Wireless Water Level Indicator using PIC16F877A

Report

Prepared by:

Omar SHIRWA - B1805.020056

İsmail AYDIN - B1705.020018

Electrical and Electronic Engineering

İstanbul Aydın University

13.01.2022

EEE471 & Embedded System Design

Dr. Abbas UĞUREVREN

Table of Contents

Abstract:

Water is nature's most important gift to mankind. Without water there is no life. Now humans have understood its importance, especially where there is no water. This is currently being done adequately in urban areas where water use exceeds availability. This wireless water level indicator and controller can automatically turn your home water pump on and off based on the water level in the tank and displays the water level on LCD as well as LED and buzzer. The project seeks to develop a circuit used for a water level indicator that can monitor the storage level in the tank to provide water throughout the day without loss.

Project Scope :

The aim of this project is to try and learn more about Microcontrollers and how can we use them in our daily lifes. So, we will see in this project , is the use PIC16F877A microcontroller as a water level indicator.

1) Introduction:

The wireless water level indicator and controller is a system that can remotely monitor the water level in the upper tank; up to 100m away wirelessly. The system includes a pair of radio transmitter receivers, eliminating the need to run wires from the roof to ground. A transmitter is placed next to the tank with a sensor inside the tank to monitor the water level. The measured level is transmitted wirelessly via an RF transmitter. It is received by a remote receiver and decoded to display the water level on the LCD. It also has a buzzer that sounds when the water level drops below 1/4 or the reservoir overflows. When the tank is 1/4, 1/2 or 3/4 full, the percentage of water level is displayed on the LCD and the engine starts and stops automatically.

Need of a water level indicator are shown below:

- Overflow problems.
- To prevent wastage of energy.
- To prevent wastage of water.
- Attention.
- Observation.
- Automatic switch off.

Explanation of how works the system:

- Water Level sensing kit is used sense the level of water which is planted in the water tank.
- Data encoder encodes the water level data and is transmitted using Wireless Transmitter.
- Wireless Receiver receives the encoded data decoder decodes the signal.
- This decoded signal is given to the PIC Microcontroller which depending upon the logic displays the level of Water on LCD Display and LED Indicators.
- The Water Pump Control Relay is controlled by the Microcontroller depending upon the water level it Starts and Stops the motor.

2) Design Methodology:

Circuit Diagram:

The Water Level Sensing Section senses the level of water in the tank and sends it (wirelessly) to the Receiver Section. Receiver Section is connected to the Controlling Section, which process the received information and produces visual, sound indications and controls the operation of the motor whenever required.

The project is divided into 3 sections:

Water Level Sensing Section:

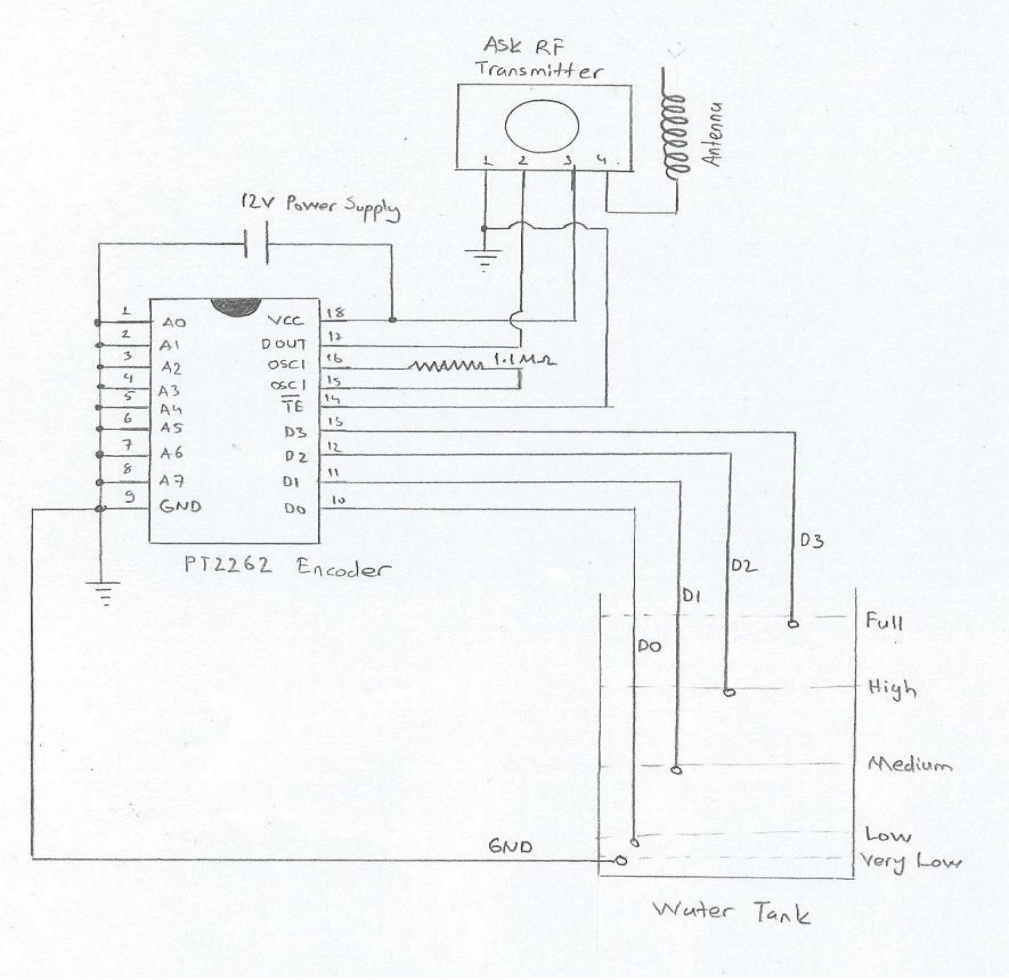

Figure 1. ASK RF Transmitter with Water Tank Connections

Level Sensor module is made of with PT2262 encoder and ASK (Amplitude Shift Keying) RF transmitter. This circuit can be drive using 9V battery. This circuit is placed near the Water Tank and connected to the tank as show in the Figure 1.

Receiver Section:

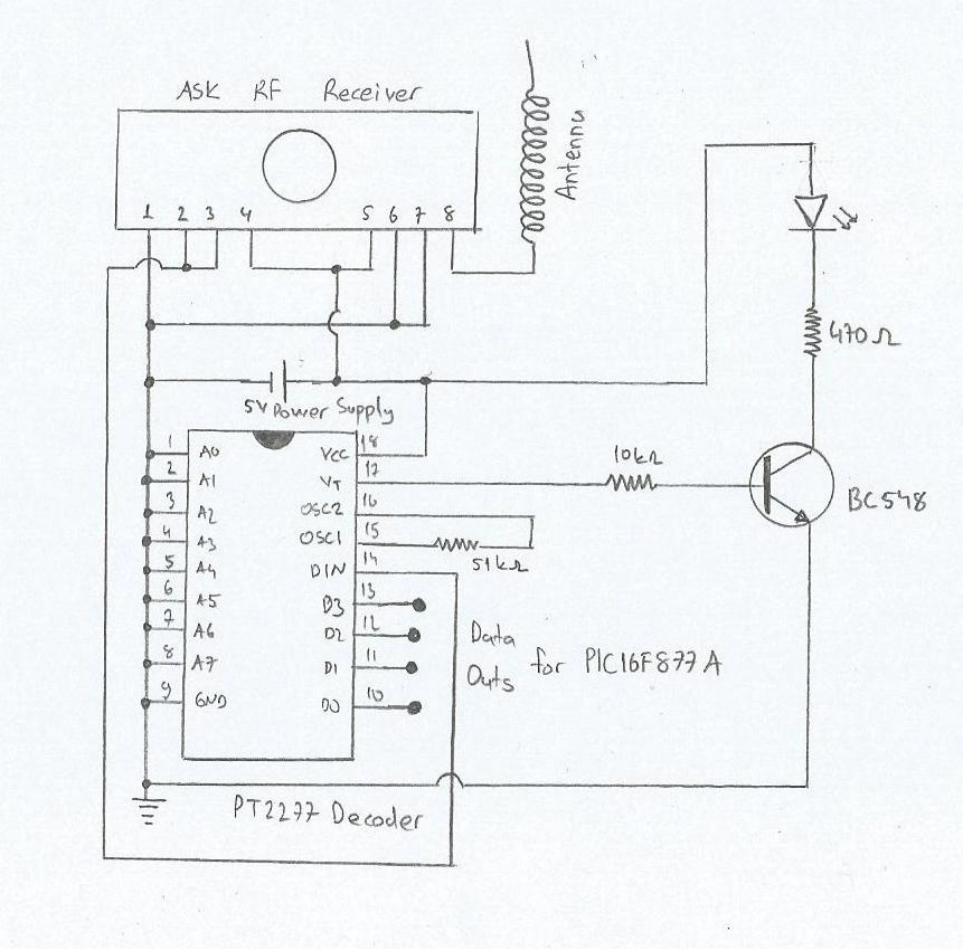

Figure 2. ASK RF Receiver

Receiver Module is made of with PT2272 decoder and ASK RF receiver. The data transmitted by the Sensor module is received by this module and is given to the Controlling Module.

Controlling Section:

The heart of the Controlling Section is PIC16F877A. It processes the data received by the Receiver Section. LCD, LED Indicators and Motor status are updated according to the data.

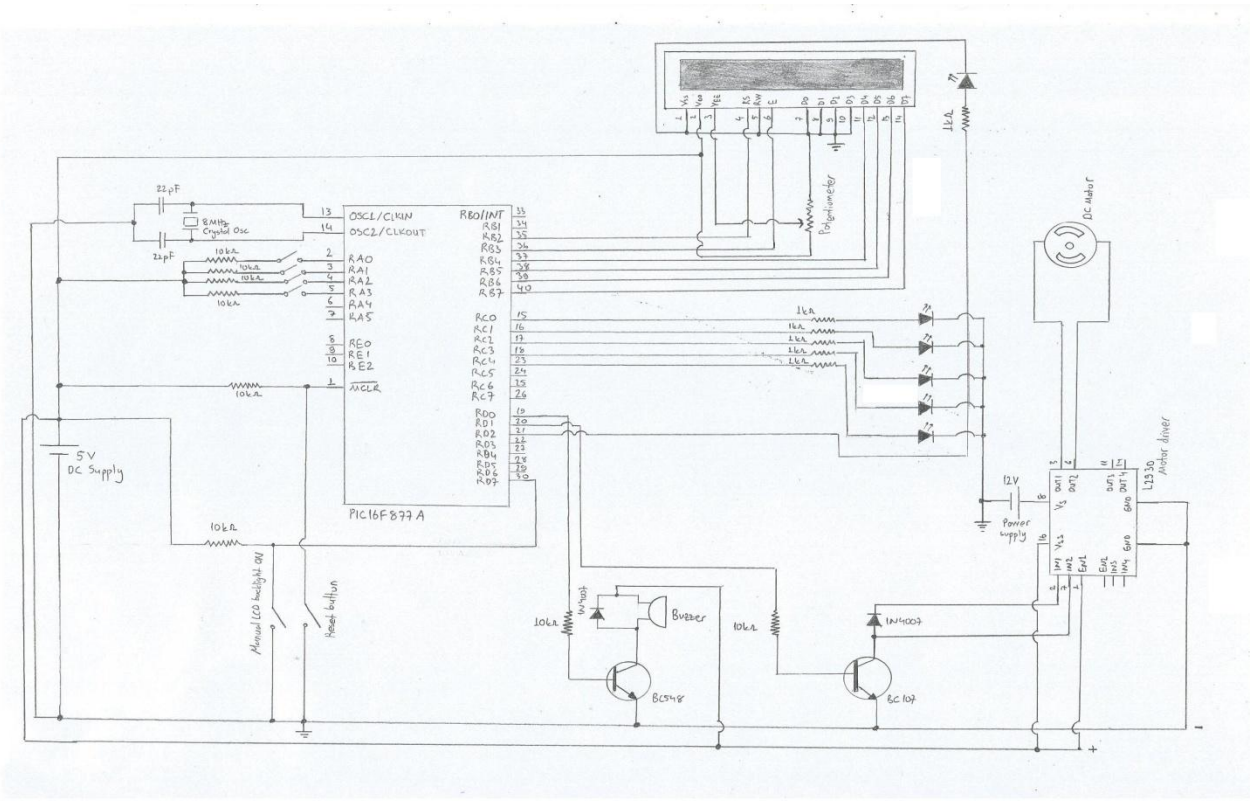

Figure 3. Circuit Diagram

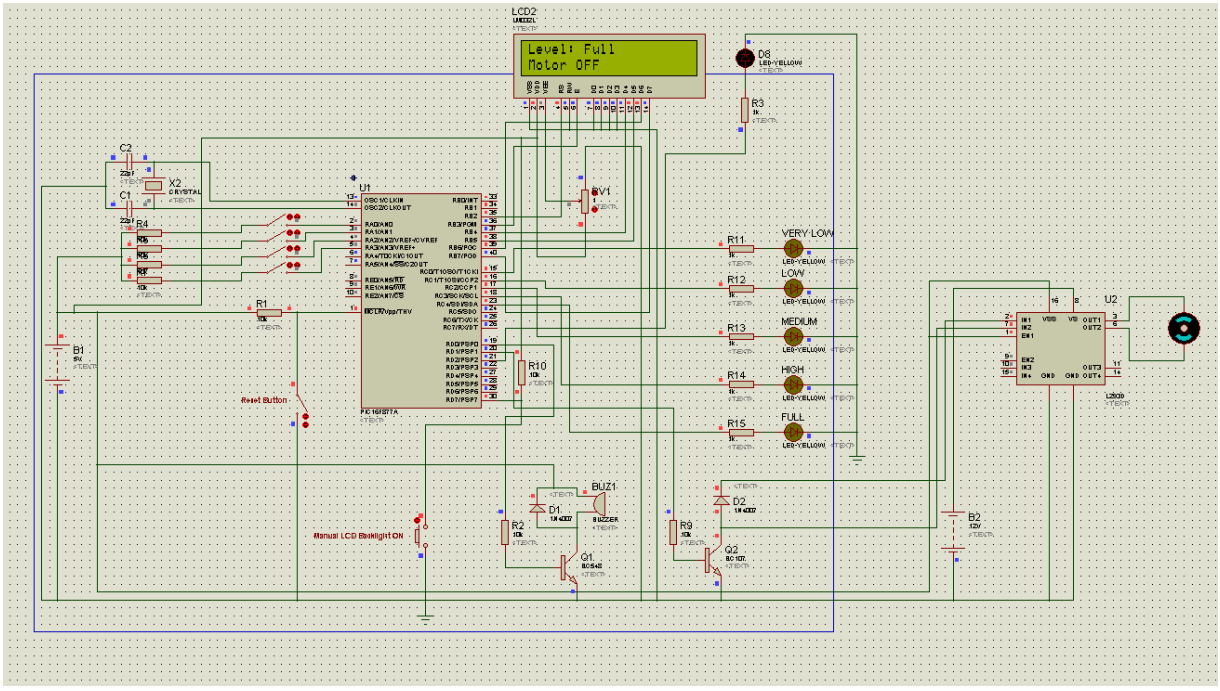

Figure 4. Proteus Circuit Diagram

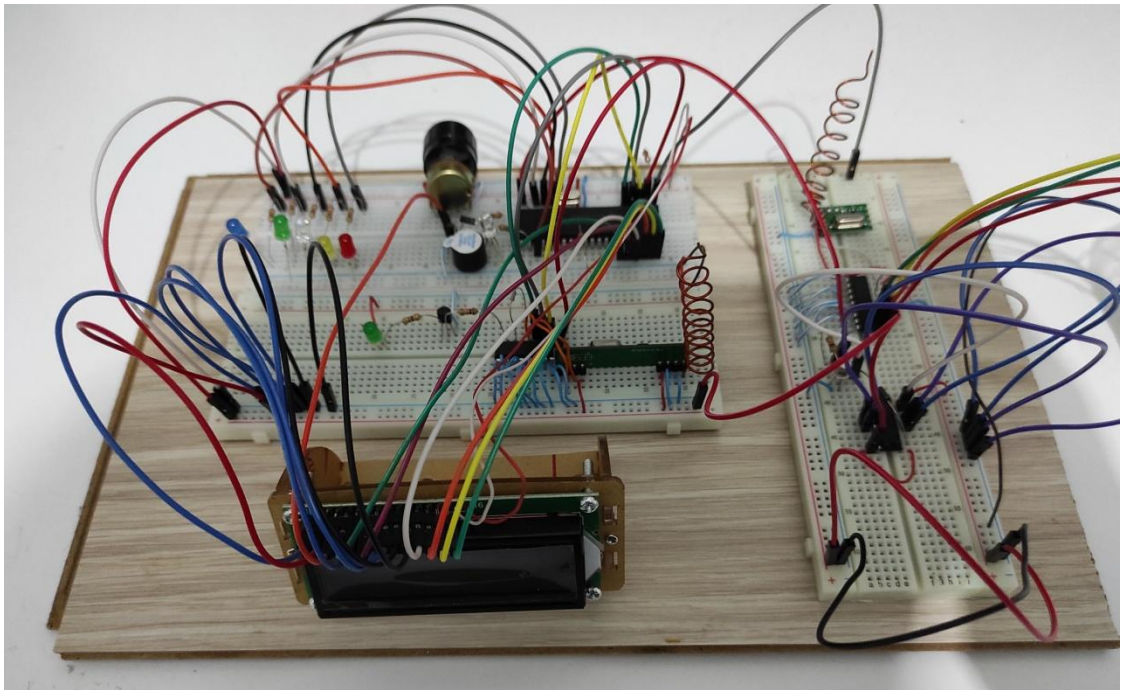

Figure 5. Circiut with RF receiver and transmitter

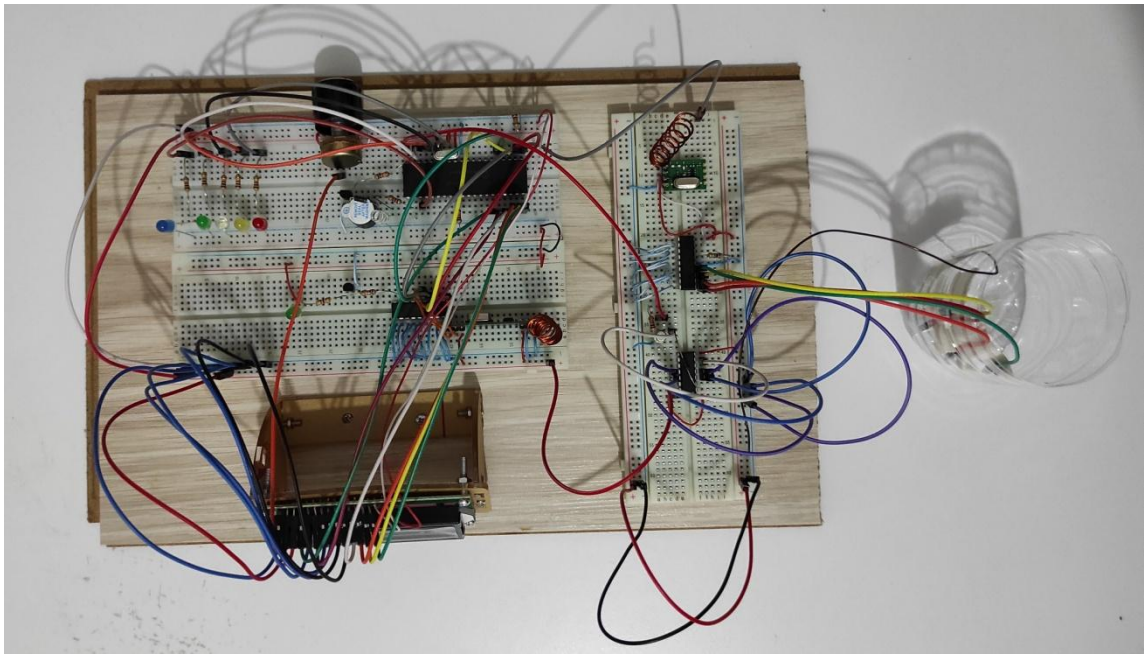

Figure 6. Top view of our Circuit

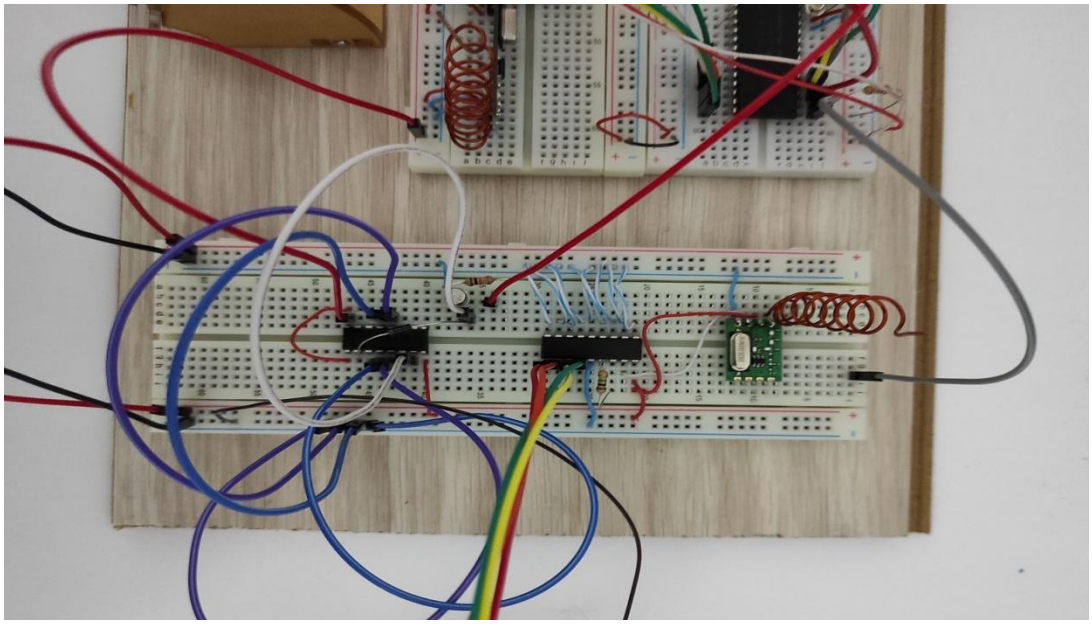

Figure 7. RF transmitter side of Circuit

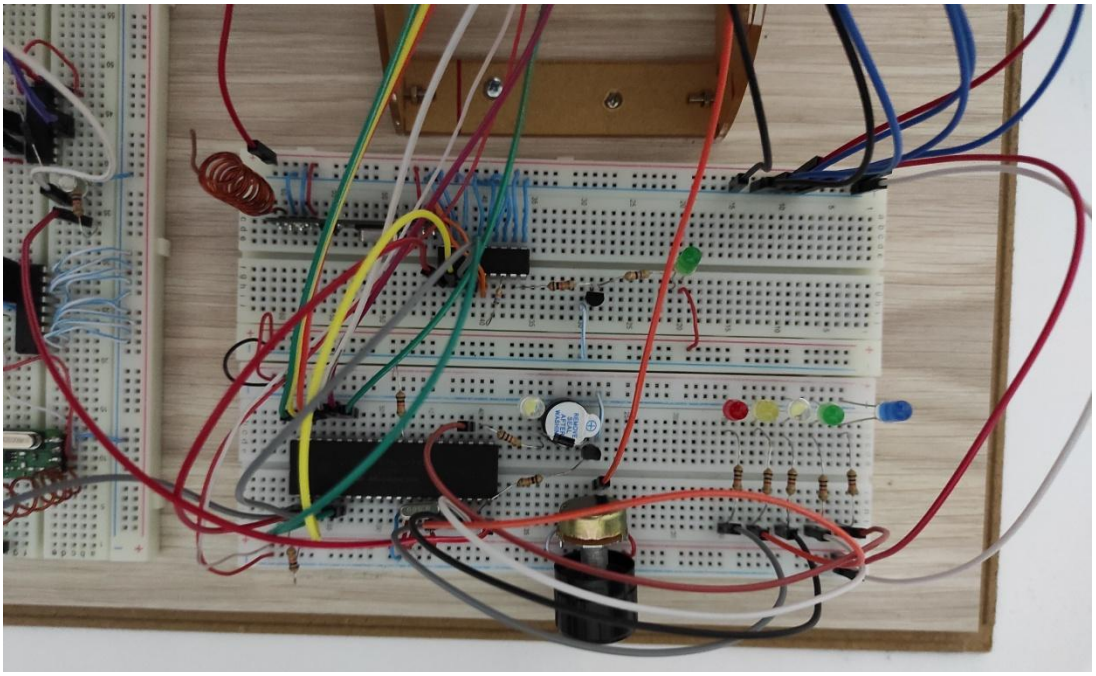

Figure 8. RF receiver side of Circuit

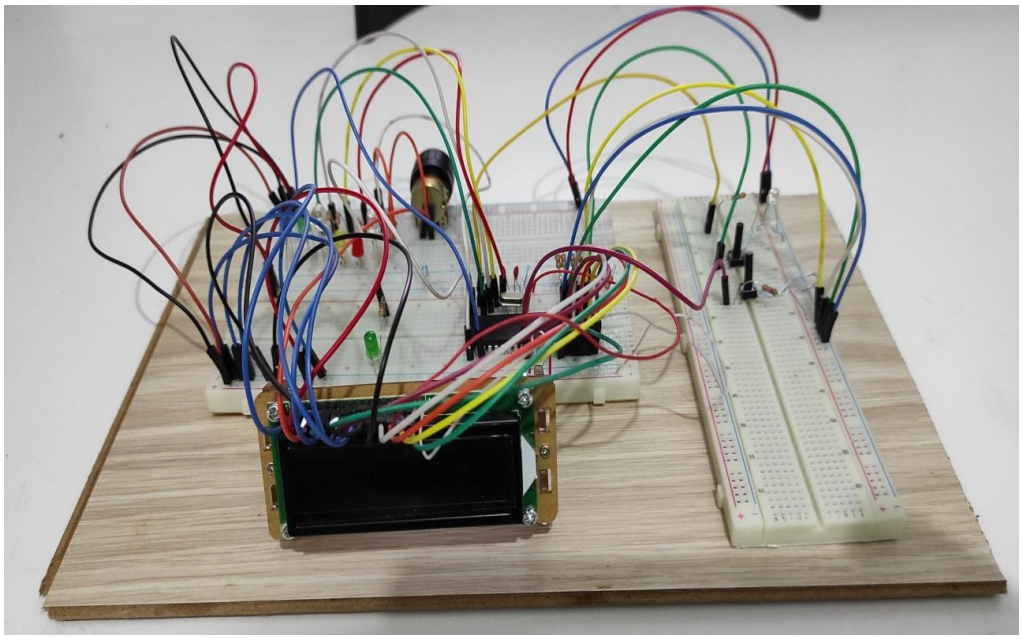

Figure 9. Circiut without RF receiver and transmitter

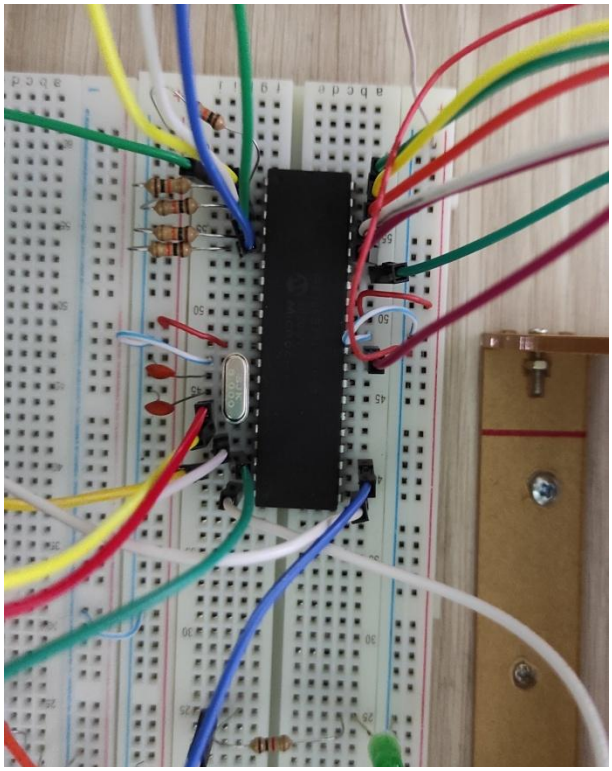

Figure 10. PIC16F877A Connections

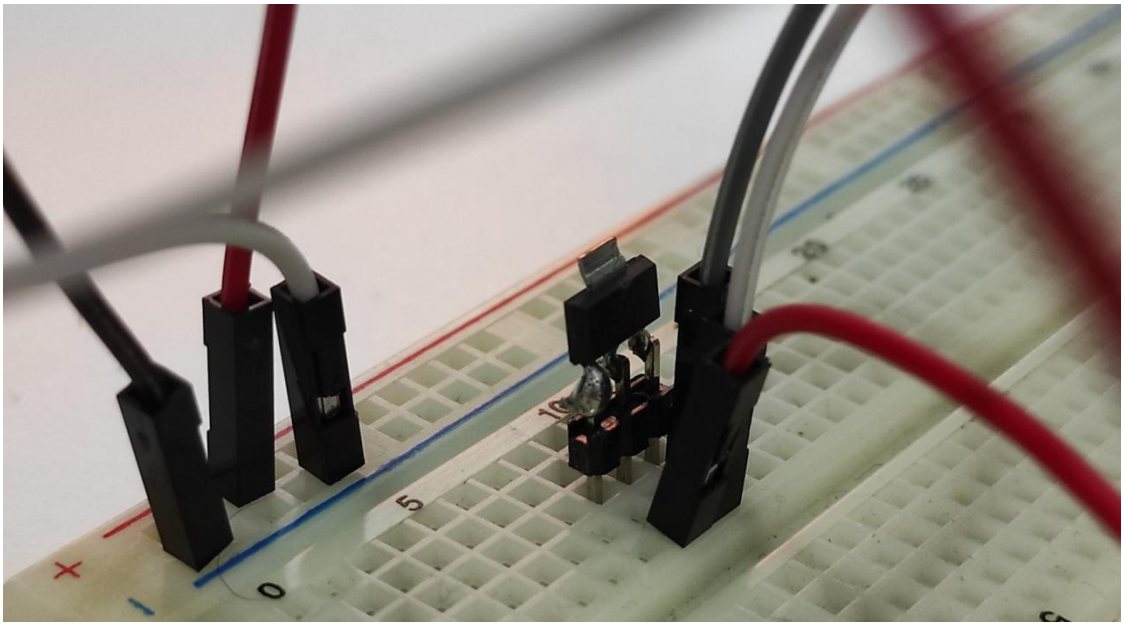

Figure 11. 7805 Regulator connection to obtain 5 V

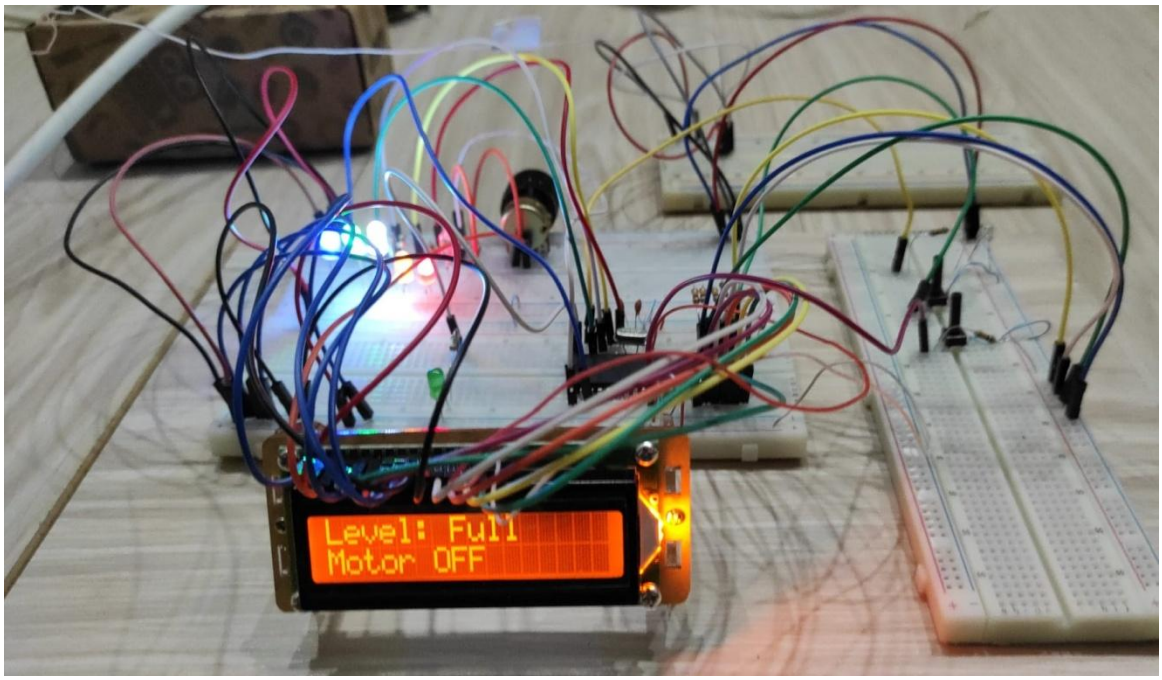

Figure 12. Circuit view when it works

3) Working:

For the reception and transmission of data signal we have used encoder-decoder pair of PT2262 and PT2272 . Both of them are CMOS ICs working voltage ranges from 2.4 to 12v. The oscillator resistances are chosen according to the datasheet. When water level raises, the data pins of the encoder will be grounded corresponding to the level of water, which will be transmitted to the Receiver via ASK RF module. The received data is decoded by the decoder PT2272. LED on the receiver indicates that it is receiving data. Then the data is given to the PIC for processing.

D0	D1	D2	D3	Status
0	0	0	0	All Data pins are grounded, indicates tans is Full.
0	0	0	1	Water level is below D3 and above D2, indicates High Level
0	0	1	1	Water level is below D2 and above D1, indicates Medium Level.
0	1	1	1	Water level is below D1 and above D0, indicates Low Level.
1	1	1	1	Water level is below D0, indicates Very Low Level.

When the water level becomes Very Low, the motor will turn ON, buzzer sounds, and the LCD backlight will automatically turn ON for 5 seconds. When the water level reaches Full level, the motor will automatically turn OFF, buzzer sounds, and the LCD backlight will automatically turn ON for 5 seconds. During normal operation you can manually turn on LCD backlight by pressing the Push button switch. The LCD indicates the Level of water (‘Very Low’, ‘Low’, ‘Medium’, ‘High’, ‘Full’) and the status of the motor (‘ON’ or ‘OFF’). The LED bar will also indicate the level of water.

4) Codes that we used in PIC16F877A:

// LCD module connections

```
sbit LCD_RS at RB2_bit;
sbit LCD_EN at RB3_bit;
sbit LCD_D4 at RB4_bit;
sbit LCD_D5 at RB5_bit;
sbit LCD_D6 at RB6_bit;
sbit LCD_D7 at RB7_bit;
sbit LCD_RS_Direction at TRISB2_bit;
sbit LCD_EN_Direction at TRISB3_bit;
sbit LCD_D4_Direction at TRISB4_bit;
sbit LCD_D5_Direction at TRISB5_bit;
sbit LCD_D6_Direction at TRISB6_bit;
sbit LCD_D7_Direction at TRISB7_bit;
```

// End LCD module connections

```
char txt1[] = "Water";
char txt2[] = "Level";
char txt3[] = "Indicator";
char txt4[] = "And Controller";
char mtr1[] = "Motor ";
char mtr2[] = "OFF";
char mtr3[] = "ON";
char wtr1[] = "Level: ";
```

```
char wtr2[] = "Very Low";
char wtr3[] = "Low";
char wtr4[] = "Medium";
char wtr5[] = "High";
char wtr6[] = "Full";

void main()
{
  int i = 0;
  int c = 16;
  int b = 0;
  CMCON = 0x07;
  ADCON1 = 0x06;
  TRISA = 0x0F;              // set direction to be input
  PORTA = 0x00;
  PORTD = 0x00;
  PORTC = 0x00;
  TRISB = 0x00;              //  set direction to be output
  TRISC = 0x00;              // set direction to be output
  TRISD = 0x80;              // set direction to be output
  PORTD.F2 = 1;
  PORTD.F7 = 1;
  Lcd_Init();                // Initialize LCD
  Lcd_Cmd(_LCD_CLEAR);       // Clear display
  Lcd_Cmd(_LCD_CURSOR_OFF);  // Cursor off
  Lcd_Out(1,1,txt1);         // Write text in first row
```

```
 Lcd_Out(2,1,txt2);          // Write text in second row
 Delay_ms(500);
 Lcd_Cmd(_LCD_CLEAR);        // Clear display
 Lcd_Out(1,1,txt3);          // Write text in first row
 Lcd_Out(2,1,txt4);          // Write text in second row
 Delay_ms(500);
 // Moving text
 for(i=0; i<15; i++)
 {
  Lcd_Cmd(_LCD_SHIFT_RIGHT);
  Delay_ms(125);
 }
 i=0;   //Motor Status OFF
 do
 {
  Lcd_Cmd(_LCD_CLEAR);
  Lcd_Out(1,1,wtr1);
  Lcd_Out(2,1,mtr1);
  if(c>0)
  {
    PORTD.F2 = 1;             //LCD Backlight ON
    c--;
  }
  else
    PORTD.F2 = 0;             //LCD Backlight OFF
  if(b>0)
```

```
{
  PORTD.F0 = 1;            //Buzzer ON
  Delay_ms(125);
  PORTD.F0 = 0;            //Buzzer OFF
  b--;
}
if(PORTD.F7 == 0)          //Manual Backlight ON
  c = 16;
if(PORTA == 0x0F)
{
   PORTD.F1 = 1;
   Lcd_Out(1,8,wtr2);
   Lcd_Out(2,7,mtr3);
   PORTC = 1;
   if(i == 0)
   {
      c = 16;              //Backlight
      b=3;                 //Buzzer
   }
   i=1;
}
else if(PORTA == 0x0E)
{
   Lcd_Out(1,8,wtr3);
   if(i == 1)
      Lcd_Out(2,7,mtr3);
```

```
    else
      Lcd_Out(2,7,mtr2);
    PORTC = 3;              //LED Bar
  }
  else if(PORTA == 0x0C)
  {
    Lcd_Out(1,8,wtr4);
    if(i == 1)
      Lcd_Out(2,7,mtr3);
    else
      Lcd_Out(2,7,mtr2);
    PORTC = 7;              //LED Bar
  }
  else if(PORTA == 0x08)
  {
    Lcd_Out(1,8,wtr5);
    if(i == 1)
      Lcd_Out(2,7,mtr3);
    else
      Lcd_Out(2,7,mtr2);
      PORTC = 15;           //LED Bar
  }
  else if(PORTA == 0x00)
  {
    Lcd_Out(1,8,wtr6);
    Lcd_Out(2,7,mtr2);
```

```
      PORTD.F1 = 0;            // Motor OFF
      if(i == 1)
      {
        c = 16;               //Backlight
        b = 3;                //Buzzer
      }
      i=0;                    //Motor Status Updated
      PORTC = 31;             //LED Bar
    }
    else
      PORTA = 0x0F;
   Delay_ms(125);
  }while(1);                  // Endless loop
}
```

5) Project Plan:

Task ID	Task Name	Start Date	End Date	% Completed	24.12.2021	26.12.2021	30.12.2021	02.01.2022	07.01.2022	31.12.2022
1	Discuss the topic	22.12.2021	24.12.2021	% 100						
2	Distribution of tasks	24.12.2021	26.12.2021	% 100						
3	Prospecting	28.12.2021	30.12.2021	% 100						
4	Design process	01.01.2022	02.01.2022	% 100						
5	Experimenting	01.01.2022	07.01.2022	% 100						
6	Material acquisition	30.12.2021	31.12.2021	% 100						

6) Proposel Budget:

Companent	Price
PT2272 Decoder	7.14 ₺
8 MHz Cyristal	2.64 ₺
10 K Resistor (50)	1.65 ₺
Buzzer	1.65 ₺
Led	1.44 ₺
1 K Resistor (50)	1.65 ₺
BC107 Transistor	4.95 ₺
433 MHz RF Transmitter	14.92 ₺
433 MHz RF Receiver	11.61 ₺
BC548 Tramsistor	1.15 ₺
22pF Capacitor	0.88 ₺
PT2262 Encoder	5.50 ₺
2x16 LCD Stand	9.89 ₺
1N4007	0.29 ₺
10 K Potantiometer	1.54 ₺
2x16 LCD	50.55 ₺
Breadboard	7.80 ₺
Cables	7.70 ₺
PIC16F877A	143.03 ₺

7) Conclusion:

This project is intended to design a simple and low cost water level indicator and controller with wireless capabilities. This is not only for water tank but also cam be used for oil level and chemical lab work. To design this system, we will use PIC microcontroller as a platform and good materials for low cost. Our target is to design a system in such a way that its components will be able to prevent the wastage of water. Microcontroller code will be developed later. The whole system operates automatically. So it does not need any experts to operate it and monitor it working and It is not expensive at all. This design has much more scope and potential for future research and development. Even though project was design to monitor and report on water levels in a tank, we hope some modifications to this project will lead to a reasonable diversity of usage and prove its usefulness.

8) Referances:

[1] Design and Implementation of a Fully Automated Water Level Indicator (American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p- ISSN : 2320-0936).

[2] Microcontroller chip Technology, 2001. PIC16F77A Datasheet www.microchip.com

[3] Research Papers from www.ijareeie.com Jatmiko, S., Mutiara, A B., 2012. Indriati—Prototype of water level detection system with wireless‖ Journal of Theoretical and Applied Information Technology, Vol. 37 pp 52-59, 2012

[4] Shao-Quan Lu, ”A Circuit for Water Level Detection and Control”, HOLTEK, White paper Wireless Water-Level Indicator By Robin Chalana, Electronics

[5] For You Magazine (January 2012) Yi-Bing Z. The long-range monitoring system of water level based on GPRS network. Advances in Control and Communication. Springer, 2012; 137:227–34.