

# The Monitoring of Water Quality in an IOT Environment using MQTT Protocol

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**Abstract:-** In this research we are doing a water quality measurement for monitoring the water in different area by using various sensors like temperature, turbidity, pH sensor which will help us to collect the parameters of the water. Arduino (nano) gather that parameters and send it to the raspberry pi3 through Wi-Fi module and then raspberry pi will process the data and compare that data with the threshold value of the sensors. For these transfers of information through raspberry pi and user is takes place using MQTT protocol, MQTT stands for Message Queuing Telemetry Transport.

**Keywords:-** Internet of Things (IoT), Arduino, Raspberry Pi, Naive Baye's, MQTT protocol etc.

## I. INTRODUCTION

By introducing an IoT in the modern world, many problems have been solved. With the use of IoT in monitoring water quality, various issues such as data collection by visiting every lake or water resource, communication ie. sending the parameters of the water, data analysis and early warnings related to water are worked on. But in order to get this into picture, technologies like IoT and protocols like MQTT are combined to get the desired output. The use of Message Queuing Telemetry Transport Protocol (MQTT) makes the whole procedure fast, reliable and secure.

### A. Purpose

The main purpose of developing an IoT technique to check water quality using MQTT protocol is to develop a system which give the end user a useful data securely and fast. In traditional technique, the water samples are gathered from different places, and then tested by the scientist at their laboratory using different techniques to determine the water quality. That way was a time consuming but now the 'Internet of Things (IoT)' has the potential to modernize the water testing, as more and more of its technology is connected to the internet. So instead of checking the water quality using old ways, this method is used which is way better, fast, cost friendly and easy to use.

### B. Background

The values of water quality were tested with the use of Global Messaging Service (GSM) technology but there are many restrictions to this technology. There was some problem with the old system like its use GSM, so the overall

manufacture cost increases. Not only the GSM technique faces security issues as the user identity confidentiality is violated by transferring the identities in unprotected form.

During the transmission of data, it is sent one after another which creates a buzz and delay in transfer of data. However, the data transfer should be simultaneous, fast and secure. So instead of using GSM technique or any other technology, MQTT protocol will be implemented in order to make the system feasible, modular, scalar, fuzz free and cost-efficient. Not only will this, with the help of MQTT protocol there be simultaneous flow of data between the sensors and other devices.

### C. Method of Investigation

In order to meet with the requirements for developing the system, some work has been done in the past to achieve the desired results. The system formed in past used sensors to gather the data concerning the water constraints. Later that the data gathers were directed to Raspberry Pi, through which it was showed to the computer or any other devices. Next examination of the data gained, the communication part was approved out by the help of GSM technology. This structure was supportive but had numerous limitations as well such as expensive, no actual time data could be produced, the system was transferring data in sequence so there was probabilities of data damage and security issues.

### D. Scope

So, to overcome all these boundaries, changes are done in this structure with the support of IoT, a new water monitoring structure is established in which utmost of the water parameters are reviewed via sensors.

Later that the supportive information will be sent to the end user through MQTT protocol. MQTT makes the communication among server and end user reliable and broadcast of information fuzz free. Apart from this it makes the system cost friendly as the overall cost of the system decreases. The main advantage of using MQTT is that there will be continuous and simultaneous flow of data between the sensors and the end devices. Thus, making it a good choice in terms of connectivity.

## II. CHALLENGES

### A. Security

Security at both the device and network levels is captious to the action of IoT. The same ability that enables devices to execute their tasks must also enable them to acknowledge and antagonize threats.

- *Secure booting*

When power is first present to the device, the authenticity and integrity of the software on the device is checked using crypt-analytic and it produce digital signatures. In the identical way like a person signs a check or a legal document, a digital signature connected to the software image and checked by the device guarantee that only the software that has been licensed to run on that device, and signed by the entity that approved it, will be loaded intent.

- *Access control*

Next, different forms of assets and access control are utilized. compulsory or role-based access controls reinforced into the operating system limit the exclusive right of device element and applications so they access only the assets that they need to do their work. if any element is compromised, access control guarantee that the intruder has as minimum access to other parts of the system as possible.

- *Device authentication*

When the device is connected into the network, it should authenticate itself before the acquiring or sending data. deeply integrated devices often do not have users sitting behind keyboards, waiting to input the password needed to approach the network.

### B. Sensor Network

A sensor network includes a group of small, battery-powered devices and wireless structure that supervisor and maintain conditions in different different environments – from the factory to the data center to a hospital lab and even out in the wild too. The sensor network connected to the Internet through raspberry pi, an enterprise WAN or LAN, or a specialized industrial network so that gathered data can be sent to back-end systems for analysis and utilized in applications.

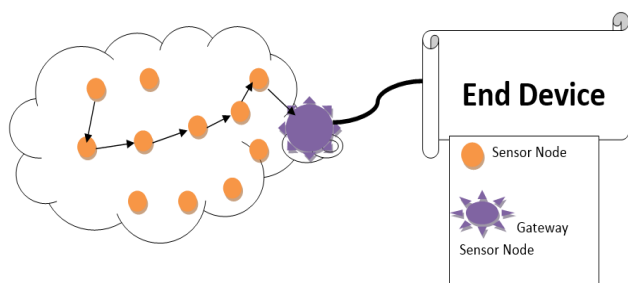


Fig 1:- Sensor Network

### C. Communication

Wireless communication system is the indispensable part of the IoT structure, which acts as the connection for dual directional communication for data collection and control

message delivery. It can be used for different IoT applications, including mission critical industries, such as power grid, oil field, and cases in our regular life like the smart city. We summarize the common situation and problem on wireless communication for IoT applications:

- Huge volume of sensors with different types and distributed sites need to be attached, managed and retained
- High dependable communication will be needed under the environment with lots of interfaces
- Accessible spectrum resources will be very restricted for new IoT wireless network
- For rough outdoor area, low power consumption and easy architecture will be needed.

## III. METHODOLOGY

- The first work is to determine which water properties would supply a close indication for water pollution. Through extended investigation the parameters are selected to be combined of pH, turbidity, and temperature.
- The second step is the selection of locales that will supply helpful data. The locations were constricted down to commercial areas, sewer waste openings and city lines where human intervention had a sizable impact. Various sensors were installed at such areas for testing.
- The third step is to convey the data from the sensors onto the arduino kit for later processing.
- The sending of the data acquire is done in the next step, from where MQTT protocol comes in the picture. With the assistance of MQTT along with raspberry pi, the data obtained is sent onto the server and the end user.
- Finally, data analysis is done on the gathered data set using naive bayes algorithm with the help of which the required data is acquire.

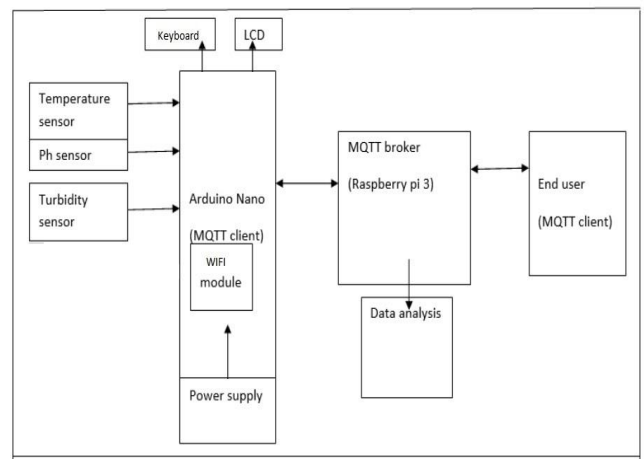


Fig 2:- Block diagram

## IV. MQTT ALGORITHM

MQTT is a Client Server subscribe messaging transport protocol. It is light weight, open, simple, and designed so it will be easy to implement. These applications make it perfect for use in many situations, considering strained environments such as for sending of data in Machine to

Machine (M2M) and Internet of Things (IoT) contexts where a small code foot-mark is needed and/or network bandwidth is at a superior.

**A. Features of MQTT**

- MQTT stands for Message Queuing Telemetry Transport. It is represented as a machine-to-machine (M2M) / IoT connectivity protocol.
- This protocol is so lightweight that it can be supported by some of the smallest measurement and observation devices, and it can convey data over far reaching, sometimes periodic networks.
- MQTT is a message transport protocol that is well define to link with real world devices and events with enterprise servers and different users who are subscribers of the protocol.
- MQTT is deliberate to take over the tasks of get-together the rapidly growing physical creation of sensors, actuators, phones, and tablets with recognized software dispensation technologies.
- So that, the MQTT is a finest message protocol and it is talented to give directing to cheap, low power and low memory devices in weak and low bandwidth systems.

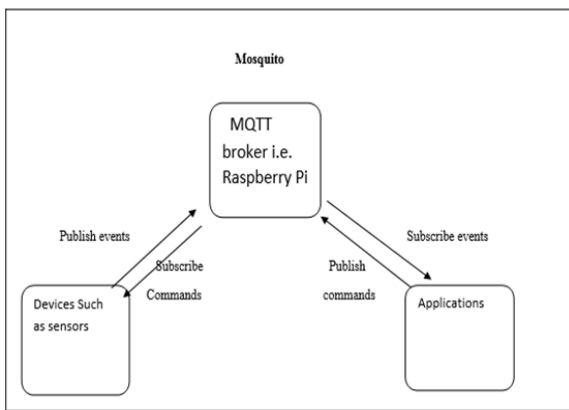


Fig 3:- Working of MQTT algorithm

**B. Functionality of MQTT**

- MQTT protocol correspond of Broker, produce and subscribe.
- The MQTT messages are transported asynchronously (“push”) over produce subscribe manner.
- The MQTT protocol works by exchanging an ordering of MQTT control packets in a distinct way.
- Each control data packets have a special use and every bit in the data packet is carefully crafted to reduce the data transmitted over the network.
- A MQTT topology consumes a MQTT server and a MQTT user. MQTT user and server interact over different control packets.

**V. NAIVE BAYE’S THEOREM**

In order to analyze the data, acquire from the sensors to the MQTT, Naive Baye’s theorem is used. Here with the assistance of this classifier, a specific or combined parameter of water quality is checked unrelated to the different attributes or it can be said that every property being categorized is independent of the value of any other property. In easy words the naive baye’s theorem can be formulated as:

$$P(a/b) = \frac{P(b/a) P(a)}{P(b)}$$

**VI. APPROACH**

The very first step is to determine the water properties used for deciding the status of the water quality. In this case the selected parameters are temperature, turbidity, pH. Secondly the gathering of data for analysis is done which is the water from ponds and lakes is collected the sensors are installed at these locations for testing.

To conveyance the data acquire from the sensors, a setup is created which consists of an arduino nano as micro-controller, a wifi router, LCD to display the values collected from the sensors. All the devices are interconnected with each other. The wifi module creates a link between the transmitter and receiver.

In the next state, raspberry pi acts as a MQTT broker which gather the data from the sensors and send to the server. The Raspberry pi is working as a Mosquitto which is an open source message broker use MQTT protocol. The entire process takes place in real time creating it simultaneous and fast. The connection between the server and the end user.

The data is stored in the database ie. the ms excel for advance analysis. The data analysis is done with the use of naive bayes algorithm. Here the limit of the values is presented, which whenever crossed gives a fluctuation in the graph. In case of temperature the max value is set as 40 degrees. The sample is gathered from 3 different sources for 2 hours and then analyzed. if the threshold value of water temperature has intersected 40 degree more times than the water is not fit for consumption. Same is the case for another parameter.

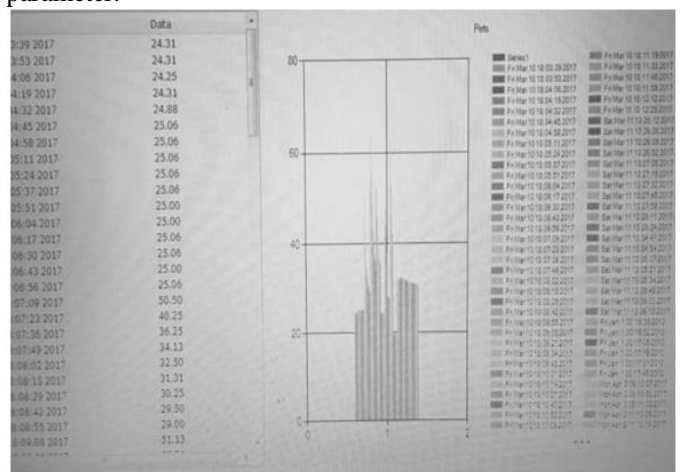


Fig 4:- Threshold of temperature for interval of 2hours

REFERENCES

- [1].Pavana NR and Dr. M.C.Padma, “Design of Low Cost System for Real Time Monitoring of Water Quality Parameters in IOT Environment”, International Journal of Advanced Research in Computer Science and Application Volume 4, Issue 5, May 2016
- [2].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.
- [3].A.N.Prasad, K. A. Mamun, F. R. Islam, H. Haqva.”Smart Water Quality monitoring System”, IEEE, 2015.
- [4].Dong He, Li-Xin Zhang, “The Water Quality Monitoring System Based on WSN,”Institute of Mechanical and electronic information, China University of Geosciences (WuHan), WuHan,China, pp. 3661-3664, 2012.
- [5].N Vijayakumar, R Ramya,” The Real Time Monitoring of Water Quality in IoT Environment”, International Conference on Circuit, Power and Computing Technologies [ICCPCT-2015], IEEE, 2015.
- [6].Wind river, “SECURITY IN THE INTERNET OF THINGS -Lessons from the Past for the Connected Future” 2015. Accessed December 17, 2016. [http://www.windriver.com/whitepapers/security-in-the-internet-of-hings/wr\\_security-in-the-internet-of-things.pdf](http://www.windriver.com/whitepapers/security-in-the-internet-of-hings/wr_security-in-the-internet-of-things.pdf)
- [7].Young Hua Lin, Jiabin Tang, Qing Yang, Chao Zui,” Wireless Communication for IoT (Internet of Things)”, IBM Research. Accessed December 17, 2016. [http://researcher.watson.ibm.com/researcher/view\\_group.php?id=4343](http://researcher.watson.ibm.com/researcher/view_group.php?id=4343)
- [8].DesignSpark ,” 11 Internet of Things (IoT) Protocols You Need to Know About?”. Accessed December 10, 2016. <https://www.rs-online.com/designspark/eleven-internet-of-things-iot-protocols-you-need-to-know-about>
- [9].OASIS -MQTT Version 3.1.1 plus Errata01.Accessed November7, 2016. <http://docs.oasisopen.org/mqtt/mqtt/v3.1.1/errata01/os/mqtt-v3.1.1-errata01-os-complete.doc>

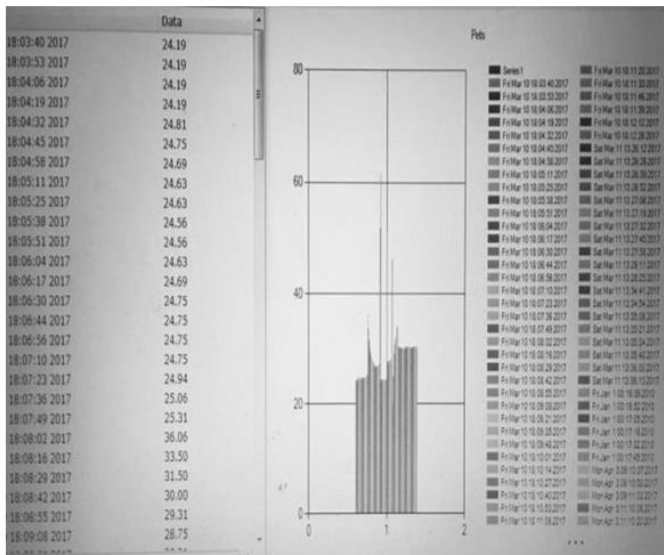


Fig 5:- Threshold of Temperature at different location for another 2 hours

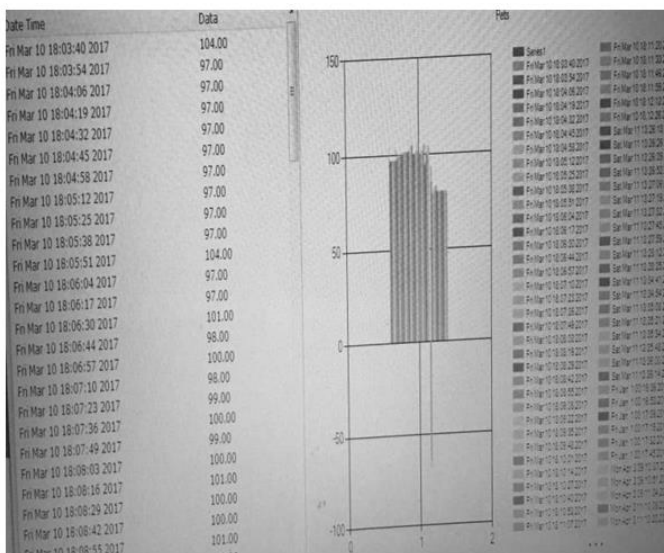


Fig 6:- Threshold of turbidity for 2 Hours

VI. CONCLUSION

During the sending of data, it is transmitted one after other which generate a buzz and delay in sending. However, the data sending should be concurrent, faster and secure.

So, in order to encounter all these requirements, different technologies can be used like MQTT (Message Queuing Telemetry Transport). Rather than using GSM network or some other technology, MQTT protocol will be developed to make the system feasible, modular, scalar and cost-efficient. With the assistance of MQTT protocol there be concurrent flow of data between the sensors and server. A bigger amount of data is transmitted continuously without any obstacle, thus making it an efficient mode of communicating.

In future the system can be implemented on a bigger scale with the help of availability of different resources. Other water parameter deciding sensors can be used for analysis for much more précised and accurate data.