Enhanced Knowledge in Sciences and Technology Vol. 2 No. 2 (2022) 257-265

EKST

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/ekst
e-ISSN : 2773-6385

Water Level Detector System Using Copper Wire Sensor

Muhamad Norhamizan[1], Muhamad Faiz[2], Afishah Alias[3]*

[1 2 3*]Department of Physics and Chemistry, Faculty of Applied Sciences and Technology,
Universiti Tun Hussein Onn Malaysia, 84600 Pagoh, Johor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/ekst.2022.02.02.027
Received 02 January 2022; Accepted 30 January 2022; Available online 23 November 2022

Abstract: Knowing the water level in the tank is a risky task that normally leads to climbing up to the tank and manually checking the level of water or letting the water overflow from the top. Therefore, the water level detector system is built to overcome the problems, especially in their residential areas such as apartments, flats, and condominiums, where the water storage tank is placed on the top of the building. The purpose of this study is to investigate the design of a water level sensor device that uses the Arduino UNO to monitor the level of water in a water tank. This prototype can transmit and receive signals when the water reaches a certain level which is low level, normal level, and high level. Single strand wire is used as a pin detector that detects the water level. The piezoelectric buzzer is used to warn the operator, while a light-emitting diode (LED) is used to display the water level in the tank whether it is a red LED which show the water level is thirty percent (30%) (Low Level), blue LED for the normal level (50%) and green LED when the water level is hundred percent (100%) (High Level). In this project design, Arduino UNO is used as the main component, and coding is written in Arduino Integrated Development Environment (IDE). With this system, the operator will be more alert with the water status in the tank and can avoid the water tank from empty or overflowing. This indirectly can also avoid any storage water tank accidents that are related to many types of factors such as maintenance error, operational mistake, sabotage, failure of equipment, crack, leak, etc. At the end of the project design, the value of the voltage at each sensor is different when it reacts with the water due to the number of resistors that are installed in this water level detector circuit.

Keywords: Water Level Detector, LED, Arduino UNO, IoT

1. Introduction

Technology is growing over time in this unequaled current of modernity. Modern technology highly depends on the system of automation and control. Automation of a manufacturing facility entails the design and construction of a control system that requires the use of sensors, instruments, computers,

Corresponding author: afishah@uthm.edu.my

and data processing. It is now well-known that manufacturing process automation is necessary not only to improve product quality and safety in the workplace but also to make the operation more effective. The main benefit of automation and control system is that it saves labor as the process is used with or without minimal human assistance [1].

One of the technology application systems that can facilitate and help to reduce the human burden is the water level detector. There are many various types of water level detectors such as radar, floating switch, paddle switch, ultrasonic, etc**.** [2]. The water level detector is a system that allows users to receive information about any water reservoir from the overhead tank or any other water container. The water level detector device is very helpful in reducing the waste of water filing this reservoir [3]. Water is commonly used in agriculture, industry, and domestic consumption areas. Therefore, it has become an essential issue for effective water management systems at home and the workplace.

1.1 Water Level Detector Design

In recent years, some of the featured innovations have been made in the design of the water level system and have progressively been upgraded with changes that benefit and are affordable for the users [4]. This water level detector system is working as a water level sensor which shows the low, normal, and overflow volume of water in the tank. It can indicate when the water level is thirty percent (30%) of a tank volume and can also indicate when the tank volume is overflowing or above a hundred percent (100%) of the volume of the tank. In this way, it would be possible to monitor the actual implementation of the system with continuous level indication and minimize the risk of the water pump being damaged or broken when the water level exceeds the suction level [5].

In this design, we are using three water level detector systems in the tank. The first water level detector was installed in the position of thirty percent (30%) of the water tank volume and will be classified as low-level water in a tank. It indirectly prevents water from drying and causes a vacuum in the water tank. The second water level detector was installed in the position of fifty percent (50%) of the water tank and will be classified as a normal level. The last water level detector system is placed above the buoyant switch which is around a hundred percent (100%) of the volume of the tank. This position is to avoid overflowing water if float switches are damaged technically and it indirectly can avoid waste of water.

In terms of concerning cabling, the wires from the water level sensor are connected to the light-emitting diode (LED) circuit. LEDs are utilized as indicator lamps in many electrical gadgets, as rear-window and brake lights in automobiles, and as alphanumeric displays or even full-color posters on billboards and signs. **[6].** The LED was placed underneath the tank for operator monitoring and it act as the dashboard that shows the information. From the information that will display through the dashboard, we can know the water level in the tank is either low, medium (normal), or high (overflow). In this LED circuit, we will only use three colors that will be displayed on the screen, which are red, blue, and green. The red LED will be lit up when the volume of water level in the tank is low which is reach thirty percent (30%). Meanwhile, the blue LED indicates the status at the normal volume of water level in the tank at fifty percent (50%). For the last one, green LED will light up and represent as the status is in the state high that is hundred percent (100%) of the volume of the tank or in sense that it exceeds the volume of the water tank

2. Components, Mechanism System, and Coding

The components and mechanism system are critical to the development of the prototype for this research project. The circuit board design, mechanism flowchart, schematic component, coding, and building of the prototype are explained briefly in this section.

2.1 Materials

During the selection process, these components were recognized in terms of their type and function. This is to avoid making errors when utilizing components and circuits during the development of these research initiatives. Below shows the list of components required for the research project:

i. Arduino
ii. Light-Emitting Diode (LED)
iii. Transistor
iv. Resistor
v. Buzzer
vi. Wire / Jumper
vii. Dry Cell (9V)

2.2 Circuit Board Design and Schematic Diagram

Figure 1 shows the arrangement of components on the breadboard circuit. While Figure 2 shows the schematic diagram circuit of the water level sensor. The circuit will detect the water level through three detector points, which are "Red LED" low water level, "Blue LED" normal water level, and "Green LED" high water level.

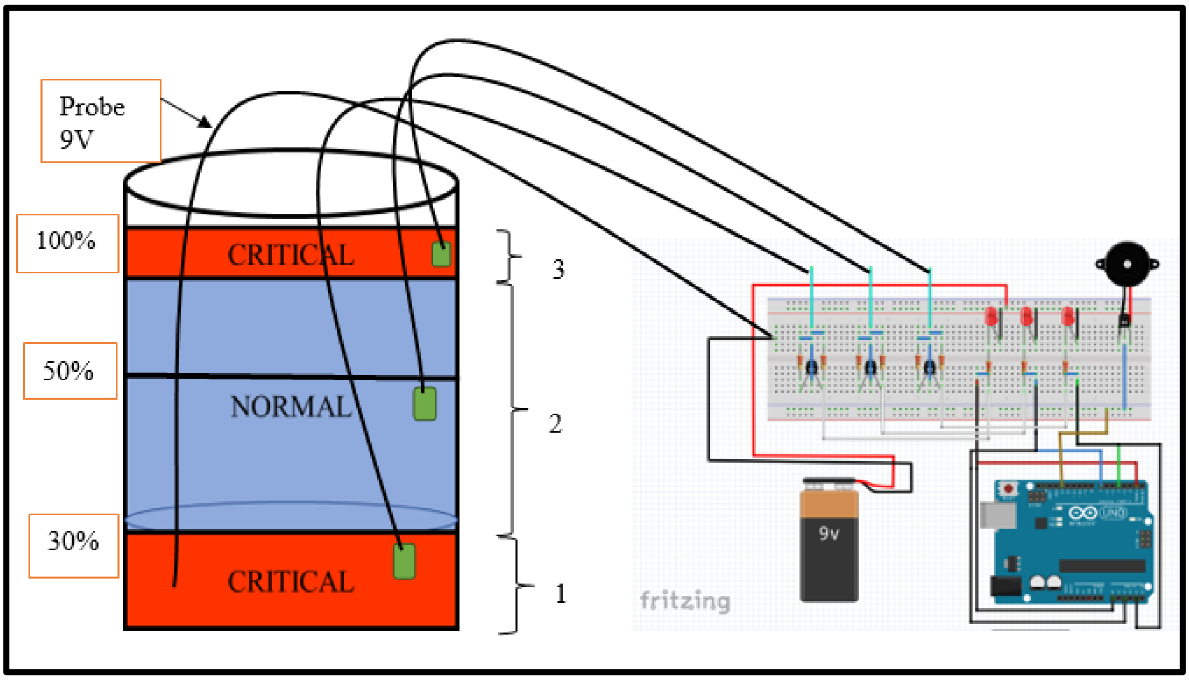

Figure 1: Arrangement of Components on Breadboard Circuit.

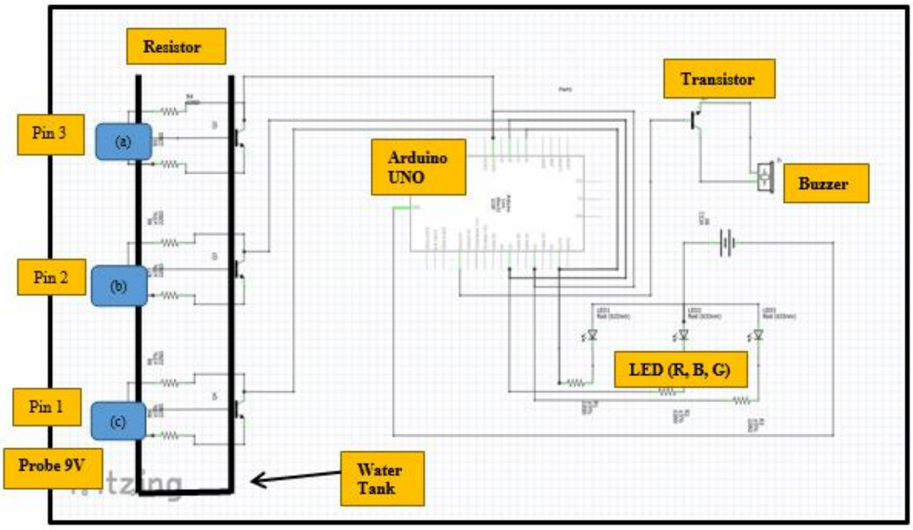

Figure 2: Schematic Diagram Circuit of Water Level Sensor.

The arrangement of components on the breadboard circuit and the schematic diagram circuit of the water level sensor was built by using the fritzing application. In this circuit, we have three transistor switches and three LEDs. When the base (a, b, c) was delivered with the current from an electrode probe, each transistor was switched on. While for led, each one will light up by the electrode probe when water was detected because of the supplied current.

2.3 Mechanism System Flowchart

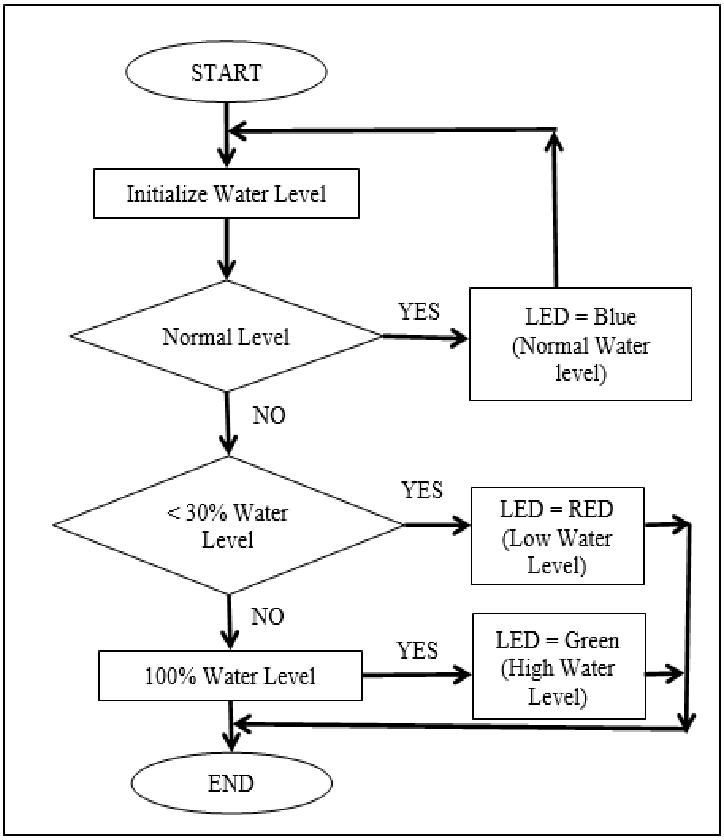

Figure 3: System Flowchart.

From Figure 3, the experiment was conducted according to the step. Firstly, the circuit will switch on. Each pin of the water level sensor was placed at a certain position in the water tank. The first pin was located at a 30% volume of the water tank. 9V electrode probe was linked to PIN 1 through water supply in tank. Red LED will light up which means the volume of water was thirty percent (30%). Meanwhile, the second pin was placed at 50% tank volume. Probe 9V has been connected by water in the storage tank with pins 1 and 2. Blue LED will be light up. This shows that the volume of water in the tank is normal. The last pins are placed at 100% volume of the water tank. Whilst pin 3 operates and switches green LED on when the water level reaches a hundred percent (100%) of the total water volume. In this situation, probe 9V was connected to pins 1, 2, and 3.

2.4 Coding

The Arduino board is the main component to control this set of water level sensors. The coding was written in Arduino Integrated Development Environment (IDE). The main editing text program for Arduino programming is the Arduino IDE. It is where you type your code in before posting it to the selected board. Arduino code is referenced as sketches.

```
bool RED = 1;
bool BLUE = 7;
bool GREEN =4;
bool buzzer = 13;
int val1 = 300;
int val2 = 500;
int val3 = 1000;
```

(bool) True or false are the only two possible values for a bool

(int) Integers function as a primary data-type for number storage

Declaration

```
bool mySensVals[3] = {A0, A2, A4};
mySensVals[0] = digitalRead (A0);
mySensVals[1] = digitalRead (A2);
mySensVals[2] = digitalRead (A4);


if(mySensVals[0] == true && mySensVals[1] ==   false &&
mySensVals[2] == false){
  RED == true;
  BLUE == false;
  GREEN == false;
  buzzer == false;
  Serial.println(" Water level = 30% ( LOW!!! ) ");  }
  else {
  Serial.println("System Error!");
}
   delay(1000);
```

Condition for low water level

From the previous coding, we will get the result from the serial monitor. A serial monitor will show or display the condition in the water tank whether it is low, normal, or high. Figure 4 shows the serial monitor that displays if the water level is in low condition.

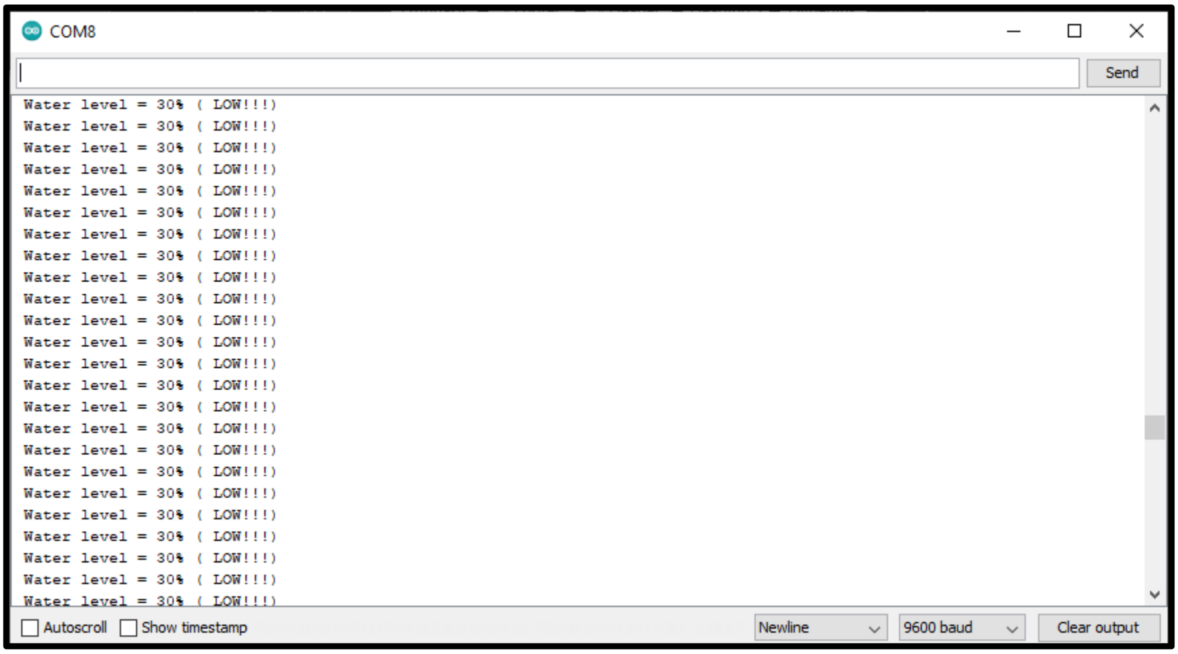

Figure 4: Serial Monitor Display Water Level in Low Condition.

3. Results and Discussion

Figure 5 is the prototype's design for the water level detector system. The prototype of the water tank was built from a simple plastic container and breadboard.

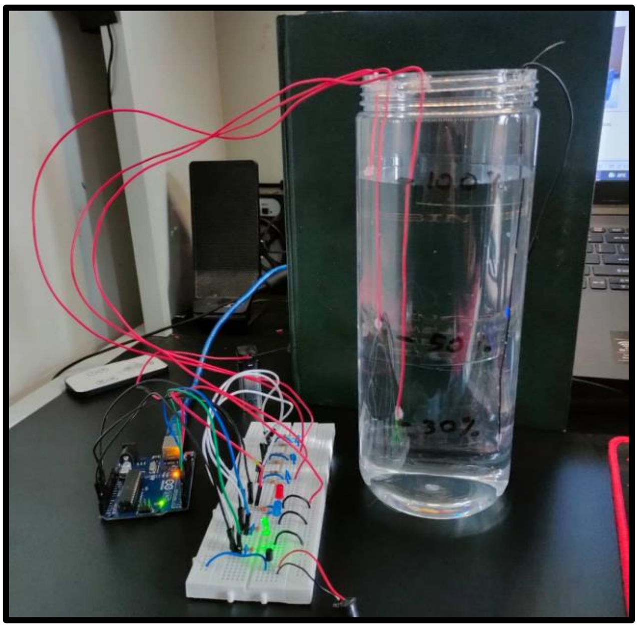

Figure 5: Prototype's Design for Water Level Detector.

Table 1 shows the result of data voltage change at each water level. When the circuit is in the closed state, the value of voltage for probe 9V is 8.8 V. As the probe 9V is connected with the pin sensor, the value of voltage will decrease. The greater number of pin sensors being used or connected, the more the value of voltage and electric current will decrease. This reduction of value is due to the number of resistors that are installed in this water level detector circuit.

Table 1: Result of data voltage change at each water level.

Water Level Detector (Sensor Pin)	Voltage (V)	LED
Probe 9V	8.8	Off
Probe 9V + Pin 1	8.5	On
Probe 9V + Pin 1 & 2	5.1	On
Probe 9V + Pin 1, 2 & 3	4.4	On

Table 1 shows the voltage change at each water level. When the circuit is closed, Probe 9V has a voltage of 8.8 volts. Pin 1 is connected to the 9V probe, resulting in 8.5 V voltage across the water medium. This is the condition for the initial detector when the water level is low. Subsequently, a voltage of 5.1 was obtained when probe 9V and pin 1 were connected to pin 2 (second water sensor for normal level). Same as before, when the water level surpasses the high level, pin 3 will be connected with pins 1 and 2 and produce the 4.4V.

Table 2: Functionality of water level detector at each water level sensor.

Water Level Detector (Sensor Pin)	LED 1 (RED)	LED 2 (BLUE)	LED 3 (GREEN)	Percentage of Water Level
Probe 9V	Off	Off	Off	0%
Probe 9V + Pin 1	On	Off	Off	30%
Probe 9V + Pin 1 & 2	Off	On	Off	50%
Probe 9V + Pin 1, 2 & 3	Off	Off	On	100%

Table 2 shows the functionality of the result based on a water level detector at each water level sensor. While the circuit was in the closed state, all the LEDs remained off and no output was produced at the light-emitting diode (LED). When probe 9V was connected with the pin sensor (through medium water), the pin sensor will transmit the signal to the Arduino and the LED will light up either red, blue, or green color.

In this project design, single strand wire had been used as a detector in the water tank. This component is utilized as a water detector due to its copper composition. When it comes to conducting electrical current via water, copper is an excellent choice, and the cost to purchase it is cheap. Due to that, the single strand wire has been chosen as a detector in this prototype. Although there are advantages in using copper, there are certain drawbacks to this detector. Because of the constant contact with water, the probe or punching pin material may lose its durability quickly. Different from other researchers (Anirudh, 2018), their project design is used an ultrasonic sensor as the detector [7]. These level sensors work by producing and receiving ultrasonic waves that reflect off a target's surface. Although this detector is expensive, in terms of durability, it can be used for a long time

4. Conclusion

For decades, liquid level sensors have been used for the identification of leaks or level identification in areas like manufacturing, medicines and household products, printing, agriculture, automotive and white goods. By current technological advancements, a variety of sensor levels have been developed to assist and facilitate the user. The vision of this project is to build a user-friendly, low-cost, and economical product that is convenient and easy to use. This is because of concerns that are rarely seen but can have a significant negative impact and damage, such as a water tank rupture disaster. Hence, by using this prototype, the destruction that may happen can be reduced.

The purpose of this prototype water level detector system was to make it easier for tank users to monitor the water levels in the tank. Signals are sent to the Arduino through detector pins at each tank level and then displayed via LEDs. There are three colors of LED which are red, blue, and green that represent the water level in the tank either is low, normal, or high. The effective construction of this detector system is a result of the integration of various components and a program that has been uploaded into the Arduino board.

The mechanism that acts as a switch in the water tank is water. Water is a medium of conductor and a 9V probe situated at the bottom of the tank was linked to PIN 1. The Arduino board received the signal and began processing it. The Arduino board will produce the LED to light up and at Arduino IDE, the serial monitor will display the volume of water level which is “Water level = 30% (LOW!!!)”. The same thing will happen at normal and high levels (“Water level = 50% (NORMAL!!!)” or “Water level = 100% (HIGH!!!)”).

At the end of this project design, we can conclude that as the number of pins being connected increases, the voltage and current values would be reduced. This decrease in value was caused by the high number of resistors used in this water level detector circuit. The value of probe 9V when the circuit is in the closed stated was 8.8 V. Meanwhile, the value of voltage when probe 9V is connected with pin 1 was 8.5 V. 5.1 V was obtained when probe 9V is connected with pin numbers 1 and 2 and 4.4 V when pins 1, 2, and 3 are connected with probe 9V.

Acknowledgment

The author would like to thank the Universiti Tun Hussein Onn Malaysia, Faculty of Applied Sciences and Technology (FAST) for its support. Thank you also to the Instrumentation Laboratory's staff for allowing to utilize the laboratory's equipment.

References

[1] Groover, Mikell P. "Automation". Encyclopedia Britannica, 22 Oct. 2020, https://www.britannica.com/technology/automation. Accessed 4 June 2021.

[2] Momin, S. A., Roy, P., Kader, G., Hasan, S., & Islam, S. (2016). Construction of Digital Water Level detector and Automatic Pump Controlling System. 03(October), 1–5.

[3] Hafisa Hameed, Jomol T Joseph, " Study On Water Level Sensors", Water and Land Management Training and Research Institute, Himayatsagar, Hyderabad - 500030.

[4] Jatmiko, S., Mutiara, A. B., & Indriati, M. (2012). Prototype of water level detection system with wireless. Journal of Theoretical and Applied Information Technology, 37(1).

[5] Implementation Of Water Level Conditioning System Using Wireless Multi-Point Communication. (2016). Implementation Of Water Level Conditioning System Using Wireless Multi-Point Communication, 5(6).

[6] Britannica, The Editors of Encyclopaedia. "LED". Encyclopedia Britannica, 12 Aug. 2021, https://www.britannica.com/technology/LED. Accessed 27 December 2021

[7] Kodavatiganti, A. (2018a). International Journal of Research in Engineering and Applied Sciences(IJREAS). *Water Level Monitoring*, *8*(9), 1. http://euroasiapub.org/journals.php