Smart Pumping System - A Smart Solution to Automize the Manual Pumping Process

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Abstracts: One of the most crucial resources for supporting life on Earth is water. It is necessary for everyday tasks like cooking, cleaning, and taking a shower. Water supply systems in residential areas are often administered by municipal corporations or other governing organizations. This project mainly focuses on the IoT-based solution for the automation of the water tank filling system in our residential area. In this project two Esp8266 MCUs connected to the same cloud channel are used, one will be at the Water Source side and the other will be at the Tank side.If the water level in the tank is low, the Esp8266 will send the Motor ON signal to the ThingSpeak IoT Cloud, and the Esp8266 at the river or dam side, which is also connected to the same cloud channel, will read that signal and turn the 'Motor ON'. The other microcontroller at the river/dam side will turn the motor OFF if the tank is full because the Esp8266 sends the "Motor OFF signal" over the cloud. Additionally, the user is given access to a web interface that shows graphs and indications so they may study and examine the data coming from the system.

Keywords: Iot**,** Esp8266 MCU, Thingspeak Iot Cloud, Web Interface.

1. INTRODUCTION

The concept behind a smart city is to use technology to improve efficiency in daily life. Water distribution is a crucial job in a smart city. The current water distribution methods are ineffective, so we should automate the complete system using IoT technology to develop the most effective and affordable method for water distribution. [1] As we know each residential area has its water tank provided by the Municipal Corporation, also in the rural area there is one tank provided to one village. The water in these tanks comes from the dam or river. The current water management method requires more time and has limited scheduling flexibility. Liters of water are wasted if there is a leak in the distribution system. We should use technology like IoT, smart sensors, and data processing to solve these issues by utilizing these technologies, we can design a suitable system that allows us to regulate both the timing and schedule of water distribution and the water quality using intelligent sensors. [2] However, the process of filling the water tank is often manual, which can be time consuming and inefficient. There is a need for an automated system that can manage the water supply in a more efficient and reliable manner. There is no such system to automate this process of refilling the tank. This system approaches automizing the manual water distribution operation in ruler and urban areas. The real-time data is collected and displayed on a website. [3] This study suggests an autonomous water level measurement system that measures the water level without coming into close contact with the water, extending the system's life. In order to address the shortcomings of manual metering systems, the paper also discusses the need for smart water systems. It then suggests a wireless sensor network of water meters installed in thousands of homes that collect periodic measurements and report them in real-time via a wireless network to a central database[5] The role of IoT in the IOT-based Smart Water Pump Switch is to enable communication between the device and the internet, which allows remote monitoring and control of the water pump.[8] If the distance goes below a certain point, it means that the water level has exceeded the optimum level.[6] The device's sensors gather information on the water level in the tank, which is then sent over the internet to the cloud. The user can then remotely control the pump using this data and access it from any location to ensure effective water management. [8] Uncontrolled water use also causes waste, which ultimately contributes to water scarcity. Water automation technologies can be used to address these problems by minimizing human effort and mistake. [9] The level of chemical liquids in tanks can also be measured in industries using this water level sensor.

The system's overall goal is to increase the precision of water level measurement and automatically operate the water pump. [10]

2. LITERATURE REVIEW

Kiran M. Dhobale et al.'s., [11] need for an automated water supply management system is discussed in this paper concerning the Smart City. The author proposes an effective and affordable method for water distribution by utilizing the Internet of Things technology. To develop a program for automating the water distribution procedure, the data gathered can be analyzed. Also, the maintenance schedules can be developed using IoT to guarantee continuous support. The sensors can be used to detect the water with the help of a rain sensor and by harvesting the rainwater it can be distributed using a supply-on-demand method.

Rosiberto Gonçalves et al.'s., [12] In this paper, the author mentioned that the current water management method requires more time and has limited scheduling flexibility. Liters of water are wasted if there is a leak in the distribution system. Emerging technologies like IoT, smart sensors, and data processing can be used to solve these issues and design a suitable system that regulates both the timing and schedule of water distribution and the water quality using intelligent sensors Also the water tank's current amount can be monitored. The suggested approach makes use of Raspberry Pi to automate the system.

D.Devasena et al.'s., [13] The manual water distribution process in cities is automated by this system technique. This system keeps an eye on the water level in above tanks as well as the quantity, flow rate, and leakage of water in the pipeline system. The system tracks water waste as well. Individual homes' real-time data is gathered and shown on the website. This project's main task is to wirelessly monitor the tank's water level using an ultrasonic sensor connected to an Arduino board. The amount of water utilized was measured using a flow meter. The Node MCU checks the water flow rate and tank level in addition to acting as a Wi-Fi adapter and wireless internet access.The primary valve was opened by the Arduino by using the Real Time Clock to deliver the digital time input. The float switch was used to detect when a tank's water level dropped below a predetermined level. The water supply was turned on and off using solenoid valves. The LCD monitor showed the amount of water in the tank. A solenoid valve was used to detect the water leak as well. The solenoid valve was also used to gauge how much water each household used. The ThingSpeak IoT Cloud's Web server displays the data from every sensor.

Kusuma S S. et al.'s., [14] This project mainly focuses on continuous and real-time monitoring of water supply. In this project, the sensors used are flow sensor, pH sensor, Soil sensor, and GPS sensor. The Raspberry Pi 3 microcontroller is used and also the ThingSpeak IoT cloud platform is used. All the sensors' Data is pushed to the ThingSpeak cloud. The solenoid Valves are used to control the on-and-off cycle of the water supply, the valves are controlled using Raspberry Pi 3 MCU. The flow of water through pipes is measured using flow sensors. The amount of water that has gone through the flow sensor is also stored in two MYSQL databases. The pH sensor is used to determine whether water is fit for consumption, and a soil sensor determines whether soil is present in the water. In this project, the GPS module is also utilized to monitor the distance to the water source.

Sathya Narayanan et al.'s., [15] In this paper, the author highlights the challenges faced by manual water supply systems. The study suggests an autonomous water level measurement system that measures the water level without coming into close contact with the water, extending the device's life. In order to address the shortcomings of manual metering systems, the paper also discusses the need for smart water systems. It then suggests a wireless sensor network of water meters installed in thousands of homes that collect periodic measurements and report them in real-time via a wireless network to a central database. An Arduino, an ultrasonic sensor, a water flow sensor, and a GSM module are all components of the system design. The method, which eliminates the disadvantages of conventional water metering systems, provides a smart water meter with an eco-friendly and energy-efficient system, according to the paper's conclusion.

Sai Sreekar Siddula et al.'s., [16] In this paper the researchers have created a system that uses Bluetooth modules, ultrasonic sensors, and an Arduino microcontroller to monitor the water level in a container. They attached a water level sensor to the top of the container to measure the distance between the water surface and the container top. If the distance goes below a certain point, it means that the water level has exceeded the optimum level. The system sends water level data to another Arduino microcontroller via Bluetooth module, and the readings appear on a display. When the water level approaches the maximum capacity of the container, a signal is sent to a servo motor that controls a gate mechanism. The second microcontroller interprets the input data and activates the servo motor connected to the gate mechanism, allowing water to flow out of the container. As the water level decreases, the second microcontroller stops sending commands to the servo motor, and the gate mechanism closes. The system can also send information about water level readings to a central command centre.

S. M. Khaled Reza et al.'s., [17] The design and implementation challenges in creating the Microcontroller Based Automated Water Level Sensing and Controlling system were covered by the author in this study. A water level sensor interface is used with the PIC16F84A microcontroller. Using MPLAB, the author coded the microcontroller. The system's complexity is decreased by the use of the PIC16F84A microcontroller, making it easier to manage and more effective.

Peddamallu Jaya Prakash Reddy et al.'s., [18] The Internet of Things (IoT) plays a crucial role in the IOT-based Smart Water Pump Switch by facilitating connectivity with the internet, allowing for remote monitoring and control of the water pump. The device's sensors gather information on the water level in the tank, which is then sent over the internet to the cloud. The user can then remotely control the pump using this data and access it from any location to ensure effective water management. In order to give voice-activated control and warnings, the device can also be integrated with other Internet of Things (IoT) devices, such as mobile phones or smart speakers.The IoT-based Smart Water Pump Switch's capabilities are improved by IoT technology, which also makes it a potent instrument for water management and conservation. The project's goal is to conserve water and electricity by turning the pump off automatically when the tank is full.

Mazharul Islam Nayeem el al.'s., [19] The author of this research proposed using an Android application to turn on and off the water pump, resulting in efficient water consumption and decreased waste. This technique has a lot of room for improvement; therefore, researchers should give it top priority. There are many uses for water automation in enterprises, families, hotels, and more. Numerous water automation projects have been developed by researchers, including android-based water pump controllers, water level sensors, billing systems, and leak detection, emphasizing the significance of this technology for water resource conservation.

Md. Mahmudul Hasan et al.'s., [20] The automatic water pump controller and water level detection system discussed in this study are useful in domestic settings as well as commercial and agricultural settings. It saves time and effort for humans as well as lessens water waste. This method is economical, effective, and has the potential to completely change how water is used and conserved in a variety of industries. We can monitor the water level in a reservoir with the help of a water level indicator system, which is a handy instrument. In this study, a microcontroller chip-based automatic water pump controller and water level monitor are introduced. The system functions by detecting when the water level in a tank is low, monitoring it on an LCD display screen, and automatically turning on the motor to refill the tank. A Reed switch sensor is used to keep track of the water level, and the system is controlled by the microcontroller IC ATmega 16A. The level of chemical liquids in tanks can also be measured in industries using this water level sensor. The system's overall goal is to increase the precision of water level measurement and automatically operate the water pump.

3. METHODOLOGY

Hardware: In this project we have used two Esp8266 MCU, Ultrasonic Distance sensor, Relay and Motor/Pump.

The main sensing component in the system is the Ultrasonic Distance sensor. This sensor gives output in form of pulse and that pulse is proportional to the time taken by the Ultrasonic sensor to emit the Ultrasonic wave and receive the reflected wave back. The Equation to calculate the actual distance is as follows.

Equation:

$$Distance = Speed \times time$$

Eq. (1) Distance formula

$$Distance\ (cm) = \left(\frac{0.034}{2}\right) \times (\text{value fromUltrasonic sensor})$$

Eq. (2) Formula to calculate Distance from Ultrasonic sensor

To automize the water supply system we are using two Esp8266 microcontrollers which are connected to the same cloud channel provided by ThingSpeak IoT Cloud. Both Microcontrollers are connected to the Cloud through different Wi-Fi routers or Mobile Hotspots. One Esp8266 Microcontroller will be deployed at the Tank side and the other will be at the dam or riverside.

The water level in the tank is sensed by the ultrasonic sensor attached to the Esp8266 microcontroller, and that value is transferred to the ThingSpeak cloud Field 1 through Esp8266. The Esp8266 at the tank side will send the Motor ON signal to the cloud by sending "1" to the Cloud field 2 if the water level in the tank drops below a particular level (distance measured by Ultrasonic sensor exceeds 100cm), indicating that the "Tank is Empty."

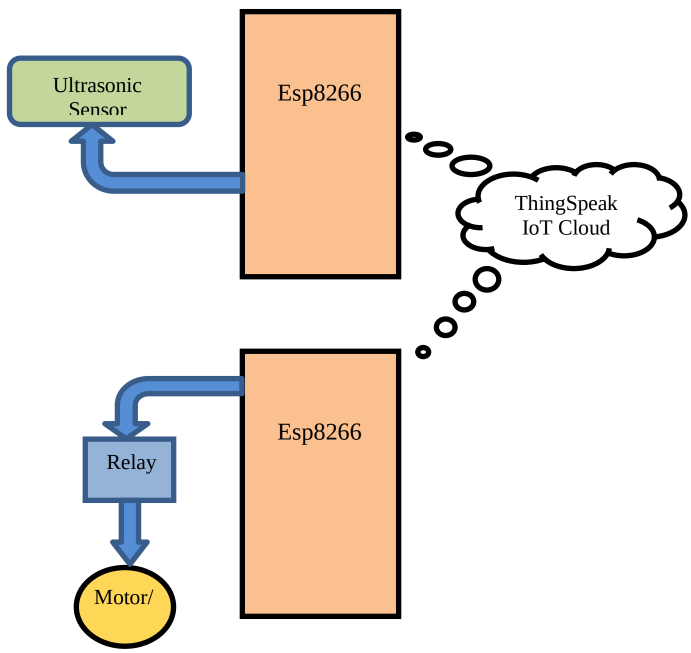

Fig.3.1. Block Diagram of the system

That signal will be received by Esp8266 at the Riverside which is also connected to the same cloud channel. It will read the value ‘1’ from Field 2 and actuate the relay connected to it and the Motor connected to the relay is turned ON automatically and the green light is indicated.

As the water is refilled, an ultrasonic sensor will measure the level of the tank's water; if the level rises (the ultrasonic sensor's measured distance drops below 11 cm), the tank is full, and the Esp8266 sends an OFF signal by sending a 0 value to Field 2. The motor is turned off, the red light is indicated, and the relay pin is set to LOW by the Esp8266 at the riverfront after reading the value "0" from Field 2.

The Microcontrollers are programmed through Arduino IDE. We can also change the threshold values in the program through Arduino IDE and reprogram the Esp8266 Microcontroller.

Additionally, we created an HTML website that is hosted on Git Hub. To the water supply system, we are using two Esp8266 microcontrollers that are connected to the same cloud channel provided by ThingSpeak IoT Cloud. This allows the user to view the Water level graph and Motor ON/OFF graph so that the user can study and analyze the number of times the Water Level changes and the number of times the Motor ON/OFF changes. Through various Wi-Fi routers or mobile hotspots, the two microcontrollers are connected to the cloud. The tank side will have one Esp8266 Microcontroller installed, and the dam or riverfront will have the other. The water level in cm is also shown on the Website which is updated every 15 seconds. Also, one green indicator is provided on the website which glows when the motor is ON. The blue light indicator for Water Level High is displayed on the webpage which glows when the water level is high means the distance sensed by the Ultrasonic sensor is below 80cm. The orange light indicator for Water Level Low is displayed on the webpage which glows when the water level falls low means the distance sensed by the Ultrasonic sensor exceeds 80cm.

All the data on the webpage is updated in real-time because of integration with Thing Speak cloud at the backend. The website also shows the Source and Destination location with the help of Google Maps integration. We can also change these locations in HTML code.

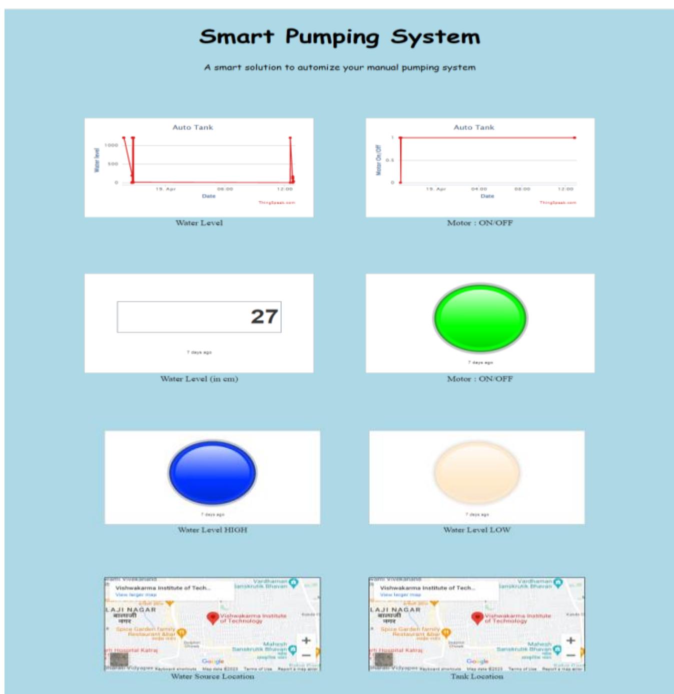

Fig 3.2. Web Interface

4. OBSERVATIONS

We have recorded the observations and graphs displayed on ThingSpeak Cloud Channel and Web interface. We have recorded the Water level and how many times the Motor gets on and off. The indicators response is also recorded for the different water levels.

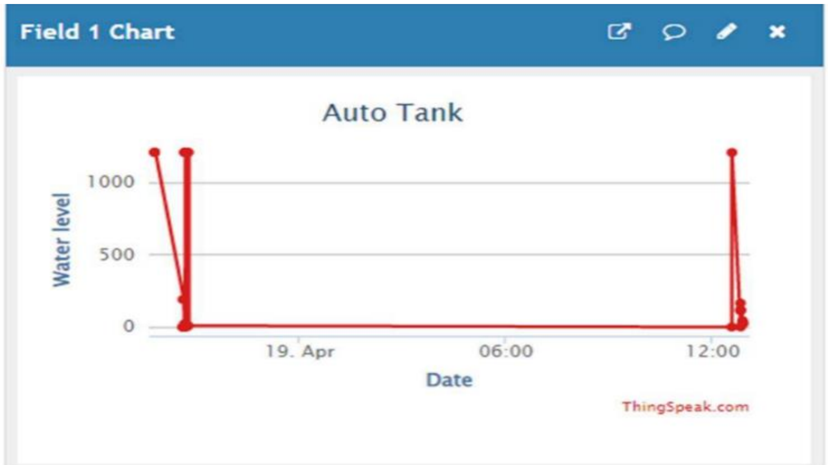

Fig 4.1. Water level recorded

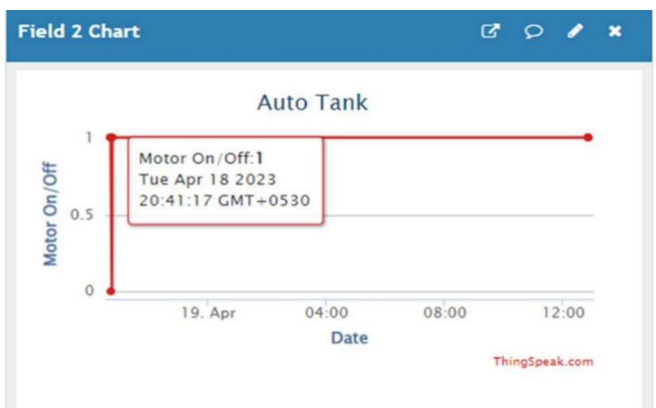

Fig 4.2. Motor ON/OFF

Table 4.1. Observations recorded

Distance sensed by Ultrasonic sensor (cm)	Water Level	Motor	
		ON	OFF
110	LOW	✓	
80	LOW	✓	
60	HIGH	✓	
20	HIGH	✓	
10	HIGH		✓

The Smart Pumping System was successfully used and evaluated. When the ultrasonic sensor detects a distance greater than 100 cm, the motor or pump automatically turns ON. It also automatically turns OFF when the ultrasonic sensor detects a distance less than 11 cm. The website responds to the parameter modification as well. The graph is updated in response to changes in the distance and water level detected by an ultrasonic sensor. The corresponding indicators also illuminate when the Motor is ON, Water Level High, Water Level Low.

CONCLUSION

To sum up, the automated water delivery system created in this project using two ESP8266 microcontrollers and cloud connectivity is a creative approach that can greatly increase the effectiveness and dependability of water supply systems in residential areas. When the water level in the tank drops below a predetermined level, the system uses ultrasonic sensors to monitor it and automatically replace it. When the water level drops below the threshold, a cloud signal activates the motor at the dam or riverfront, and the engine pushes water into the tank until the water level reaches the necessary level. then the motor is turned off by the system. Monitoring the water level and motor status via the cloud channel makes it simple to keep tabs on the system's functioning. This approach may be a sustainable way to guarantee a steady supply of water in residential areas while also lessening the administrative burden on the regulatory authorities in charge of regulating these systems.

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