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Real Time Water Monitoring System

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Abstract - *Water is one of the most important and basic natural resources. This safe and clean drinking water is essential to the full enjoyment of life and all other human rights. In the Constitution of India, the Article 47 says that 'conferring the duty of providing clean drinking water and improving public health standards to the State'. This priority has been given by them. However, it is not always easy to collect the data. The parameters - turbidity, dissolved oxygen, temperature, conductivity are of major concern. All these parameters are interrelated. Hence there is need of monitoring the parameters of water. The system includes sensors, transmitter and raspberry pi and a cloud server. Sensors are industry grade with IP68 coating and standard 4 to 20mA output current. Transmitter is heart of the system that has been developed. The lacunas present in other water monitoring system is rectified by this system.*

Key Words: Real time, Sensor, Transmitter, Turbidity, Monitoring, Conductivity, Dissolved Oxygen.

1. INTRODUCTION

Water is one of the most important and basic natural resources. Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection. In the international policy forums, water, sanitation and hygiene for health and development have been considered important. In 2010, the United Nations (UN) General Assembly declared that safe and clean drinking-water and sanitation is a human right. This safe and clean drinking water is essential to the full enjoyment of life and all other human rights. In the Constitution of India, the Article 47 says that 'conferring the duty of providing clean drinking water and improving public health standards to the State'. This priority has been given by them.[1]

Water quality monitoring data is useful in many ways but however it is not always easy to collect the data. Hence there is need of monitoring the parameters of water. Results obtained can be used to pinpoint any changes that appear in water bodies. Monitoring of parameters helps in designing and developing pollution prevention and management strategies. It gives the monitoring progress and measure results. One can easily compare results with standard values.

1.1 Previous Work

(1)Swaroopa Rani N. Gupta (2016) analyzed physico-chemical and biological parameters of drinking water samples collected from the selective locations of Nagpur and Amravati to assess health impacts linked with the consumption of drinking water . Analysis of 45 drinkingVwater samples was carried out to develop a data base on the quality of water being consumed.[2]. Measurement of Temperature, pH, Conductivity, Total Dissolved Solids (TDS), Salinity, Turbidity and Dissolved Oxygen was done by Digital Water and Soil Analysis kit Labtronics Model-191E-an ISO 9001 and the data was compared with WHO and ISO standards.

(2) In previous work done by Aanchal M.Pande, Krishna K. Warhade, Rajkumar D. Komati, from Department of Electronics and Telecommunication
MAEER'S MIT College of Engineering, Kothrud Pune (Maharashtra), India proposed a system wherein different sensors(pH, turbidity, temperature, level sensor) being interfaced on to a microcontroller and the data obtained would be transmitted over raspberry pi wirelessly. Further the data would be then used to transfer wirelessly using IOT. According to them their system can be used for smart cities and big housing societies wherein the system would be installed directly on to the overhead tanks in buildings.[3]

The quality of water is dependent on various factors like temperature, the oxygen content, amount of suspended particles, metals, etc. Variation in all these parameters affects the quality of water. According to the studies, the parameters turbidity, dissolved oxygen, temperature, conductivity are of major concern. All these parameters are interrelated wherein as temperature increases, DO decreases. Also there is decrease in DO as contaminants in water increases. Conductivity depends on temperature and salinity of water. When water temperature increases, conductivity increases. Temperature variation affects the alkalinity, salinity, dissolved oxygen and conductivity. The rate of chemical reactions generally increases at higher temperature. Turbidity is independent of electrical conductivity. There is rise in water temperature because of turbidity. The

present water quality monitoring systems in use do not provide online data over which the data can be accessed remotely. Also the time required for the measurement of water parameters is of long duration and requires special maintenance for sensors.

Systems working in present, use methods which include various tests to be performed in laboratory in order to get results. Hence it is difficult for common people to access the data easily and also due to less knowledge about its data cannot be easily interpreted. Also these systems do not provide accurate and reliable data. Some problems related to water quality testing are degradation of water samples while its transpiration to the laboratory, transportation and storage of water samples and also the equipment used for it needs to be taken proper care and handled properly, not proper methods for storing of these samples and sometime due to lack of time the analysis process may take time and hence may lead to further complications.

This system mainly focuses on real time monitoring of physical parameters of water. The sensors used are of industry grade with output 4-20 mA .The system includes getting the data from the sensors. This data will be transmitted to the transmitter where signal conditioning takes place. Then the data will be send over the cloud where people can access it easily.

2. SYSTEM DESCRIPTION

A system is developed which include sensors, transmitter and raspberry pi and a cloud server. Sensors are industry grade with IP68 coating and standard 4 to 20mA output current. Transmitter is heart of system that is been developing. The lacunas present in other transmitter system is rectified by this transmitting system. Following are the features of the transmitter: Transmitter has Input Output ports as per the communication protocol of each sensor. It has its own IP address. It has a USB and Ethernet port. It has an IP68 coating. A screen is present in the transmitter which will display the sensor data.

Transmitter is in prototyping mode hence only standard sensors can be interfaced to it. Standards sensors are industry grade which are calibrated for almost a year. But for some sensors calibration should be done in 6 months. Therefore raspberry PI 3B is used in this system for non-standard kind of sensors. Output of sensors are either digital or analog. Conductivity sensor is analog.

3. WORKING PRINCIPLE

The system consists of tank, transmitter, Raspberry pi, modbus, wires in which tank dimensions are 1 meter in diameter and 5 meter in height. In this tank, analog conductivity sensor and digital sensor are dissolved oxygen and turbidity sensors are vertically mounted. The immersion fitting is used to hold the following sensors and position is at different immersion depth. It also protects the sensor against extreme environment condition. Dissolved oxygen sensor should be below water. Turbidity sensor measures 90 degree scattered light in temperature, conductivity are of major concern. All these parameters are Analog sensor is directly interfaced to transmitter and digital sensors are interfaced through modbus to transmitter. Digital sensors communicates with transmitter through TCP IP protocol. Other external sensors are to be interfaced using Raspberry pi 3B. Raspberry pi communicate with transmitter using modbus TCP IP protocol.

Data is obtained from the sensor and it can be viewed in modbus software .Every port has assigned an address and the sensors are interfaced to these ports. While getting the data, addresses assigned to these ports have to be mentioned while analysing in the software. Data received from the sensors will be send to cloud and further monitor will be used for analysis. Real time data can be seen (continuous monitoring).

4. METHODLOGY

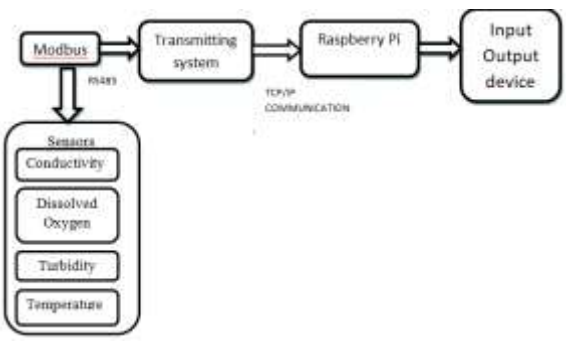

Fig -1: Block Diagram

1. Start the system.
2. Check the connections.
3. Read the data from the sensors.
4. Process the data on transmitter.
5. Transmit the data on modbus to raspberry pi.
6. Send the raspberry Pi data to the cloud via thingsboard.

5. RESULT

System monitors the quality factor for the following parameters which are conductivity in terms of us/cm , turbidity in NTU (Nephelometric Turbidity Unit) and dissolved oxygen in terms of ppm (part per million).

6. CONCLUSIONS

It can be observed from the table that the value of conductivity varied from 244.2 µS/cm to 267.2 µS/cm. Initially the value of turbidity was found to be 0.1 NTU. Then after addition of impurities like soil, turbidity changes to 0.9 NTU and for dissolved oxygen variation from 4.61 ppm to 3.45 ppm was observed. Meaning that for any changes relating to impurities added or any additional salts introduced in the water leads to variation in these parameters. If these impurities are present in abundance it can deteriorate water quality.

Table.1. Data obtained from sensors

Sr. No.	Date	Temperature	Conductivity	Turbidity	Dissolved Oxygen
1.	Day 1	30.1 ^{0}C	244.2 µS/cm	0.1 NTU	4.61 ppm
2.	Day 2	30.2^{0}C	242.3 µS/cm	0.1 NTU	4.60 ppm
3.	Day 3	30.6 ^{0}C	254.1 µS/cm	0.1 NTU	4.60 ppm
4.	Day 4	31.4 ^{0}C	255.2 µS/cm	0.1 NTU	4.60 ppm
5.	Day 5	31.9 ^{0}C	258.9 µS/cm	0.5 NTU	4.21 ppm
6.	Day 6	32.0 ^{0}C	259.1 µS/cm	0.5 NTU	4.24 ppm
7.	Day 7	32.8^{0}C	259.6 µS/cm	0.7 NTU	4.04 ppm
8.	Day 8	34.5 ^{0}C	260.2 µS/cm	0.7 NTU	4.02 ppm
9.	Day 9	33.9 ^{0}C	272.4 µS/cm	0.9 NTU	3.48 ppm
10.	Day 10	33.3 ^{0}C	267.2 µS/cm	0.9 NTU	3.45 ppm

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