AIP Conference Proceedings

AIP Publishing

Volume 2680

Proceedings of the 4th Tarumanagara International Conference of the Applications of Technology and Engineering (TICATE) 2021

Jakarta, Indonesia • 5–6 August 2021

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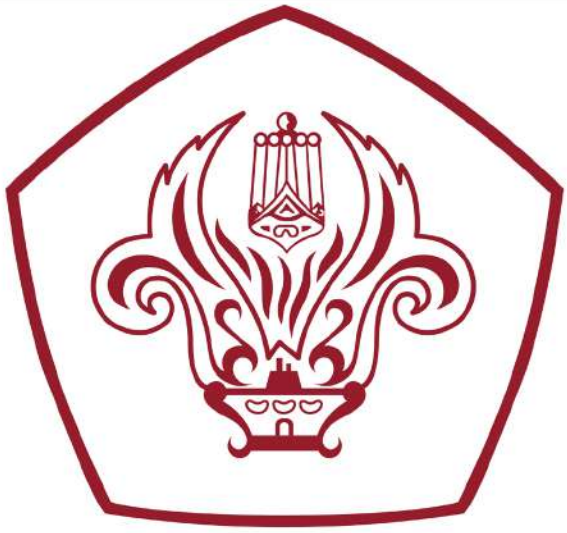

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RESEARCH ARTICLE | DECEMBER 07 2023

Temperature, humidity, voltage and current data logger for LED street light luminaire FREE

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AIP Conf. Proc. 2680, 020053 (2023)
https://doi.org/10.1063/5.0127315

Temperature, Humidity, Voltage and Current Data Logger for LED Street Light Luminaire

Joni Fat[1, a)], Endah Setyaningsih[1], Yohanes Calvinus[1], Vinsensius Reinard[1], Andrew Hendisutio[1]

[1]*Universitas Tarumanagara, Jakarta, Indonesia*

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Abstract. Public street lighting is one of the facilities for road completeness. This is due to the condition of national electricity which is still experiencing a shortage. With 8.9% of the population that has not been electrified. Therefore, lighting on public roads needs to use energy-saving lamps, namely lamps based on LED technology. The use of this LED technology is quite dependent on the characteristics of the LED chip, as well as on the temperature changes generated by the components in the luminaire against the weather. Therefore, it is necessary to carry out photometric, electrical, and temperature (PET) monitoring. That's what this data logger system is designed for. This data logger records temperature, humidity, voltage and current. Temperature and humidity are read using the DHT11 sensor, the voltage using the ZMPT101B sensor and the current using the SCT013 sensor. The output of the DHT11 sensor is directly connected to the input pin of the ESP8266 as the processing module, while the output of the ZMPT101B and SCT013 sensors is connected to the ADS1115 ADC module before being inputted to the ESP8266. The ADS1115 converts the analog inputs of the ZMPT101B and SCT013 into 16 bit digital values. Using I2C communication, the data is sent to the ESP8266. The ESP8266 has an integrated WiFi module. Using this module, data is sent over the Internet to the database server. The data is recorded into a database to be stored and then processed according to the needs of monitoring the condition of the street lamp luminaires.

INTRODUCTION

Street lighting or often referred to as Public Street Lighting (PJU), is one of the complete road facilities. It is stated that every road used for traffic must be equipped with street lighting [1]. One of the reasons PJU is a mandatory facility is because lighting can reduce accident rates and increase safety [2, 3, 4, 5]. In addition, the perception of road users states that car drivers feel safer and clearer in identifying traffic signs and road markings with street lighting [6]. In view of this, every road must be equipped with street lighting, especially for roads with complex geometric elements such as bends, inclines, and sharp descents or areas with limited visibility [7].

However, the problem is that the availability of electricity by PLN has not been able to support the lighting on all roads. This shortage of electrical energy is also reflected in the statement that around 23 million people or 8.9% of the population of 261 million Indonesians, do not have electricity. One way to overcome this problem is the use of energy-saving lamps based on LED technology, to replace conventional lamps which have the characteristics of consuming large amounts of electricity and short lamp life. LED technology replaces the current portion of public street lighting as a technology that is known to save electricity.

The use of PJU LED luminaires depends on the characteristics of the LED chip, but it must be noted that PJU LED luminaires are sensitive to temperature changes between the heat generated by the LED components and the weather. For this reason, PJU LED luminaires really need to be tested by photometric (photometric), electricity (electrical), and temperature (thermal) which is known as PET theory. PJU LED luminaires installed in Indonesia must be able to adapt to the climatic/weather conditions in Indonesia. In addition, the luminaire must also be able to

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Published by AIP Publishing. 978-0-7354-4698-4/$30.00

cope with the heat from the surrounding environment. Indonesia, which has a humid tropical climate, has high environmental temperatures and humidity. These two parameters must be a concern in designing the lamp housing. Therefore, this data logger is desined for sending data on temperature, humidity, current, and voltage. The data is sent to a myphpadmin database webserver.

METHODOLOGY

The temperature sensor used has a fairly high sensitivity for temperature changes in electronic devices, namely 20°C - 70°C. Humid tropical climates have air temperatures between 21°C to 35°C [14]. Air temperature will affect the temperature level of the paired electronic device and will be different in the area where it is exposed to direct sunlight. Therefore, the temperature of the electronic device in general must be able to adjust to the temperature of the electronic device in which it is placed. Factors that can affect electronic damage in humid tropical climate conditions in addition to temperature, also high humidity.

In addition to temperature and humidity sensors, it is also necessary to measure changes in current and voltage to PJU LED lights so that current and voltage sensors are needed. All parameters of these conditions must be monitored with the IoT module using Internet as a network medium to transmit sensor data and using a cloud database to store data within a certain period of time.

The data logger reads humidity and temperature with a DHT11 sensor, the sensor readings are directly using ESP8266 as the main processor. Current values are read with the current sensor SCT013, and the output of this sensor is sent to ADC ADS1115. Voltage values are read with the ZMPT101B voltage sensor. The output of this sensor is sent to same ADC as the current sensor. The ADC converts the analog input of the current and voltage sensors into a 16-bit which is sent to the ESP8266 by I2C communication. ESP8266 is connected using Wi-Fi to Internet via integrated Wi-Fii module. Sensor data is sent to a phpmyadmin database on the server via Internet.

RESULTS AND DISCUSSION

Processor

This data logger uses microprocessor ESP8266 (NodeMCU v3) as it main processing unit. This microprocessor is suitable for this application because of its lightweight and low power consumption. ESP8266 also has a Wi-Fi built-n, so it is suitable for Internet of Things (IoT) application.

Temperature and Humidity

For logging temperature and humidity values from its surrounding, this data logger using DHT11. There are three DHT11 sensors in this system The humidity value that it logs is relative humidity value which is measured using two electrodes. Figure 1 shows how this DHT11 connect to ESP8266 (NodeMCU v3) in this data logger. DHT11 is connected to D3 (GPIO0) and set as ID 1, ID 2 is connected to D4 (GPIO1) and ID 3 is connected to D5 (GPIO14). To read the sensor values, library DHT.h is used. The function for reading temperature values is *obj*.readTemperature(), and for humidity is *obj*.readHumidity(). In this program, *obj* is defined with dht. Table 1 shows results of the testing. These data are logged in the period of 15 minutes.

Voltage

The sensor voltage which is used in this data logger is ZMPT101B. Figure 2 shows the implementation of ZMPT101B to ESP8266 (NodeMCU v3). In this implementation, ZMPT101B is connected to ADS1115. To read the value, in the program, library Adafruit_ADS1X15.h is used. Tabel 2 shows the values that logged from this sensor using ESP8266. These values are recorded in the period of 15 minutes and it shows that the values are stable.

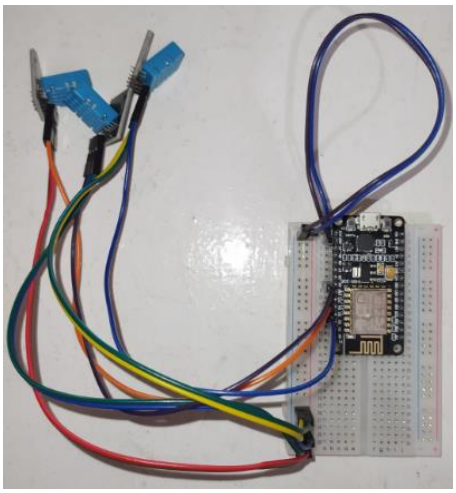

FIGURE 1. Implementation of DHT11 to ESP8266

TABLE 1. DHT11 ID 1, 2 and 3 Data Logger Testing

ID	Temperature	Humidity
1	30.2	66
2	30.2	65
3	30.3	66

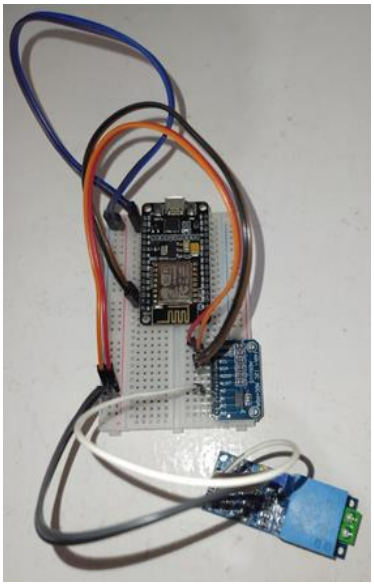

FIGURE 2. Implementation of ADS1115 to ESP8266

TABLE 2. ADS1115 Data Logger Testing

No	AC Voltage
1	204.35
2	204.35
3	204.35

Current

The current sensor which is used is SCT013. This sensor is connected to ADC ADS1115 as an interface module to ESP8266. Figure 3 shows this implementation. Tabel 3 shows the data that are logged from this sensor in the testing. The data are recorded in the period of 15 minutes.

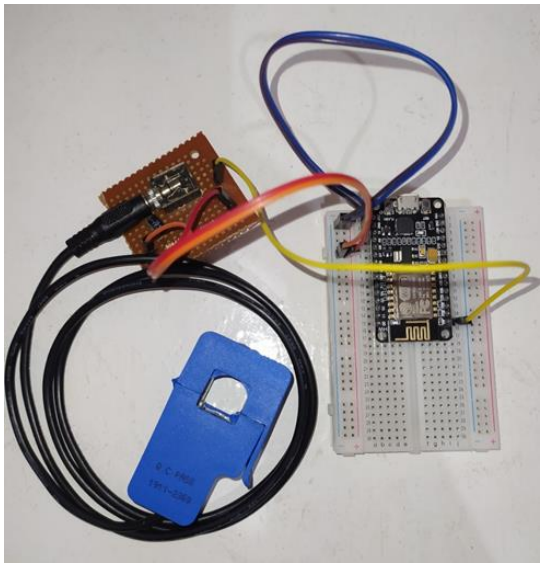

FIGURE 3. Implementation of SCT013 to ESP8266

TABLE 3. SCT013 Data Logger Testing

ID	AC Current
1	0.08
2	0.08
3	0.08

ADC

Because ESP8266 (NodeMCU v3) Analog Pins are not enough to accomodate all the sensors, ADC module is required. In this implementation, voltage and current sensors are connected to ADC ADS1115. ADS1115 then connected to ESP8266. The pins that are used are D1 (GPIO 5) and D2 (GPIO 4) which are connected respectively to SCL and SDA in ADS1115.

Data Logger

Data logger system that is built in this study could be seen in Figure 4. The whole data testing could be seen in Table 4. These data are recorded in MySQL RDBMS which is hosted using XAMPP in localhost.

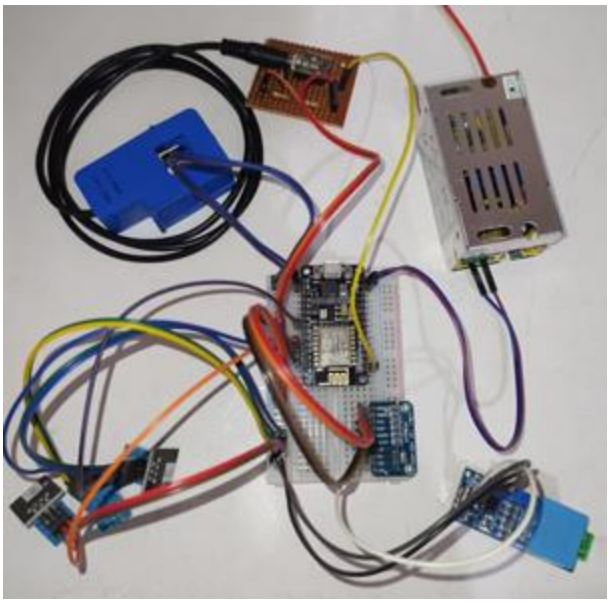

FIGURE 4. Data Logger

TABLE 4. Data Logger Testing

TempID1	TempID2	TempID3	HumID1	HumID2	HumID3	ACCurr	ACVolt	TimeStamp
30.2	30	29.8	66	63	62	204.35	0.08	2021-07-25 18:24:11
30.2	30.1	29.8	65	62	62	204.35	0.08	2021-07-25 18:24:19
30.2	30	29.8	65	62	62	204.35	0.08	2021-07-25 18:24:28

CONCLUSION

This testing for data logger system shows that the system could log data from sensor DHT11, ZMPT101B and SCT013. The microprocessor module that is used in this system, ie. ESP8266 (NodeMCU v3) is sufficient for implementing because of its number of Pins and also it has a Wi-Fi built-in.

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Submission date: 11-Dec-2023 09:21AM (UTC+0700)
Submission ID: 2254906901
File name: 020053_1_5.0127315.pdf (554.55K)
Word count: 1855
Character count: 9292

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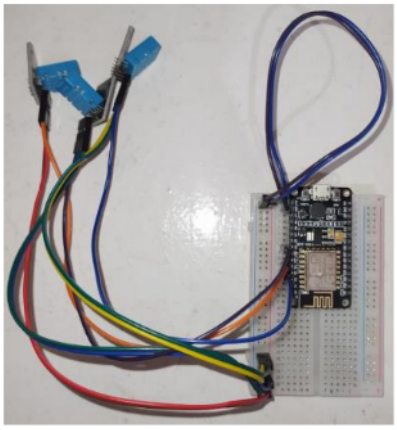

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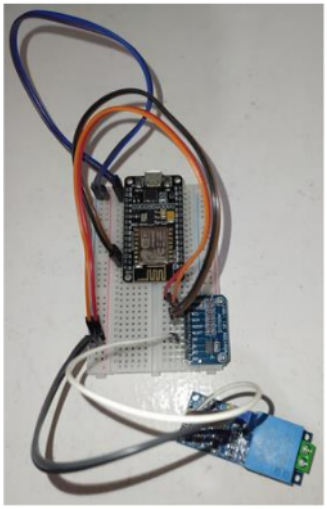

FIGURE 2. Implementation of ADS1115 to ESP8266

TABLE 2. ADS1115 Data Logger Testing

No	AC Voltage
1	204.35
2	204.35
3	204.35

Current

The current sensor which is used is SCT013. This sensor is connected to ADC ADS1115 as an interface module to ESP8266. Figure 3 shows this implementation. Tabel 3 shows the data that are logged from this sensor in the testing. The data are recorded in the period of 15 minutes.

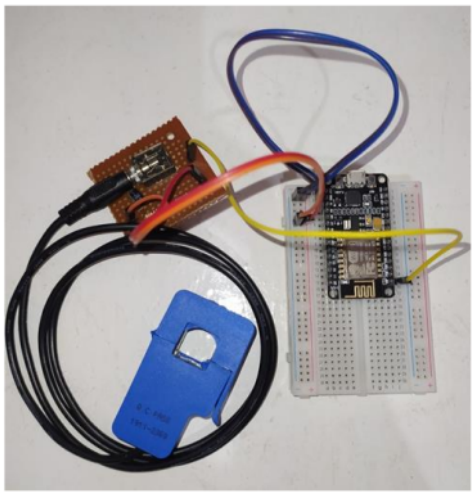

FIGURE 3. Implementation of SCT013 to ESP8266

TABLE 3. SCT013 Data Logger Testing

ID	AC Current
1	0.08
2	0.08
3	0.08

ADC

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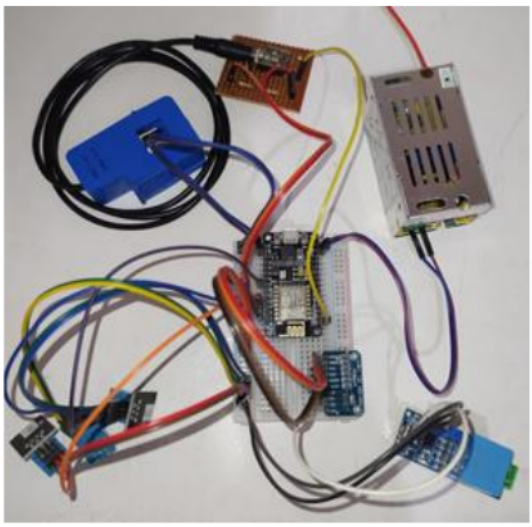

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