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Smart Water Quality Monitoring and Management System

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Abstract— One of the world's most pressing problems nowadays is water contamination. Contaminated and damaged water is no longer safe to drink. Furthermore, water storage is crucial for water management as it ensures a consistent flow of water for several uses and serves as a fallback in times of shortage. In this article, we'll look at several state-of-the-art water management strategies that make use of data collection, sensors, smart water meters, and decision support systems to increase efficiency, sustainability, and self-sufficiency. By using IoT technology, this solution is offered. Temperature, dissolved oxygen levels, the presence of suspended particulates, an RFID reader, and a GSM module are just a few of the water characteristics that may be measured by a smart water quality sensor. Automatically determining the liquid level in tanks or storage containers of different sizes is possible with a water level monitoring system. That way, even in faraway places, people may drink water that is both safe and full of nutrients. The ability to precisely measure the water flow required by each distribution line results in significant electricity savings.Automated notifications for low water levels or water contaminants, secure access control, real-time water monitoring, and location tracking for better maintenance are just a few of the benefits of the proposed system. A number of components are used by the system, including a pH sensor, an RFID reader, a keypad, a solenoid valve, an LCD, a GSM module, and a GPS module. Notify the proper authorities or a chosen water supply company with the help of the GSM module. In order to make water management and maintenance more effective, the GSM module may communicate with the tank's position data that is collected by a GPS module. Current methods rely on arduous and error-prone human monitoring of water level and quality. This water management system is now undergoing the integration of sophisticated technology to provide a complete solution for improving efficiency and optimizing water consumption. This system's prototype has been tested and deployed with no hitches. PH sensor, ultrasonic sensor, radio frequency identification, global system for mobile communications, GPS, keypad.

I. INTRODUCTION

Many improvements have occurred, but new problems have also arisen, such as pollution and climate change. Pollution causes water to become less potable and less pure. Due to the abundance of chemical and contaminant sources, it is challenging to produce water that is both clean and safe to drink [1]. It is essential to include water storage into water management systems. It regulates the flow of water, which helps keep the supply and demand of water in balance. The remedies for water pollution are provided by advances in technology. Oftentimes, the most advanced technology and sensors are associated with the Internet of Things (IoT). A tiny chip and an antenna make up RFID (Radio Frequency Identification) tags, which are tiny electrical devices.Radio waves are used by these tags for the storage and transport of data. Semipassive, active, and passive RFID tags are the three main varieties. Intelligent water management that incorporates IoT technology improves efficiency and well-being by meeting the need for water storage and filtration among other processes with the provision of components, a solenoid valve, an LCD, GSM, GPS, and real-time vital sign monitoring. With the help of the Internet of Things (IoT), the Smart Water Management project is using radio frequency identification (RFID) technology to completely revamp water distribution and conservation. This research emphasizes the easily explicable lack of uniformity in the literature survey. An effort at evaluating the change in land use/cover (LULC) was made in [2]. There is an immediate need for a long-term strategy to manage water resources, and our assessment contributed to that effort. For smart grids that include interconnected water and energy networks, Faegheh Moazeni et al. addressed the issue of economic dispatch (ED) using a mixed-integer linear programming (MILP) paradigm [3]. With the goal of managing the flow of big data information from the Water Treatment Plant's (WTP) many sensors and smart devices, a smart management system was developed.[4]. The purpose of this operate risk management strategy is to reduce the smart WTP's operating downtime and overcome failure scenarios. Using smart home technology, an innovative way is presented to automate classic reusable water collecting and reuse systems, such as drain water collection systems, rainfall harvesting systems (RHWs), and wells. This research emphasizes the most practical and cost-effective approach [5]. The authors took a look at the problem, the tech challenges, and the study subjects. Next, by developing a paradigm for risk analysis specific to the urban water supply system, the authors offered a potential remedy. The outcomes demonstrated that this approach works better overall. Early warning systems for industrial water quality risks was supported [6]. The proposed approach in [7] was easily modifiable to handle energy-efficient automated water supply management and to address problems with the deployment of interoperable portable smart devices. My goal was to investigate monitoring and control systems that rely on the Internet of Things. The literature covered basic knowledge as well as latest advancements in the field of irrigation management [8]. In order to manage and keep tabs on water resources, the writers created a whole new web platform they dubbed the Internet of Water Things (IoWT).Raw water availability might be controlled and managed with the help of the proposed method [9]. The use of hybrid DL models, LSTM-equipped convolutional neural networks (CNNs), and GRUs in aquaculture WQP is recommended. Aquaculture water quality features were effectively collected by CNN; however, GRU and LSTM are able to extract long term dependencies from the time series data [10]. Oilfield activities that use a lot of water to increase oil production prompted the development of a new optical water management system. This work offered a groundbreaking manual for next studies aimed at incorporating IoT in the realm of water management and monitoring [11]. Manually checking water levels and quality is the current system's weak spot; it's laborious and error-prone. The limitations of literature surveys are intended to be circumvented by the suggested approach.

II. PROPOSED METHODOLOGY

Using an ultrasonic and a pH sensor, the suggested solution circumvents the shortcomings of the current model to provide the real-time monitoring of water levels and quality. Figure 1 shows the suggested methodological system in action, which makes use of an Internet of Things (IoT) control console with a number of linked components—including RFID tags, a keypad, a relay, a solenoid valve, a GSM module, a GPS module, and an LCD display—to efficiently monitor and manage water resources.

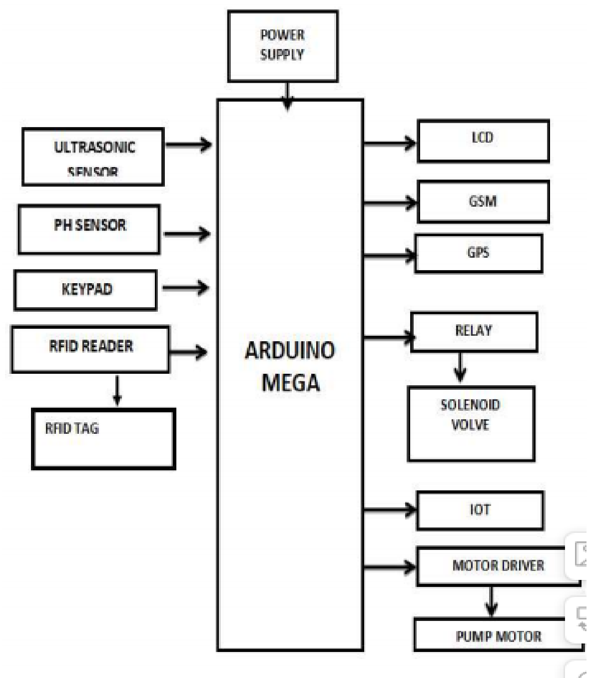

Fig. 1. Block diagram for proposed system

The water supply system, the alert system, and the water tank monitoring system are the three main components of the suggested system. The three modules are connected using the Arduino Maga microcontroller. You can see the schematics of these modules in Figures 2, 3, and 4.

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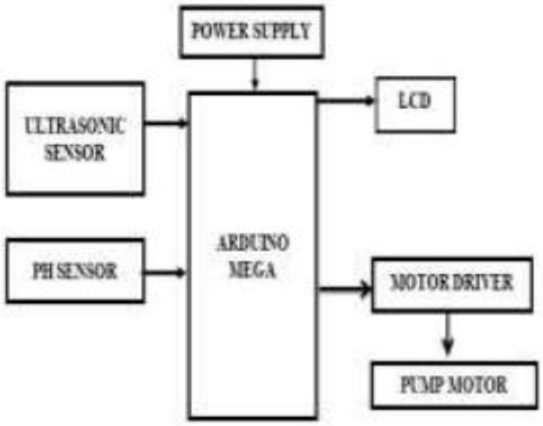

Fig. 2. Water tank monitoring system

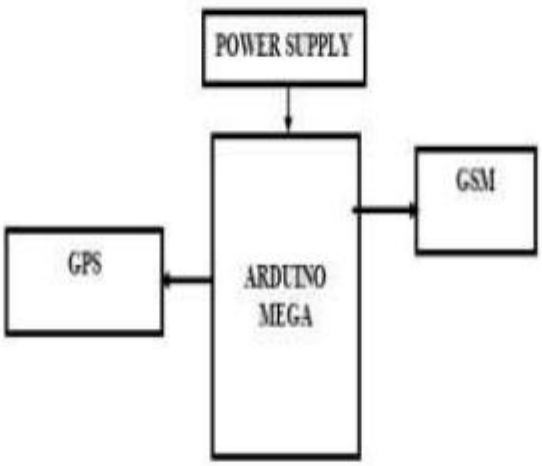

Fig. 3. Alret system

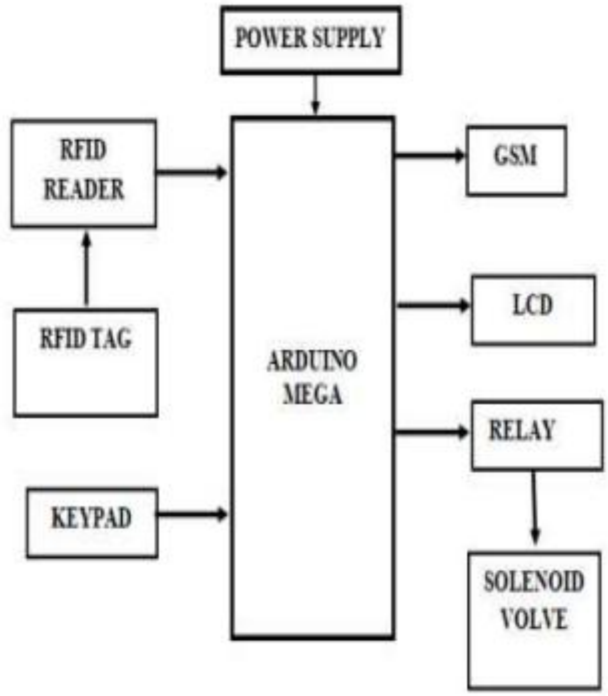

Fig. 3. Water supply system

III. WORKING

The system's central processing unit (CPU) is an Arduino mega microcontroller. There are ultrasonic and pH sensors that make up the water tank monitoring system. An ultrasonic sensor is used to measure the water level in the tank. One way to find out what the water's pH is is to use a pH sensor. You may choose between two different pump motors. Due to the fact that acid corrosion reduces the pump's lifespan, this system is designed to activate the right side pump motor if the water acidity level is surpassed.The left-side pump motor will activate if the base level is surpassed. The components of an alert system are GPS and the Global System for Mobile Communication (GSM). The position of the tank may be determined using GPS. The amount of water needed to fill the water tank may be sent to the corporate over GSM. should the water level in the tank be low or if its pH value indicates that the water has become polluted. You can see the current water and person status in the tank on the Liquid Crystal Display (LCD). The tank has an RFID reader attached to it. People's identification cards are RFID tags. People may input the amount of liters they require using the keypad. To open or shut the solenoid valve, a relay is used. To turn the water supply to the tank on and off, a solenoid valve is used. All of the data on the website is updated using the GSM module. In Figure 5, we can see the final product and all of the gear that went into the project.

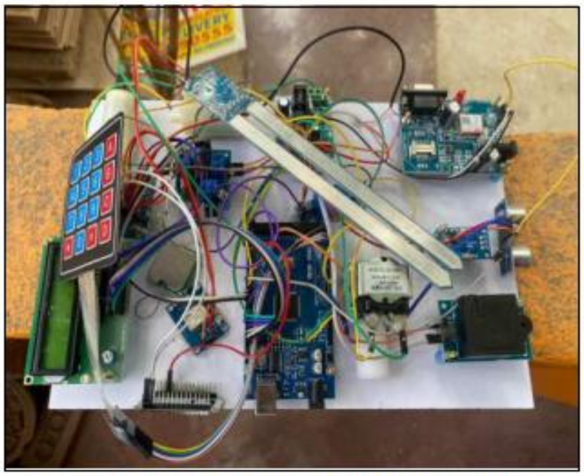

Fig. 5. Hardware implementation of proposed system.

IV. RESULT

We have developed and tested the system prototype. As soon as the hardware is turned on, it will send a message with the water tank's position information and a map. The Rajalakshmi Institute of Technology is where the water level flow is measured. The left half of the hardware system monitors water level, quality, and pH levels, while the right half is responsible for other measurements. Figure 6 illustrates that when the power source is linked to GND, and the pH strip is linked to water, the result is 8.38, indicating that the solution is basic.

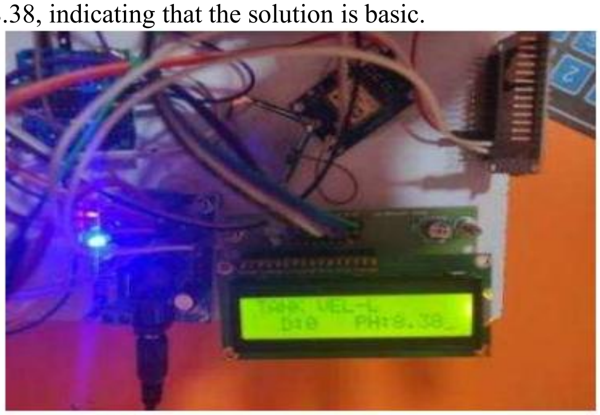

Fig. 6. pH value

Distributing water to people is the responsibility of the hardware on the right side. The 3.3-pin power source is linked to the water supply. When the RFID tag is tapped on RFID reader which is represented in 7, the LCD display comments to click the keyboard how much liters is needed is shown in Fig. 8. As seen in Figure 9, the timer begins to fill the tank after the necessary liters have been clicked. The relay will be on in two pins but when water started to fill the tank , only one pin is on . This is the last step before filling the tank. By keeping an eye on the water and pH levels, the adafruit.io is linked to the IOT website.

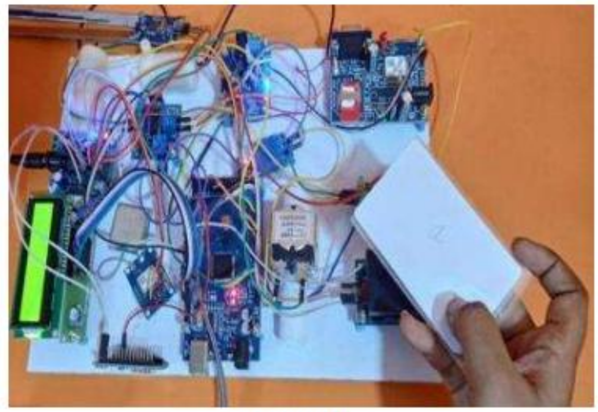

Fig. 7. RFID tag

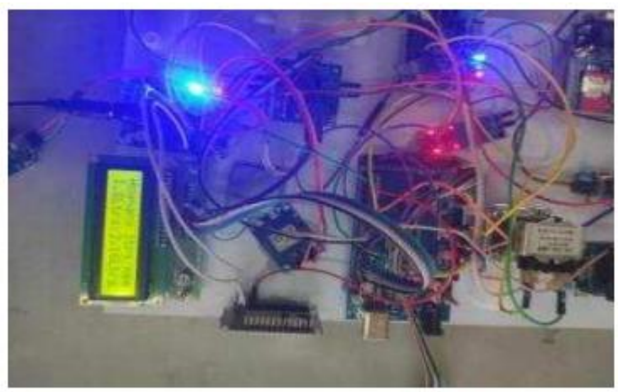

Fig. 8. Number of liters required

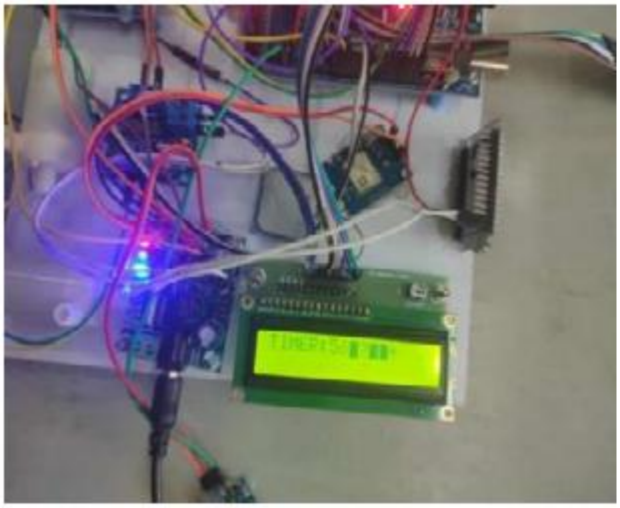

Fig. 9. Timer

V. CONCLUSION AND FUTURE SCOPE

In order to control water use and cut down on waste, a portable system is being considered. Water waste was significantly reduced and water quality was significantly improved by the adoption of the suggested method. Internet of Things (IoT) sensors and radio frequency identification (RFID) tags may help businesses understand how their customers use water. The used resource's billing readings are accurate, and a lot of waste is significantly reduced.So, the system is integrated effectively with the aid of these latest technologies. In order to optimize water availability and minimize dependency on external providers, the system may be expanded to handle additional water sources, such as rainwater collecting systems, in the future. Harvested rainwater may be efficiently managed and put to good use via the use of systems.

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