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The Real Time Monitoring of Water Quality in IoT Environment

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Abstract: In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. In this paper we present a design and development of a low cost system for real time monitoring of the water quality in IOT (internet of things). The system consist of several sensors is used to measuring physical and chemical parameters of the water. The parameters such as temperature, PH, turbidity, conductivity, dissolved oxygen of the water can be measured. The measured values from the sensors can be processed by the core controller. The raspberry PI B+ model can be used as a core controller. Finally, the sensor data can be viewed on internet using cloud computing.

Keywords: IoT; Ethernet; pH Sensor; Turbidity Sensor; Temperature Sensor, Ethernet Shield

I. INTRODUCTION

With the rapid development of the economy, more and more serious problems of environment arise. Water pollution is one of these problems. Routinely monitored parameters of water quality are temperature, pH, turbidity, conductivity, dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), ammonia nitrogen, nitrate, nitrite, phosphate, various metal ions and so on. The most common method to detect these parameters is to collect samples manually and then send them to laboratory for detecting and analyzing. This method wastes too much man power and material resource, and has the limitations of the samples collecting, long-time analyzing, the aging of experiment equipment and other issues.

Sensor is an ideal detecting device to solve these problems. It can convert no power information into electrical signals. It can easily transfer process, transform and control signals, and has many special advantages such as good selectivity, high sensitivity, and fast response speed and so on. According to these characteristics and advantages of sensors, Monitoring of Turbidity, PH & Temperature of Water is designed and developed. The measured values from the sensors can be processed by the core controller finally, the sensor data can be viewed on internet using cloud computing.

Turbidity is a measure of the cloudiness of water. Cloudiness is caused by suspended solids and plankton (microscopic plants and animals) that are suspended in the water column. Moderately low levels of turbidity may indicate a healthy, well-functioning ecosystem, with moderate amounts of plankton present to fuel the fuel the food chain. Water Temperature is a controlling factor for aquatic life: it controls the rate of metabolic activities, reproductive activities and therefore, life cycles. If stream temperatures increase, decrease or fluctuate too widely, metabolic activities may speed up, slow down, malfunction, or stop all to get. PH is an important limiting chemical factor for aquatic life. If the water in a stream is too acidic or basic, the H+ or OH- ion activity may disrupt aquatic organisms' biochemical reactions by either harming or killing the stream organisms. pH is expressed in a scale with ranges from 1 to 14. A solution with a pH less than 7 has more H+ activity than OH-, and is considered acidic. A solution with a pH value greater than 7 has more OH- activity than H+, and is considered basic.

II. BLOCK DIAGRAM

The system relies on IoT, based on the connection and data flow between the different-different sensor(s) from the base station to the Arduino board and then to the remote station.

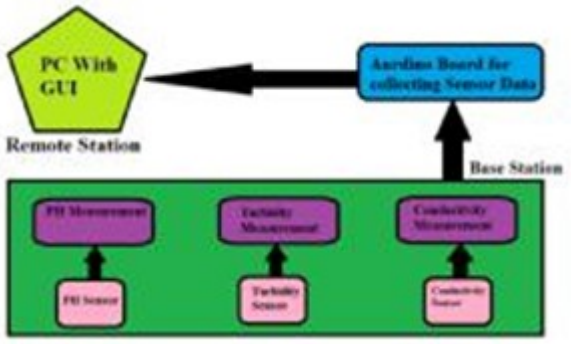

Fig 1. System Architecture of Monitoring Water Quality in IoT Environment

The Arduino can be powered via the USB connection or with an external power supply. The power source is selected automatically. External power can come either from an AC-to-DC adapter or battery. Turbidity is a

measure of the cloudiness of water. Cloudiness is caused by suspended solids and microscopic plants and animals that are suspended in the water column. Water Temperature is a controlling factor for aquatic life: it controls the rate of metabolic activities, reproductive activities and therefore, life cycles. pH is an important limiting chemical factor for aquatic life. A solution with a pH less than 7 has more H+ activity than OH-, and is considered acidic. A solution with a pH value greater than 7 has more OH- activity than H+, and is considered basic. Conductivity sensor measures the salt level in the water. All this data from the base station is send to the Arduino board and then to the Remote station where the data will be displayed to everyone.

III. EXISTING SYSTEM

In many countries like Australia, England, Germany, India, USA, rivers like Murray, Thames, Wye, Main, Elbe, Ganga, Mississippi, etc. have water quality monitoring system but these systems do not give real time water quality due to lack of new technologies like IoT. Along with it, they are mostly based on ARM 11 processor, and relies on heavy large scale hardware's which are costly to buy as well as maintain. Moreover, they require constant monitoring and result need to be calculated by human intervention and those systems are not based on real time and are not reliable therefore there is a need of new systems which can help us in all conditions and must be capable of providing the result in short duration.

IV. PROPOSED SYSTEM

In our proposed method, Arduino / Raspberry PI B+ is used as a core controller. The raspberry pi is run on LINUX kernel by the use of keyboard and monitors the LINUX OS is boot on to the Arduino / Raspberry PI. The temperature sensor, conductivity sensor, turbidity sensor, dissolved oxygen sensor, pH sensor can be read directly from the command line. However, this requires us to input a command every time we want to know the sensors reading. In ordered to access all the terminals of the sensors, python program is used, which will read the sensors value automatically at set time intervals. Then the sensors data will be combined in the base station and send to the remote station and there the data will be displayed to all the society. By using this technology quality of water can be checked on the regular basis. Since it is a Real Time Model so it has to complete its process within a specified time limit and thus, it leads to reliable and efficient system.

V. FUNCTIONAL REQUIREMENTS

There are two functional requirements:

A. *Hardware Requirements:* -

a) *Raspberry Pi 3 Micro Controller:* The Raspberry Pi is a series of small single-board computers All models feature a Broadcom system on a chip (SoC),which includes an ARM compatible central processing unit (CPU) and an on-chip graphics processing unit (GPU, a Video Core IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or Micro SDHC sizes. Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. Pi 3 has on board Wi-Fi and Bluetooth.

b) *Turbidity Sensor:* Turbidity is a measure of the cloudiness of water. Cloudiness is caused by suspended solids (mainly soil particles) and plankton (microscopic plants and animals) that are suspended in the water column. Moderately low levels of turbidity may indicate a healthy, well-functioning ecosystem, with moderate amounts of plankton present to fuel the fuel the food chain. However, higher levels of turbidity pose several problems for stream systems. Turbidity blocks out the light needed by submerged aquatic vegetation. It also can raise surface water temperatures above normal because suspended particles near the surface facilitate the absorption of heat from sunlight.

c) *Temperature Sensor:* Water Temperature is a controlling factor for aquatic life: it controls the rate of metabolic activities, reproductive activities and therefore, life cycles. If stream temperatures increase, decrease or fluctuate too widely, metabolic activities may speed up, slow down, malfunction, or stop all to get. There are many factors that can influence the stream temperature. Water temperatures can fluctuate seasonally, daily, and even hourly, especially in smaller sized streams. Spring discharges and overhanging canopy of stream vegetation provides shade and helps buffer the effects of temperature changes.

d) *PH Sensor:* PH is an important limiting chemical factor for aquatic life. If the water in a stream is too acidic or basic, the H+ or OH- ion activity may disrupt aquatic organisms' biochemical reactions by either harming or killing the stream organisms. pH is expressed in a scale with ranges from 1 to 14. A solution with a pH less than 7 has more H+ activity than OH-, and is considered acidic. A solution with a pH value greater than 7 has more OH- activity than H+, and is considered basic. The pH scale is logarithmic, meaning that as you go up and down the scale, the values change in factors of ten. A one-point pH change indicates the strength of the acid or base has increased or decreased tenfold. Streams generally have a pH values ranging between 6 and 9, depending upon the presence of dissolved substances that come from bedrock, soils and other materials in the watershed.

e) *Power Supply:* The Raspberry PI can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC

adapter or battery. The adapter can be connected by plugging a 2.1mm center positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

B. *Software Requirements:*

The software requirements of the project are:

a) *Raspberry Pi OS:* It is a Linux distribution ported from Debian 7.0 (Wheezy), and is the official OS for Raspberry Pi optimized for the device's architecture. While there are other options for running your favorite OS on the Pi, we'll use Raspbian because of its simplicity. Installing an operating system onto a Raspberry Pi is simple.

b) *Python:* It is a widely used high-level programming language for general-purpose programming Python features a dynamic type system and automatic memory management and supports multiple programming paradigms, including object-oriented, imperative, programming, and procedural styles. It has a large and comprehensive standard library. Python interpreters are available for many operating systems, allowing Python code to run on a wide variety of systems.

VI. APPLICATIONS

The applications are mentioned below:

1. This system is used in commercial and domestic use.
2. Water supply agencies and for Irrigation purposes.
3. For health department to identify the reason of water diseases.
4. It can be used for defence purposes for ex: during mission's soldiers can use it to determine the quality of water so that it can be consumed or not.
5. In Sea and Dam water quality monitoring equipment.
6. It can be used to determine the Salinity of groundwater.

VII. ADVANTAGES

The advantages are mentioned below:

1. Due to automation it will reduce the time to check the parameters.
2. This is economically affordable for common people.
3. Low maintenance.
4. Prevention of water diseases.
5. It is Reliable and Portable.

VIII. CONCLUSION AND FUTURE ENHANCEMENT

Monitoring of Turbidity, PH & Temperature of Water makes use of water detection sensor with unique advantage and existing GSM network. The system can monitor water quality automatically, and it is low in cost and does not require people on duty. So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters.

The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value. To give information to whole users those are depends on that plant Detecting the more parameters for most secure purpose Increase the parameters by addition of multiple sensors.

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