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Monitoring Water Storage System Based Internet of Things (IoT)

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Abstract: The Monitoring Water Storage System Based Internet of Things (IoT) is a water level monitoring system specially designed for water tanks at home to solve the problem for residential household to prepare for the water shortage. The system is built to monitor the tank's water level and prepare them to save the remaining water inside the tank if any unwanted things happen during the time. This system is designed using HC-SR04 ultrasonic sensor, a solenoid valve, and the Blynk IoT platform. The ultrasonic sensor evaluates the water level in a tank and sends the data to the Blynk application, following the user to monitor the water level in real-time. Furthermore, the system controls the solenoid valve to open and close the water flow based on water level which the user has set the minimum and maximum value of the tank. The system has succeeded in monitoring the tank's low, medium, and high volumes of water. This system also can provide a cost-effective solution for monitoring and controlling the water level in a tank and can be used in various applications such as in agricultural, residential, or commercial applications.

Keywords: Water Storage Monitoring, Internet of Thing, Blynk Platform

1. Introduction

Every creature, notably people and animals, requires enough clean water to support sustained economic and everyday living activities [1]. In Malaysia, the water supply shortage is a big issue that needs to be addressed. With the rising in population and urbanization in Malaysia the authorities must be the one that cater the rising demand to keep the sustainable of the clean water. Moreover, according to the data from the National Water Services Commission (SPAN) in [2], the average daily water consumption per person in Malaysia is about 201 litres. This is equivalent to consuming approximately 134 bottles of water with a capacity of 1.5 litres each. It's worth noting that this estimated daily use is higher than the amount suggested by the World Health Organization (WHO). As a result, having a reliable monitoring system is necessary, especially for residential homes where it may help residents plan for water shortages. This project focuses on rural areas, especially at Pasir Mas, Kelantan because it has been a regular occurrence for the villagers [3]. Due to the inconsistent water supply, they did not know when their storage water tank would deplete or when the water would fill. Therefore, in this

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project, a monitoring water storage system based IoT is suggested to make things, especially for the villagers, to monitor the water tank level and can give them a heads-up to save the remaining water inside the tank if there are any unpleasant scenes happen. Blynk is used for monitoring applications. As stated in [4], Blynk is a system that allows users to monitor the water level through their mobile phones using a Blynk interface. When the user presses a button on their mobile phone to operate the motor, the command is sent to the Arduino. The Arduino then uses this command to control the motor and adjust its action accordingly.

This water storage system-based Internet of Things (IoT) uses microcontroller NodeMCU ESP32. ESP 32 is used for this work focusing on testing water quality and quantity to save water. The ESP32 was chosen for this project because of its advantages of high frequency, low cost, built-in sensors, and Wi-Fi and Bluetooth integration. It speeds up to 150Mbps and is simple to set up. Apart from that, the monitoring water storage system based the Internet of Things (IoT) uses an ultrasonic sensor to measure the level of depth water (cm) in the tank. According to [5], an ultrasonic sensor is used to measure the distance of a target. It works by emitting ultrasonic sound waves and then detecting the reflected sound, which is then converted into an electrical signal. One of the benefits of using this type of sensor is that it can be produced at a lower cost compared to other alternatives, making it a cost-effective choice that can help keep project expenses down.

The solenoid valve additionally manages the water flow. Based on [6], states that a solenoid activates a plunger or armature in a solenoid valve, an electro-mechanical valve frequently used to control the flow of liquid or gas via a valve body. The solenoid valve will act as a controller to control the flow of water to flow-in inside the tank. When the plunger or armature is opened and fill the tank with water, the water will flow through the pipe when the current powers it.

2. Methodology

This part describes the methodology used to develop the water storage monitoring system based on IoT. The first part shows the complete block diagram of the system, and the next part explains the flowchart of the system mechanism and the details of each mechanism.

2.1 Block Diagram

The block diagram of monitoring water storage system based IoT is shown in Figure 1. Based on the block diagram, it shows the flow of the system which is the input, process and the output. The ultrasonic sensor works as input in this system where it needs to read the volume of water inside the tank. Blynk server and NodeMCU ESP32 as the process in this system. Lastly, solenoid valve and Blynk application are the output of the system.

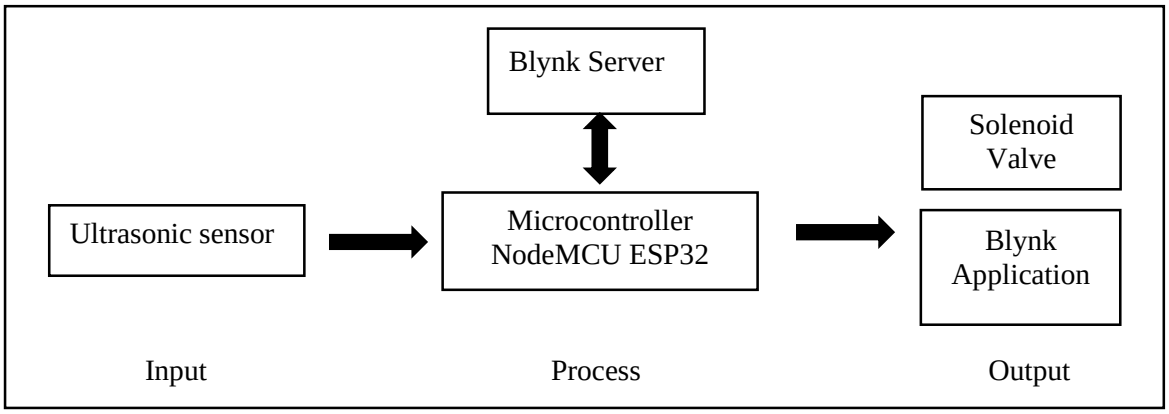

Figure 1: Block diagram of monitoring water storage system based IoT

2.2 Flowchart

The flowchart in Figure 2 shows how the monitoring water storage system based IoT system works. Firstly, when the supply is turned on, it will initialize the ultrasonic sensor module. Next, the ultrasonic sensor will calibrate and check the value inside the water tank. After that, the input data from the ultrasonic sensor will be transferred to NodeMCU. If the tank is 90 percent full, the solenoid valve will turn off, and at the same time, it will send the data of the current water value to the Blynk application. Meanwhile, if the tank is below than 70 percent, the solenoid valve will turn on, and at the same time, it will send the water level data to the Blynk. This process keeps on repeating continuously.

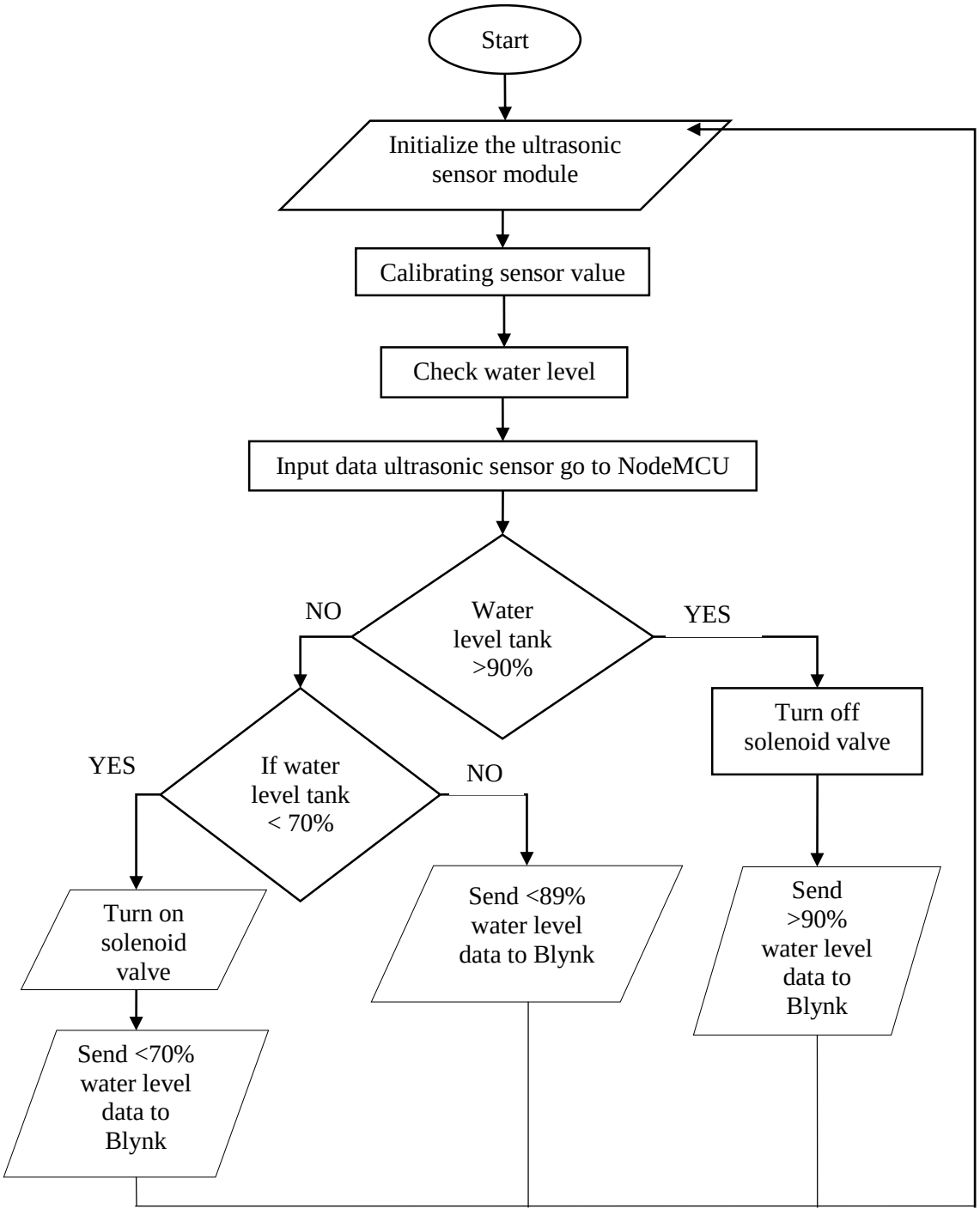

Figure 2: Flowchart of The Monitoring Water Storage System Based IoT

3. Results and Discussion

The outcome that has been achieved throughout this study are analyzed and explained in this section. The system has been done through the testing on the prototype. This testing is to observe the functionality and performance of the system.

3.1 Functionality of The Prototype System

Figure 3 shows the condition of the low water level inside the tank is filling automatically determined from the reading of the ultrasonic sensor. In the water tank, the solenoid will turn on automatically when the water level is below 19 cm which is less than 70 percent of the tank. Through the Blynk Application based on the Figure 3, the water in the tank is 3 percent therefore solenoid valve is on, and the water start to fill up in the tank. Based on Figure 4, water level in the tank is 92 percent which is 25 cm. In this condition solenoid valve has been turned off automatically to stop the water from flowing inside the tank. If water inside the tank flow-out (been used), and it reach the minimum level (70%) the solenoid will turn on and water start to fulfil the tank again. This process will keep on going repeatedly. Next, the Blynk application shows the tank's water level in real time and allows users to visualize water level data.

Figure 3: Low water level

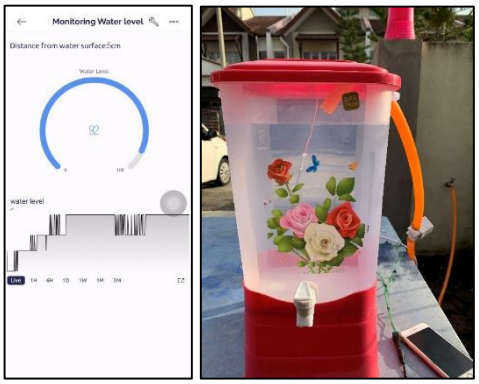

Figure 4: High water level

3.2 Testing on Performance of The System

The testing is done to evaluate the performance of the ultrasonic sensor detection and Blynk applications for monitoring. In general, water monitoring is designed to detect the height of water in the tank and help users monitor the quantity of water inside the tank. The system can show an interface that can display the quantity of water level inside the tank. It can show the level status from 0% - 100% condition water level inside the tank. There are three conditions level that has been testing in this system which is high level when the level is at 81% - 91% with the height of the water being at 22 cm – 25 cm. Next is the middle level when the level is at 59% - 70% with the water level height being 16 cm – 19 cm. Lastly, low level when the water is 29% - 37% with the height of the water is 8 cm – 10 cm.

Table 1 shows the system experiment on testing the ultrasonic sensor. The ultrasonic sensor is tested on the three condition which is low, medium, and high. The data that has been obtained is to compare the height of water by giving the actual height data and the ultrasonic sensor read the water. The result will show the difference of error value between the sensor read and the actual water level.

Table 1: Ultrasonic Sensor Testing by given actual value

No	Display Value in Blynk Application (%)	The Actual Water Level to Fill the Tank (cm)	Water Level Using Ultrasonic Sensor (cm)	Error Value (cm)	Condition of Water
1	29%	8	7	1	Low
2	37%	10	10	0	Low
3	59%	16	15	1	Medium
4	70%	19	19	0	Medium
6	81%	22	22	0	Full
7	91%	25	25	0	Full

Figure 5 shows the comparison between the actual water level and water level using ultrasonic sensor. In terms of precision for the height of water within the tank, there is a little variation between actual level and ultrasonic sensor. The difference may happen because the principle of the ultrasonic sensor emits the sound waves to the surface to detect the actual distance and bounce back to read the data from the detection. In this case, refraction may be happened because sound waves emitted by the ultrasonic sensor may be refracted (bent) as they pass through the water, which could cause the sensor to measure a different distance than the actual water level.

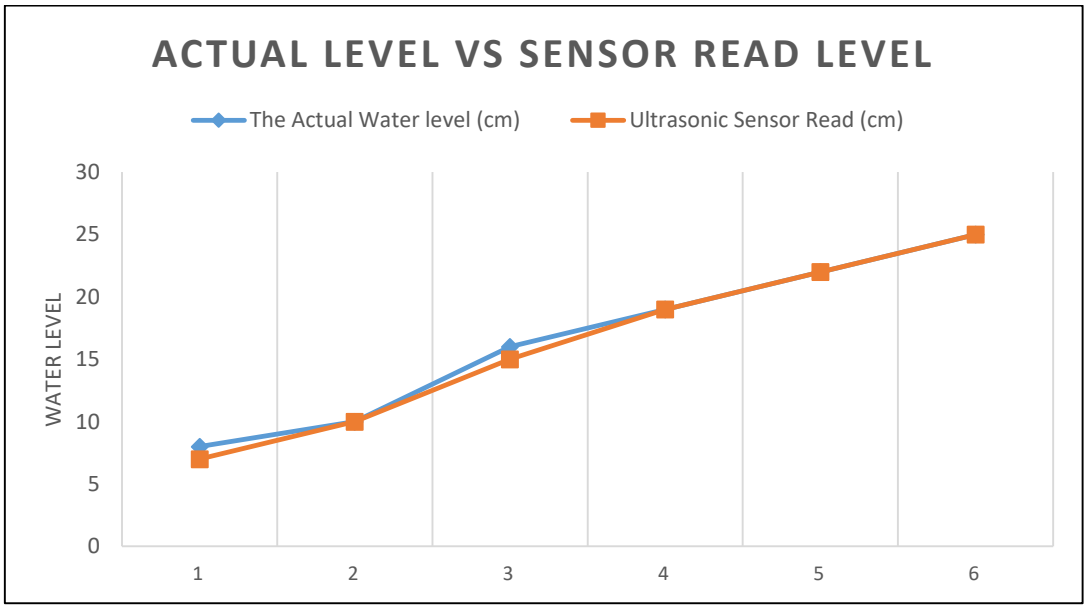

Figure 5: The graph of comparison between the actual water level and ultrasonic sensor read level

Figure 6 shows a testing for the Blynk application to monitor water level in three condition which are low level, medium level, and high level. The water automatically filling in the tank when it is in a low state of condition, medium state, and high state by monitor in the Blynk Application. The interface of gauge displays the percentage of water inside the tank it can indicated the quantity of water inside the tank. Furthermore, the graph is generated based on real time monitoring and the system has been working perfectly according to the instruction set.

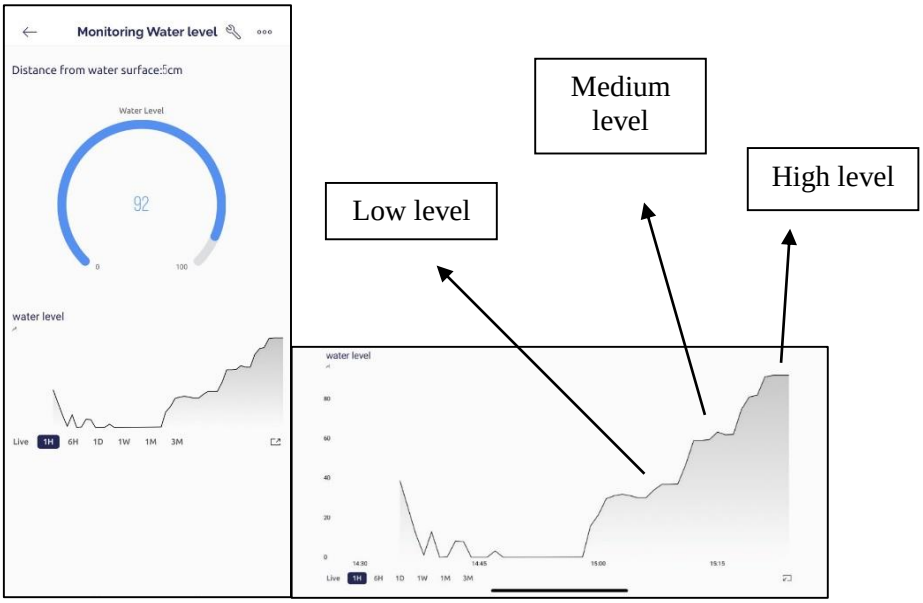

Figure 6: Testing the water level condition in the tank using Blynk application

4. Conclusion

For the conclusion of the Monitoring Water Storage System based Internet of Things (IoT) that has been done it can conclude that the system is successfully working through the testing on the prototype. The testing that has been done to test the functionality of the ultrasonic sensor when reading the data of water level, solenoid valve for controlling the water flow to fulfil the tank with instruction set from the ultrasonic sensor and Blynk application to monitor the status water inside the tank. In the Blynk application interface, it can show the water level in three condition which is low state, medium state and high state of water inside the tank.

Acknowledgement

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