

Design & Construction of Oxygen Saturation Measuring Equipment through the Thingspeak Server with Max 30100 Sensor

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Abstract *The human body requires sufficient oxygen levels for daily life, so it is important for humans to maintain oxygen levels in their bodies. Good oxygen saturation will facilitate the distribution of substances in the body, red blood cells carry oxygen from the lungs and are distributed throughout the body. It is very important for humans to keep oxygen within normal limits. Excess oxygen in the blood or hyperoxaemia: above 120 mmHg. The normal limits for oxygen levels in human blood are between: 75-100 mmHg. Lack of oxygen or hypoxaemia is less than 75 mmHg. A blood oxygen level below 60 mmHg indicates a very severe blood deficiency and you need supplemental oxygen. The design of an oxygen saturation monitoring tool through the Thingspeak server with a max 30100 sensor based on nodemcu 8266 aims to make it easier to monitor oxygen levels in the blood so that it can take early anticipation to avoid unwanted things. The design of this tool is equipped with monitoring using a Thingspeak server that can be connected to the internet or WIFI so that we can do it when we are there. This blood tool is designed using a MAX 30100 sensor as an oxygen detector which is clamped on a finger and then connected to NodeMCU 8266. After waiting for a while the sensor detects oxygen levels < 80% >, 100% NodeMCU 8266 sends data to the LCD and Thingspeak. On the Thingspeak server we can observe the oxygen levels in our bodies. We can use this tool far away so we don't need to go to the hospital or health center to measure the oxygen saturation in our bodies*

Keywords *Oxygen, MAX30100, NodeMCU 8266, Thingspeak*

I. INTRODUCTION

Humans need oxygen as a very important chemical element. Oxygen in the respiratory process acts as a distributor of metabolic needs in the human body. The body's metabolism produces energy that is used in daily activities and to protect against various diseases and viruses. Low or poor methanolism can cause inhibition of human activities in daily life.

In the blood there is a hemoglobin molecule that functions to bind oxygen in the human body. Oxygen saturation is a very important element in the supply of oxygen throughout the body. Good and smooth oxygen saturation will facilitate hemoglobin in distributing oxygen to the organs of the human body so that damage to human organs can be minimized. Patients who have undergone surgery or suffer from respiratory disorders are

very important in monitoring oxygen saturation. (Mallo, 2012)

The decrease in oxygen saturation in the blood can decrease or decrease and can increase beyond normal limits under certain conditions, therefore a tool is needed that can monitor oxygen saturation in the blood in real time and can be done anywhere without having to go to a hospital or health center, so as to minimize the occurrence decrease or increase in oxygen saturation levels in the human body. If the decrease in oxygen saturation is below 75 mmHg, immediately take the patient to the nearest hospital or health center because the patient needs additional oxygen. Because if left for 3 minutes will cause damage to the brain and heart.

This is the author's consideration in making a tool that can be used at home or wherever located to be able to monitor oxygen saturation in the blood of the human body by making "Design of an Oxygen Saturation Monitoring Tool through a Thingspeak Server with a MAX30100 Sensor based on NodeMCU 8266" I hope this tool is useful for the community can be used easily and effectively as a form of first anticipation in the treatment of hypoxemia or hyperoxemia.

II. METHODS

Tool design includes the design of the physical appearance that will be built as desired. This section consists of mechanical and electrical designs that are interconnected to carry out a step-by-step process according to the design.

The design of the tool includes the design of the physical appearance that will be built as desired. This section consists of mechanical and electrical designs that are connected to each other to carry out the step-by-step process according to the design.

1. Design Scheme

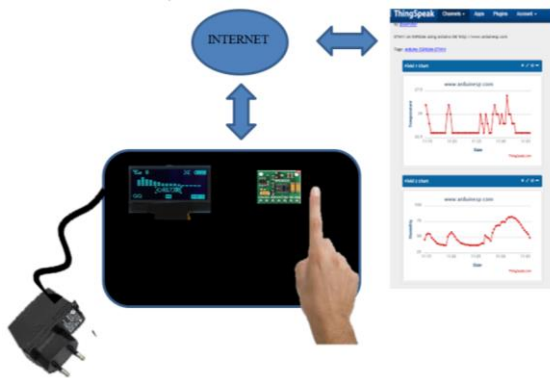


Figure 1 Product design scheme

2. Channel creation on the ThingSpeak server.

- a. Create a ThingSpeak account
- b. Next, users can create a new channel by going to the Home Page and selecting my channel, then fill in the completeness provided in the new channel and click Save channel.
- c. After filling out the form on the new channel, the user can see the desired field or display and the user can modify the chart according to their wishes and needs.
- d. To connect the device with thingspeak, you need an api key and get the READ and WRITE API codes that are used in sending and reading data programs.

3. Wiring Device

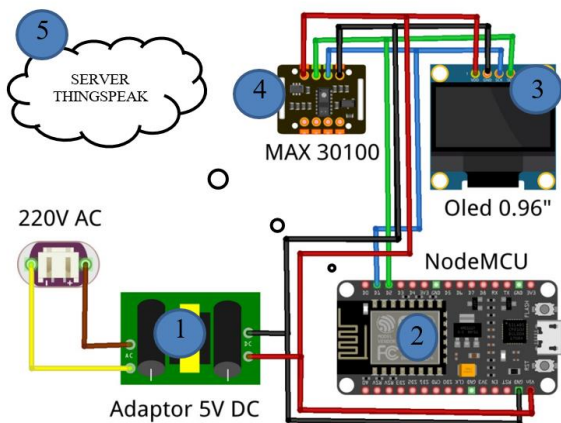


Figure 2 Wiring Device

- 1) In number 1, namely the equipment power supply as a voltage source using a 5V DC adaptor
- 2) In number 2, the NodeMCU 8266 module which functions as a liaison from the tool to be made by the researcher to the Thingspeak server and used as control.
- 3) At number 3, the 0.96 OLED OLED functions to display the results of the sensor

that detects oxygen saturation in the form of a number.

- 4) In number 4 there is a MAX30100 sensor, how this tool works using the properties of hemoglobin which absorbs light and the natural pulse of blood flow in the arteries to measure oxygen levels in the body.
- 5) Number 5 is the thingspeak server, so after the saturation results are detected the NodeMCU module sends data via wifi/internet to the server so that it can be monitored.

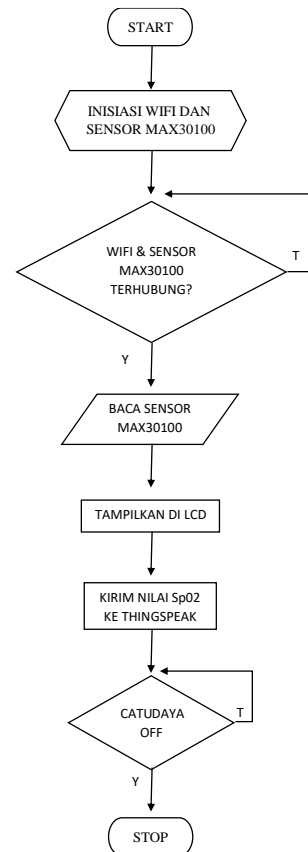


Figure 3 Application Flowchart System.

III. RESULTS OF DATA ANALYSIS

This series of oxygen saturation measuring devices can be used by the general public, especially for people who are carrying out self-isolation which can be monitored by health workers. The use of this tool is quite easy because it uses an adapter with an output of 5 Volts.

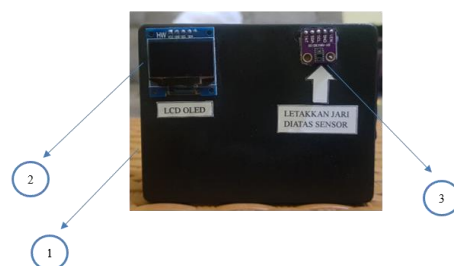


Figure 4. Front look

Installed components

1. Power Input
2. LCD Oled 0,96
3. Sensor MAX30100

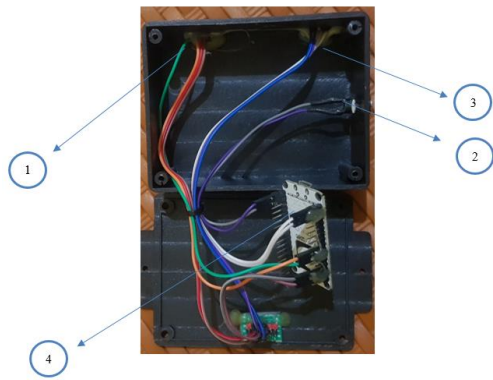


Figure 5. Inside View

Installed components

1. LCD Oled 0,96
2. Power Input
3. Sensor MAX30100
4. NodeMCU 8266

Table 1. First Subject

No	SpO2 (%) Oximeter MAX30100	Waktu Pengiriman ke Thingspeak (s)
1	98	16
2	97	20
3	97	20
4	97	15
5	97	20
6	97	15
7	97	20
8	97	15
9	97	20
10	97	15

In Table 1. the researchers conducted 10 trials, each of which was tested for 10 minutes. In the first experiment, a woman aged 26, oxygen saturation levels were still on the verge of normal with an average value of 97.1% with the speed of sending data to the server an average of 17.6 seconds.

Table 2. Second Subject

No	SpO2 (%) Oximeter MAX30100	Waktu Pengiriman ke Thingspeak (s)
1	97	21
2	97	20
3	97	25
4	97	20
5	101	20
6	97	21
7	97	20
8	90	19
9	97	15
10	97	16

Tests on the second subject, relatively normal SpO2 levels can be seen in the table. In tests that get normal SpO2 levels, this is in accordance with the research design. With an average time or length of data transmission to Thingspeak of 19.7 seconds and an average oxygen saturation level of 96.7%.

Table 3. Third Subject

No	SpO2 (%) Oximeter MAX30100	Waktu Pengiriman ke Thingspeak (s)
1	103	16
2	97	20
3	99	20
4	97	15
5	99	20
6	98	15
7	99	20
8	97	15
9	99	20
10	99	15

Tests on the 3rd subject relatively normal SpO2 levels can be seen in the table. In tests that get normal SpO2 levels, this is in accordance with the research design. With an average time or length of data transmission to Thingspeak of 17.6 seconds and an average oxygen saturation level of 98.7%.

Table 4. Accuracy Test

No	SpO2 (%) Oximeter	SpO2 (%) Oximeter	Percent Error (%)
First Subject			
Percent of Accuracy = (V Max30100 – V Commercial)/V commercial x 100			
	MAX30100	commercial	
1	98	96	2,083
2	97	90	7,778
3	97	95	2,105
4	97	96	1,042
5	97	96	1,042
6	97	96	1,042
7	97	96	1,042
8	97	96	1,042

9	97	96	1,042
10	97	96	1,042

$$\text{Average Error} = \frac{\sum \text{error}}{n} \quad \mathbf{1,926}$$

Second Subject

$$\text{Percent of Accuration} = \frac{(V \text{ Max30100} - V \text{ Commercial})/V \text{ commercial} \times 100}{\text{MAX30100} \quad \text{commercial}}$$

1	99	97	2,062
2	99	98	1,020
3	98	98	0,000
4	99	98	1,020
5	100	98	2,041
6	99	98	1,020
7	99	98	1,020
8	99	98	1,020
9	99	98	1,020
10	99	98	1,020

$$\text{Average Error} = \frac{\sum \text{error}}{n} \quad \mathbf{1,125}$$

Third Subject

$$\text{Percent of Accuration} = \frac{(V \text{ Max30100} - V \text{ Commercial})/V \text{ commercial} \times 100}{\text{MAX30100} \quad \text{commercial}}$$

1	103	98	5,102
2	99	98	1,020
3	99	98	1,020
4	98	98	0,000
5	98	98	0,000
6	98	98	0,000
7	99	97	2,062
8	97	97	0,000
9	99	98	1,020
10	99	98	1,020

$$\text{Average Error} = \frac{\sum \text{error}}{n} \quad \mathbf{1,125}$$

In table 4, the percent error in the first, second and third measurements is calculated, namely, the first subject is 1.926%, the second subject is 1.125%, and the third subject is 1.125%. The percentage of error obtained is relatively small where the accuracy of the data from the research design tool is directly proportional to the commercial tool or standard tool. The average error of the whole test of 3 samples is 1.392%, the percent error of the overall data is small, so the research tool can be used to detect SpO2 levels.

4. Testing the whole tool by testing in several hospital places along with testing the time of sending data to the thingspeak server.

a. Hospital 1 (Community Health Center in Taman)

Address: Taman Sidoarjo Health Center JL. Raya Ngelom No. 10 Taman Sidoarjo, Jl. Raya Ngelom No.50, Ngelom, Kec. Taman, Sidoarjo Regency, East Java 61257. Distance from home: 1.0km

Table 5 Hospital 1

Data Input	Sending Time (Second)
2022-06-19 T09:24:33+07:00 297,95	16
2022-06-19 T09:25:14+07:00 298,97	71
2022-06-19 T09:25:40+07:00 299,98	34

b. Hospital 2 (Siti Khodijah Hospital)

Address: Siti Khodijah Muhammadiyah Hospital, Jl. Raya Bebekan, RT.02/RW.01, Bebekan, Kec. Taman, Sidoarjo Regency, East Java 61257. Distance from home are 400m

Table 6 Hospital 2

Data Input	Sending Time (Second)
2022-06-19 T09:30:18+07:00 300,96	17
2022-06-19 T09:33:45+07:00 301,96	27
2022-06-19 T09:34:47+07:00 302,96	102

c. Hospital 3 (Mitra Keluarga Hospital)

Address: Mitra Keluarga Waru, Jl. General S. Parman No. 8, Krajan Kulon, Waru, Kec. Waru, Sidoarjo Regency, East Java 61256

Table 7. Hospital 3

Input Data	Sending Time (Second)
2022-06-19 T15:50:21+07:00 308,94	18
2022-06-19 T15:51:33+07:00 309,94	112
2022-06-19 T15:51:59+07:00 310,94	26
2022-06-19 T15:53:41+07:00 311,96	182
2022-06-19 T15:54:27+07:00 312,95	86

d. Hospital 4 (Sidoarjo Hospital)

Address: Sidoarjo Regional General Hospital, Jl. Mojopahit No.667, Sidowayah, Celep, Kec. Sidoarjo, Sidoarjo Regency, East Java 61215. Distance from home: 19.4km

Table 8. Hospital 4

Input Data	Sending Time (Second)
2022-06-19 T16:16:31+07:00 320,94	17
2022-06-19 T16:16:53+07:00 321,95	22
2022-06-19 T16:17:20+07:00 322,96	36
2022-06-19 T16:18:26+07:00 323,93	106

From several experiments in various hospitals, it can be concluded several points, namely:

1. Internet affects the process of sending data
2. There is a delay in the delivery process
3. Requires stable internet for fast data

CONCLUSIONS

From the results of planning, design to testing the authors can draw the following conclusions:

1. The author succeeded in making a monitoring system for blood oxygen levels using the MAX30100 sensor which functions as a pulse oximeter or SpO2 detector in the blood based on NodeMCU8266 as the microcontroller board.
2. The author succeeded in assembling and building a blood oxygen level detector (SpO2) where the tool can run as the system is running, namely the tool detects blood oxygen levels and then sends the results to the Thingspeak server with the help of a connected internet network. With a relative error percent small size and fast delivery time, the tool can be declared running and can be used to detect levels of oxygen in the blood or SpO2.

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