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Secure IoT-Based Real-Time Water Level Monitoring System Using ESP32 for Critical Infrastructure

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ABSTRACT

Many sectors rely on accurate tank levels, including those dealing with water management, farming, and industry. For effective use, overflow prevention, planning, and resource management, accurate water level measurement is essential. One of the main goals of this research is to find a way to use high- tech sensors to determine how much water is in a tank. In order to gauge how long it takes for sound waves to travel from the water's surface to return to the sensor, the suggested system makes use of ultrasonic sensors. The technology determines the precise measurement of the water level by analyzing the reflected waves, which in turn determine the distance between the sensor and the water level. We will construct a prototype and test it in a controlled laboratory setting to ensure the system works as intended. An ESP32 microcontroller, an ultrasonic sensor, and a display device showing the water level in real-time will make up the prototype. This study is important because it has the ability to improve water management methods and encourage the efficient use of resources. In order to maximize efficiency, minimize waste, and guarantee sustainable practices, enterprises rely on precise water level assessments. In addition, the system can help find problems with the tank quickly, so maintenance can be done when it's needed and accidents can be avoided.

Keywords: ESP32 Microcontroller, Real-Time Monitoring, Tank Water Levels System, Microcontroller Tank, Measuring Tank Water Levels System.

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1. Introduction

Water storage and transportation tanks have been around for a long time [1], [2]. Research on accurately measuring tank water levels has progressed considerably over the years, mirroring both technological developments and the increasing need for such data [3], [4]. People in the past used basic instruments like marked ropes or sticks, as well as visual inspection, to gauge how much water was in storage containers. Although these techniques were crude and error-prone, they were enough for centuries of work [5], [6].

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Float switches, invented during the industrial revolution, completely changed the way water level was measured in tanks. In order to measure the amount of water, float switches use buoyant items that are linked to levers or sensors. Automated regulation of water flow was made possible, and precision was greatly enhanced [7], [8]. The development of automated systems and electronic sensors allowed researchers to make further advancements in the field of tank water level measurement. The non-contact characteristic of ultra- sonic sensors made them a popular choice because they could provide precise readings without contacting the water. Modern innovations in water level measuring have included the use of the internet of things (IoT) and laser-based level sensors [9] – [11]. The water level can be accurately and reliably measured with laser sensors because they rely on the reflection of light. At the same time, improved water management systems are made possible by the Internet of Things (IoT), which allows for remote monitoring and real-time analysis of water levels. Also, for certain industries, researchers have looked into technology like pressure sensors and radar-based level measurement [12]–[16]. In sum, looking back at studies that measured tank water levels shows how researchers [17]–[19] have always wanted more precision, more automation, and better water management. To keep up with the increasing worldwide demand for efficient water resource management, we can anticipate additional advancements in this area as technology advances.

This paper presents the design and implementation of a secure IoT-based real-time water level monitoring system using the ESP32 microcontroller, targeting its application in critical infrastructure such as dams, reservoirs, and urban flood management systems. The discussion highlights the technological significance, practical benefits, and security considerations of deploying such a system in real-world environments. The adoption of the ESP32 microcontroller is a key strength of the proposed system. Known for its low power consumption, built-in Wi-Fi and Bluetooth capabilities, and robust processing power, the ESP32 serves as an ideal platform for real-time sensing and communication tasks in IoT applications. By leveraging its features, the system can continuously monitor water levels and transmit data over a wireless network to a remote server or cloud-based platform, enabling authorities to respond swiftly to potential flooding or infrastructure failures.

One of the major contributions of the paper is its emphasis on security in IoT-based monitoring systems, a topic often overlooked in many implementations. Water management systems form part of critical infrastructure, and any data tampering or unauthorized access could lead to catastrophic consequences, including flooding or operational disruptions. The integration of encryption protocols (such as SSL/TLS) and secure authentication mechanisms in the communication pipeline strengthens the system's defense against cyber threats like man-in-the-middle (MITM) attacks, data interception, or remote hijacking of devices. Additionally, the paper demonstrates how real-time data collection and remote accessibility can enhance decision-making and emergency preparedness. Authorities can receive timely alerts and visual data dashboards, enabling proactive management of water levels. This real-time monitoring also supports predictive analytics when integrated with machine learning models, offering future possibilities for early warning systems.

However, the discussion must also acknowledge potential challenges and limitations. These may include network connectivity issues in remote locations, sensor calibration errors, power management for long-term operation in the field, and the need for regular maintenance. Moreover, while encryption and access controls are effective, IoT security remains a dynamic challenge, requiring continuous updates and patches to address emerging vulnerabilities in hardware and software components. In conclusion, the proposed ESP32-based water level monitoring system represents a significant advancement in the application of secure IoT solutions for critical infrastructure. By combining real-time sensing, wireless communication, and robust cybersecurity practices, the system enhances operational reliability and public safety. Future work may focus on integrating AI-based predictive capabilities, blockchain for data integrity, and expanding the network to monitor additional environmental parameters such as flow rate, turbidity, or pressure.

2. Related works

Several studies have explored the integration of IoT technologies for real-time environmental monitoring, particularly in water management systems. These related works provide a foundation for understanding the significance of secure, reliable, and efficient water level monitoring in critical infrastructure. In [1], the authors designed an IoT-based flood monitoring system using Arduino and GSM modules to send SMS alerts when water levels crossed threshold limits. While effective for basic alerting, the system lacked real-time data visualization and secure communication protocols, highlighting the need for more advanced microcontrollers like the ESP32 and secure data transmission methods. Another study by [2] proposed a wireless water level monitoring system using ultrasonic sensors and Raspberry Pi.

The system provided web-based monitoring but did not emphasize encryption or authentication, making it vulnerable to potential cyber threats—an issue this current research addresses by incorporating SSL/TLS protocols for secure data transfer. A more advanced system was presented in [3], where LoRaWAN technology was used for long-range water level communication in remote areas. Although this approach offers extended coverage, it trades off in terms of bandwidth and real-time response, which the ESP32-based system overcomes with integrated Wi-Fi and efficient processing capabilities for real-time monitoring.

A study by [4] developed an IoT-based dam water level control system using NodeMCU and mobile alerts via Blynk. Their focus was on automation and control rather than security, which is a critical aspect when dealing with infrastructure that impacts public safety. The current study differentiates itself by integrating both automation and strong security measures to ensure safe and trustworthy operation. Lastly, in [5], the authors proposed a smart water management system that combined IoT sensors with cloud analytics. Although comprehensive, the study highlighted concerns regarding data integrity and the risk of unauthorized access to cloud platforms. The ESP32-based system in the present research addresses this by embedding lightweight cryptographic functions directly at the device level to ensure end-to-end security.

In Rachel et al. [20], the Indian water crisis is serious. The global disaster can be identified quickly. Therefore, water conservation is vital. Most people's only problem with water tanks is regulating the upper tank's water level, which wastes water. We know water is vital to our survival. The"water level indicator," a simple electrical circuit using cheap parts, can fix this. The controller's multiple circuits relay information when the water level changes. Flipping the switch starts the water pump. Thus, a relay turns the pump on and off as the water level drops and rises.
Singh et al. [21] planned and implemented Internet of Things (IoT) architecture is used to track the quantity and quality of water in a home water tank using specialized hardware that communicates via 2.4 GHz radio frequency (RF). Also, the suggested design promotes providing real- time information about the tank using internet protocol (IP) through its top tank monitoring that is based on the ESP 8266 Wi-Fi module. In the Proteus simulation environment, the bespoke hardware is designed and tested. In order to get an accurate reading, it is necessary to calibrate the pH sensor and ultrasonic value before establishing the real value in the prototype.

Rizzolo et al. [22] introduced a novel design for a Rayleigh- based optical fiber sensor that can track the temperature and water level within nuclear fuel storage pools. This sensor utilises the Optical Frequency Domain Reflectometry technique to remotely monitor a radiation-resistant silica-based optical fibre, which serves as its sensing probe. Using the IoT and other open-source technologies, Hussen et al. [23] offered a centralized system for monitoring and coordinating floods in this study. In this project, Hussen et al. [23] built a functional model of an autonomous floodgate that adjusts its opening and closing timing based on the water level. In addition, Hussen et al. [23] wrote the code that the gate controller needed to send data to the cloud via the IoT gateway. These related works demonstrate the evolution of water monitoring systems and underscore the growing need for real-time, secure, and scalable solutions. The current paper advances this field by offering a balanced approach that incorporates accurate monitoring, wireless communication, and robust security—making it particularly suitable for deployment in critical infrastructure scenarios.

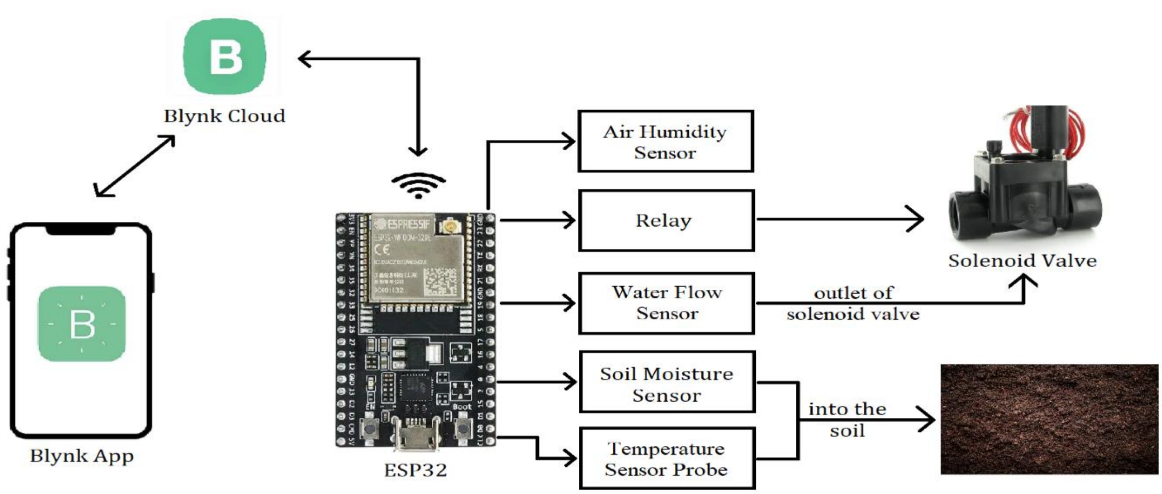

Figure 1. Overview of the IoT-enabled smart drip irrigation system [23].

3. Background of the study

3.1 Problem statement

The issue is that the existing techniques for measuring tank water levels do not offer the precision and accuracy needed for studies and real-world applications. There are a number of businesses that depend on reliable water level information, and this makes it harder to monitor water supply, usage, and management. Further, existing approaches can be pricey, which makes them unfeasible for areas with limited resources or for small-scale applications. The situation is made worse because less and fewer trustworthy technology for measuring water levels are available and used. As a result of their limitations in handling variables like tank shape, obstacles, and turbulent conditions, current approaches could not work for all tank designs. This restriction hinders the broad adoption of precise methods for measuring water levels. It is necessary to find a better way to measure the water level in tanks and solve these problems. Thanks to its flexibility, low cost, great precision, and reliability, this approach should work with any type of tank. More accurate water level data can be obtained by researchers and practitioners if these restrictions are overcome. This will improve water resource management and decision-making.

3.2 Objective of the study

The overarching goals of the project are to assess the tank's water level accurately, efficiently, effectively, and affordably in real-time while also integrating data, making the system user-friendly, and reducing costs. To summarize, here is what the "Measure the Water Level in the Tank" project aims to do:

• Accurate Measurement: Improving the accuracy of tank water level measurement systems is the main focus of this study. For accurate water level monitoring, the device must deliver exact values.
• Real-Time Monitoring: Achieving real-time monitoring of the tank's water level is the primary objective of the project. This makes it possible to quickly identify any changes or fluctuations in the water level, which in turn allows for timely maintenance or intervention.
• Efficiency and Automation: An automated system that does away with the requirement for human measurement or visual inspection is the goal of this project. A more streamlined and efficient procedure is the goal of in- stalling sensors and data collecting equipment.
• Data Collection and Analysis: Gathering and analyzing information about the tank's water level is the main objective of the project. Better decision-making and preventative maintenance are both made possible by the ability to spot trends, patterns, and possible problems in this data.
• Integration and Connectivity: Our goal is to develop a system that can easily communicate and share data with other control or monitoring systems. Some other devices, databases, or network systems may need to be integrated in order for this to work.
• User-Friendly Interface: The goal of this project is to create an interface that is easy for anyone to use to get the water level data. Making real-time data and records easily accessible to consumers requires the development of user-friendly displays or apps.
• Cost-Effectiveness: The goal is to provide a system that is easy to adopt, maintain, and scale, all while keeping costs down. The goal is to give a simple, inexpensive, and effective way to keep tabs on water levels.

3.3 Research questions

• What is the most accurate and efficient method or device to measure the water level in a tank?
• How does the water level measurement accuracy vary between different types of sensors or devices?
• What are the factors that can affect the accuracy of water level measurements in a tank?
• How can environmental factors such as temperature, humidity, and external pressure affect the accuracy of water level measurements?
• What is the optimal placement or positioning of the water level sensor or device in a tank to ensure accurate measurements?

• Can the water level in a tank be measured remotely or wirelessly, and if so, what are the best technologies or methods for achieving this?
• Are there any limitations or challenges associated with measuring the water level in large or irregularly shaped tanks compared to smaller or regular ones?
• How does the cost of water level measurement devices vary, and what factors contribute to a higher or lower price?
• Can water level data collected from tanks be used for predictive analytics or forecasting purposes, such as predicting maintenance needs or detecting leaks?
• What are the potential applications or industries where accurate water level measurements in tanks are crucial?

4. Methodology

4.1 Components of the proposed system

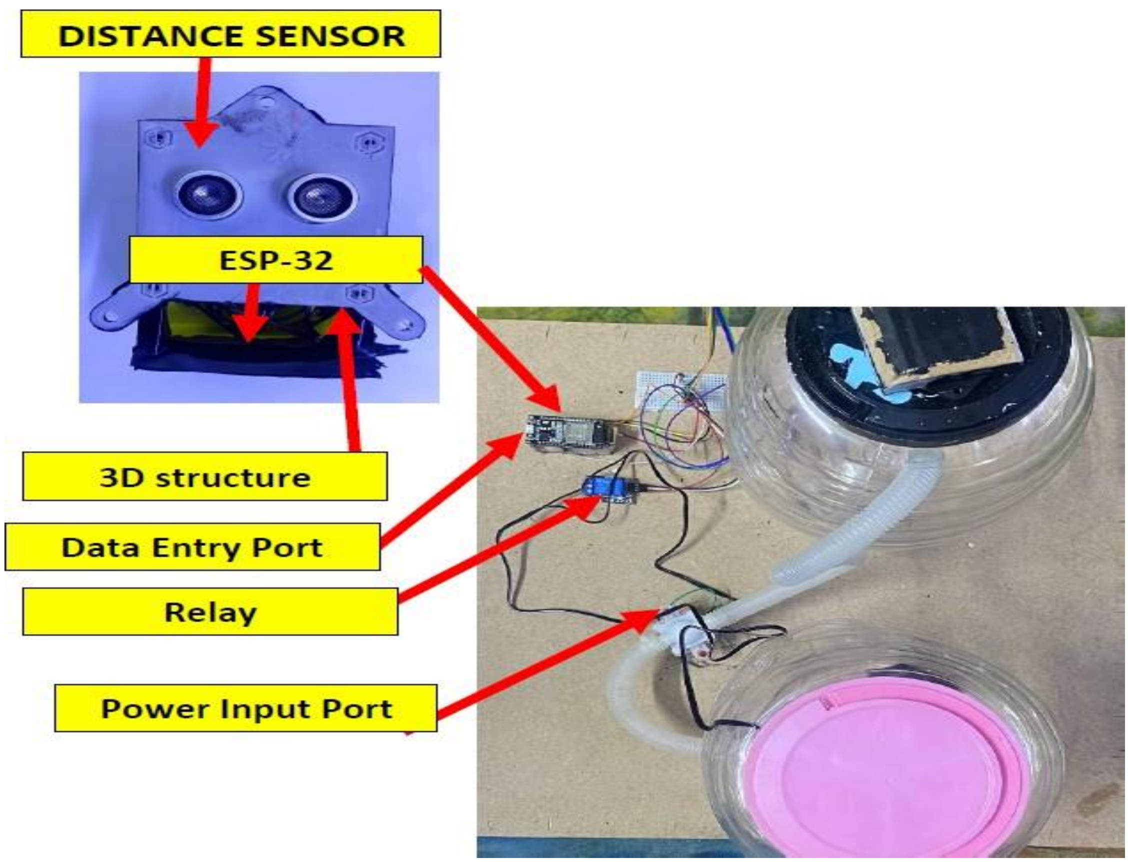

Figure 1. The general structure of the project.

1) Ultrasonic distance sensor

The purpose of an ultrasonic distance sensor in water is to determine the exact distance from the sensor to the water's or liquid's surface. It measures the depth or level of water in a container or tank using ultrasonic waves. A specialized instrument called an ultrasonic distance sensor in water may detect the distance between itself and the surface of a liquid or watery substance. It finds the depth or level of water in a container or tank by means of ultrasonic vibrations. Finally, when it comes to detecting the depth of water in containers or tanks, an ultrasonic distance sensor works well and is dependable. It helps businesses that deal with water or other liquids enhance their inventory management, safety, and efficiency by providing real-time data on water levels.

2) ESP-IDF

ESP-IDF (Espressif IoT Development Frame- work) is a comprehensive IoT development framework pro- vided by Espressif Technology. It uses C/C++ as the main development language and supports cross-compilation under mainstream operating systems such as Linux, Mac, and Windows. The software examples included in this were developed using ESP-IDF, which offers the following features: System- level SoC drivers. ESP-IDF includes drivers for the ESP32, ESP32-S2, ESP32-C3, and other chips. These drivers include low-level peripheral library (LL), hardware abstraction layer library (HAL), RTOS support, upper layer drivers, etc. Basic components. ESP-IDF includes the core components needed for IoT development. This includes multiple sets of network protocols such as HTTP and MQTT, a power management framework with dynamic frequency modulation, features such as Flash Encryption, Secure Boot, etc. As shown in Figure 1, the general structure of the project.

4.2 Phone application

The Android system mobile app is depicted in Figure 2. The data from the liquid distance sensor in the tank is transmitted directly to the app utilizing transmitter and receiver technology.

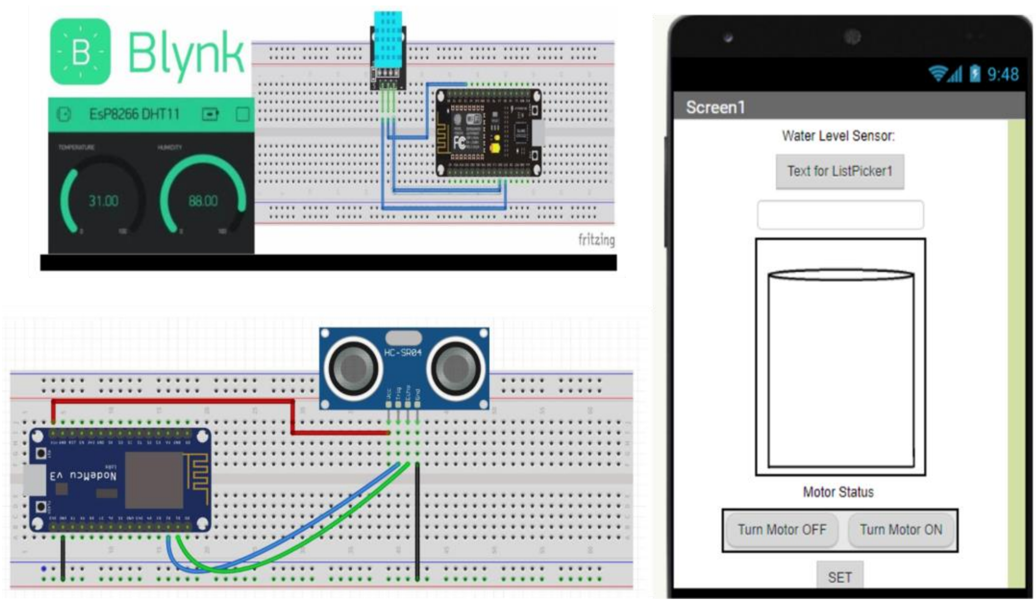

Figure 2. Phone Application of Proposed Tank Water Levels System.

4.3 Working steps

Figure 3 shows the overall shape of the project. Specific gravity is an important factor to consider when determining the level of a liquid. Take this equation into consideration.

$$P = SG \times H \quad (1)$$

The liquid's height, expressed in units such as inches, centimeters, meters, feet, etc. At the base of the tank, there is a hydrostatic head pressure that is measured in inches of water column, feet of water column, bars, psi, Pascal's, and other units. The dimensionless value known as media's specific gravity (SG) is determined by dividing the density of the substance being measured by the density of water at 4 °C. As an example, paraffin has a density of 0.82 g/cm3. The specific gravity of kerosene, thus, is 0.82 g/cm3 multiplied by 1.00 g/cm3, or 0.82.

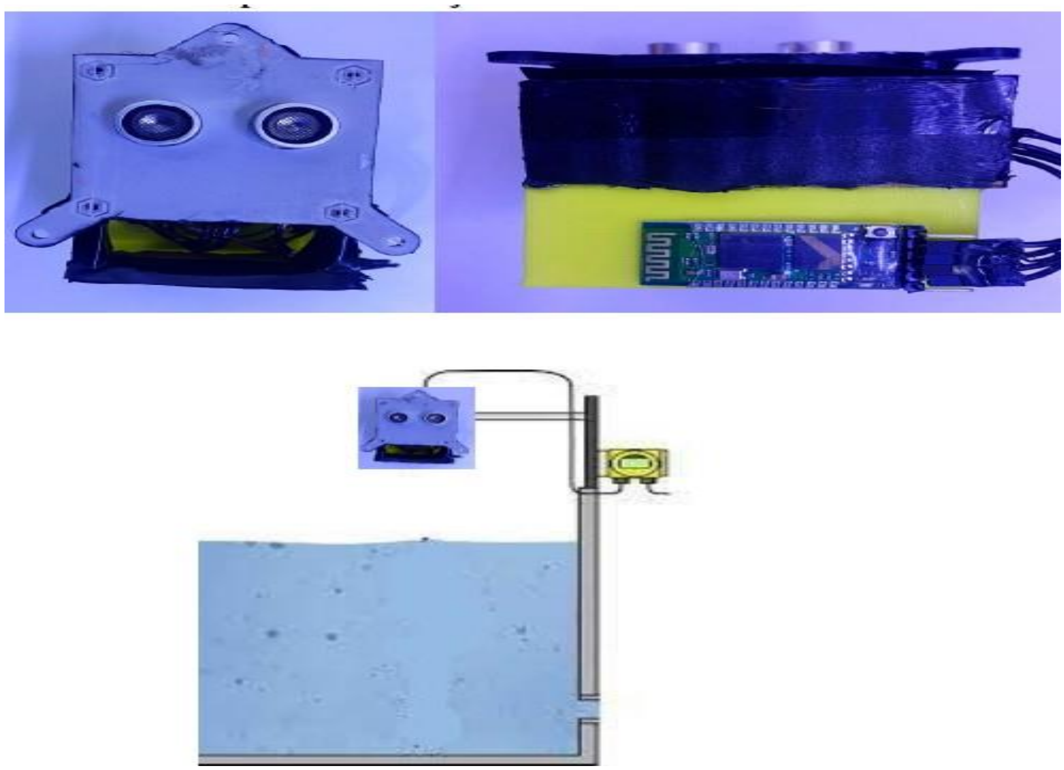

Figure 3. The overall shape of the project.

As an example, consider an 8-inch-deep container of water. A specific gravity of 1.00 is assigned to water. The hydrostatic pressure at the container's base can be determined by taking the following into account: Water depth equals eight inches P=1 • 8 inches = 8 inches W.C., where SG= 1 and P=x PSI.

5. Results and discussion

The water level in the tank is 75% full, according to the measurements. This indicates that there is a considerable quantity of usable water remaining in the tank. But keep an eye on the water level; if it drops too low, it could spell trouble. With the present level of water being within the required range, there is sufficient water for a variety of uses, including domestic and commercial ones. According to this measurement, there is now no pressing requirement for refill or increased water supply. Importantly, the water level has not shown any notable changes or anomalies throughout the years. It appears that there are no overflows or leaks, and the water supply to the tank is stable, based on this consistency. Consistently checking the water level to make sure it stays at the ideal level is crucial for sustainable water management methods. In the event that any problems, such leaks or unusual water consumption, are detected during routine inspections, they can be swiftly resolved. Finally, the water level in the tank is just right, so there's enough of water for all kinds of things. Maintaining the ideal water level and warding off any difficulties would necessitate constant monitoring and upkeep.

6. Conclusion

One of the main goals of this research is to find a way to use high- tech sensors to determine how much water is in a tank. In order to gauge how long it takes for sound waves to travel from the water's surface to return to the sensor, the suggested system makes use of ultrasonic sensors. The technology determines the precise measurement of the water level by analyzing the reflected waves, which in turn determine the distance between the sensor and the water level. We will construct a prototype and test it in a controlled laboratory setting to ensure the system works as intended. An ESP32 microcontroller, an ultrasonic sensor, and a display device showing the water level in real-time will make up the prototype. This study is important because it has the ability to improve water management methods and encourage the efficient use of resources. In order to maximize efficiency, minimize waste, and guarantee sustainable practices, enterprises rely on precise water level assessments. The last point to make about water resource management is the importance of tank level measurements. Improve your water level measuring process with the help of sensor-based monitoring systems, data logging, threshold warnings, weather forecasting integration, predictive maintenance, remote monitoring and control, and system integration. These next projects make proactive maintenance, real-time monitoring, precise data capture, and prompt notifications possible. They also make it possible to optimize water sup- ply, change consumption habits in response to weather, and guarantee a steady supply of water. We can better manage water resources, reduce water waste, and find and fix problems or leaks quickly if we constantly refine the method of measuring water levels. This guarantees a steady supply of water and also aids in the preservation of an important natural resource. Keep in mind that protecting our environment and guaranteeing the welfare of future generations depends on the prudent management of water resources. For a future free of water scarcity, let us collaborate to develop better methods of measuring water levels.

7. Future directions

• Start with an internet of things (IoT) device or water level sensor to automatically measure the tank's water level. 2. Set up a sensor-based monitoring system. The requirement for human measurement takers will be removed, and real-time data will be provided.
• Establish a method for recording and storing data: Make a plan to log the water level over time. If we can track the water level over time, we can see trends and anomalies.
• Configure the monitoring system to send notifications or alarms when the water level reaches a specified threshold. This will enable you to establish threshold alerts. This will assist in triggering prompt actions, such checking for possible leaks or refueling the tank.
• Incorporate weather forecasts into the monitoring system to anticipate water usage patterns and modify water management appropriately. As a result, water supply and resource distribution can both be improved.
• Apply predictive maintenance by creating algorithms or ML models to foresee when the tank would fail or have problems like leaks or broken pumps. The water supply will remain uninterrupted thanks to this preventative strategy that allows for prompt maintenance.
• Make it possible to monitor and manage the water flow and level from afar by granting users remote access to the monitoring system. In cases where touching the object is not an option, this will make it more accessible and convenient.
• Connect the water level monitoring system to other systems that are relevant, such water treatment plants or utility networks, to help with water management and make sure there's always enough water.
Ultimately, these future works can optimize the tank's water level measurement, which in turn improves water resource management, identifies problems early, and makes it more convenient for users.

8. Recommendation of the study

This research recommends several effective methods for measuring the water level in a tank:

Ultrasonic Level Sensor: This method uses sound waves that are emitted from the sensor and bounce off the water surface. The time it takes for the echo to return is used to calculate the water level. It's a non-contact, accurate, and reliable technique.

Pressure Transducer: Installed at the bottom of the tank, this sensor measures the pressure exerted by the water column. Since pressure correlates with water height, it provides a precise reading of the water level.

Capacitance Level Probe: This sensor detects changes in capacitance caused by variations in the water level. It's a non-contact method that offers stable readings, unaffected by changes in water temperature.

Float Switch: A simple mechanical device that floats on the water's surface and triggers a switch when the water reaches certain levels. It's easy to install and useful for basic level detection.

Visual Inspection: The most straightforward method, where the water level is checked manually by looking through a transparent section of the tank or using a marked gauge. While inexpensive, this method may not be practical for large or hard-to-access tanks.

Infrared Sensor: This method uses infrared light to determine the water level based on the reflection or absorption characteristics of the light. It's suitable for non-contact measurement and works well in clean water applications. Each method has its own advantages depending on the tank's size, location, required accuracy, and environmental conditions.

References

[1] Al-Shareeda, M. A., Anbar, M., Alazzawi, M. A., Manickam, S., & Hasbullah, I. H. (2020). Security schemes based conditional privacy-preserving in vehicular ad hoc networks. Indonesian Journal of Electrical Engineering and Computer Science, 21(1).
[2] Al-Shareeda, M. A., Anbar, M., Manickam, S., Hasbullah, I. H., Abdullah, N., Hamdi, M. M., & Al-Hiti, A. S. (2020). NE-CPPA: A new and efficient conditional privacy-preserving authentication scheme for vehicular ad hoc networks (VANETs). Applied Mathematics, 14(6), 1–10.
[3] Al-Shareeda, M. A., Gaber, T., Alqarni, M. A., Alkinani, M. H., Almazroey, A. A., & Almazroi, A. A. (2025). Chebyshev polynomial based emergency conditions with authentication scheme for 5G-assisted vehicular fog computing. IEEE Transactions on Dependable and Secure Computing.
[4] Al-Shareeda, M. A., Manickam, S., Saare, M. A., & Arjuman, N. C. (2023). Proposed security mechanism for preventing fake router advertisement attack in IPv6 link-local network. Indonesian Journal of Electrical Engineering and Computer Science, 29, 518–526.
[5] Almazroi, A. A., Alqarni, M. A., Al-Shareeda, M. A., Alkinani, M. H., Almazroey, A. A., & Gaber, T. (2024). FCA-VBN: Fog computing-based authentication scheme for 5G-assisted vehicular blockchain network. Internet of Things, 25, 101096.
[6] AlMetwally, S. A. H., Hassan, M. K., & Mourad, M. H. (2020). Real-time Internet of Things (IoT)-based water quality management system. Procedia CIRP, 91, 478–485.
[7] Baballe, M. A., Muhammad, A. S., Usman, F. A., Mustapha, N. K., Naisa, A. H. K., & Shehu, A. K. (2022). A review of an automatic water level indicator. GJR Publication, Global Journal of Research in Engineering and Computer Science, 2(03). Retrieved from https://gjrpublication.com/gjrecs
[8] Barbade, G., Shreyas, C., Vedant, S., Vaibhav, N., & Umesh, P. (2021). Automatic water tank filling system with water level indicator. Indian Journal of Microprocessors and Microcontroller (IJMM).
[9] Chalchisa, D., Megersa, M., & Beyene, A. (2018). Assessment of the quality of drinking water in storage tanks and its implication on the safety of urban water supply in developing countries. Environmental Systems Research, 6, 1–6.
[10] Djalilov, A., Sobirov, E., Nazarov, O., Urolov, S., & Gayipov, I. (2023). Study on automatic water level detection process using ultrasonic sensor. In IOP Conference Series: Earth and Environmental Science (Vol. 1142, p. 012020). IOP Publishing.
[11] Jan, F., Min-Allah, N., Saeed, S., Iqbal, S. Z., & Ahmed, R. (2022). IoT-based solutions to monitor water level, leakage, and motor control for smart water tanks. Water, 14(3), 309.
[12] Johari, A., Abd Wahab, M. H., Latif, N. S. A., Ayob, M. E., Ayob, M. I., Ayob, M. A., & Mohd, M. N. H. (2011). Tank water level monitoring system using GSM network. International Journal of Computer Science and Information Technologies, 2(3), 1114–1120.
[13] Kulkarni, S. A., Raikar, V. D., Rahul, B., Rakshitha, L., Sharanya, K., & Jha, V. (2020). Intelligent water level monitoring system using IoT. In 2020 IEEE International Symposium on Sustainable Energy, Signal Processing and Cyber Security (iSSSC) (pp. 1–5). IEEE.
[14] Pandey, A., Andhale, G., Sonawane, A., Amrutkar, A., & Andhare, T. (2022). Automatic water level indicator and controller. International Journal for Research in Applied Science & Engineering Technology (IJRASET), 10(11), 1043–1047.
[15] Pereira, G. P., Chaari, M. Z., & Daroge, F. (2023). IoT-enabled smart drip irrigation system using ESP32. IoT, 4(3), 221–243.
[16] Rachel, P. N., Sophia, D., Rani, G. S., Rishika, J. J., & Annapurna, P. S. (2019). Automatic water level indicator and controller by using Arduino. International Journal of Research in Engineering and Technology, eISSN: 2319–1163.
[17] Rizzolo, S., Périsse, J., Boukenter, A., Ouerdane, Y., Marin, E., Macé, J. R., Cannas, M., & Girard, S. (2017). Real-time monitoring of water level and temperature in storage fuel pools through optical fibre sensors. Scientific Reports, 7(1), 8766.
[18] Sheng, J. (2019). Real-time DC water tank level control using Arduino Mega 2560. In 2019 IEEE 28th International Symposium on Industrial Electronics (ISIE) (pp. 635–640). IEEE.
[19] Singh, R., Baz, M., Gehlot, A., Rashid, M., Khurana, M., Akram, S. V., Alshamrani, S. S., & AlGhamdi, A. S. (2021). Water quality monitoring and management of building water tank using industrial internet of things. Sustainability, 13(15), 8452.
[20] Hajjaj, S. S. H., Sultan, M. T. H., Moktar, M. H., & Lee, S. H. (2020). Utilizing the Internet of Things (IoT) to develop a remotely monitored autonomous floodgate for water management and control. Water, 12(2), 502.
[21] Pasika, S., & Gandla, S. T. (2020). Smart water quality monitoring system with cost-effective using IoT. Heliyon, 6(7).
[22] Olisa, S. C., Asiegbu, C. N., Olisa, J. E., Ekengwu, B. O., Shittu, A. A., & Eze, M. C. (2021). Smart two-tank water quality and level detection system via IoT. Heliyon, 7(8).
[23] Pereira, G. P., Chaari, M. Z., & Daroge, F. (2023). IoT-enabled smart drip irrigation system using ESP32. IoT, 4(3), 221–243. https://doi.org/10.3390/iot4030013

Biographies

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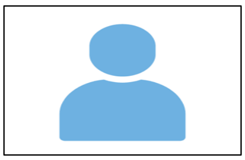

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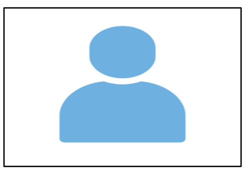

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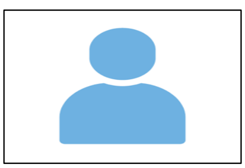

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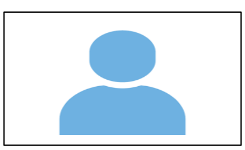

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