

Monitoring Power Consumption On LED Using LED Matrix P10 Panel

Prasetyo Yuliantoro¹, Shinta Romadhona², and Deva Ourelia Ayuninda³

^{1,2,3} *Telecommunication Engineering Department, Institut Teknologi Telkom Purwokerto, Banyumas, Indonesia*

Abstract—Information media is an essential medium in communication. So that the information provided is easy to see and read, the media used is placed in a visible place. Nowadays, data has become an inseparable part of process performance. With the advancement of technology, many new information media use electronic media that is used not only as news and advertising media but also as information media located in buildings or offices. Display running text matrix can be used to make the text according to the desired character. Besides, all Work and human needs are highly dependent on electrical energy. Human negligence in using electrical energy will cause waste, which also impacts the cost of using electrical energy. Therefore, we need a tool that can monitor the consumption of electrical power and limit the current use of the load, even if the user of electrical energy is not in place. Of course, making this tool requires a voltage sensor, sensor current ACS712, Arduino nano, and NodeMCU. This tool will monitor the power IoT-based and can be monitored via the internet as a graphical display on the server thingspeak.com. The results of this design can measure voltage one and voltage sensor two with an average error value of 1.75% and 1.38%, and the current measurement has an error value between 0.22% to 3.82% with an average error value of 1.46%.

Keywords— Running Text; LED; Power Consumption; Thingspeak Platform.

1. Introduction

Media information is essential medium in communication. In order to deliver the information quickly, the information media which deliver the information should be located in the strategic place and easy to see. Media should provide the writing and good design to attract the attention of the general public. Information media is growing rapidly If previously the information media is still limited through word of mouth and use the writing on the announcement board, now there are many kinds of media, namely print media, digital media, and electronic media. These kinds of media provide not only information, news, and education, but also advertisement. [1]. Internet of things also has been widely used such as control temperature room [2], controlling many parameters in agriculture [3][4], also for sending many data from sensors [5][6].

Further, electricity energy is an essential part of modern life because it is a basic human need. Starting with our house to our office, electricity is important for operating all appliances and facilities. Today many parties use modern digital information media such as the Matrix Display Panel made of LED collection in such a way. This Matrix Display Panel is used to provide and spread information including the welcome speech sentence, etc in buildings such as hotel. [7].

Implementation of Running Text is very useful in the aspect of information because it can display the text animation on matrix display. This matrix display can be used to make the following appropriate characters [8].

By looking at this medium advantage, the researcher decides to conduct a study by monitoring of power

consumption used in the LED Running Text P10 panel in conditions when all LEDs are on, static conditions, dynamic conditions and when 1-2 blocks are reduced by the current so that the block is off. That aims to know how much power consumption used when the LED is on. This process is applied to figure out the conditions which display information with low and ideal power consumption.

2. Method

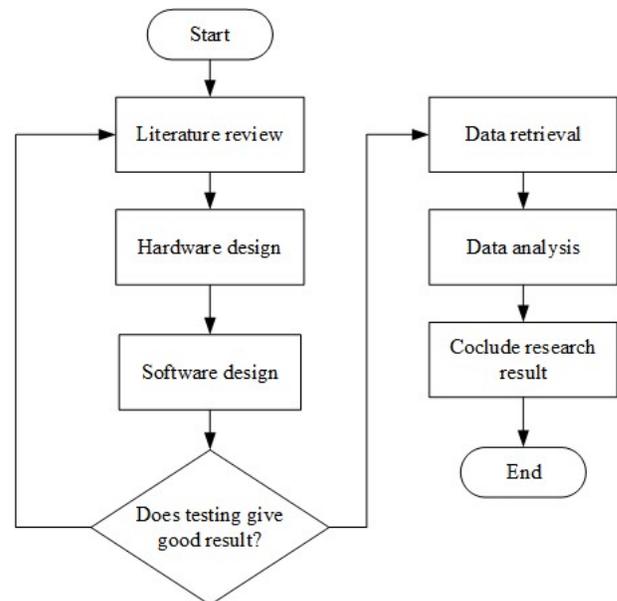


Fig. 1. Good quality with clear lettering.

The research planning is done in various stages, starting with searching the literature to get supporting information for this study. It is done by reading a book, scientific journal and article on the Internet relating to the research material. The next stage is that hardware planning including collecting of tools and materials such as Arduino Nano V3, Arduino Voltage sensor, Currents sensor ACS712 30A and Microcontroller Nodemcu Esp8266 which uses WiFi communication in submission data session, then extended to the Software Planning lstage.

At this software design stage, the researchers use the Arduino Ideal app to program microcontroller. Further, on the next stage, the researchers also use Thingspeak, for the data intake such as the power of the production sensor whose output is stored on the Thingspeak platform. Furthermore, the researchers test the appropriateness of instruments with its function. And at the last stage, the researchers collect the data from the test results made at the previous stage.

3. Result and Discussion

In this study there are 4 tests of conditions, such as all the LEDs are fully on, when displaying the static text, when displaying running text, and when the 1-2 block panel blocks are turned off after some interval time. In static and dynamic conditions (running) the variation of the text that is shown is "IT TELKOM PURWOKERTO". Data intake performed by 6 tests where each data recapture test of 40 samples which takes about 10 minutes.

On the first test which is full testing, the LED goes on all and in static conditions.



Fig 2. LED Condition in Fully Lit

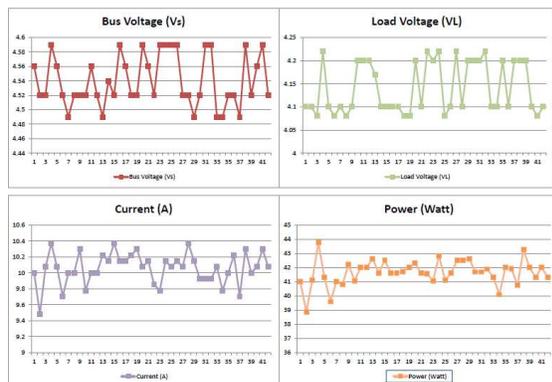


Fig 3. LED Condition Graph in Fully Lit

Table 1. LED Condition Measurement

Condition: LED is fully lit		
Parameter	Average	Sample
Bus Voltage (V_s)	4.54	1
Load Voltage (V_L)	4.141	.
Current (A)	10.058	.
Power (W)	41.653	40

As shown in Table 1, Power Supply Panel on5F 40A rating should reduce voltage lower due to high current consumption, above 10A. Giving a LED with lower voltage than it should not be a problem, although there is a voltage drop on the voltage load but the system still works well and displays graphics with maximum [8]. With an average of a significant voltage of 4.141V and the current 10,058a, the panel consumes an average of 41.653W power with a minimum range. In this full condition it can be concluded that when all LEDs in the panel are lit and the panel is used for the text of writing or graphics, the power consumption is lower than this condition [9].

The second test is when in full condition or entire LED goes on and in static conditions. But in this test some of the later intervals, the researchers turns off 1 to 2 panel blocks.



Fig 4. LED condition is fully lit (1-2 blocks are turned off)

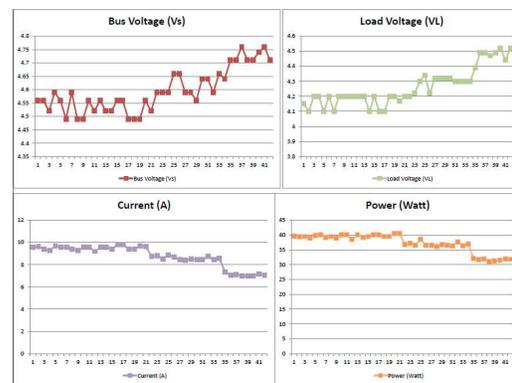


Fig 1. Graph of LED Panel Condition Full Line (1-2 blocks turned off)

Table 2. Measurement Results LED Panel Condition Full Line (1-2 blocks turned off)

Kondisi: LED Panel Condition Full Line (1-2 blocks turned off)		
Parameter	Average	Sample
Bus Voltage (V_s)	4.595	1
Load Voltage (V_L)	4.264	.
Current (A)	8.764	.
Power (W)	37.262	40

It can be seen in table 2 that the voltage supplied by the power supply is on average 4.595V and the resulting load voltage is on average 4.264V. The average consumed current is 8,764A and the power consumed is an average of 37,262W. In this test, the sampling process took 10 minutes. when in the 5th minute the researcher removed 1 panel block and continued in the 8th minute to remove the second panel. It can be seen in Figure 4.5 starting from the 22nd data sample, it can be seen that the supply voltage and the resulting load voltage are increasing little by little, but on the current side the value is getting lower. This is because there are 2 panel blocks that researchers remove, so the resulting power consumption will also be lower in value.

The third test uses a static scenario, where the text displayed is set in a silent state. In this test the researcher inputs the text "IT TELKOM PURWOKERTO".



Fig 6. The condition of the LED Panel displays static conditions

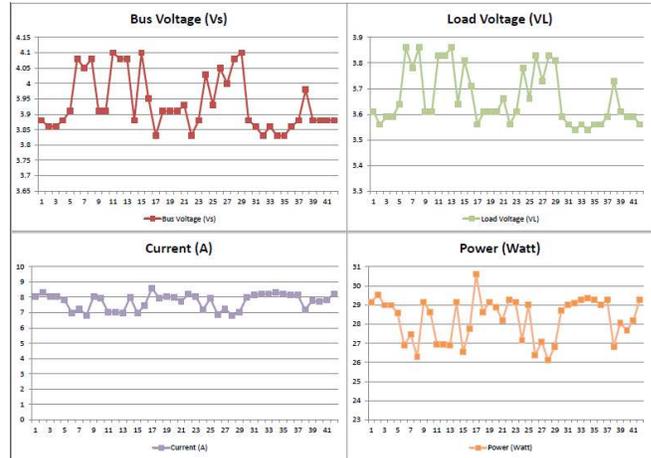


Fig 7. Graph of LED Panel Conditions showing static conditions

Table 3. Results for measuring the condition of the LED Panel displaying static characters

Condition: Static LED		
Parameter	Average	Sample
Bus Voltage (V_s)	3.973	1
Load Voltage (V_L)	3.724	.
Current (A)	7.172	.
Power (W)	26.685	40

In this scheme, the voltage supplied by the power supply is on average 3.973V, which is below the power supply rating of 5V. The load voltage is on average 3.724V with an average current consumed of 7.172A and the power consumed is an average of 26.685W. The condition of the voltage drop is usually caused by the greater current flowing [10].

In the analysis of researchers in general, the more text characters used in LED panels under static conditions, the less efficient they will be used in conveying text as information or in terms of power consumption [11].

The fourth test uses a static scenario, where the displayed text is set to static. Where in this test the researcher inputs the text "IT TELKOM PURWOKERTO". However, in this test, some time later the author turned off 1 to 2 LED panel blocks.



Fig 10. The condition of the LED Panel displays dynamic conditions (running)

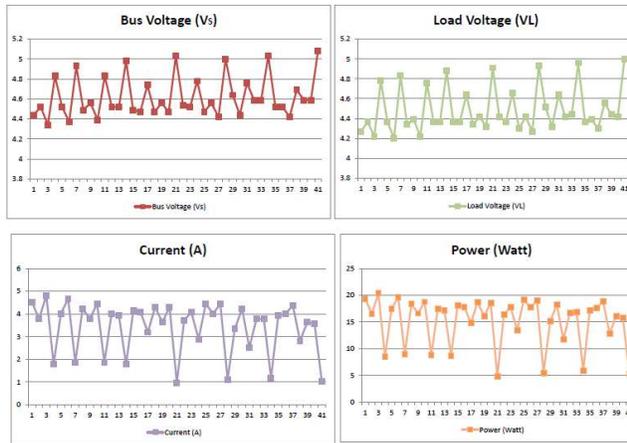


Fig 11. The LED Panel Condition Graph displays dynamic (running) conditions

Table 5. Results for measuring the condition of the LED Panel displaying dynamic characters

Condition: LED panel displays dynamic character.		
Parameter	Average	Sample
Bus Voltage (Vs)	4.791	1
Load Voltage (VL)	4.685	.
Current (A)	2.338	.
Power (W)	11.799	40

In table 5 it can be seen that the voltage supplied by the power supply is on average 4.791V and the resulting load voltage is on average 4.658V, while on the current side the average is 2.33, it can be concluded that running conditions shows more power saving compared to the previous static condition with an average power in this condition which is 11.799W. This condition shows that the running condition is much more power efficient than the static condition.

The sixth test uses dynamic or running scenarios, where the displayed text is set to run from right to left. In the test, the researcher input the same text as the previous test, namely "IT TELKOM PURWOKERTO". However, in this test, some time later, the authors turned off 1 to 2 blocks of LED panels gradually and then saw how the conditions differed.



Fig 12. Dynamic LED Panel Condition (1-2 blocks turned off)

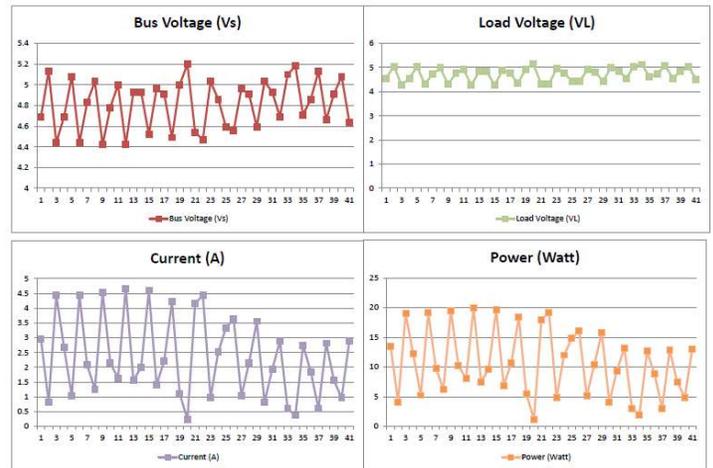


Fig 13. Dynamic LED Panel Condition Graph (1-2 blocks off)

Table 1. Measurement Results Dynamic conditions (1-2 blocks off)

Condition: Dynamic LED (1-2 blocks off).		
Parameter	Average	Sample
Bus Voltage (Vs)	4.812	1
Load Voltage (VL)	4.709	.
Current (A)	2.338	.
Power (W)	10.648	40

Then in the sixth test, in dynamic conditions, when one to two blocks are turned off, it can be seen that the source voltage and load voltage have increased slightly compared to the previous test when all blocks were on. In table 6 the source voltage is at an average of 4,812 and the load voltage is at an average of 4,709. while on the side the average current is 2,338A and the power consumption is 10,648W.

According to the researchers' analysis, the difference between static and dynamic testing can be seen from the minimum-maximum value of the static testing current which tends to have a difference that is not too far away. Meanwhile, the minimum-maximum value of the running testing current has a more significant difference. This is caused by the LED refresh status which is assisted by the passage of text. At the end of the text it can be observed that the panel has a time delay to display the same text from the beginning so that there is a time lag when all the LEDs turn off. And in this case, reducing power consumption.

4. Conclusion

The voltage and current results are obtained based on this power consumption monitoring test under the condition that the LED panel is fully lit. The result shows that the supply voltage is in the 4.52V-4.59V range with an average of 4.54V, the load voltage is in the 4.1V-4.22V range with an average 4.141V, and the current consumed is in the range of 9.482A-10.371A with an average of 10.058A. In static conditions, the supply voltage is in the 3.88V-4.13V range with an average of 3.973V, the load voltage is in the 3.64V-3.91V range with an average of 3.724V so that the

current consumed is in the 6.44A-7.63A range with average 7.172A. And in dynamic conditions, having a supply voltage with a range of 4.42V-5.18V, the load voltage consumed is in the range of 4.27V-5.15V with an average of 4.685V, so the current consumed is in the range of 0.225A-4.668A with an average the average is 2.338A. The researchers can conclude that when the current consumed is higher, the voltage consumed will decrease.

LED power in running/dynamic conditions consumes lower power, is in the range of 1,161W-19,935W with an average of 11,799W compared to static conditions which is in the range of 25.01W-27.92W with an average of 26,685 and full conditions with vulnerable 38.877W-43.765W with an average of 41.653W. It can be concluded that dynamic conditions have ideal power consumption.

The condition when 1-2 blocks of LED panels are turned off, the power generated in full conditions is 37.262W on average, in static conditions the average power generated is 24.391W, and in dynamic conditions the average power after 1-2 blocks is turned off to 10.648W. This is influenced by the voltage supplied by the power supply and the resulting load voltage increases slightly, so that the current consumed decreases slightly so that the power consumed will decrease.

References

- [1] D. Suri, "Pemanfaatan Media Komunikasi dan Informasi dalam Perwujudan Pembangunan Nasional," *J. Komun. Pembang.*, vol. 17, no. 2, pp. 177-187, 2019, doi: 10.46937/17201926848.
- [2] P. Yuliantoro, S. Romadhona, and A. Hikmaturokhman, "Real-Time Signboards using Panels P5 RGB and NodeMCU esp8266 with Library PxMatrix," *10th IEEE Int. Conf. Commun. Networks Satell. Comnetsat 2021 - Proc.*, pp. 337-341, 2021, doi: 10.1109/COMNETSAT53002.2021.9530785.
- [3] O. N. Samijayani, R. -, and F. Iftikar, "Perancangan Sistem Penulisan Teks pada Running text Menggunakan SMS," *J. AL-AZHAR Indones. SERI SAINS DAN Teknol.*, vol. 2, no. 3, p. 164, 2015, doi: 10.36722/sst.v2i3.137.
- [4] A. Jha, "Smart LED Streetlighting System with Improved Power Quality and Low Standby Consumption," *2019 3rd Int. Conf. Recent Dev. Control. Autom. Power Eng. RDCAPE 2019*, vol. 3, pp. 131-136, 2019, doi: 10.1109/RDCAPE47089.2019.8979119.
- [5] F. Al-Maghribi, I. Al Fayyadh, K. A. Hernandi, R. Nugraha, Estananto, and M. Abdurrohman, "Web-based smart LED for saving energy consumption," *J. Phys. Conf. Ser.*, vol. 1882, no. 1, 2021, doi: 10.1088/1742-6596/1882/1/012135.
- [6] Suprianto, "Analisa Tegangan Jatuh pada Jaringan Distribusi 20kV PT.PLN Area Rantau Prapat Rayon Aek Kota Batu", *J. Electrical Technology*, vol.3, no. 2, pp. 64-72, 2018.
- [7] Z. Arifin, Safrizal, "Koordinasi Running Text Display LED Berbasis Android", *J. Ilmu-ilmu MIPA*, vol. 19, no. 2, pp. 200-207, 2019, doi: 10.20885/eksakta.vol19.iss2.art10.