
WIRELESS WATER LEVEL SENSORS

Project : Development of a wireless waterproof sensor module for real-time monitoring of water levels .

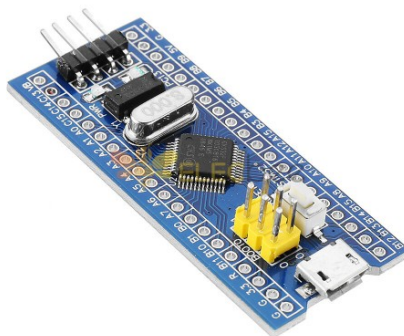
Objective : The primary objective of this project is to design, develop, and implement a wireless waterproof water level sensor module that can be used in various applications such as water tanks, flood monitoring systems, agricultural irrigation, and other water management systems. The module should provide accurate real-time data on water levels, be durable in wet environments, and support wireless communication for remote monitoring.

Components Required :

i) **Ultrasonic Sensors** (JSN-SR04T)



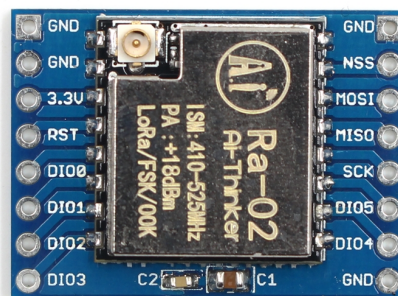
ii) **Microcontroller** (STM32 Chip)



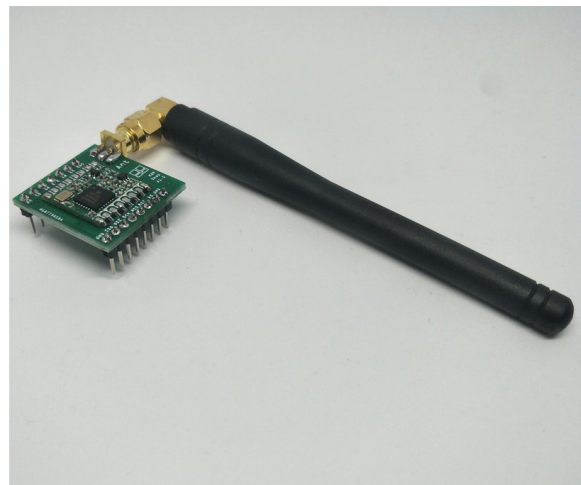
iii) Jumper Wires



iv) LoRA Module (*SX1278 LoRa Module*)



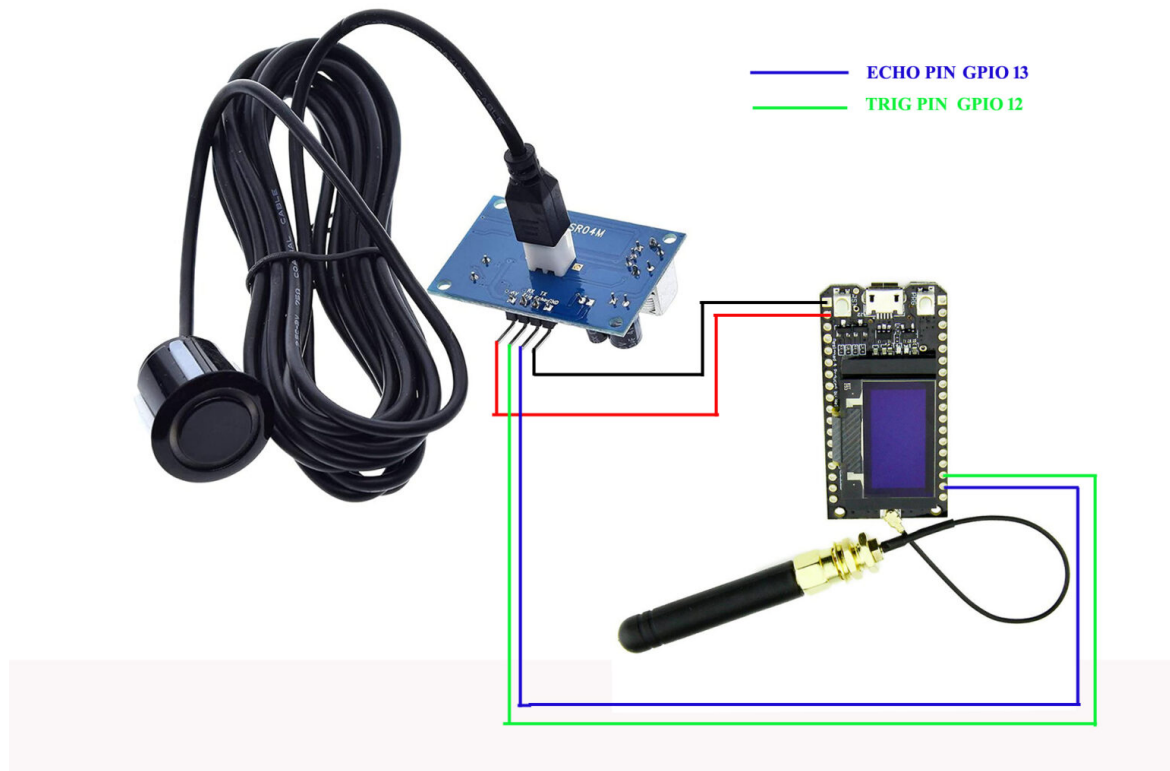
v) Antenna LoRa Module



Tools & Software Required :

- **Hardware Tools** (soldering iron, multimeter, breadboards, etc.)
- **Software Tools** (Arduino IDE, PCB design software, programming tools)

CIRCUIT DIAGRAM AND PROCEDURE :



Working Explanation :

The system operates by interfacing the JSN-SR04T waterproof ultrasonic sensor with the STM32 microcontroller. The ultrasonic sensor emits high-frequency sound waves towards the water surface and measures the time taken for the echo to return. This duration is then converted into a distance measurement representing the water level.

The STM32 microcontroller processes the distance measurements and encodes them into packets for transmission. The LoRa module facilitates long-range communication by transmitting these packets wirelessly to a LoRa gateway or receiver. The receiver can then decode the packets and extract the water level data for monitoring and analysis.

Connections : Ultrasonic sensor JSN-SR04T has four pins Vcc, GND, Trig and Echo which are used to connect it with Microcontroller for data transferring and processing .

Ultrasonic Sensor to Microcontroller (STM32)

- Connect the VCC pin of the JSN-SR04T to the 5V pin on the STM32.
- Connect the GND pin of the JSN-SR04T to a GND pin on the STM32.
- Connect the TRIG pin of the JSN-SR04T to a GPIO pin on the STM32 (PA1).
- Connect the ECHO pin of the JSN-SR04T to another GPIO pin on the STM32 (PA0).

LoRa Module to STM32 Connections:

- SPI Pins (SCK, MISO, MOSI) of LoRa Module to respective SPI pins of STM32.
- NSS (Slave Select) pin of LoRa Module to a GPIO pin of STM32 (e.g., PB12).
- DIO0 pin of LoRa Module to a GPIO pin of STM32 (e.g., PB5).
- Antenna connected to the LoRa Module for long-range communication.

CODE :

```
1  #include <SPI.h>
2  #include <LoRa.h>
3
4  const int trigPin = PA0; // Trigger pin for JSN-SR04T
5  const int echoPin = PA1; // Echo pin for JSN-SR04T
6  const int csPin = PB12; // LoRa radio chip select
7  const int resetPin = PB14; // LoRa radio reset
8  const int irqPin = PB15; // LoRa radio IRQ
9
10 void setup() {
11     // Initialize serial communication for debugging
12     Serial.begin(115200);
13     // Initialize LoRa module
14     LoRa.setPins(csPin, resetPin, irqPin);
15     if (!LoRa.begin(915E6)) {
16         Serial.println("Starting LoRa failed!");
17         while (1);
18     }
19     Serial.println("LoRa Initializing OK!");
20     // Initialize the pins
21     pinMode(trigPin, OUTPUT);
22     pinMode(echoPin, INPUT);
23 }
24 void loop() {
25     long duration, distance;
26     // Trigger the ultrasonic sensor
27     digitalWrite(trigPin, LOW);
28     delayMicroseconds(2);
29     digitalWrite(trigPin, HIGH);
30     delayMicroseconds(10);
31     digitalWrite(trigPin, LOW);
32     // Measure the echo pulse duration
33     duration = pulseIn(echoPin, HIGH);
34     // Calculate distance in centimeters
35     distance = duration * 0.034 / 2;
36     // Print the distance to the serial monitor
37     Serial.print("Distance to water: ");
38     Serial.println(distance);
39     LoRa.beginPacket();
40     LoRa.print(distance);
41     LoRa.endPacket();
42
43     delay(1000);
44 }
```

Code Explanation:

The provided code initialises the STM32 microcontroller to interface with the JSN-SR04T waterproof ultrasonic sensor and the LoRa module. It measures the distance to the water surface using the ultrasonic sensor, converts the measurement to centi meters, and transmits this data wirelessly using the LoRa module. The results are also printed to the serial monitor for debugging purposes. This setup allows for remote monitoring of water levels over long distances.

References :

1. Datasheets:

- STM32F103C8T6 Microcontroller: STMicroelectronics, [STM32F103C8T6 Datasheet] (<https://www.st.com/resource/en/datasheet/stm32f103c8.pdf>)
- SX1278 LoRa Module: Semtech, [SX1278 Datasheet] (https://www.semtech.com/uploads/documents/sx1276_77_78_79.pdf)
- JSN-SR04T Ultrasonic Sensor: Shenzhen Jinshan Electronic, [JSN-SR04T Datasheet] (<https://www.mikroe.com/downloads/get/2811/jsnsr04t.pdf>)

2. STM32 Documentation:

- STMicroelectronics, [STM32CubeIDE] (<https://www.st.com/en/development-tools/stm32cubeide.html>)

3. LoRa Library:

- Arduino, [RadioHead Library] (<http://www.airspayce.com/mikem/arduino/RadioHead/>)

4. Tutorials:

- STM32 Getting Started Guide: [Getting Started with STM32] (<https://www.st.com/en/development-tools/stm32cubeide.html>)
- LoRa Communication Tutorial: [LoRa Communication with SX1278] (<https://randomnerdtutorials.com/esp32-lora-rfm95-transceiver-arduino-ide/>)
- Ultrasonic Sensor Interfacing: [JSN-SR04T Tutorial] (<https://lastminuteengineers.com/jsn-sr04t-arduino-tutorial/>)

Annexure:

Data sheets: Data sheet for STM32 microcontroller (STM32F103C8T6) Data sheet for LoRa module (e.g., SX1278 LoRa Module) Data sheet for JSN-SR04T waterproof ultrasonic sensor

Code References: Official documentation for STM32CubeIDE or Arduino IDE RadioHead library for LoRa communication: RadioHead Library.

LMIC library for LoRaWAN on STM32: LMIC Library.

Tutorials: STM32 Getting Started Guide LoRa Communication Tutorials Ultrasonic Sensor Interfacing Tutorials