IOT Based Water Monitoring System

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Abstract: **The quality of water varies from place to place, depending on the condition of the source and the treatment it receives. 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, water level & Temperature sensor, 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.The data will be sent to monitoring center and alert the public at the same time using IOT environment. The proposed paper 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 has 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 proposes a low cost system for real time monitoring of the water quality in IOT environment.**

Keywords: IOT, Sensors, Microcontroller, Zigbee

I. INTRODUCTION

Drinking water is more precious and valuable for all the human beings so the quality of water should be monitored in real time. Some water quality detection parameters 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 sensor 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 IOT environment using Zigbee protocol and data from the core micro controller which can be interfaced with multiple sensors at a given time.

II. BLOCK DIAGRAM

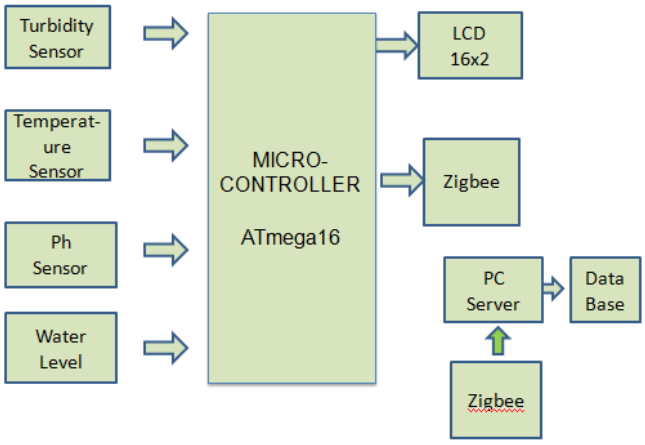

Figure.1

This section explains the complete block diagram of the proposed system. Also, it presents the detail explanation of each and every block. The overall block diagram of the proposed system is as shown in figure 1. This proposed block diagram consist number of devices having respective sensors, and the collected data from all devices are gathered at the core controller via Zigbee protocol IEEE 802.15.4. Taking close look of the device, which shown in figure.1. The device consist several sensors for measuring water quality parameter such as pH, turbidity, water level, temperature. The data of sensors are not in a proper manner for sending them directly to the core controller using Zigbee protocol. So, the microcontroller is introduced in a proposed system for getting data from sensors and processes on them to make compatible for Zigbee module. Zigbee has low data rate, low power consumption, more node density that makes it suitable for sensor networking in the proposed system. A Zigbee module consists router Zigbee, which located on all devices that transmit the processed data to the coordinator Zigbee, which collects data from devices connected in the same network. The router Zigbee and coordinator Zigbee are connected in same network using a same PAN ID (personnel are network) for all Zigbee devices in the network. The PAN ID provides the personal area network for wireless data communication

for sensor networking. Coordinator Zigbee is connected to the core controller, the core controller manages data coming from different devices. The core controller puts the data in a text file which is transmitted to the IOT module. For transmitting data to the IOT, gateway is created on the core controller using FTP (file transfer protocol) protocol. The brief introduction of IOT module is discussed in further. In the proposed system,to monitor processed data on the internet cloud computing technology is use which provides the personal local server. In cloud computing, separate IP address is provided which make possible to monitor data from anywhere in the world using the internet. To access that monitor data and make system user-friendly browser application is introduced which work on HTTP. So, by using browser application user can access and monitor the data from all over the world.

III. WORKING PRINCIPLE

In our proposed system ,water quality parameters are measured by the different water quality monitoring sensors such as pH, turbidity and temperature. These sensor-values are processed by the microcontroller and theses processed values are sent to the core controller remotely using Zigbee IEEE 802.15.4 protocol. In the proposed system,as shown in Figure1, IOT module is used to access processed data from the core controller to the cloud with the help of Zigbee protocol. The processed data can be monitored through a browser application using a special IP address. Furthermore, with the help of IOT environment, we can provide facility to access data remotely from all over the world.

a) INTERNET OF THINGS

In the past decade, human life changed because of the internet. The internet of things has been heralded as one of the major development to be realized throughout the internet portfolio of technologies. The Internet of Things (IOT) is concerned with interconnecting communicating objects that are installed at different locations that are possibly distant from each other. Internet of Things represents a concept in which, network devices have ability to collect and sense data from the world, and then share that data across the internet where that data can be utilized and processed for various purposes. The internet of things describes a vision where objects become part of internet: where every object is uniquely identified and access to the network. IOT communication is quite different from the traditional human to human communication, bringing a large challenge to existing telecommunication and infrastructure. Furthermore, IOT provides immediate information regarding access to physical objects with high efficiency. The concept of Internet of Things is very much helpful to achieve real time monitoring of sensor data. Internet of Things (IOT) is a kind of network technology, which is based on information sensing equipments such as RFID, infrared sensors, GPS, laser scanners, sensors and so on, can make anything join the Internet to exchange information, according to the protocol, which gives intelligent identification, location and tracking, monitoring and management.Cloud computing provides the access of applications as utilities, over the internet.. Cloud computing is a large scale processing unit which processes in run time and it is also a very low cost technology based on the IP. The application area of IOT includes building and home automation, smart city project, smart manufacturing of various products, wearables, health care systems and devices, automotive etc.

b) Zigbee Protocol:

The ZigBee specifications were introduced in December 2004 and the ZigBee network specification is one of the first standards for ad-hoc and sensor networks. Zigbee is developed by the Zigbee Alliance for personal-area networks (PANs). Zigbee Alliance is an association that promotes the Zigbee standard for a wireless network using low cost, low power consumption and low data rate connectivity devices. The Zigbee is an IEEE 802.15.4 based specification, which defines the Media Access Control (MAC) layer and physical layer for low-rate wireless personal-area network (LR-WPAN) that provide high-level communication for PANs. The Zigbee specification is an open standard that allows manufacturers to develop their own specific application which require low cost and low power. Zigbee adds network structure, routing, and security to complete the communication suite. A ZigBee network, is always created by the coordinator node. The coordinator controls the network and allocates a unique address to each device in the network, regardless of its topology. Zigbee devices use a mesh topology for sending data to the long distance. There is also another protocol available for wireless data communication such as Wi-Fi and Bluetooth. Zigbee is supposed to do what Wi-Fi or Bluetooth which do not provide both way communication between multiple devices over a simple network using very low power and at very low cost.

c) MICROCONTROLLER (ATmega16)

The ATmega16 provides the following features: 16K bytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 512 bytes EEPROM, 1K byte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary scan

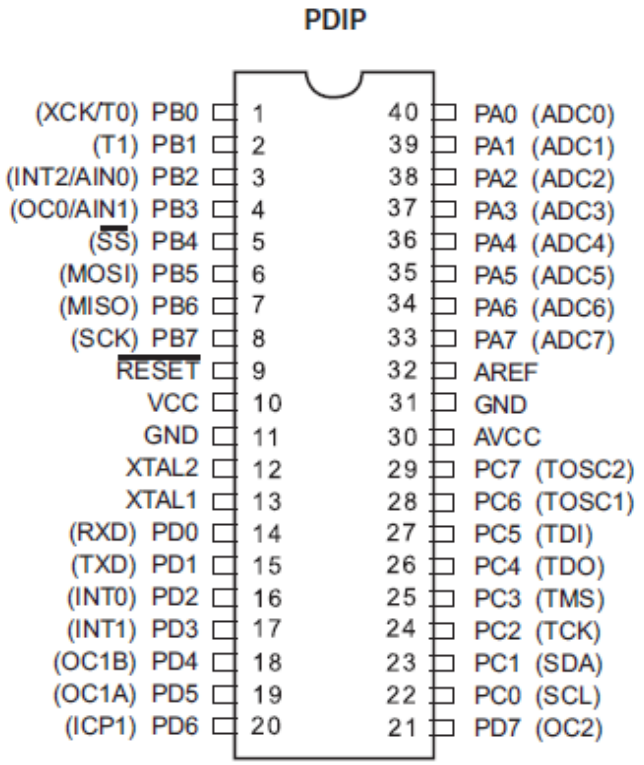

Figure.2

, On-chip Debugging support and programming, three flexible Timer/Counters with compare modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage withprogrammable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the USART, Two-wire interface, A/D Converter, SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next External Interrupt or Hardware Reset. In Power-save mode, the Asynchronous Timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except Asynchronous Timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. In Extended Standby mode, both the main Oscillator and the Asynchronous Timer continue to run. The device is manufactured using Atmel's high density nonvolatile memory technology. The Onchip
ISP Flash allows the program memory to be reprogrammed in-system through an SPI serial interface, by a conventional nonvolatile memory programmer, or by an On-chip Boot program running on the AVR core. The boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By
combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega16 is a powerful microcontroller that provides a highly-flexible and cost-effective solution to many embedded control applications.The pin diagram is shown in Figure.2

d) 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.A basic turbidity sensor is shown in Figure.3.

Figure.3

e) 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. The 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 sensor allows its universal use for temperature monitoring, control, and Switching in windings, bearings, machines, motors, transformers and many other industrial applicationsA temperature sensor for illustration is shown in Figure.4.

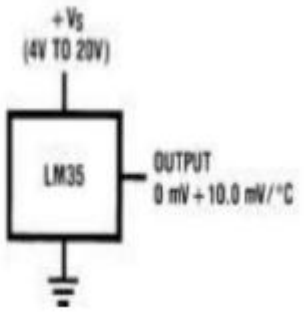

Figure.4

f) 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.

IV. CONCLUSION

The proposed paper elaborates on monitoring of Water Level, Turbidity, PH & Temperature of Water which makes use of water detection sensors with unique advantage of IOT environment. The proposed 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.

V. REFERENCES

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