AUTOMATIC WATER TANK FILLING SYSTEM

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Physics at work II

Certificate of Originality

The work embodied in this report entitled **"Automatic Water Tank Filling System"** has been carried out by **Chappa Sri Vinay, Kavya Jaiswal and Rishika Bhatia** for the paper "**Physics at work II"**. We declare that the work and language included in this project report is free from any kind of plagiarism.

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Abstract

Automatic Water Tank Filling System

by

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Water supply is the most important thing in daily home activity especially for washing, cleaning, and taking a bath and many more things.
However, the utilization of non-automated switch used to turn on and turn off a pumping machine sometimes causes either the water spills or a wasteful electrical consumption.
In this work, an automated water tank filling system is proposed.
The system is designed by applying an ultrasonic sensor, an automatic switch module, an Arduino microcontroller, and a submersible water pump in order to automatically switch the water filling.
We hope with this system, people will enjoy the supply of water without any worries related to water spills and a wasteful electrical consumption.

I. INTRODUCTION

The utilization of non-automated switch used to turn on and turn off a pumping machine sometimes causes either the water spills or a wasteful electrical consumption.

In this work, an automated water tank filling system is proposed.

An ultrasonic sensor is mounted on the top of the tank and transmits an ultrasonic pulse down into the tank.

This pulse which travels at the speed of sound will be reflected back to the transmitter from the liquid surface.

The time delay measurement between transmitted and received signals enables the device to calculate the distance to the surface.

The Arduino Uno microcontroller is programmed to automatically determine the liquid level and switch the pumping machine.

PREVIOUSLY USED METHODS TO FIND WATER LEVEL IN WATER TANK

In past, wires of different lengths were dipped in water tank and they were used to measure the water level in water tank. This made the system so complicated and wired.

IN THIS PROJECT:

We will be using an ultrasonic sensor which will be mounted on the top of the water tank and it wont be in contact with the water.

II. RESOURCES USED:

Hardware:

1. Arduino Uno
2. Ultrasonic sensor
3. Single Channel Relay Board
4. LCD Screen
5. 10K ohm potentiometer
6. Motor pump (DC or AC)
7. Buzzer
8. LM7805 IC (Voltage regulator)
9. Solar Panels
10. Battery Management System (Battery)
11. 9V battery or 240V AC Adapter
12. Bread board
13. Jumper wires
14. Water pipes
15. Water containers

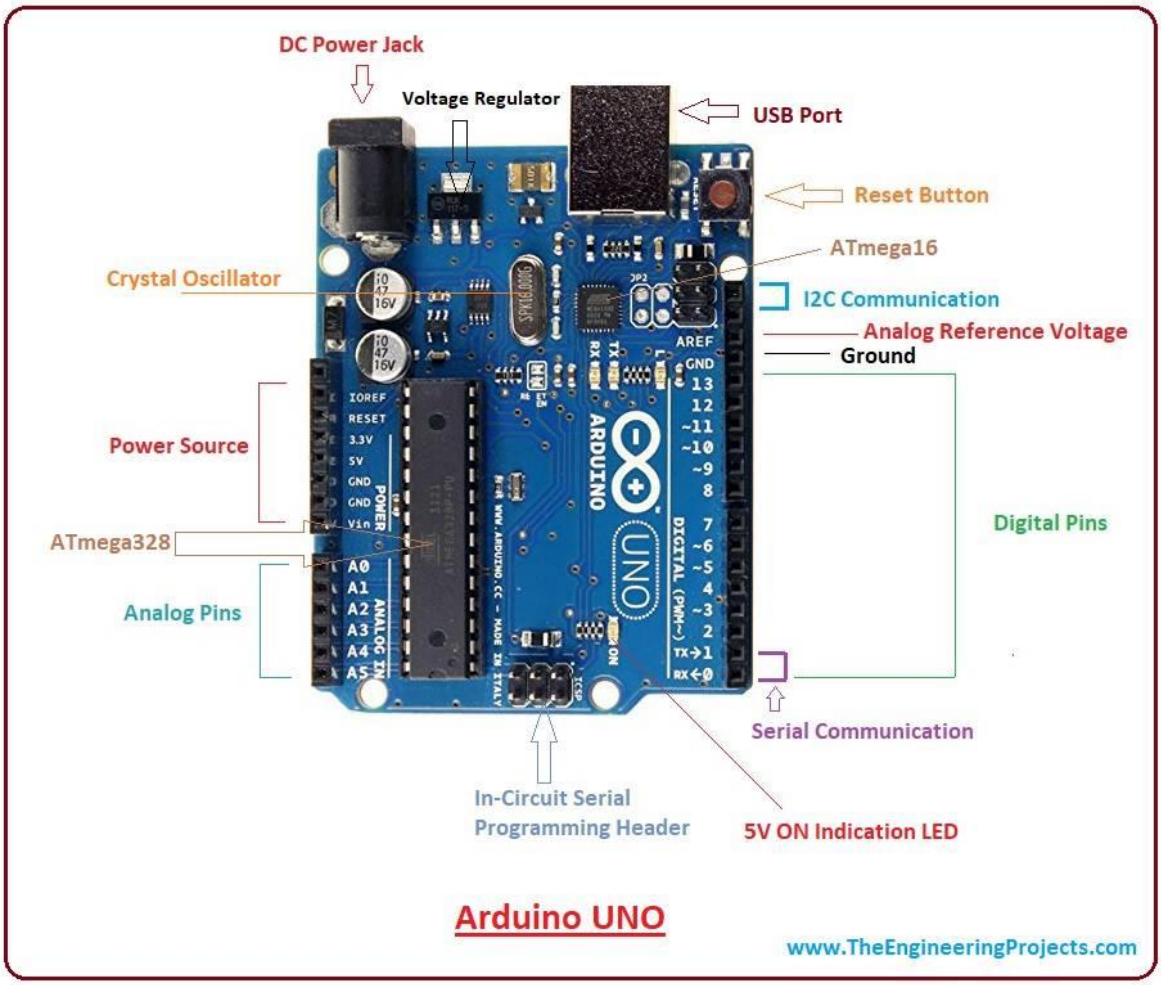
Software:

1. Arduino Environment (Arduino IDE)

III. DESCRIPTION OF MAIN COMPONENTS:

1. Arduino Uno:

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.



2. Ultrasonic Sensor:

ultrasonic sensors measure distance by using ultrasonic waves.

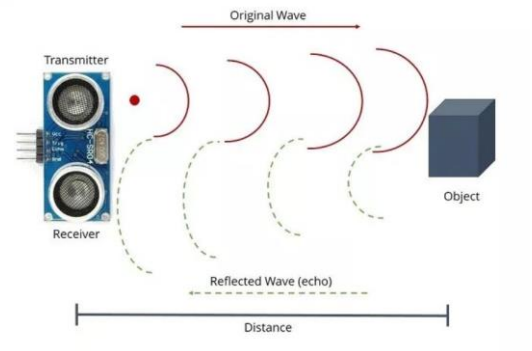
The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

The ultrasonic sensor uses sonar to determine the distance to an object. Here's what happens:

1. The transmitter (trig pin) sends a signal: a high-frequency sound.
2. When the signal finds an object, it is reflected and…
3. … the transmitter (echo pin) receives it.

The time between the transmission and reception of the signal allows us to calculate the distance to an object. This is possible because we know the sound's velocity in the air.

distance = (travel time/2) x speed of sound

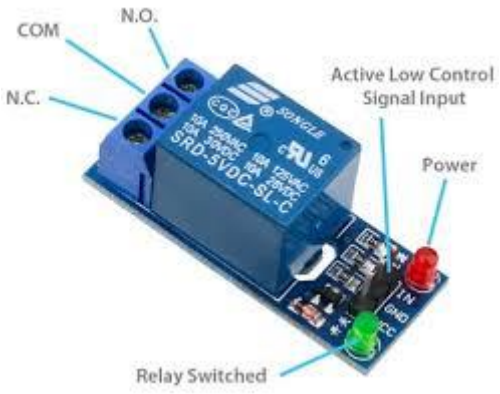


Pins

- VCC: +5VDC
- Trig : Trigger (INPUT)
- Echo: Echo (OUTPUT)
- GND: GND

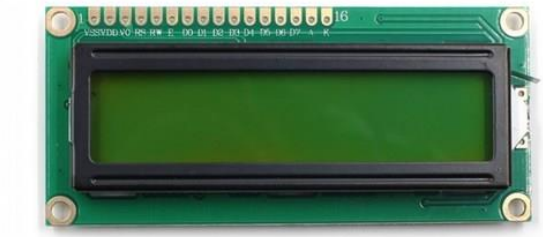
3. Single Channel Relay Board:

A relay is an electrically operated device. It has a control system and (also called input circuit or input contactor) and controlled system (also called output circuit or output cont actor). It is frequently used in automatic control circuit. To put it simply, it is an automatic switch to controlling a high-current circuit with a low-current signal.



4. LCD Screen:

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with
low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays, as in a digital clock.



5. 10K ohm potentiometer

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.

The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

6. Motor pump (DC or AC)

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps.

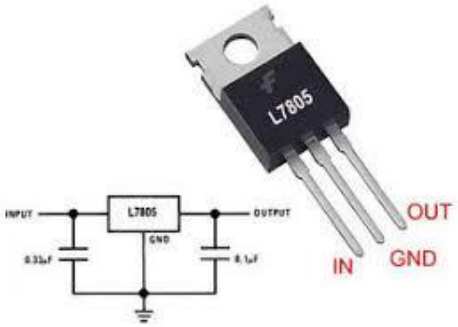
Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

7. Buzzer

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

8. LM7805 IC (Voltage regulator)

IC 7805 is a 5V Voltage Regulator that restricts the output voltage to 5V output for various ranges of input voltage. It acts as an excellent component against input voltage fluctuations for circuits, and adds an additional safety to your circuitry.

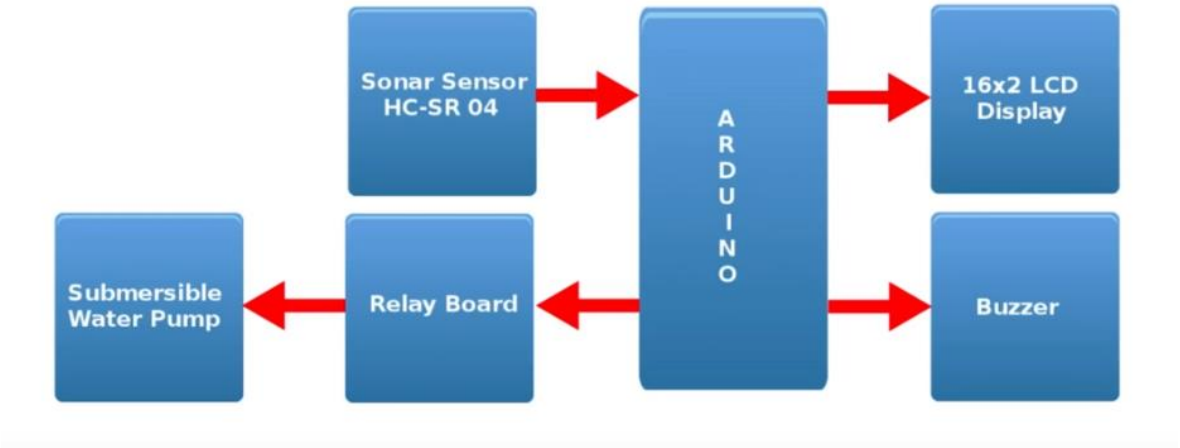


9. Solar Panels

A solar panel is actually a collection of solar (or photovoltaic) cells, which can be used to generate electricity through photovoltaic effect. These cells are arranged in a grid-like pattern on the surface of solar panels. Thus, it may also be described as a set of photovoltaic modules, mounted on a structure supporting it. A photovoltaic (PV) module is a packaged and connected assembly of 6×10 solar cells. When it comes to wear-and-tear, these panels are very hardy. Solar panels wear out extremely slow. In a year, their effectiveness decreases only about one to two per cent (at times, even lesser).

IV. WORKING:

Block Diagram:



Explanation of Block Diagram:

The 1st Block is Arduino Uno, Arduino is the brain of this project. It will take input from the sensors and control all other units according to the value received.

The 2nd block is 16x2 LCD display. This unit will display the Water Level in percentage as well as in Bar Diagram, it will also show the Pump status. This section will also notify us whenever the Sump tank is empty.

The 3rd Block is the Ultrasonic Sensor. This is used to measure the water level present on the overhead water tank.

Sonar Sensor emits an ultrasound at 40 kilohertz, which travels through the air, and if there is an object or obstacle on its path, It will bounce back to the module.

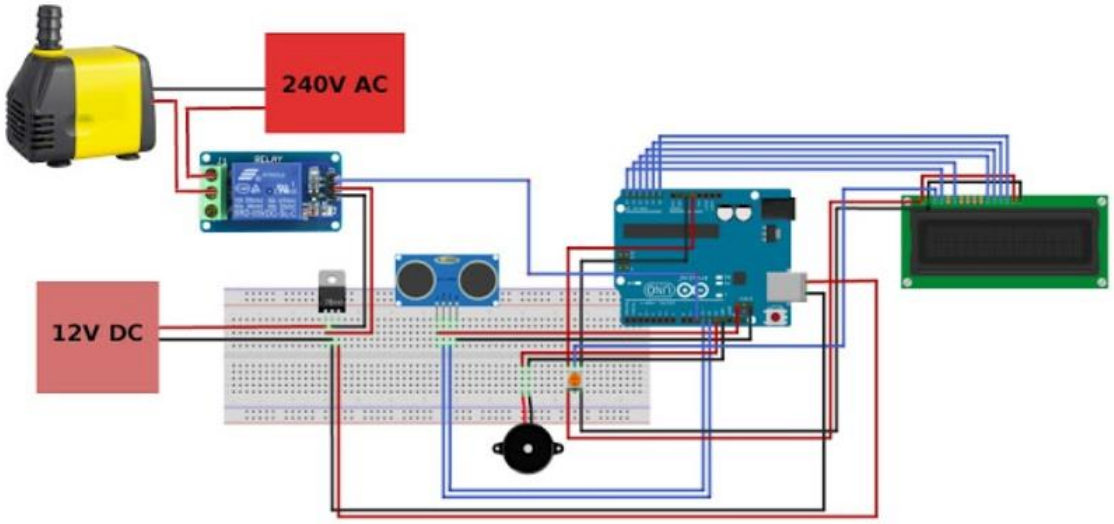
Arduino will use the echo pin, present on Ultrasonic sensor to measure sound wave travel time in microseconds.

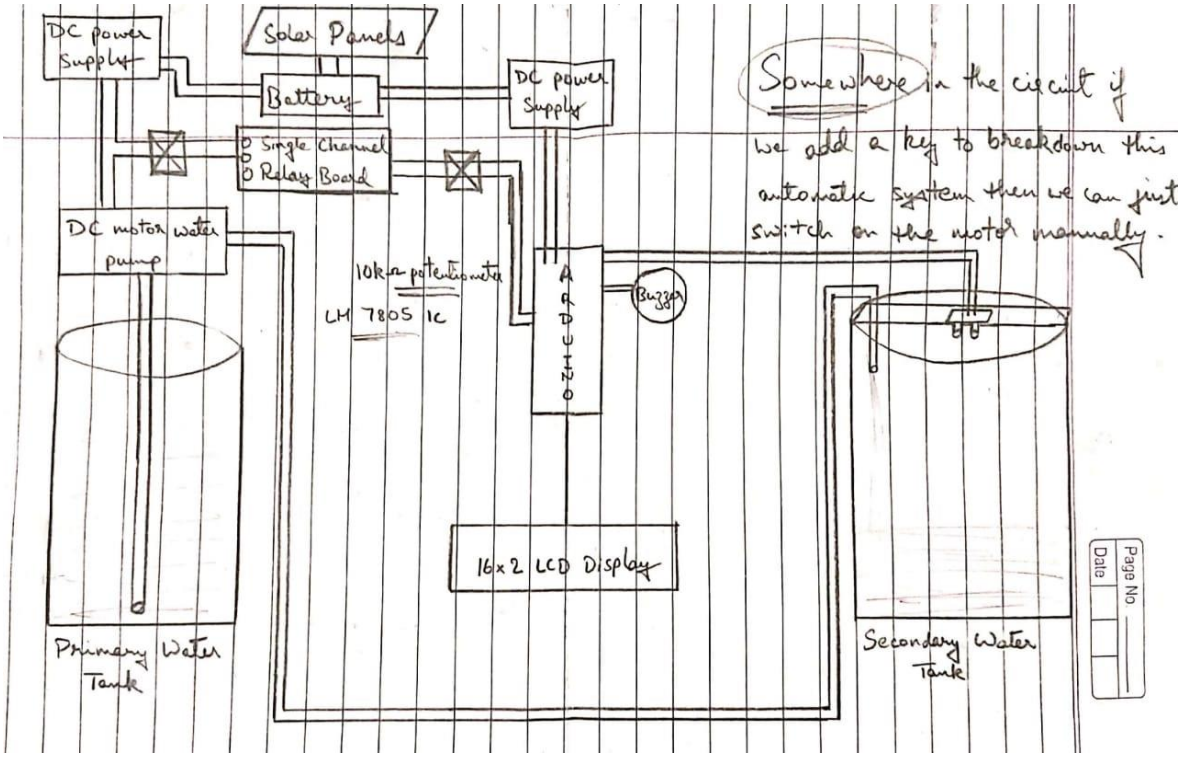
Considering the travel time and the speed of the sound, you can calculate the distance using the formula shown here.

The 4th + 5th block is the Internal Relay plus Water Pump. Arduino will control the Water pump using the Internal relay. The relay present on the circuit can be used to start any kind of 1 HP single phase Water pump without starters. You can replace the internal relay with any relay which is operating in 5V DC to get better power rating for driving the Water pump.

The 6th block is the Buzzer, this is used to notify when the sump tank is empty.

V. CIRCUIT DIAGRAM:





VI. CIRCUIT EXPLANATION:

The ultrasonic sensor senses the water level in the water tank.

If the water level in the water is low according to the code we have uploaded, then the ultrasonic sensor sends signals to the Arduino uno microcontroller that the water level in the tank is low.

Now, the Arduino uno sends signals to the relay board, which is simply like an switch which is controlled by Arduino uno.

When the signal is sent to relay board by Arduino, the relay board switches on the water pump.

Now, the water pump will fill the water from primary tank to the storage(secondary) tank until the tank is full.

The ultrasonic sensor continuously keeps on sensing the water level when the water is being filled.

Once the water level in the water tank is almost full, the ultrasonic sensor sends signals to Arduino.

Then the Arduino uno sends signals to relay board.

Then the relay board switches of the water pump.

The water is filled in the tank. This process keeps on repeating.

Since the setup of Arduino uno board and ultrasonic sensor will be on the terrace(in most cases) the Arduino uno board is powered by a 6V solar panel.

The solar panel is connected to battery management system and then the power is drawn from the battery management system(battery)

The motor pump is powered by a 9V battery if the motor is DC motor, or 240V AC power if the motor is AC motor pump.

CONCLUSION

We could make a prototype of the automatic water tank filling system and it is working successfully.

The future improvements we want to make in this project are we want to replace the solar panel with the solar tracker which tracks the sunlight so that we can get more electricity and we want to connect this system to mobile using Wi-Fi module so that we will get data of what is happening in the system to mobile and we can also control the motor pump wirelessly using the mobile.

APPENDIX

```
[1]  #include <NewPing.h>
[2]
[3]  #define TRIGGER_PIN  12  // Arduino pin tied to trigger pin on the ultrasonic sensor.
[4]  #define ECHO_PIN     11  // Arduino pin tied to echo pin on the ultrasonic sensor.
[5]  #define MAX_DISTANCE 24 // Height of the Water Tank  (in centimeters).
[6]
[7]  #include <LiquidCrystal.h>
[8]  int RS=A5, E=A4, D4=A3, D5=A2, D6=A1, D7=A0;
[9]  LiquidCrystal lcd(RS, E, D4, D5, D6, D7); // initialize the library with the numbers of
     the interface pins
[10] int Buzzer = 13;
[11] int Relay = 10;
[12] int val=0;
[13] NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE); // NewPing setup
     of pins and maximum distance.
[14]
[15] // Creating Charaters for Bar Graph and Reverse Mode Icon
[16] byte Level0[8] = {
[17]       0b00000,
[18] 0b00000,
[19] 0b00000,
[20] 0b00000,
[21] 0b00000,
[22] 0b00000,
[23] 0b11111,
[24] 0b11111
[25] };
[26] byte Level1[8] = {
[27]       0b00000,
[28] 0b00000,
[29] 0b00000,
```

```
[30] 0b00000,
[31] 0b11111,
[32] 0b11111,
[33] 0b11111,
[34] 0b11111
[35]};
[36]byte Level2[8] = {
[37]        0b00000,
[38] 0b00000,
[39] 0b11111,
[40] 0b11111,
[41] 0b11111,
[42] 0b11111,
[43] 0b11111,
[44] 0b11111
[45]};
[46]byte Level3[8] = {
[47]        0b11111,
[48] 0b11111,
[49] 0b11111,
[50] 0b11111,
[51] 0b11111,
[52] 0b11111,
[53] 0b11111,
[54] 0b11111
[55]};
[56]byte NoLevel[8] = {
[57]        0b00000,
[58] 0b00000,
[59] 0b00000,
[60] 0b00000,
[61] 0b00000,
[62] 0b00000,
```

```
[63] 0b00000,
[64] 0b00000
[65] };
[66]
[67]
[68] void setup()
[69] {
[70]  lcd.createChar(0, Level0);
[71]  lcd.createChar(1, Level1);
[72]  lcd.createChar(2, Level2);
[73]  lcd.createChar(3, Level3);
[74]  lcd.createChar(4, NoLevel);
[75]  lcd.begin(16, 2); // set up the LCD's number of columns and rows:
[76]  pinMode(Buzzer,OUTPUT); //Setup Buzzer pin as output pin
[77]  pinMode(Relay,OUTPUT); //Setup Relay pin as output pin
[78]   digitalWrite(Relay,LOW);
[79] }
[80]
[81] void loop()
[82] {
[83]  delay(50); // Wait 50ms between pings (about 20 pings/sec). 29ms should be the
      shortest delay between pings.
[84]  val=sonar.ping_cm();
[85]  lcd.setCursor(0, 1);
[86]  lcd.print("LOW");
[87]  lcd.setCursor(11, 1);
[88]  lcd.print("HIGH");
[89] if(val<4) //Water level reaches the Top of the Tank
[90]  {
[91]
[92]  delay(50);
[93]  lcd.setCursor(3, 1);
[94]  lcd.write(byte(0));
```

```
[95]  lcd.setCursor(4, 1);
[96]  lcd.write(byte(0));
[97]  lcd.setCursor(5, 1);
[98]  lcd.write(byte(1));
[99]  lcd.setCursor(6, 1);
[100]     lcd.write(byte(1));
[101]     lcd.setCursor(7, 1);
[102]     lcd.write(byte(2));
[103]     lcd.setCursor(8, 1);
[104]     lcd.write(byte(2));
[105]     lcd.setCursor(9, 1);
[106]     lcd.write(byte(3));
[107]     lcd.setCursor(10, 1);
[108]     lcd.write(byte(3));
[109]     digitalWrite(Relay,LOW); //Pump off
[110]     lcd.setCursor(0,0);
[111]     lcd.print("PUMP OFF                    ");
[112]     }
[113]
[114]     else if(val<=15&&val>4) //Water level is getting close to the tank
[115]     {
[116]     lcd.setCursor(3, 1);
[117]     lcd.write(byte(0));
[118]     lcd.setCursor(4, 1);
[119]     lcd.write(byte(0));
[120]     lcd.setCursor(5, 1);
[121]     lcd.write(byte(1));
[122]     lcd.setCursor(6, 1);
[123]     lcd.write(byte(1));
[124]     lcd.setCursor(7, 1);
[125]     lcd.write(byte(2));
[126]     lcd.setCursor(8, 1);
[127]     lcd.write(byte(2));
```

```
[128]     lcd.setCursor(9, 1);
[129]     lcd.write(byte(4));
[130]     lcd.setCursor(10, 1);
[131]     lcd.write(byte(4));
[132]
[133]
[134]     }
[135]       else if(val<=20&&val>15)
[136]     {
[137]    lcd.setCursor(3, 1);
[138]     lcd.write(byte(0));
[139]     lcd.setCursor(4, 1);
[140]     lcd.write(byte(0));
[141]     lcd.setCursor(5, 1);
[142]     lcd.write(byte(1));
[143]     lcd.setCursor(6, 1);
[144]     lcd.write(byte(1));
[145]     lcd.setCursor(7, 1);
[146]     lcd.write(byte(4));
[147]     lcd.setCursor(8, 1);
[148]     lcd.write(byte(4));
[149]       lcd.setCursor(9, 1);
[150]     lcd.write(byte(4));
[151]     lcd.setCursor(10, 1);
[152]     lcd.write(byte(4));
[153]
[154]
[155]
[156]     }
[157]
[158]       else if(val<=21&&val>20)
[159]     {
[160]
```

```
[161]    lcd.setCursor(3, 1);
[162]    lcd.write(byte(0));
[163]    lcd.setCursor(4, 1);
[164]    lcd.write(byte(0));
[165]    lcd.setCursor(5, 1);
[166]    lcd.write(byte(4));
[167]    lcd.setCursor(6, 1);
[168]    lcd.write(byte(4));
[169]    lcd.setCursor(7, 1);
[170]    lcd.write(byte(4));
[171]    lcd.setCursor(8, 1);
[172]    lcd.write(byte(4));
[173]      lcd.setCursor(9, 1);
[174]    lcd.write(byte(4));
[175]    lcd.setCursor(10, 1);
[176]    lcd.write(byte(4));
[177]
[178]
[179]    }
[180]    else if(val>21) // Water is empty on the Tank
[181]    {
[182]
[183]    digitalWrite(Buzzer,HIGH);
[184]    delay(1000);
[185]    digitalWrite(Buzzer,LOW);
[186]    delay(1000);
[187]    digitalWrite(Relay,HIGH); // Pump ON
[188]    lcd.setCursor(0,0);
[189]    lcd.print("PUMP ON                    ");
[190]    lcd.setCursor(3, 1);
[191]    lcd.write(byte(4));
[192]    lcd.setCursor(4, 1);
[193]    lcd.write(byte(4));
```

```
[194]     lcd.setCursor(5, 1);
[195]     lcd.write(byte(4));
[196]     lcd.setCursor(6, 1);
[197]     lcd.write(byte(4));
[198]     lcd.setCursor(7, 1);
[199]     lcd.write(byte(4));
[200]     lcd.setCursor(8, 1);
[201]     lcd.write(byte(4));
[202]     lcd.setCursor(9, 1);
[203]     lcd.write(byte(4));
[204]     lcd.setCursor(10, 1);
[205]     lcd.write(byte(4));
[206]     }
[207]
[208]
[209]
[210]   }
[211]
      //End of program
```