Automatic Water level Controller using IOT

Janardhan Gurram[1*], *P. Vinodh Kumar*[2], *Makam Pravalika*[3] *and T. Venkat Narayana Rao*[4]

[1]Senor Assistant Professor, EEE Dept. CVR College of Engineering, Hyderabad, Telangana, India.
[2]Associate Professor EEE Dept. CVR College of Engineering, Hyderabad, Telangana, India.
[3]Assistant Professor Department of CSE-IOT, Sreenidhi Institute of Science and Technology, Yamna pet, Hyderabad, Telangana, India.
[4]Dr.Venkat Narayana Rao, Professor and HOD CSE-IOT, Sreenidhi Institute of Science and Technology, Hyderabad. Yamna pet, Hyderabad, Telangana, India.

Abstract. Many people living in residential areas experience problems with their water tanks, such as running out of water or experiencing overflow due to an excess supply. It can be difficult for users to judge the water level more precisely in their tanks, leading to potential overflow when the pump is turned on. This project seeks to answer these issues by implementing a water tank management system. By incorporating a water level sensor, users can observe the water level in their tanks and the motor pump will turn on automatically when the water level drops below the lower reference point. In the event of an overflow, the sensor will detect the high-water level and turn the motor pump off automatically, thereby preventing the wastage of water and conserving electrical energy.

1. Introduction

The Automatic Water Level Controller with IoT is a state-of-the-art system designed to provide efficient water management by exploring the power of the Internet of Things. Water is a precious resource, and its conservation has become more important with the growing population. The system is a smart and effective solution for maintaining water levels in tanks and reservoirs, ensuring that there is no wastage or overflow [2]. The system employs advanced sensors and connecting technology to indicate water levels in real time purpose. The sensors installed in the tanks detect the water level and send the data to the IoT platform [4]. The IoT platform then processes the data and provides an accurate reading of the water level, which is displayed on the user's dashboard [3]. The user can set specific water levels and customize alerts based on their requirements. For example, if the level of the water in the tank drops below a particular level, the system can trigger a pump to fill the tank with water from an external source or provide an alert to notify the user. This ensures that there is always sufficient water available in the tank for various purposes, such as irrigation, household use, or industrial processes [10].

The Automatic Water Level Controller with IoT is designed to be user-attractive and easy to install. The system can be integrated with mobile devices, computers, and other digital

* Corresponding author: janardhamn.gu@gmail.com

platforms, allowing users to monitor water levels remotely, receive alerts, and adjust the system [4].

Overall, the Automatic Water Level Controller with IoT presents a cost-effective, sustainable, and convenient solution for managing water resources, making it a reliable choice among homeowners, businesses, and industries alike[4]. With its advanced technology and features, it offers a promising solution for sustainable water management practices, promoting water conservation, and reducing water wastage [3].

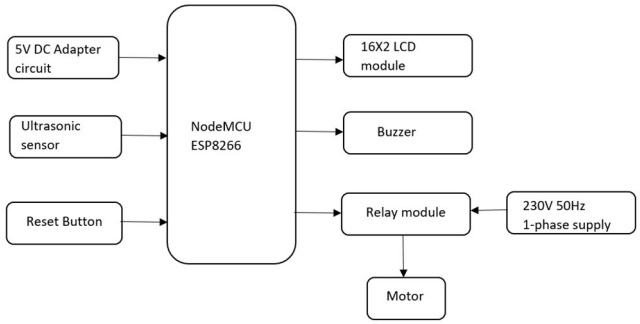

Fig. 1. Graphical representation of Proposed Automatic Water level Control using IOT.

Table 1. Components required.

Components chosen	Specifications
Node MCU/ESP8266/ESP32	32 bit onboard Processor, 120MHz frequency (Wifi Enabed)
Hi-Link Power supply	5V, 1A, 5Watts
Display	128*64 LED Display/LCD Display
Ultra sound Sensor	Operating Frequency 40MHz, 3Cm-3.5M
Relay Module	5V,70mA time of operation <10msec

1.1 Proposed Prototype

1.1.1 NodeMCU

The NodeMCU is a versatile firmware and development kit that simplifies the process of building IoT projects. The platform is built on the ESP8266 microcontroller, which is a low-cost, with an inbuilt Wi-Fi chip that can be programmed using Lua scripting language[7]. With NodeMCU, users can easily connect to the internet and control various devices such as sensors, motors, and lights. Additionally, NodeMCU serves as a platform for developing web-based applications and controlling devices through a web interface[4]. One of the benefits of NodeMCU is its ease of use, making it accessible for both beginners and experts. The user-friendly interface and large community of developers create an environment that supports the development of libraries and tools that simplify programming. NodeMCU has many applications, including home automation, remote monitoring, and data logging, and its popularity has grown due to its versatility, ease of use, and affordability[2].

1.1.2 Power supply

A 230V AC to 5V DC adapter is a device that converts high-voltage alternating current (AC) into low-voltage direct current (DC). The adapter is commonly used to power low-voltage electronic devices, such as mobile phones, routers, and small appliances [3].The adapter typically comprises a step-down transformer, a rectifier, and a voltage regulator. The transformer reduces the incoming voltage to a required lower level, which is then rectified to produce a pulsating DC voltage [7]. The voltage regulator then filters the DC voltage to produce a steady and regulated 5V DC output, which is then supplied to the electronic device. The adapter is designed to be safe and efficient, and it typically comes with various safety features such as protection against over current, protection against over voltage, and short-circuit protection. These features help prevent damage to the electronic device being powered and ensure the user's safety. Overall, the 230V AC to 5V DC adapter is a crucial component for powering low-voltage electronic devices, and it is widely used in different variety applications, including homes, offices, and industries. Its small size, portability, and ease of use make it a great choice among consumers and electronics manufacturers [10].

1.1.3 Ultrasound Sensor

An ultrasonic or distance sensor is an electronic component that emits high frequency signals and detects its reflection to detect distance or detect the presence of objects. The sensor typically contains an ultrasonic transmitter that generates sound signals at a frequency higher than the human hearing capacity, and a receiver that detects the sound waves reflected by an object [4]. The sensor works based on the time required for the sound waves to reach the object and back. By measuring the time taken between the transmission and reception of the sound waves, the sensor can calculate the distance of the object from the sensor [3]. This technique is used in various applications, including distance measurement, obstacle detection, and level sensing [10]. Ultrasonic sensors are used widely in automation, robotics, and industrial applications, where they are used to detect objects, measure distances, and control the movement of machinery [2]. They are also used in automotive applications, such as parking sensors and collision avoidance systems. Overall, ultrasonic sensors are the most reliable devices that offer a non-contact and accurate method of sensing objects and measuring distances. Their ease of use, low cost, and high precision make them a popular choice for a wide range of applications.

1.1.4 Relay Module

A relay is an electrical switch that can be controlled by a low-power signal to switch on or off a high-power circuit. The relay works using an electromagnet that mechanically moves contacts to complete or break a circuit. The primary function of a relay is to allow control of circuits with high voltage or current using low voltage or current signals, thereby protecting the low-power signal source from damage[3]. In addition, relays are useful when there is a need to control multiple circuits using a single control signal, as in many automotive and industrial control systems. Different types of relays are available, including electromechanical, solid-state, and reed relays, with each type having its own advantages and limitations.

1.2 BLYNK IOT

Blynk is a web-based application with which we can easily implement IoT applications. Blynk provides header files for Arduino boards, NodeMCU ESP8266, etc [9]. With which we can easily connect Arduino devices with IoT and share data between devices. For this project, we used the free version of Blynk which is enough to demonstrate but if we want to work with multiple devices, we need to use the premium.
Blynk Library: This is the core library for Blynk and provides the communication interface between your device and the Blynk app. It supports a different of communication methods, which includes Wi-Fi, Bluetooth, Ethernet, and cellular [1].Widget Libraries: Blynk provides a range of widget libraries that you can use to create custom interfaces for your connected devices. These libraries include widgets for buttons, sliders, graphs, LCD displays, and more.

Simple Timer Library: This library provides a simple way to set up timed events in your Blynk application. One can use it to schedule events, such as turning a device on or off at a specific time [9]. Blynk Timer Library: This library provides a more advanced timer system for Blynk applications. It allows you to set up multiple timers, each with its own interval and callback function. ESP8266WiFi Library: This library is used to connect ESP8266-based devices to Wi-Fi networks. It provides a range of functions for connecting to Wi-Fi, configuring the network settings, and monitoring the connection status [7]. Adafruit GFX Library: This library provides a range of graphics functions for creating custom interfaces on devices with graphical displays. It includes functions for drawing shapes, text, and images [9]. Adafruit SSD1306 Library: This library is specifically designed for devices that use the SSD1306 OLED display. It provides a range of functions for controlling the display, including drawing graphics and displaying text [1].

2 Software and Setup

2.1 software

- Arduino code (C++)
- Hypertext Markup Language and Cascading Style Sheets
- JavaScript

2.2 Setup Process

In the initial setup process, the device acts as the server and enables a hotspot. So, we need to make ON the wi-fi in our Mobile and connect to the “My Tank” hotspot. Then we need to browse 192.168.4.11 in any web browser[9]. This will launch a website on the device where we need to provide the following details

- Wi-Fi name (SSID)
- Wi-Fi password
- Auth Token (each device has a unique token)
- Height of the tank

After providing all the above details on clicking submit. Our ESP8266 Load all the details from the server to EEPROM (Electronically Erasable Programmable Read-Only Memory). Hence the details are stored permanently on the device. Now the device gets restarted automatically and connects to wi-fi if available otherwise device continues to run in offline mode. In offline mode, we cannot control the device remotely.

3 Operation and Control

This switch is provided for directly turning on and off the motor from the device. This is connected in such a way that the automatic operation done by the controller will not affect the motor status. If the user turned the motor ON with this switch the motor will be on even after the tank is full. Users need to take care of it [12]. Here we consider 4 cases,
Below 30% - In this case, the device turns on the motor.
Below 20% - In this case, the device raises.
an alarm, as this level is reached only when the device is not able to turn on at the level of 30%. Above 70% - In this case, the device turns off the motor. Above 85% - In this case, the device raises an alarm, as this level is only reached when the device is failed to turn off the motor at a level of 70%.As the device continuously monitors the status of the tank with the ultrasonic sensor, we can be able to handle many cases like a failure of the sensor, failure to turn off the motor, failed to turn on the motor.
The device manufacturing includes essentially a prototype which includes wifi enabled controller, ultrasound sensor to detect water level , a relay to operate the motor and display to indicate the level of the water in the tank. A 5V high link power supply device to supply power to the controller is embedded in the device shown in Fig.2

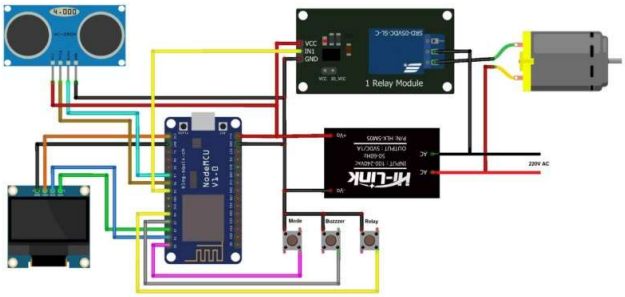

Fig. 2. Circuit diagram Proposed Automatic Water level Control using IOT.

(a) (b) (c)

Fig. 2. Prototype of Proposed Automatic Water level Control using IOT.

The prototype of the automatic water level indicator and actuator are embedded in the box shown in Fig.2(a) and (b). Fig.2(c) shows the Blynk interface of the level of water on a dial indicating 58% of the water level is shown.

3.1 Sensor Reading /Error Handling

3.1.1Indicators on the device
Green LED to indicate the motor status i.e., glowing indicates motor ON.
Red LED to indicate the Error. Blinking faster (100 milliseconds delay) indicates sensor error and blinking slower (500 milliseconds delay) indicates wi-fi error.
3.1.2 Using the button on the device.
Users can perform two actions using this button ***Restart:*** Restart can be done by pressing the holding button for less than 5 seconds. This will restart the device where no data is lost.
Reset: Reset can be done by pressing and holding the button for more than 5 seconds. This will erase all the data related to wi-fi credentials. This will prompt the user again to the setup stage.
3.1.3 Sensor Reading Accuracy Handling.
As we are using an ultrasonic sensor for getting the level of water in the tank some error readings may come to the device due to the reflection of sound with the walls of the tank, movement of water while filling., etc. To handle these cases, we take the readings from the sensor which are under the height of the tank and also we provided enough delay to avoid receiving old transmitted sound waves. For improved accuracy, we performed an average of three readings which validated the above condition. As the device will refresh its status every 3 seconds even if some error occurred in reading in the next reading device will set the status back to correct working condition.
3.1.4 Error Handling
The code is written like that the device can detect the following error

- Device can detect whether the sensor is working properly or not. If the readings from the sensor are not in the range of the height of the tank the device will start alerting the user.
- The device will indicate the status of the connection to the Wi-Fi network. If there is any issue with connecting to Wi-Fi an error indicating led will glow continuously.
- Device can also be able to detect the status of the motor based on the water level in the tank. Hence if any case motor controlling failed device raises an alarm.

3.1.5 Features

- Monitors the live status of the tank.
- Automatic turn on and off motor based on the status of the tank.
- We can monitor and control the device from mobile.
- Provides automatic mode and manual mode.
- Self-damage detection and alerting (wi-fi errors, sensor errors).

4. Conclusions

The automatic water level controller and indicator using IoT with an ultrasonic sensor and Blynk IoT application, along with the ESP8266 controller, is a reliable and efficient solution for managing water levels in various applications[7]. This technology offers several benefits, including accurate and real-time monitoring of water levels, automatic water supply control, and remote access through the Blynk application. Additionally, this system is easy to set up, affordable, and customizable to meet specific needs[2]. With the increasing demand for efficient and sustainable water management solutions, the automatic water level controller

and indicator using IoT technology provides an innovative and practical solution that can contribute to improving water conservation efforts globally[3]. The automation of different systems and components has significantly increased in recent years, aimed at reducing human intervention and saving time. Improper water management can have significant negative impacts on both the water distribution system and the environment. The primary objective of this project is to reduce the need for manual labour and to ensure the efficient use of water resources. The Automatic Water Level Controller with IoT provides an innovative solution for sustainable water management practices. The system significantly reduces the need for human intervention and can be easily installed, making it suitable for a wide range of users. With the growing concern for water conservation, this system presents a promising solution for addressing water scarcity and wastage challenges. Its efficiency and ease of use make it a suitable option for large-scale applications, and it is poised to play a significant role in ensuring the efficient and sustainable use of water resources.

5. References

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