INEXPENSIVE REAL TIME WATER QUALITY MONITORING IN IOT ENVIRONMENT

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Pollution of wateris one of the relevant issue faced by the green globalization. Variation of the water parameters like pH, turbidity and temperature indicates the presence of pollutants. In our proposed system we design and develop aninexpensive system for real time water qualitymonitoring in IoT. In present scenario, water parameters are detected by chemical test or laboratory test, where the testing equipment are stationary and samples needs to be provided to testing equipment. Thus the current water quality monitoring system is a manual system which is time consuming. To ensure the real time acquisition of data, the testing equipment can be placed in the water resources and detection of pollution can be done remotely. To measure the physical and chemical parameters of the water, this paper introduces a Sensor Based Water Quality Monitoring System. The most important water quality parameters such as Temperature, pH and Turbidity of the water, which is measured using sensors, are processed by a core controller. We used Arduino as a core controller and the sensor data is made available on webpage using ThingSpeak API. The uniqueness of our proposed paper is the water monitoring system with high frequency, high mobility, low cost and low power.

KEYWORDS: IoT, Arduino, ThingSpeak API.

1. INTRODUCTION

Water is a limited resource in the world, day by day the water gets polluted, and many scientists and researchers are trying to find a solution for this problem by checking the quality of water. The aim of this paper is to test the water quality in a real time environment. Conventional method involves manual collection at different locations of water samples, followed by laboratory analytical techniques to estimate the quality of water. It takes longer and less efficient to use these methods.The physical, chemical and biological agents are determined by the current methodologies. It has several disadvantages such as poor spatiotemporal coverage, high labor costs and lack of real time water quality information to enable critical decisions. Therefore, it is essential to check the water quality continuously. There are various types of water quality measuring devices on the market, ranging from cheap to expensive, and from house to industrial. Current devices are expensive and are unable to meet the consumer's quality control needs ineffectively and quickly. Using a single system, it is essential to check the pH, turbidity and water temperature value and determine if the water is suitable for normal use.pH value shows the water is acidic or alkaline Turbidity measures the large number of suspended particles in water that is invisible. Higher the turbidity higher the risk of diseases. Temperature sensor measures whether the water temperature is high or low. And it is essential to check the temperature in cosmetics, healthcare and various other industries.

Our paper design and develop a low cost system for real time monitoring of water quality in the IOT environment by observing the above issues. We use Arduino as our core controller in our design. The design system includes a specialized IOT module to access sensor data from the core controller to the cloud, and a special API key can be used to view it on the Thingspeak.

2. MATERIALS AND METHODS

The proposed method is used to overcome the drawbacks of currently existing devices that have high cost. So we introduce a low cost and robust system with Arduino UNO as a microcontroller to process the data from sensors and it is upload in to the clouds. pH, Temperature and Turbidity are the most important parameters of water. The overall functions of the system given below

- Arduino UNO microcontroller is used to collect and process the data from sensors.
- To check the water quality we use pH, Temperature and Turbidity sensors.
- pH sensor is used to measure hydrogen ion concentration of water.
- To measure water temperature we use temperature sensor and check whether the water is hot or cold.
- Turbidity sensor can detect suspended particles in water.
- ESP8266 is a Wi-Fi module connected with Arduino to transfer the data to PC.
- LCD display is also used to display the output correspondingly.

Around 2.1 billion people are uses internet in their daily life. In the past decade internet has changed all the human lives. The Internet of Things becomes a basis for connecting things, sensors and other intelligent

technologies. The major enabling technologies of IoT are RFID, NFC, ubiquitous computing, wireless sensor network, cloud computing.

Cloud computing is the used to deliver a service over a network with the help of hardware and software. Users can access files and applications from any device that can access the Internet. It is a large - scale, low - cost processing unit used for calculation and storage which is based on the IP address.

BLOCK DIAGRAM

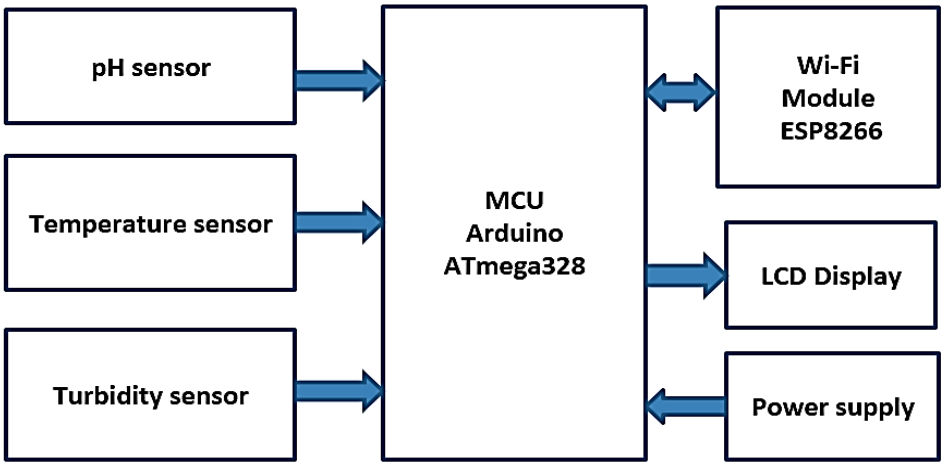

Fig- 1: Block diagram

Block diagram description

Arduino UNO

An Arduino UNO is used as a core controller based on ATmega328P by ATmel. Multiple analog input sensors are with the Arduino board. ATmega32 consist of 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Using a language derived from C and C++ Arduino boards are programmed in Integrated Development Environment (IDE). It consist of an ADC of 10 bit resolution is used to convert the analog voltage into bits. Arduino UNO haveanother microcontroller named as ATmega 16U2 is used as a USB to serial converter.

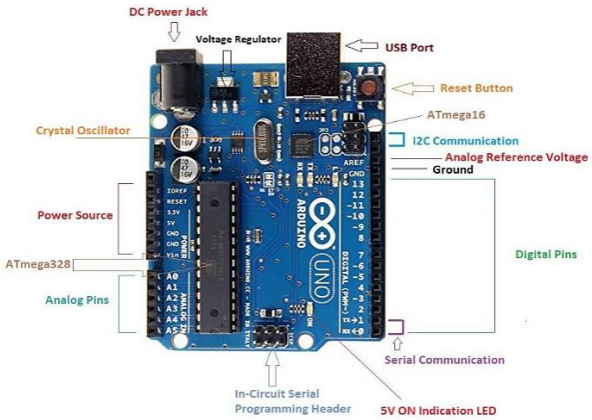

Fig- 2: Arduino UNO

pH sensor

pH of water is an important parameter to monitor because high and low pH levels can have enormous effects on the source. pH value of a solution can range from 1 to 14, indicates its acidity or alkalinity. Voltage is positive for acids, null for neutral and negative for bases. The pH meter works on the principle that an electrical potential can be measured by the interface of two liquids.pH or hydrogen ion concentration of the system is determined by the potential difference between the two electrodes and is pre-amplified to strengthen it.

$$E = V_{pH} - V_{ref}$$

V_{pH} : Voltage potential at measurement electrode
V_{ref} : Voltage potential at reference electrode

Fig- 3: pH sensor

Turbidity Sensor

Turbidity is a property of solid particle being suspended in water, rather than dissolved into it. Turbidity testing is an important part of water quality. The increased levels of turbidity raises water temperature, because heat is absorbed by the suspended particles.Turbidity sensor consists of light transmitter and receiver, the transmitter needs to transmit clear light to the receiver if it not clear, it is said to be turbid. Normally, it measures the amount of light coming from the source of the light to the light receiver, in order to calculate water turbidity. Its unit is NTU (Nephelometric turbidity unit). Turbidity value of a normal water ranges from 0-5 NTU.

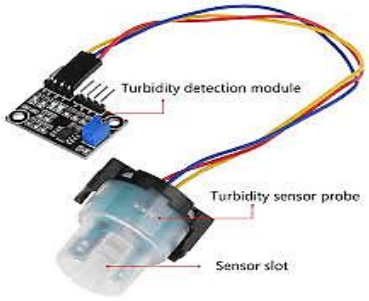

Fig- 4: Turbidity sensor

Temperature sensor

DS18B20 is a programmable one wire temperature sensor used to measure temperature in harsh environments such as chemical solutions, mines or soil, etc. The sensor's constriction is rough and can also be purchased with a waterproof option to facilitate the mounting process. A wide temperature range from-55 ° C to+ 125 ° C can be measured. The sensor has a unique address and requires only one MCU pin to transfer data, making it a very good choice to measure temperature at multiple points without compromising much of the microcontroller's digital pins.

Fig- 5: Temperature sensor

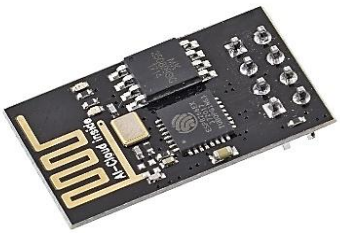

Fig- 6: ESP8266Wifi module

Wifi module

ESP8266 is used as a Wifi module works with 3.3V only. It is a low cost and user friendly device to provide internet connectivity. The module is used as an Access point as well as a station. Hence it can easily fetch data and upload it into the **Internet of Things.** It uses API keys to fetch data from internet to access any information that is available in the internet. The most important feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user friendly.

ThingSpeak

ThingSpeak is an open source "Internet of Things" application used to store, collect, store and analyse and retrieve data from things using HTTP over the Internet with the help of API keys. It is also used to visualize sensor data in real-time. In addition to storing and retrieving, the ThingSpeak API allows numeric data processing such as time scaling, summing, median, averaging, and rounding. Each ThingSpeak Channel supports data entries of up to 8 data fields, elevation, longitude, latitude, and status.

3. RESULTS AND DISCUSSION

Water quality monitoring is important for various applications such as pond and ecosystem monitoring of the environment, distribution and measurement of drinking water, detection of contamination in drinking water, etc. We need a separate technique to monitor the water quality for these applications.

In this implementation model three sensors are connected to the core controller ATmega328 with Wi-Fi module. These sensor measures Temperature, pH and Turbidity parameters of the water when they dipped in water. In our proposed system, by using cloud computing we can monitor the parameters of water quality on the internet.

The Arduino will access the data from these sensors and process the data, finally sends the data to ThingSpeak API using network. The Figures which shows the readings of all the sensors measuring Temperature, pH and Turbidity levels of Water from different resources.

i. **Water Temperature measurement;** Sensor measures the water temperature in the range from -50°C to 125°C. Basically water temperature is classified into three categories based on its temperature, cold, normal and hot. If the temperature is ranging from -55°C to 20°C is treated as cold water, 21°C to 39°C is treated as normal water and 40°C to 125°C is treated as hot water.

ii. **Water pH measurement;** Sensor measures pH value of the water that ranges between 0 and 14. Water
is classified as acidic, normal and basic, depending on the pH value. It is considered as acidic if the val ue is below 7, above 7 it is considered as basic and 7 as normal or safe water. Low acid (3 - 6) and high acid (0 - 2) are the classification of acidity. Similarly alkalinity can be classified into two types, low basic (8-10) and high basic (11-14).

iii. **Water Turbidity Measurement;** Water Turbidity defines the clarity of water. If any particles of mud, slit or sand etc. are mixed with the water, the quality of the water will vary. Normal water ranges from 0 NTU to 5 NTU (Nephelometric Turbidity Units) and a maximum of up to 5 NTU are permitted based on water quality standards. It is classified as turbid or mud mixed water if the water turbidity level rose above 6 NTU up to 3000 NTU.

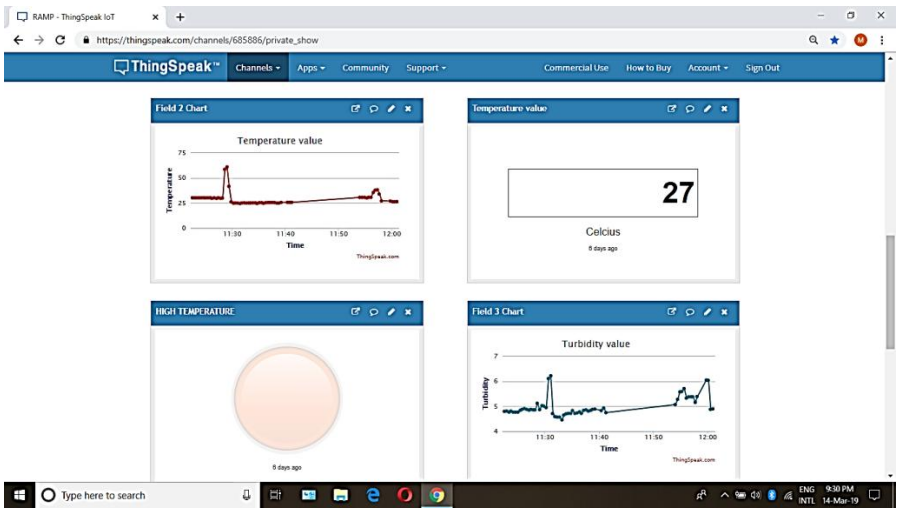

Fig- 7: Water Temperature measurement

4. CONCLUSION

In our proposed system, the design consist of Inexpensive real time monitoring of water quality in IoT environment. Several water quality detecting sensors, Arduino Atmega328P core controller and a Wifi module are used in this system. With the help of Arduino and various sensors we measured Temperature, Turbidity and pH values of water. It is costless, high efficient and doesn't require labors on duty. The core controller is capable of collecting, analyzing and sending data in to the cloud using IoT. The data can be accessed from the cloud server anywhere anytime in the world. By changing the relevant software programs and replacing the corresponding sensors, other water quality parameters can be measured by this system. In future, we plan to monitor water parameters such as conductivity, hardness, chloride, ammonia, iron, fluoride etc to monitor the water quality for various purposes like drinking water, textiles, agricultural and health care industries.

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