Sri Lanka Institute of Information Technology

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A water tank monitoring system

Proposal Document

Group 04

IT Number	Name
IT24100307	I.G.C. Bandara
IT24102800	K.R.D.A.P.M. Rajapaksha
IT24102611	H. H. Hassan
IT24103615	F.M. FAYAD
IT24103157	M.N.R. AHAMED
IT24100844	E.M.N.N. Ekanayaka
IT24102935	R.M.K.V. Rajamanthree

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Introduction

Most of the regions across the globe are haunted by problems related to inadequate water or improper management of water. Almost all residential areas have the common problem of inconsistent levels of water availability in their water tanks at homes, which usually results in either wastage or a shortage of water. We intend to develop a monitoring system called "Water Tank Monitoring System" efficient and automatic in managing household water tanks.

This project, therefore, is about the design and development of a smart water tank monitoring system using Arduino and the Blynk app. The constituents for this system are the microcontroller Nodemcu ESP8266, an ultrasonic sensor that would measure the water level, a relay module to turn on or off the water flow, and an LCD display to indicate real-time water level measurement. Other than these, there are LED indicators to produce visual warnings, and the whole system will be monitored and controlled via smartphone or computer.

This system will ensure proper utilization of the water resource and prevention of wastage through overflowing or dry tanks and, at the same time, contribute to efforts involved in saving water. Automation is a way of convenience and thus sustains the concept of sustainable water management.

Problem and Motivation

Problem

Water management remains a very serious issue worldwide in urban and rural areas. The problem area is the lack of efficient monitoring and control of the water level in the storage tanks. Conventional management is by hand, which is not only labor-intensive but also very prone to human error. This might make many problems when managed manually, such as:

- ***Overflow of water:*** Water drains out unnecessarily from the tanks most of the time due to overflow, if required intervention is not taken on time.
- ***Water Shortage:*** On the other hand, lack of timely topping up leads to water shortage in the organization, which in turn affects daily activities and operations.
- ***High Utility Costs:*** Inefficient water use and overflow raise the water bill, directly impacting operational cost increases.
- ***Environmental Concerns:*** Water wastage due to overflow contributes to environmental problems and diminishes water resources, hence affecting the ecosystems.

In these challenges, it identifies the urgent requirement of an automatic, reliable solution to manage and control water levels within storage tanks efficiently.

Motivation

An automated monitoring system would help resolve the problem of inefficient water management and offer an array of benefits to society.

- ***Water Conservation:*** An automated system constantly monitors the level of water and prevents overflowing, allowing pumps to turn on and off at the moment for the perfect consumption of this precious resource, thus avoiding wastage, hence saving a lot of water resources globally.
- ***Cost Efficiency:*** It assumes control of the water level and self-monitors, thus reducing any necessity for manual intervention. This saves not only time but also costs related to labor feasible in water management.
- ***Convenience and Reliability:*** This will keep users updated with the water tank system from anywhere and control it with the implementation of the Blynk app, making it very convenient with an assurance of reliable management of water levels without its continuous manual checking.
- ***Technological Advancement:*** The implementation of the IoT-based solution gives a touch of modern technology in real-life applications. This would further increase the demand for smart solutions in other areas of resource management, hence driving innovation and further improvement of technological capabilities.

The accruable benefits from the automated water tank monitoring system are to be harnessed toward efficient and sustainable management of water resources. This work will help act as a practical example of using IoT technology in bettering everyday living and improving environmental and economic benefits.

Aim and Objectives

Aim

This project can be said to entail the development of a fully automated, effective, and controlled water tank monitoring system using Arduino technology with the Blynk remote measuring and control app to promote water conservation while giving convenience in remote monitoring and control.

Objectives

Design and Build the Hardware System:

- Assemble the Nodemcu ESP8266 microcontroller with an ultrasonic sensor, relay module, LCD screen, I2C module, LED bulbs, resistors, jumper wires, and a breadboard.
- Ensure proper connections and functionality of all components to measure water levels and control the water pump (*here we have decided to use a fan to represent the water pump*)

Develop the Software Interface:

- Programing the Nodemcu ESP8266 for an interface with the ultrasonic sensor for accurate measurement of water levels.
- Implementing the control logic to turn ON or OFF the module according to predefined water level thresholds.
- Displaying real-time water level data on the LCD screen and LED indicators.

Integrate with the Blynk App:

- Connect the Blynk app to Nodemcu ESP8266 for remote monitoring and control using a smartphone or computer.
- Configure the app to display water level data and control the water pump remotely.

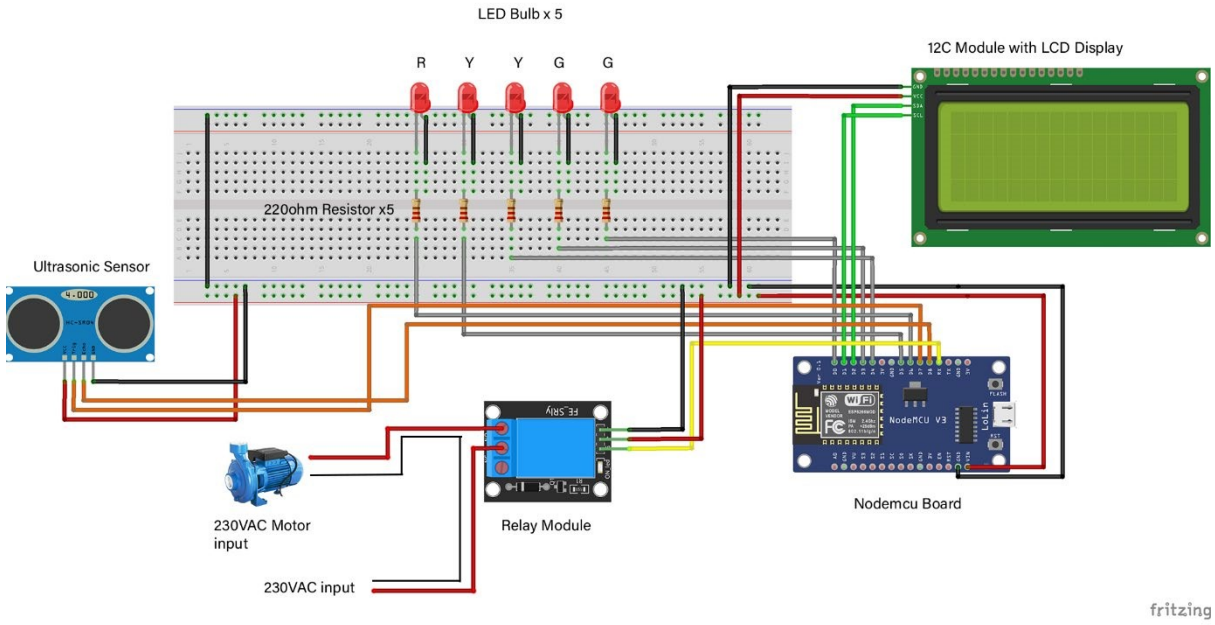
Testing and Validation:

- Testing the hardware and software elements to make sure that the water level reading is correct and the pump control reliable.
- Checking the performance of the system under various conditions to ascertain its robustness and efficiency.

System Diagram

Below is the system diagram for the water tank monitoring system. It shows the overview of the various blocks of the system and their interconnections, showing how they help the system work together in unison.

- ***Nodemcu ESP8266:*** It is used as the central microcontroller unit, reading data from the ultrasonic sensor and controlling the relay module with an LCD display.
- ***Ultrasonic Sensor:*** Installed at the top of a water tank, this device can measure the level of the water by sending out ultrasonic pulses to calculate its distance by the time it takes for the waves to bounce back.
- ***Relay Module:*** This module is connected to the water pump and controls the on/off of the pump with respect to the signals received from the Nodemcu ESP8266.
- ***LCD Screen (with I2C Module):*** Displays real-time water level data. The I2C module simplifies the connections to the Nodemcu ESP8266.
- ***LED Bulbs***: Provide a visual indicator of the water level, with different colors representing various levels (e.g., full, half, low).
- ***Power Supply***: Provides necessary power to all the components.
- ***Blynk App:*** Allows one to monitor and control the system from a distance using a smartphone or computer, where the Nodemcu ESP8266 communicates via Wi-Fi with the Blynk app.



(*here we have decided to use a fan to represent the water pump*)

Methodology

The Water Tank Monitoring System will be developed through hardware assembly, software development, and system integration. The methodology will be performed in the steps as follows

Component Selection and Procurement:

- Sourcing and purchasing all these components upon need: NodeMcu ESP8266, ultrasonic sensor, relay module, LCD, I2C module, LED bulbs, 220-ohm resistors, jumper wires, breadboard and fan to represent the water pump

Hardware Assembly:

- Place the components on the breadboard according to the design of the circuit.
- Connect the ultrasonic sensor with the Nodemcu ESP8266 to measure the water level.
- Wiring the relay module to drive the fan.
- Connect the LCD display with the I2C module to work out a display of the water level readings.
- Set up LED indication for the water level.

Software Development:

- Write the Arduino code for the interface of the ultrasonic sensor in measuring the water level.
- Add control logic to the code to turn on or turn off the relay module according to the water level.
- Write code to show the water level on the LCD and control the LED indicators.

Blynk App Integration:

- Create a project in the Blynk app, add widgets, and adjust them to monitor and control the water tank system.
- Write a code using the Blynk Library, establishing the communication between Nodemcu ESP8266 and the Blynk app.
- Create virtual pins in the Blynk app to receive the water level data and transmit the control signals to the relay module.

System Integration and Final Testing:

- Integrate all the components of the system and conduct final testing to ensure everything works according to expectations.
- Test the integration with the Blynk app to ensure everything is fine for remote monitoring and control.

Evaluation Method

Testing of the monitored water tank system will be done using various tests to prove the demands it shows and works reliably at different times. Following are the methods which shall be used for evaluation

Functionality Testing:

- Integration Testing: The whole thing will be tested to ensure that all the ingredients of the system work together seamlessly. This is for verifying that communication between the Nodemcu ESP8266 and the Blynk app is proper.

Accuracy and Calibration:

- Water Level Measurement Accuracy: The accuracy will be tested based on the readings obtained with the ultrasonic sensor, opposed to real values of the water level measured. Several measurements will have to be taken to prove consistency and reliability for different water levels.

Performance Testing:

- System Response Time: The time taken for the system to respond to changes in water level and update the display on the LCD screen and Blynk app will be measured.

Remote Monitoring and Control:

- Blynk App Functionality: The testing to be done will involve real-time data on the water level displayed on the Blynk app and remote control of the water pump. It tests the user interface of the app about user-friendliness and responsiveness.

Conclusion

The "Water Tank Monitoring System" basically is a technical approach to the most critical problem related to water management using Arduino and the Blynk app. Not only does this system save water, but it also has the economic and environmental benefits associated with automating the monitoring and control of water levels. The project can be useful to demonstrate the practical ability of IoT technology in everyday life by implementing accurate sensors, reliable control mechanisms, and a user-friendly interface.

The methodology to be proposed will ensure that the design, development, and testing of the system are all systematic in undertaking to achieve the intended objectives. The methods of evaluation indicated will prove the functionality and accuracy of the system and user satisfaction and, furthermore, confirm that it reliably works under various conditions.

The problems associated with manual water management are addressed in this project, hence contributing to the sustainability of resource management and encouraging the need for the adoption of smart technologies in daily applications. The successfully executed outcome of this project will be useful for households and facilities, providing them with a realistic solution for waste and problems linked with the management of water.

We are confident that this Water Tank Monitoring System will be worth the effort; a lot of associated benefits and model solutions for other IoT-based resource management solutions accrue. We express great desire to put this project before the audience in the best possible way.

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