Final Semester Project

Digital Logic Design

05.06.2022

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Submitted to Honorable Maam, Huma Altaf

Acknowledgment

We express sincere gratitude to our course teacher, **Huma Altaf** for her leadership and constant motivation provided in successful completion of our academic semester. We record it as our privilege to deeply thank you for providing us facilities and knowledge to make our ideas into reality.

We are pleased to acknowledge the indebtedness to our lab technician, **Ahsan Iqbal Khan** who devoted himself directly or indirectly to make this project successful.

Last but not the least we express our deep gratitude and affection to our parents who stood behind us in all our endeavors.

Overview

Water tank overflow is a typical issue that results in water waste. In Pakistan, almost every house wastes rhougly around 3000 liters to 5000 liters per month. These are staggering figures and since NASA has predicted that by 2025 Pakistan will face a severe drought, a solution should be sought to this problem. There are a variety of alternatives, such as ball valves that automatically shut off the water flow when the tank is full. But, as an electronics fan, wouldn't you prefer an electrical solution? So, after thorough research and days of hard work and dedication, we have been able to design a circuit that not only tells you the water level in your tank but also switches the motor on and off automatically.

Goals

1. To understand the working of the ICs.
2. To be able to successfully build a working module for an automated Water Tank.

Methodology

Our team in whole put in great effort in researching, designing, and physically implementing the circuit. The workload was equally divided among the three members and all worked hard and devoted their time into this project. We did face some difficulties trying

to operate a 220V AC water pump but later overcame the problem by using a relay module. We all had a great time learning and implementing the circuit.

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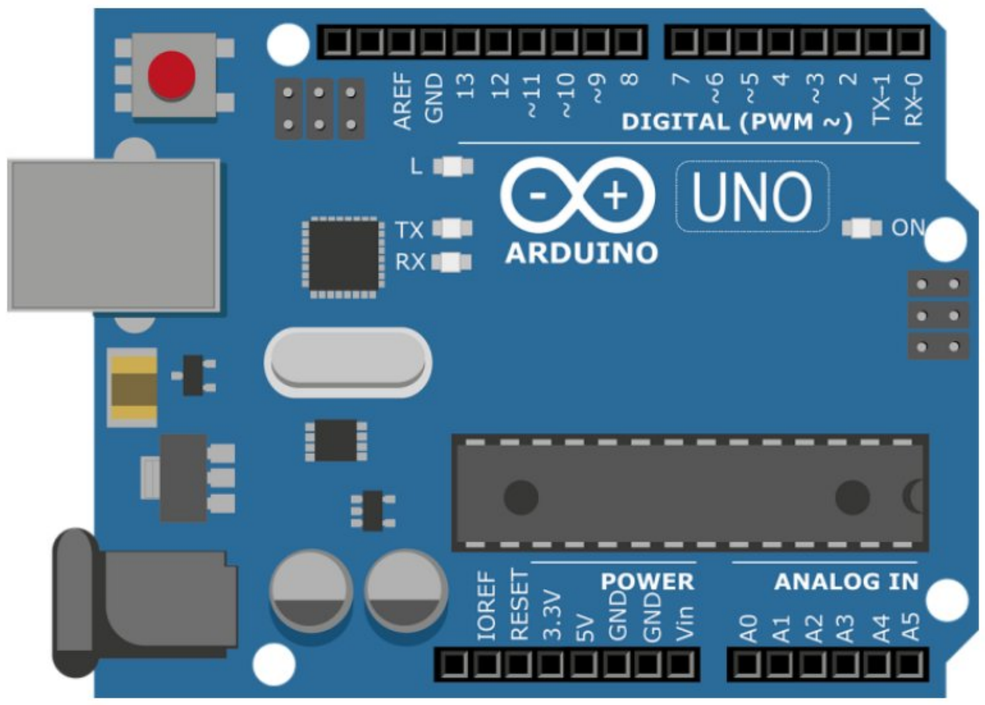
About the Components

Arduino:

Because of its open source hardware characteristic, an Arduino is a microcontroller-based kit that may be used either straight from the vendor or manufactured at home using the components. It is mostly utilized for communications as well as controlling and operating a variety of devices.



The Arduino UNO is a microcontroller board that uses the ATmega328P microcontroller. There are 14 digital input/output pins (six of which can be used as PWM outputs), six analogue inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button on the board. It comes with everything you'll need to get started with the microcontroller; simply plug it into a computer with a USB cable or power it with an AC-to-DC adapter or battery. You can experiment with your UNO without fear of making a mistake; in the worst-case situation, you can replace the chip for a few dollars and start over.

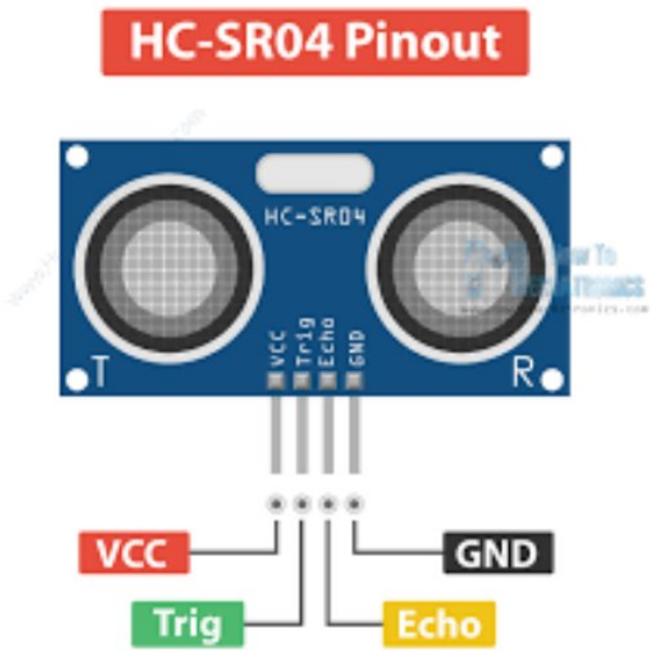
Relay Module

An electromagnet operates a power relay module, which is an electrical switch. A separate low-power signal from a microcontroller activates the electromagnet. The electromagnet pulls to open or close an electrical circuit when energized.

A simple relay is made up of a wire coil wrapped around a soft iron core, known as a solenoid, an iron yoke that provides a low reluctance channel for magnetic flux, a moveable iron armature, and one or more sets of contacts. The moveable armature is connected to one or more sets of moving contacts and is hinged to the yoke. When the relay is

de-energized, the armature, which is held in place by a spring, leaves a gap in the magnetic circuit. One of the two sets of contacts is closed in this configuration, while the other stays open.

UltraSonic Sensor (HC-SR04)



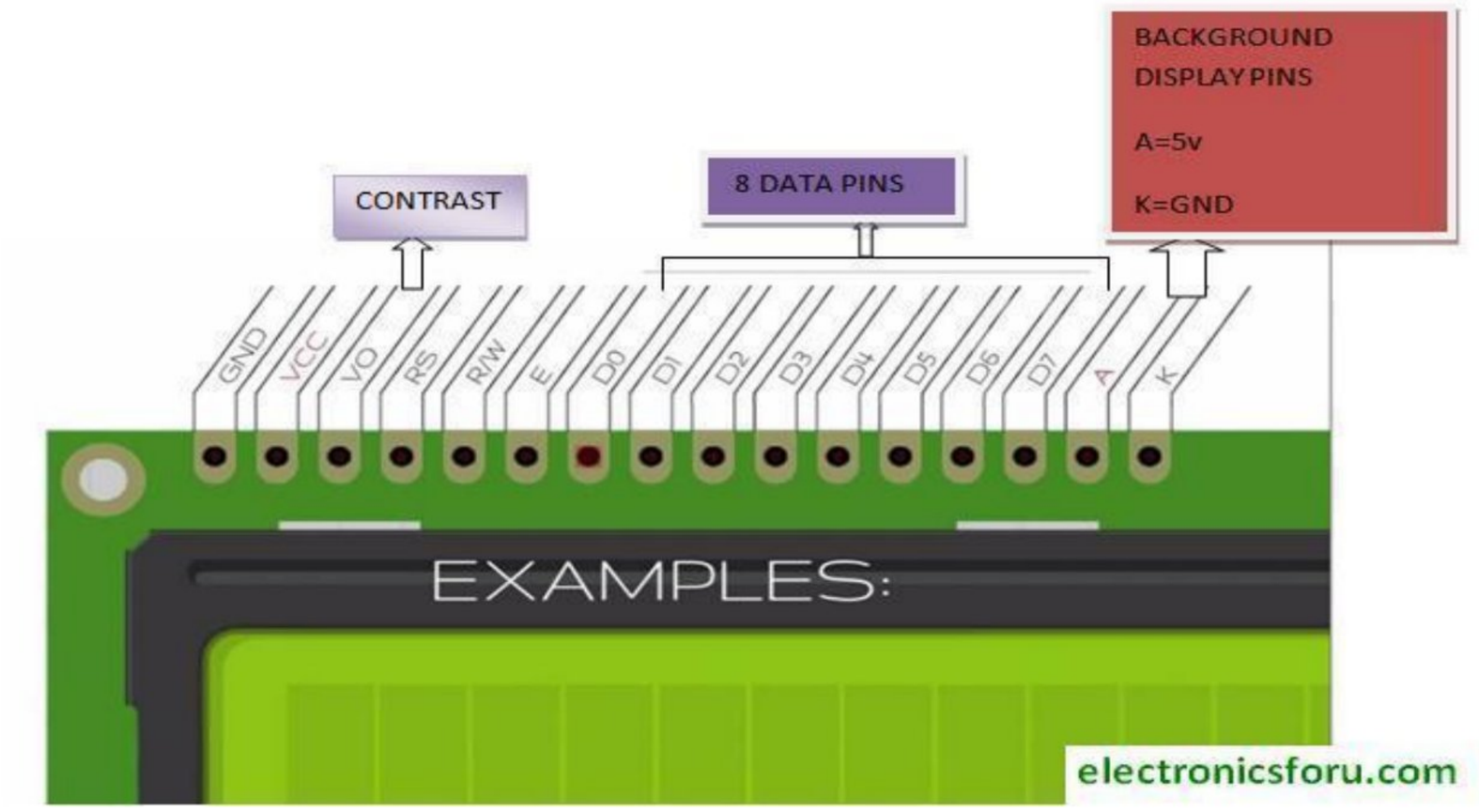
An ultrasonic sensor is an electronic device that emits ultrasonic sound waves and converts the reflected sound into an electrical signal to determine the distance between a target object and the sensor. Ultrasound waves travel at a faster rate than audible sound waves (i.e. the sound that humans can hear). The transmitter (which uses piezoelectric crystals to generate sound) and the receiver are the two primary parts of an ultrasonic sensor (which encounters the sound after it has traveled to and from the target).

Water Pump

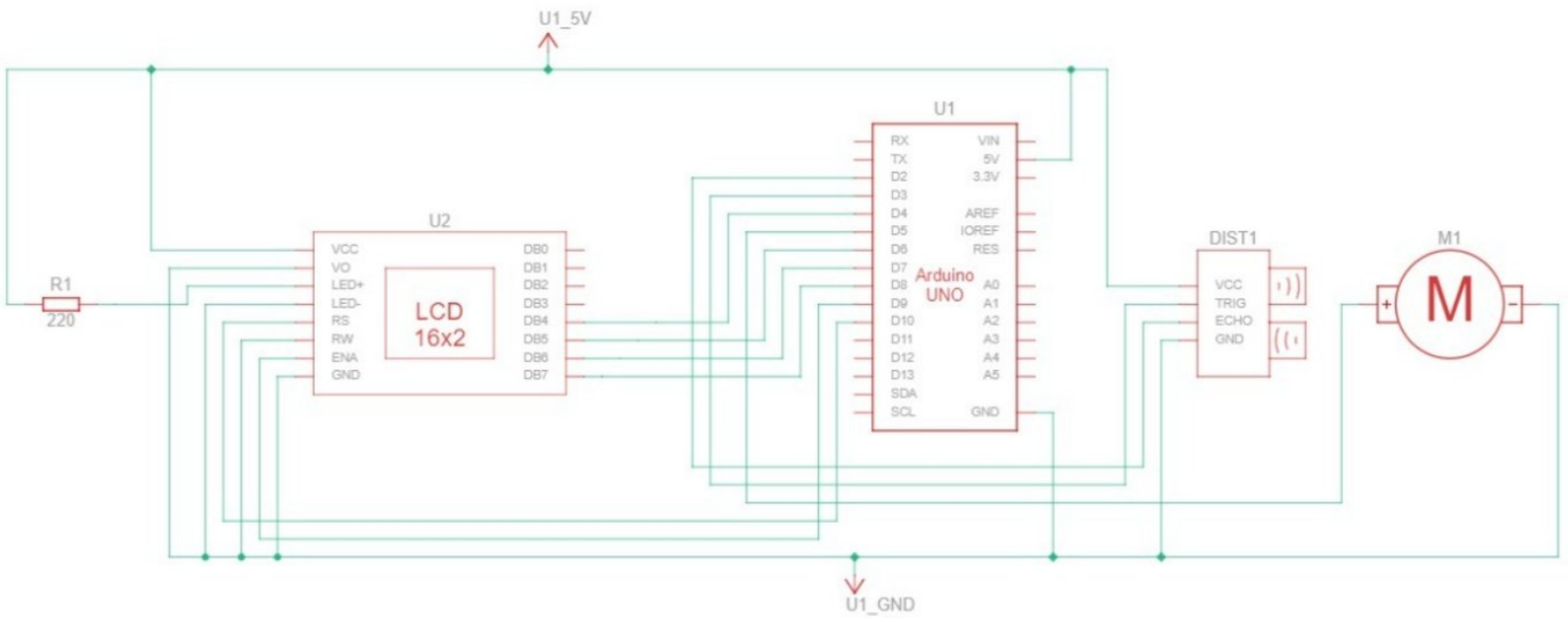
A 220V water submersible pump which is used as the main source to fill the water tank.

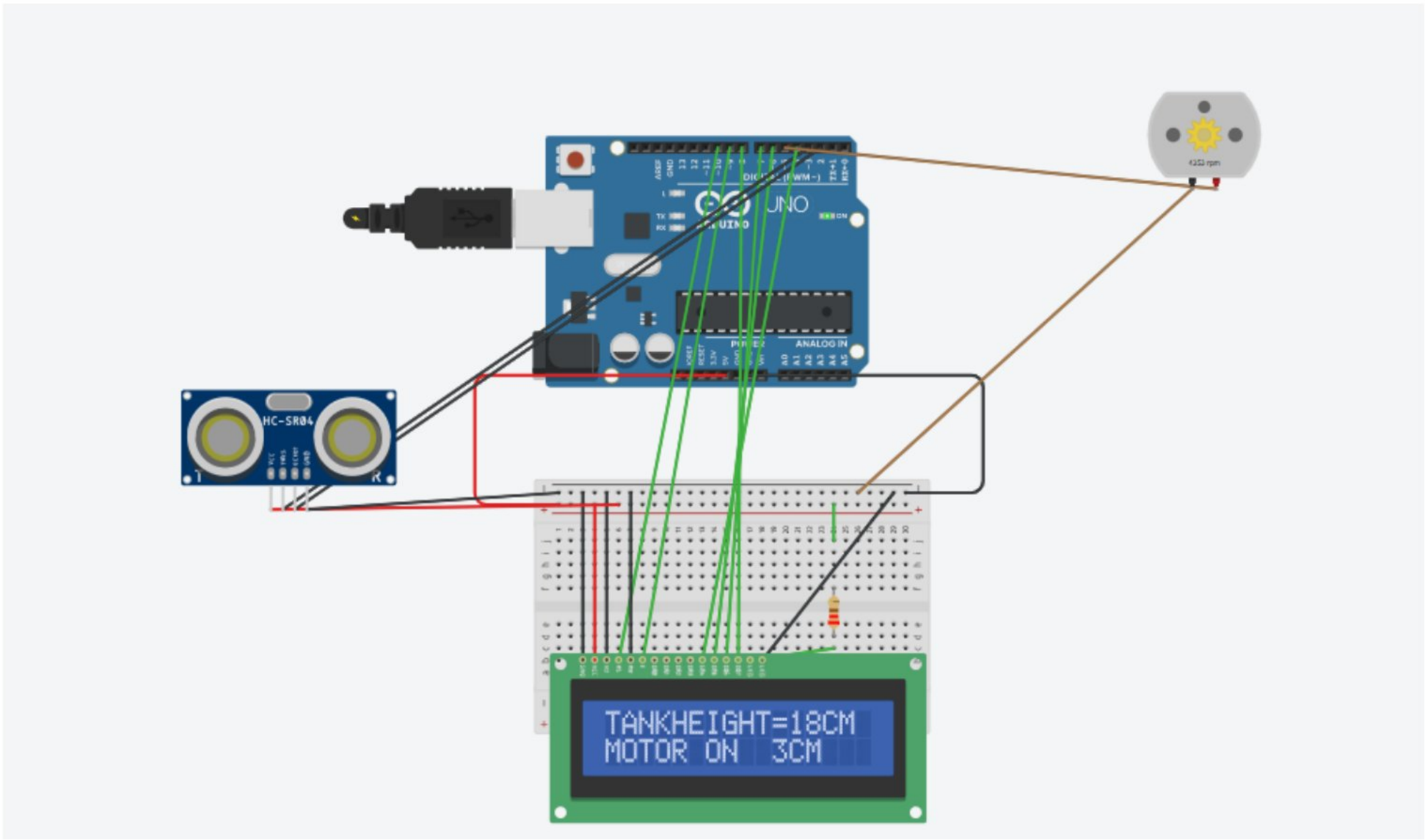
Lcd Display (16x2)

A liquid crystal display (LCD) is an electrical display module that produces a visible image using liquid crystal. The 162 LCD display is a fairly basic module that can be found in many DIY projects and circuits. The 162 refers to a two-line display with 16 characters per line. Each character is presented in a 577-pixel matrix on this LCD.



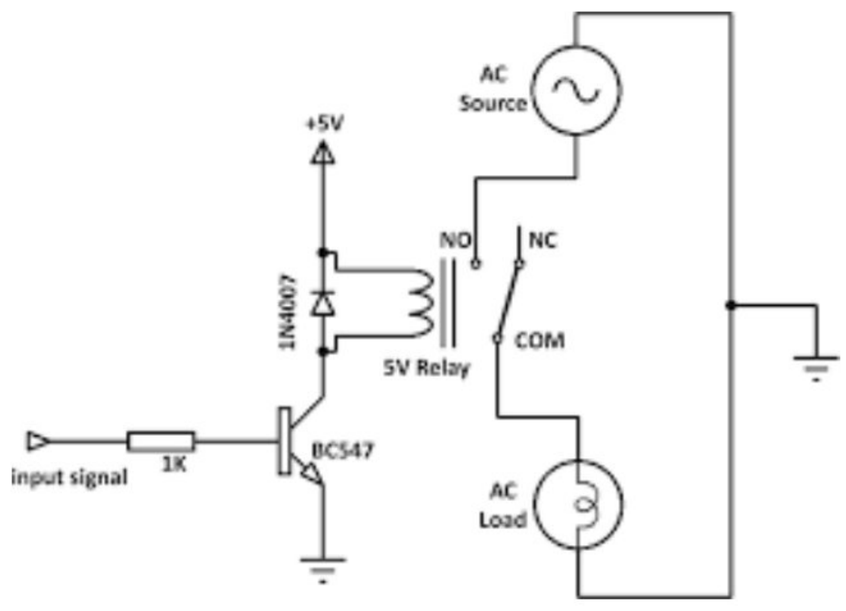
Circuit Design





NOTE:

Relay module was not available in the software, hence we used a dc motor to demonstrate the working on the diagram. A separate diagram for the relay is attached below. The output from arduino pin 5 is attached with the input signal. The AC load is the 220 water pump.



Explanation of Circuit

1. We used an Arduino board and programmed it to our requirements. The code is attached below for reference. We connected the ultrasonic sensor to the pins 3 & 4 of the arduino board. The ultrasonic sensor was then attached with the water tank to measure the water level using this formula: **distance= duration*0.034/2 - 3.9.** We then converted the distance into percentage using this formula. **(h/tankheight*100)** where **h** is **tankheight-distance.**
2. A lcd is also attached with the Arduino board to display information like the tank height and the water level. It also shows the status of the motor(ON/OFF). The data pins of the lcd are attached with pins 10,9,8,7,6, and 4 of the Arduino board respectively.
3. The input (Vin) of the relay module is attached with pin 5 of the Arduino board. The relay is then further connected with the 220V AC water pump. The relay basically helps in operating the water pump from a low voltage (5V).

Code

```
#include <LiquidCrystal.h>

int pos=0;

const int rs = 10, en = 9, d4 = 4, d5 = 6, d6 = 7, d7 = 8;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

const int trigPin = 3;

const int echoPin = 2;

const int buzz=5;

long duration;

float distance;

float tankheight = 10.5;

int timer = 0;

String motor_status;

void setup()

{   lcd.begin(16, 2);

pinMode(trigPin, OUTPUT);
```

```
pinMode(echoPin, INPUT);
Serial.begin(9600);
lcd.setCursor(0,0);
lcd.print("TANKHEIGHT=");
lcd.print(tankheight);
lcd.print("CM");
}
void loop()
{
digitalWrite(trigPin,LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);

float h= tankheight-distance;
//Serial.println(h);
delay(500);
lcd.setCursor(0,0);
  lcd.print("TANKHEIGHT=");
  lcd.print(tankheight);
  lcd.print("CM  ");
  lcd.setCursor(0,1);
  lcd.print(motor_status);
lcd.setCursor(10,1);
lcd.print(int(h/tankheight*100));
lcd.print("%   ");
int x=h;
```

```
if(h<=3&&h>=0)
{
  analogWrite(buzz,255);
  lcd.setCursor(0,0);
  lcd.print("TANKHEIGHT=");
  lcd.print(tankheight);
  lcd.print("CM   ");
  delay(1000);
  timer++;
//  Serial.println("MOTOR ON");
  lcd.setCursor(0,1);
  lcd.print("MOTOR ON ");
  motor_status = "MOTOR ON ";
  analogWrite(buzz,255);
}
else if(h>=9&&h<=11)
{
  analogWrite(buzz,0);
  lcd.setCursor(0,0);
  lcd.print("TANKHEIGHT=");
  lcd.print(tankheight);
  lcd.print("CM  ");
  delay(500);
  timer++;
//  Serial.println("MOTOR OFF");
  lcd.setCursor(0,1);
  lcd.print("MOTOR OFF");
  motor_status = "MOTOR OFF";
}
```

```
if(timer > 2)
{
  timer = 0;
  lcd.clear();
}
}
//IN PLACE OF BUZZER WE REPLACED IT BY RELAY
```

Advantages of our Project

1. Energy Saver

A water level controller is great for saving energy in an age when we need to be more careful of how much energy we use. Normally, adjusting water levels necessitates the use of electricity as well as the waste of water. Automatic controllers, on the other hand, limit the amount of electricity used as well as the amount of water required to regulate a supply.

2. Affordability

A water level controller helps you save money by reducing water and electricity waste. These gadgets precisely manage how much energy is utilized in order to avoid wasting water or power. The amount of money saved over time is fairly significant.

3. Automatic.

Another noteworthy benefit of these devices is that they self-regulate. The hassles of manually monitoring water tanks are reduced by using a timed switch to eliminate manual activities. The automatic operation of these devices ensures that water levels remain at the optimum levels.

4. Water Maximization

Water pumps are utilized more frequently in the middle of the day on average. A water level controller can increase the amount of water available during the day while automatically reducing it at night. As a consequence, an adequate level of water is maintained at all times, while you get the most out of your water at the right moments.

Disadvantages

- Water level controls need to be replaced every 3 years.

- The rust, foul and deteriorate
- Electronics are usually built separately
- More difficult installation
- Most float switches are outdated
- No LED indicator lights
- No Warranty or Guarantee

Applications & Uses

The uses of a water level indicator include the following applications:

- Can be used in water tanks to control water levels
- Automatically turn ON/OFF pumps
- Can be used in factories, commercial complexes, apartments, home,
- Fuel tank level gauging
- Oil tank level control
- High & low-level alarms
- Pool water level control
- Life station switches
- Leachate level control
- Cooling tower water level control
- Sewage pump level control
- Remote monitoring liquid
- Water level control
- Pump controller
- Stream level monitoring
- Sump pump
- Tsunami warning and sea level monitoring
- Process batch control & monitoring
- Irrigation control

Conclusion

We learned how Arduino works, its hardware and software characteristics, and the applications in which it is currently employed in this project. We've also learned how to use Arduino's own IDE to write sketches (software). With Arduino, the possibilities for fresh ideas are unlimited. The opportunities for learning and developing new concepts with an Arduino are endless. Though it has its own set of restrictions, it is an excellent tool for learning.

Moreover, we came to about the great advantages and opportunities relay modules provide for circuits and were able to operate a 220V water pump from it which completed the objective of our project.