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SMART WATER OVERSIGHT: IOT-BASED MONITORING SYSTEM

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ABSTRACT: Water quality varies by location and the extent of treatment. To test temperature, pH, and turbidity in the traditional manner, samples must be gathered by hand and submitted to a lab for analysis. However, it has proved unable to meet the demands of current water quality tracking. A tracking system was developed to monitor water temperature, pH, and turbidity. The system includes a monitoring center, a data gathering module with a single-chip microcontroller, an information transfer module, turbidity, pH, water level, and temperature sensors, and additional components. A single integrated circuit computer automatically measures the water's temperature, pH, and turbidity throughout the day. After receiving the data, the single chip processes and examines it. The data will be forwarded to a monitoring center, which will notify the public via an Internet of Things (IoT) system. The project successfully used modern data analysis methods, efficient information networking, and robotics to monitor the water's quality. Precision, efficiency, and the effective utilization of people and resources are just a few of the qualities that make it useful. When using alternative technologies, setting up and calibrating a large number of tracking sensors incurs significant costs. Our current technology works effectively in particular instances, but not in huge complicated systems. In the context of the Internet of Things, our research provides a low-cost solution to monitor water quality in real time. This solution addresses the issues that were previously mentioned.

KEYWORDS: IOT, Sensors, Microcontroller, Zigbee

I. INTRODUCTION

Because drinking water is so valuable and crucial to everyone, it is critical to continually monitor its quality. Scientists use temperature, pH, turbidity, conductivity, dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), ammonia nitrogen, nitrate, nitrite, phosphate, various metal ions, and other factors to assess water quality. The most typical method for determining these characteristics is to collect samples manually and then submit them to a lab for detection and analysis. There are various drawbacks to this method, such as the fact that it involves a lot of work and materials, generates a lot of waste, requires samples to be gathered, takes a long time to analyze, employs antiquated experimental equipment, and has other issues. A monitor is the most effective tool for identifying and resolving these issues. It can convert sensor signals into electrical impulses. The sensor has a number of wonderful qualities, such as high sensitivity, fast response times, a large selection, and ease of data transmission, adjustment, and management. Sensors' unique qualities and benefits have resulted in the construction and development of water temperature, pH, and turbidity monitoring systems. The central manager can analyze and measure the sensor data that has been collected. Finally, the Internet of Things (IoT) ecosystem and the Zigbee protocol allow sensor data to be viewed and accessed online. The microcontroller in the middle can link to several sensors at the same time.

II.BLOCK DIAGRAM

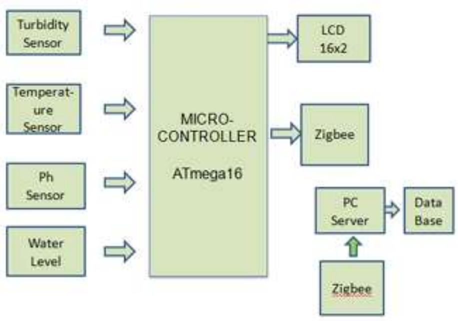


Figure.1

This section provides a detailed description of the proposed system's block diagram. In addition, a detailed explanation is provided for each block. Figure 1 shows a complete block schematic of the proposed system. The suggested block diagram depicts a large number of devices, each with its own sensor. The primary controller gets data from all connected devices via the Zigbee or IEEE 802.15 interface.4. Following a comprehensive inspection of the equipment, as seen in the image.1. The device is made up of multiple sensors that measure water quality variables like temperature, turbidity, pH, and water level. The sensor data is not properly prepared for transmission to the core controller over the Zigbee channel. In light of this, the suggested system includes a microcontroller capable of collecting data from sensors and performing operations on it in order to interact with the Zigbee module. Zigbee is an excellent candidate for sensor networking in the proposed system due to its large number of nodes, low power consumption, and delayed data rate. A Zigbee module consists of a router Zigbee, which is installed on each device and sends processed data to a coordinator Zigbee. Zigbee, the coordinator, gets data from other devices on the same network. The coordinator and router can connect to the same network by using the same PAN ID (Personal Area Network Identifier) for all Zigbee devices in the network. The PAN ID enables sensor networks to wirelessly transmit data. The primary controller, which monitors data from numerous sources, is linked to the Zigbee dispatcher. The core manager sends a text file with the data to the IOT module. The FTP protocol is used to configure a gateway on the core processor for data transmission to the Internet of Things. A more detailed description of the IOT module is provided. The suggested method uses cloud computing, which provides a single local computer, to remotely monitor processed data. Cloud computing assigns each item of data a unique IP address, allowing viewers from all over the world to access it via the internet. It comprises a browser application that uses the HTTP protocol to improve data monitoring and system usability. As a result, web applications make it easier to retrieve and manage data from anywhere on the earth.

III.WORKING PRINCIPLE

Significant indicators of water quality, such as pH, turbidity, and temperature, are all monitored by a large number of sensors in our proposed system. The microprocessor processes sensor data remotely and delivers the results to the core controller via the Zigbee IEEE 802.15.4 protocol. Figure 1 depicts an Internet of Things (IoT) module, which is part of the proposed system. This module gets processed data from the core processor and sends it to the cloud using the Zigbee protocol. It is possible to monitor data in transit using a web browser utility and a unique IP address. The Internet of Things ecosystem also allows us to provide you with the capacity to remotely access data from any location in the world.

INTERNET OF THINGS

In the last decade, the internet has radically affected the way people live. Several predictions predict that the internet of things will be one of the most significant advances in internet technology. The Internet of Things (IOT) is made up of networked devices that are spread across several places, some of which may be quite far apart. The term "Internet of Things" refers to network devices that may receive and process data from external sources and then transfer it online for further use and processing. The "internet of things" concept envisions a global interconnected system in which each object has its own unique identification and ways of connecting to the network. The nature of communication in the Internet of Things (IoT) differs dramatically from traditional human-to-human discourse, creating difficulties to current telecommunications systems and infrastructure. The Internet of Things (IoT) also delivers information about the accessibility of physical things in an effective and timely manner. The concept of the "Internet of Things" allows for real-time monitoring of sensor data. The Internet of Things (IoT) is a network that collects information via RFID, infrared sensors, GPS, laser scanners, and other similar devices. These devices connect a variety of things to the Internet and simplify data flow using a protocol that allows for intelligent monitoring, identification, and management. Cloud computing facilitates the use of apps as utilities over the internet. When applied on a broad scale as an IP-based real-time processing unit, cloud computing is an efficient and cost-effective technology. Intelligent buildings and dwellings, digital technology, healthcare systems and equipment, and automotive innovations are examples of objects that can be connected to the Internet of Things (IoT).

b) Zigbee Protocol:

The ZigBee network protocol, announced in December 2004, was one of the first to create standards for sensor and ad hoc networks. The Zigbee Alliance is in charge of developing the Zigbee personal area network (PAN) transmission protocol, as the name suggests. The Zigbee Alliance, a non-profit organization, supports the ZigBee wireless network standard. Zigbee networking devices are known for their low cost, limited bandwidth, and energy economy. The IEEE 802.15.4-based Zigbee protocol defines the physical and Media Access Control (MAC) layers for low-rate wireless personal-area networks (LR WPANs). At a higher level, these layers make communication between PANs easier. The Zigbee specification is an open standard, so developers can construct their own low-cost, low-power applications. Zigbee improves the communication suite by incorporating routing capabilities, security features, and network design. The leader node is responsible for establishing the ZigBee network. Regardless of network setup, the supervisor assigns each device a unique IP address and manages the network. Zigbee devices use mesh design to transport data across long distances. In addition to Wi-Fi and Bluetooth, there is another technology that can be used to transmit and receive data wirelessly. Zigbee is designed to replace Wi-Fi and Bluetooth since it is low-cost, energy-efficient, and can communicate with multiple devices over a simple network without requiring two-way communication.

c) MICROCONTROLLER (ATmega16)

It is possible to assert the following about the ATmega16: A JTAG port for border scanning is included, along with 16K bytes of Write-Once, Read-Aloud In-System Programmable Flash Program memory, which includes 32 general-purpose working registers, 32 general-purpose I/O lines, 512 bytes of EEPROM, and 1K bytes of SRAM.

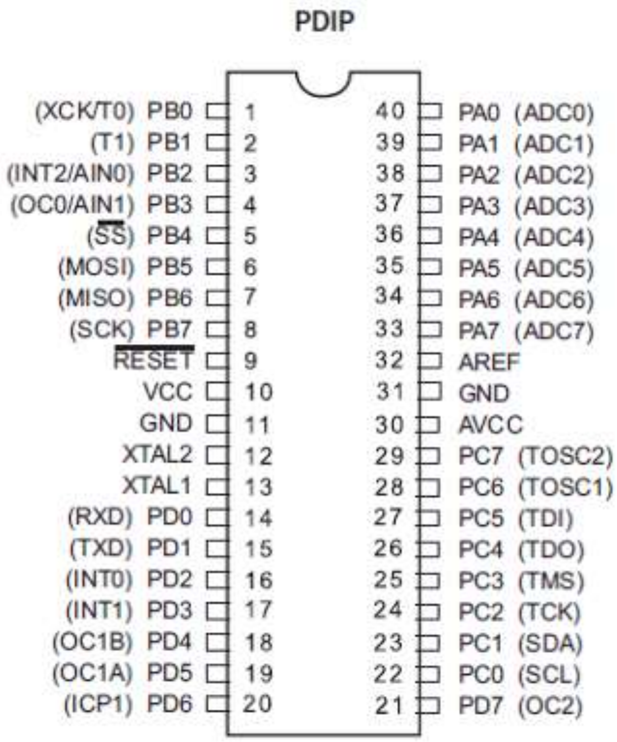


Figure.2

The TQFP programming and debugging package includes an SPI serial port, an 8-channel, 10-bit ADC with an optional differential input stage and programmable gain, three flexible timer/counters with compare modes, internal and external interrupts, a serial programmable USART, and a byte-oriented Two-wire Serial Interface. The software selects power-saving modes. When the CPU is not in use, the USART, two-wire interface, A/D converter, SRAM, timer/counters, SPI port, interrupt system, and SRAM remain operational. During power-down mode, the CPU remains idle save for hardware reset and external interrupt. In this mode, the register values stay unaltered, but the oscillator is turned off. The Asynchronous Timer can be used in Power-save mode to track time while the rest of the device is inactive. Activating the ADC Noise Reduction mode reduces switching noise generated during ADC adjustments. This state disables all I/O modules except the Asynchronous Timer and ADC. Similarly, the CPU is deactivated. The crystal/resonator oscillator is in dormant mode, with the rest of the device remaining inactive. This causes the computer to start up quickly and consume less energy. While the device is in Extended Standby mode, the Asynchronous Timer and main frequency continue to operate simultaneously. The gadget was manufactured using Atmel's high density nonvolatile memory technology. A nonvolatile memory programmer, an On-chip Boot application that runs on the AVR core, or an SPI serial link can all be used to reprogram the program memory while the chip is in operation. The launch software can get an application program from the Application Flash memory via any interface. The Boot Flash component's software has actual Read-While-Write capabilities, allowing it to continue running while the Application Flash section is being updated. The Atmel ATmega16 microcontroller, built from a single semiconductor, is a powerful device with an 8-bit RISC CPU and In-System Self Programmable Flash. As a result, it provides a flexible and cost-effective solution for a wide range of embedded control applications. The pin configuration is shown in Figure 2.

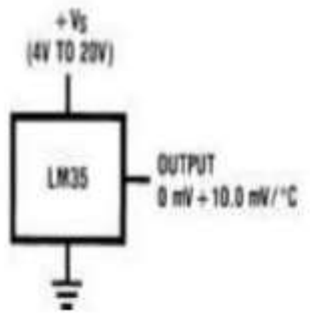
d) TURBIDITY SENSOR

The term "turbidity" refers to the degree of cloudiness in water. Turbidity in water is caused by plankton, which includes both terrestrial and aquatic bacteria, as well as suspended solids, which are primarily made up of soil particles. Moderately low turbidity levels may suggest a healthy and functional habitat with enough plankton to support the food chain. High turbidity levels, on the other hand, present a number of challenges to stream ecosystems. Turbidity reduces the amount of light available for aquatic vegetation growth. Furthermore, the presence of particles on the surface of the water aids in the absorption of solar energy. This causes the surface temperature of the water to rise over its normal range. Figure 3 illustrates a rudimentary turbidity monitor.

Figure.3

e) TEMPERATURE SENSOR

Water temperature influences the biological diversity of aquatic animals by regulating the rate of metabolic processes, the extent of reproduction, and, ultimately, the lifetime of creatures. Significant changes in stream temperatures have the ability to stymie or stop metabolic processes. There are several factors that can influence the stream's temperature. The water temperature of tiny streams might vary by the hour, week, or even seasons. The convergence of stream vegetation and spring water forms a cover that protects the water from sun radiation and reduces the effects of temperature changes. People use the sensor in areas where accurate temperature monitoring is required to avoid measurement errors. The resistor's direct temperature dependence makes it suitable for a wide range of mechanical applications. Due to its great precision, the sensor can be used in a wide range of industrial applications, including rollers, tools, motors, transformers, temperature control, and switching. Figure 4 illustrates the operation of a temperature monitor.



f) PH SENSOR

One of the most important chemical boundaries for aquatic life is pH. Overly basic or acidic water can injure or kill stream species by interfering with marine life' metabolic activities. This is related to the nature of H+ and OH- ions in water. On a scale of 1 to 14, pH levels range from acidic to basic. A solution is acidic if its pH is less than 7, suggesting that the concentration of H+ ions exceeds that of OH- ions. A solution is characterized as basic if its pH exceeds 7, suggesting that there are more OH- ions than H+ ions. As one moves along the logarithmic pH scale, values change by a factor of a hundred. A one-unit change in pH represents a tenfold increase or decrease in acidity or alkalinity, respectively. Streams often have a pH between 6 and 9. The concentrations of dissolved elements originating from minerals, soils, and other components within the watershed have an impact on these levels.

IV. CONCLUSION

This article describes in great depth how water detection sensors can be used to assess water level, turbidity, pH, and temperature, which is extremely useful in an Internet of Things (IoT) scenario. The proposed technology is less expensive, does not require human supervision, and can independently monitor water quality. As a result, water quality testing should be faster, easier, and less expensive. The approach can be applied in a variety of ways. This approach is only intended to monitor new water quality measurements. This can be accomplished by selecting the appropriate program and replacing the sensors. Following through on the procedure is simple. The system can be expanded to monitor water levels, air pollution, industrial and agricultural output, and other factors. Its growth can be employed for a variety of purposes.

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