

Internet of Things (IoT) for Detecting, Monitoring and Measuring Water Quality

A.Gupta^{1*}, B.Gupta², K.K. Gola³

^{1,2}Dept. of Computer Science and Engineering, GB Pant Institute of Engineering & Technology, Pauri Garhwal, 246194, India

³Dept. of Computer Science and Engineering, Faculty of Engineering, Teerthanker Mahaveer University, Moradabad, 244001, India

*Corresponding Author: ag83111@gmail.com, Tel.: 8395058944

DOI: <https://doi.org/10.26438/ijcse/v7i4.11141119> | Available online at: www.ijcseonline.org

Accepted: 17/Apr/2019, Published: 30/Apr/2019

Abstract— According to latest survey of world health organization 77 million people face problem of unsafe water in all over the India. Despite the advancement in global technology, still there are not sufficient tools to measure the quality of water. Keeping in mind on this major issue we have proposed a model of water pollution detection system which is based on internet of things as well as it is cost efficient too. This model has capacity to measure and detect the pollution level as well as turbidity, temperature and many parameters. Turbidity measures the large no of suspended particles in water which is fully invisible and can't be able to see with naked eyes. If water contains higher number of turbidity then it can cause various diseases like diarrhea, and cholera, while if turbidity is in low amount the water will consider pure and drinkable. PH is another important measure which measures the acidic and basic level of water. Temperature sensor measures the temperature of water that how much cold or hot it is.

Keywords—Water quality monitoring, internet of things, rural development, machine learning, cloud computing, ESP8266, arduino micro-controller, RFID

I. INTRODUCTION

Water is one of the most important and crucial part of human to live and sustain. As a survey of World Economic Forum water crisis is the most global risk throughout the world. Moreover almost 200 children are dying from unsafe water across the world. Water has various parameters to measure, which specify that weather it is safe to drink or not like PH level, Dissolve oxygen, Chemical Oxygen Demand, total Suspended Solids, ammonical nitrogen. All these parameters can be measured before consumed. We all are well known about that various kind of disease can be generated from impure water like Fluorosis, and bone deformities, diarrhea, cholera. Other pollutant in water is in form of petroleum pollutants, volatile phenol, sulphide, and other discharges in running water. In this proposed system is consisting of various sensors which are able to measure the chemical composition of water. On comparing to other method, it is more cost effective and easy to use. It also works on real time which helps in giving the instant result.

II. RELATED WORK

Various paper which has presented before this in the topic of "Water Pollution Detection Using IoT" is using different

useful and scientific method for monitoring, detecting, and measuring the water quality.

Atif A, Wasai Shadab, Mohammad Hassan, Shamim, Alelaiwi and Anwar Hossain entitled[3] "A Survey on Sensor-Cloud: Architecture, Applications, and Approaches" In this paper writer describes about the infrastructure of sensor-cloud, different approaches related to this area, as well as about the layers of IOT architecture which are helpful in data transmission using cloud computing.

Nikhil Kedia [3] entitled "Water Quality Monitoring for Rural Areas-A Sensor Cloud Based Economical Project" in this paper the writer wants to focused on the embedded system and sensors which specify the quality of inbuilt system.

Pradeep kumar M, Monisha J, Pravenisha R, Praiselin V, Suganya Devi K [3] entitled "The Real Time Monitoring of Water Quality in IoT Environment" this paper mainly centered about the architecture of IOT as well as Cloud Computing. As we are well known about the IOT has ability to connect and transmitting data throughout the world.

III. INTERNET OF THINGS

Internet of things provides real time operational benefits. IOT increases at a very rapid speed worldwide, it has been expected that before 2020 there will be 28.1 billion connected devices.

IOT Devices (in billions)

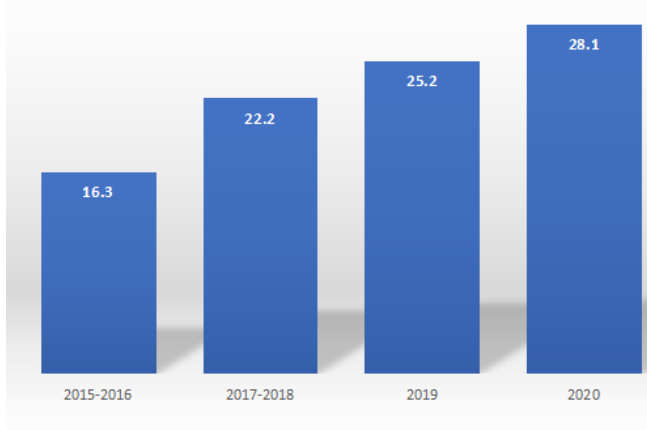


Fig.1 Worldwide and Regional IOT Forecast

We can say that internet of things is the collection of interconnected uniquely identifiable embedded computing device in the existing internet infrastructure. Internet of things has the ability to put the process, data, devices so that it can create a relevant response. Initially we need the device named Arduino, Netduino, and Raspberry Pi to program to read the sensors as well as monitor the process. After this we will need to get data transmitted from device to a place where it can use by us or other devices to further process.

For the data transmission we could either create our own web services or interface with them or we can use some of services called IOT Services like -

- Microsoft Azure with intelligent systems and services
- Amazon web services with AMZ Kinesis
- IFTTT- If This Then That
- Buddy services

IV. THEROTICAL INFORMATION

According to a SENASA some parameters has been set to define water quality to human use and other water discharge in various source of water.

Some of those parameters are PH, conductivity, ammonium toxic, alkalinity, dissolve oxygen, BOD, temperature, nitrates, hardness etc.

Parameter	Safe/optimal range
PH	6.5 - 8.5
Temperature	24°C- 32°C
Turbidity	0 - 5 NTU
Conductivity/Hardness(CaCO3)	50 - 500 mg/l
Oxygen	4.5 mg/l - 10 mg/l
Alkalinity	500 mg/l
Dissolve solids	1000 mg/l
Nitrate (NO2-N)	<20 mg/l
Conductance	2000µS/em
Calcium	200 mg/l
Ammonium toxic (NH3)	0.01 - 0.1 mg/l
Fecal Coliform	Nil Colonies / 100ml

Fig.2 Water parameters with safe range [5] [9]

Water quality monitoring is important for various applications like drinking water distribution and measurement, monitoring of pond and ecosystem, contamination detection in drinking water, measurement of health of water bodies like river, pond, ocean etc.

V. EXPERIMENT AND SIMULATION SETUP

Block Diagram and explanation

To make establish the connection tight and right we have to connect the EPS8266 with the arduino. We must have to keep in mind one thing that ESP8266 runs on only 3.3v, so we have to give only that amount of voltage from arduino system to work properly. If we will give more than 3.3v our system may get damaged.

EPS8266 is a Wi-Fi module gives our projects access to Wi-Fi or internet. It is cheap which makes our project very powerful and efficient. It can communicate with other micro controller and it is most leading device in the platform of IOT.

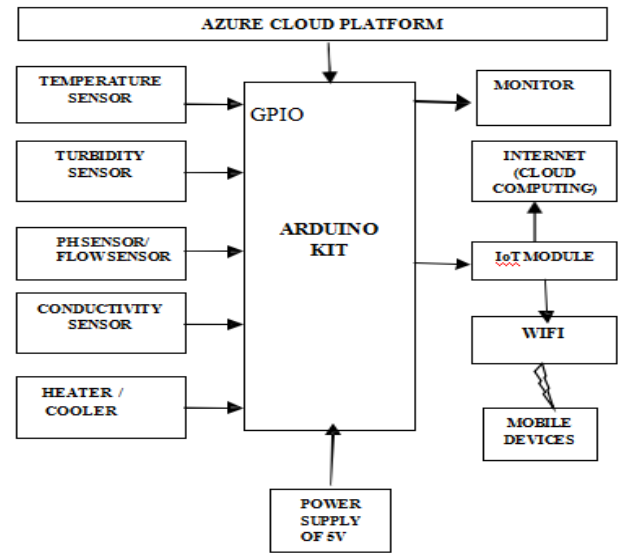


Fig.3 Overall block diagram [2] [4]

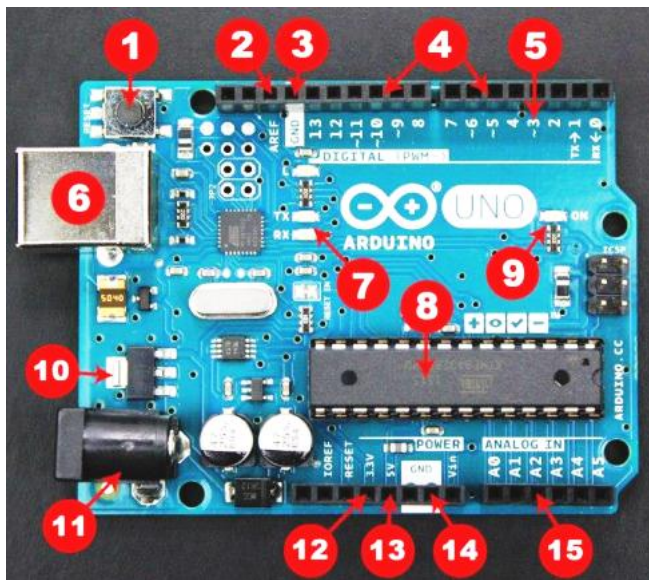
VI. SENSING MODULE

The components required for this project are as follows

- Arduino UNO
- LCD Display
- DHT22 temperature and humidity sensors
- Ph sensors
- Connecting wires
- Breadboard

Arduino UNO

The micro controller is used to link all the components, get the digital data from all the ADSs, process them, and store them on the memory card. It also distributes power to all of the sensors.



Here are the specification of the board which are mentioned above

1. Reset button- it will remove/erase the pre-loaded code in the memory of board.
2. AREF
3. Ground pin
4. Digital input/output
5. PWM
6. USB connection

7. TX/RX

8. AT mega micro controller

9. Power LED indicator

10. DC power Barrel Jack

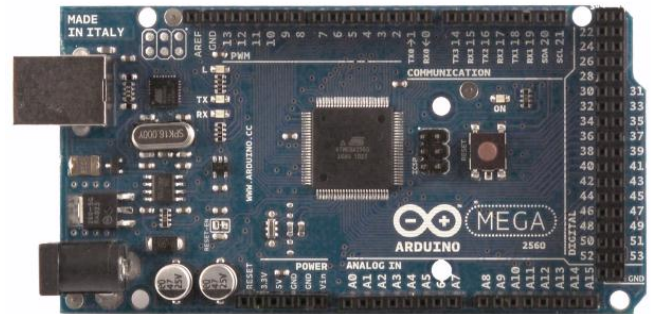
11. 3.3v pin

12. 5v pin

13. Ground pin

14. Analog pin

An Arduino mega is used as a core controller. Arduino used here is mega 2560 because multiple analog input sensors probes need to be connected with the Arduino board.



This arduino board has various specifications to perform various tasks. Some of them has discussed below-

Micro controller- ATmega2560

Operating voltage - 5v

Input voltage - 7-20 v

Digital I/O pins - 54

Analog input pins - 16

Flash memory - 256kb

SRAM - 8kb

EEPROM - 4kb

Clock speed - 16MHz

LCD Display

Liquid Crystal Display is kind of screen which is being used to display the output of system. It is flat in shape.

A 16x2 is most commonly used LCD in day to day.

LCD has 2 registers to store data

A) Command

B) Data

Each and every character in LCD takes almost 5x7 pixel matrix to display.

If we are talking about 16×2 LCD then it will be able to display 16 characters in a specific line, and there are only two lines in this type of LCD

DHT22 temperature sensor

Here LM35 is used as the temperature sensor for sensing the temperature. Generally it will use to sense the temperature of the room, if we place the sensor inside the copper electrode and placed into the water. It is capable of detecting the temperature of water also. The average temperature of the room is 20-25.

Ph sensor

The pH of water is essential parameter to monitor so it can be detected that whether the quality of water is acidic or basic. Basically the pH of a solution can range from 1 to 14. A

Ph sensor is also known as potentiometric pH meter. As we all well known about pH scale which lies between 0-14 which denotes about the specific solution that whether it is acidic, basic or neutral in nature. With the help of pH sensor we can calculate solutions nature by measuring the hydrogen-ion

Mathematically pH is referred as,

$$\text{Ph} = -\log [\text{H}^+]$$

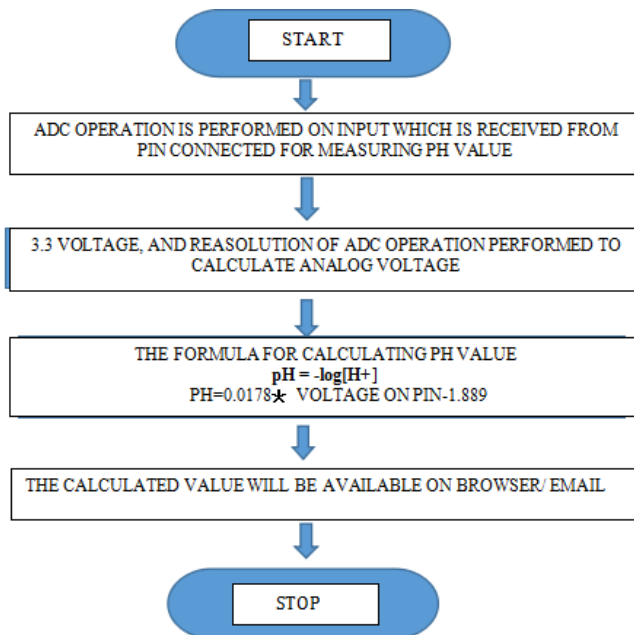


Fig.4 Flow chart for measuring PH value [1]

VII. DATA ANALYTICAL MODULE

After the analysis of water the acquired data will be sending to the web page so that it can be beneficial to many consumers.

Using HTTP protocols we can use to transfer data over network in all over the world. Wireless communication

which makes possible through IOT and protocols. Some of the protocols are HTTP, CoAP, Web Socket, MQTT, XMPP, DDS, and AMQP.

How to get started

- Sending emails using arduino an ESP8266 wifi module
- Controlling RGB LED using Arduino

Required Components/ parts

- Arduino Uno
- ESP8266 wifi module
- USB cables
- Connecting wires
- Laptops
- Power supply

Circuit connection

For Circuit connection we mainly required arduino and Wi-Fi module. EPS8266

Ground pin (GND) and Vcc is connected to GND socket of arduino kit, which provides 3.3v of power to the system.

CH_PD node required 3.3v of power. Pin no Rx and Tx of Wi-Fi module is connected to the pin 2 and 3 of the arduino kit. Pin 0 and 1 of arduino is generally used for serial communication which is default. While if we want to use serial library we will be able to serial communication on other pins of the arduino.

VIII. SYSTEM DESCRIPTION

Connection of Wi-Fi module to Wi-Fi router is necessary and most important for the access of network connectivity.

After making connectivity, we will be able to communicate, and transmission of data to local server. This will be start communication either sending or receiving of data from the cloud.

Proposed Connection Algorithm [11] [12]

Here are various commands and statement which are helpful in establishment of connection.

- Test the Wi-Fi module** - for testing the Wi-Fi module is working or not send **AT command**.

If the module is working properly it will response in **OK**

- For selection of mode** - command **AT+CWMODE =mode_id** is using to select mode

Mode id=3

Mode ids name are

- A) Station mode (client)
- B) AP mode (host)
- C) AP+station mode

3. Disconnect the Wi-Fi - command **AT+CWQAP** is being used to disconnect the Wi-Fi module.

A) Then we can reset the module by **AT+RST**

B) Then we need to connect Wi-Fi router by using **AT+CWJAP=Wi-Fi_password"**

4. Get IP Address- command **AT+CIFSR**

it will give an IP address

5. Enable multiplex mode - AT+CIPMUX=1

0 for single connection
1 for multiple connection

6. Configure server- AT+CIPSERVER=1, port_no =80

This command will configure EPS8266, by this Wi-Fi connection is ready
0 for delete server
1 for create server

7. Send Data - sending details like ID and length using:
Serial.println

8. Close connection - command **AT+CIPCLOSE=0**

9. At last in browser's address bar type IP Address.

Then press **Enter**.
Data is being started transmitting to webpage

IX. CHALLENGES

Here we are mentioned various challenges and hindrances during the water sample collection in rural as well as urban area. Water is basic need to mankind for daily use. As the pollution level is increasing day by day in river as well as pond and other water resources.

- Due to the continuous drainage omitting of water pollutant it is more critical to describe to real time pollution level of water.
- Collection of water samples from those location which are in remote, hilly and faraway areas.

- To make people aware from garbage disposal in water and water generated disease to leads a healthy life.
- In various cultural program people used to wash away their waste and other material in the water, it is most important to make them aware.

X. FUTURE WORK

The main reason of writing this paper is to make aware people from various water related problem so that they will be able to use right kind of water purification system and live and healthy life. In future we will try to collaborate with state and central government work flow, so that it will enable fast response rate from government officers thus improving the quality of life and water in rural as well as urban areas.

- Most of the villagers of India are not much interested in this, so government should take and initiative in this so that people may get connected with this program.
- Under the Digital India program initiated by the prime minister of India various villages are connecting with Wi-Fi, so we will try to make them connect to the people.
- Mobile GPRS module by this our system enabling it to transmit data over 3G or 4G channels.
- Replicate old model sensors with high quality sensors so that it can detect more efficiently chemical and physical parameters effecting the quality of water can improve our results and thus making our system effective.
- On the basis of the result of this system people will be able to use right kind of RO purifier.
- Continue effort in adding some more and more research to make this system more efficient.

XI. CONCLUSION

This paper proposed a practical solution for monitoring the quality of water especially in rural areas where people are not that much aware of such kind of water related problems. Here I am presenting such a vital solution to make their life better by making them aware of consumptional water quality and proving them solution of their problem, in this proposed method of water detection we include the property of

emerging technologies like real time connectivity of IoT, storage capacity of cloud computing and previous experiences from Machine learning to make a perfect and real time system for this human health related problem and to make them resolves.

REFERENCES

- [1] Anjana S, Sahana M N, Ankith S, K NAtarajan, K R Shobha “An IOT based 6LoWPAN enabled Experient for Water Management”IEEE ANTS 2015 1570192963
- [2] K. GOPAVANITHA “ALow Cost System for Real Time Water Quality Monitoring and Controlling using IoT”978-1-5386-1887-5/17/©2017IEEE
- [3] Nikhil Kumar Koditala, “Water Quality Monitoring System using IoT and Machine Learning,”978-1-5386-2599-6/18/ ©2018IEEE
- [4] N Vijayakumar“A Real Time Monitoring of Water Quality IN IoT Environment”978-1-4799-6818-3/15/©2015IEEE
- [5] Ricardo Yauri, Milton Rios, Jinmi Lezama“Water Quality Monitoring of Peruvian Amazon Based in the Internet of Things”978-1-5090-6363-5/17/©2017IEEE
- [6] R.Karthik Kumar, M.Chandra Mohan, S.Vengateshapandiyam, M.Mathan Kumar, R.Eswaran. ”Solar based advanced water quality monitoring system using wireless sensor network” 2014, International Journal of Science, Engineering and Technology Research, 2014
- [7] S. Zhuiykov, “Solid-state sensors monitoring parameters of water quality for the next generation of wireless sensor networks,” Sens. Actuators B, Chem., vol. 161, no. 1, pp. 1–20, 2012
- [8] T. P. Lambrou, C. G. Panayiotou, and C. C. Anastasiou, “A low-cost system for real time monitoring and assessment of potable water quality at consumer sites,” in Proc. IEEE Sensors, Oct. 2012, pp. 1–4.
- [9] Uferah Shafi, Rafia Mumtaz, Hirra Anwar, Ali Mustafa Qamar “Surafce Water Pollution Detection Using Inter of Things”978-1-5386-8354-5/18/©2018IEEE
- [10] Vaishnavi V. Daigavane, Dr. M.A Gaikwad. “Water Quality Monitoring System Based on IOT” 2017 Advances in Wireless and Mobile Com- munications, Nov 2017 ISSN 0973-6972
- [11] http://circuitdigest.com/microcontroller_projects/sending-email-using-arduino-and-esp8266-wi-fi-module
- [12] <http://circuitdigest.com/microcontroller-projects/arduino-humidity-measurement>