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Power Measurement System Prototype Design Used in Household Loads with The Arduino

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ABSTRACT

Modernization is indeed very influential in people's lives today, with the existence of this modern era everything is always related to technology. Apart from that, the use of household appliances and electricity also follows in accordance with existing developments, as seen by the development of prepaid electricity meters, which are all digital. However, with this existence, the community has not been able to control and monitor the use of electric power in detail. From the description of the problem above, the researcher found an idea to make a prototype Electric Power Monitoring tool that can work automatically. This tool uses an Arduino microcontroller coupled with a PZEM-004T Current, sensor, and along with an LCD. The way this tool works is to detect incoming electrical arcs, input from a load of electrical equipment on the PZEM 004T sensor, then systemically the sensor will receive the incoming arcs then the anus is directed to the microcontroller module. Arduino to convert systemically with the calculation of the power formula (Wh) Wh = Ixt (Ares x time) so that it will get the results of the electric power used during use in the form of current, days, voltage, cosphi, and KWH costs.

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1. INTRODUCTION

Electricity users in the household sector do not know in detail which household electrical appliances consume electricity. So that users feel the use of electricity is wasteful. The amount of electricity used is affected by the load of the electrical equipment and the duration of use of the electrical equipment. It is possible that equipment with a small power load with long use consumes more power than equipment with a large power load but uses it for a short time.

There are two services offered by PLN to consumers in Indonesia, namely prepaid and postpaid electricity. Prepaid electricity is like top-up pulses on cell phones, customers first buy credit (vouchers or refill electricity tokens) which can be obtained through ATM outlets of a number of banks or through online electricity bill payment counters. Meanwhile, for postpaid electricity, customers pay bills every month. PLN officers regularly check the electricity usage of customers who use a postpaid electricity system. Even though there are many advantages to using prepaid electricity, there are still many users who use postpaid electricity, according to the pln.co.id website the number of prepaid electricity users in 2013 was only 24% of the total 42.5 million households customers, swelling of prepaid electricity could occur. payment of monthly electricity fees because it does not have a monitoring control feature that is owned by postpaid electricity.

Regarding the shortage of prepaid electricity that was complained about in the case study, a system is needed that can monitor electricity usage in a residence. This can be circumvented by a system called Arduino which can connect current sensors. Where the Arduino application acts as a measure of the load

power that has been used in residential homes, then the power that has been used can be monitored through the LCD screen.

2. METHOD

In conducting this research, the type of research used is qualitative research with experimental methods. This type of research was chosen because the author considered this type to be very suitable for the research carried out by the author because he developed a tool and conducted research in the form of experiments on the author's research object. The research location and tool design are carried out at the author's residence.

In designing the prototype application of Arduino as the main component of the power measuring system used in household loads, this is to design a system that utilizes the PZEM-004T module as a current and voltage meter and Arduino Nano as a processing medium.

This series of power measuring devices consists of several main components, namely:

1. Arduino Nano 1 piece
2. PZEM-004T Module 1 piece
3. Alphanumeric LCD 1 piece
4. 9 Volt AC-DC Adapter 1 piece

The circuit design is to install the components based on the intended work system. The design of the overall component circuit is shown in the figure below:

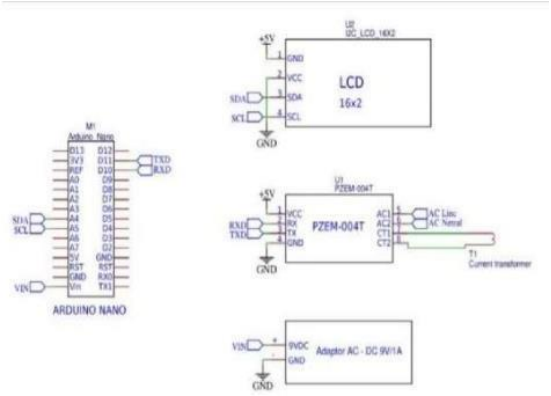

Figure 1. Overall system circuit

3. RESULTS AND DISCUSSION

3.1. PZEM-004T Sensor Testing

After designing the PZEM-004T Sensor with Arduino Nano, a test was carried out to ensure that the sensor is functioning. The sensor for measuring the parameters of rms voltage, rms current, active power, and power consumption (wh) on the PZEM-004T sensor carried out 2 voltage tests, such as input and output tests. The results of testing the sensor

PZEM-004T can be seen in the table below. Testing the PZEM-004T Sensor can be seen in the table below.

Table 1. Testing the PZEM-004T sensor

PZEM-004T Sensor	Voltage (v)
Inputs	204 AC
Outputs	4,97 DC

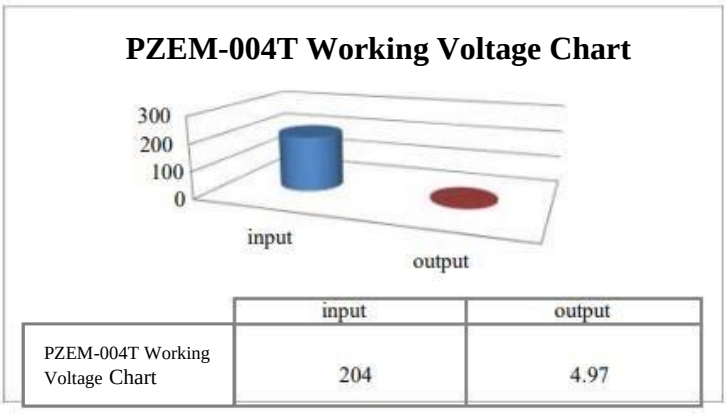

Figure 2. Graph of the working voltage of the PZEM-004T

3.2. Adapter Testing

System design requires a power supply to supply voltage to the system, then testing is carried out to ensure that the adapter is functioning. On the adapter, 2 voltage tests are carried out, such as input voltage and output voltage. The test results can be seen in table 2

Table 2. Adapter testing

Adapter	Voltage (v)
Inputs	207 AC
Outputs	9,43 DC

3.3. Testing the PZEM-004T sensor is loaded and before it is loaded

The design of the PZEM-004T sensor is then tested for ensure that the PZEM-004T sensor functions when it is loaded. On the sensor, one monitoring system is carried out in the LCD display, such as how many amperes (A) after being loaded. The results of testing the PZEM-004T sensor when it is loaded can be seen in table 3.

Table 3. Testing of the PZEM-004T sensor under load and before loading

PZEM-004T Sensor	Voltage (v)
When under load	0,06A
Before being loaded	0,00A

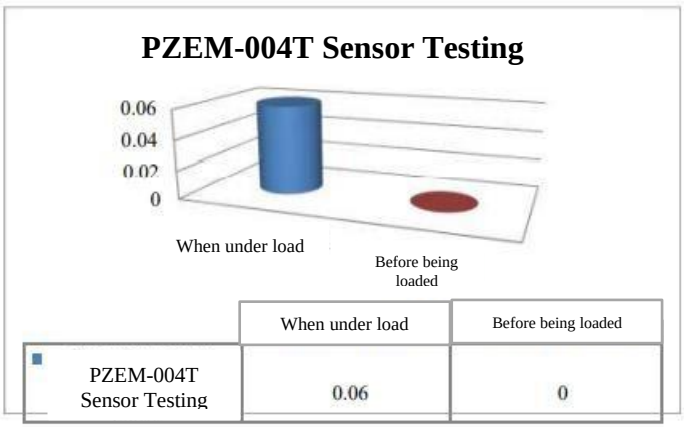

Figure 3. PZEM-004T sensor testing graph

3.4. PZEM-004T sensor when Energy is used and financing

The design of the PZEM-004T sensor is then tested for ensure that the PZEM-004T sensor functions when it is loaded. On the sensor, 2 monitoring systems are carried out on the LCD display, energy used and financing. The PZEM-004T sensor when energy is used and financing can be seen in table 4

Table 4. Energy used and financing

PZEM-004T Sensor	Energy (w) and cost (Rp)
Energy used (w)	334.00
Financing (Rp)	451.57

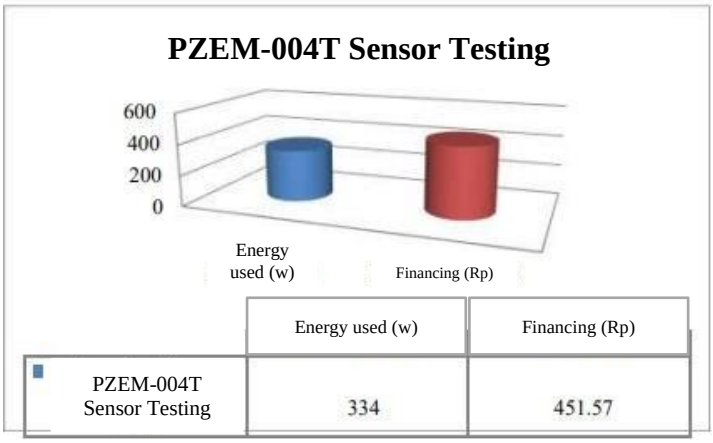

Figure 4. Graph of the relationship between used energy and financing

3.4. Testing the PZEM-004T sensor RMS current and power

The design of the PZEM-004T sensor is then tested to ensure that the PZEM-004T sensor functions when the entire system is connected. On the sensor, 2 monitoring systems are carried out in the LCD display in the form of current and RMS power of the PZEM-004T sensor. The PZEM-004T sensor RMS current and power can be seen in table 5

Table 5. Testing the current and RMS power of the PZEM-004T sensor

RMS sensor PZEM-004T	(A) and (W)
Cos phi	0,56
Power	0,07

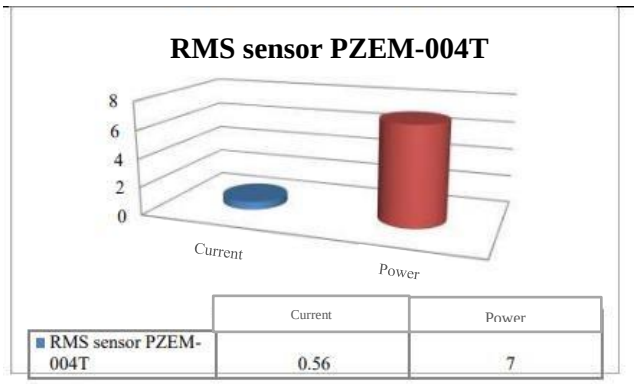

Figure 5. Cosphi test graph and RMS power sensor PZEM-004T

4. CONCLUSION

Based on this final project, a prototype of the Arduino application has been successfully created as the main component of the power meter system. After carrying out several stages of testing on the prototype, it can be concluded that:

1. A prototype power meter system has been created using Arduino as the main component for measuring and monitoring the electrical power that has been used in household loads. By using this system, the process of monitoring electric current power can be carried out in real time according to the condition of the device or load that enters the PZEM-004T sensor.
2. In the testing process, this tool can calculate the power cos phi based on the calculation of several household loads connected to the PZEM-004T power sensor and can be displayed on the LCD screen.
3. At the time of testing when a load is given within 1 hour, an energy of 334.00 W is obtained and the cost is IDR 451.57

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