Smart Water Management towards Quality and Improvement using IoT

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Abstract: The raw water from rain water, ground water, bore well water, lakes, river, is filtered and fed into water tank using pre-filter and make it use for drinking purpose. In this paper, it has been mainly focused to measure and maintain the TDS value, pH value range between 30 to 400 ppm and neutral respectively in water quality improvement and also it is used to make it suitable for drinking water purpose. The whole process is monitored by using an open source Internet of Thing (IoT) application. It works via internet or via local area network. To measure TDS value and pH value in the water, required sensors are connected with node MCU controller, depending upon sensor output the antiscalant liquid is injected using submersible pump to maintain the essential parameters in the drinking water. Through the android device the information is send to the cloud which is used to monitoring the values. The values are automatically updated for every 15 seconds by IoT application by representing the date and time of occurrence of the value of TDS and pH of drinking water.

Keywords: Internet of things, water management, controller, monitoring.

1. Introduction

Water is the most essential factor for all living organisms and it is very important to protect it. The quality of water can be monitored by means of information acquired by the sensors immersed in water in order to maintain the water resource within a standard described for domestic usage to take necessary actions to restore the health of the degraded water body[1]. Using different sensors, this system can collect various parameters from water, such as temperature, pH, and so on. It is necessary to monitor and control the certain parameters of drinking water in order to lead a healthy life. The controlling parameters are Total Dissolved Solids (TDS) and pH in the drinking water. After the normal filtration process, the
main component present in the water is Total Dissolved Solids which consists of some organic and inorganic materials that includes minerals and ions and its range lies between 30 to 400 ppm[10]. The pH is defined as the nature of the water may be acid or base and the value of pH for drinking water is around 7 as a neutral value [6]. The whole process is monitored by an open source internet of thing application and an API to store and retrieve data, it can work via internet or local area network. The application is the builder that allows visualizing sensor value and monitored the value. Then the values can be access by using internet of thing and monitoring the parameters[4].

2. Literature Review

Prasad M.Pujar, et.al., proposed a technique “Real time water quality monitoring and control system”. In this paper, the quality of water helps to check the parameters present in the water and to identify the trends of change, pollution level, and so on. The ultimate aim of the above mentioned paper was the development of a system which comprise of online connectivity for collection data from water body for monitoring and control. The water quality monitoring system done by mobile phone which is possible through the interface of PLC with arduino and Bluetooth module allows remote controlling monitoring system.

Akanksha Purohit, et.al., proposed the paper “Real Time Water Quality Measurement System based on GSM” which is used to monitor the real time water quality occurring because of dense populated area, minimum water content, and so on. This can be done by a new technique called IOT based water quality analysis using data acquisition and transmission with enhancement of GSM technology.

Jyotimaya Ijaradar, et.al., proposed technique “Real time water quality monitoring system” states that water level parameters are collected by the sensor in order to enhance the quality of water by imparting IOT application along with the interface devices. The monitoring parameters are CO2, temperature, pH sensor, water level sensor, turbidity sensor were sensor send the data to microcontroller board and the whole process monitoring and controlled by cloud based wireless communication devices. The output is in form of analog value it is need to convert into digital form before connecting to the controller.

3. Proposed Method

The proposed method is used to measure the TDS value, pH value and these values were feed into the valve and it is shown in the figure 1. Depending upon the output of sensor, the controller uses the submersible pump to inject the antiscalant (C5H8NO4Na: Monosodium Glutamate) liquid which is used for maintain the essential parameters in water and also this liquid is used to maintain the range between 30 to 400 ppm[3].
3.1 Working of Hardware setup

Raw water from rainwater, groundwater, river, lakes and so it is not safe to drink which is untreated water of drinking purpose for human being. The raw water is treated by using pre-filter it is used to remove the unwanted particle present in water such as sand, dust, insects etc., and filtered water store it in a water tank. In this project, a small hand-held device used to indicate the Total Dissolved Solids in water, which is called as TDS meter. The conductivity of the solution is increased by dissolved ionized salts, such as salts and minerals in the given solution by using this TDS meter. Inside the water tank TDS electrode and pH electrode used to measure the TDS value and pH value in the water tank respectively which is connected to the node MCU ESP8266 module with interfacing boards and these boards are powered by Arduino boards.

An android device is connected to internet of thing application for monitoring the parameters by creating a channel in thing view using its API key and ID number. Arduino is used in this module to power the interfacing chips of the electrodes. When the TDS value and pH value is above or below certain threshold value means, antiscalant liquid is pumped by using solenoid valve through Arduino controller.

The controller used in this is node MCU (ESP8266) and Arduino controller. Node MCU module consists of built in Wi-Fi facility which is used to send the information to the cloud[8][11]. The information stored in the cloud can be accessed through the android device. It is used for the purpose of monitoring the values and it works via Internet or Local Area Network[7]. Hardware setup of the given project has been illustrated in figure 2. by connecting water tank along with pH electrode, TDS meter and also with Arduino board to execute the IoT application.

![Block Diagram](image-url)
4. Material and Methods

4.1. Interface TDS Meter With Arduino Board

A TDS meter is connected with the Signal Transmitter Board. In TDS meter, the analog output pin is connected with the Arduino’s analog pin A1. Positive pin of the TDS Meter is coupled with the Arduino’s 5 V supply, while the negative pin is connected with the Arduino’s ground. Pin number 1 and pin number 16 are linked with the Arduino’s ground. Pin number 2 and pin number 15 are connected with the Arduino’s 5 V supply. Pin number 3 is the contrast pin of the 16×2 LCD and is connected with the middle leg of the Variable resistor or Potentiometer.

While the other two legs of the variable resistor are connected with the Arduino’s 5 volts and ground. The Arduino’s pin number 10 is coupled with the RS pin of LCD, the R/W pin is connected with the ground, the enable pin is connected with the Arduino’s pin number 9. The Arduino’s pin number 6, 5, 4, and 3 are interlinked with the data pins D4 to D7 of the LCD. The data pin is connected with the Arduino’s pin number 7. The VCC is connected with 5 volts, while the ground is connected with the Arduino’s ground.

4.2 Interfacing pH Sensor With Arduino Board

Voltage to be maintained as possible as 5 V with the help of an external switching power supply. To maintain more accurate results in monitoring pH value, pH sensor electrode to be connected with arduino board to the digital pins 2 and 3 of arduino controller. pH electrode fed into the standard solution whose of the arduino IDE, then it represent the pH value.

4.3 Internet Of Things (IoT)

Internet of things is an application which is used to to accumulate and get back the data and also it can work via both in internet or local area network[4]. Internet of thing is used to monitoring the value of TDS and pH parameters by creating a channel in application using its API key and its ID number [9].
4.4 **Arduino IDE**

The open source running software which makes it very easy to write code and upload it on the board.

5. **Results and Discussion**

The parameters like TDS, pH values to be measured and monitored by internet of things. Then, the measurement of all the data of water parameters can be done with the help of Wi-Fi module. Using IoT application, the data is regularly observed and displayed on every action. The data is monitored frequently and displayed on every action in IoT application. The data is refreshed every 5 seconds. The value gets updated automatically in the thingspeak denoting the data and time of occurrence of the value. The value gets updated every 15 seconds in the IoT application. In the figure 3, pH output level varying from 4.88 value to 7 which shows that the given sample as neutral one. In X axis, it has been indicated as TDS obtained value from the drinking water plotted against the voltage developed across the meter in Y axis as shown in the figure 5. Manually, TDS output voltage and pH values can be measured in terms of voltage and it has been tabulated in Table no: 1 and 2.

![pH output level](image1)

**Figure 3. pH output level**

![pH vs Voltage](image2)

**Figure 4 pH vs Voltage**
Table 1. TDS in terms of (ppm) Vs Voltage have been tabulated for the given sample

| S.No | TDS(ppm) | Voltage(V) |
|------|----------|------------|
| 1.   | 151      | 1.01       |
| 2.   | 159      | 1.09       |
| 3.   | 163      | 1.12       |
| 4.   | 173      | 1.21       |
| 5.   | 177      | 1.24       |
| 6.   | 182      | 1.29       |
| 7.   | 187      | 1.34       |
| 8.   | 198      | 1.37       |
Table 2. pH value in terms of (ppm) Vs Voltage in (V) have been tabulated for the given sample to distinguish the solution from acidic or alkaline

| S.No | pH (ppm) | Voltage(v) |
|------|----------|------------|
| 1.   | 1.82     | 1.82       |
| 2.   | 6.18     | 1.97       |
| 3.   | 6.27     | 2.02       |
| 4.   | 6.32     | 2.09       |
| 5.   | 6.45     | 2.15       |
| 6.   | 6.71     | 2.21       |
| 7.   | 6.97     | 2.33       |
| 8.   | 7.12     | 2.42       |

6. Conclusion

Monitoring and controlling the parameters in the water is automated to increase the purity of water, reduce man power and cost efficient. Thus, this process makes more suitable for drinking and to avoid water borne diseases.

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