ENGINEERING RESEARCH JOURNAL (ERJ)
Vol. 1, No. 43 Jan. 2020, pp. 100-104
Journal Homepage: http://erj.bu.edu.eg

Water Quality Monitoring system of the Nile River

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Abstract. : The world suffers from the problem of pollution of water resources, which greatly affects the life of the individual and the community, because water is an urgent need for the survival of man and all living things on earth. Water pollution may be the main reason for ending life on the planet and is defined as any chemical or physical change in water quality, whether directly or indirectly, making it unsuitable for the required uses. In this paper, the problem of pollution of the Nile water in Egypt is discussed and the role of the Egyptian government in coordination with the Ministry of Environment to develop the necessary plans to reduce the pollution of the Nile River and also to monitor the water quality, to confront the incidents of water pollution and reduce the negative damage resulting from them. Hence the importance of the IOT "Internet of things" in real time monitoring the quality of water of the Nile River to extract the necessary data from each remote sensor "Nods" installed at specific distances along the River Nile. The System proposed in this paper includes a NODE MCUmicro controller connected to four main sensors such as Temperature sensor, Dissolved Oxygen sensor, pH sensor and Turbidity sensor which selected to measure its parameter that determine the quality of water used in different cases of experiments proposed in our practical work then the NOD MCU sends and displays all those data in real time through thing speak server website. From the data extracted from each sensor during the proposed experiments, we can monitor, analyze, evaluate and determine the water quality parameters of the Nile River compared to The World Health Organization (WHO) standard for Drinking-water quality.

Keywords: Temperature sensor, Dissolved Oxygen sensor, pH sensor, Turbidity sensor, WHO, IOT, NODE MCU, thing speak server.

1. INTRODUCTION

The Nile River is the longest river in the world and one of the most important rivers in the world. It is very important for the economies of the Nile Basin countries, especially Egypt. Recently, the Nile River has been exposed to many negative phenomena that have affected the quality of water in it, The Nile River is exposed to several negative practices that cause its pollution. The most important of these pollutants are: industrial pollutants from factories near the river, which dump tons of chemical and solid residues in the waters of the Nile River, as well as pollute the small springs that flow into the river.

The largest number of these plants pump wastewater into the Nile without treatment, which causes an imbalance in water temperature. In addition to affecting the dissolved oxygen rate in water and the death of organisms from algae, aquatic plants, etc., the Nile River is exposed to water pollution caused by water Drainage where this water has caused the transfer of micro and pathogens and parasites living organisms to the Nile River. The issue of pollution of the Nile River is a major challenge for the competent authorities, which must do their best to prevent this pollution or at least to minimize it, to enforce laws and regulations that prevent the dumping of contaminants, and to develop strong plans to confront and prevent pollution. It is negligible, and the pollution of its waters causes countless disasters.

The wireless communication technologies are increased for aiding human's personal and daily tasks. There are many applications developed for building control, automation, data acquisition in recent years. There are many benefits like low cost, easy installation, and maintenance. The remote device network is applicable in several functions like farming, traffic management, remote health care, forest management, security and surveillance [1].

The aim of this paper is to find the methodology depending on IOT "Internet of things" for monitoring the water quality parameters like temperature, dissolved oxygen, pH and turbidity. The following table (1) shows the ideal WHO standard parameters for the suitable drinking water.

Table1: Ideal water ranges in according to WHO standards [1]

Parameters	Quality Ranges	Units
Turbidity	5-10	NTU
pH	6.5-8.5	-
Conductivity	300-800	Micro S/cm
DO	4-6	mg/L
Temperature	27-33	°C

This paper gives an introduction and highlights the important to protect our resources of water and methods of determination and monitoring the quality of water and how to connect sensors with each other to make a wireless sensor network "WSN" NODs based on internet of things "IOT". in part two the literature review of previous works clarified on determination the quality of water based on some parameters extracted from some sensors that connected to each other to make a circuit implementation and its result those clarified in part three and four respectively, finally the conclusion of this paper clarified in part five and the future works expected.

2. Literature Review

The IoT keyword is very synonym with the latest wireless monitoring system in our daily life. From the healthcare to the environmental surveillances, the IoT system is widely used fora reliable data acquisition in a real-time monitoring process [3].All the practical work, design and results of experiment proposed in this paper are in compared to the following paper works [4], [5],….[9] and [10].

3. Experimental Study

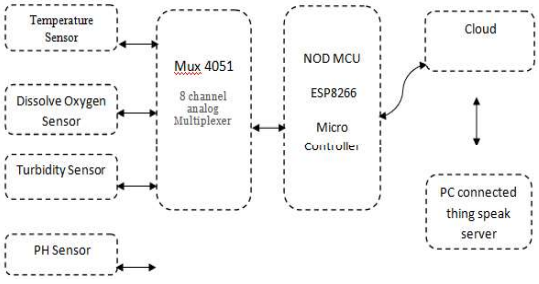

FIG1: Experiment Block Diagram

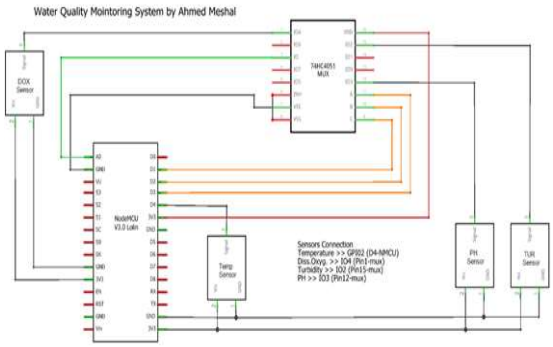

FIG2: System Proposed Connection

The water quality monitoring system proposed in this paper block diagram and system connection shown in Figure (1) and Figure (2) respectively. As shown we connect the NOD MCU to 4051 analog Multiplexer with 8 channels which allow to use multiple analog sensor to be connected to our system and the reason of using mux generally is that NOD MCU allow only one sensor to be connected at a time. After setup connection of the system proposed and connect it to our pc through USB cable, hence the first step is to make calibration of all sensors connected separately, second step is to test each sensor and displays the corresponding test values data through serial monitoring of the Arduino IDE program ,third step is to make the experiment of each sensor under its circumstances as discussed in details in part 4 (Results), then send those data through the internet on the thing speak server web site which provide a real time monitoring of the extracted data from the experiment. When this system to be applied in the Nile, more than Wireless sensor nodes (WSN) to be fixed in specific range such as 5km distance separated each other and there will be like a Hub or switch that connect all nodes with each other and collect data from them.

4. Results and Discussion

In this part, the result of each experiment for each sensor will show in details,

4.1 Results for (Temperature Sensor)

First experiment, we use water proof DS18B20 digital temperature sensor (usable with 3-5.5V and is good up to 125 °C) connected directly to GPI02 (D4) of the NOD MCU and the sensor probe drown in the water basin one time contains fish inside and the other one without fish under the following circumstances during six hours continuously but varying the AC temperature from at (18, 20, 22, 24, 26, 28) °C for each hour respectively, Readings recorded every 10 min.

Fig. 3&4 shows the experiment results for temperature sensor extracted from thing speak.

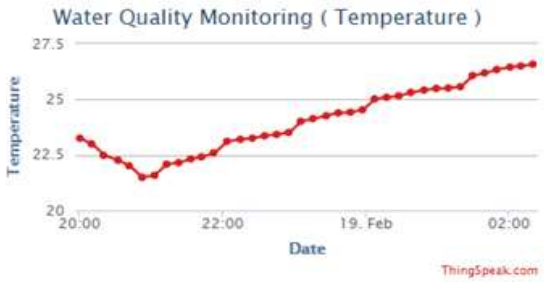

FIG 3: Temperature Sensor Experimental Results with fish inside basin.

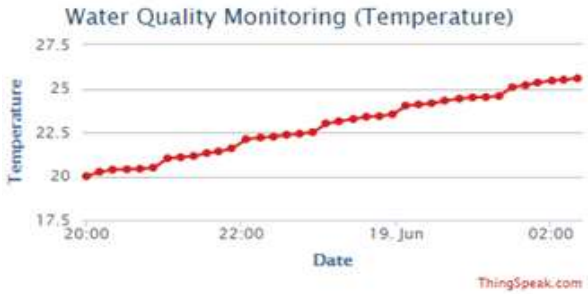

FIG4: Temperature Sensor Experimental Results without fish inside basin.

From the two cases results available here either in the case of the basin filled of fish or without fish, the remarkable hint is that a little increase found of temperature values in case of fish inside the basin than the case of the basin without fish under the same circumstances applied.

4.2 Results for (PH Sensor)

Second experiment, we use PH meter (SEN 0161) that has (PH range 0~14, standard solution PH value is 7, more than 7 is Alkaline and less than 7 is Acid). PH sensor connected to 4051 analog Multiplexer (pin 12) that connected to NOD MCU and the sensor probe drown in the water basin one time contains fish inside and the other one without fish under the following circumstances during three hours continuously but varying the type of the following solutions (Tap water, Baking Soda, Urine) for each hour respectively, Readings recorded every 5 min. Fig 5&6 shows the experiment results for PH sensor extracted from thing speak server.

FIG5: PH Sensor Experimental Results with fish inside basin.

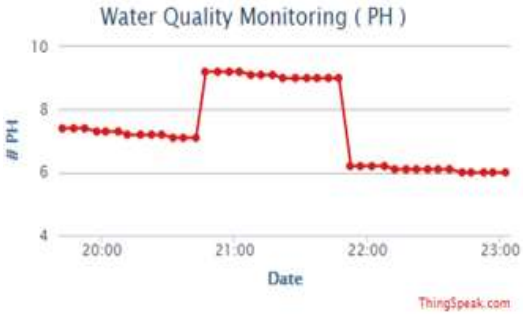

FIG 6: PH Sensor Experimental Results without fish inside basin

From the two cases results available here either in the case of the basin filled of fish or without fish, the remarkable hint is that a little decrease found of PH values in case of fish inside the basin than the case of the basin without fish under the same circumstances applied.

4.3 Results for (Turbidity Sensor)

Third experiment, we use Turbidity sensor (SEN 0189) that has (NTU < 0.5, output voltage 4.1±0.3V)If you leave the sensor in the pure water, Turbidity sensor connected to 4051 analog Multiplexer (pin 15) that connected to NOD MCU and the sensor probe drown in the water basin one time contains fish inside and the other one without fish under the following circumstances during eight hours continuously but varying the type of the following solutions (Potable water, Tap water, Tap water mixed with 1,2,…,6 spoon of coffee) for each hour respectively, Readings recorded every 5 min. Fig 7&8 shows the experiment results for Turbidity sensor extracted from thing speak server and the corresponding NTU values of the sensor calculated from the equation shown in each figure .

FIGURE 7: Turbidity Sensor Experimental Results with fish inside basin.

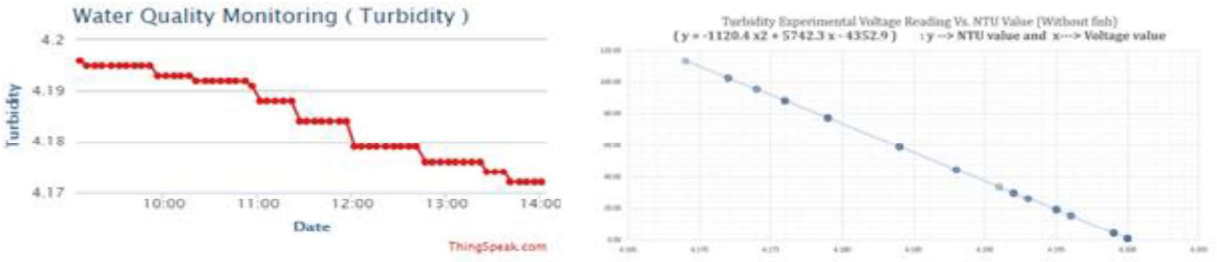

FIG 8: Turbidity Sensor Experimental Results without fish inside basin.

From the two cases results available here either in the case of the basin filled of fish or without fish, the remarkable hint is that a little increase found of Turbidity values in case of fish inside the basin than the case of the basin without fish under the same circumstances applied.

4.4 Results for (Dissolved Oxygen)

Fourth experiment, we use Dissolved Oxygen (SEN 0237) that has (Detection Range: 0~20 mg/L and Temperature Range: 0~40 ℃) and before using we should make calibration process of the sensor in 0.5 mol/L NaOH solution. Dissolved Oxygen sensor connected to 4051 analog Multiplexer (pin 1) that connected to NOD MCU and the sensor probe drown in the water basin contains fish inside under the following circumstances during four hours continuously but varying in the following cases(First: two hours at 25℃ without filter, Second: two hours at 25 ℃ with filter) respectively, Readings recorded every 5 min. Fig 9&10 shows the experiment results for Dissolved Oxygen sensor extracted from thing speak server.

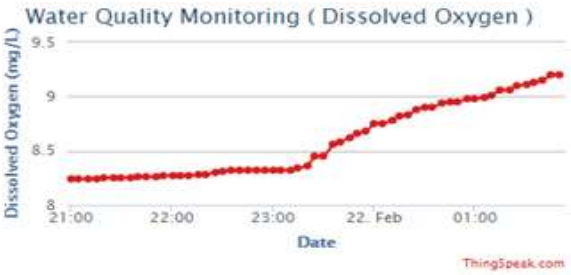

FIG 9: Dissolved Oxygen Sensor Experimental Results with fish inside basin.

FIG 10: Dissolved Oxygen Sensor Experimental Results without fish inside basin.

From the two cases results available here either in the case of the basin filled of fish or without fish, the remarkable hint is that a little decrease found of Dissolved Oxygen values in case of fish inside the basin than the case of the basin without fish under the same circumstances applied.

4.5. System Design Model of the Experimental work

The following Fig 11 show a real shape of the practical system proposed as a NOD inside the basin with fish contains all sensors available that connected with through the pc and the thing speak server for monitoring the quality of water.

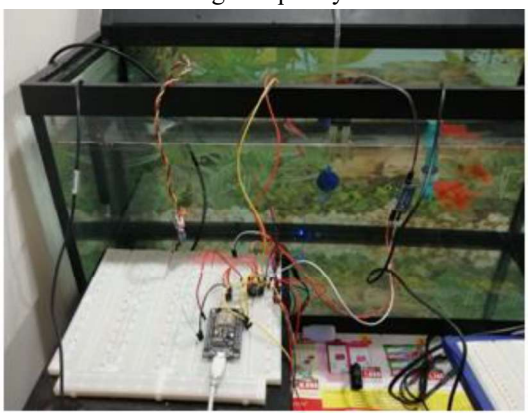

FIG 11: System Design Model of the experiment.

4.6. WSNs design model expectation for Nile River

The following Fig 12 show the expectation of the system proposed with all Wireless sensor nodes (WSNs) fixed when it will be applied in the Nile that has a length of 1,500 Kilometers in Egypt only from 6,650 the total length (about 22%), So the distance calculation proposed to be 5 Kilometers between each sensor nodes separated each other and there will be a central NOD or switch that control, connect all nodes with each other and collect data from them, hence we have about 300 WSNs need to be setup and each sensor node will cost about 1000$ or 16,000 EGP so the total expected cost will be 300,000$ or about 5 million EGP included the cost of all other facilities and components that will be setup to achieve this system proposed.

FIG 12: WSNs Design Model expectation for the Nile River

5. Conclusion and Future Work

The System proposed for water quality monitoring system based in IOT consists of NOD MCU micro controller connected to four main sensors like Temperature sensor, Dissolved Oxygen sensor, pH sensor and Turbidity sensor, hence this system has the benefit for analyze and check for the water quality parameters and determine if those parameters extracted from each sensors are suitable for drinking water or not. In addition to a proposed plane for design the system proposed to setup the WSNs in real life along the Nile River in Egypt with all cost and distance calculation. Future Work may use more sensors like sensors measure conductivity, water level and salinity percentage in water and may provide adds on in our system like we connect GSM module that provide sending daily report through SMS for specific numbers to guarantee a continuously real time monitoring water quality parameters from Sensors.

6. References

[1] Li S, Xu L, Wang X, “Integration of Hybrid Wireless Networks in Cloud Services Oriented Enterprise Information Systems”, Enterp. Inf. Syst., Vol.6, (2012), pp.165–187.

[2] S. Geetha and S. Gouthami,” Internet of things enabled real time water quality monitoring system”, Springer open (2017) 2:1 DOI 10.1186/s40713-017-0005-y.

[3] Kamarul Hafiz, Kamaludin Widad Ismail “Water Quality Monitoring with Internet of Things (IoT) ”, 2017 IEEE Conference on Systems, Process and Control (ICSPC 2017), 15–17 December 2017, Melaka, Malaysia.

[4] Vaishnavi V. Daigavane and Dr. M.A Gaikwad "Water Quality Monitoring System Based on IOT ", Advances in Wireless and Mobile Communications. ISSN 0973-6972 Volume 10, Number 5 (2017), pp. 1107-1116.

[5] A.N.Prasad, K. A. Mamun, F. R. Islam, H. Haqva "Smart Water Quality Monitoring System",DOI: 10.1109/APWCCSE.2015.7476234 Conference: 2nd IEEE Asia Pacific World Congress on Computer Science and Engineering, At Fiji Islands.

[6] K.Spandana, V.R.Seshagiri "Internet of things (Iot) based Smart Water Quality Monitoring System", international journal of Engineering &Tech. (2018) 259-262.

[7] Vennam Madhavireddy, B. Koteswarrao "Smart Water Quality Monitoring System Using Iot Technology", International Journal of Engineering & Technology, (4.36) (2018) 636-639.

[8] Anuradha T, Bhakti, Chaitra R, Pooja D "IoT Based Low Cost System for Monitoring of Water Quality in Real Time ", International Research Journal of Engineering and Technology (IRJET),Volume: 05 Issue: 05 | May-2018.

[9] Gowthamy J, Chinta Rohith Reddy,"Smart Water Monitoring System using IoT", International Research Journal of Engineering & Technology (IRJET), Volume 05, Oct 2018.

[10] M. Joseph Vishal Kumar, Krishna Samalla," Design and Development of Water Quality Monitoring System in IOT ", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-5S3, February 2019.