

Water Quality Monitoring Using MQTT Algorithm with IOT (Internet of Things)

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Abstract— The degradation of water resource has become a common problem. The conventional method of testing water quality is to gather sample of water manually and send to the lab to test and analyze water sample were tested in the laboratory using the rigorous skill. The method is the time consuming, wastage of man power and costly. The old method of water quality detection and communication was time consuming and wastage of man power it impacts on cost. By focusing on above issues a low cast water quality monitoring system is developed and designed that can monitor water quality in real time using IOT (Internet of Things). In the proposed system water quality parameters are measured by different sensors such as PH, Temperature and Dissolved Oxygen for communicating data onto a platform via microcontroller system. So in order to meet all these requirements, other technologies can be used such as MQTT (Message Queuing Telemetry Transport) which allows publishing and subscribing of data between the sensor and end device. And with the help of MQTT algorithm there will be simultaneous flow of data between the sensors and the servers. This system can keep a strict check on the pollution of the water resources and be able to provide an environment for safe drinking water.

Keywords: MQTT, IOT, Arduino, Naive Bayes' theorem, Raspberry Pi, PH, Temperature

I. INTRODUCTION

Water is one of the most essential natural resource that has been gifted to the mankind. But the rapid development of the society and numerous human activities speeded up the contamination and deteriorated the water resources. For above water quality monitoring is necessary to identify any changes in water quality parameters from time-to-time to make sure its safety in real time. The Central Pollution Control Board (CPCB) has established a series of monitoring station on water bodies across the county which monitor the water quality on either monthly or yearly basis. Since the time IOT has evolved a lot of problem have been solved in the world. By using IOT in this water quality monitoring system various issues such as communication, data collection, data analysis, early warning have been worked on. But in order to get this into picture, technologies and protocols are combined to get the desired output. Here the use of MQTT makes the whole procedure fast and reliable.

A. Purpose:

The main purpose of using an IOT approach to monitor water quality using MQTT algorithm is to develop a system which provides the end user a useful data used. Conventionally, the water samples are collected from different place and tested rigorously by scientists in the laboratory using many techniques to determine the water quality. Therefore older methods were time consuming process but now the 'Internet

of things (IOT) has the potential to modernize the water production, as more and more of its technology is connected to the Web. This IOT approach is far better than conventional methods since it is cost friendly, faster and easy to use.

B. Background:

The parameters for testing the water quality are monitoring with the use of Global messaging Service (GSM) technology but there are various limitation to this technology. First of all it by using GSM, the overall development cost increases. Not only is this GSM face security issues as the user identity confidentiality violated by transmitting the identities in unprotected form.

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

C. Method of Investigation:

In order to meet the requirements for developing the system some work has been done prior to achieve the desired result. The system created earlier use sensors to gather information regarding the water parameters. After that the information gathered was send to raspberry pi, through which it was displayed to the computer or any devices. After analysis of the data obtained, the communication part was carried out with GSM technology. This system was helpful but had limitations as well such as expensive, no real time data could be generated and security issues.

D. Scope:

To beat these restrictions, changes are done in this framework with the assistance of IOT, another water checking framework is created in which all the water parameters are examined utilizing sensors. After that the valuable information will be send to end client through MQTT calculation. MQTT makes the correspondence and transmission of information solid and fluff free. Aside from this it makes the framework diminishes. The principle favorable position of utilizing the MQTT is that there will be synchronous stream of information between the sensors and the server. In this manner settling on it a perfect decision as far as network.

II. CHALLENGES

There are basically three common challenges this system face they are security, sensor network and the communication.

A. Security

Security is an essential factor for any system. Security at both the device and network level is critical to the authenticity and network level is critical to the operation of IOT.

1) Secure booting:

When power is first introduced to the device, the authenticity and integrity of software on the device is verified using cryptographically generated digital signatures.

2) Access control:

Next the different form of resource and access control and applied. Mandatory or roll based access control built into the operating system limit the privileges of device components and application so they access only the resources they need to do their jobs. If any component is compromised, access control ensures that the intruder has a minimal access to other parts of the system as possible.

3) Device authentication:

When the device is plugged into the network, it should authenticate itself prior to receiving or transmitting data. Deeply embedded device often do not have user sitting behind keyboards, waiting to input the credentials required to access the network.

B. Sensor Network

A Sensor arrange involved gatherings of modest, normal battery fueled gadgets and remote framework that screen and record condition in any number of situations from the manufacturing plant floor to the server farm to a clinic lab and even out in nature. The sensor arrange interface with the web, a venture WAN or LAN, or a specific mechanical system so gathered information can be transmitted to back end frameworks for examination and utilized in applications.

C. Communication

Wireless communication system is the essential part of the IOT infrastructure, which acts as a bridge for data collection and control message delivery. It can be applied to various IOT applications including mission critical industries, such as power grid, oil field and cases in our routine life like the smart city we summarize the common challenges and issues on wireless communication for IOT applications.

- Huge volume of sensors with varied types and distributed sites need to be connected, managed and maintained.
- High reliable communication will be required under the environment with Iot of interfaces.
- Available spectrum resources will be very limited for new IOT wireless network.
- For harsh outdoor area, low power consumption and simple architecture will be required.

III. METHODOLOGY

- The First task is to determine which water parameter would provide a close indication of water pollution. Through extensive research the parameter are chosen to be composed of pH, dissolved oxygen and temperature.
- The second step is selection of locales that will provide useful data. The location were narrowed down to industrial areas, sewer waste openings and city lines where human interface has a considerable impact.

Various sensors were installed at such locations for testing.

- The third step is to transmit the data from the sensor on to the Arduino kit for further processing.
- The transmission of data obtained is done the next step, from where MQTT comes in the picture .With the help of MQTT along with raspberry pi, the information obtained is passed onto the server and the end user.
- Finally data analysis is done on the acquire data set using Nave Bayes' algorithm with the help of which the desired information is obtained.

IV. NAIVE BAYES' THEOREM

.In order to analyze data obtained from the sensors to the MQTT, Naïve Bayes' theorem is used. Here with the help of this classifier a particular or combined parameter of water quality is checked unrelated to the other attributes or it can be said that every feature being classified is independent of the

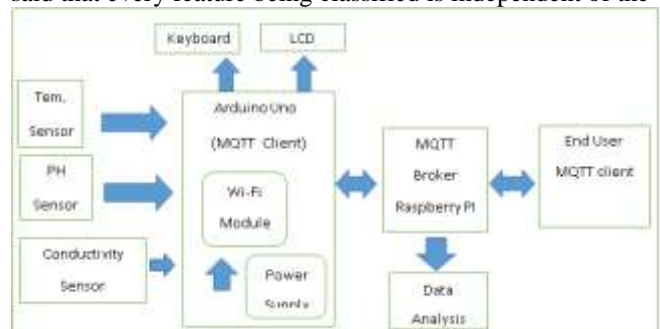


Fig. 1: Block Diagram

Value of any other feature. In simpler word the Naïve Bayes' Theorem can be formulated as:

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

V. INTRODUCTION TO MQTT

MQTT is Client Server publish/subscribe messaging transport protocol. It is light weight, open, simple, and designed so as to be easy to implement. These characteristics make it ideal for use in many situation, including constrained environments such as for communication in Machine to machine (M2M) and Internet of Things (IOT) contexts where a small code footprint is required and/or network bandwidth is at a premium.

A. Features of MQTT

- MQTT stands for message Queuing Telemetry Transport. It is described as a machine-to-machine (M2M)/ IOT connectivity protocol.
- This protocol is so lightweight that it can be supported by some of the smallest measuring and monitoring device, and it can transmit data over far reaching, sometimes intermittent networks
- MQTT is publish/subscribe messaging transport protocol that is optimized to connect physical world devices and events with enterprise servers and other consumers.
- MQTT is designed to overcome the challenges of connecting the rapidly expanding physical world of sensors, actuators, phone, and tablets with established software processing technologies.

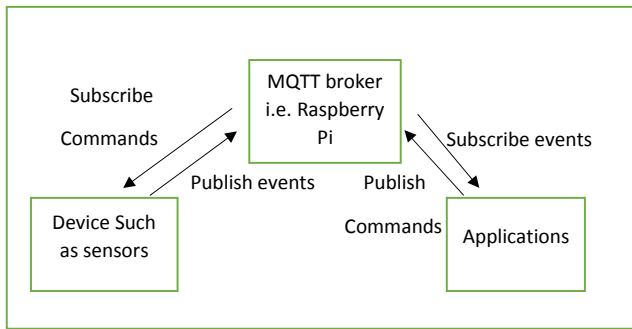


Fig. 2: Working of MQTT algorithm

B. Functionality of MATT

- MQTT algorithm consists of Broker, publish and subscribe.
- The MQTT messages are delivered asynchronously (“Push”) through publish subscribe architecture.
- The MQTT protocol works by exchanging a series of MQTT control packets in a defined way.
- Each control packet has a specific purpose and every bit in the packet is carefully crafted to reduce the data transmitted over the network.
- A MQTT topology has a MQTT server and a MQTT client. MQTT client and server communicate through different control packets.

VI. CONCLUSION

During the transmission of data, it is send one after another which creates a buzz and delay intranmission. However, the data transmission should be simultaneous, faster and secure.

So in order to meet all these requirements, other technologies can be used such as MQTT (Message Queuing Telemetry Transport). Instead of using GSM network or any other technology, MQTT algorithm will be implemented to make the system feasible, modular, scalar and cost-efficient. Not only with the help of MQTT algorithm there be simultaneous flow of data between the sensors and server. A large amount of data is send continuously without any hurdle, thus making it an efficient mode of communication.

In future the system can be implemented on a larger scale with the help of availability of various resources. Other water quality determining sensors can be used for analysis for more precise and accurate data.

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