International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

IoT Based Real Time Water Quality Monitoring System

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Abstract:

Internet of Things (IoT) had emerged as a technology critical for environmental applications. Water is a natural resource and is the basic need for living things. In the current world, there is a scarcity of water due to overpopulation and also contamination of water resources. It is very crucial to save our drinking water for current and future generations. IoT based smart water quality monitoring system is proposed to monitor the quality of water. Different sensors are used to monitor various parameters like pH value, turbidity in the water. The microcontroller unit is interfaced with the sensors to process the data and GSM is used to send information to the monitoring center for further actions to be performed. Results proved that the quality of the water is verified and SMS is sent to a higher authority.

Keywords:

1.Arduino IDE program software. 2.Development board Arduino uno 3.Communication devices.

4. Sensors.

5. Watering devices.

l. Introduction:

The introduction of a real-time water quality monitoring system is a groundbreaking development that has the potential to revolutionize the way we manage and protect our precious water resources. In recent years, the importance of monitoring water quality has become increasingly evident, as the world grapples with the challenges of climate change, population growth, and environmental degradation. Water is a vital component of our ecosystem, and its quality has a direct impact on human health, the environment, and the economy. However, water pollution remains a significant problem worldwide, with millions of people lacking access to safe and clean drinking water. The consequences of water pollution are far-reaching, ranging from the spread of waterborne diseases to the degradation of aquatic ecosystems and the loss of biodiversity. Traditional methods of water quality monitoring, which involve

collecting and analyzing water samples in a laboratory, are time-consuming and often provide delayed results. This can lead to a lag in response time, allowing pollution to spread and causing further damage to the environment. In contrast, a real-time water quality monitoring system provides instantaneous data on water quality parameters, enabling swift action to be taken to prevent or mitigate pollution. A real-time water quality monitoring system typically consists of a network of sensors and monitoring equipment that are deployed in the water body to collect data on various water quality parameters, such as pH, temperature, turbidity, and levels of pollutants like bacteria, nutrients, and heavy metals. The data collected by these sensors is transmitted in real-time to a central server, where it is analyzed and interpreted using advanced software and algorithms.

COMPNENTS OF REAL TIME WATER QUALITY MONITORING SYSTEM

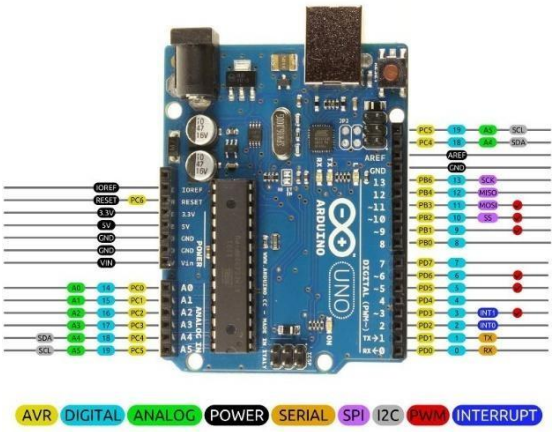
1)Arduino IDE program software: Arduino IDE is an open-source software platform used for programming Arduino microcontroller boards.

Arduino IDE is a user-friendly integrated development environment.

1. It simplifies programming for Arduino boards using C/C++.
2. It offers a code editor with syntax highlighting and auto completion.
3. Libraries and examples are included to facilitate code development.
4. A simple interface uploads code to the connected Arduino hardware.
5. It supports various Arduino board models and compatible hardware.
6. Serial monitoring tools assist in debugging and data exchange.

1. Arduino IDE is free and available for Windows, macOS, and Linux.

2. Development board Arduino UNO :



Connectivity

Sensor Data Collection: The pH sensor determines if the water is acidic or basic.The turbidity sensor detects suspended particles in water. The temperature sensor monitors water temperature variations.

Data Processing: Arduino reads analog signals from the sensors. It converts the signals into meaningful values (e.g., pH level, NTU for turbidity).

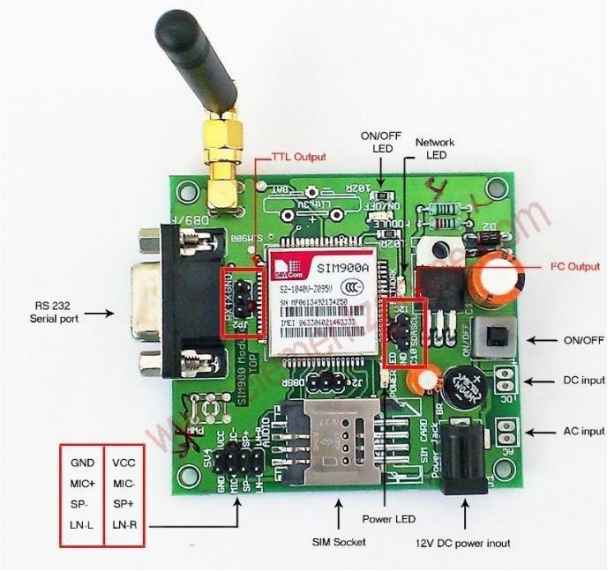
Real-Time Display & Control: The processed values are displayed on an LCD/OLED screen. If the water quality

exceeds a set threshold, Arduino can trigger a relay to turn on a DC submersible motor for corrective action (e.g., filtration).

Wireless Data Transmission: Using ESP8266 WiFi module, data is sent to the cloud (Blynk, Thingspeak, Firebase, etc.) If using a GSM module, SMS alerts can be sent when parameters exceed limits.

Remote Monitoring & Alerts: Users can monitor real-time data on their mobile or web dashboard. Alerts and notifications can be set for abnormal water conditions.

3. Communication devices:



Data Communication: The Arduino uno connects to a GSM module, typically via UART communication. The GSM module has a SIM card for cellular data access.

Internet Connectivity: Once connected, the Arduino uno can access the internet through the GSM module. It can send and receive data from a central server or cloud platform for real-time monitoring and control.

Remote Control: Smart irrigation systems can be controlled remotely via SMS or through a web interface hosted by the Arduino uno. Users can change irrigation schedules, turn the system on or off, or receive system status updates.

Data Logging: The Arduino uno can log sensor data and upload it to a central server for historical analysis and decision- making. This data may include soil moisture levels, weather forecasts, and irrigation schedules.

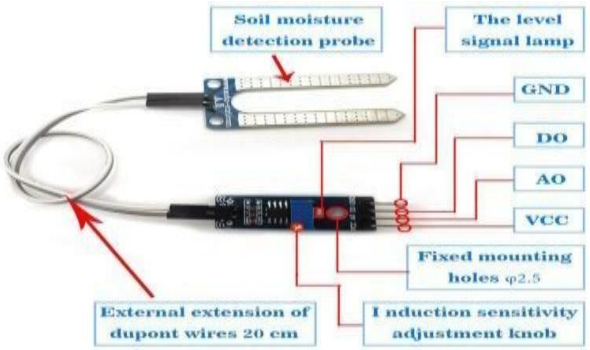
Notifications: The system can send SMS or push notifications to users for alerts, such as low soil moisture or system malfunctions. Users can be informed of important events in real-time.

Energy Efficiency: To conserve power in remote areas, the Arduino uno and GSM module can be configured to enter sleep mode when not in use, reducing energy consumption.

Scalability: GSM connectivity makes water quality monitoring systems more versatile and suitable for remote locations where Wi-Fi or wired internet access is not available. We can control and monitor the water quality monitoring system using GSM from all over the India.

4. SENSORS:

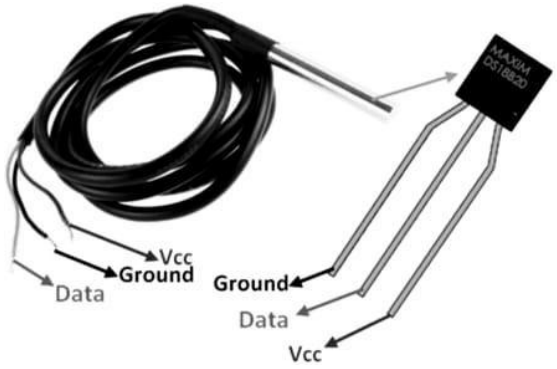
- SOIL MOISTURE SENSOR:



Soil moisture sensor using a measuring moisture level and get moisture level like a Dry or wet, normal.Dry: (520 430], Wet:

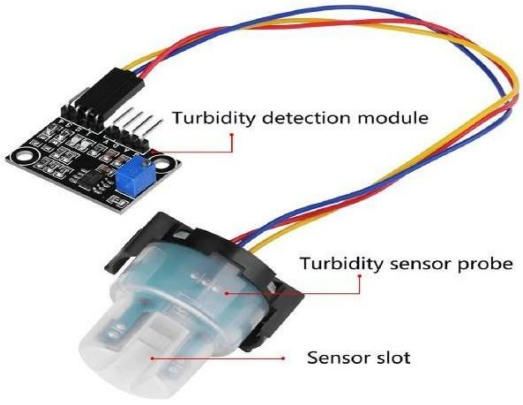
(430 350],Water: (350 260] .Peak value of sensor 1024. It commonly uses in Smart farming.

- TEMPERTURE SENSOR



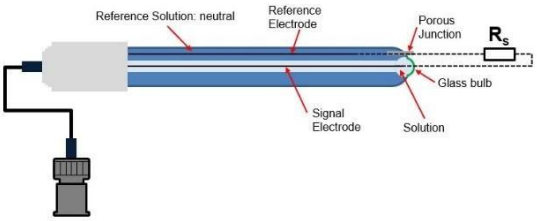
As this is a 1-wire digital temperature sensor, it needs only the data pin and GND pin to interface with the Arduino or microcontroller. The temperature sensing of the sensor ranges from -55°C to +125°C with an accuracy of ±5°C. It is the best temperature sensor to measure the temperature value at multiple points and requires only one data/digital pin of the Arduino or microcontroller unit to transfer the data.

TURBIDITY SENSOR



A turbidity sensor is an analytical sensor that measures turbidity. They are highly useful and effective instruments to identify the clarity and particle content in a solution, like water. Turbidity sensors are used to reduce waste, improve yields, and analyze water quality in a wide range of industries.

It commonly uses in water testing. PH SENSOR



A pH sensor measures the acidity or alkalinity (pH) of a solution by detecting the concentration of hydrogen ions using a glass electrode, a reference electrode, and a pH meter, displaying the pH value on a scale of 0 to 14.

pH is a measure of the acidity or alkalinity of a solution, ranging from 0 to 14, with 7 being neutral. Values below 7 indicate acidity, and values above 7 indicate alkalinity.

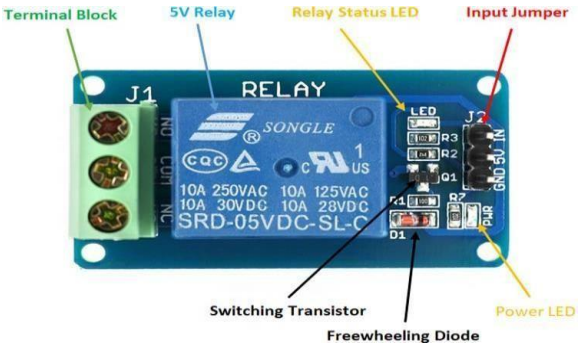
5. Devices:

Water pump:

A water pump in a smart irrigation system is essential for efficiently delivering water to crops. It is controlled by sensors and automation technology to provide the right amount of water at the right time, conserving resources and optimizing plant growth. The system can adjust pump operations based on weather forecasts and soil moisture levels. This smart approach helps reduce water wastage and improve crop yields. ESP8266 controlled the motor

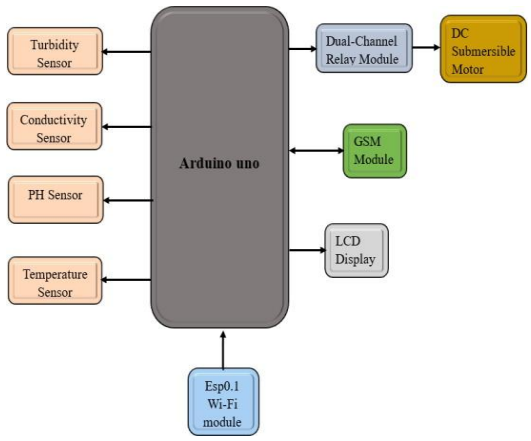
and send the status of motor conditions with the support GSM.

Single relay channel:

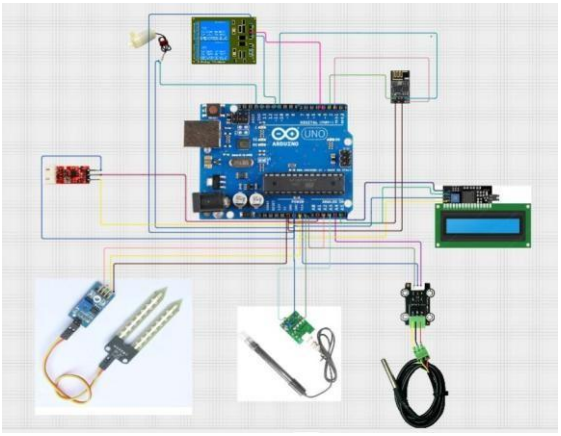


A relay channel in a smart irrigation system controls a water pump. It serves as a switch that can be remotely operated to start or stop the pump, allowing for efficient and automated irrigation. This technology enables precise control over water distribution in agricultural fields, conserving resources and optimizing crop growth.

BLOCK DIAGRAM:



Circuit Diagram:



Connections:

1. Sensors: Soil moisture sensors, Turbidity sensor, ph sensor, temperature sensor connected Arduino to the system to gather data about soil conditions

2. Control Unit: A central control unit or controller Arduino uno, GSM often connected to the internet, processes the sensor data and controls irrigation schedules.

3. Valves: Solenoid valves are used to control the flow of water to different zones. These valves can be connected to the control unit for remote operation.

4. Pumps: In some cases, water pumps are integrated into the system to ensure adequate water pressure for irrigation.

5. Communication: The system may use Wi-Fi, GSM, cellular, or other communication methods to connect to the internet, allowing remote control and monitoring via smartphone apps or web interfaces.

6. Mobile Apps: Users can connect to the system through mobile apps like GSM sends notification to monitor the system, adjust settings, and receive alerts.

Conclusion:

The real-time IoT-based water quality monitoring system provides an efficient and cost-effective solution for continuously tracking key water parameters such as temperature, pH, turbidity, and conductivity. By integrating Arduino Uno, ESP8266 (ESP-01), and multiple sensors, the system ensures real- time data collection, local display on an LCD, and remote monitoring via Blynk Cloud. This allows users to access water quality data from anywhere, enabling quick responses to contamination or irregularities. The system's scalability makes it suitable for applications in households, agriculture, aquaculture, and industrial water management. Future improvements, such as machine learning for predictive analysis and additional sensors for detecting more contaminants, can further enhance its reliability and effectiveness in ensuring safe water quality.

References:

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2. J.Smith, Johnson, Williams Development of an IoT-based water quality monitoring system Int. J. Environ. Sci. Technol., 17 (6) (2020), pp. 3057-3068