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# Water Level Monitoring System

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**Abstract**: This paper focusing on implement a water level monitoring system that is used for water tanks in agricultural facilities to perform crop watering activities. This will improve monitoring of water level in water tank if this sector facing a water crisis such as water supply cut off. This will help the farmers to prepare the next step with help water level monitoring system that gives accurate water quantity in water tank or storage. Water Level Monitoring System is helpful to the farmers knowing the actual amount of water in the water tank for agricultural usage. Bylnk application as the Internet of things (IoT) platform that will give all the information about the water level and monitoring the activities of water consumption at a certain time. Hence, from the findings of the study, the water level monitoring system is successfully developed according to monitor the water level in the water tank. Based on the result analysis shows the Water Level Monitoring System is capable of monitoring water level and also the Blynk application successfully displays the water level and notifies if the water level is at lower condition.

**Keywords**: Water Level Monitoring System, Bylnk Application, IoT

## 1. Introduction

Technology that has an accurate, inexpensive, and reliable level of measurement is very important for today's technology so that the smooth use and the functions of the technology could be successful. In the biochemical industry, transportation, providing flood warnings, and basic water level management in homes [1]-[2]. There are many types of level control that can be done. The most common ones are those with overflow control used to prevent exceeding the maximum level of the that a storage tank can hold and those with fully drain for preventing the pomp to work without liquid. The instruments and machinery used primarily or entirely to support agricultural enterprises are agricultural technology. Plows, threshers, and irrigation systems are examples. These modes of technology, many of which are commonly used in modern agricultural environments, have a long history in agriculture and have been constantly reinvented and redesigned. For instance, ploughs were originally pulled by animals but are now typically powered by motors [3]. From a variety of sources, agricultural water comes. Surface water such as rivers, streams, and irrigation ditches, open canals, impounded water such as ponds, and lakes are typical agricultural water sources.

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The problem stamen of this paper is some of the water tanks for agriculture are still using a traditional technique. For example, some of the users need to open first the water tank to see the water level on the water tank Furthermore, some water levels are using a pressure transmitter is used for detecting levels [2]. This causes high costs when the component is broken and needs to be changed immediately. Furthermore, some of the controllers are by using PID controllers that are more complex than the Arduino [4]-[5]. On the other hand, some of the frames are still using the basic or old techniques to check the water level and some of the frames are needed to open the water tank first before knowing the condition of the water tank.

The main objective and aim of this project are to design a Water Level Monitoring System for modern agriculture to design a Water Level Monitoring System that can monitor the water level without opening the water tank. To develop a Water Level Monitoring System by using the Arduino Nano that can show the water level automatically on user devices through apps (Blynk). To evaluate the performance of a Water Level Monitoring System that can give an accurate value of the water level in the water tank.

## 2. Methodology

This section presents the framework planning that might be used to work plan regarding the topic. it comprises all of the information of the sensors and components including from microcontroller to the type of Wi-Fi module. this section also discusses the method used in order to achieve the objectives of this project. the main focuses of this chapter incorporate the design of the water monitoring system which is powered by Arduino Nano as a microcontroller as well as the application of the IoT technology that includes transmitting the data of water level in the water tank and display the data on the user device base on Blynk application.

### 2.1 Block Diagram

In this section, the project design, components preparation, application of software, and project flow will be discussed thoroughly. Referring Figure 1 shows the block diagram of the project design that is using Arduino Nano as a micro-controller and ESP8266 as Wi-Fi module that will transfer data from the Ultrasonic sensor to Blynk Application.

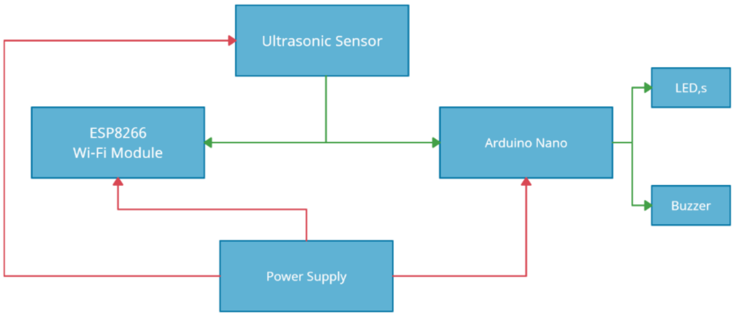



**Figure 1: The block diagram of the project**

Figure 2 shows the flowchart of the proceeds for the Water Level Monitoring System. The process will start when the Ultrasonic Sensor measures the distance between the surface of the water and the Ultrasonic sensor. The data from the Ultrasonic sensor will transfer to Arduino Nano and calculate the water level based on the formula. If the level of the water tank is in a low condition, the buzzer and LED will be activated. at the same time, the data will transfer to the Wi-Fi module NodeMCU (ESP 8266). Lastly, the data will be received on the user's smartphone via the Blynk application.

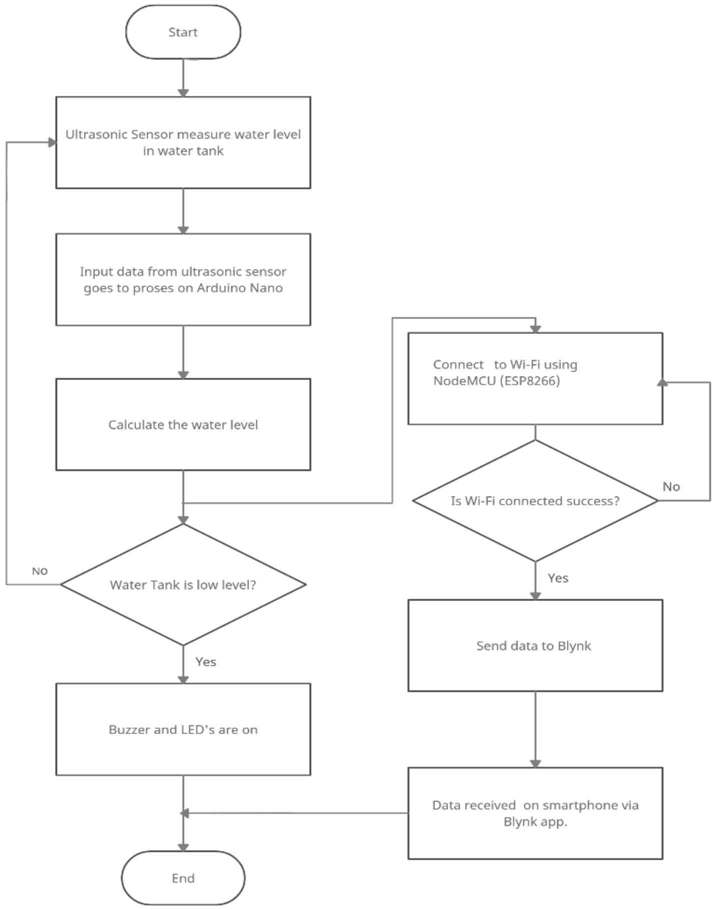



**Figure 2: Flowchart of Water Level Monitoring System**

## 2.2 Hardware Development

In order to develop the Water Level Monitoring System, a few suitable components with high performance is used to achieve the objectives. All of the components were at a reasonable cost to build an Internet of things (IoT) platform of water Level Monitoring System and each part or component has its advantages. Table 1 shows that the unit of component used in this project.

**Table 1: List of components**

| Component | Unit |
|---|---|
| Arduino Nano | 1 |
| NodeMCU (ESP8266) | 1 |
| Ultrasonic Sensor (HC-SR04) | 1 |
| Buzzer | 1 |
| LED | 5 |
| Resistor 330Ω | 5 |
| Voltage Regulator 3.3V(LD1117) | 1 |

### 2.3 Software Development

The software implemented and programmed for this project includes the Arduino Software IDE which allows the Arduino program to be uploaded to the Arduino board, as well as the Blynk IoT platform which allows users to monitor real time data on Blynk application. Blynk platform can allow the user to create a digital dashboard where can build the interface based on the function of the project. Blynk can compatible with many types of microcontrollers such as Node MCU ESP8266. The blynk application has three major components that are very useful for this project. First, Blynk application is used to control and display data on widgets. Next, Blynk serve is a cloud service responsible for all communication between smartphones and projects. Lastly, Blynk libraries, which include various widgets enable a device to send data obtained from a sensor to be displayed on a mobile application inconvenient way [6].

### 2.4 Parameter Measurement

To perform parameter measurement, water level monitoring system are use several formulas that are set up on the controller that able to measure the volume of water in litre in the water tank. In this part, there are several formulas that implement in Arduino Nano and also apply on manual calculation for these studies. For measurement volume of water in water tank formula that are used is Actual height, Volume of cylindrical (water tank) and Water in Litre. The manual calculation also uses a formula percent Error.

- Actual Height

  Actual Height is can determine as the range from ultrasonic sensor to water level in water tank. The Actual Height is expressed in mathematical form like Eq.1.

$$h = R_{max} - D \qquad \textit{Eq.1}$$

- Volume of cylindrical

  Volume of cylindrical is use due of shape of water tank in cylindrical shape. The Volume of cylindrical is expressed in mathematical form like Eq.2.

$$V = \pi r^2 h \qquad \textit{Eq.2}$$

- Water in Litre

  To obtain the value in litre, value from volume of cylindrical will convert by using this formula. The Water in Litre is expressed as Equation (3).

$$L = V/1000 \qquad \textit{Eq.3}$$

- Percent Error

  Equation (4) shows the equation Percent Error that are used in these studies to observe the error form this water level monitoring system. This equation will use measurement and manual calculation to obtain the Percent Error.

$$\% \text{ error} = \frac{|\text{m} - \text{c}|}{c} \times 100\% \qquad Eq.4$$

Where,

$h$ =Actual Height
D =Distance
$V$ =Volume of cylindrical (water tank)
$\pi$ = Pi
r = Radius
L = Litre
m= Measured
c = Manual calculation

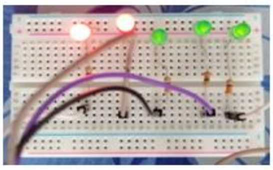
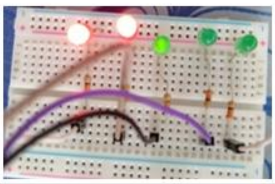
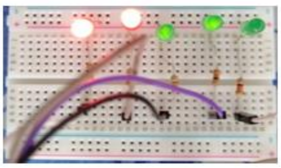
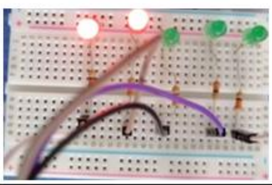
## 3. Results and Discussion

This section analyses the experimental results and progress of the project development for the Water Level Monitoring System attained from each phase of the methodology implemented from this project. For hardware results, this project needs to achieve the Water Level Monitoring System are can operate smoothly according to the four stages of distance and give a LED indicator and buzzer activated properly. The result also shows the Blynk application will display the water level in the water tank and will provide real time monitoring with giving a measurement in litres and notification if the water level is in a lower condition.

### 3.1 Hardware Results and Blynk application

The Blynk application is an application that will display the water level in the water tank and will provide real time monitoring with giving a measurement in litres. At the same time, LED indicators from the Water Level Monitoring system are have 5 LED that indicates the water level in the water tank. LED indicator has two different colours that are green and red. The green colour will indicate the water level in good condition, while the red LED will indicate low condition. All the behaviour of LED will according to the four stage of distance which are distance <= 80, distance <= 60, distance <= 40, and distance <= 20. Table 2 shows the LED indicator with different stages that will indicate the water level in the water tank.

**Table 2: LED indicator with different stages**

| LED Indicator | Blynk app. | | |
|---|---|---|---|
|  |  |  |  |
|  |  |  |  |

### 3.2 Result Realtime monitoring and calculation

For the water level monitoring systems, the measurement is ultrasonic. The sensor is important and giving high accuracy for ultrasonic reading to measure tank water level. Based on the study, the ultrasonic sensor from this water level monitoring system is used for distance measurement based on the measurement of time-of-flight. Ultrasonic sensors operate by emitting a sound wave that is beyond the human hearing range. The sensor's transducer functions as a microphone, receiving and transmitting ultrasonic sound. The experiment was conducted in two ways, first is to measure the height and the distance base on the 1000L water tank and the second test is to monitor the water level base on the precision, and data is collected from the Blynk application.

In the first experiment, the water level monitoring system needs to collect 50 different readings of height or distance base on the high of the water tank. In this experiment, the maximum height is based on the specification of the water tank is 1000 litres and has a radius of 53.2 cm. Figure 3 shows the user interface from the Blynk application that is monitoring the condition of the water level at that time. The starting measurement of height is 104.2 cm until 26.0 cm. From the height measurement, the data are collected and record the volume of the water level based on the height at that time. Table 3 shows recorded data are that have different heights the value from the manual calculation. The percent error is for comparing the real time data and manual calculation based on the formula that is used in this water level monitoring system.

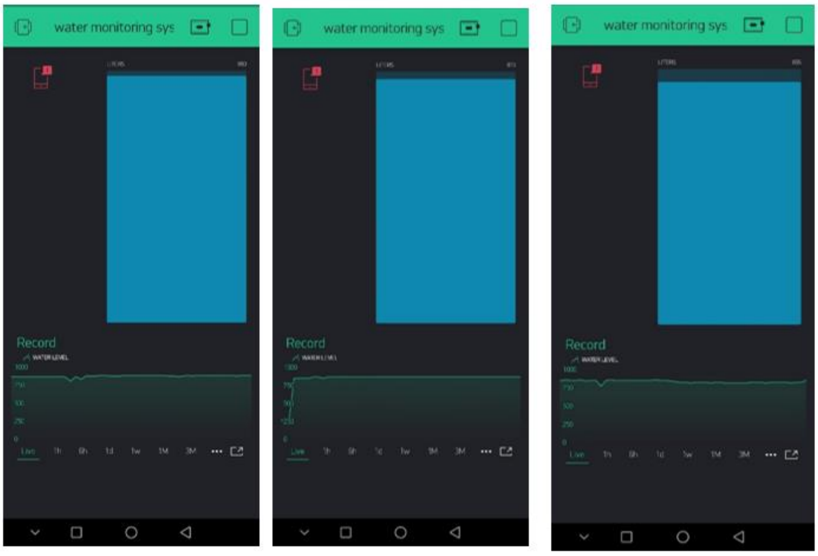



**Figure 3: The user interface from Blynk application**

**Table 3: Water level data from water level monitoring system**

| No. | Measurement (L) | Distance (cm) | Actual Height (cm) | Manual Calculation(L) | %Error |
|---|---|---|---|---|---|
| 1 | 926 | 0.8 | 104.20 | 926.02 | 0.02 |
| 2 | 890 | 4.86 | 100.14 | 889.94 | 0.06 |
| 3 | 882 | 5.75 | 99.25 | 882.03 | 0.03 |
| 47 | 61 | 98.14 | 6.86 | 60.96 | 0.04 |
| 48 | 44 | 100.05 | 4.95 | 43.99 | 0.01 |
| 49 | 35 | 101.06 | 3.94 | 35.01 | 0.01 |
| 50 | 26 | 102.07 | 2.93 | 26.04 | 0.04 |

From the result, there have 50 different heights and volumes of water level from the water level monitoring system. Based on the result, the water level monitoring system uses several formulas that are set up on the controller that is able to measure the volume of water in litre in the water tank. The maximum range that is set on the controller is 105 cm. To manage a water level measurement, the water level monitoring system uses the distance between the ultrasonic sensors to the water surface in the water tank. After the ultrasonic sensor measure the distance, the value will be used to have the actual high of the water level in the water tank. Table 4 shows all the data from this experiment including manual calculation and percent error.

**Table 4: Water level data from water level monitoring system**

| No | Measurement (L) | Distance (cm) | Actual Height (cm) | Manual Calculation | %Error |
|---|---|---|---|---|---|
| 1. | 0 | 64.00 | 0.00 | 0.00 | 0.00 |
| 2. | 9 | 59.04 | 4.96 | 8.97 | 0.33 |
| 3. | 18 | 54.10 | 9.9 | 17.97 | 0.17 |
| 4. | 21 | 52.39 | 12.00 | 21.00 | 0.00 |
| 5. | 27 | 48.87 | 15.13 | 27.36 | 0.22 |
| 6. | 41 | 41.32 | 22.68 | 41.01 | 0.02 |
| 7. | 50 | 36.20 | 27.80 | 50.28 | 0.57 |
| 8. | 75 | 22.58 | 41.42 | 74.91 | 0.12 |
| 9. | 95 | 10.98 | 53.02 | 95.60 | 0.62 |
| 10. | 108 | 3.81 | 60.19 | 108.86 | 0.79 |

Based on the result from the manual calculation for the volume of water in the water tank, in comparing the reading from real time, there is only a little difference in terms of decimal points. This is because manual calculations are set into two decimal points while the value from the Blynk application is display in whole numbers. If the decimal value will convert into a whole number, the result will give the same value with display value on Blynk application on the user device. Table 3 shows, on data number 1 the measurement value from Blynk application was a display at 926 Litre and the manual calculation is 926.02 litre. If manual calculation is converted into the whole number, the value will same as the display value on the Blynk application.

To investigate the accuracy of the water level monitoring system, the formula of percentage error will apply to this experiment. For measurement value number one, the measured value is 926Litre and manual calculation is 926.02Litre. The percent error there have on this data is 0.02%. The percent error there have on this data is 0.02%.%. Through data for present error, overall the result is not more than 0.07%. The biggest error that has on this water level monitoring system at data number 37 that have record 0.06% and all level are recoded only at range 0.01% to 0.05%.

For the second experiment, the water level monitoring system is tested to measure a real water level and observe the precision to collect the data form the Blynk application. The water level monitoring system using the same source code is but the different specification of water tank or storage. The water level monitoring system will collect 10 different data bases on the water level on the water storage. Additionally, all one set of data has 5 readings that are needed to record the value for the purpose of conducting this study.

**Table 5: Average five reading from Blynk application**

| No. | Reading 1 | Reading 2 | Reading 3 | Reading 4 | Reading 5 | Average |
|---|---|---|---|---|---|---|
| 1. | 0 | 0 | -5 | 0 | 0 | -1 |
| 2. | 9 | 9 | 9 | 9 | 9 | 9 |
| 3. | 18 | 18 | 18 | 18 | 18 | 18 |
| 4. | 21 | 21 | 21 | 21 | 21 | 21 |
| 5. | 27 | 27 | 27 | 27 | 27 | 27 |
| 6. | 41 | 41 | 41 | 41 | 41 | 41 |
| 7. | 50 | 50 | 50 | 50 | 50 | 50 |
| 8. | 75 | 75 | 75 | 75 | 75 | 75 |
| 9. | 95 | 94 | 95 | 95 | 94 | 94.6 |
| 10. | 108 | 108 | 108 | 110 | 108 | 108.4 |

In this experiment, all the data have different values, and the LED indicator has different patterns. For example, if the water level monitoring sensor indicates the water level in low condition two red LED and a buzzer is activated and a warning notification will appear on the user's smartphone. Figure 4 shows the LED indicator and notification from the Blynk application.

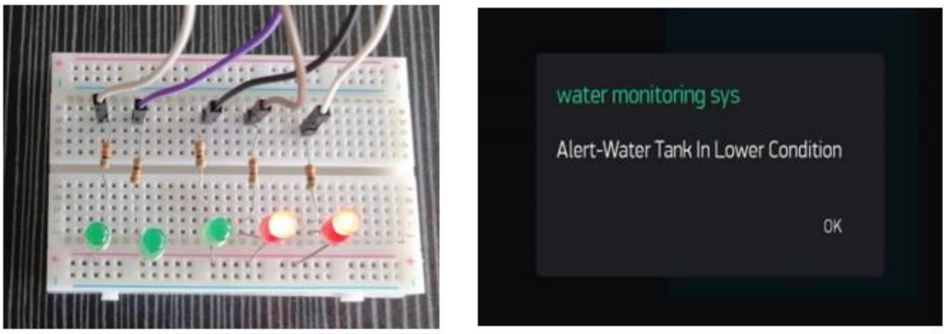



**Figure 4: LED indicator and notification from Blynk application**

This part shows the values from the water level monitoring system. Each level will be taken five times and recorded the all data in one table. Table 5 shows all the data and this data is used to observe the value from the Blynk application. All values will take the average from five readings that were taken and recoded for these studies.

From the experiment, five readings are taken and all the data have an average value from the five readings. All the data are having the same reading as all readings that are taken. But only three from ten data have differences in terms of pattern on reading value. On data number one, the difference is on reading 3 that shows value is -5L. Next on data number 9, during water level in the high condition, the water level on that time is 95L but during taking data on the second and fifth time the value show 94L. Lastly also for the water level in high condition, the fourth reading displays a value of 110L. From this experiment, equation 4.5 is used to obtain the average value of all data. From this process, there are only three data that affected due to having different readings under five readings that are taken before this. For data number one, nine and ten average value is 1L,94L, and 108.4L. The reason for this value is due to water waves in water storage water waves in the water storage causing the reading on the ultrasonic sensor to be interrupted. However, this is just a minor effect. The water level monitoring system will give back an accurate value on the Blynk application.

## 4. Conclusion

This project regarding on Water Level Monitoring System powered by Blynk application. This monitoring system will give a piece of information about the condition of the water level in the water tank. The Water Level Monitoring System will give the information to a user based on the LED indicator, buzzer, and through smartphone by using Blynk application. Overall, in this project, the water level monitoring system is successfully developed according to monitor the water level in the water tank. Based on the result analysis shows the Water Level Monitoring System is capable of monitoring water level and also the Blynk application successfully displays the water level and notifies if the water level is at lower condition. Even the Water Level Monitoring System can display the water level in a liter, the precision is slightly unstable based on percent error and average reading. It means this Water Level Monitoring System can increase the accuracy to measure the volume of water level. Therefore, further research with various forms of design can be done to improve the accuracy and precision of the Water Level Monitoring System with use a different level detection and apply two or three decimal places to display the volume of water in liter.

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