NodeMCU Microcontroller Based Electrical Energy Consumption Monitoring System

Raafi' Yanuar Purnama Arifian[1], Denny Irawan[2]
Department of Electrical Engineering
University of Muhammadiyah Gresik
rafi.arifian1@gmail.com[1], den2mas@gmail.com[2]

Abstract

Electricity is one of human needs in everyday life. Based on these problems, this research was carried out, with the aim of creating a prototype to record electrical power loads and display the amount of electricity consumption in rupiah levels to monitor electrical energy consumption and convert it into rupiah. To conduct this research, the author used observational research methodology or field study and literature study. In this research, it is necessary to pay attention to understanding how to think and how to carry out the results of thinking according to scientific steps. By conducting this research, researchers hope to be able to find out data on daily electrical energy consumption and prevent electricity waste.

Keywords: Electrical Energy; Monitoring System; PZEM-004T; Microcontroller.

1. Introduction

Electricity is one of human needs in everyday life. In Indonesia, there is a state-owned company, namely PT Perusahaan Perusahaan Listrik Negara (Persero), which is the only electricity producer serving all regions of Indonesia. Measurements are usually carried out using simple measuring instruments and recording is still manual so that the data obtained cannot be done all the time and the results take too long to obtain. Therefore, previous research has been carried out, "Rancang Bangun Monitoring Pemakaian Energi Listrik Maksimal 1000W Berbasis Smartphone Android via Wifi". In this study, researchers discussed how to monitor electrical energy via Android via WiFi, with a NodeMCU microcontroller, LCD and PZEM-004T sensor. This tool system has the advantage that it does not require many modules, the disadvantage is that the tool system does not have a data record from the testing tool.

Meanwhile, in another research on "Prototype Monitoring Energy Dan Biaya Listrik Tiap Ruang Menggunakan Telegram Apk Berbasis Mikrokontroler Atmega2560 Pada Rumah Hunian". Researchers discussed how to monitor home electricity via the Telegram APK. Using modules in the form of Atmega2560, NodeMCU, ZMPT101b Sensor, SCT-013 Sensor, TFT LCD and Telegram Application. The advantage of this tool is that it consumes electrical energy via a telegram bot. The drawback is that it cannot display data on electrical energy consumption records that have been tested.

With updates from subsequent researchers to make it easier to monitor electrical energy in real time with a module. Consisting of a PZEM-004T sensor which is used to measure single-phase AC voltage and current, a microcontroller used by NodeMCU which will process the sensor results, display using a Liquid Crystal Display (LCD) type 16x2 to display data on current, voltage, power, electrical energy consumption. To record data using XAMPP which functions to manage the host and can be displayed via the website in real time and must it connected to Wi-Fi. Therefore, the title of this thesis is "NodeMCU Microcontroller Based Electrical Energy Consumption Monitoring System". Through this device we can combine the use of electrical energy at any time by receiving information from the 16x2 LCD and the website.

2. Research Methodology

This chapter explains the design, method, or approach used to answer research problems to achieve research objectives. The explanation includes research parameters, models used, research design, data acquisition techniques and data analysis and theories supporting research implementation.

Picture 1. Tool Completion *Flow Chart*

Related Literature

The research method begins with literature study, namely searching for information through books, journals, articles and the internet related to the elements used in this research. Direct sources are obtained from discussions or consultations with lecturers or people who have competence in this field. The literature studied are:

1. *Sistem kendali dan monitoring listrik rumahan menggunakan ethernet sheeld dan rtc (real time clock) arduino*
2. *Prototype monitoring energy dan biaya listrik tiap ruang menggunakan telegram apk berbasis mikrokontroller atmega2560 pada rumah hunian*

Hardware Design

At this stage, a NodeMCU microcontroller-based electrical energy consumption monitoring system is designed which has a maximum current limit of 100A. The power source will later be monitored via a 16x2 LCD by activating the PZEM-004T sensor. The sensor reads the current and voltage and then displays it on the 16x2 LCD display. Displays power, voltage, current, energy and total cost of electrical energy usage.
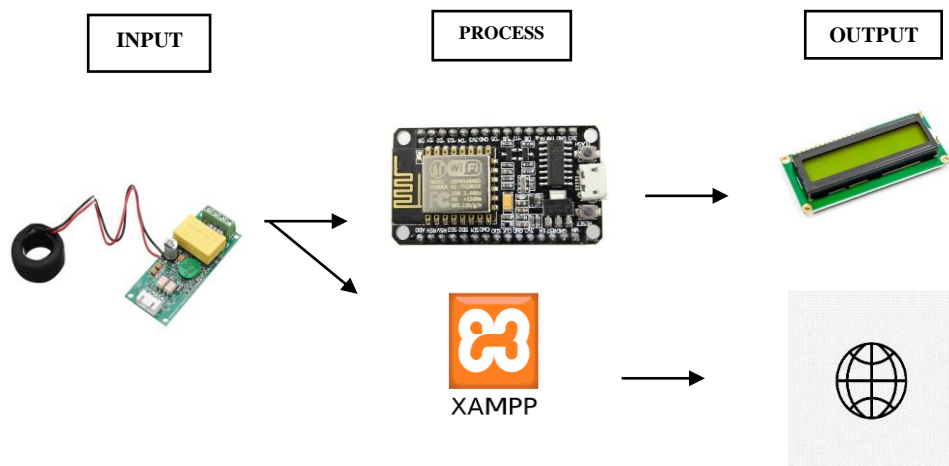
Picture 2. System Block Diagram

Software Design

Here is the system flow of how the tools described work.
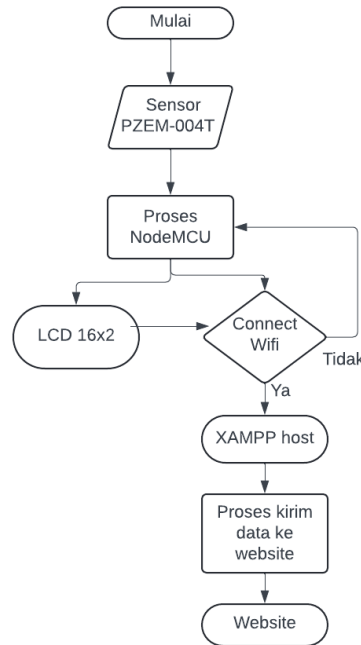
Picture 3. Software *Flow Chart*

The initial display processes the data that has been obtained by the PZEM-004T sensor. For power, voltage, current can be displayed directly, for the amount of power it is calculated in the formula :

$$kWh = \frac{Power\ detected}{1000}$$

To display electricity costs, it is calculated in the formula:

$$Cost = kWh\ Total\ x\ cost\ per\ kWh$$

The results of the sensor input for current, voltage, power and the number of kWh of electricity, costs will be displayed on the 16x2 LCD and the website displays this data in real-time.

Design Interface Website

At the beginning, there are columns for power, voltage, current, amount of power and amount of charge.
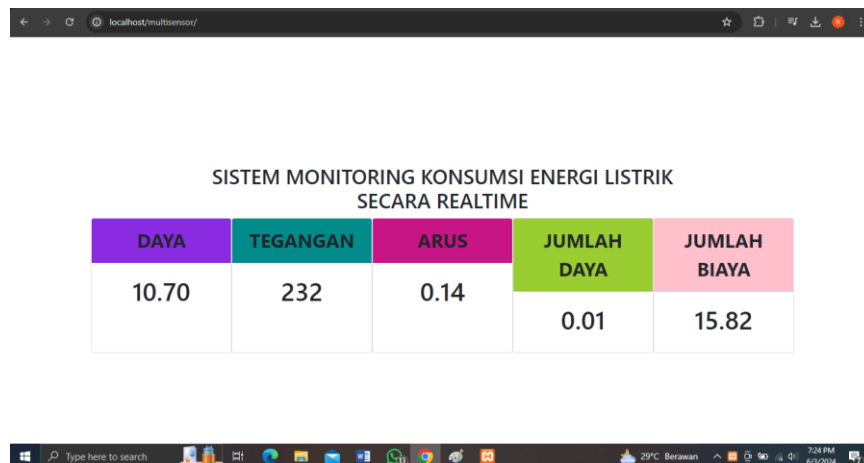
Picture 4. Website Interface

3. Findings and Discussion

In testing this tool, several tests were carried out on both the software system and the hardware. The purpose of this test is for the results obtained to be analyzed. The following is a test on the parts including:

Software:

A. Arduino IDE for microcontroller programming.

B. XAMPP to create host a website.

Hardware:

a. PZEM-004T sensor as a power, voltage and current detection sensor.

b. NodeMCU as a microcontroller.

c. 16x2 LCD as interface display.

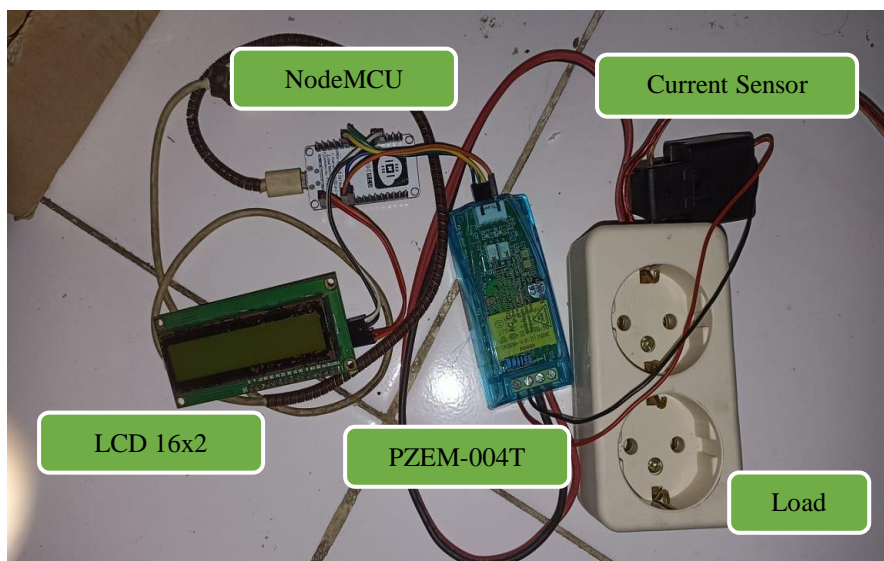**Tool testing results**

Based on the tool testing results that have been carried out, the results obtained are as follows:

Sample	Power(W)	Voltage(V)	Current(A)	kWh Total	Cost
Mini rice cooker	464,5	227	2,5	0,46	Rp. 627,06
Mini fan	5,1	230	0,05	0,01	Rp. 6,9
Iron	402,4	228	1,77	0,4	Rp. 544,59
Charger laptop	11,9	231	0,16	0,01	Rp. 17,17

Table 1. Tool testing results

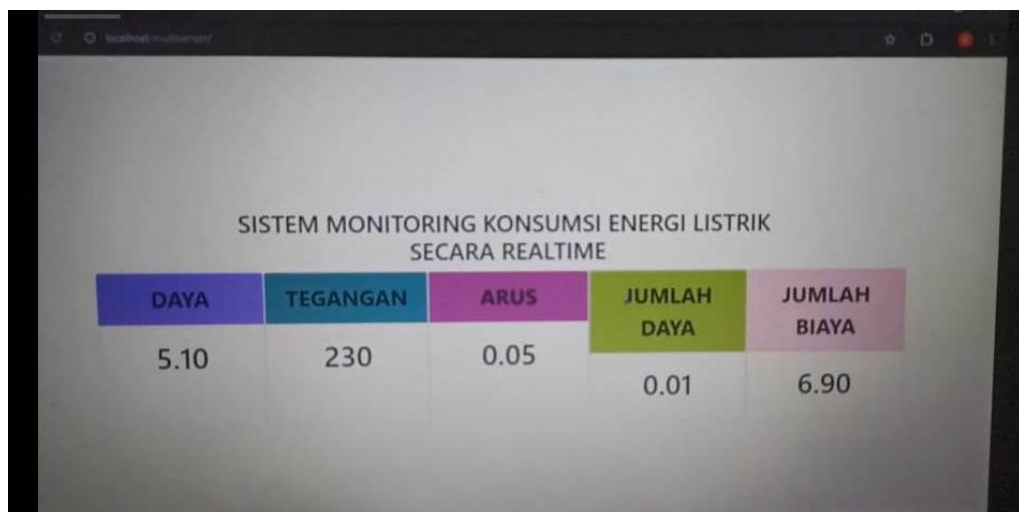**Wiring system tools**

Picture 5. Wiring system tools

Testing Sensors and Microcontroller Software

Picture 6. The test displays power, voltage, current, amount of power

Picture 7. Software testing displays costs and sends data to the website display

Picture 8. Website testing displays power, voltage, current, total power and total cost by the XAMPP host

4. Conclusion

From this research, the weakness of using the XAMPP database is that the XAMPP Control Panel ensures that the Apache and MySQL condition bars must be at action start, because to synchronize the data processed from the NodeMCU, the XAMPP state must be connected to standby so that the website can display data in real-time as the PZEM-004T sensor runs. and the website produces the same data as the data displayed on the 16x2 LCD.

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