IoT based Customer KWH Meter Design

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ABSTRACT
At this time many people are using PLTS (solar power plants) in their homes. The PLTS panel voltage and current must be checked every day to ensure that the PLTS operates and produces sufficient electric current for consumer needs. This research aims to enable consumers to monitor the kWh meter online via a smartphone using an application/platform without having to go to the panel. To avoid monitoring problems on the panel, this IoT-based sensor monitoring tool is used. The developing microcontroller creates a mcu node that uses wifi. The method used is that the electric current coming out of the kWh meter will be directly read by the sensor, and sent to NodeMCU, the data intended for NodeMCU is sent to the blynk web page and can be accessed on smartphones in real time. The Pzem 004t sensor is a sensor that checks current and voltage using this sensor to check voltage and current on the PANEL with the NodeMCU ESP8266 wifi microcontroller and android application Based on research results, the kWh meter IoT is very useful for consumers in minimizing the use of electric current for destination places tourism if the owner lives far from the location. The owner can monitor the electric current, in the form of how much costs will be incurred, this can save electricity, and can control the electric current or loads used if it exceeds the specified limit which can automatically be turned off online.

Keywords
NodeMCU ESP8266, PZem-004Tv30,Blynk ,Wifi, IoT

1. INTRODUCTION
Technological developments in a short period of time have progressed very rapidly, as is the case with technology which will be developed in various aspects of life, namely the Internet of Things, also known as the acronym IoT, is a concept that aims to expand the benefits of internet connectivity. continuously connected. As for the capabilities such as data sharing, remote control, and so on, this also includes objects in the real world. For example, foodstuffs, electronics, collections, and any equipment, including living things, all of which are connected to local and global networks through sensors that are embedded and always active. Internet of Things technology is created and developed by humans to facilitate every work and business in various aspects of life. One of them can be applied in everyday life, namely controlling household electrical equipment to turn off and on remotely using internet communication via an Android smartphone. The use of a system that can be used effectively to monitor electric current on a kWh meter can be done by utilizing the Internet of Things (IoT). With the use of IoT, operators can monitor the electric current from a smartphone without having to visit the location.

2. METHODOLOGY

2.1 HARDWARE DESIGN
In hardware design, it is necessary to describe the system that will be made later so that it makes it easier for writers to make the system. The description of the system to be made is in the form of a block diagram of the entire system. The system block diagram is shown in Figure 1.

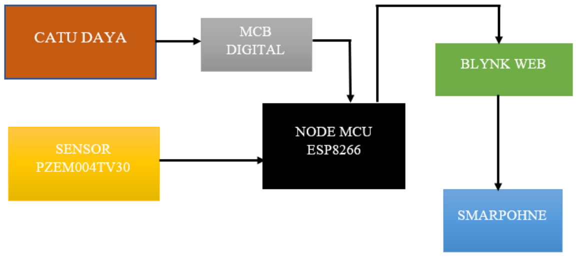

Fig 1. Block Diagram

The input from the 220V power supply goes to the digital MCB and the input from the current sensor goes to the esp8266 mcu node, the mcu node as a process and also the Blynk web as a process. The data sent from the sensor is processed by the node sent to the blynk web and the output is a smartphone.

For the design of the tool, the author uses a panel box 30 cm long and 20 cm wide. The panel box is made of light iron which is designed according to size, as shown in Figure 2.

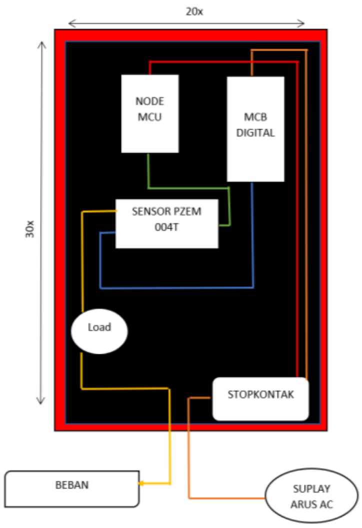

Fig 2. Tool Design

In addition, the device installation design is as shown in Figure 3.

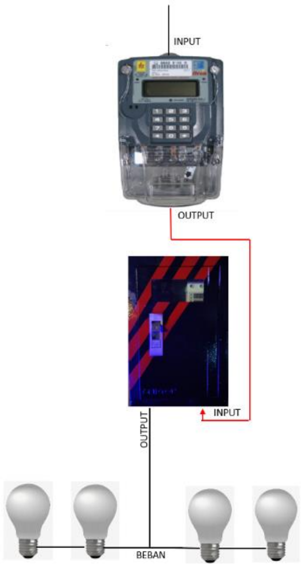

Fig 3. Tool Instalation

When installing the tool above, the output from the Kwh meter enters the input of the monitoring device, and from the monitoring device, the output goes to the load, for example, the lamp in the picture. In the implementation of this tool, the load to be used lies in the houses.

2.2 SOFTWARE DESIGN

Software design is needed to describe the workflow of the program to suit the program requirements of the security system being created. Software Design for controller needs Software design for controlling the work system is in the form of a flowchart for the need to control the work of the entire system which will later be used for the work of the nodeMCU controller

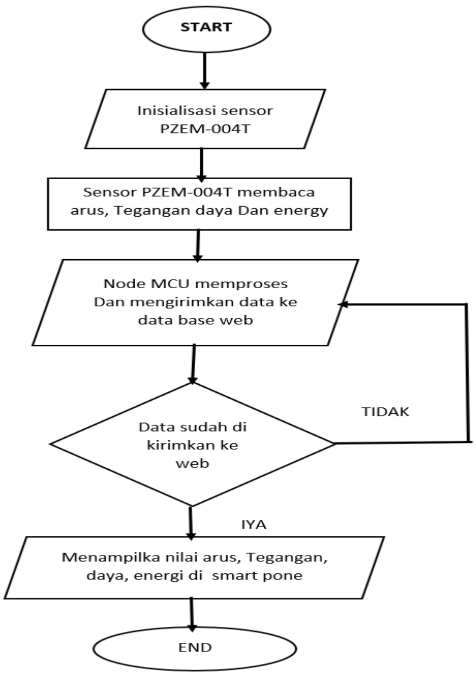

Fig 4. System Flowchart

The system work control flowchart is shown in Figure 4. The start is the part to start it. Enter the sensor initialization section. This section does the programming between the sensor and the MCU Node, the program that we input is that the sensor will read the current, voltage, power, and energy values. When the sensor successfully sends data, the MCU node will automatically process the data and send it to the web address of the platform that we use. From the web address, it is processed and the data is sent to the smartphone to display the data sent.

2.3 HARDWARE MANUFACTURING

Hardware manufacturing is carried out concerning the hardware design results in the form of: ESP8266 MCU Node, PZEM004Tv30 Sensor, digital mcb, and jumper cables Figure 5 shows the results of hardware manufacturing.

Fig 5. Hardware

2.4 MAKING DEVICES FOR THE MCESPP8266 NO

Making software for the work requirements of controlling system work which will later be embedded into the NodeMCU ESP8266 controller is made based on the results of the software design, with reference to the stages of the algorithm in accordance with the flowchart made. The process of making software for the operating system using the Android IDE is shown in Figure 6.

Fig 6. Coding Node

2.5 WEB CONNECTION AND NODEMCU ESP8266

The web connection is made by utilizing the facilities provided by Palfom, namely the BLYNK APP. Blynk is used as a storage medium and informs data on the results of detection and monitoring of the PZEM004Tv30 Sensor.

3. RESULT AND DISCUSSION

3.1 TOOL TESTING

In the testing section, I carried out the first 3 stages to test whether Nodemcu was connected to the internet. The second test uses a load and the third test is over-current. in the testing section, the MCU node is displayed as shown in the picture

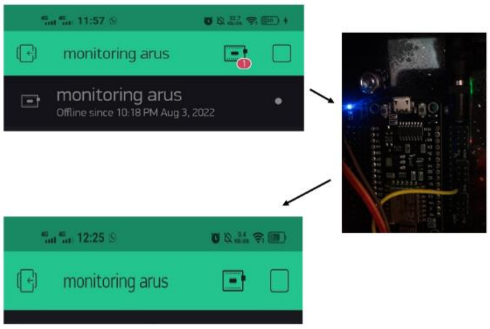

Fig 7. Display node mcu connected to int

When the MCU node is on, the offline writing and the red color on the Blynk app will automatically disappear and the Blynk app is on or off. The next stage is load testing, which is a 20W Philips lamp, a 45W fan, a 150W Asus laptop car, and a 400W water heater. The results can be seen in the following image:

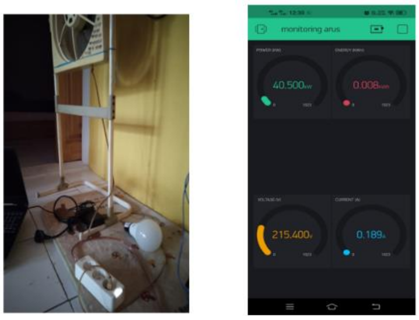

Fig 7. Lamp load test

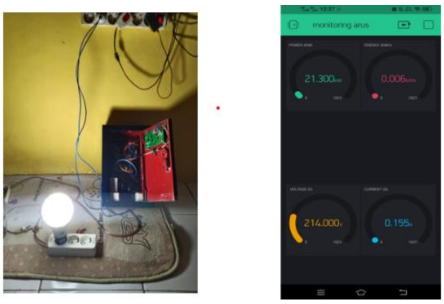

Fig 8. Fan load test

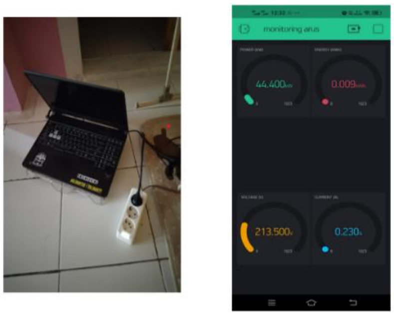

Fig 9. Cars laptop load test

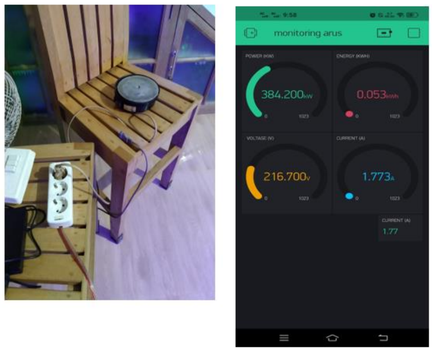

Fig 10. Load testing of water heaters

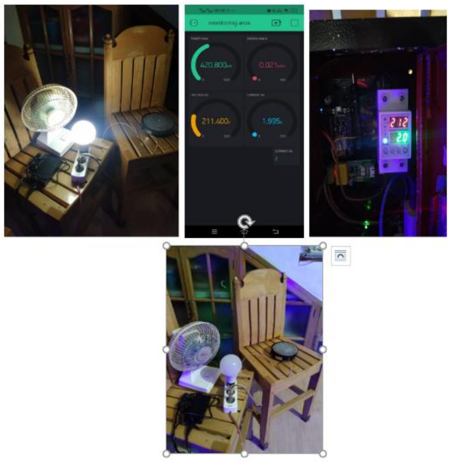

Fig 11. Over Current Testing

The results of IoT-based monitoring system monitoring data are shown in table 1.

NO	WEIGHT	kW	kWh	V (voltase)	A (amper)
1	Lampu pihlips 20W	21.3	0.006	214	0.155
2	Kipas angina 45W	40.5	0.008	215	0.189
3	Cars leptop 150W	104.4	0.011	214	0.515
4	Pemanas air 400W	384.2	0.053	216	1.773
5	Lampu,kipas, pemanas air	420.8	0.021	211	1.995

In the test results of the 4 loads, it can be concluded that the water heater load is the highest amperage of this load can reach 3 amperes if the load gets hotter.

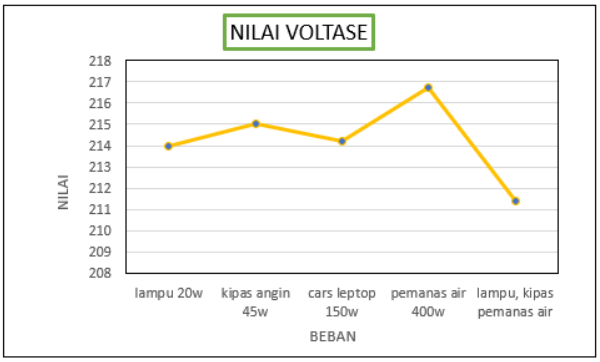

Fig 12. Voltage Value Graph

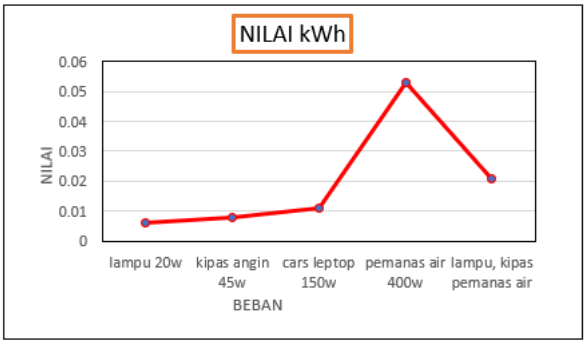

Fig 13. Graph of kWh Values

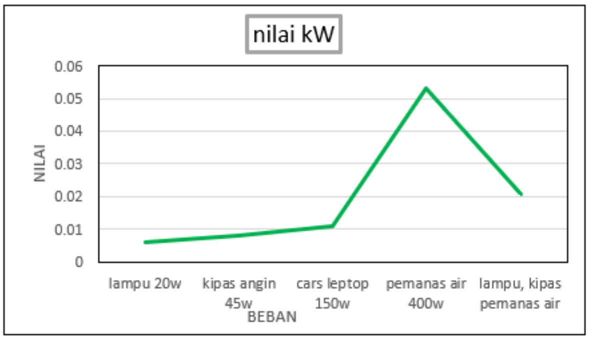

Fig 14. Graph of kW values

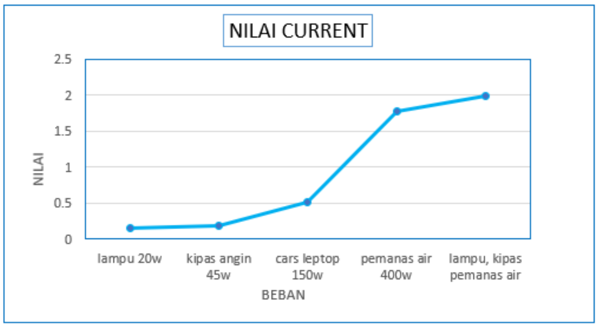

Fig 15. Graph of current value

3.2 ANALYSIS

Data transfer speed measurement is done by calculating the maximum amount of data that can be sent every minute. In this study, the results of measuring the data transfer speed were obtained as follows. The figure shows a graph of the relationship between the delay time and the data transfer rate per minute. The highest data transfer speed is at 31200 data per minute with a delay of 100 ms. The highest speed can be achieved using AT-Command, the next highest speed is at 25500 data per minute, 200 delay time.

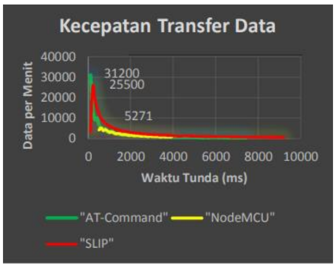

Fig 13. Data transfer speed

Tabel 2. Data Transfer

Methods	Delay (ms)	Data Transfer Speed (data per minute)	Number of data sent (percent)
ATCommand	1100	4036	74
NodeMCU	800	4481	59,75
Pzem004Tv	400	15000	100

From table 2, data transmission using Pzem has the highest quality because it manages to send 100% of data with a maximum speed of 15000 data per minute and a delay time of 400 ms. While using the AT-Command maximum speed of 4036 data per minute with the amount of data sent is 74%. The last sequence using NodeMCU gets a maximum speed of 4481 data per minute and 59.75% of data sent.

Tabel 3. Lamp load data transfer speed

TIME	KW	KWH	VOLTAGE	CURRENT
1 SECOND	40.5	0.004	212	0.5
2 SECOND	40.5	0.008	211	0.10
3 SECOND	40.5	0.008	214	0.130
4 SECOND	40.5	0.008	214	0.185
5 SECOND	40.5	0.008	215	0.189

Tabel 4. Fan load data transfer speed

TIME	KW	KWH	VOLTAGE	CURRENT
1 SECOND	21.3	0.003	211	0.05
2 SECOND	21.3	0.006	212	0.05
3 SECOND	21.3	0.006	215	0.110
4 SECOND	21.3	0.006	214	0.155
5 SECOND	21.3	0.006	214	0.155

Tabel 5. Car laptop load data transfer speed

TIME	KW	KWH	VOLTAGE	CURRENT
1 SECOND	104.4	0.03	211	0.55
2 SECOND	104.4	0.011	214	0.515
3 SECOND	104.4	0.011	212	0.515
4 SECOND	104.4	0.011	213	0.515
5 SECOND	104.4	0.011	214	0.515

Tabel 6. Water heater load data transfer speed

TIME	KW	KWH	VOLTAGE	CURRENT
1 SECOND	384.2	0.05	215	1.773
2 SECOND	384.2	0.010	212	1.773
3 SECOND	384.2	0.050	214	1.773
4 SECOND	384.2	0.053	217	1.773
5 SECOND	384.2	0.053	216	1.773

4. CONCLUSION

The control system is made in the form of an IoT-based KWH meter, which can detect current, voltage, energy, and power.
In real time, the advantages of this IoT system can be monitored via a smartphone from various places, even remote places. Data transmission using Pzem has the highest quality

because it manages to send 100% of data with a maximum speed of 15000 data per minute and a delay time of 400 ms. Whereas using NodeMCU gets a maximum speed of 4481 data per minute and 59.75% of data sent. Data transmission is calculated per second so at the first load of the lamp, in the first second KW immediately shows the result 21.3, KwH 0.003 Voltage, 211 and Current, 0.05. So for all the data transmission loads that change frequently, only the Kwh Voltage and current. the fuse voltage fluctuates. And the MCB breaker can work when the amperage rises. then the MCB will cut off the electric current in 5 seconds and turn on in 10 seconds this will repeat "as long as the amperage is still over or up.

5. REFERENCES

[1] Pengembangan Sistem Pemantauan Konsumsi Energi Rumah Tangga Berbasis Internet of Things (IoT)HARTONO BUDI SANTOSO, SAPTO PRAJOGO, SRI PARYANTO MURSID

[2] Muhamad Irfan Kurniawan, Unang Sunarya, & Rohmat Tulloh, (2018). Internet of Things : Sistem Keamanan Rumah berbasis Raspberry Pi dan Telegram Messenger. ELKOMIKA. 6(1) :1-15 Sekretariat PT. PLN, (2015).

[3] Statistik PLN 2014. diterbitkan oleh Sekretariat PT PLN (persero)RANCANG BANGUN ALAT PEMANTAU ARUS DAN TEGANGAN DI SISTEM PANEL SURYA BERBASIS ARDUINO UNO

[4] Muhammad Junaldy, Sherwin R.U.A. Sompie, Lily S. Patras Totok Budioko, (2016). Sistem Monitoring Suhu Jarak Jauh Berbasis Internet Of Things Menggunakan Protokol MQTT. Seminar Riset Teknologi Informasi (SRITI). : 353-355

[5] Fajar Wicaksono, Mochamad (2017) IMPLEMENTASI MODUL WIFI NODEMCU ESP8266 UNTUK SMART HOME. KOMPUTIKA - Jurnal Sistem Komputer, Vol.06. ISSN 2252-9039

[6] Kadir, Abdul. 2013. Paduan Praktis Mempelajari Aplikasi Mikrokontroler Dan Pemrogramannya Menggunakan Arduino. Yogyakarta: ANDI.

[7] Winasis, Azis Wisnu Widhi Nugraha, Imron Rosyadi, & Fajar Surya Tri Nugroho, (2016). Desain Sistem Monitoring Sistem Photovoltaic Berbasis Internet of Things (IoT). JNTETI. 5(4), Nov.

[8] Nanda Chayangtia Pratama, Muhammad Ary Murti, Ratna Mayasari, 2016, "SISTEM AUTOKONEKSI PERANGKAT CERDAS YANG DITERAPKAN PADA SISTEM PENGAWASAN DAN KONTROL DENGAN MENGGUNAKAN INTERNET OF THINGS", Jurnal Penelitian dan Pegembangan Telekomunikasi, Kendali, Komputer, Elektrik, dan Elektronika (TEKTRIKA), Volume 1, Nomor 2, Juli 2016