahan signal (error) represents the difference between setting the magnitude scale aktualmya. This difference will affect the controller, to issue a positive signal (to accelerate the achievement of price setting) or negative (slowing down the achievement of the desired price).

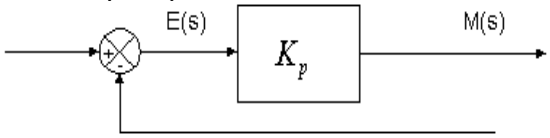


Figure 1. Proportional controller block diagram (Sharon, 1992)

PROTOTYPE SYSTEM

In figure 2 can be explained that in a chemical reactor to produce heat in the form of heat energy. On the other hand on the computer and data communications systems currently use a comparable amount of electricity. In this study, type LM 35 temperature sensor which is a type of semi-conductors.

Computers are digital devices, on the other hand the temperature sensor is an analog device. Therefore the device needs an analog to digital data converter that will convert the temperature weighting proportional to the weight of digital numbers. In general, ADC has a certain voltage level analog input voltage sensor amplifier is needed to achieve the required voltage level of the ADC. In this experiment, the internal ADC 10 bits of mikrokontrol ATmega 8535 AVR, which can be programmed to solve the necessary protocol.

Mikrokontrol has the capability able to communicate in serial and parallel, so that it can communicate with the computer via the parallel port (LPT 1), serial (COM 1), or USB.

In this system to perform wireless data communication used Wifi 802.11g specifications. Wifi injected data from a computer using a standard protocol TCP / IP. By doing a set of IP addresses allows the data on a computer can be accessed by another computer around it.

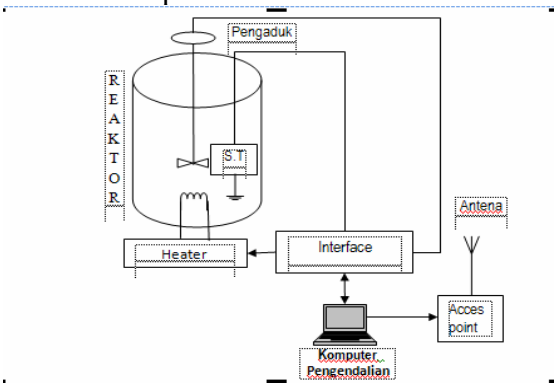


Figure 2. Temperature Control System Prototype

SENSOR

In this study, type LM 35 temperature sensor which is a type of semi-conductors because it is cheap and has a signal conditioning integrated therein, linearitasnya pretty good. LM35 does not require external calibration which provides accuracy of ± ¼ ° C at room temperature and ± ¾ ° C in the range of -55 to +150 ° C.

INTERFACE

Mikrokontrol interface circuit in the form in which among others consists of several relays to drive the motor and control the heater. A cooling fan installed to cool the mikrokontrol and electronic circuit that is inside the box.

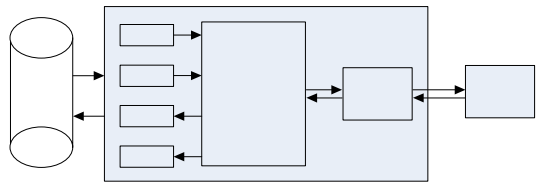


Figure 3. The prototype device interface

Mikrokontrol as this interface using ATMega 8535 because this IC has the advantage of one of them is to program the microcontroller to use the C language, and have more speed than the other IC and has more memory. And advantages already have an ADC (analog to digital converter).

TCP/IP

Data communication protocol is defined as the procedures and regulations governing the operation of data communications equipment.

TCP / IP as an independent and general protocol enables communication of data between different computer networks different (heterogeneous) that uses a variety of computers with different architectures following a different operating system.

WIFI

Wifi is short for Wireless Fidelity, which has the sense of a set of standards used for Wireless Local Networks (Wireless Local Area Networks - WLANs) based on IEEE 802.11 specification. The latest standards of specifications 802.11a or b, such as 802.16 g, the latest specification will offer many improvements ranging from more extensive coverage to the transfer speed.

CONTROL SYSTEM AT THE REACTOR

Pegontrolan system created using telemetry systems where the control process performed by the computer servers that are given instructions by the operator through the client computer, both computers are connected using Wifi network so it does not require a cable data transmission media, although both are great distances apart.

On the client computer can monitor and regulate the conditions of the reactor directly and in real time (real time). All monitored data can be recorded in the form of worksheets that can be opened and read in Microsoft Excel.

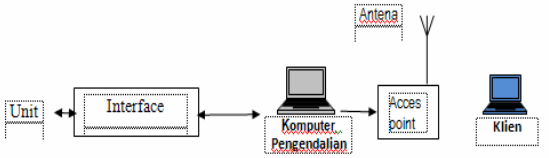


Figure 4 Diagram of control system using Wifi

All activities that occur on the reactor is controlled by a computer server, in this case is the control computer shown in figure 4 diagram of control system using Wifi.

Computers are getting digital information signal from the microcontroller, which acts as an interface (interface) which read temperature physical property that is sent to a computer server as a unit of the control processors. Besides, as the executor (actuators) of the server request to turn off or turn on the relay of the heater as a form of expression of the control system. Then emitted from the computer control using Wifi to the client computer. From the client computer can be done to control the process of monitoring and setting the point on the reactor temperature.

The process of data collection the temperature of the reactor unit can be accessed from client computers using a network Wifi. Wifi injected data from a computer using a standard protocol TCP / IP.

By doing a set of IP addresses allows the data to the computer control can be accessed by another computer around, where the path Wifi uses the 802.11g specification, which is the default path of Wifi.

ADC
COUNTER
PROSES
LOGIKA
RELAY
ARITMATIKA
RELAY
Reaktor
MIKROKONTROLER AVR ATMEGA8

Then the temperature data stored in the data acquisition control computer in a database in the form of Microsoft Excel.
The program interface system and system devices for reading data record and graph visualization using Borland Delphi programming language.

VALIDATION

Perform testing and validation using the validation test tool temperature thermo type instrument 300 of the orange product.

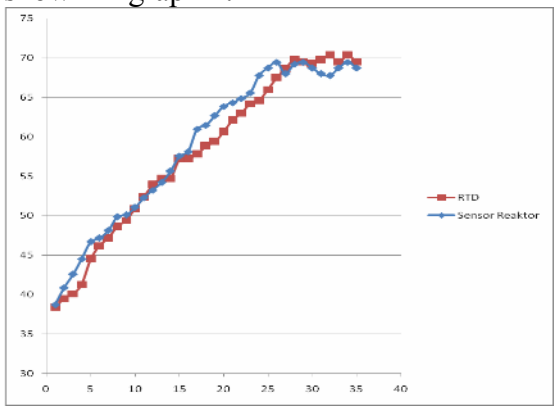
Testing is done by comparing the measurement system made by Thermo standard gauge 300 with a way to enter the sensor from the test device into a reactor.

Results of testing the system on the condition of the motor state death data obtained table 1.

Table 1 Validation Results

Temperature	Speed	RTD (THERMO 300)
38,72	0	38,4
40,89	0	39,5
42,59	0	40,1
44,52	0	41,3
46,7	0	44,5
47,18	0	46,2
48,15	0	47,2
49,85	0	48,6
50,09	0	49,4
51,06	0	50,9
52,27	0	52,4
53,23	0	53,9
54,2	0	54,7
55,65	0	54,7
57,59	0	57,2
58,07	0	57,2
60,98	0	57,8
61,46	0	58,8
62,67	0	59,4
63,85	0	60,6
64,33	0	62,1
64,85	0	63
65,57	0	64,2
67,75	0	64,6
68,72	0	66
69,45	0	67,5
67,99	0	68,6
69,2	0	69,8
69,45	0	69,5
68,72	0	69,3
67,99	0	69,8
67,75	0	70,3
68,72	0	69,5
69,45	0	70,3
68,72	0	69,5

From the data table the temperature validation test is then made graphs the relationship between reactor temperature sensor LM35 with Thermo 300 which is shown in graph 1.



Graph 1. Relations temperature readings in the motor dies

From the results of the validation of measurement tests using standard test equipment Thermo 300 and then calculated the value of precision control system that is made by using the equation:

Kesalahan : $E = \frac{\Delta T}{T \text{ Set point}} X\ 100\ \%$

(0,902286 / 70) x 100% = 0,0128%

Precision = K = 100% - E

100% - 0,0128% = 99,9872%

From the data and calculations for motor condition die obtained 99.98% precision

VISUALIZATION RESULTS

Set point comes passwords for users who do not have permission to access can not do a set of points, this is to protect the reactor temperature control system so as not to be altered by users who do not have a license, such as terterra in Figure 5.

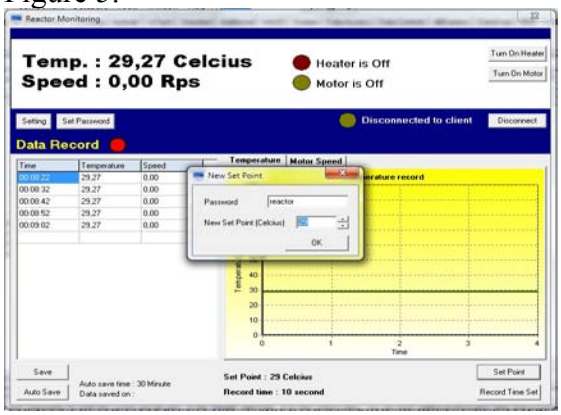


Figure 5 Password

In addition, to avoid the set point with a temperature that is too high then the temperature needs to be restrictions by giving early warning at the time of the set point. So if the set point which included a high temperature warning will appear as shown as Figure 6.

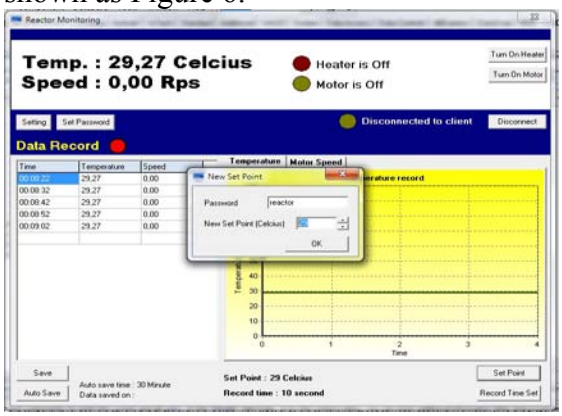


Figure 6 Early warning

Set Point Variation

Testing is done by varying the set point at 40oC, 60oC, and in order to know the result of good performance and system tools are made. Results obtained from testing of the reactor control system is as follows:

By the time of observation every 60 seconds at 40 ° C temperature condition and the motor on the condition of death, obtained records of the results shown in table 2.

Table 2 Tests at 40 oC observations every 60 seconds, the motor dies.

Time	Temperature	Speed
15:09:04	38,05	0.00
15:10:04	38,05	0.00
15:11:04	39,76	0.00
15:12:04	40,73	0.00
15:13:04	40,73	0.00
15:14:04	40,49	0.00
15:15:04	39,76	0.00
15:16:04	39,76	0.00
15:17:04	39,76	0.00
15:18:04	39,76	0.00
15:19:04	39,27	0.00
15:20:04	39,27	0.00
15:21:04	39,02	0.00
15:22:04	38,78	0.00

From the table is then created charts the relationship between time and temperature so obtained as in graph 2.

Figure 2 Response time temperature of 40 motor death

From the observation data is an average temperature of 39.51357143 oC, and then calculated the percentage of fault to find good work these tools to obtain the percent error using the equation:
Error: E

Table 3 Tests at 40 oC observations every 60 seconds the motor life

Time	Temperature	Speed
15:30:13	38,05	21.49
15:31:13	38,05	21.59
15:32:13	38,05	21.59
15:33:13	38,05	21.65
15:34:13	38,78	21.65
15:35:13	39,27	21.81
15:36:13	40,73	21.78
15:37:13	40,73	21.75
15:38:13	40,73	21.67
15:39:13	40,73	21.77
15:40:13	40,73	21.94
15:41:13	40,73	21.79
15:42:13	40,73	21.78
15:43:13	40,73	22.02

DISCUSSION

Temperature control monitoring system online using Wifi been running well with the percent error range of less than 2% which is made by mixing factor motors have an influence on the temperature stability of the temperature control process. Tests at higher temperatures with the same record time data every 60 seconds and the motor on making the process of temperature rise for a while due process of mixing fluids in a stirred reactor and the heating process of the heater.

CONCLUSION

Setting the temperature control set point is done from the client computer and data acquisition process can run well. In addition, only users who have the authorization code (password) that can exercise control (set point). The process of data acquisition can be done automatically and recording data that can be done in accordance with the desired time, monitoring the temperature in the reactor can be more accurate and observations can always real time.

From the observation that temperature control system can know the maximum temperature, minimum temperature and average temperature.

ADVICE

It needs a pengembangkan more complex control system with control system combines several types. Need to develop monitoring systems for temperature control telemetry using Wifi technology to control the distance reach even further.

Keep the temperature control system development by using another method or by combining several methods.

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