Real Time smart water management system using IOT

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***Abstract*—Water quality monitoring plays a significant role in the transition towards intelligent and smart agriculture. As new technologies are continuously developed and adopted in agricultural and daily human life, there is a need for reliable models with accurate and thorough datasets. In this review article, the authors analyze water quality monitoring models that utilize sensors gathering water properties during live experiments. The goal is to convey conclusions regarding concerns, issues, difficulties, and research gaps that have existed over the past five years (2018–2022). The study explores real-time automated IoT-based systems for water quality monitoring, including pH, temperature, ammonia, and nitrate levels.These systems enable aquaponics farmers to monitor water quality effectively.**

Keywords— Ultrasonic sensor, Temperature sensor, Water flow sensor, ESP8266 WI-FI module, SIM 900 GSM module

I. INTRODUCTION

In recent years, the world has faced significant challenges regarding water scarcity, pollution, and inefficient water management systems. The burgeoning global population, rapid urbanization, and climate change have exacerbated these issues, necessitating innovative solutions to ensure sustainable water resource utilization. In response to these challenges, The incorporation of Internet of Things (IoT) technology into water management systems represents a compelling strategy to improve efficiency, track usage trends, and minimize wastage in real-time.

The convergence of IoT and water management has opened avenues for the creation of smart systems with the ability to monitoring, analyzing, and controlling various aspects of water distribution, consumption, and treatment.

These systems leverage a network of interconnected sensors, actuators, and data processing units to collect, transmit, and analyze data related to water quality, quantity, and distribution infrastructure. By harnessing the power of IoT technology, stakeholders in water management, including municipalities, industries, and agricultural sectors, can gain valuable insights into water usage patterns, identify leaks or inefficiencies, and optimize resource allocation in real-time. Moreover, the paper will discuss the emerging trends and future directions in the field of IoT-enabled water management, including advancements in sensor technology, data analytics algorithms, and integration with other city.

Water is a fundamental necessity for human survival on our planet. All living organisms heavily rely on water for their existence. With the increase in water consumption due to population growth, concerns about water scarcity have escalated. Beyond the shortage of freshwater for drinking purposes, there are also growing worries about water scarcity in agricultural contexts. To address these challenges, effective water management is crucial. Real-time monitoring of water mobility plays a key role in achieving this. By continuously tracking water volume, we can closely monitor its movement and usage. Such a system can even detect water leaks within a smart home by analyzing water levels at different times of the day. This is essential for the well-being of our planet. One of the main reasons for the slow adoption of this system has been its high cost. However, with the advent of IoT (Internet of Things) for smart cities, the cost has significantly decreased. IoT involves a network of interconnected devices capable of transmitting data. Efforts are underway to measure and assess water quality, focusing on parameters such as pH, conductivity, dissolved oxygen, temperature, biochemical oxygen demand, and total dissolved solids (TDS).

Furthermore, the paper will delve into case studies and practical implementations of IoT-based water management solutions from various contexts around the globe. By analyzing these real-world examples, we aim to highlight the efficacy of IoT technology in addressing water management challenges and fostering sustainable practices. Overall, This research paper aims to enhance the current understanding of IoT applications in water management. It provides valuable insights that can guide policymakers, urban planners, and industry stakeholders as they work toward creating robust and efficient water systems for the future.

II. RELATED WORKS

Numerous researchers are actively exploring the realm of IoT and its practical applications. Among these applications, Smart Water Management stands out. Scientists and engineers are developing systems that can monitor water levels in tanks, track water usage, and ensure water quality. These systems incorporate various sensors, including turbidity sensors, pH sensors, and salt sensors within water tanks. By analyzing data from these sensors, they can detect contamination, assess alkalinity, and identify harmful salts that may pose health risks to living organisms. Additionally, another IoT-based system has been proposed for detecting and displaying water levels in storage tanks, facilitating efficient water management and planning .

The system proposed by Divyapriya et al. involves continuously monitoring the water level in water systems such as overhead tanks using IoT technology. In their approach,The user can communicate with the system to retrieve information about the water level in the tank. This functionality is enabled by integrating ultrasonic sensors and GSM technology, allowing effective control over water levels.

Conversely, Kumar and colleagues developed an IoT-driven water management system tailored for campus environments, emphasizing real-time monitoring. Their solution incorporates an HC-SR04 ultrasonic sensor positioned atop the water tank. This sensor emits 40kHz ultrasound pulses directed at the water surface and precisely calculates the water level by analyzing the reflected waves.

Both approaches leverage ultrasonic sensors to monitor water levels, but they may differ in the specifics of implementation, such as sensor placement, communication protocols, and data processing methods. The use of GSM technology in Divyapriya et al.'s system enables remote monitoring and control, allowing users to access water level information from anywhere using their mobile devices. Conversely, Kumar et al.'s system focuses on real-time monitoring within a campus setting, possibly emphasizing local data processing and feedback mechanisms..

In summary, these studies highlight the versatility of IoT technology in addressing water management challenges and demonstrate the potential for Enabling real-time monitoring and management of water resources through cutting-edge sensor technologies.

III. EXISTING SYSTEMS

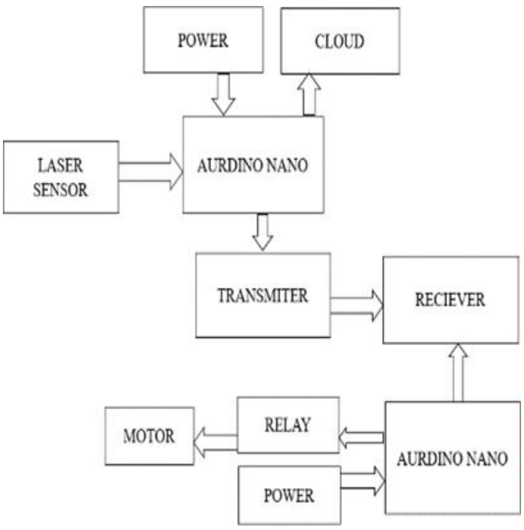

Fig.1: Block diagram of existing model

This system is designed for water level detection and automatic control of water tank motors. Utilizing IoT technology, the data is uploaded to the Adafruit platform. A laser sensor is positioned above the tank to monitor the water level. When the water level drops below a predefined threshold, the motor is automatically activated.

IV. PROPOSED SYSTEM

In the proposed system the following parameters can be

- The ultrasonic sensor measures the water level in the tank, helping prevent water overflow.
- The water usage from the tank can help regulate water conservation and prevent wastage.
- To monitor the real-time temperature inside the water tank.

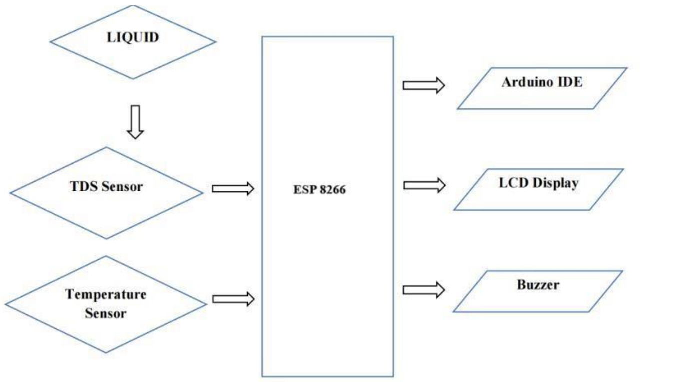

Fig. 2: Block Diagram of Proposed System

The Arduino UNO features convenient power management and built-in voltage regulation. It can be powered directly via USB or an external power supply.

The external power source can be supplied via

- Supplying power to the DC power jack using a 7-12V DC source.
- Linking a battery lead to the Vin (voltage input) and Gnd (ground) pins.

The 5V and 3.3V power supplies are utilized to energize sensors and modules during their connection. For temperature sensing, the LM35IC temperature sensor is employed. This integrated circuit sensor provides an electrical output directly proportional to the measured temperature. Compared to a thermistor, the LM35IC offers more accurate temperature measurements. Additionally, the sensor circuitry is sealed, making it resistant to oxidation and other environmental factors. With its three-terminal design, this sensor can accurately measure ambient temperatures within the range of -55°C to 150°C.

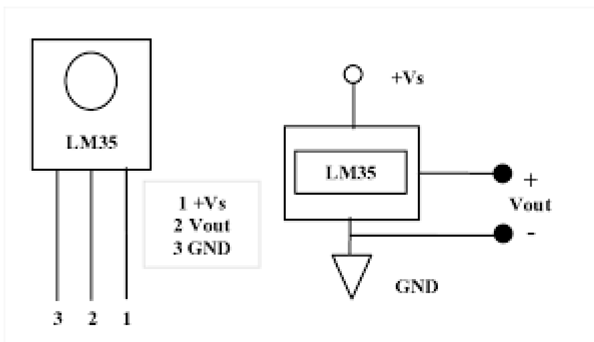

Fig. 3: temperature sensor

Water flow sensors are typically installed at water sources or within pipes to measure the flow rate of water and calculate the total volume passing through the pipe. Flow rates are usually measured in liters per hour or cubic meters. These sensors consist of a plastic valve through which water can flow. Inside the sensor, a water rotor is coupled with a Hall effect sensor. The fundamental working principle of this sensor relies on the Hall effect. As the rotor rotates due to water flow, it induces a voltage difference in the conductor. This induced voltage is perpendicular to the electric current, allowing the sensor to accurately measure water flow.

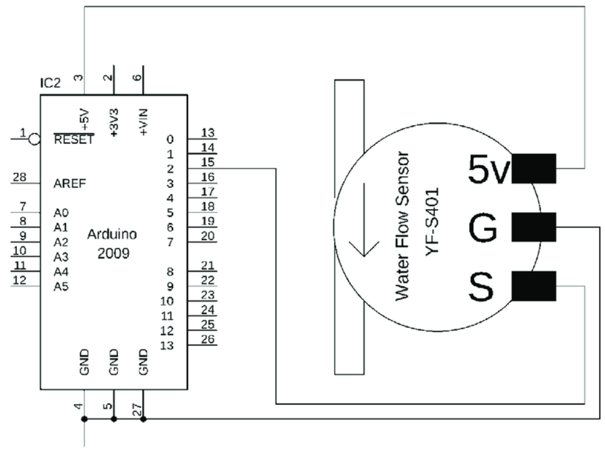

Fig. 4: water flow sensor

The HC-SR04 ultrasonic module is designed for non-contact distance measurement within a range of 2cm to 400cm, with impressive ranging accuracy down to 3mm. It operates based on the principle of echolocation. The sensor has both trigger and echo pins. When the Arduino sends a high signal (lasting 10 microseconds) to the trigger pin, the sensor emits an 840kHz ultrasonic wave toward the water surface. Upon reaching the water, the wave reflects back to the sensor, and the Arduino calculates the time elapsed between triggering and receiving the echo. This time measurement allows precise determination of the water level.

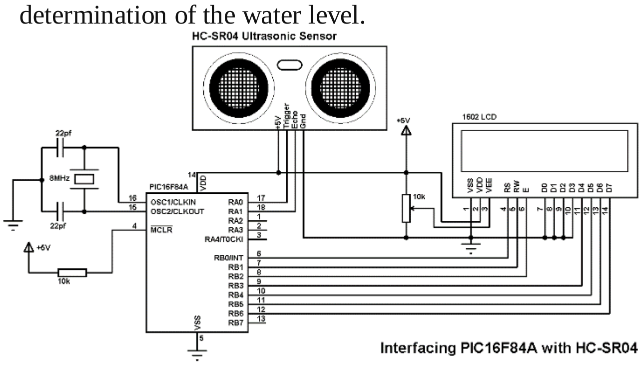

Fig. 5: Ultrasonic sensor

The Arduino Uno serves as the microcontroller in this setup, equipped with 14 advanced input/output pins. Of these pins, 6 are utilized for interfacing with sensors—specifically, water flow, ultrasonic, and temperature sensors. Additionally, the system integrates the ESP8266 Wi-Fi module with the Arduino, creating an electronic network. The Arduino board itself is based on the Atmega328p microcontroller, featuring a 16 MHz quartz crystal, USB connectivity, a power jack, and a reset button.

The ESP8266 can serve either by offloading Wi-Fi networking functions from another application processor or by directly hosting an application. As a Wi-Fi module, the ESP8266 acts as a standalone system-on-a-chip (SoC) with an integrated TCP/IP protocol stack. It allows any microcontroller to connect to Wi-Fi networks. Thanks to its powerful processing capabilities and ample memory, it can seamlessly interface with various sensors.

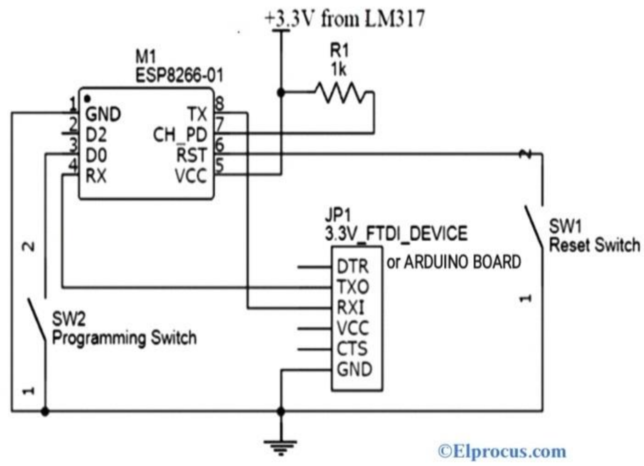

Fig. 7:ESP 8266 WI-FI module

The SIM900 is a quad-band GSM/GPRS solution available as a surface-mount technology (SMT) module that can be seamlessly integrated into customer applications. With an industry-standard interface, the SIM900 provides GSM/GPRS performance across the 850/900/1800/1900MHz bands, supporting voice, SMS, and data communication while maintaining low power consumption.

V. RESULTS

Deploying an IoT-based real-time smart water management system leads to optimized water utilization , improved quality control, reduced wastage through leak detection, cost savings, and environmental conservation. This system optimizes operations, ensures safe water supply, and empowers data-driven decision-making for sustainable water resource management, benefiting public health, finances, and environmental sustainability

S.no.	Type of water	TDS	Temperature	Volume
1.	RO Water	150	25C	5
2.	Underground Water	400	13C	15
3.	Sullage Water	270	27C	7

VI. CONCLUSIONS

This system's design gains autonomy through rapid data transmission using IoT. The key advantage of IoT lies in its ability to send data even when clients are not directly connected to the network. When a client eventually connects to the node, they can access the previously transmitted data.

Implementing smart water management can significantly reduce water overflow in tanks and provide real-time monitoring of water usage in liters per hour. This cost-effective system promotes efficient water utilization, thereby minimizing water wastage. Additionally, the project's impact can be further enhanced by leveraging the results obtained from the current implementation.In this system, a turbidity sensor is placed inside the water tank to assess water quality. This information helps identify any chemicals present in the water. Furthermore, a pH sensor is also installed in the tank to determine whether the water is suitable for consumption by living beings. The integration of IoT technology enables real-time monitoring and decision-making.

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