

HIGH QUALITY CONTROLLING SPEED OF AN ELECTRIC MOTOR WITH INTERNET NETWORK

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Abstract—The development of applications using microcontroller is growing rapidly, including microcontroller applications as a means of control and monitoring of a process in the industry, to control and monitor the remote can be used various communication media including the intranet/internet. Intranet / internet has the advantage can be used as a medium for the transmission of various data from a variety of equipment and exhibits a broad range. In this paper discussed the design of the control system and monitoring the speed of a DC motor via the intranet. The system is made using AVR microcontroller, so that the microcontroller can function as a server that has its own IP address which can communicate directly via the intranet with a master computer control, we need a controller IC. W3100A is used as a controller IC that can implement the TCP / IP protocol therein. On the master computer controls yreceive data monitoring settings motor speed of the microcontroller. To speed up the response to changes in motor speed and the speed setting value of motor speed to minimize errors, the system is made to apply a closed system with PID control as the controller.

Keyword—Speed of Electric Motor; Microcontroller; Internet Network

I. INTRODUCTION

With the rapid development of the Internet in various regions so we can communicate with the great distance and business process including tele banking, email, receive email, as well as shopping from various places around the world that there is a internet network [7],[8],[9]. In an industry which contained intranet / internet, the industry can use the network not only as a medium of communication between the computer and the computer but can also be used for communication between mikrontroler media as a means of control and computer as a master control [4],[6],[10]. With the use of intranet/ Internet can be obtained various advantages such that the cable network media saving less, can be accessed from a variety of places that no internet network as well as the savings due to the size of a microcontroller which is very small compared with the computer.

II. DESIGN SYSTEM

This system has six main components of the master computer control, the controller TCP / IP, 3 pieces AVR microcontroller, LCD viewer, the viewer seven segment, and a DC motor. The block diagram of the major components shown in Figure 1.

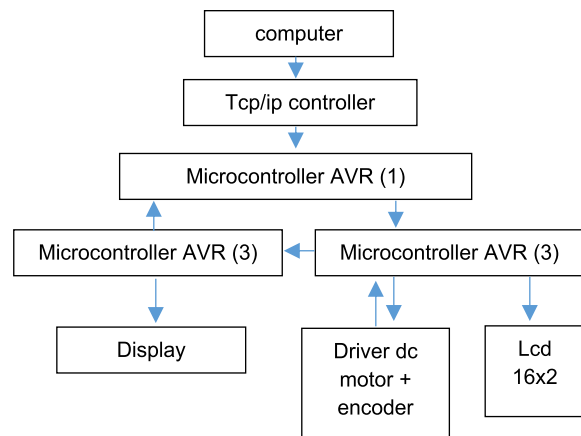


Figure 1 Block diagram of the system

Each section of the block diagram can be explained as follows:

- In the master control computer created a client program that provides motor speed setting value and me to monitor the magnitude of the resulting motor speed and store it in the database [1],[3].

- TCP / IP controller receives the register settings of the AVR microcontroller (1) so that it can take the existing data in the network that are addressed to an IP address that has been determined by means of AVR microcontroller (1), the communication between the microcontroller AVR (1) and TCP / IP controller using I2C communication[1],[2].

- Data from the network is processed by the microcontroller AVR (1) and the data is sent to the speed setting AVR microcontroller (2) using serial communications. By AVR microcontroller (2) the data set speed displayed on the LCD and then processed through a digital PID is then converted into a PWM signal (Pulse Width Modulation), pwm signal is used as the input of the motor driver circuit [1],[4],[5].

• When rotating the motor circuit in the motor encoder generates pulses calculated by AVR microcontroller (2) every second, the result of this calculation is shown to the LCD and sent to the AVR microcontroller (3). Motor speed calculation data that has been received by the AVR microcontroller (3) is displayed to 4 pieces viewer sevensegment with scanning method and sent to the AVR microcontroller (1) with serial communication will be sent to the master control computer over the network [1],[5],[8].

III. SOFTWARE DESIGN

Software created 4 pieces, namely:

A. For AVR microcontroller (1) which is used as a controller and the data from the IC makers TCP / IP controller, flowchart software created for AVR microcontrollers (1) shown in Figure 2. In this communication system applied is the type of Passive Open communication is created as a tool to configure the server so that the tool always check the SYN signal addressed to the tool from the network. The steps are performed in this mode are:

1. CLOSED STATE: initialization channel to execute commands or command sys_init Close
2. INIT STATE: set the number of ports that are used in the channel by executing the command sock_init
3. LISTEN STATE: always wait for a connection from the peer (menunggu signal SYN), after the SYN signal on the specified port is received then a SYN, ACK ditranmisikan and switch to SYNRCVD STATE

In SYNRCVDSTATE after a SYN, ACK sent the IC W3100A waiting for a reply signal ACK from the peer, if the reply is received, the switch to ESTABLISHED STATE. Figure 3 shows an illustration of the server mode. Once in ESTABLISHED STATE then the program to loop continuously and check the state of the socket, there are three kinds of circumstances socket namely: 1. SOCK_ESTABLISHED (06H) is a state of connection has occurred but in the passive mode.

2. SOCK_CLOSE_WAIT (07H) that the connection has been disconnected.
3. SOCK_CLOSED (00H) that the connection is disconnected.

If in case it is done reading SOCK_ESTABLISHED socket, the data received by the speed setting is copied to the variable to be sent to the AVR microcontroller (2) via serial communication, whereas if the client program on the computer requests data, the results of monitoring carried out writing the data to the monitoring results for the socket then sent to the client over the network. If the connection has been disconnected happened (SOCK_CLOSE_WAIT) then the socket is closed, and the state is the state of the socket SOCK_CLOSED deliberately closed by the microcontroller AVR (1)/ server or by a program in the computer/client. Socket state examination conducted

continuously since TCP/IP is a protocol that Connection Oriented that connection that checks the data that has been sent to the client and wait for a reply from the client that the data sent has been received, if within the specified time no reply then the data is attempted to be sent again, the absence of a reply from the client to make the state of menjadi SOCK_CLOSE_WAIT socket.

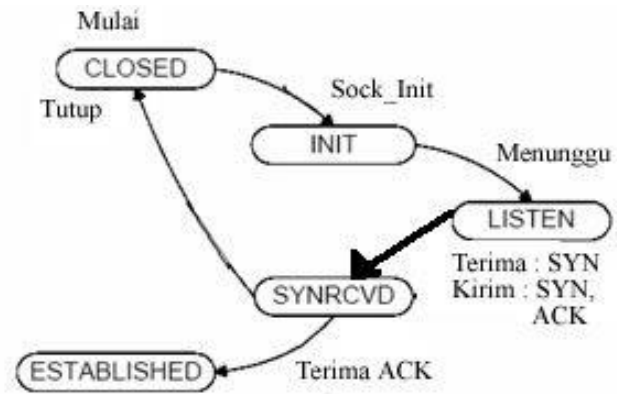


Figure 3 Illustration of fashion Server

B. For AVR microcontroller (2) is used as PWM generator with a PID controller and timer pulse of the encoder and LCD viewer, flowchart software for AVR microcontrollers (2) shown in Figure 4.

Pulse counting is done for one second to generate the frequency in Hertz, In this instrument the number of holes in the existing rotary encoder 30 pieces so as to convert the unit into a speed in RPM (Round Per Minute) / number of revolutions per minute then were calculated as follows:

$$\text{RPM} = (\text{pulse counting results} / 30) \times 60 = \text{X 2 pulse counting results}$$

Digital PID process as shown in Figure 5. Flowchart Explanations Digital PID is as follows:

- Error (E) is the difference between the Set Point (SP) to the Process Variable (PV).
- On the count value $K_i \cdot E \cdot T$ with K_i is the integral constant in this thesis found using experimental methods and T is the sampling period in this thesis is 1 second.

Calculated integral value:

$$\Sigma_i = \Sigma_i + K_i \cdot E \cdot T \quad (1)$$

- Calculated values $K_d \cdot E$. with K_d is constant Differential in this task also searched using the experimental method.

Calculated values Differential :

$$\Delta D = (K_d \cdot E - K_d \cdot E_{\text{old}}) / T \quad (2)$$

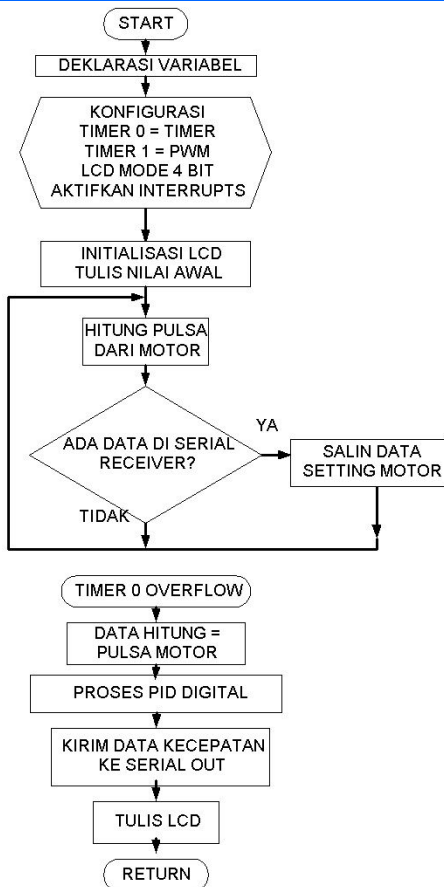


Figure 4 Flowchart AVR (2)

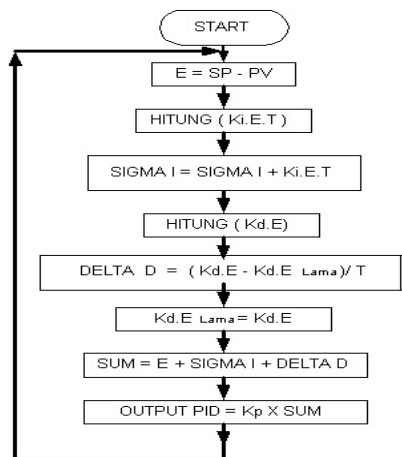


Figure 5 Flowchart Digital PID

- $K_d.E$ long is the value $K_d.E$ previous calculation process so that could be used to further process the value $K_d.E$ now saved with the old $K_d.E$ command = $K_d.E$.

- The sum total is:

$$SUM = E + \Sigma i + \Delta D \quad (3)$$

- The output of the PID is the product of K_p with SUM, with K_p is the proportional constant. K_p in this thesis also found using experimental methods.

- For AVR microcontroller (3) used as a viewer seven segment with scanning method. Figure 6 shows the flowchart of the AVR microcontroller (3).

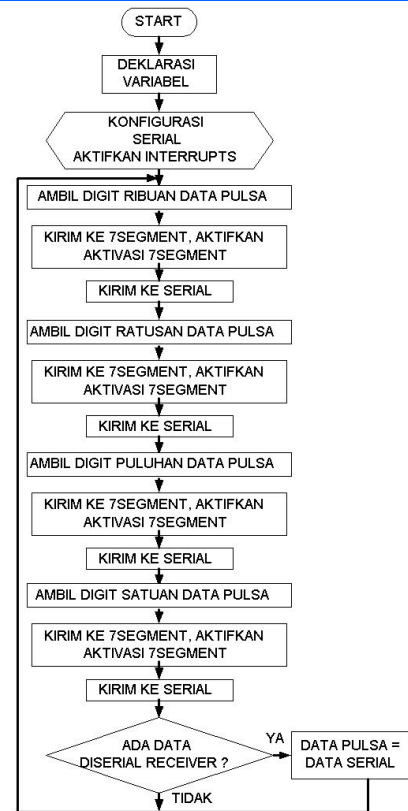


Figure 6 Flowchart AVR (3)

C. While the existing software in the master control computer as a client of a tool made designed using the Delphi programming language 7. flowchart software on the master control computer is shown in Figure 7.

IV. RESULT OF TOOLS TESTING

The parts of the system being tested include: transmisi data over the network between a tool created by the master computer control, and testing of motor response to the speed setting.

- Testing the comparison of data received by the data sent in the network configuration is done with peer to peer, through switches, dam via hotspot. Of the three configurations is obtained the same results as shown in Table 1 with the data sent from the tool and table 2 with the data sent from the master computer control.

- Testing the response speed of the motor to the speed set is performed to determine the response speed of the motor as well as the characteristics of the PID controller are made in equating the motor speed to the speed setting. From experiments found that for speed 2500 rpm, corresponding K_p of 0.5, K_i and $K_d = 0:02 = 0:01$,

Testing done by looking at the response speed of the motor at speed setting.

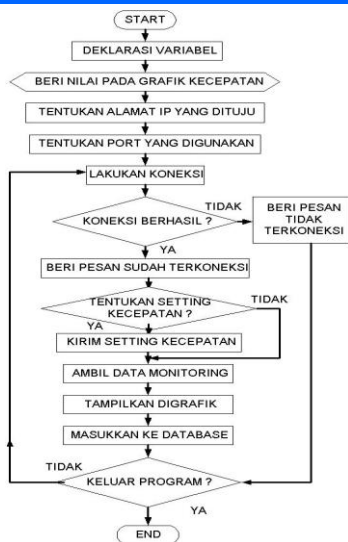


Figure 7 Flowchart Client Program

Table 1 Results of the transmission of data from the tool to the Client

Delivery to	Data sent from the tool (rpm)	Data received client computer (rpm)
1	0	0
2	1	1
3	10	10
4	50	50
5	100	100
6	500	500
7	1000	1000
8	1525	1525
9	2010	2010
10	3500	3500

Table 2 Results of the data transmission from the client to the tool

Delivery to	Data sent from the tool (rpm)	Data received client computer (rpm)
1	0	0
2	1	1
3	10	10
4	50	50
5	100	100
6	500	500
7	1000	1000
8	1500	1500
9	2000	2000
10	3500	3500

100 rpm, 500 rpm, 1000 rpm, 1500 rpm, 2000 rpm, 2500 rpm, 3000 rpm and 3500 rpm. Image response of the motor speed of 100 rpm speed settings shown in Figure 8.

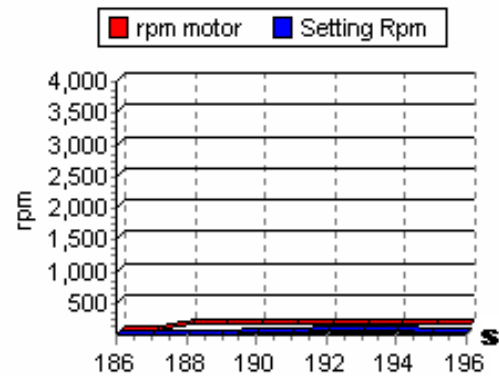


Figure 8 Response motor for speeds of 100 rpm

- Pictures response of the motor speed at 500 rpm speed settings are shown in Figure 9.

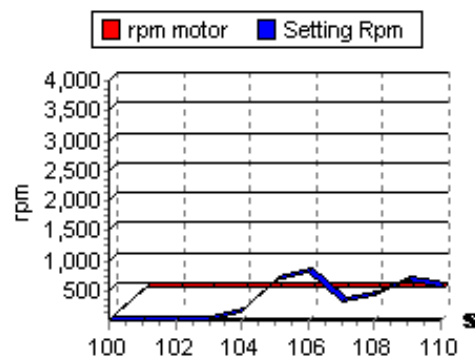


Figure 9 Response motor for speeds of 500 rpm

- Pictures response of the motor speed at 1000 rpm speed settings shown Figure 10.

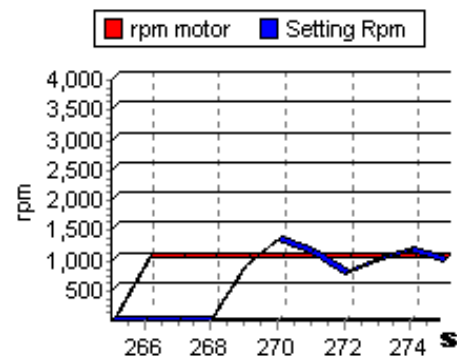


Figure 10 Response motor for speed 1000 rpm

- Pictures response of the motor speed at 1500 rpm speed settings shown in Figure 11.

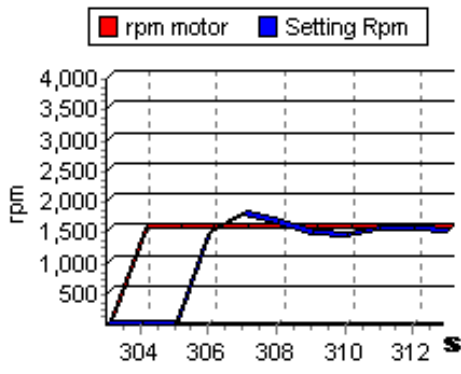


Figure 11 Response motors for speed 1500 rpm

- Pictures response of the speed of the motor at a speed of 2000 rpm settings shown in Figure 12.

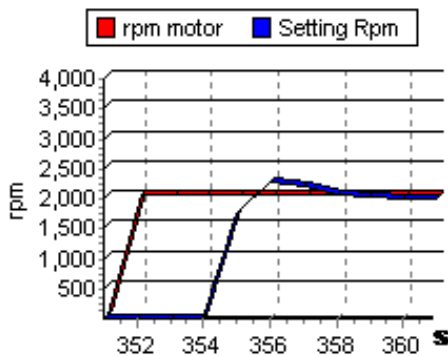


Figure 12 Response to a speed of 2000 rpm motors

- Pictures response of the motor speed at 2500 rpm speed settings shown in Figure 13.

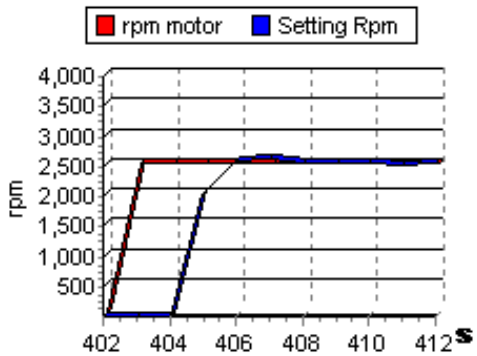


Figure 13 Response motors for speed 2500 rpm

- Pictures response of the motor speed at 3000 rpm speed settings shown in Figure 14.

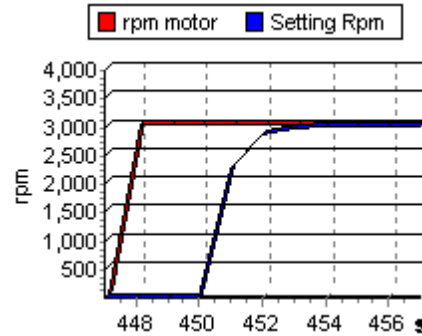


Figure 14 Response motors for speed 3000 rpm

- Pictures response of the motor speed at 3500 rpm speed settings shown in Figure 15

Of the various speed settings that were tested contained steady state error. Table 3 shows the average error rate that occurs from a variety of testing speed settings, the average error is taken from 10 data retrieval steady state.

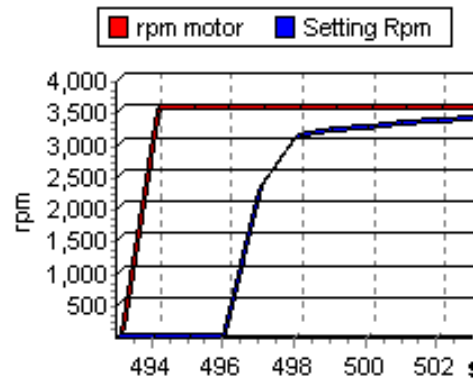


Figure 15 Response motors for speed 3500 rpm

Table 3 the average error steady state of the various

speed settings	Average error (rpm)
100	33.4
500	252.2
1000	24.6
1500	21.2
2000	14.4
2500	10.2
3000	8.6
3500	4.2

V. CONCLUSION

The conclusion in the design and manufacture of this system are:

- In communications using TCP / IP data sent to the data received will be the same (0% error) for TCP/IP is a connection oriented communication is communication that always check the communication that occurs and check data by using error detection to transmission.
- To be able to communicate in a network a device should be recognized in the network.

- In this study the transmission medium does not affect the suitability of the data sent to the data received.

- To get a fast response speed motor with minimum error should use a closed-loop controller.

VI. REFERENCE

[1] MCS Electronics Team, *Easy TCP/IP guide*, MCS Electronics, www.mcselec.com. D. Ardiyansah, *Teknologi Jaringan Komputer*, www.ilmukomputer.com.

[2] W. Kelik, *Pengantar Pengkabelan dan Jaringan*, www.ilmukomputer.com.

[3] T.P.M. Hutapea, *Pengantar Konsep dan Aplikasi TCP/IP Pada Windows NT Server*, www.ilmukomputer.com.

[4] ATMEL CORPORATION, *Microcontroller with 16K Bytes In-System Programmable Flash:*

ATMEGA8535, 2003.

[5] Tim Wahana Komputer Semarang, *Penanganan Jaringan Komputer*, ANDI OFFSET, 2001.

[6] L. Hendrawan dan B. Wijaya, *Implementation of Embedded Web Server for Remote Control and Monitoring Based on AVR ATMEGA16*.

[7] International Conference on Instrumentation, Communication and Information Technology (ICICI) 2005 Proc., August 3 -5, 2005, Bandung, Indonesia.

[8] Wiznet INC, *W3100A Datasheet*, Wiznet Inc, www.WIZnet.co.kr.

[9] D. Purwanto, *Electronic Control System*, Jurusan Teknik Elektro ITS.

[10] ---. *Protokol TCP/IP*, Prasimax, Teknologi Departemen Center, 2002