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Abstract

This project presents a liquid-level alarm that overcomes the problem of electrolysis and corrosion of probes in traditional water-level controllers. The alarm uses a 1 kHz AC signal passed through the probes, preventing electrolysis, and increasing the lifespan of the probes. The circuit consists of a signal generator, sensing circuit, and alarm circuit, and is powered by a 12 V unregulated power supply. The alarm can be used to detect any conductive liquid and is an effective solution for maintaining proper current flow in water-level controllers.

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Chapter 1: Introduction

Water-level controllers are devices that monitor and regulate the water level in tanks, reservoirs, or other containers. They are widely used in various applications such as irrigation, water supply, hydroelectric power generation, and industrial processes. Water-level controllers typically use metallic probes fitted in the water tank to sense the water level. A DC current is passed through the probes to detect the presence or absence of water.

1.1 Problem Statement

A major drawback of using metallic probes in water-level controllers is that they are prone to electrolysis and corrosion. Electrolysis is the process of decomposition of water into hydrogen and oxygen gas due to the passage of electric current. Corrosion is the process of deterioration of metal due to chemical reactions with water and oxygen. Both electrolysis and corrosion reduce the conductivity and durability of the probes, affecting their performance and accuracy. As a consequence, probes have to be replaced regularly to maintain proper current flow.

1.2 Project Objective

The objective of this project is to design and fabricate a liquid-level alarm that overcomes the problem of electrolysis and corrosion of probes in water-level controllers. The liquid-level alarm uses a 1kHz AC signal passed through the probes, preventing electrolysis and increasing the lifespan of the probes. The liquid-level alarm consists of a signal generator, sensing circuit, and alarm circuit, and is powered by a 12V unregulated power supply. The liquid-level alarm can be used to detect any conductive liquid and is an effective solution for maintaining proper current flow in water-level controllers.

1.3 Report Outline

The rest of this report is organized as follows: Section 2 describes the methodology used for designing and implementing the liquid-level alarm. Section 3 presents the results of the project and discusses how the liquid-level alarm overcomes the problem of electrolysis and corrosion of probes. Section 4 summarizes the main points of the project and suggests future work or improvements that could be made to the liquid-level alarm.

Chapter 2: Methodology

This section describes the design and implementation of the liquid-level alarm. The liquid-level alarm consists of three main components: a signal generator, a sensing circuit, and an alarm circuit. The circuit diagram and block diagram of the liquid-level alarm are shown in Figure 1 respectively.

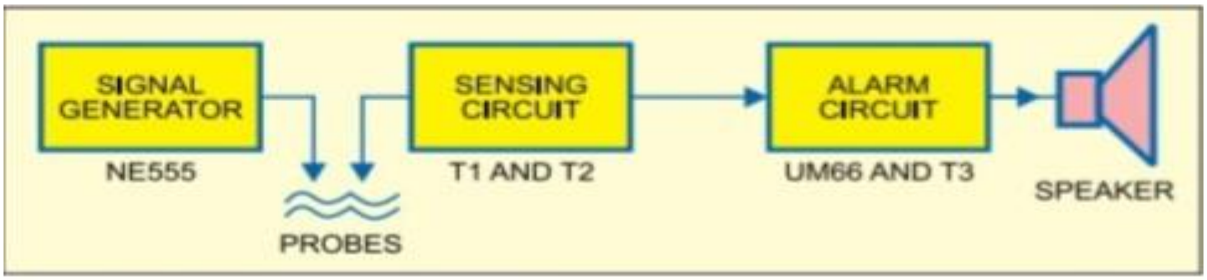

Figure 1 *Block Diagram of Water Level Indicator*

2.1 Components Used

1. IC 555 (IC1): This is an integrated circuit used as an astable multivibrator to generate a 1kHz square wave signal.

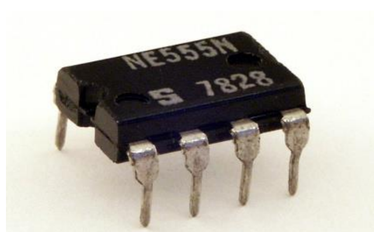

Figure 2 *IC 555*

2. DC blocking capacitor: This capacitor blocks DC current and allows only the AC signal to pass through to one of the probes.

Figure 3 *Capacitor*

3. Jumper Wires: These wires are fitted in the water tank to sense the water level. They receive the 1 KHz signal from IC1 via the DC blocking capacitor.

Figure 4 *Jumper Wires*

4. PNP transistor (T1): This transistor receives a negative base bias when water fills up in the tank and conducts during the negative half cycle of 1kHz signals.

Figure 5 *PNP Transistor*

5. NPN transistor (T2): This transistor conducts to provide 3.3V DC to melody generator IC UM66 (IC2) when it receives base bias from capacitor C7.

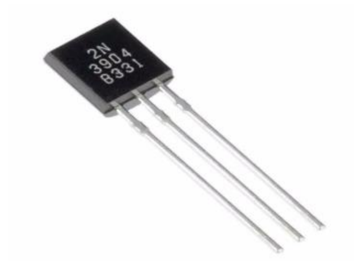

Figure 6 *NPN Transistor*

6. Melody generator IC UM66 (IC2): This integrated circuit generates a melody when it receives 3.3V DC from NPN transistor T2.

Figure *7 IC UM66*

7. Preset VR1: This acts as the output loudness controller and can be varied to set the alarm sound from the speaker at the desired level.

Figure 8 *Preset (Potentiometer)*

8. Arduino Uno: This is a microcontroller board used to control the Water Sensor and LCD Module of this project.

Figure 9 *Arduino Uno*

Flowchart

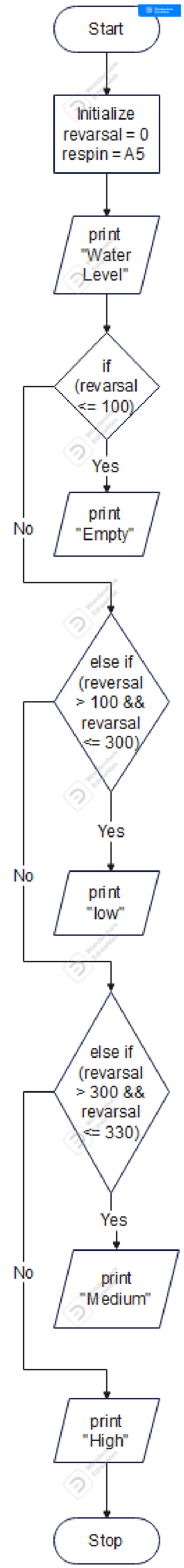

Figure 10 *Flowchart*

Algorithm

Here is the step-by-step algorithmic explanation of the above flowchart.

- Include the LiquidCrystal library.
- Initialize the LiquidCrystal object with the interface pin numbers.
- Set resval to 0 and respin to A5.
- In the setup function, begin the LCD with 16 columns and 2 rows, and print "WATER LEVEL: " to the LCD.
- In the loop function, set the cursor to column 0, line 1.
- Read data from analog pin A5 and store it in resval.
- If resval is less than or equal to 100, print “Empty” to the LCD.
- Else if resval is greater than 100 and less than or equal to 300, print “Low” to the LCD.
- Else if resval is greater than 300 and less than or equal to 330, print “Medium” to the LCD.
- Else if resval is greater than 330, print “High” to the LCD.
- Wait for 1 second before repeating the loop.

7. Water sensor: This sensor detects the presence of water and sends a signal to the Arduino Uno.

Figure 11 *Water Sensor*

8. LCD display module: This module displays information about the water level in the tank.

Figure 12 *LCD Module*

2.2 Working of Water Level Indicator

The signal generator is an astable multivibrator built around IC 555 (IC1). It generates a 1kHz square wave signal, which is fed to one of the probes via a DC blocking capacitor. The signal generator provides an AC signal to the probes, preventing electrolysis and increasing their lifespan.

The sensing circuit consists of two transistors (T1 and T2) and a capacitor (C7). The sensing circuit detects the presence or absence of water in the tank by receiving the 1kHz signal from IC1 via the probes immersed in water. When the water tank is empty, pnp transistor T1 does not get negative base bias and remains off. But as water fills up in the tank, T1 receives the 1kHz signal from IC1 and conducts during the negative half cycle of the signal. Due to the presence of capacitor C7, npn transistor T2 continues to get base bias and conducts to provide 3.3V DC to the alarm circuit.

The alarm circuit consists of a melody generator IC UM66 (IC2), a preset VR1, and a speaker. IC UM66 is a three-pin device that generates a musical tone when powered by a DC voltage. Pin configuration of IC UM66 is shown in Fig. 3. Preset VR1 acts as the output loudness controller. It can be varied to set the alarm sound from the speaker at the desired level.

The display module consists of an Arduino board and an LCD character display. The Arduino board receives the analog signal from the water level sensor and converts it into a digital value. The Arduino board then sends this value to the LCD display, which shows the water level as empty, low, medium or high. The LCD display is connected to the Arduino board using six wires, following the wiring diagram on Fig. 3. The Arduino board is programmed using the code provided on the current web page context, which uses the LiquidCrystal library to control the LCD display. The code also sets the threshold values for each water level category based on the sensor output. The display module can be powered by a USB cable or a battery pack.

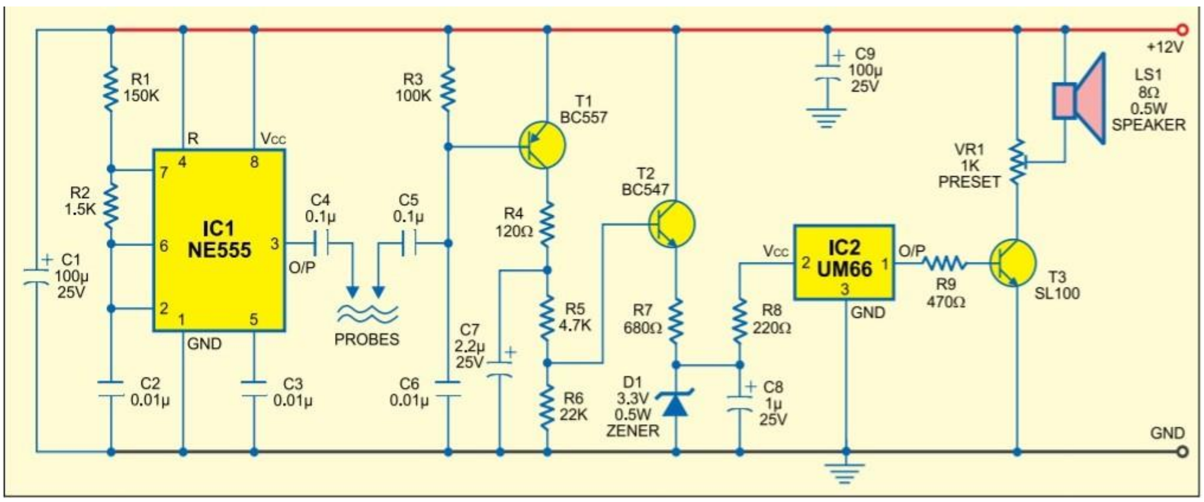

Figure 13 *Circuit Diagram of Water Level Indicator*

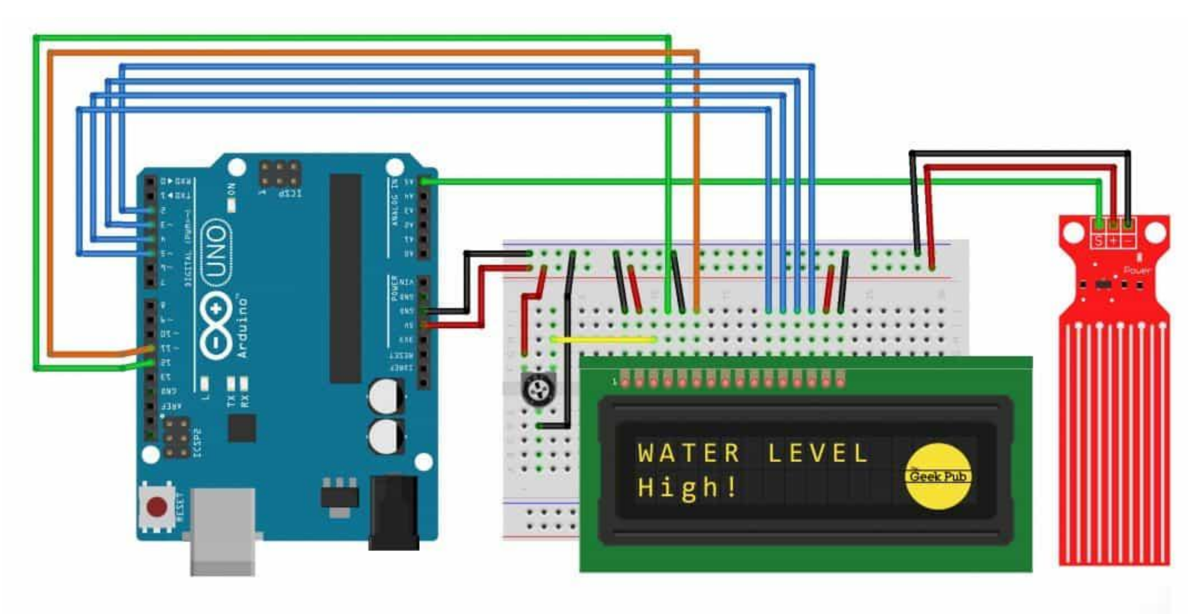

Figure 14 *Circuit Connection of Display Module*

Chapter 3: Results

This section presents the results of the project and discusses how the liquid-level alarm overcomes the problem of electrolysis and corrosion of probes. The results are based on the testing and observation of the liquid-level alarm in different conditions. The implementation of Water Level Indicator is shown on Figure 14 and Figure 15

3.1 Testing Procedure

The testing procedure involved the following steps:

- Connect the liquid-level alarm to a 12V unregulated power supply and a water tank with two probes.
- Adjust the preset VR1 to set the desired loudness of the alarm sound.
- Fill the water tank gradually and observe the response of the liquid-level alarm.
- Drain the water tank gradually and observe the response of the liquid-level alarm.
- Repeat steps 3 and 4 for different types of conductive liquids such as salt water, vinegar, and lemon juice.

3.2 Testing Results

The testing results showed that the liquid-level alarm performed as expected in different conditions. The main observations were:

The liquid-level alarm produced a musical tone when the water level reached the upper probe and stopped when the water level dropped below the lower probe.

The liquid-level alarm worked for different types of conductive liquids such as salt water, vinegar, and lemon juice, with varying loudness depending on the conductivity of the liquid.

The liquid-level alarm did not cause any electrolysis or corrosion of the probes, as there was no visible gas formation or metal deterioration on the probes after prolonged use.

3.3 Discussion

The testing results demonstrated that the liquid-level alarm overcomes the problem of electrolysis and corrosion of probes in water-level controllers. By using a 1kHz AC signal instead of a DC current, the liquid-level alarm prevents electrolysis and increases the lifespan of the probes. The liquid-level alarm also detects any conductive liquid and provides an audible indication of the liquid level in the tank.

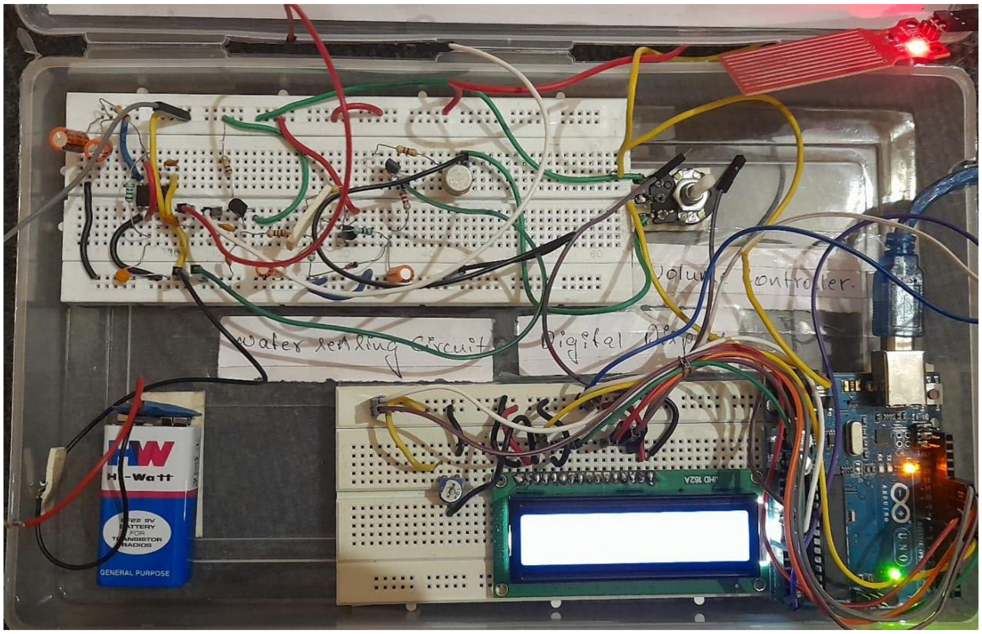

Figure 15 *Implementation of Water Level Indicator*

Figure 16 *Outer Layer of Water Level Indicator*

Chapter 4: Conclusion and Future Work

This section summarizes the main points of the project and suggests future work or improvements that could be made to the liquid-level alarm.

4.1 Conclusion

The project aimed to design and fabricate a liquid-level alarm that overcomes the problem of electrolysis and corrosion of probes in water-level controllers. The liquid-level alarm used a 1 KHz AC signal passed through the probes, preventing electrolysis, and increasing their lifespan. The liquid-level alarm consisted of a signal generator, sensing circuit, and alarm circuit, and was powered by a 12V unregulated power supply. The liquid-level alarm could be used to detect any conductive liquid and provide an audible indication of the liquid level in the tank.

4.2 Future Work

The project could be further improved or extended in the following ways:

- The liquid-level alarm could be interfaced with a microcontroller or a wireless module to transmit the liquid level data to a remote device or a computer for monitoring or control purposes.
- The liquid-level alarm could be adapted to work for non-conductive liquids such as oil or petrol by using capacitive or ultrasonic sensors instead of metallic probes.

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