Water Level Indicator With Temperature Management System

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Abstract

In this mini-project, we propose a smart and wireless solution for efficient household water resource management, focusing on water level monitoring and temperature management. This system is especially designed to assist elderly individuals, minimizing the need for physically checking overhead tanks.

The setup employs two ESP32 microcontrollers configured in ESP-NOW communication mode, where one ESP32 (transmitter) reads the water level using a waterproof ultrasonic sensor and wirelessly transmits the data to another ESP32 (receiver) based on its MAC address. The receiver ESP32 then processes the data, displays the water level on a 16x2 LCD display, and activates a buzzer alarm when critical levels (above 90% or below 10%) are reached—thereby preventing overflow and dry run conditions.

Additionally, a DS18B20 digital temperature sensor is integrated with the system to continuously monitor the water temperature. The real-time temperature data is also displayed on the LCD, providing the user with comprehensive status updates.

This project integrates wireless IoT technology, sensor-based automation, and user-friendly display and alert mechanisms to ensure convenience, safety, and water conservation. The design ensures low cost, simplicity, and reliability, making it ideal for household applications, especially for the elderly or people with limited mobility.

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ACKNOWLEDGEMENT

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Lastly, we are thankful to the academic institution for fostering an environment that encourages experiential learning, innovation, and the practical application of theoretical knowledge. The successful completion of this project has been made possible through the collective support, guidance, and contributions of all those mentioned above, and for that, we are truly grateful.

Name with signature

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2. Introduction

Efficient water resource management is becoming increasingly important in modern households, especially in areas facing water scarcity or where water usage needs to be carefully monitored. Traditional methods of checking water levels in overhead tanks often require manual inspection, which can be inconvenient and potentially dangerous for elderly or physically challenged individuals. Similarly, monitoring the temperature of stored water is important for both domestic usability and energy management, particularly in areas with high seasonal temperature variations.

To address these concerns, this project introduces a smart, wireless water level and temperature monitoring system using ESP32 microcontrollers and sensor technology. The system is designed to provide real-time feedback on water levels and temperature through a 16x2 LCD display, and to alert users with a buzzer when the tank is either too full or nearing empty.

A pair of ESP32 boards communicate using ESP-NOW protocol, where the transmitter ESP32 gathers data from an ultrasonic sensor to detect water level and sends it to the receiver ESP32, which triggers the appropriate response based on the readings. Additionally, a DS18B20 digital temperature sensor is used to measure the water temperature and display it alongside the water level information.

This system offers an affordable, user-friendly, and scalable solution for household water management. Its wireless design ensures flexibility in installation, while the integration of temperature monitoring adds value by expanding the system's capabilities beyond simple level indication.

Background of Wireless Mobile Communications

Wireless mobile communications have revolutionized the way data is transmitted between devices without the need for physical connections. Technologies such as Wi-Fi, Bluetooth, and ESP-NOW enable real-time, low-power, and efficient data transmission, making them ideal for Internet of Things (IoT) applications. In the context of smart home systems, wireless communication plays a crucial role in enabling seamless monitoring and control of household utilities like water, electricity, and temperature.

Importance of the Selected Topic

Managing water resources efficiently is essential, especially in urban and semi-urban households where water supply can be inconsistent. Traditional water level checking requires physical effort and can be especially challenging for the elderly. Similarly, water temperature monitoring is important for various household uses but is often overlooked. Our project addresses these gaps by providing a wireless and automated solution for water level and temperature monitoring using ESP32 microcontrollers, thereby ensuring convenience, safety, and water conservation.

Objectives of the Project

- To measure and monitor water levels in overhead tanks using a waterproof ultrasonic sensor.
- To wirelessly transmit water level data using ESP-NOW protocol between two ESP32 modules.
- To display real-time water level and temperature data on a 16x2 LCD display.
- To alert users via a buzzer when water levels reach critical thresholds (too high or too low).
- To measure and display water temperature using the DS18B20 digital temperature sensor.

Scope and Limitations

The project focuses on home-level water management and is designed for domestic water tanks. The system supports wireless communication over short range using ESP-NOW, making it ideal for single-household usage. The design emphasizes low cost and simplicity, ensuring easy deployment in most homes. However, the system currently does not include advanced analytics, mobile app integration, or water quality monitoring (like TDS sensors), which could be considered in future upgrades.

3. Literature Review

Previous Research and Related Work

Several research studies and DIY implementations have explored smart water monitoring systems using microcontrollers such as Arduino and ESP8266. These systems typically use ultrasonic sensors to detect water levels and buzzers or relays to trigger alerts or automate motor operations. For example, a study titled *"Design and Implementation of Monitoring System Automatic Water Level Reservoir Controller"* demonstrated how ultrasonic sensing and microcontroller-based control can prevent water tank overflow and dry running of pumps.

Recent works have also explored the integration of TDS (Total Dissolved Solids) sensors and DS18B20 temperature sensors to monitor water quality and safety. Projects have used Wi-Fi-enabled modules like ESP32 to remotely transmit data to smartphones or cloud dashboards. However, most of these systems are either wired or internet-dependent.

Key Advancements in the Topic Area

With the advent of the ESP-NOW protocol by Espressif, a new avenue has opened up for low-power, low-latency peer-to-peer communication between ESP32 devices without relying on Wi-Fi or cloud connectivity. This protocol is particularly suitable for local automation systems such as water management within a household. The DS18B20 digital temperature sensor has also become a popular choice due to its high accuracy, digital output, and one-wire communication, making it easy to interface with microcontrollers.

Existing Challenges

Despite the progress, several challenges remain. Many water monitoring systems still rely on wired connections or require Wi-Fi setup, which may not be feasible or stable in all homes. Moreover, integrating multiple sensors (like water level, temperature, and TDS) without increasing complexity or cost remains a concern. There is also limited research on the long-term durability of waterproof ultrasonic sensors in diverse environmental conditions.

Power management and the reliability of real-time alerts over wireless protocols like ESP-NOW in environments with potential interference are also ongoing issues. Furthermore, user interfaces are often limited to local displays, lacking integration with mobile or cloud-based platforms for remote access and logging.

4. Methodology

This project integrates core concepts from IoT (Internet of Things), wireless communication, and sensor-based automation. At its core, it uses the ESP-NOW protocol, a connectionless and lightweight wireless communication protocol developed by Express if, allowing ESP32 modules to communicate directly without needing a Wi-Fi network. The ultrasonic sensor works on the principle of time-of-flight of sound waves, calculating distance (water level) based on the time it takes for the sound wave to reflect back from the water surface. For temperature measurement, the DS18B20 digital sensor is used, which provides accurate readings over a 1-wire interface.

System Architecture

The system architecture consists of two ESP32 modules functioning in a transmitter-receiver setup:

- Transmitter ESP32:
    - Connected to a waterproof ultrasonic sensor (HC-SR04 or JSN-SR04T).
    - Continuously measures the water level in the tank.
    - Sends data to the receiver ESP32 via ESP-NOW using the receiver's MAC address.
- Receiver ESP32:
    - Receives water level data from the transmitter.
    - Connected to a 16x2 LCD for real-time display of water level and temperature.
    - Monitors temperature using a DS18B20 sensor.
    - Activates a buzzer if water levels cross critical thresholds (above 90% or below 10%).

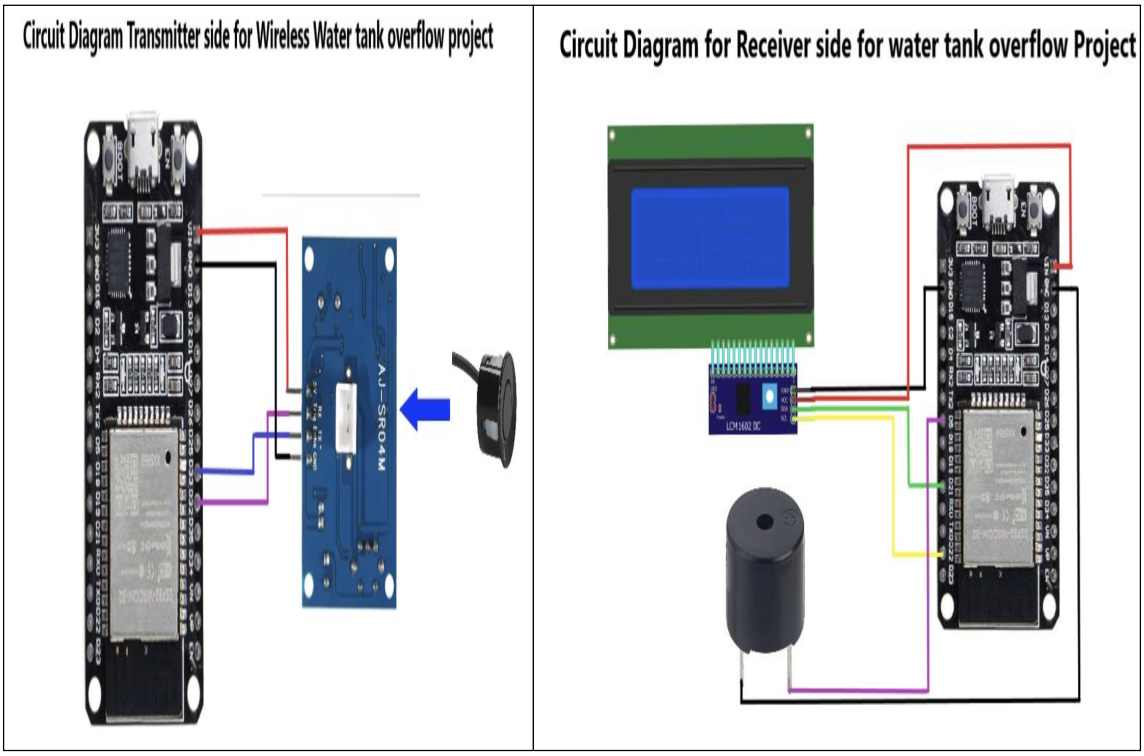
Tools and Technologies Used

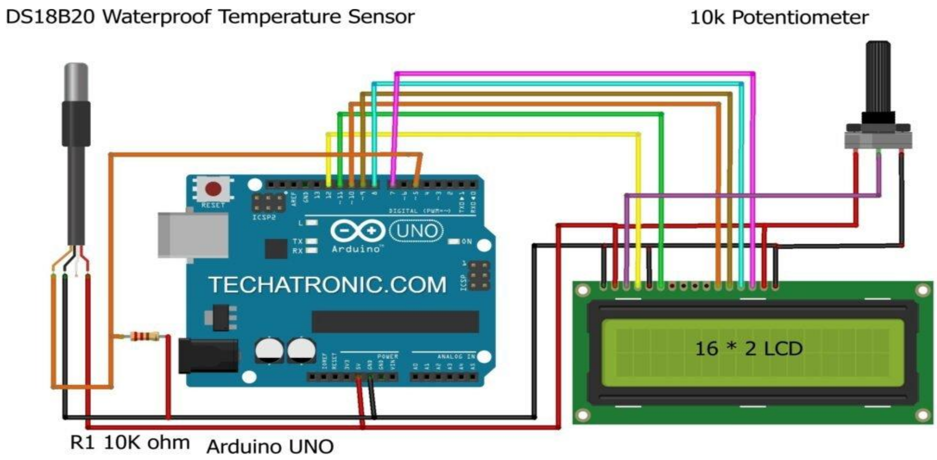
- ESP32 (2 Modules) – microcontroller with built-in Wi-Fi and ESP-NOW support.
- Ultrasonic Sensor (Waterproof) – for measuring water level.
- DS18B20 Digital Temperature Sensor – for temperature monitoring.
- 16x2 LCD with I2C module – to display water level and temperature.

- Buzzer – to alert users in case of abnormal water levels.
- Arduino IDE – for programming the ESP32 modules.
- ESP-NOW Protocol – for wireless data transmission between modules.

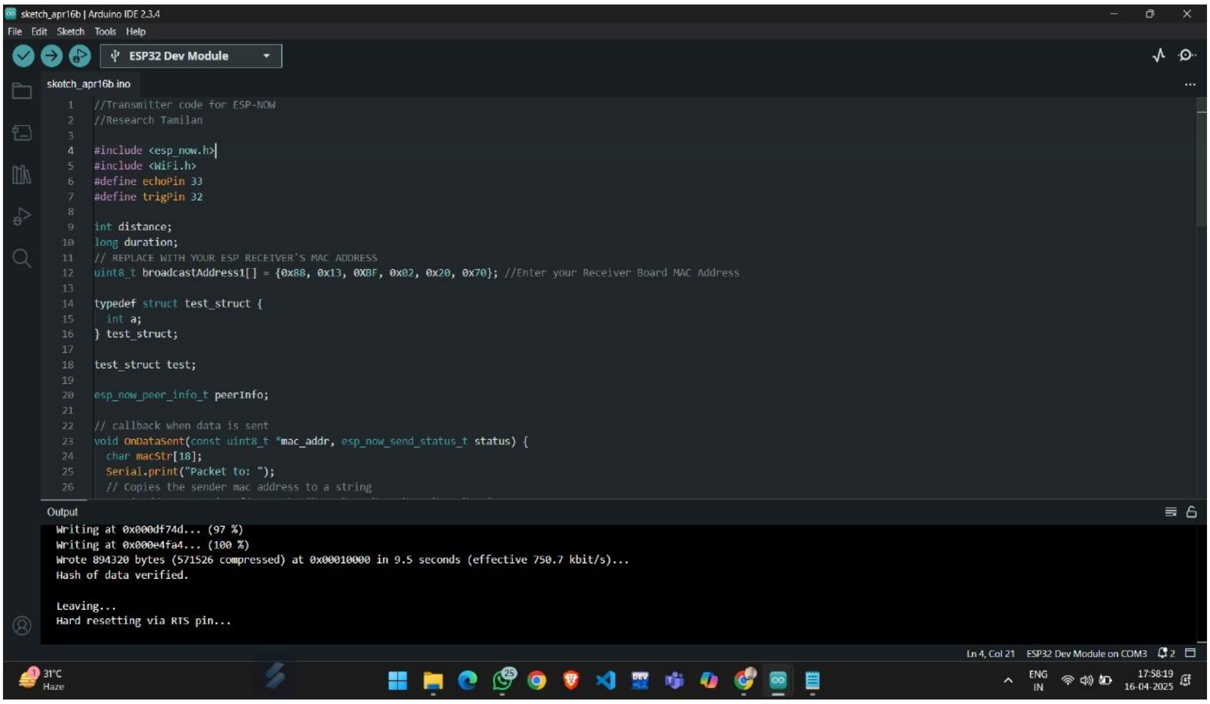
Working Flow

1. Initialization: All sensors, LCD, and communication parameters are initialized.
2. Measurement: The transmitter ESP32 reads water level from the ultrasonic sensor.
3. Data Transmission: The water level data is sent wirelessly via ESP-NOW to the receiver ESP32.
4. Temperature Monitoring: Simultaneously, the receiver reads temperature from DS18B20.
5. Display and Alerts: The LCD displays both values, and the buzzer is activated if level thresholds are crossed.
6. Looping: The process repeats at regular intervals (e.g., every second).





DS18B20 Waterproof Temperature Sensor
10k Potentiometer
TECHATRONIC.COM
16 * 2 LCD
R1 10K ohm
Arduino UNO



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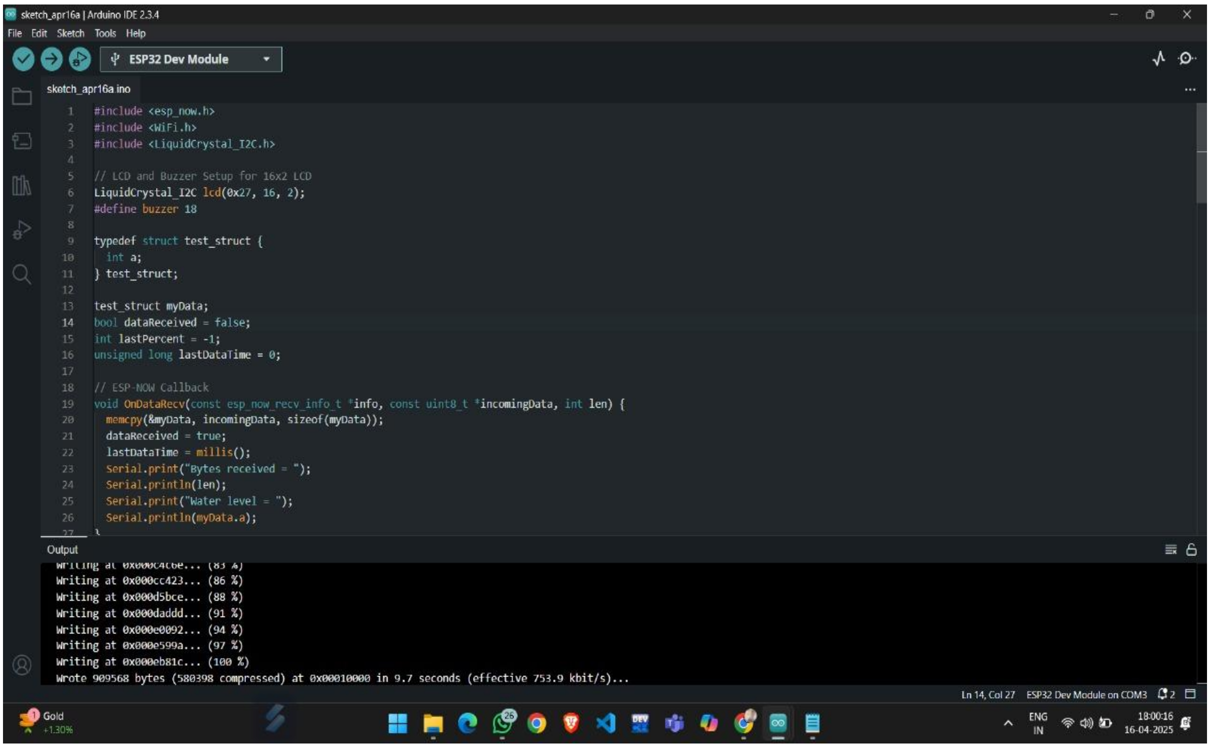
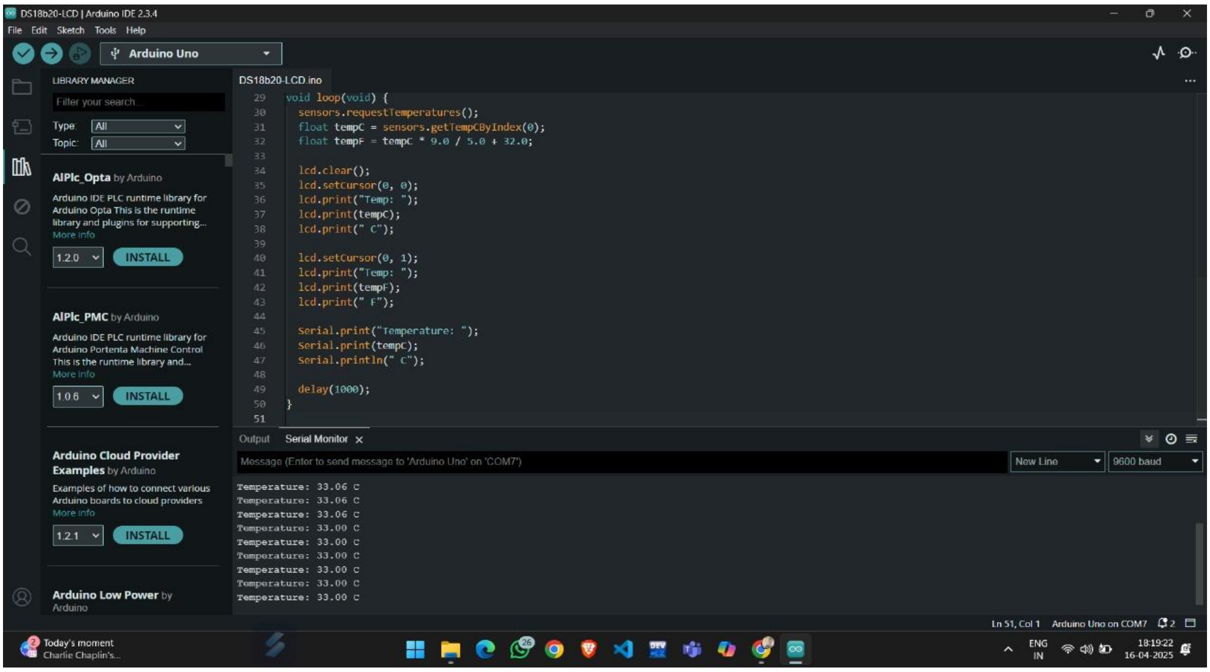
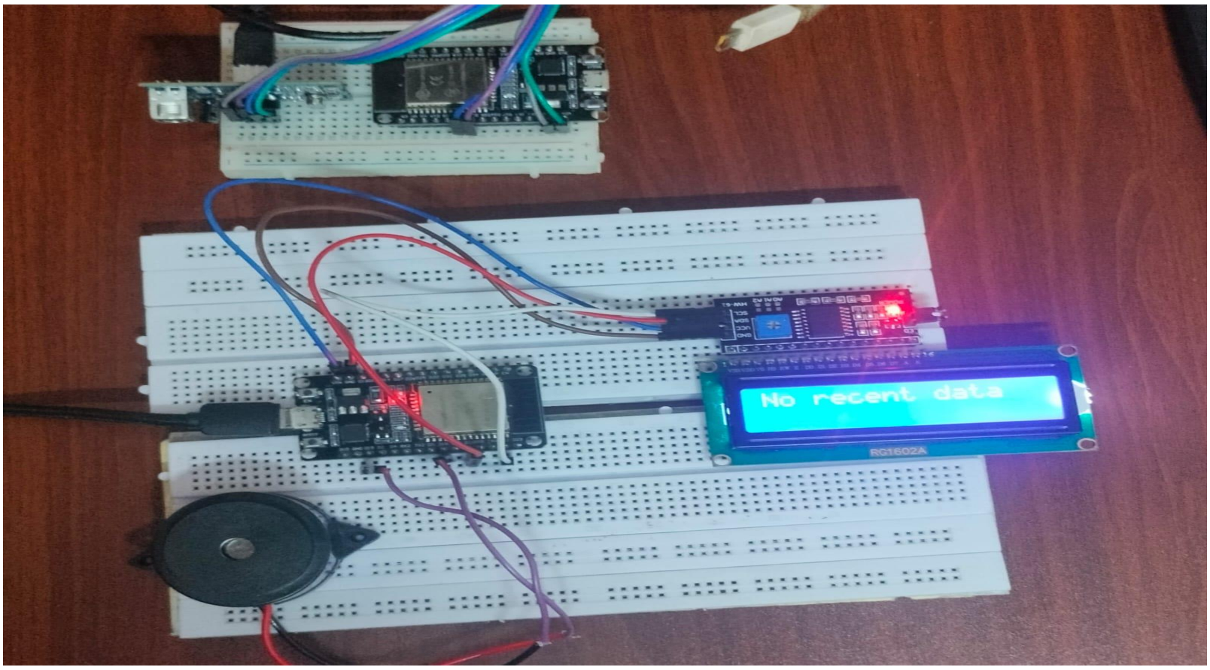
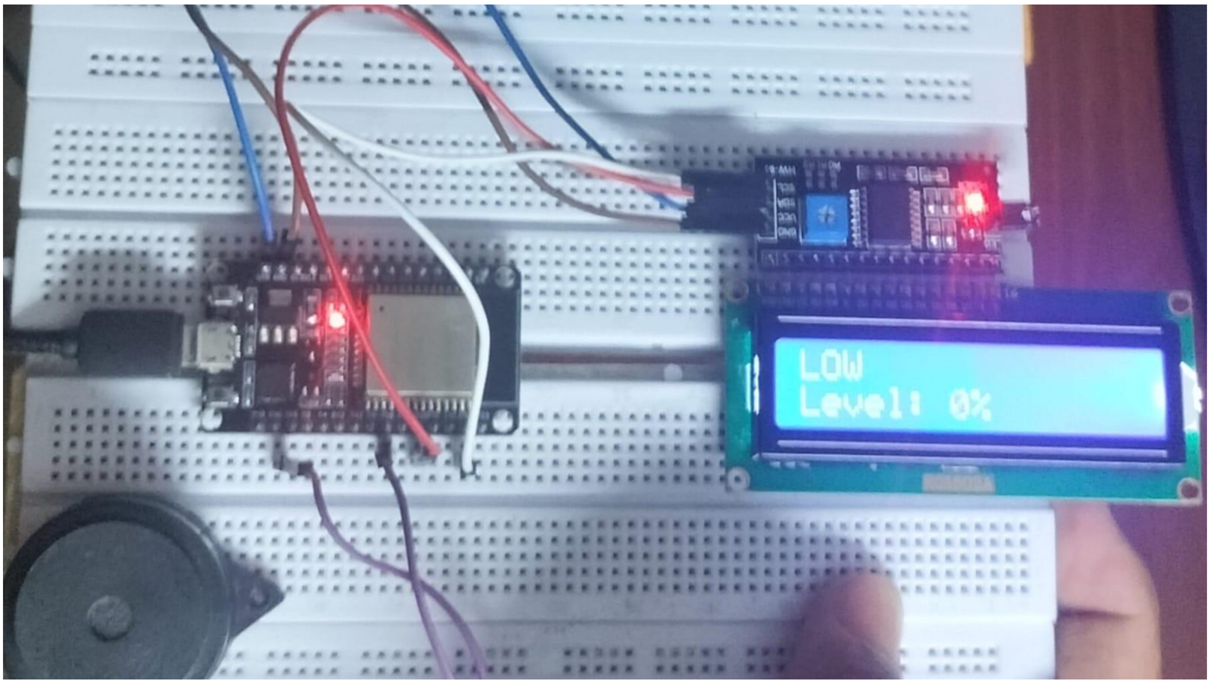
File Edit Sketch Tools Help
ESP32 Dev Module
sketch_apr16b.ino
//Transmitter code for ESP-NOW
//Research Tamilan
#include <esp_now.h>
#include <WiFi.h>
#define echoPin 33
#define trigPin 32
int distance;
long duration;
// REPLACE WITH YOUR ESP RECEIVER'S MAC ADDRESS
uint8_t broadcastAddress1[] = {0x88, 0x13, 0XBF, 0x02, 0x20, 0x70}; //Enter your Receiver Board MAC Address
typedef struct test_struct {
int a;
} test_struct;
test_struct test;
esp_now_peer_info_t peerInfo;
// callback when data is sent
void OnDataSent(const uint8_t *mac_addr, esp_now_send_status_t status) {
char macStr[18];
Serial.print("Packet to: ");
// Copies the sender mac address to a string
Output
Writing at 0x000df74d... (97 %)
Writing at 0x000e4fa4... (100 %)
Wrote 894320 bytes (571526 compressed) at 0x00010000 in 9.5 seconds (effective 750.7 kbit/s)...
Hash of data verified.
Leaving...
Hard resetting via RTS pin...
Ln 4, Col 21 ESP32 Dev Module on COM3
31°C
Haze

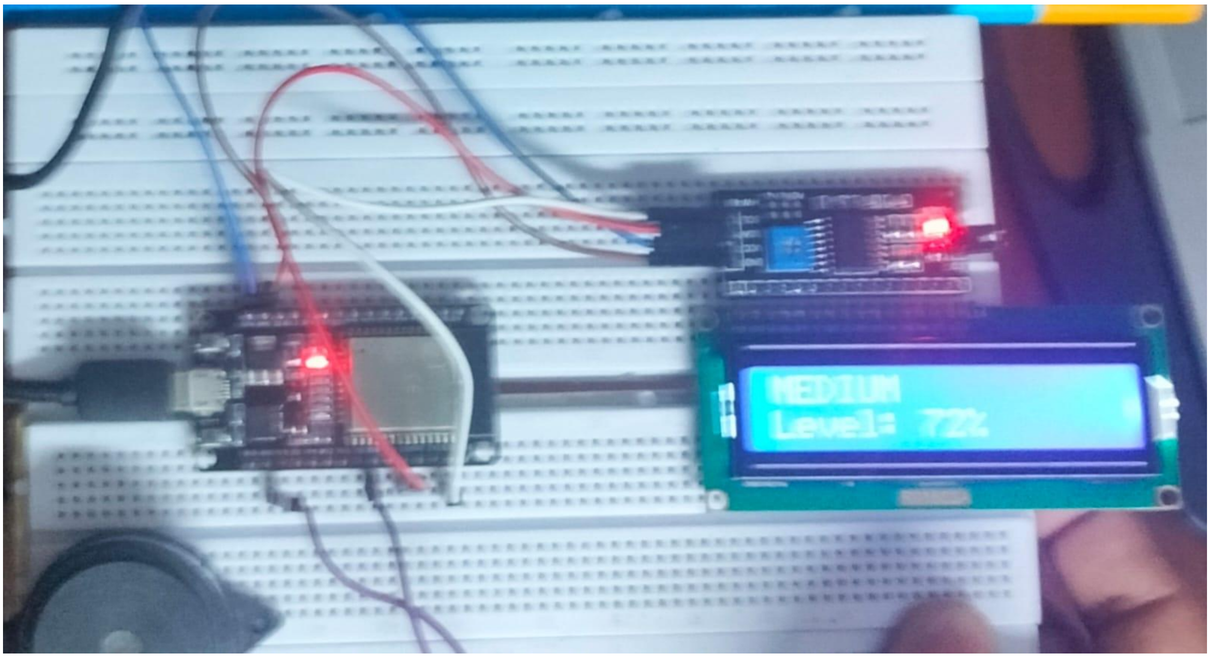

sketch_apr16a | Arduino IDE 2.3.4
File Edit Sketch Tools Help
ESP32 Dev Module
sketch_apr16a.ino
#include <esp_now.h>
#include <WiFi.h>
#include <LiquidCrystal_I2C.h>
// LCD and Buzzer Setup for 16x2 LCD
LiquidCrystal_I2C lcd(0x27, 16, 2);
#define buzzer 18
typedef struct test_struct {
int a;
} test_struct;
test_struct myData;
bool dataReceived = false;
int lastPercent = -1;
unsigned long lastDataTime = 0;
// ESP-NOW Callback
void OnDataRecv(const esp_now_recv_info_t *info, const uint8_t *incomingData, int len) {
memcpy(&myData, incomingData, sizeof(myData));
dataReceived = true;
lastDataTime = millis();
Serial.print("Bytes received = ");
Serial.println(len);
Serial.print("Water level = ");
Serial.println(myData.a);
Output
Writing at 0x000cc423... (86 %)
Writing at 0x000d5bce... (88 %)
Writing at 0x000daddd... (91 %)
Writing at 0x000e0092... (94 %)
Writing at 0x000e599a... (97 %)
Writing at 0x000eb81c... (100 %)
Wrote 909568 bytes (580398 compressed) at 0x00010000 in 9.7 seconds (effective 753.9 kbit/s)...
Ln 14, Col 27 ESP32 Dev Module on COM3
Gold
+1.30%
ENG
IN
18:00:16
16-04-2025

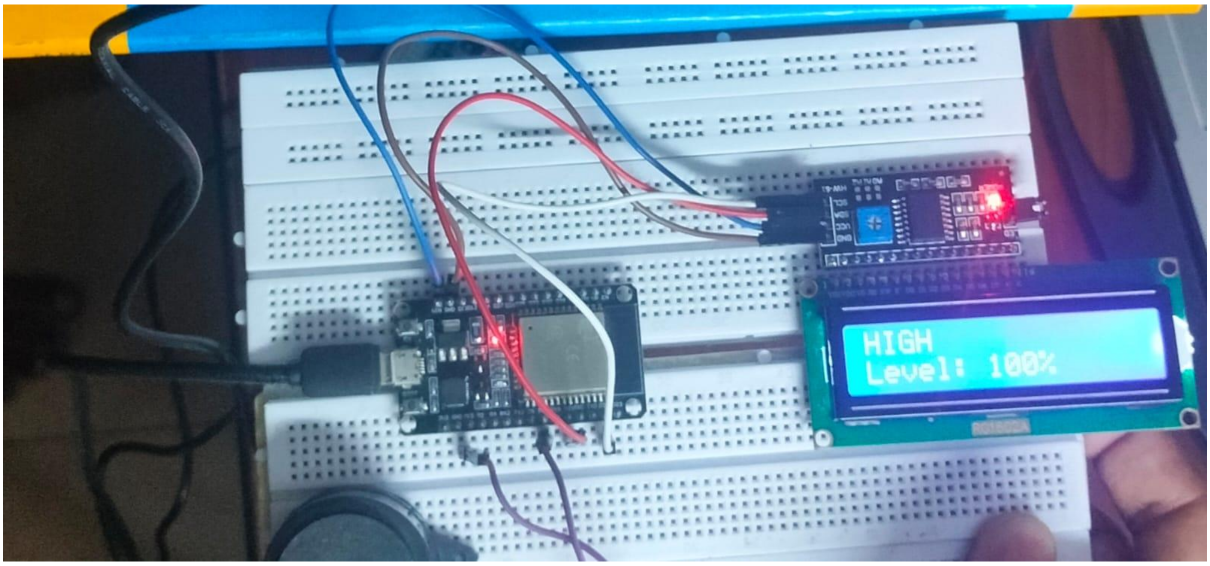

DS18b20-LCD | Arduino IDE 2.3.4
File Edit Sketch Tools Help
Arduino Uno
LIBRARY MANAGER
Filter your search...
Type: All
Topic: All
AIPlc_Opta by Arduino
Arduino IDE PLC runtime library for Arduino Opta This is the runtime library and plugins for supporting...
More info
1.2.0 INSTALL
AIPlc_PMC by Arduino
Arduino IDE PLC runtime library for Arduino Portenta Machine Control This is the runtime library and...
More info
1.0.6 INSTALL
Arduino Cloud Provider Examples by Arduino
Examples of how to connect various Arduino boards to cloud providers
More info
1.2.1 INSTALL
Arduino Low Power by Arduino
DS18b20-LCD.ino
void loop(void) {
sensors.requestTemperatures();
float tempC = sensors.getTempCByIndex(0);
float tempF = tempC * 9.0 / 5.0 + 32.0;
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("Temp: ");
lcd.print(tempC);
lcd.print(" C");
lcd.setCursor(0, 1);
lcd.print("Temp: ");
lcd.print(tempF);
lcd.print(" F");
Serial.print("Temperature: ");
Serial.print(tempC);
Serial.println(" C");
delay(1000);
}
Output Serial Monitor
Message (Enter to send message to 'Arduino Uno' on 'COM7')
New Line
9600 baud
Temperature: 33.06 C
Temperature: 33.06 C
Temperature: 33.06 C
Temperature: 33.00 C
Temperature: 33.00 C
Temperature: 33.00 C
Temperature: 33.00 C
Temperature: 33.00 C
Temperature: 33.00 C
Ln 51, Col 1 Arduino Uno on COM7
Today's moment
Charlie Chaplin's...
ENG
IN
18:19:22
16-04-2025

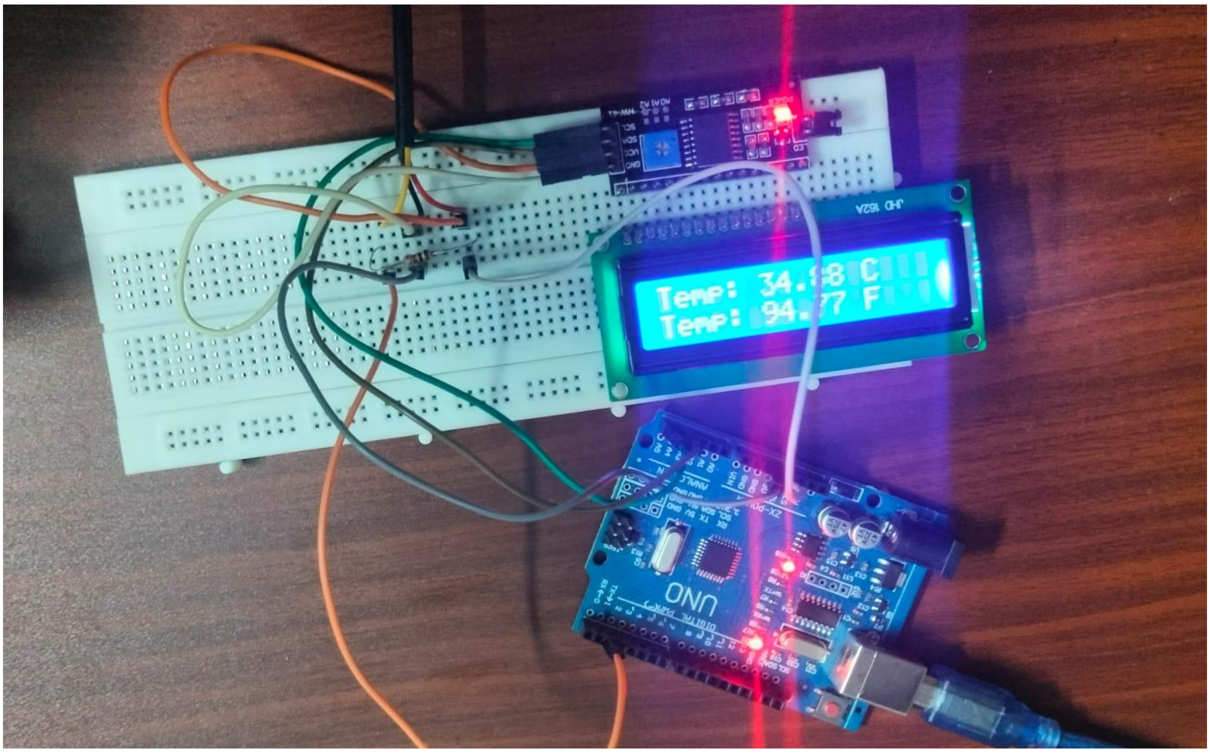
5. Implementation

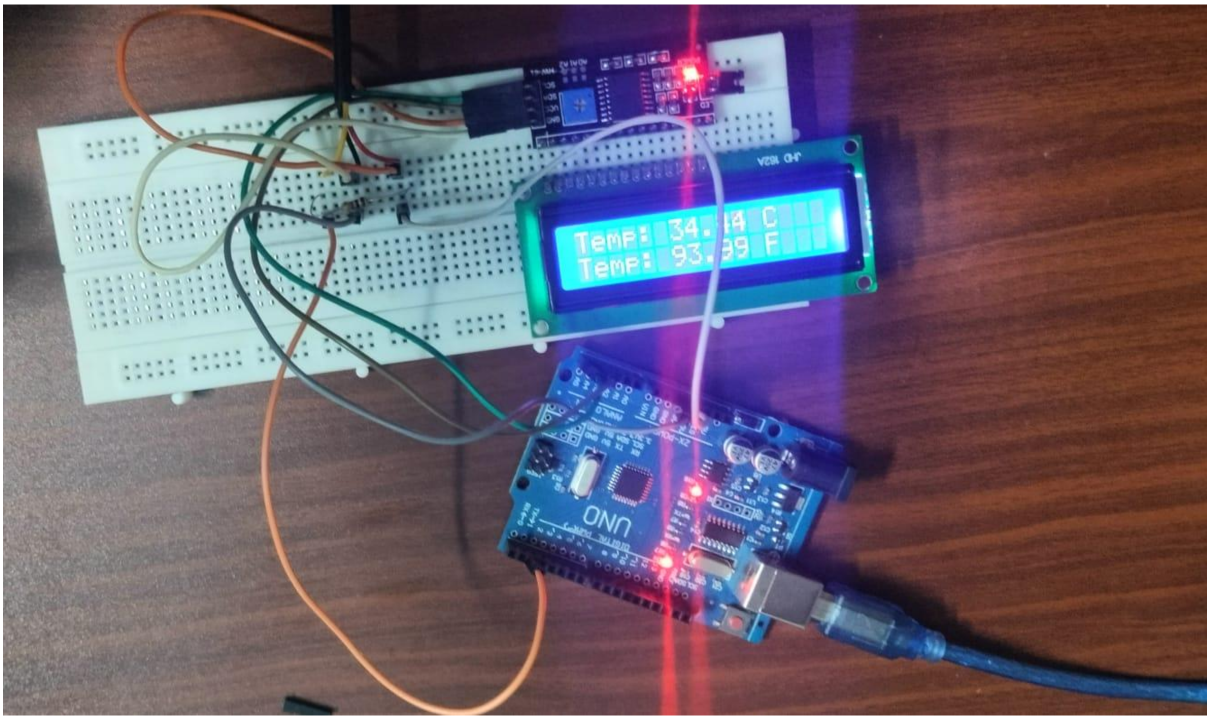





MEDIUM
Level: 72%


HIGH
Level: 100%





6. Analysis and Discussion

System Behavior and Real-Time Monitoring

Upon implementing and testing the system, it successfully demonstrated real-time monitoring of both water level and temperature. The transmitter ESP32, connected to the waterproof ultrasonic sensor, accurately measured the distance from the sensor to the water surface. The ESP-NOW protocol ensured stable and fast communication between the transmitter and receiver ESP32 modules, with near-instantaneous data transfer observed in all test cases.

The receiver ESP32, upon receiving water level data, effectively mapped the values to predefined container levels (e.g., Empty, Low, Medium, High, Full). The buzzer alarm reliably triggered when water levels dropped below 10% (indicating low water) or exceeded 90% (indicating risk of overflow), alerting users promptly.

Temperature Display and Accuracy

The DS18B20 temperature sensor, connected to the receiver ESP32, consistently provided accurate readings in Celsius with a resolution of 0.5°C. The sensor responded effectively to gradual and sudden changes in water temperature. All readings were clearly displayed on the 16x2 LCD, offering users a continuous update on both parameters.

Data Interpretation and Validation

To ensure accuracy, multiple tests were conducted at different tank fill levels and temperatures:

- At **0-20% water level**, the buzzer activated and LCD displayed "LOW".
- At **90-100% water level**, the buzzer activated and LCD displayed "FULL".
- Between these thresholds, the system displayed the appropriate status (e.g., "Medium" or "High").
- Temperature data matched reference thermometer readings within ±1°C.

Performance Observations

- **Response Time**: ESP-NOW offered fast and reliable wireless updates, typically within 100–200 milliseconds.

- **Power Efficiency**: The system operated efficiently on USB power and is suitable for battery-powered setups with deep sleep implementation.
- **User Interface**: The use of a 16x2 LCD provided a clear and user-friendly display, suitable for all age groups.

Limitations Noted During Testing

- **Range of Communication**: The ESP-NOW connection was stable within a 10–15 meter range; beyond this, signal strength weakened unless a clear line of sight was maintained.
- **Environmental Interference**: Reflections or obstructions in the tank caused occasional inaccurate ultrasonic readings. These were mitigated through simple software filtering.
- **No Water Quality Measurement**: The system excluded TDS or pH sensors, focusing only on level and temperature monitoring.

7. Challenges and Future Scope

Challenges

1. **Accuracy of Ultrasonic Sensor**:
   The ultrasonic sensor, while effective for measuring water level, faced occasional interference due to surface turbulence or obstructions in the tank. This caused slight inaccuracies in measurements, especially when the water surface was not calm. Although filtering algorithms helped mitigate this, it remains a challenge for large or irregularly shaped tanks.

2. **Limited Communication Range**:
   The ESP-NOW protocol is efficient but operates best within a limited range (approximately 10–15 meters under ideal conditions). In large houses or multi-story buildings, the range might be insufficient without signal repeaters or Wi-Fi support. The system would benefit from exploring other communication protocols like LoRa for extended range.

3. **Power Consumption**:
   Although ESP32 is a low-power device, continuous communication and sensor readings can drain power quickly, especially when the system operates 24/7. This may become a limitation for battery-operated systems. Power-saving modes like deep sleep could reduce consumption, but this would need to be optimized further.

4. **Integration with Other Smart Systems**:
   While the system is functional in isolation, it lacks integration with other smart home systems, such as mobile apps or cloud-based dashboards. This limits its remote access and monitoring capabilities, making it dependent on local displays and alarms.

Future Scope

1. **Integration of Water Quality Sensors**:
   Future versions of the system can incorporate **TDS (Total Dissolved Solids)** or **pH sensors** to measure water quality in addition to temperature and level. This would provide users with a more comprehensive analysis of their water and enable timely interventions if the water quality is poor.

2. **Wireless Extenders/Repeaters**:
   To overcome the communication range limitations, the system can incorporate **Wi-Fi-based repeaters** or **signal boosters** to ensure communication stability across larger areas. Alternatively, adopting more advanced low-power communication protocols like **LoRa** or **Zigbee** could extend range for larger buildings.
3. **Mobile and Cloud Integration**:
   The system could be extended to include **mobile app integration** for remote monitoring and alerts. Cloud-based solutions can be implemented to log water levels, temperature trends, and alerts for future analysis. This would also allow users to manage multiple tanks or monitor trends over time.
4. **Automated Control Mechanism**:
   The system can be expanded to include automatic control mechanisms, such as automatically turning on a pump when the water level reaches below 10%, or shutting off when it reaches above 90%. This would automate water management, further reducing the need for manual intervention.
5. **Smart Home Integration**:
   Future development could also include integrating this system into **smart home platforms** like Google Home or Amazon Alexa, allowing voice-activated commands or alerts for water levels and temperature.

8. Conclusion

The Water Level Indicator with Temperature Management System successfully demonstrates the integration of wireless communication, sensor-based monitoring, and real-time feedback to efficiently manage household water usage. By utilizing ESP32 microcontrollers and the ESP-NOW protocol, the system offers a cost-effective and reliable solution for monitoring water levels and temperature in overhead tanks. The system alerts users in real time when water levels exceed safe thresholds, preventing overflow or dry running of pumps, and displays accurate water temperature, enhancing overall water management.

The project highlights the importance of wireless IoT technologies in domestic automation, offering significant benefits in terms of user convenience and energy efficiency. The implementation of ultrasonic sensors for level detection and DS18B20 sensors for temperature measurement proved to be effective and practical in a household environment.

Despite its success, challenges like communication range, sensor accuracy under different conditions, and the need for integration with other smart home systems were identified. However, these limitations provide valuable insight for future improvements, including the addition of water quality sensors, power-saving strategies, and mobile app integration for enhanced functionality.

In conclusion, this project lays a strong foundation for developing smart water management systems, with vast potential for scalability and future advancements, ensuring better water conservation and user-friendly monitoring.

9. References

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10. Appendices

Transmitter code:

```
#include <esp_now.h>
#include <WiFi.h>
#define echoPin 33
#define trigPin 32

int distance;
long duration;
uint8_t broadcastAddress1[] = {0x88, 0x13, 0XBF, 0x02, 0x20, 0x70};

typedef struct test_struct {
  int a;
} test_struct;

test_struct test;

esp_now_peer_info_t peerInfo;

void OnDataSent(const uint8_t *mac_addr, esp_now_send_status_t status) {
  char macStr[18];
  snprintf(macStr, sizeof(macStr), "%02x:%02x:%02x:%02x:%02x:%02x",
           mac_addr[0], mac_addr[1], mac_addr[2], mac_addr[3], mac_addr[4], mac_addr[5]);
  Serial.print(macStr);
  Serial.print(" send status:\t");
  Serial.println(status == ESP_NOW_SEND_SUCCESS ? "Delivery Success" : "Delivery Fail");
}

void setup() {
  Serial.begin(115200);
  pinMode(echoPin, INPUT);
  pinMode(trigPin, OUTPUT);
  WiFi.mode(WIFI_STA);

  if (esp_now_init() != ESP_OK) {
    Serial.println("Error initializing ESP-NOW");
    return;
  }

  esp_now_register_send_cb(OnDataSent);

  peerInfo.channel = 0;
  peerInfo.encrypt = false;
  memcpy(peerInfo.peer_addr, broadcastAddress1, 6);
  if (esp_now_add_peer(&peerInfo) != ESP_OK){
    Serial.println("Failed to add peer");
    return;
  }
}
```

```
void loop() {
  esp_err_t result = esp_now_send(0, (uint8_t *) &test, sizeof(test_struct));
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = duration * 0.0344 / 2;
  test.a = distance;
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");

  delay(1);
  if (result == ESP_OK) {
    Serial.println("Sent with success");
  }
  else {
    Serial.println("Error sending the data");
  }
  delay(2000);
}
```

Receiver Code:

```
#include <esp_now.h>
#include <WiFi.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);
#define buzzer 18

typedef struct test_struct {
  int a;
} test_struct;

test_struct myData;
bool dataReceived = false;
int lastPercent = -1;
unsigned long lastDataTime = 0;

void OnDataRecv(const esp_now_recv_info_t *info, const uint8_t *incomingData, int len) {
  memcpy(&myData, incomingData, sizeof(myData));
  dataReceived = true;
  lastDataTime = millis();
  Serial.print("Bytes received = ");
  Serial.println(len);
  Serial.print("Water level = ");
  Serial.println(myData.a);
}
```

```
void setup() {
  Serial.begin(115200);
  WiFi.mode(WIFI_STA);

  pinMode(buzzer, OUTPUT);
  digitalWrite(buzzer, LOW);

  lcd.init();
  lcd.backlight();

  if (esp_now_init() != ESP_OK) {
    Serial.println("Error initializing ESP-NOW");
    return;
  }

  esp_now_register_recv_cb(OnDataRecv);
}

void loop() {
  if (!dataReceived) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Waiting for data");
    digitalWrite(buzzer, LOW);
    delay(1000);
    return;
  }

  if (millis() - lastDataTime > 3000) {
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("No recent data");
    digitalWrite(buzzer, LOW);
    delay(1000);
    return;
  }

  if (myData.a < 0 || myData.a > 41) {
    Serial.println("Invalid sensor reading. Ignoring...");
    digitalWrite(buzzer, LOW);
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("Invalid reading");
    delay(1000);
    return;
  }

  int oldpercent = map(myData.a, 41, 0, 0, 99);
  int newpercent = constrain(oldpercent * 2, 0, 100);

  Serial.println("Tank Percent = " + String(newpercent) + "%");

  if (newpercent != lastPercent) {
    lcd.clear();
```

```
    if (newpercent > 90) {
      lcd.setCursor(0, 0);
      lcd.print("HIGH");
      digitalWrite(buzzer, HIGH);
    }
    else if (newpercent < 20) {
      lcd.setCursor(0, 0);
      lcd.print("LOW");
      digitalWrite(buzzer, HIGH);
    }
    else {
      lcd.setCursor(0, 0);
      lcd.print("MEDIUM");
      digitalWrite(buzzer, LOW);
    }

    lcd.setCursor(0, 1);
    lcd.print("Level: ");
    lcd.print(newpercent);
    lcd.print("%");

    lastPercent = newpercent;
  }

  delay(500);
}
```

Temperature code:

```
#include <OneWire.h>
#include <DallasTemperature.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

#define ONE_WIRE_BUS 2

OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);

LiquidCrystal_I2C lcd(0x27, 16, 2);

void setup(void) {
  Serial.begin(9600);
  sensors.begin();

  lcd.init();
  lcd.backlight();
}

void loop(void) {
  sensors.requestTemperatures();
  float tempC = sensors.getTempCByIndex(0);
```

```
  float tempF = tempC * 9.0 / 5.0 + 32.0;

  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("Temp: ");
  lcd.print(tempC);
  lcd.print(" C");

  lcd.setCursor(0, 1);
  lcd.print("Temp: ");
  lcd.print(tempF);
  lcd.print(" F");

  Serial.print("Temperature: ");
  Serial.print(tempC);
  Serial.println(" C");

  delay(1000);
}
```