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Real Time Monitoring of Water Quality

Mohanabarathy.R¹, Sindhu Parvathi.M², Priyanka.K³,Theresa Princy.D⁴

Assistant Professor, Department of Electronics and Communication Engineering, KPR Institute of Engineering and
Technology, Coimbatore, Tamilnadu, India¹

U.G. Student, Department of Electronics and Communication Engineering, KPR Institute of Engineering and
Technology, Coimbatore, Tamilnadu, India^{2,3,4}

ABSTRACT: Water quality determines the “goodness” of water for particular purpose of development of effective means for continuous monitoring of water quality represents an unmet need of significant importance actually for monitoring water quality, samples must be regularly taken and (bio) chemically analysed and the method is too slow to develop operational response. There is a clear need for cost effective means for on line monitoring of water resource. The system proposed in this paper measures pH, turbidity, conductivity and temperature which are considered as the most important parameters to determine the water quality and display the status in the web page using ThingSpeak IOT platform. These tests will give information about the health of the water way. By testing water over a period of time, the changes in the quality of water can be seen.

KEYWORDS: Water quality, pH, Turbidity, Temperature, Conductivity, IoT,ThingSpeak.

I. INTRODUCTION

Water influences natural system and human activities in the context of river basin. As the earth’s population, resulting anthropogenic footprint and impact on climate increase the need to maintain and protect fresh water resources for sustainable development, balancing social needs with economic development and environmental stewardship. In order to reduce hazards to human beings it is necessary to check the quality of water before supplying it to every individual.

India is rich in water resources, being endowed with a network of rivers and blessed with snow cover in the Himalayan range that can meet a variety of water requirements of the country. However, with the rapid increase in the population of the country and the need to meet the increasing demands of irrigation, human and industrial consumption, the available water resources in many parts of the country are getting depleted and the water quality has deteriorated. Indian rivers are polluted due to the discharge of untreated sewage and industrial effluents. The Central Pollution Control Board (CPCB) has established a network of monitoring stations on rivers across the country. The present network comprises of 870 stations in 26 States and 5 Union Territories spread over the country. Among the 870 stations, 567 are on rivers, 55 on lakes, 9 on drains,12 on canals, 4 on tank, 3 on and creeks,2 on pond and 218 are groundwater stations. The monitoring of water quality at 257 stations is being done on monthly basis, 393 stations on quarterly basis, 216 on half yearly basis and 4 stations on yearly basis. The bar graph shown in figure 1 the monitoring network covers 189 Rivers, 53 Lakes, 4 Tanks, 2 Ponds, 3 Creeks, 3 Canals, 9 Drains and 218 Wells[1].

The water quality parameter measures the concentration of hydrogen ions. It shows the water is acidic or alkaline. Pure water has 7 pH values less than 7 is acidic and more than 7 is alkaline. The range of pH is 0-14. For drinking purpose it should be 6.5-8.5pH. Turbidity measures the large number of suspended particles in the water that is invisible. Higher the turbidity higher the risk of diarrhoea, cholera. Lower the turbidity then the water is clean. Temperature sensor measures how the water is whether hot or cold.

Hence the contamination of water can be monitored in “Think Speak” IOT platform in a graphical manner and the data is also stored in the SD card for further analysis.

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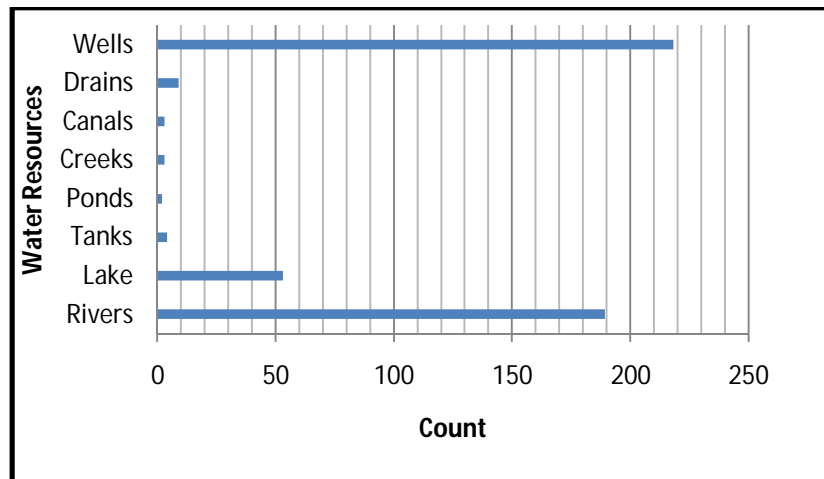


Fig 1.Bar Chart of Water Resources

II. RELATED WORK

Design of Smart Sensors for Real-Time Water Quality Monitoring

This paper describes the design and development of a water quality monitoring system, with the objective of notifying the user of the real-time water quality parameters. The system is able to measure physiochemical parameters of water quality, such as flow, temperature, pH, conductivity and the oxidation reduction potential. These physiochemical parameters are used to detect water contaminants. The sensors which are designed from first principles and implemented with signal conditioning circuits are connected to a microcontroller-based measuring node, which processes and analyses the data. In this design, ZigBee receiver and transmitter modules are used for communication between the measuring and notification node[2].

Water Pollution Detection System using pH and Turbidity Sensors

The parameters involved in this paper to detect water pollution are pH value and turbidity that are measured in real time with the help of sensors. pH is an important parameter to determine the nature of water whereas turbidity is also an equally important parameter since it causes adverse effects on aquatic ecosystems. This paper proposes a water pollution detection system by taking into consideration various aspects like cost, easy setup and easy handling[3].

Water Quality Monitoring using TDS, Turbidity, Temperature & pH sensor

Using different sensor the system can collect various water parameter values such as temperature, hardness of water, turbidity and pH etc. Collected data is first compared with the preset range if data is not within the range that means water is not suitable for drinking and a GSM module sends the data (as a regular message) to the officer and also a buzzer and light indicator will alert the neighbourhood people of the reservoir[4].

III. PARAMETER TO BE MEASURED

The water parameters focussed in this project are Ph, temperature, conductivity and turbidity. Certain Water contaminations can be detected by using these physiochemical parameters.

pH

pH represents the concentration of hydrogen ions(H^+) in water. This concentration could be expressed in the same kind of units as other dissolved species, but H^+ concentrations are much smaller than other species in most waters. The

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activity of hydrogen ions can be expressed most conveniently in logarithmic units. pH is defined as the negative logarithm of the activity of H⁺ ions:

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

where [H⁺] is the concentration of H⁺ ions in moles per liter (a mole is a unit of measurement, equal to 6.022 x 10²³ atoms). The pH is one of the important factors when investigating water quality, as it measures whether the water is acidic or basic. Water with a pH of 11 or higher can cause irritation to the eyes, skin and mucous membrane. Acidic water (pH 4 and below) can also cause irritation due to its corrosive effect. Accurate measurement of pH is difficult as reference electrodes are required. The reference electrodes hold a solution with a known pH value and require recalibration when used over long period of time.

Turbidity

Turbidity is a measure of the amount of suspended particles in the water or the ability of light to pass through water. Suspended particles diffuse sunlight and absorb heat. This can increase temperature and reduce light available for algal photosynthesis. If the turbidity is caused by suspended sediment, it can be an indicator of erosion, either natural or man-made. Turbidity is measured in Nephelometric Turbidity Units (NTU's). Water does not always guarantee healthy water. Extremely clear water can signify very acidic conditions or high levels of salinity.

Category	NTU's
Excellent	_ 10 NTU's
Fair	15-30 NTU's
Poor	> 30 NTU's

Table 1. Turbidity Standardised Values

Temperature

The temperature measurements of the water are required for compensation, as it can have an effect on other parameters. A temperature sensor is used to measure the temperature of the water. The measured voltage is proportional to the temperature with either a negative temperature coefficient (NTC) or a positive temperature coefficient (PTC).

Conductivity

Conductivity gives an indication of the amount of impurities in the water, the cleaner the water, the less conductive it is. In many cases, conductivity is also directly associated with the total dissolved solids (TDS). The required and/or recommended ranges for human consumption of each water parameter have already been determined by the WHO guidelines. Electrical conductivity is an important parameter for determining the water quality for drinking and agricultural purposes.

IV. SYSTEM DESIGN

The Water Quality Monitor comprises of four sensors (pH, Temperature, Turbidity and Conductivity), Wifi Module, SD card Module and Controller as illustrated in the block diagram in figure 2. The water parameters data are sensed by the sensors and converted to digital. These digital values are fed to controller as input. The digital sensor data is stored in the cloud using the Wifi module. The sensor data is also stored in SD Card for further analysis.

At present buoy are used for water quality monitoring in Ganga and Yamuna which is fixed in a location. In Buoys the water is pumped from the water resource floor and tested for the water quality parameters in some time intervals. The sensed data is viewed in web pages for immediate action in case of contamination. The major disadvantage is that it is Expensive and so it is not affordable enough to place many locations.

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Block Diagram

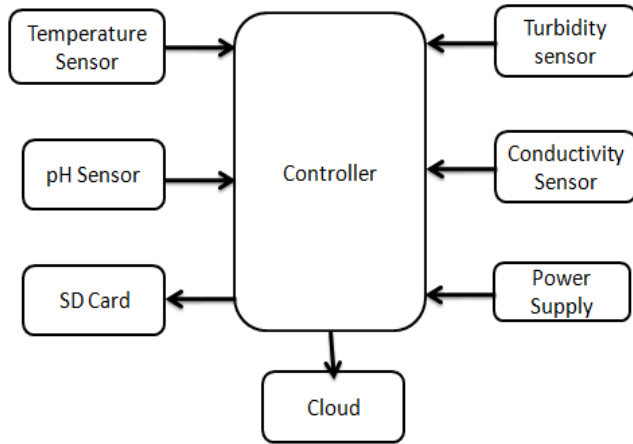


Fig 2. Block Diagram



Fig 3. Water Quality Monitoring RC Boat

In order to solve this problem it is proposed to make use of low cost sensors available to integrate with open source Arduino platform summing up a low cost real time monitoring device for the cause. The device is planned to float by placing the sensors in the RC (Remote Controlled) boats as shown in figure 3. As of now featured with data storage in SD card along with Thingspeak IOT Platform and plans are there to make robotic swam to float around the water body and make measurements.

Sensor Connections

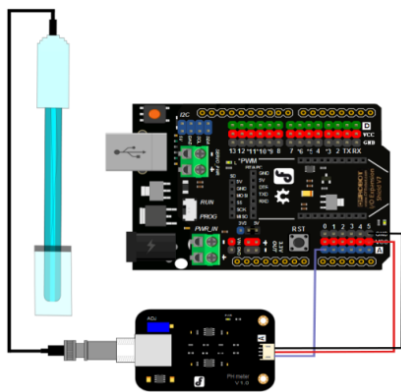


Fig 4. pH Sensor

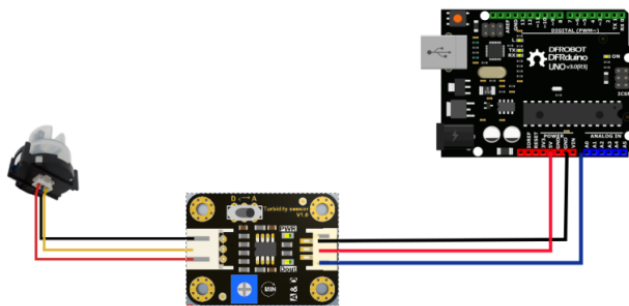


Fig 5. Turbidity Sensor

The figure 4 shows the interface of the pH sensor with the controller. The DF robot product SEN0161 –V2 Analog pH meter is used which is compatible with arduino uno and requires 5V power supply. The pH sensor is easy to code it provides with the analog values which are converted to digital by the ADC in arduino. The connection diagram of arduino uno with the turbidity sensor is shown in figure 5.

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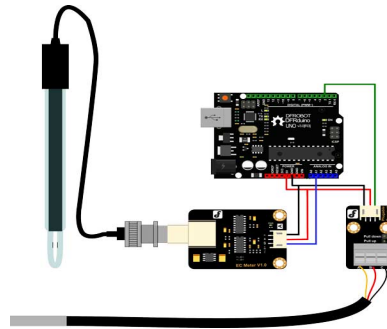


Fig 6. Conductivity and Temperature Sensor

The interface diagram of the conductivity sensor which senses the electrical conductivity of water, important parameter to determine the quality of water is shown in figure 6. The purity of water is directly proportional to the electrical conductivity.

V. RESULTS AND DISCUSSION

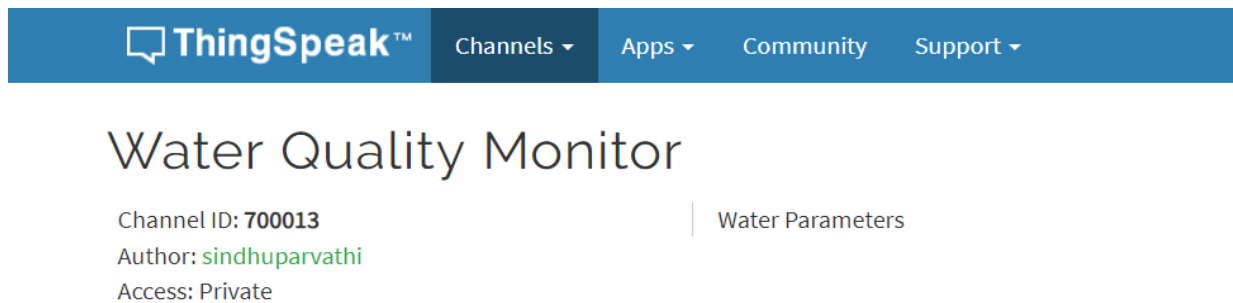


Fig 7. Thingspeak Channel

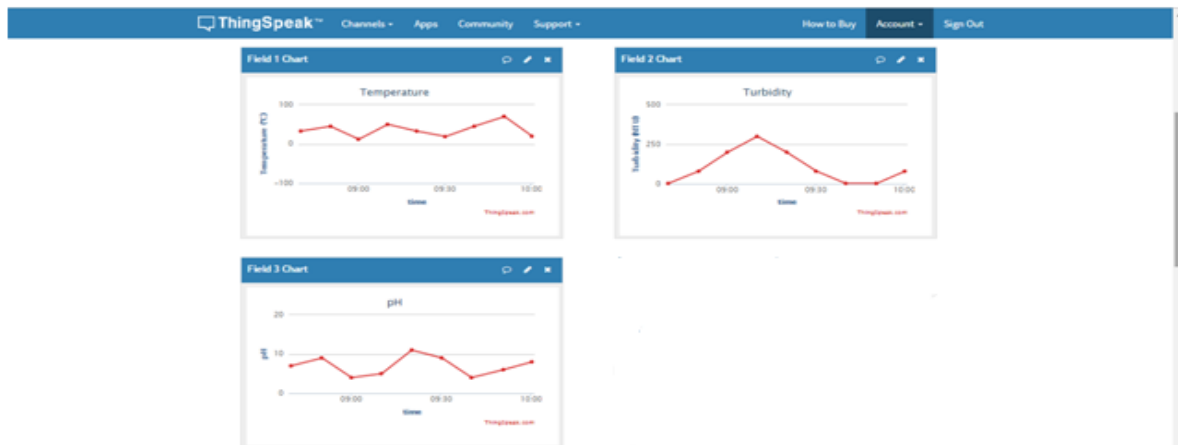


Fig 8. Output in Thingspeak

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The figure 7 and 8 illustrates the channel created in the ThingSpeak platform and real time sensor data in graphical form. The system is connected to the IoT platform by configuring the wifi module to a network connection, create a channel in ThingSpeak website, add the number of sensors with description ,generate API key and finally use key in the code to connect it to the server

VI. CONCLUSION AND FUTURE SCOPE

Monitoring of water quality by sensing turbidity, pH, temperature and conductivity by placing the sensors in easy movable remote controlled boats makes it easy to use and reliable. This system is more economical and only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters. As the water parameter reading our displayed in the webpage it can be monitored from anywhere and immediate action can be taken when water contamination is detected. In future plas te sensors can be placed in swarm bots.

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