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The Real Time Monitoring of Water Quality in IoT Environment

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ABSTRACT: Drinking water varies from place to place, depending on the condition of the source water from which it is drawn and the treatment it receives, but it must meet EPA regulation. The traditional method of testing Turbidity, PH & Temperature is to collect samples manually and then send them to laboratory for analysis. However, it has been unable to meet the demands of water quality monitoring today. So a set of Monitoring of Turbidity, PH & Temperature of Water quality has been developed. The system consists of Turbidity, PH & Temperature sensor of water quality testing, single-chip microcontroller data acquisition module, information transmission module, monitoring center and other accessories. Turbidity, PH & Temperature of water are automatically detected under the control of single chip microcontroller all day. The single chip gets the data, and then processes and analyzes them. If the water quality is abnormal, the data will be sent to monitoring center and alert the public at the same time. It is convenient for management to take corresponding measures timely and be able to detect real-time situation of water quality remotely. The system has realized the automation of water quality monitoring intelligence of data analyzing and networking of information transferring. It is characterized by advantages of shortcut, accuracy and using manpower and material resources sparingly. The use of other technologies are having high cost associated with installation and calibration of a large distributed array of monitoring sensors. The existing technology will be suitable for particular area but it is not suitable for large system. By focusing on the above issues our paper propose a low cost system for real time monitoring of the water quality in IOT environment.

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, 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.

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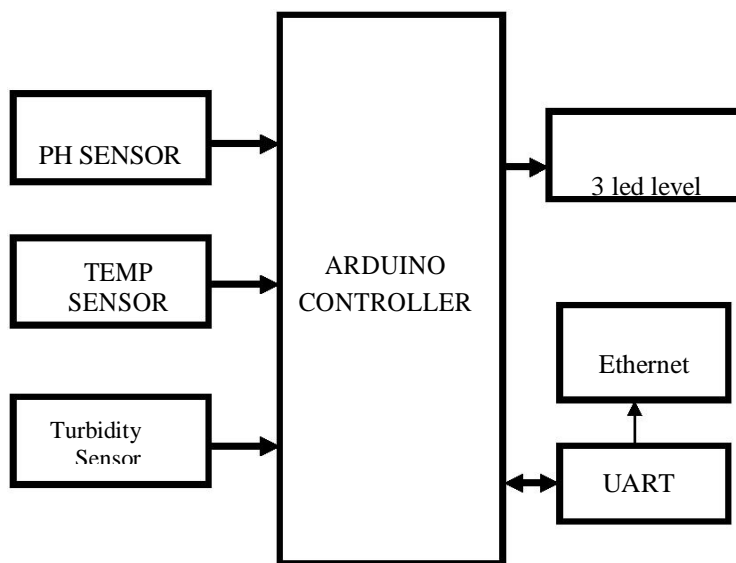
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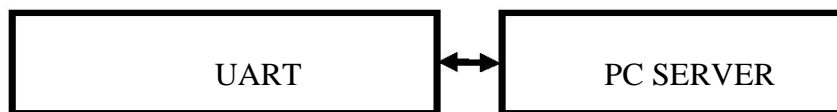
II. PROPOSED SYSTEM

BLOCK DIAGRAM

2.1 NODE 1 TRANSMITTER SECTION



2.2 RECEIVER SECTION



III. HARDWARE DESCRIPTION

3.1 ARDUINO MICRO CONTROLLER

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward.

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Fig 3.1: Arduino Microcontroller

3.1.1 Power

The Arduino Uno 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 (wallwart) 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.

The Power Pins Are As Follows

- **VIN:** The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V:** The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.
- **3.3V:** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND:** Ground pins.
- **INPUT & OUTPUT:** Each of the 14 digital pins on the Uno can be used as an input or output, using `pinMode()`, `digitalWrite()`, and `digitalRead()` functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 2050 kOhms. In addition, some pins have specialized functions:
- **Serial 0 (RX) and 1 (TX):** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts 2 and 5:** These pins can be configured to trigger an interrupt on a low value, arising or falling edge, or a change in value.

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- **PWM 3, 5, 6, 9, 10, and 11:** Provide 8-bit PWM output with the analogWrite() function.
- **SPI 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK):** These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- **LED 15:** There is a built-in LED connected to digital pin 15. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. The Uno has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality.
- **I2C: 4 (SDA) and 5 (SCL).** Support I2C (TWI) communication using the Wire library.
There are a couple of other pins on the board,
- **AREF:** Reference voltage for the analog inputs. It is therefore used with analogReference().
- **Reset:** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

3.2 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 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.



Fig 3.2: Turbidity sensor

3.2.1 Turbidity Information From Interior Health Good < 1 NTU Interior Health and the Village of Ashcroft remind customers of the provincial recommendation that newborns and people with compromised immune systems drink boiled water or a safe alternative if served by an unfiltered surface water source.

Fair 1 - 5 NTU Interior Health and the Village of Ashcroft recommend that children, the elderly and people with compromised immune systems drink boiled water or a safe alternative.

Poor > 5 NTU Interior Health and the Village of Ashcroft recommend that all users drink boiled water or a safe alternative. Tap water intended for drinking should be brought to a rolling boil for at least one minute.

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3.3 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.

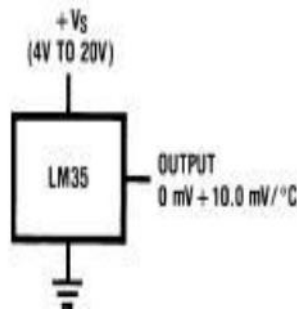


Fig.3.3: Temperature sensor (RTD)

3.3.1 Basic information

The PT100-sensor is used for precise temperature monitoring applications, where errors in measurement have to be excluded. The linear relationship of the resistor to temperature, Simplifies its use in many electronic applications. The precision of the PT100 allows its universal use for temperature monitoring, control, and Switching in windings, bearings, machines, motors, transformers and many other industrial applications .

3.3.2 Application

1. Temperature control of bearings,
2. Conductor-rails, machine parts and windings.

3.3.3 General function

The PT100-sensor is a temperature dependent component. The resistance of the PT100-sensor rises linearly with the temperature.

3.3.4 Advantages

1. Very precise measuring: measuring temperature $\pm 0.5^{\circ}\text{C}$.
2. Precise linear temperature-resistance characteristic.

4 PH SENSOR

3.4 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

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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.



Fig.3.4:PH sensor

3.4.1 Preparation for Use

Soak the glass bulb and the fibre junction of the electrode in N/10 Hydrochloric Acid for 24 hrs to activate the sensing membrane. Then rinse the bulb with distilled water a number of times. Never use ordinary tap water. Preparation of N/10 Hydrochloric Acid Take 1 ml of concentrated Hydrochloric Acid and dissolves it in 100 ml of double distilled water. Shake the solution inside the electrode to let it fall into the bulb. Fill the electrode with freshly prepared 2 M Potassium Chloride solution into three fourth. Preparation of 2 M Potassium Chloride Solution Dissolve 14.91 g of A.R. KCl in 100 ml of double distilled water and add a few crystals of A.R. AgCl

IV. PRINCIPLE

The flow is given below

1. Water Sources
2. Water Tank
3. Alert System
4. Distribution Of Water

4.1 Water Sources

water is water in a river, lake or fresh water wetland. Surface water is naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, transpiration and sub-surface seepage. Although the only natural input to any surface water system is precipitation within its watershed, the total quantity of water in that system at any given time is also dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs, the permeability of the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. All of these factors also affect the proportions of water loss. Human activities can have a large and sometimes devastating impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. Humans often increase runoff quantities and velocities by paving areas and Channelizing stream flow

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SOURCES

- 1) Under river flow
- 2) Ground water
- 3) Desalination

4.2 Water Tank

A water tank is a container for storing water. The need for a water tank is as old as civilization, providing storage of water for drinking water, irrigation agriculture, fire suppression, agricultural farming, both for plants and livestock, chemical manufacturing, food Preparation as well as many other applications. Water tank parameters include the general design of the tank, and choice of construction materials. Various materials are used for making a water tank: plastics (polyethylene, polypropylene), fiberglass, concrete, and stone, steel (welded or bolted, carbon, or stainless), Earthen ponds function as water storage.

1. Chemical contact tank of FDA and NSF polyethylene construction, allows for retention time for chemical treatment chemicals to "contact" (chemically treat) with product water. (Black tank in foreground).The tank is used in Rajasthan as a traditional form of rainwater harvesting
2. Ground water tank is made of lined carbon steel, it may receive water from a water well or from surface water allowing a large volume of water to be placed in inventory and used during peak demand cycles
3. Elevated Water Tank is also known as a water tower, an elevated water tower will create pressure at the ground-level outlet of 1 psi per 2.31 feet of elevation, thus a tank elevated to 70 feet creates about 30 psi of discharge pressure. 30 psi is sufficient for most domestic and industrial requirements.

4.3 Alert System

Alert system of our project "Monitoring of Turbidity, PH & Temperature of Water ". in which a single controller can interface with water quality parameter sensor which continuously measures the value of parameters and if the values are beyond the limit then it will send the message on the mobile of management body of water supply that water is not good for drinking. Then the authority will take respective action for purify the water and then distribute them

V. CIRCUIT DIAGRAM

The circuit diagram of system is shown in Fig .5. Circuit Layout

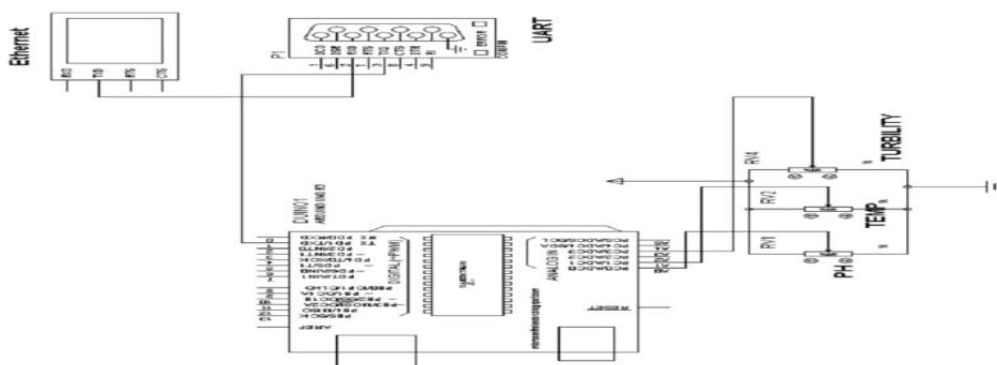


Fig.5:Overall circuit diagram

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VI. WATER QUALITY ANALYSIS RESULT



S/N	Parameter	Value	Unit
1	Temperature	32	Fahar
2	Turbidity	10	Nelson
3	PH	7.50	lit

Fig.6:Result of water quality analysis

VII. FUTURE SCOPE

- Σ To give information to whole users those are depends on that plant
- Σ Detecting the more parameters for most secure purpose
- Σ Increase the parameters by addition of multiple sensors
- Σ By interfacing relay we controls the supply of water

7.1 APPLICATIONS

- Σ This system is used in commercial and domestic use.
- Σ Water supply agencies.
- Σ For health department to identify the reason of water dieses.

7.2 ADVANTAGES

- Σ Due to automation it will reduce the time to check the parameters.
- Σ This is economically affordable for common people.
- Σ Low maintenance.
- Σ Prevention of water diseases.

VIII. CONCLUSION

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

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hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.

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