ES-116 Project Report

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***Abstract*—This project aimed to design and develop a prototype of a water level monitoring and control system for large water tanks using an ultrasonic sensor. The system detects and displays the water level in the tank and automatically controls the motor based on the water level.**

The project was implemented using an Arduino microcontroller, an ultrasonic sensor, a relay module, and a DC motor. The ultrasonic sensor was used to measure the water level in the tank, and the microcontroller was programmed to control the motor based on the water level. The relay module was used to switch the motor on and off.

The results showed that the system was able to accurately measure the water level and control the motor accordingly. The system provided highly accurate readings, was non-invasive, and worked in a variety of tank shapes and sizes.

The successful implementation of this prototype has the potential to greatly benefit industries that rely on accurate water level measurements, such as agriculture and manufacturing.

Overall, the system provides an efficient and cost-effective solution for monitoring and controlling water levels in large tanks.

***Index Terms*—Arduino, Ultrasonic sensor,etc.**

I. Aim

TO design a prototype of a product using an Ultrasonic sensor to detect and display the water level in tanks, while also automatically controlling the motor based on the water level.

II. Theory

The ultrasonic sensor[1] will detect the distance of water from the top of the tank. If that distance is less than a constant distance depending upon the height of the tank then the Arduino will turn off the DC Motor using relay of IO Board. If that distance is more than constant distance then the Arduino will command the Relay to turn on the motor. Basically, the project uses measuring the propagation time of sound between transmitted and received.

III. Instruments

1) Arduino Uno R3[2]
2) Ultrasonic Sensor (HCSR-04)
3) Breadboard
4) DC Motor
5) IO Board(Relay Module)
6) Jumper Wires
7) Breadboard

IV. Procedure

Ultrasonic sensor testing Connect the 5V, ground and 6,7 pins of arduino to the Vcc, Gnd, Echo, Trig of ultrasonic sensor. Using the monitor plotter we can see the distance of a particular object.

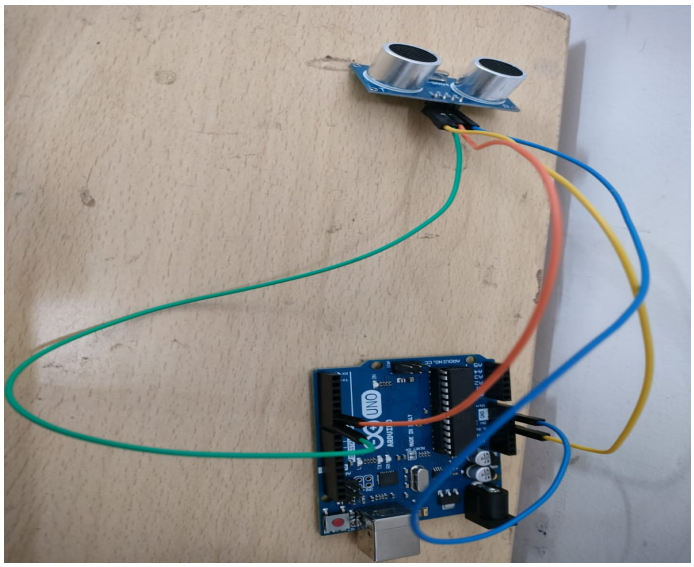

Fig. 1. Connections of Arduino and ultrasonic sensor

To set up the system, we followed these steps:

1) Uploaded the code to the Arduino.
2) We connected the ground and 5V supply on the breadboard.
3) Then we connected the Ultrasonic sensor to the breadboard, and then the 6th and 7th digital pins of the Arduino to the Echo and Trig pins of the ultrasonic sensor, respectively.
4) We connected the IO Board to the breadboard and then the A3 pin of the Arduino to the relay pin of the IO Board.
5) Then we connected the relay module in the IO Board to the DC motor, making sure to properly connect the wires.
6) Finally, we provided voltage supply to the Arduino. These steps enabled our system to detect the water level using the Ultrasonic sensor and control the DC motor based on the detected level.

V. Results

Upon successful completion of the setup, the system was able to accurately detect the level of water present in the tank using the Ultrasonic sensor. Additionally, the system was also able to control the DC motor based on the detected level, turning it on and off to maintain an optimal water level in the tank.

Instead of DC Supply we used another arduino board to give DC supply to the DC motor. Now for its practical application,

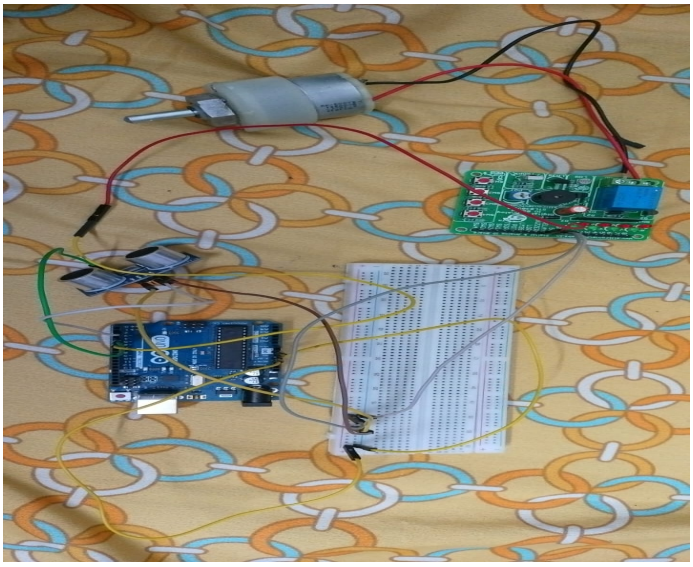

Fig. 2. The final setup

instead of this arduino we can AC supply of 220V and 60Hz. We could have done the same project without using ultrasonic sensor, by using water level sensors such as float sensor. But we wanted to take a different approach on this that lead us to use an Ultrasonic sensor.

We tried to display the water level using LED Display but we were unable to integrate it with our complete setup.

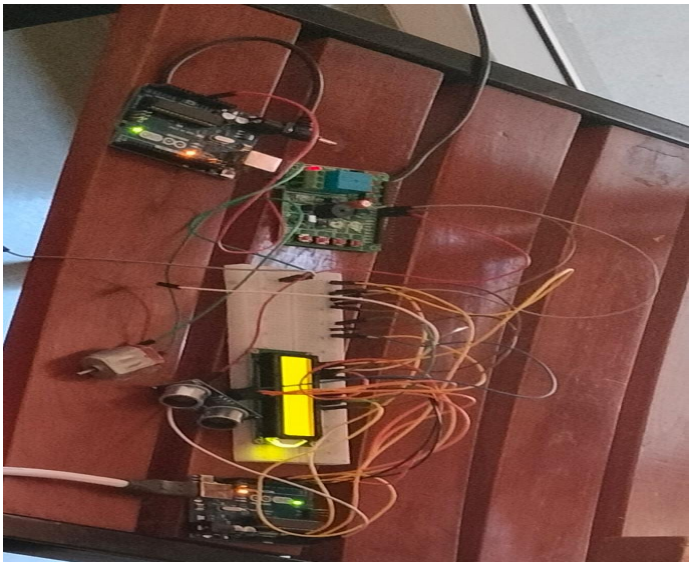

Fig. 3. Failed Attempt

We can see the working of the model in the video given below. url: https://drive.google.com/file/d/1hb-eHuC02j4JQwYbVWAz830_Rwa_vsqN/view?usp=share_link

Now, we can replace the DC motor with water pumping motor and giving an additional 220V 60Hz supply with relay module.

VI. Discussion

Ultrasonic sensors are more accurate, non-invasive as it is not kept under water, versatile, and have a longer lifespan than floating sensors.Hence we used an Ultrasonic sensor

The Ultrasonic sensor operates by transmitting and receiving waves and it proved to be a highly efficient and accurate tool for detecting the level of water in the tank. It calculates the receiver's distance based on the speed of the waves and the time taken for them to reach the receiver. If the waves transmitted do not reach the receiver, it shows a distance of approximately 1200cm.

To ensure optimal efficiency, it is necessary to keep the sensor at an angle of 30 degrees. However, when the water level reaches near the top, there is a possibility that the water may splash onto the sensor, affecting its lifespan or even damaging it. Therefore, using waterproof Ultrasonic sensors can increase the fidelity of the readings and prevent damage to the sensor.

To turn on the motor using relay from arduino we gave analog signal instead of digital signal. Which made us think for a while but then we understood the importance of analog and digital signals.

Appendix A
Code.

- Code for Ultrasonic sensor testing

```
const int Trig = 7;
const int Echo = 6;
void setup() {
Serial.begin(9600);}
void loop() {
long duration, cm;
pinMode(Trig, OUTPUT);
digitalWrite(Trig, LOW);
delayMicroseconds(2);
digitalWrite(Trig, HIGH);
delayMicroseconds(10);
digitalWrite(Trig, LOW);
pinMode(Echo, INPUT);
duration = pulseIn(Echo, HIGH);
cm = microsecondsToCentimeters(duration);
Serial.print(cm);
Serial.print("cm");
Serial.println();}
```

- Final code

```
const int Trig = 2;
const int Echo = 4;

void setup() {
Serial.begin(9600);
pinMode(5,OUTPUT);
}
```

```
void loop() {
long duration, cm;
digitalWrite(5,LOW);
pinMode(Trig, OUTPUT);
digitalWrite(Trig, LOW);
delayMicroseconds(10);
digitalWrite(Trig, HIGH);
delayMicroseconds(10);
digitalWrite(Trig, LOW);
pinMode(Echo, INPUT);
duration = pulseIn(Echo, HIGH);
cm = microsecondsToCentimeters(duration);
Serial.print(cm);
Serial.print("cm");
Serial.println();
if (cm¿ 20)
{digitalWrite(5,HIGH);
delay(2000);}
if (cm¡5)
{digitalWrite(5,LOW);
delay(2000);}

}
long microsecondsToCentimeters(long microseconds) {
return microseconds / 29 / 2;
}
```

- Code for LED Display with complete setup

```
#include ¡LiquidCrystal.h¿
LiquidCrystal lcd(7, 9, 10, 11, 12, 13);
const int Trig = 2;
const int Echo = 4;

void setup() {
Serial.begin(9600);
pinMode(5,OUTPUT);
// lcd.begin(16, 2);

}

void loop() {
long duration, cm;
digitalWrite(5,LOW);
pinMode(Trig, OUTPUT);
digitalWrite(Trig, LOW);
delayMicroseconds(10);
digitalWrite(Trig, HIGH);
delayMicroseconds(10);
digitalWrite(Trig, LOW);
pinMode(Echo, INPUT);
duration = pulseIn(Echo, HIGH);
cm = microsecondsToCentimeters(duration);
Serial.print(cm);
Serial.print("cm");
Serial.println();
if (cm¿ 20)
{digitalWrite(5,HIGH);
delay(2000);}
if (cm¡5)
{digitalWrite(A3,LOW);
delay(2000);}
int z=20-cm;
lcd.setCursor(0, 0);
lcd.print("Water Level ");
lcd.setCursor(14, 0);
lcd.print(z);

}
long microsecondsToCentimeters(long microseconds){
return microseconds / 29 / 2;
}
```

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[1] A. Carullo and M. Parvis, "An ultrasonic sensor for distance measurement in automotive applications," IEEE Sensors Journal, vol. 1, no. 2, p. 143, 2001, doi: https://doi.org/10.1109/jsen.2001.936931.

[2] Arduino, "UNO R3 — Arduino Documentation," docs.arduino.cc, 2022. https://docs.arduino.cc/hardware/uno-rev3