Physical Parameters of Drinking Water Quality Monitoring and Analysis System

[1]S.Vamshi Krishna, [2]Ch.Ashokvardhan Reddy,[3]K.Soma Rahul Reddy, [4]A.Prabhakar Siva Ram, [5]A.Lalitha Chandra,
[1]Associate Professor, [2]Student, [3]Student, [4]Student, [5]Student,
[1]Electronics and Communication Department,
[1]Godavari Institute of Engineering and Technology (Autonomous), Rajahmundry, India

Abstract: Due to fast industrialization and urbanization water body gets affected rapidly. This phenomenon not only affect the water body but also supports the other harmful organisms which can cause a severe diseases problem for the mankind. The internet of things technology could play vital in determining the water quality which may further improve its quality. In this paper, an attempt has been made to develop a frame work model which could capable for addressing the water quality parameters. The vital water quality parameters such as pH level, water body temperature and turbidity were observed through internet of things technology and presented in this paper.

Index Terms **- Water, Internet of Things (IoT), pH, Temperature, Turbidity**.

1. INTRODUCTION

There are many natural resources available for mankind such as air, coal, natural gases, minerals, natural oil, forest & timber, soil and water. Among all-natural resources, water could be considered as a one of the most important and precious natural resources for mankind. Water is a vital natural resource to mankind's existence on the earth, without it there would be no life on the earth. The earth's surface contains approximately 1.4×10^9 cubic kilometers of water in the form of oceans, seas, rivers, lakes, ice, etc., but only 3% of the total volume water (fresh water) are available for drinking purposes [1],[3]. These fresh waters may be found in rivers, lakes, and groundwater.

Due to the fast industrialisation and urbanisation many fresh water bodies get polluted which degrades the its quality. Therefore, a real time monitoring is very much necessary in order to assess the water quality [4],[5]. The quality of water can be determined by its chemical, physical and biological characteristics. The aim of this paper is to utilise the internet of things technology in order to determine the quality of water [2],[8]. The interne of things technology is a latest upcoming technology which can help us for monitoring of water quality in real time. This paper may provide a driveway for assessing the water quality which help in maintaining the proper quality of water.

2. INTERNET OF THINGS TECHNOLOGY

The prevalence of internet connectivity into physical devices and everyday objects is called Internet of things (IOT). It is embedded with electronics, internet connectivity, and other forms of hardware such as sensors. These devices can communicate and interact with others over the Internet, which can be monitored remotely. It is an emerging new concept that has a sufficient potential to run anything virtually. The things in in the reference of IOT could be defined as an object such as cardiac monitor to an any sensor. In 1999 Kevin Ashton was the first researcher who gave an idea of linking the sensor with internet [9].

The journey of IOT has taken over a century to gain the present popularity and this journey gaining constant attention in both academic and industrial sector. In the present study, the node microcontroller (NODEMCU) was used as an open source software and hardware which is built around the ESP8266 system. This system contains all crucial elements of the modern computer such as CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. The block diagram of NODEMCU with different sensor card is presented in Figure 1, which is used to assess the quality of water samples.

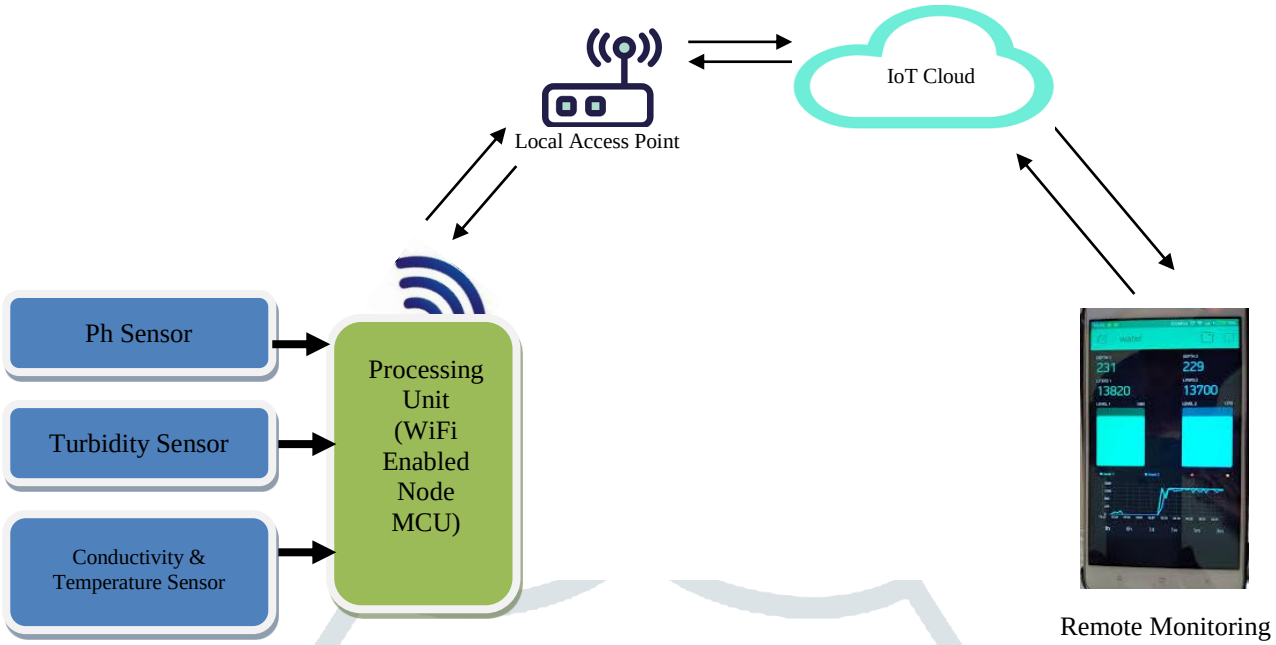

Fig1: Water Quality's Physical Parameters Monitoring Framework

3. DEVELOPMENT OF IOT TECHNOLOGY FOR WATER QUALITY MEASUREMENT

The first task of this project work is to determine the which water parameters would provide a close indication of its pollution. In this paper, we choose the three water parameters such as pH, turbidity (temperature) and conductivity level of water body. As presented in Figure 1, there are four main components which having a prime impact on the development of IOT technology for determining the water quality, such as NODEMCU, pH sensor, conductivity sensor and turbidity (temperature) sensor. The overall system block diagram for degerming the water quality is presented in Figure 2. In which all the water parameter sensor namely, pH, conductivity and temperature are connected to the analogue to digital converter through the microcontroller. Further, the collected data can be stored on board SD card or can be sent to File Transfer Protocol (FTP) server or can be sent to cloud server. The detail discussion of each component with their specification are given in the below subsections.

Table 1. Technical specifications of NODEMCU

Sl. No.	Parameters	Specification
1	Voltage limit	3.3V
2	Current consumption	10uA~170mA
3	Flash memory attachable	16MB max (512K normal)
4	Processor	Tensilica L106 32-bit
5	Processor speed	80~160MHz
6	RAM	32K + 80K
7	GPIOs	17 (multiplexed with other functions)
8	Analog to Digital	1 input with 1024 step resolution
9	Maximum concurrent TCP connections	5

3.1 pH Sensor The pH of a substance is showing an indication of how many hydrogen ions it forms in a certain volume of water. A typical pH meter has two basic components first the meter itself and second either one or two probes (which is used for the insertion into the solution whose testing is required). The first one could be a moving coil meter or a digital meter. If the pH meter has two probes then each probe carries a separate electrode whereas for a single probe meter both the electrode is built inside it for the purpose of simplicity and convenience. These electrodes are not same as a normal electrode they have a mini chemical set in its own right. The schematic diagram of pH sensor is shown in Figure 3. The technical specifications of the pH sensor used in the work is given in Table 2.

Table 2. Technical specifications of pH sensor

Sl. No.	Parameters	Specification
1	Operating voltage	9V
2	Measuring range	0-14 pH
3	Measuring temperature	0-60 ℃
4	Accuracy	± 0.1pH
5	Response Time	≤ 1min

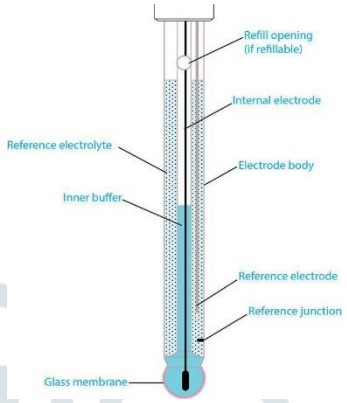

Fig 2: Ph Sensor

3.3. Temperature Sensor

A temperature sensor is a device which is used for the measurement of temperature through electrical signal. The temperature sensor i.e., thermocouple is made from two dissimilar metals that generate electrical voltage in direct proportion with changes in temperature. The resistance temperature detector (RTD) is a variable resistor that will change its electrical resistance in direct proportion to changes in temperature in a precise, repeatable and nearly linear manner. The turbidity of the water body could be measured by knowing the temperature of it. The technical specifications of the temperature sensor are given in Table 3 and the photographic view it is presented in Figure 4.

Table 3. Technical specifications of temperature sensor

Sl. No.	Parameters	Specification
1	Operating voltage:	3.0V – 5.0V
2	Accuracy	±0.5°C
3	Temperature range	-55 to 125°C

Fig 3. Temperature sensor

3.4. Turbidity Sensor

The gravity Arduino turbidity sensor detects water quality by measuring the levels of turbidity. It uses light to detect suspended particles in water. By measuring the light transmittance and scattering rate, which changes with the amount of total suspended solids (TSS) in water, the percentage of total suspended particles in water can be calculated. As the TSS increases, the liquid turbidity level increases. Turbidity sensors are used to measure water quality in rivers and streams, wastewater and effluent measurements, control instrumentation for settling ponds, sediment transport research and laboratory measurements. This liquid sensor provides analog and digital signal output modes. The threshold is adjustable when in digital signal mode. Figure 5 represents the turbidity sensor with program module and its specification is tabulated in Table 4.

Table 4. Technical specifications of Turbidity sensor

Sl. No.	Parameters	Specification
1	Operating voltage	5V DC
2	Operating current	40mA (MAX)
3	Response Time	<500ms
4	Insulation Resistance	100MΩ

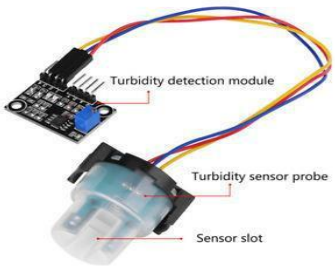

Fig 4. Turbidity sensor

4. Analysis of Water Parameter Through IoT Technology

The water samples are collected from the surface water source and tested to determine the water quality parameter. The collected samples were tested simultaneously at indoor ambient temperature condition. The output of pH sensor on cloud data base and its analysis is shown in Figure 5. The real time data of water quality properties through user interface from the developed cloud are analyzed. This analyzed data can be used to improve the quality of water body. The other water body quality parameter such as temperature and turbidity are presented in Figure 6 and Figure 7.

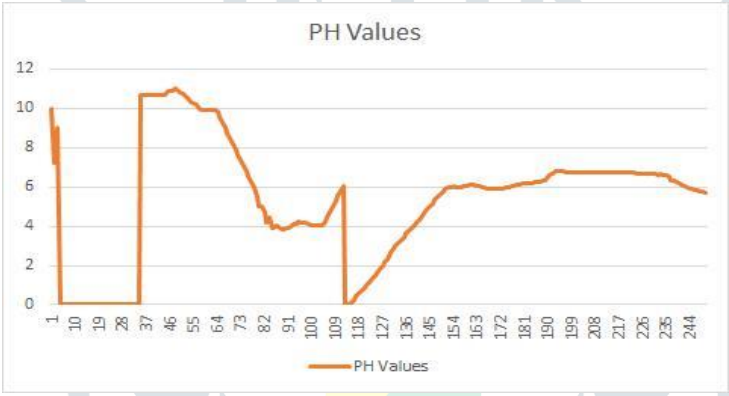

Fig 5. Graph on pH values of water quality

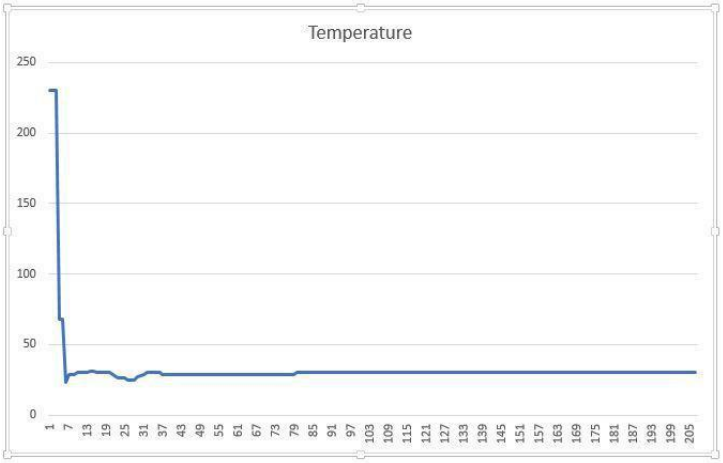

Fig 6. Graph on Temperature of water

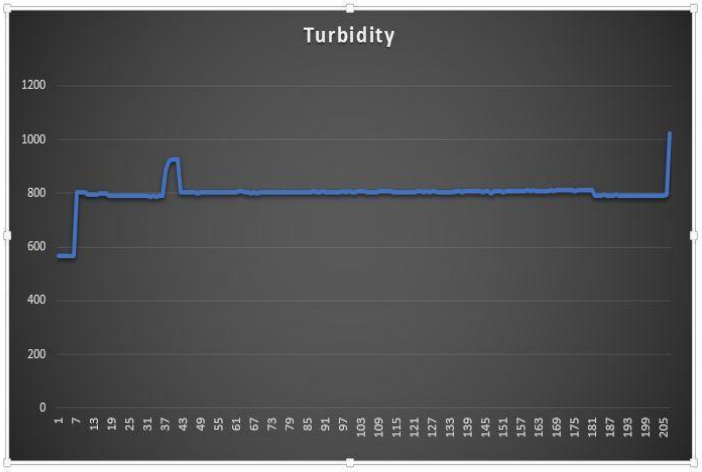

Fig 7. Graph on Turbidity values of water on quality basis

The paper demonstrates the technique of measurement the water quality by using internet of thing technology. The important water quality parameters namely pH, temperature, turbidity was observed and presented in the paper. The selection of an appropriate sensor for measurement of the parameters was the key factor of this research. The developed network is capable of measuring the water quality parameters in real time monitoring which can help in the improvement of water purity. In a nutshell, the system has proved its worth by delivering the accurate and constant data through internet of thing technology.

5. Conclusions

The paper demonstrates the technique of measurement the water quality by using internet of thing technology. The important water quality parameters namely pH, temperature, turbidity was observed and presented in the paper. The selection of an appropriate sensor for measurement of the parameters was the key factor of this research. The developed network is capable of measuring the water quality parameters in real time monitoring which can help in the improvement of water purity. In a nutshell, the system has proved its worth by delivering the accurate and constant data through internet of thing technology.

REFERENCES

[1] World Health Organization (WHO). Water Sanitation and Health. 2015. Available online: https://www.who.int/water_sanitation_health/monitoring/midtermeval.pdf (assessed on 17 March 2019).

[2] Bitton, G. Microbiology of Drinking Water Production and Distribution, 1st ed.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2014; p. 312.

[3] Ingerson-Mahar, M.; Reid, A. Microbes in Pipes: The Microbiology of the Water Distribution System A Report on an American Academy of Microbiology Colloquium; ASM Academy: Boulder, CO, USA, 2012; p. 26.

[4] Alhamlan, F.S.; Al-Qahtani, A.A.; Al-Ahdal, M.N. Recommended advanced techniques for waterborne pathogen detection in developing countries. J. Infect. Dev. Ctries 2015, 9, 128–135.

[5] Leclerc, H.; Schwartzbrod, L.; Dei-Cas, E. Microbial agents associated with waterborne diseases. Crit. Rev. Microbiol. 2002, 28, 371–409.

[6] Centers for Disease Control and Prevention (CDC). Global Water, Sanitation, and Hygiene (WASH). Available online: http://www.cdc.gov/healthywater/global/ (assesed on 17 February 2015).

[7] APHA., Standard methods for examination of water and waste water 15th Ed.American pub. Health Asso., Washington D.C. (1995).

[8] BIS Bureau of Indian Standards IS: 10500, Manak Bhavan, New Delhi, India (1998).

[9] N. Vijayakumar, R. Ramya, "The Real Time Monitoring of Water Quality in IoT Environment", International Journal of Science and Research, 2013.

[10] Sarita B. Dhoble,N. K. Choudhari, A. R. Chaudhari, "Sensor Based Electronics System for Evaluation of Water Quality", Research Journal of Engineering Sciences, vol. 3, no. 11, pp. 6-10,November 2014.

[11] P. J. Puri, M. K. N. Yenkie, S. P. Sangal, N. V. Gandhare, G. B. Sarote and D. B. Dhanorkar - "Surface water (Lakes) quality assessment in Nagpur city (India) based on Water quality index (WQI)", Vol.4, No.1, 43-48 (2011).

[12] S. Hussaina, V. Maneb, S. Takdea, A. Pathanc, M. Farooquic - " Comparison between Treated and Untreated water so as to study water treatment plant of Ahmadpur Dist. Latur," International Journal of Modern Engineering Research (IJMER) www.ijmer.com, Vol.1, Issue2, pp- 564-569, ISSN: 2249-6645.

[13] J Anal Bioanal-"Analysis of Physical and Chemical Parameters in Ground Water Used for Drinking around Konso Area, Southwestern Ethiopia" Tech 2017, Vol8 (5): 379.DOI: 10.4172/2155-9872.1000379.

[14] Arvind Kumar SwarnakarNational Institute of Technology Raipur –"Analysis of Physiochemical parameters for Water Quality": A review Conference Paper · January 2016 BITCON, at durg, Chhattisgarh, India, Volume: 15-16.