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Analysis of Water Quality Around the Coast Based on Physical Parameters (Temperature, Salinity and Metal Content) using Wireless Network System

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ABSTRACT

Testing and analyzing the water quality had been conducted by combining several characteristics of sensors (temperature, turbidity and heavy metals) integrated in the wireless network system to determine the quality comparator parameters of water worth drinking in coastal areas. Using sensors made of chitosan compounds to detect heavy metals contained in water. Testing was also done using the DS18B20 sensor (temperature) and TDS (salt levels) by operating a wireless network to transmit data in real time to the web through the GPRS network with the automation system. The sampling used purposive sampling by seafront distance, ± 1 km distance and ± 3 km distance. Testing of copper chips with the addition of Chitosan showed a more stable reading result than without using copper plates (read: pure PCB). At Chitosan biosensors, the addition of CMC shows more varied readings compared to using chitosan biosensors alone. The Ds18b20 Sensor was able to work at high temperatures, with stable value readings. From Sensor readings TDS (EC meter), it's obtained that the higher the water solution, the greater the reading from the TDS sensor. It was shown on a chart that describing the closer to the sea area, the higher the level of the dissolved substances. The tool was accessed in real time through the Thing Speak platform in accordance with the specified account.

Keywords: Chitosan, Water Quality, Sensor DS18B20, TDS Sensor

I. INTRODUCTION

Water is an indispensable source of life by living things. Water is used for industrial purposes, agriculture, firefighting, recreation areas, means of transportation, as an energy source. Therefore, clean water is needed with sufficient quality and quantity so that it can be consumed for daily life.

Water quality is a qualitative condition of water that is measured and tested based on certain parameters and specific methods. Water quality can be expressed with water quality parameters. These parameters include physical, chemical, and microbiological parameters.

Therefore an automated system is needed and must be able to measure water quality in real time through area monitoring which is a common application of WSN (Wireless Sensor Network). In monitoring areas, WSN is placed in areas where some phenomena should be monitored. Wireless sensor network (WSN) refers to a group of spatially dispersed and specialized sensors to monitor and record the physical condition of the environment and organize the data collected in the central location. WSN measures environmental conditions such as temperature, sound, pollution levels, humidity, wind, and so on and is then transmitted wirelessly. The development of wireless sensor networks is widely used in many industrial and consumer applications, such as industrial process monitoring and control, machine condition monitoring, and so on.

II. METHODS AND MATERIAL

The materials used were water near the beach, Wemos D1 Mini, Temperature sensor Ds18b20, TDS (Total Dissolved Solid), Chitosan Biosensor. The tools used were Arduino Software, PLX-DAQ convert to Excel, Web Server (ThingSpeak), and ThingSpeak Platform.

Real-Time Monitoring for water pollution using the Wireless Sensor Network which was run on this study consists of several stages. The stage begins with the initiation of a system consisting of the Wemos D1 Mini microontroller, Wifi-Local, and the sensors (Ds18b20 Sensor, TDS, and Chitosan Biosensors) were used.

At this stage Wifi-Local sent the data it receives to a preconfigured database server (ThingSpeak) to get its API value. The processed data then sent to Platorm IOT (ThingSpeak) using the –POST method every few seconds.

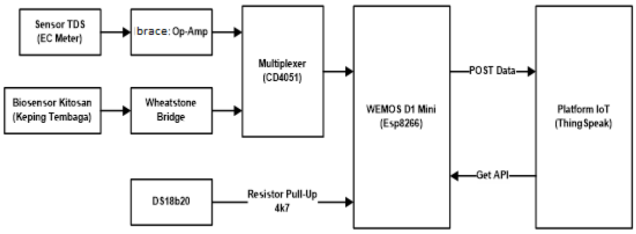

Figure 1. Block Diagram

In the design of this microcontroller-based sensor control used several types of sensors namely, Ds18b20 sensor (to measure water temperature), TDS used to measure the level of water salt content (salinity of water), and Chitosan Biosensor (to determine the heavy metals contained).

The design of the DS18b20 Temperature sensor circuit serves as a temperature level detector found in fluid in both the upper and lower sensors. According to the datasheet, the output emitted by the DS1820 sensor was the configuration of numbers 1 and 0, which indicates a specific temperature.

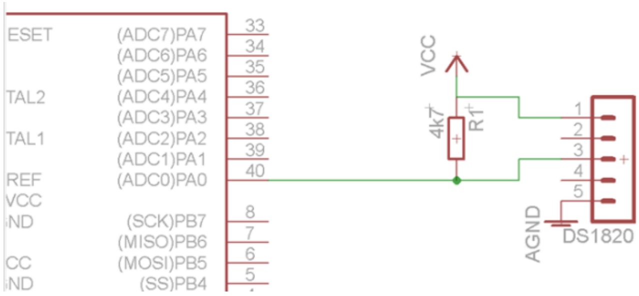

Figure 2. Sensor Circuit Ds18B20

The design of the TDS sensor used conductivity principles. By using two electrodes placed in a solution given the difference in electrical potential (normally sinusoidal), the plate flew electric current. The conductance of a solution was comparable to the concentration of ions in the solution. This was done to be able to know the amount of dissolved substances in the water that determine the quality of the water.

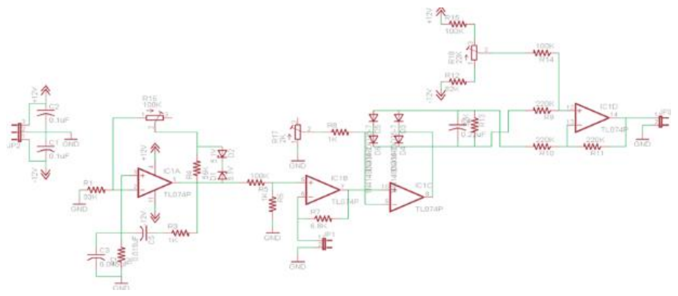

Figure 3. Sensor Module Circuit and TDS Sensor Signal Conditioning Circuit

Chitosan filmmaking and Chitosan film with the addition of CMC mass variation begun with the selection of mixed compositions for Chitosan and Chitosan solutions - CMC. It's important to determine the characteristics of a preparatory film. In this study a total of 0.05 g of chitin was dissolved in a certain amount of acetic acid with a concentration of 2%. As for making chitosan film - CMC, into the solution of chitosan added CMC with a mass variation of 0 gr, 0.05 g; 0.1 g. This amounts were selected based on preliminary studies to determine the exact number of CMCs in which the solution of chitosan - CMC can still stick to copper keeping (forming a thin film on the layout surface).

In the dissolving process, chitosan was not completely perfectly soluble hence the entire solution making component was mixed with the blending method using magnetic stirrer at a constant speed for ± 24 hours at room temperature. The result was obtained 5 types of solutions with different compositions.

From the fabrication process of chitosan film-based sensors - CMC obtained five sensor samples with various compositions, namely, pure sensor 1 without the addition of chitosan, sensor2 based on chitosan film with, 0.05 g CMC (CS - CMC 0.05w/v), chitosan film-based 3 sensor with 0.1 g CMC addition (CS - CMC 0.1w/v), chitosan-based 4 sensor with 0.05gr and 5 chitosan film-based sensor 0.1gr chitosan.

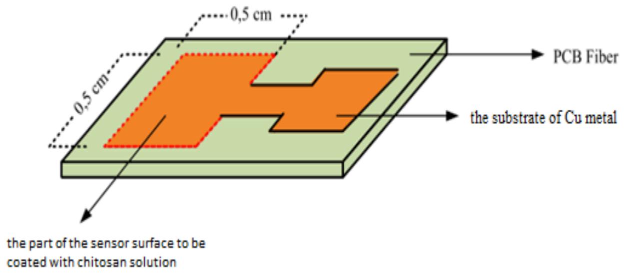

Figure 4. Fabricated Sensor Shapes

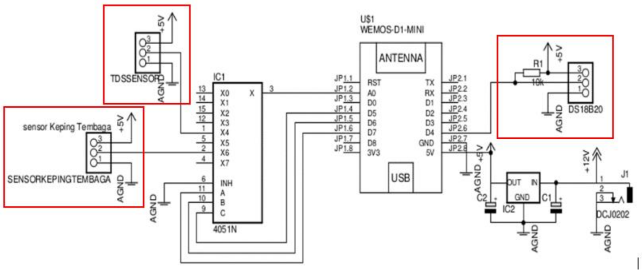

Figure 5. Ds18B20 Sensor Series Schematics, TDS Sensors (EC Meters) and Chitosan Sensors

III.RESULTS AND DISCUSSION

Sensors were performed using 2 nodes each consisting of TDS (EC Meter) sensors, Ds18b20 Sensors and Chitosan Biosensors.

A. Ds18b20 Sensor Testing and Analysis

In the Ds18b20 sensor test it takes data retrieval as a comparison of the digital values derived from the Ds1820 sensor for each 10C change. Below is data obtained from the DS1820 sensor with a Digital Thermometer.

From below results obtained were almost linear, where the temperature was measured from a reading of 29°C to a temperature of 60°C digital thermometer as a comparison of the Ds1820 sensor.

TABLE 1

Ds18b20 Testing with Digital Thermometer Comparison

No.	sensor Ds18b20 (^{0}C)	termo digital (^{0}C)
1	22.5	29
2	23.05	30
3	24.5	31
4	25	32
5	25.95	33
6	26.9	34
7	27.8	35
8	28.8	36
9	29.85	37
10	30.25	38
11	31.1	39
12	31.75	40
13	32.5	41
14	33.05	42
15	33.95	43
16	34.7	44
17	35.4	45
18	36.3	46
19	37.2	47
20	38.1	48
21	39	49
22	39.85	50
23	40.65	51
24	41.45	52
25	42.2	53
26	43.05	54
27	44	55
28	44.5	56
29	45.2	57
30	45.95	58
31	46.6	59
32	47.3	60

B. TDS Meter sensor testing

Testing was conducted at 3 different points namely the seafront area, the area <1 km from the sea and the area of <3km) from the sea.

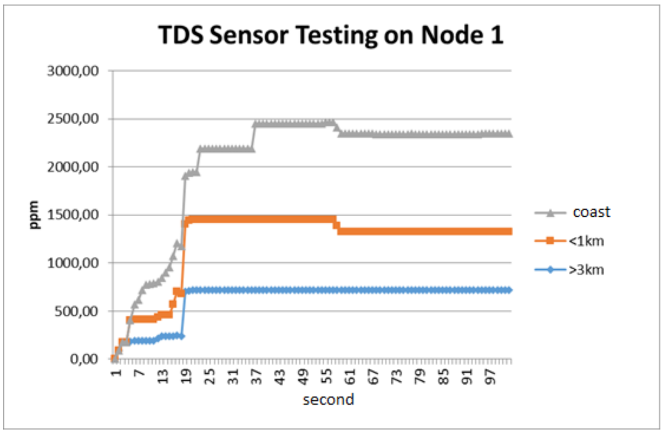

Figure 6. TDS Sensor Testing on node 1

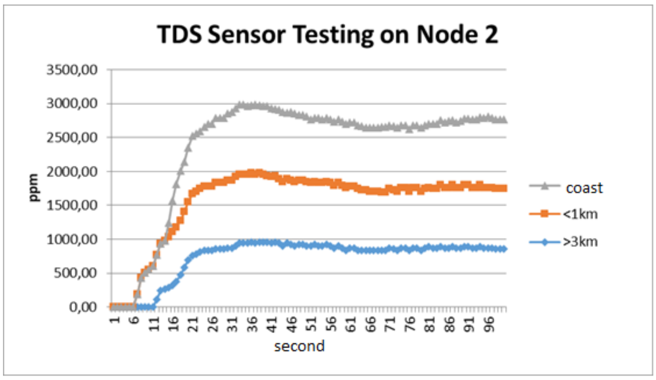

Figure 7. TDS Sensor Testing on node 2

From both charts, conclusions are made, namely:

1. TDS sensor showed a long reading, i.e. at the 15th second the new data starts to read and stable in the 20th to 40th seconds
2. The closer the water source to the marine area, the system showed higher ppm levels. This was certainly above the WHO recommended drinking water eligibility threshold of between 100 to 300 ppm for the good category and 300 to 600 ppm for the moderate category.

C. Biosensor Chitosan Testing

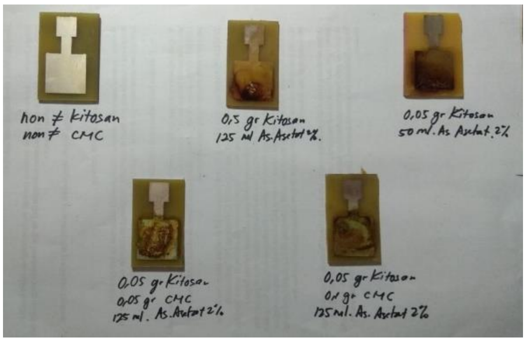

Figure 8. Chitosan Biosensor Fabrication Results

The result of film fabrication of chitosan solution and solution of chitosan +CMC that had been deposited above the sensor substrate obtained 5 sensor samples, namely sensor 1 pure pcb; sensor 2 with the use of chitosan 0.05gr and 50ml acetic acid 2%; sensor 3 with the use of chitosan 0.05 gr and 100ml acetic acid 2%, sensor 4 with the use of chitosan 0.05gr, 125ml acetic acid 2% and 0.05gr CMC; sensor 5 with the use of chitosan 0.05gr, 125ml acetic acid 2% and 0.1gr CMC.

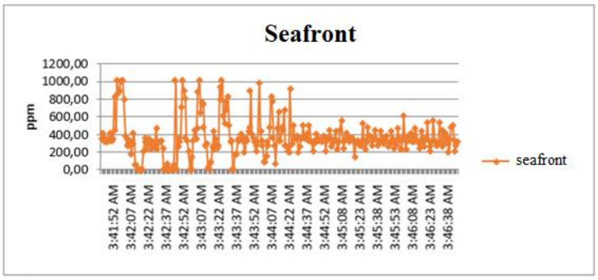

Figure 9. Pure PCB Chip Sensor Testing

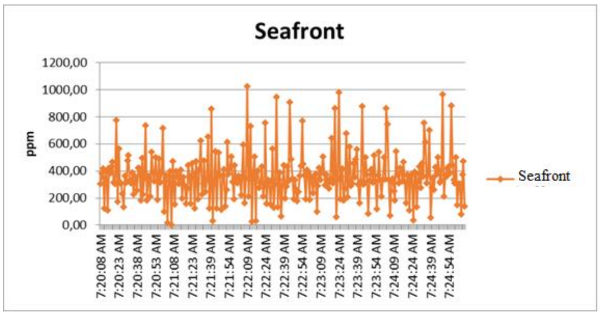

Figure 10. PCB Chip Sensor Testing coated 0.5 gr Chitosan + 50ml acetic acid

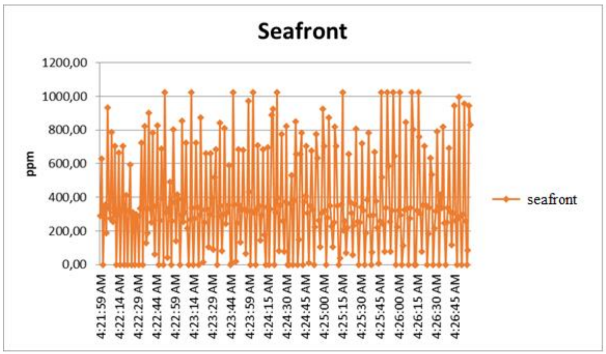

Figure 11. PCB Chip Sensor Testing coated 0.5 gr Chitosan + 100ml acetic acid 2%

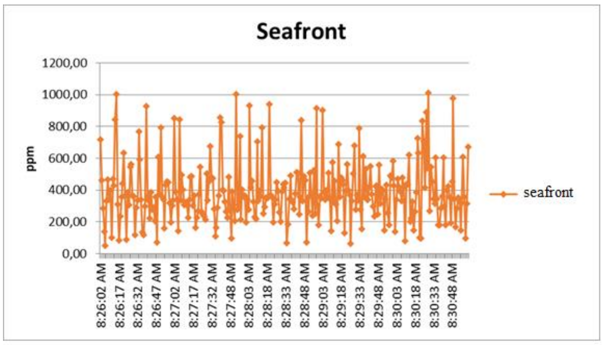

Figure 12. PCB Chip Sensor Testing coated 0.05 gr Chitosan + 125ml acetic acid + 0.05 gr CMC

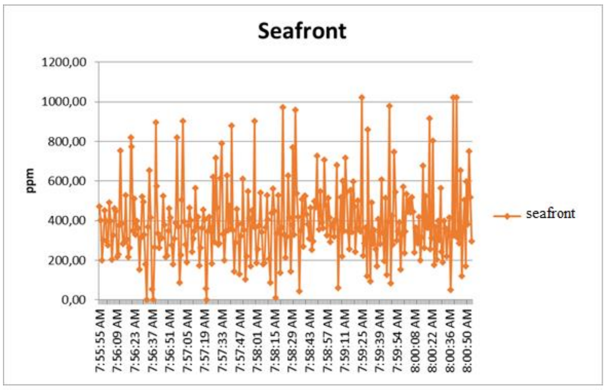

Figure 13. PCB Chip Sensor Testing coated 0.05 gr Chitosan + 125ml acetic acid + 0.1 gr CMC

Test results on copper chips with the addition of the number of chitosan showed a more stable reading result when compared to without the use of copper plates (read: pure pcb). The readings differ in height even with graphs that up and down quite large, but can be read more stably.

IV.CONCLUSION

After testing and analysis, several conclusions were able to be drawn, namely on copper pieces the addition of the amount of chiosan shows a more stable reading result when compared without the use of copper plates (read :pcb pure). The readings differ in height even with the graph sizing up and down, but were able to be read more steadily. Systems and tools had worked as they should, by combining chisosan biosensors that able to read ppm (parts per million), TDS sensors were able to read dissolved substances and Ds18b20 sensors read temperature. The system and tools had worked properly, i.e. both nodes (node 1 and node 2) had been able to read the state of the water in the surrounding environment and sent the data to the web server (IoT Platform/ ThingSpeak) so that it was able be monitored in real-time.

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