

The Real Monitoring of Three Phases Power Based on Microcontroller Which Can Be Readed Online (Case Study in Laboratory of Microprocessor of Padang State Polytechnic)

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Abstract

The development of more modern technology, requires us to constantly develop the technology of electrical measurement from the conventional system into a digital system that works in real time. Using the tools of three phases power monitoring system to be able to see how much power is used, which is known from the current load on the phase R, S and T are detected and processed by the arduino would facilitate implementing monitoring with display the power on the LCD. In addition to the application of the Ethernet Shield, the data can be stored in a MySQL database and can be displayed on the web, so that implementers can monitor periodically checks easily, anywhere, anytime while connected to the ethernet.

Keywords : *arduino Ethernet Shield, ethernet, load, monitoring, mysql*

1 INTRODUCTION

Along with the development of technology, it takes practicality in all respects, including the implementation of the monitoring system in real time. One application of monitoring technology is the amount of electricity monitoring system in real time. One of the benefits obtained by the measurement of electrical quantities in realtime is monitoring the use of electrical energy. This monitoring aims to get the latest data and the data can be processed to get the chance of electrical energy efficiency.

Real time monitoring of electrical quantities of data will be measured using CT sensors, the sensor readings forwarded to the microcontroller for processing and then stored in database. To display the existing data in the database is displayed through a web browser. Making it easier for admins to see the results of the current sensor circuit in the form of graphs. For the manufacture of GUI is used PHP software, Ajax and Java script. By using real time technology is expected to provide the following benefits :

1. Can display the electrical quantities of data in real time.

2. Process the data of the electrical quantities to obtain accurate data relating to the quality and quantity of the electrical quantities.

Research About the real time monitoring of these previously been done by Yusnan Badruz-zaman in 2012. Commercial products which contain real time data monitoring program has also been made by one brand that operates in the field of industrial automation, namely Schneider Electric. They launched called ION Enterprise software. Power Logic ION Enterprise is a software that provides a complete power management solution for energy providers and industrial or commercial operations. This software provides engineering and management information they need to cut costs related to energy, avoid downtime and optimize the use of equipment.

1.1 The Three Phases Systems

In the 3-phases power system, ideally electric power generated, distributed and absorbed by the load everything balanced, P generation = P usage, and also on a balanced voltage. In a balanced voltage 1 phase consists of a voltage having the same magnitude and frequency but between one phase to another have a phase difference of 120° electricity, while physically have a difference of 60° , and can be connected in star (Y, wye) or triangle (delta, Δ , D) (Srividya Devi P., Pusphalatha D.V. and Sharma P.M, 2013) . The number of power supplied by a generator 3 phases or the power absorbed by the load 3-phase, obtained by summing the power of each phase. In a balanced system, the total power equal to three-phases power, because power in each phase is the same (Katsaprakakis, et.al, 2008) If the angle between current and voltage is equal to θ , then the amount of power each phases are :

$$P_{phase} = V_{phase} \cdot I_{phase} \cdot \cos \theta \quad (1)$$

while the total amount of power is the root multiplication three of the amount of power per phase, and can be written by

$$P_T = \sqrt{3} \cdot V_f \cdot I_f \cdot \cos \theta \quad (2)$$

1.2 Electrical Power

1.2.1 Active power

Active power is commonly used by consumers. Active power is what usually can be converted into work. Unit active power expressed in watts. Active power (real power) (Suryatmo, 1997) obtained from the equation:

$$P = V \cdot I \cos \theta (kW) \quad (3)$$

1.2.2 Reactive power

Reactive power is the amount of power required for the formation of a magnetic field. From the formation of the magnetic field (Suryatmo, 1997) . It will form a magnetic flux. Reactive power unit expressed in Var obtained from the equation :

$$Q = V \cdot I \cdot \sin \theta (kVAr) \quad (4)$$

Table 1: .Comparison of ADC with Current Measured Value In Each Phase Value

ADC Value	Current Measured (A)	ADC Value	Current Measured (A)
512	0	744	2.81
533	0.15	786	3.25
561	0.61	829	3.75
592	1.02	873	4.19
626	1.5	918	4.68
663	1.82	964	5.03

2 RESEARCH METHODOLOGY

In this section, presented a brief discussion of the design and implementation of the system and explained about how the system works contained in the outline of the design of the system and is followed by a description of the hardware (hardware) which consists of several parts that serve to cultivate the data. Kemudian followed by design and the creation of software.

2.1 Design of Hardware

2.1.1 Electronics circuit 3 Phases Power Monitoring Tool

Figure 1 above shows the electronics circuit of 3 phases power monitoring tool. The circuit is divided into five parts, namely (1) the current sensor circuit R. (2) current sensor circuit S, (3) current sensor circuit T, (4) Circuit Microcontroller ATmega3128, (5) LCD circuit.

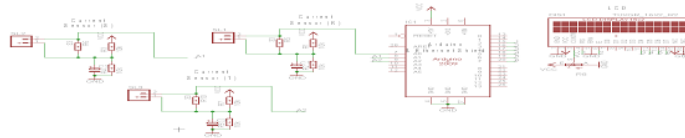


Figure 1: electronics circuit 3 Phases Power Monitoring Tool

2.1.2 Current Sensor circuit with CT Sensor

Current sensor is designed using CT sensor. These sensors change the magnitude of the primary current into the secondary current magnitude with a certain ratio and phase angle difference has nearly zero on the polarity of the corresponding relations (Open Energy, 2014). Magnetic Field happens to the conductor plate will be captured and converted to a DC voltage. This output will be forwarded to the microcontroller ADC PORT namely A0, A1 and A2 are previously passed several supporting components. Then the output will be converted into units of amperes in accordance with the current read on the measuring tool pliers amperes. Here is a table 1 that shows the results of the conversion.

2.2 Implementation of the Arduino Ethernet Shield with Electronic circuit 3 Phases Power Monitoring Tool For WebClient

The arduino used in this research is arduino UNO with ATMEGA 328 microcontroller coupled with Ethernet shield as a connect arduino to the computer network (Fadilah, 2012). To make arduino for a webclient, arduino should dicoding then advance in accordance with the procedures to be coding arduino for webclient that can transmit data from current censor circuit to the server and all the data sent by the current censor circuit will be stored in the database.

2.3 Design of Software

In the design and manufacture of software in this study, the current censor communication with the microcontroller and the entire process using the C language software arduino IDE. While on the microcontroller communication with the server using PHP programming language to be sent and stored in the database using PHP application MyAdmin, this application is displayed via a web browser using PHP software, Ajax and Java script.

2.3.1 Flowchart Software

The following Figure 2 is a flow diagram in the software program

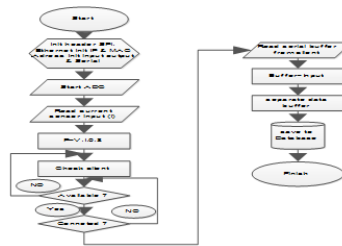


Figure 2: Flowchart Software

From the flow chart above can be explained, first performed declaration Ethernet, IP and MAC address of the ethernet shield and baud serial 9600. The data from the sensor is in the analog data form, thus arduino which has a ADC series (Analogue Digital Converter) will convert the analog data to digital data to be displayed on the analog read serial. Besides to read and display the serial value of the load current read, arduino UNO is a means of control of the results is issued, where the read current value will be multiplied by the ADC. The formulation which multiply to the ADC obtained from regression theory, so that the value of the square of the data errors to a minimum, so that even though there will be differences of each increment of data, after which is given the formula can be approached precision. Using the comparison data source between the measured data by data ampere pliers tool and data of current censor readings. Which has been converted and then inserted into the equation of the active data :

$$P = V.I. \cos \theta (kW) \quad (5)$$

Table 2: The Test of Current sensor

Number of lights (pcs)	Power (Watt)	ADC Data	Measured Current with plier Ampere (A)	Measured Current with sensor (A)	Error
No load	0	512	0	0	0
1	100	533	0.15	0.2	0.05
2	200	561	0.61	0.6	-0.01
3	300	592	1.02	0.98	-0.04
4	400	626	1.5	1.48	-0.02
5	500	663	1.82	1.8	-0.01

Where V is the voltage grid = 220V, while cos angle between current and voltage = 0.8. After that, the serial data from each phase R, S and T are sent to the database via the ethernet shield.

3 RESULTS AND DISCUSSION

Based on the specifications and work systems described earlier, then further testing of the system. The purpose of this test is to determine whether the systems that have been made are in accordance with previous plans.

3.1 Current Sensor Testing

Testing to the results of current sensor readings with measured current using a measuring tool pliers ampere. The purpose of this test is to determine the accuracy of the sensor to the measured electrical quantities. To determine the error deviation between the sensor readings data and the measured data at measuring tool pliers ampere, used the following equation :

$$Error(\%) = \frac{\text{Difference between the sensor value and measuring instrument value}}{\text{measuring instrument value}} \times 100\% \quad (6)$$

The result of Current sensor test can be seen in Figure 3 and Table 2 below



Figure 3: The result of Current sensor test

From the measurement results can be seen, that the average value of the resulting error is small enough so that the current sensor design fit for use.

3.2 The Testing Results Overall

This system testing conducted in the room of microprocessors laboratory, Padang State polytechnic. This system is built with the database server located in the room of the puslabkom Padang State polytechnic and webclient. Untuk webclient used arduino UNO AT-MEGA 328 coupled with the current sensor circuit and Ethernet shield which serves to

Table 3: Phase Power data R, S and T

load attached	Power (Watt)		
	R	S	T
No Load	0	0	0
AC On 1 pcs	625	192,24	6.1
AC On 2 pcs	1042.67	173,84	6.1
PC On 4 pcs	15.107	192,24	529,55
Lecturers room Lamp On	15.1	173,84	6.1
Practising room Lamp On	15.1	173,84	6.1
Technicians room Lamp On	15.1	173,84	6.1

connect the arduino to the computer network, so that all the data captured by the sensor circuit current in each phases R, S and T can be submitted online and are stored in the database server to be analyzed.

The test of arduino as a webclient using the HTTP protocol, arduino successfully used as a webclient, evidenced by looking at the existing database on the server. When arduino, ethernet shield and circuit power current sensors transmit data on phases R, S and T, the data will go directly to the database server and displayed in a web browser in real time. Views from the web browser and its database can be seen in Figure 4. For graphs of arduino as webclient can be viewed by accessing URSL: <http://kontrol.polinpdg.ac.id/tigaphase/fgrafik>



Figure 4: web browser GUI Display acquisition phase power R, S and T in the microprocessor laboratory

In figure 4 above views the data sent by the arduino as webclient. On the label appears the date, time and total power consumption. For the blue graphic is power data R, graphic black is power data S while the green graph is the power of T. Based on the chart above can be a data phase power R, S and T is sent to the web browser, which served into table 3

In the laboratory of microprocessor attached 2 pieces AC, Computer in practising room and lighting in the lecturers room, technicians and practising room. From the data of table 3 above can be seen that the air conditioning in the laboratory room microprocessor connected to phase R, computers in the practising room connected in phase T while the lights in the room are not connected to the panel room. Look no unbalanced load on each phase R, S and T. The data shown in the web browser will not appear immediately, because data is first entered into the database, then the data will be parsed into a web browser, the data phase R, S and T in the database PhpMyadmin can be seen in the picture below.

In the table 4 above, shown power on phase the R, S and T are sent to the database, table 4 shows the data that is sent to the web browser same with existing data in the database, there are : the phase R = 1042.67, S = 192.24 and T = 529.55, with testing 2 pieces air conditioner are on, 4 pieces personal computers are on, all the lamps in technicians, lecturers and practising room are turn on. The data on this database PhpMyadmin that will be parsed into a web browser to display a graph form.

Table 4: Display Database in Server

id	tgl	waktu	r	s	t
1	1/10/2014	13.26.51	1042.67	282.19	545.91
2	1/10/2014	13.26.54	1042.67	192.24	529.55
3	1/10/2014	13.26.57	1042.67	224.95	529.55
4	1/10/2014	13.27.04	1042.67	93.03	531.6
5	1/10/2014	13.27.57	1042.67	173.84	550
6	1/10/2014	13.27.57	1042.67	100.25	558.17

To test arduino as webclient is successful because arduino as webclient has successfully transmit power in phase R, S and T are captured by the current censor circuit to be sent to the server, which then power the data on phase R, S and T will be displayed to the web browsers in the form of graphs.

4 CONCLUSION

The conclusion from this research are as follows. The test of arduino become HTTP-based webclient was successful, proven with the power of data on phases R, S and T, each of which uses a flow sensor of this research is done, it can be sent by arduino to the server, evidenced by power data in phase R, S and T on the arduino is phase R = 1042.67, S = 192.24 and T = 529.55 sent to the web server and the data stored in the database.

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