Remote Electrical Parameters Measurement Using The Blynk Application

Setiyono

Electrical Engineering Department, Universitas Gunadarma, Jakarta Indonesia

*Correspondent author: setiyono@staff.gunadarma.ac.id

Received: September 18, 2022

Accepted: September 26, 2022

Abstract
The recording of the amount of electrical energy consumed by the public on postpaid electricity customers often experiences reading errors by officers. The contributing factor is the absence of occupants of the house when recording the amount of power used by the officer so that the officer records the use of electrical power based on the average previous use. Therefore, to find out the amount of electrical energy that is being used, a periodic electrical energy monitoring system is needed. This device is designed to support monitoring the use of electrical energy in household consumers. Arduino Uno as a microcontroller-based atmega28, current sensor, and voltage sensor are supporting devices used as a monitoring system for the use of electrical energy that can provide information on electrical parameters such as voltage, current, power values, using the blynk application by utilizing the development of Internet of Think technology (IoT) so that the use of electrical power can be seen anytime and anywhere via the internet network. This tool has an average reading error value of 13.68% for current and 14.06% for power. Based on these data, this system is very suitable to be used for monitoring electric power consumption because the error generated is quite small.

Keywords: blink application, remote electric power, internet of thing, electric power consumption, PLN consumers

1. Introduction

Electrical energy is one of the primary needs that is very important for human life where almost all activities require electrical energy. The electricity needs of the Indonesian people are supplied by the Perusahaan Listrik Negara (PLN) where every consumer is required to pay a fee for using electrical energy. The recording of electrical power that has been used can be seen on the installed KWH meter. PLN has two groups of household customers, namely prepaid and postpaid electricity customers [1]. On postpaid electricity customers, consumers can pay electricity bills for a period of one month of use. In fact, there are often errors in recording the amount of electricity consumption on the KWH meter by PLN officers which can cause losses for customers. This happened because during the recording process the KWH meter checking was done manually from homes. Problems occur when there are no occupants of the house, the
officer cannot record the KWH meter so usually, the officer will add the next month's bill based on the average usage of the previous month.

Internet of things Technology (IoT) is an information technology that continues to be developed until now. One of the implementations of this technology is applied to read and monitor electricity consumption remotely in real-time. This technology is an efficient and effective solution to provide information on energy consumption and the number of electricity bills to consumers [2]. The internet of things includes the part of computer science that provides methods and techniques for connecting various digital electronic devices to work automatically [3]. Amar Ma'ruf succeeded in developing a blynk application that is used to monitor voltage, current, and electric power factor parameters using a remote ZPEM-004T sensor with a current reading error rate of approximately 0.001, an average error reading of 0.1 for voltage and 0.02 for electric power factor [4]. Ratna Aisuwarya made a remote control system to turn on and turn off the performance of the water pump using a mobile application that can be accessed via a smartphone. However, the equipment built still has a reading error rate of 13.63% [5]. Deni Adiputra, created a monitoring system for electrical power usage and protection against electrical loads using Arduino Mega 2560 and Android in real-time.

The equipment built is equipped with a power limiter of 2 A (440 W) so that if the load draws more than 2A the system will cut off the power automatically [6]. Previous research related to power consumption has also been carried out, such as the use of the Internet of Things (IoT) technology, including Smart Home System Control and Monitoring, [7],[8], [9] monitoring substations at PLTU West Java. Monitoring and controlling digital equipment and electrical loads remotely in addition to using the help of IoT technology, of course, is also supported by a microcontroller as the control brain of a system. Node MCU ESP8266 microcontroller which is integrated with android smartphone using features IoT. The output obtained from this research is that it can control and monitor lights and fan [10]. Electrical equipment control household using Arduino Mega. microcontroller with ethernet shield Wiznet 5100 replaces the use of a computer that can be monitored and controlled via a web browser on a PC or smartphone from around the world via Internet Network [11]. Arduino microcontroller can be used as controller of a PJU system that displays the power parameters of a solar cell on a Web page [12]. The use of microcontrollers for other electrical equipment control applications in the same type of research is still being developed [13].

Other important supporting equipment is a current sensor and a voltage sensor. This equipment is needed to detect a large amount of electricity (current or voltage) which will be processed by the microcontroller into certain signals as information data. The PZEM-004T is a non-invasive CT sensor, for measuring electric current can be used for monitoring the use of electrical energy [14]. The LM35 temperature sensor and PIR sensor can be used to detect temperature changes in the number of people in the room. This information is sent to the data processing center to remotely control the performance of the air-conditioning equipment [15]. The SCT-013 sensor and relay module can be applied for remote control of household appliances with an average delay time of less than 1 second [16]. Current sensor ACS712 and ATmega 328 microcontroller made by ATMEIL, functioned as data processing equipment in a Real Time Electrical Energy Consumption Monitoring System [17]. Control of other electrical equipment can also use PLC (Power Line Communication) technology [18].

With so many cases as above, the author wishes to create a remote monitoring system for recording electricity consumption using the blynk application.

2. Material and Methods
Research Methodology

This research was related by building an electronic circuit that records voltage, current, and electrical power along with a list of programs to run a device that can be monitored remotely using the blynk application. In general, the system design can be seen in Figure 1.
Figure 1 describes the four main parts of the system design that was built, namely, the activator, input, process, and output sections. The design of this tool uses a DC 9 Volt supply voltage to operate the activator, Arduino Uno R3 and Ethernet Shield. The input section, consisting of a voltage sensor ZMPT101B, and a current sensor ACS712 supplied with a DC voltage of 5 V, this unit serves to provide logic signals to the process section. The Arduino Uno process block accepts analog data input from both sensors and processes it into an output signal. Ethernet Shield w5100 acts as an output signal sending medium, and requires a modem to connect to the internet network using an RJ-45 LAN cable. The blynk application is installed on a smartphone as a display of voltage, current, power parameters and the estimated costs to be paid for electricity consumption.

**Wiring Diagram and Hardware Implementation**

Each unit of the system design that is built and then connected to each other. The resulting hardware is then connected to the source of the nets to be tested and data taken from observations.

**System Software Design and Blynk Application**

The design of system software aims to find out what systems will be used in implementing a monitoring system tool for power current voltage and electricity cost estimates using the blynk application. This platform application is for the application of Mobile OS (iOS and Android) which aims to control Arduino, Raspberry Pi, ESP8266, WEMOS D1 modules, and similar modules via the Internet. This
application is a creative place to create a project's graphical interface that will be implemented only by the drag and drop widget method. **Figure 3** is an interface display for the monitoring system of the tool that was built in the form of 2 Gauge Widgets to display the values of Voltage, Power and Current, and a Terminal widget that displays electricity bill information in real time every one second. and the second is the Super Chart widget, this widget is useful for graphically viewing the overall performance of this monitoring tool, which can be set live, 15 minutes, 1 hour, 12 hours, 1 day even in 1 week.

![Monitoring system interface display](source: Researcher data (2019))

3. Results and Discussion

The sequence of work processes in detail and the relationship between one process (instructions) and other processes on this monitoring system tool are divided into 2 parts. The first part is a flowchart of how the tool works, and the second flowchart is to discuss the flow of using the application, these two flowcharts are interconnected with each other. **Figure 4** is a flow diagram of how the tool works, initial initiation by providing an input voltage of 9 volts DC to activate the Arduino Uno, Ethernet Shield, if the microcontroller device is not active then the experiment is complete and if the microcontroller is active it will automatically activate the sensor on the device, then connect to the modem via LAN cable, if it is not connected it will return to the beginning and if it is connected it will proceed to the next stage.

This monitoring system works if the electrical load gets electricity from a voltage source, but if the electrical load is not fed by a voltage source, the input source of this tool does not work. After the device is given a voltage, the sensor will record the input signal and be processed by the microcontroller. Furthermore, if the tool is given an electrical load, the system will measure and calculate the parameters of voltage, power current, and estimated electricity costs. If no voltage is connected, the sensor and microcontroller will only read the source of the electrical voltage.
Figure 4. The Sequence of work flow design system
Source: Researcher data (2019)
Figure 5 is the second flow diagram, namely the application on the device as an interface. The device was previously aligned with the source code. When you open the application, the device will initialize the application. If the client is not connected or fails, the user must manually repeat the application, and if the client is connected, the application will give a momentary delay to receive the data from the microcontroller. The application will read the incoming electrical load at the beginning of the calibration. Then when the tool is given input in the form of a new electrical load, the results of the new load will be displayed. It will repeat continuously according to input until the user restarts the application.

Programs Analysis

Source code consists of several parts, each part will be explained in several programs, such as initialization program, input program, and process program, this program is made using C language in Arduino IDE then uploaded to Arduino uno R3 with ethernet shield to connect to application blynk, the following program is used:

```c
#include <SPI.h>
#include <Ethernet.h>
#include <BlynkSimpleEthernet.h>
```

The initial part of the program listing for the blynk installation, often referred to as the header or library on the Arduino IDE, #include <SPI.h> is a library that specifically handles SPI serial communication (serial peripheral interface), then #include <Ethernet.h> this library which is used to activate the Ethernet Shield device module. Finally, the #include <BlynkSimpleEthernet.h> library that is used is the same for the ethernet shield module, rather it can connect well with the blynk application.
#define W5100_CS 10
#define SDCARD_CS 4
#define BLYNK_PRINT Serial

This section is used to initialize the pins used by the ethernet shield, then declare variables to determine the pins on the Arduino uno, pin 10 for the ethernet shield, pin 4 for use with the micro SD card reader and blynk_print serial. Built-in Blynk "print status" such as ASCII logo and ticked time messages [millis] such as "Connecting to.. printed on monitor serial port

    char auth[] = "ca65ae13bf2f466188faef541b8923a4"; double
daya, dayaaawal, dayatotal=0, biayaawal, biaya=0;
    //untuk tegangan
double
    sensorValue=0, sensorValue1=0;
    int crosscount=0, climbhill=0;
    double VmaxD=0; double VeffD; double Veff;  //untuk arus
double
    arus_temporary=0.0; float
    adc_Volt, cal_value, temp;

    unsigned long waktu_kalibrasi=0, kalibrasi=5;
    boolean
calibration=false;
    int vpi n = A0; int
    vpin1 = A1;

This section is the declaration of variables and data types used in programming in the form of char which functions as a grouping of variables with character or letter values. The double type is useful for storing real numbers. Int or integer that functions for grouping integers and unsigned long is the same data type as long, but is calculated from the number 0 or has a value ranging from 0 to 4,292,967,295 and is a boolean data type which only has 2 data, namely true and false. (false). Char auth is a code obtained from the blynk application for the validation process so that data between users will not be confused, the data used is appropriate in the box for the first two variables for the voltage sensor and the second for the current sensor variable.

BlynkTimer timer;
WidgetTerminal terminal(V1);

This Blynk Timer is used to perform a timed periodic action in the context of the void main () loop. Furthermore, the Widget Terminal (V1) is used to initialize the terminal widget that is used on the Virtual pin.
Voltage Measurement Results

Testing on the voltage sensor that enters the ZMPT100b sensor and is processed by Arduino and then displayed on the Blynk, the data obtained is a sample of 15 data taken for 3 days.

<table>
<thead>
<tr>
<th>No.</th>
<th>Date Time</th>
<th>Blynk Application Voltage (Volt)</th>
<th>Rate Voltage (Volt)</th>
<th>Voltage Error %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2019-08-01 10:27:00</td>
<td>208,478</td>
<td>198</td>
<td>5.29</td>
</tr>
<tr>
<td>2.</td>
<td>2019-08-01 10:28:00</td>
<td>196,924</td>
<td>198</td>
<td>0.54</td>
</tr>
<tr>
<td>3.</td>
<td>2019-08-01 10:29:00</td>
<td>192,728</td>
<td>198</td>
<td>2.66</td>
</tr>
<tr>
<td>4.</td>
<td>2019-08-01 10:30:00</td>
<td>189,335</td>
<td>196</td>
<td>3.40</td>
</tr>
<tr>
<td>5.</td>
<td>2019-08-01 10:31:00</td>
<td>195,212</td>
<td>198</td>
<td>1.41</td>
</tr>
<tr>
<td>6.</td>
<td>2019-08-02 19:06:00</td>
<td>188,923</td>
<td>186</td>
<td>1.57</td>
</tr>
<tr>
<td>7.</td>
<td>2019-08-02 19:07:00</td>
<td>190,329</td>
<td>187</td>
<td>1.78</td>
</tr>
<tr>
<td>8.</td>
<td>2019-08-02 19:08:00</td>
<td>194,991</td>
<td>187</td>
<td>4.27</td>
</tr>
<tr>
<td>9.</td>
<td>2019-08-02 19:09:00</td>
<td>180,238</td>
<td>186</td>
<td>3.10</td>
</tr>
<tr>
<td>10.</td>
<td>2019-08-02 19:10:00</td>
<td>184,724</td>
<td>188</td>
<td>1.74</td>
</tr>
<tr>
<td>11.</td>
<td>2019-08-03 8:15:00</td>
<td>182,921</td>
<td>185</td>
<td>1.12</td>
</tr>
<tr>
<td>12.</td>
<td>2019-08-03 8:16:00</td>
<td>180,225</td>
<td>185</td>
<td>2.58</td>
</tr>
<tr>
<td>13.</td>
<td>2019-08-03 8:17:00</td>
<td>177,655</td>
<td>187</td>
<td>5.00</td>
</tr>
</tbody>
</table>
Table 1 the voltage value in this 1-phase house is measured at a value of 185-198 Volts and the voltage displayed in the application varies between 169,111-208,478 Volts, there is a difference in the real value with the value obtained in the application because of the data transmission factor from Arduino to the application displayed on the device. Although this is still within the tolerance limit because the average error is only 3.01%.

Current Measurement Results

Testing on the current sensor is the initial test of the current that enters the acs712 sensor and is processed by Arduino and displayed on Blynk. Table 2 is the current data measured in a single-phase house for some time at a value of 1.52-3.45 A. When compared with the current displayed in the application, the value is more varied and there is even a significant difference, this is because there are factors namely the current sensor that is used is indeed less precise in obtaining data, the disruption of the internet network so that it gets an average error of 13.68%.

Table 2. Current measurement results

<table>
<thead>
<tr>
<th>No.</th>
<th>Date Time</th>
<th>Blynk Application Current (A)</th>
<th>Rate Current (A)</th>
<th>Current Error %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2019-08-01 10:27:00</td>
<td>1,553</td>
<td>1.66</td>
<td>6.42</td>
</tr>
<tr>
<td>2.</td>
<td>2019-08-01 10:28:00</td>
<td>1,788</td>
<td>1.66</td>
<td>7.11</td>
</tr>
<tr>
<td>3.</td>
<td>2019-08-01 10:29:00</td>
<td>0,669</td>
<td>1,52</td>
<td>55.99</td>
</tr>
<tr>
<td>4.</td>
<td>2019-08-01 10:30:00</td>
<td>1,330</td>
<td>1.6</td>
<td>16.88</td>
</tr>
<tr>
<td>5.</td>
<td>2019-08-01 10:31:00</td>
<td>1,722</td>
<td>1.6</td>
<td>7.62</td>
</tr>
<tr>
<td>6.</td>
<td>2019-08-02 19:06:00</td>
<td>3,22</td>
<td>3.42</td>
<td>5.85</td>
</tr>
<tr>
<td>7.</td>
<td>2019-08-02 19:07:00</td>
<td>2,78</td>
<td>3.21</td>
<td>13.40</td>
</tr>
<tr>
<td>8.</td>
<td>2019-08-02 19:08:00</td>
<td>3,19</td>
<td>3.45</td>
<td>7.54</td>
</tr>
<tr>
<td>9.</td>
<td>2019-08-02 19:09:00</td>
<td>3,44</td>
<td>3.45</td>
<td>0.29</td>
</tr>
<tr>
<td>10.</td>
<td>2019-08-02 19:10:00</td>
<td>3,29</td>
<td>3.44</td>
<td>4.36</td>
</tr>
<tr>
<td>11.</td>
<td>2019-08-03 8:15:00</td>
<td>1,22</td>
<td>2.34</td>
<td>47.86</td>
</tr>
<tr>
<td>12.</td>
<td>2019-08-03 8:16:00</td>
<td>2,21</td>
<td>2.3</td>
<td>3.91</td>
</tr>
<tr>
<td>13.</td>
<td>2019-08-03 8:17:00</td>
<td>2,25</td>
<td>2.28</td>
<td>1.32</td>
</tr>
<tr>
<td>14.</td>
<td>2019-08-03 8:18:00</td>
<td>2,12</td>
<td>2.3</td>
<td>7.83</td>
</tr>
<tr>
<td>15.</td>
<td>2019-08-03 8:19:00</td>
<td>1,89</td>
<td>2.31</td>
<td>18.18</td>
</tr>
</tbody>
</table>

Error Average 13.68

Source: Researcher data (2019)

Table 2 is the current data measured in a single-phase house for some time at a value of 1.52-3.45 A. When compared with the current displayed in the application, the value is more varied and there is even a significant difference, this is because there are factors namely the current sensor that is used is indeed less precise in obtaining data, the disruption of the internet network so that it gets an average error of 13.68%.

Power Test

Power testing using samples of voltage and current obtained for 3 days is directly proportional to the data taken previously.
4. Conclusion

Arduino Uno-Based Single Phase Voltage, Current, Power and Electricity Cost Estimation System using the Blynk Application works well. This tool is able to work if there is a good connection between the internet network and the ethernet shield. The output displayed on the blynk application is in the form of graphs, screens and gauges in real time. The form of graphic output in various time periods from 1 hour, 3 hours, 12 hours, 1 day, 2 days, 3 days even for the last 1 month. This tool is able to facilitate monitoring of electricity usage at home and estimated costs to be paid. The disadvantage of this tool is that it cannot be used if it is not connected to the internet network, so that its operation requires a fairly stable signal. Apart from that, the sensor of this tool is still less precise, so that the data transmission process results in different results, even though it is still within the tolerance limit for voltage measurement, but in current and power measurements, there are significant differences up to 13.68% for current and 14.06% for power.

5. Acknowledgment

I would like to thank Gunadarma University and friends majoring in electrical engineering for their support and advice until the completion of this research. Hopefully this research can be useful for institutions and society.

6. References


