Jurnal Mantik
Volume 4, Number 3, Nov 2020 pp. 2013-2016 E-ISSN 2685-4236
https://iocscience.org/ejournal/index.php/mantik

CO2 (Carbon Dioxide) Metric Monitoring Tool Based on Internet of Things (IoT)

Iwan Pahendra[1], Eva Darnila[2], Ermatita[3]

[1]Department of Electrical Engineering, University of Sriwijaya, Palembang
[2]Department of informatics, University of Malikussaleh, Lhokseumawe
[3]Department of Informatics, University of Sriwijaya,Palembang

E-mail: iwanpahendra@unsri.ac.id, eva.darnila@unimal.ac.id, ermatitaz@yahoo.com

ARTICLE INFO

Article history:
Received: 12/07/2020
Revised: 22/08/2020
Accepted: 30/11/2020

Keywords:
Internet of Things (IoT), Sensors, Green Campus

ABSTRACT

Monitoring of CO2 (Carbon Dioxide) metric on campus is very necessary to do. A lot of vehicles passing by on campus will make pollution bigger day by day. Development of green campus has to be done at this time. Based on UI Green Metric 2018, 719 campuses have participated to develop a green campus and issues of sustainability. One of requirement is implementation of smart system to solve pollution problems. To develop CO2 metric monitoring tool based on IoT needs hardware and software. The hardware consists of CO2 sensor type MG-811, communication module SIM 800, ADC module ADS1115 and microcontroller ESP32. Software is done using PHP and database. Parameters to be measured is CO2 level. Furthermore, information about CO2 level can be displayed and accessed in real-time via computers. The sensors read the value every in 5 seconds. The results is in average value, CO2 level is 25.50 ppm (parts per million). There is below threshold value for CO2 level according to government regulation. It is a normal condition and no pollution because campus is still in lockdown.

1. Introduction

Monitoring of CO2 (Carbon Dioxide) metric on campus is very necessary to do. CO2 came from vehicle exhaust emissions. This gas is very dangerous for humans at certain rates. A lot of vehicles passing by on campus will make pollution bigger day by day. Development of green campus has to be done at this time. Based on UI Green Metric 2018, 719 campuses have participated to develop a green campus and issues of sustainability [9]. One of requirement is implementation of smart system to solve pollution problems.

Previous research has done, the title is "Development of Environmental Temperature Monitoring Based on Internet of Things (IoT)" [10]. Other research, "Smart Home Development with ESP32 Microcontrollers and MC-38 Door Magnetic Switch Sensor Based on Internet of Things (IoT) to Improve Early Detection of Housing Security" [1]. Other research, "Application of Microcontroller Interfacing Trainer Based on Internet of Things Using ESP 32 in Interfacing Subject," [3].

In previous research, it only measured temperature parameter, for home security and learning. This research we have developed to measure CO2 level in environment. Similarity of this research and previous, using the same component based on Internet of Things (IoT). They all use microcontroller ESP32 for IoT application because microcontroller ESP32 is a series of low-cost and low-power and be developed with integrated Wi-Fi and dual Bluetooth modes [2],[4].

To develop CO2 metric monitoring tool based on IoT needs hardware and software. Hardware consists of sensor, Communication module, Analog to Digital Converter (ADC) module and microcontroller ESP32. Software is a web base programmig such as PHP and database. The tool will be installed in campus of Malikussaleh University. This instrument is expected to prepare a green campus development.

2. Method

Block diagram of CO2 metric monitoring tool as shown in Figure 1. This system is divided into hardware and software. Hardware consists of CO2sensors type MG-811, Communication module type SIM 800, ADC module type ADS1115 and microcontroller ESP32. Software is web base programming using PHP, MySQL and Grafana Template.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

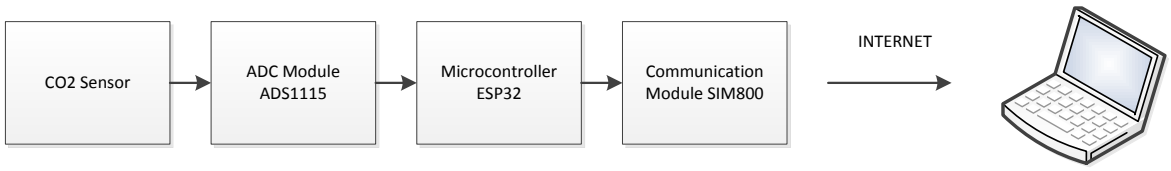

Fig.1 Block Diagram

Next, based on the block diagram, it is implemented into electrical circuit scheme as shown in Figure 2

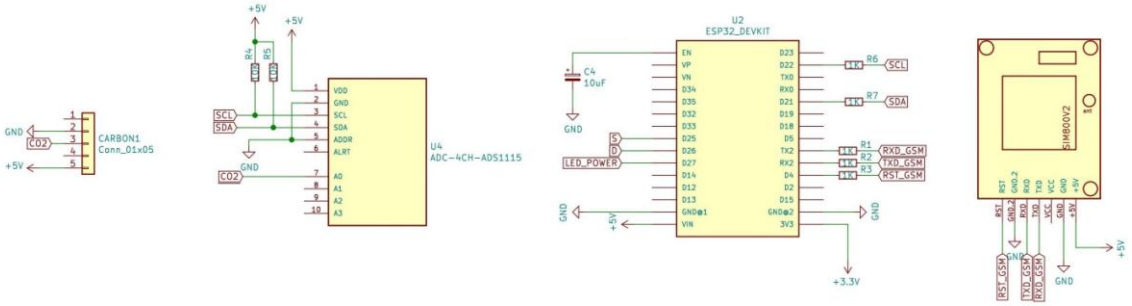

Fig.2 Electrical Circuit Scheme

Working process of this system is divided into three modes such as data measuring, transmit and monitoring. Parameters to be measured is CO2 level. Value in units of CO2 is ppm (parts per million). Output from CO2 sensor is still analog. We need analog to digital converter (ADC) type ADS1115 to convert it. Explanation about real circuit scheme detailed is presented in Figure 3.

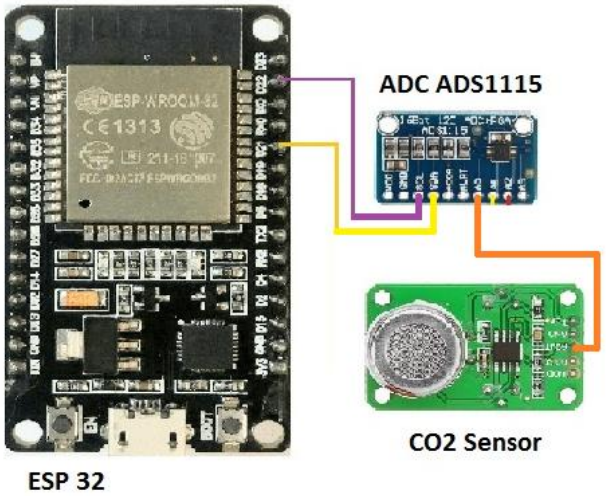

Fig.3 Real Circuit Scheme

Next, measured data are transferred to the web server. SIM 800 is used as communication module. Internet connection must be always checked continuously to ensure that the tool always transmit data. This is an iteration process. The following is a flowchart for transmit process as shown in Figure 4.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

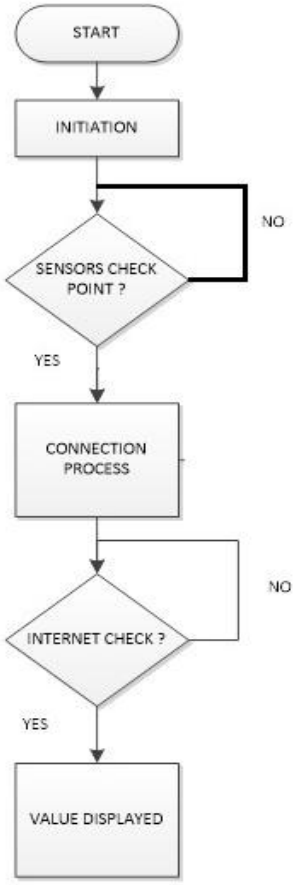

Fig.4 Flowchart

Measuring simulation use motorcycle exhaust emission. Before testing, motorcycle needs to be gassed with maximum torque about ± 1 minute to stabilize vehicle exhaust gas. After vehicle engine is stable. It can be done measurement of carbon dioxide levels (CO2) in vehicle exhaust gases. Measured data of sensors can be taken within a range in 5 seconds. It is programmed in microcontroller ESP32. The results are presented in Grafana Load Database. This form will be displayed on the user's PC.

3. Result

Measured data are presented as shown in Table 1.

Table. 1.
Measured Data

No	Time	CO2 (ppm)
1	2020-10-24 09.56.06	25.00
2	2020-10-24 09.56.11	25.00
3	2020-10-24 09.56.17	25.00
4	2020-10-24 09.56.22	25.00
5	2020-10-24 09.56.26	25.00
6	2020-10-24 09.56.31	30.00
7	2020-10-24 09.56.36	25.00
8	2020-10-24 09.56.41	25.00
9	2020-10-24 09.56.46	25.00
10	2020-10-24 09.56.51	25.00
11	2020-10-24 09.56.57	25.00
12	2020-10-24 09.57.01	25.00
13	2020-10-24 09.57.06	25.00
14	2020-10-24 09.57.11	25.00
15	2020-10-24 09.57.16	25.00
16	2020-10-24 09.57.22	25.00

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

No	Time	CO2 (ppm)
17	2020-10-24 09.57.27	25.00
18	2020-10-24 09.57.32	25.00
19	2020-10-24 09.57.36	25.00
20	2020-10-24 09.57.41	25.00
21	2020-10-24 09.57.46	25.00
22	2020-10-24 09.57.51	25.00
23	2020-10-24 09.57.56	25.00
24	2020-10-24 09.58.02	25.00
25	2020-10-24 09.58.07	25.00
26	2020-10-24 09.58.11	25.00
27	2020-10-24 09.58.16	25.00
28	2020-10-24 09.58.21	25.00
29	2020-10-24 09.58.27	25.00
30	2020-10-24 09.58.31	25.00
	Average	**25.50**

4. Discussion

Measurement data results must be compared with regulation standards set by the government. This is to find out whether CO2 level conditions are normal or dangerous. Standard Regulations by Indonesian Government namely :

a) Regulation of Environmental Ministry No.12/2010 [5].
b) Regulation of Health Ministry No.70, 2016 [6].
c) Regulation of Manpower and Transmigration Ministry No. 13, 2011 [7].
d) Regulation of Manpower, Transmigration and Cooperation Ministry No. 1, 1978 [8].

According to the regulation, CO2 level maximum 3180 ppm. Based on measured data results in Table 1. The results is in average value is 25.50 ppm (parts per million). There is below threshold value for CO2 level. Others, it is a normal condition and no pollution because campus is still in lockdown.

5. Conclusion

We have successfully designed a CO2 metric monitoring tool based on IoT. Information about CO2 level can be accessed via computers. This tool will be an instrumentation for preparation of green campus development. For future research, it can be adding for more sensors so more environmental parameters will be measured.

6. References

[1] A. Setiawan and A. I. Purnamasari, "Smart Home Development with ESP32 Microcontrollers and MC-38 Door Magnetic Switch Sensor Based on Internet of Things (IoT) to Improve Early Detection of Housing Security," *Journal of RESTI*, vol. 3, no. 3, pp. 451 - 457, 2019.
[2] Espressif System, "ESP32 Series Datasheet," Espressif Inc., 2019.
[3] H. Kusumah and R. A. Pradana, "Application of Microcontroller Interfacing Trainer Based on Internet of Things Using ESP 32 in Interfacing Subject," *Journal of Cerita*, vol. 5, no. 2, 2019.
[4] Kolban, "Kolban's Book on ESP32," https://leanpub.com/kolban-ESP32.M, 2017.
[5] Ministry of Environment Indonesian Republic, "Ambient Air Quality Standards," *Regulation of Environment Ministry* No.12, 2010.
[6] Ministry of Health Indonesian Republic, "Light level requirements in traffic zones and public areas," *Regulation of Health Ministry* No.70, 2016.
[7] Ministry of Manpower and Transmigration Indonesian Republic, "Noise Threshold Value," *Regulation of Manpower and Transmigration Ministry* No. 13, 2011.
[8] Ministry of Manpower, Transmigration and Cooperation Indonesian Republic, "Temperature and Humidity Threshold Value," *Regulation of Manpower, Transmigration and Cooperation Ministry* No. 1, 1978.
[9] University of Indonesia, "Sustainable University in a Changing World : Lessons, Challenges and Opportunities," *Journal of UI GreenMetric World University Rankings*, 2019.
[10] Y. A. Suryo, "Design of Portable Environmental Temperature Monitoring Based on Internet of Things," *Cyclotron*, vol. 2, no. 2, 2019.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.