ESP32 Projects IoT Projects LoRa Projects

ESP32 & LoRa SX1278/76 Transmitter Receiver with OLED

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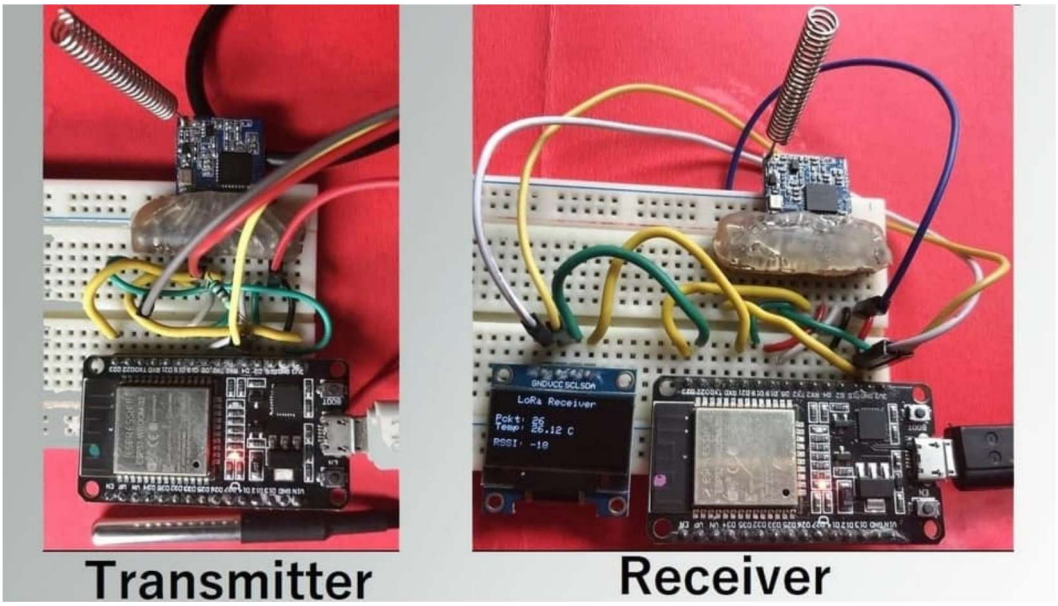

In this tutorial, we will make **Lora Transmitter & Receiver using Lora Module SX1278 & ESP32 Wifi Module**. The communication type is a point to point and data will be transferred wirelessly from one end (transmitter) to another end (receiver).

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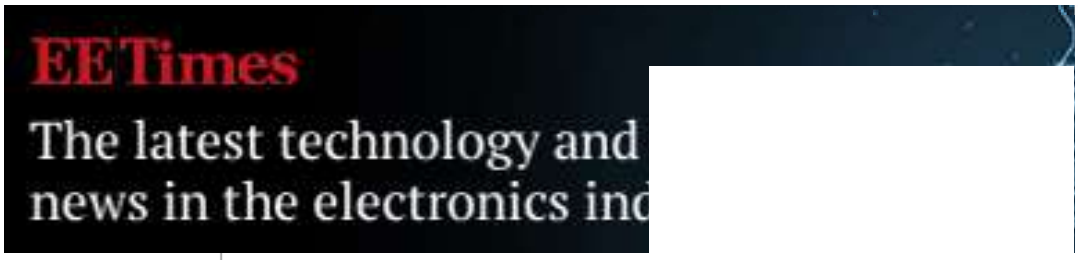


Overview

In the last couple of years, there is a number of communication technologies available for interaction between **IoT devices**. The most popular ones are the **Wi-Fi** Technology and **Bluetooth** Module. But they have few limitations like limited range, limited access points & high power consumption. So LoRa technology is introduced by Semtech to fix all these issue. Using a single battery the device operates over a year.

examples for learning **LoRa SX1278/76 & ESP32 Communication**. First, we will transmit a simple packet and check whether the data is received at the receiver end or not. Then we will add **DS18B20 Waterproof Temperature Sensor** to transmitter Circuit and send the temperature value wirelessly to the receiver end. The value can be seen on OLED Display

Before getting started, you can visit the following posts:

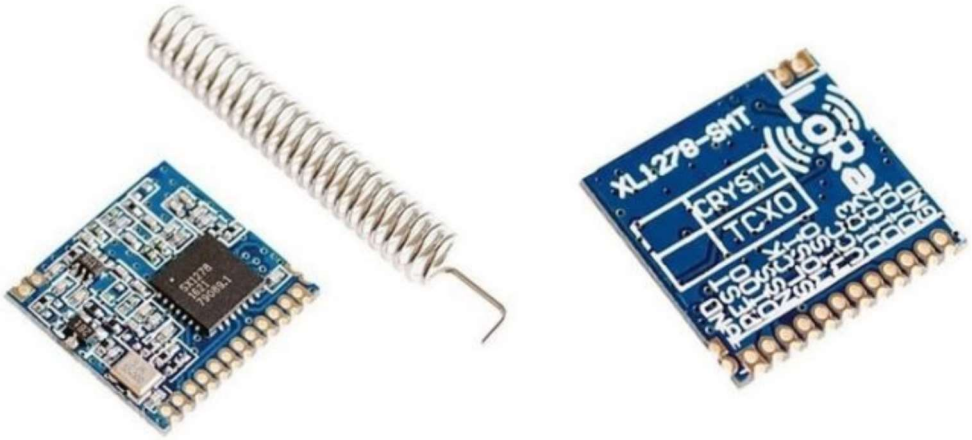
1. *Interfacing SX1278 (Ra-02) LORA Module with Arduino*: Check Here
2. *Sending Sensor Data Wirelessly with LoRa SX1278 & Arduino*: Check Here
3. *ESP8266 & LoRa SX1278 Transmitter Receiver with DHT11*: Check Here
4. *ESP32 LoRa Sensor Data Monitoring on Web Server*: Check Here
5. *ESP32 LoRa Thingspeak Gateway with LoRa Sensor Node*: Check Here

Bill of Materials

S.N.	COMPONENTS	DESCRIPTION	QUANTITY	amazon
1	ESP32 Board	ESP32 ESP-32S Development Board (ESP-WROOM-32)	2	https://amzn.t
2	LoRa Module	SX1278/76 Lora Module	2	https://amzn.t
3	OLED Display	0.96" I2C OLED Display	1	https://amzn.t
4	Connecting Wires	Jumper Wires	20	https://amzn.t
5	Breadboard	-	1	https://amzn.t
6	DS18B20 Sensor	DS18B20 One-Wire Waterproof Temperature Sensor	1	https://amzn.t

SX1278 Module

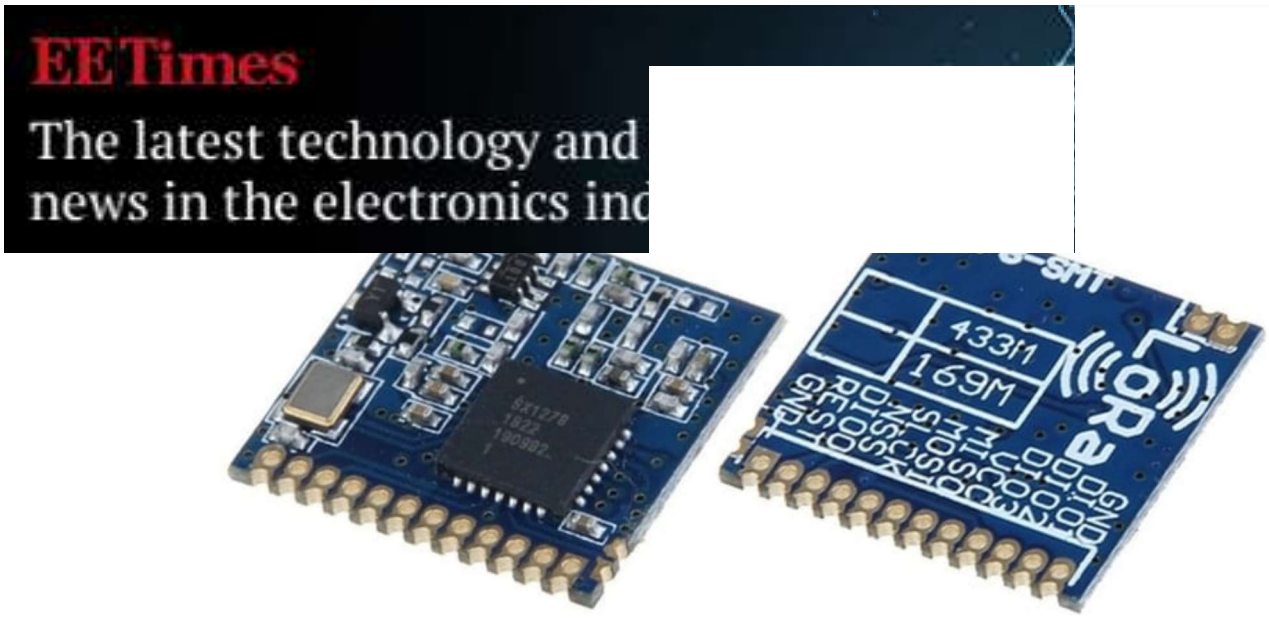
The **SX1276/77/78/79** transceivers feature the LoRa® long range modem that provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption.



SX1278 can achieve a sensitivity of over **-148dBm** using a low-cost crystal. The high sensitivity combined with the integrated **+20dBm power amplifier** yields industry leading link budget making it optimal for any application requiring range or robustness. Lora SX1278 also provides significant advantages in both blocking and selectivity over conventional **modulation techniques**, solving the traditional design compromise between range, interference immunity and energy consumption. Learn more about it at: Semtech SX1278 Datasheet.

Semtech SX1278 Pinout

There are different versions and types of **SX1278 breakout board** available in market. But basically all of them has same pinout as **LoRa**



This module version of SX1278 has **12 pins** for interfacing with **microcontroller** & additional two pins for antenna.

Pin	Name	Description
1	GND	Ground (0 V)
2	D101	Digital I/O
3	D102	Digital I/O
4	D103	Digital I/O
5	VCC	Power (3.6 V Maximum)
6	MISO	SPI Data Output
7	MOSI	SPI Data Input
8	SLCK	SPI Clock
9	NSS	SPI Chip Select
10	D100	Digital I/O
11	RESET	Reset
12	GND	Ground (0 V)

DS18B20 Waterproof Digital Temperature Sensor:

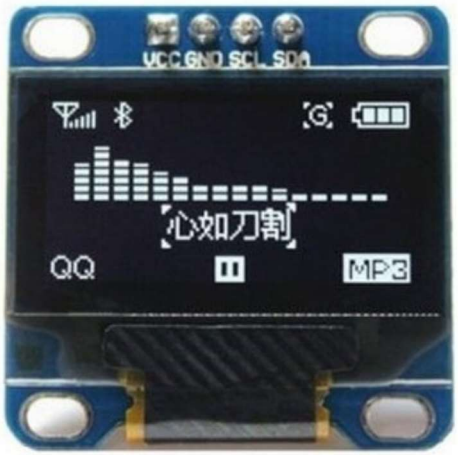
This is a pre-wired and **waterproofed version of the DS18B20 sensor**. Handy for when you need to measure something far away, or in wet conditions. The Sensor can measure the temperature between **-55 to 125°C** (-67°F to +257°F). The cable is jacketed in PVC.

Because it is digital, there is no signal degradation even over long distances. These 1-wire digital temperature sensors are fairly precise, i.e ±0.5°C over much of the range. It can give up to 12 bits of precision from the onboard digital-to-analog converter. They work great with any microcontroller using a single digital pin.

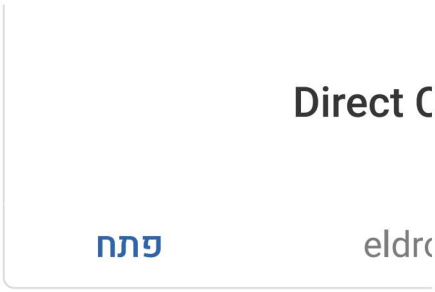
To learn more about this, check here: Temperature Meter using DS18B20 OLED Display & Arduino

0.96″ OLED Display

This is a **0.96 inch** blue OLED display module. The display module can be interfaced with any microcontroller using **SPI/IIC protocols**. It is having a resolution of **128x64**. The package includes display board, display,4 pin male header pre-soldered to board.



OLED (Organic Light-Emitting Diode) is a self light-emitting technology composed of a thin, multi-layered organic film placed between an anode and cathode. In contrast to LCD technology, OLED does not require a backlight. OLED possesses high application potential for virtually all types of displays and is regarded as the ultimate technology for the next generation of flat-panel displays.



Required Libraries

First add these following libraries to Arduino IDE. Without these libraries the code won't compile.

1. Adafruit_SSD1306 : https://github.com/adafruit/Adafruit_SSD1306
2. Adafruit_GFX : https://github.com/adafruit/Adafruit-GFX-Library
3. LoRa Library: https://github.com/sandeepmistry/arduino-LoRa
4. One Wire Library: https://github.com/PaulStoffregen/OneWire
5. Dallas Temperature Library: https://github.com/milesburton/Arduino-Temperature-Control-Library

Simple ESP32 & LoRa SX1278/76 Transmitter Receiver

receiver.

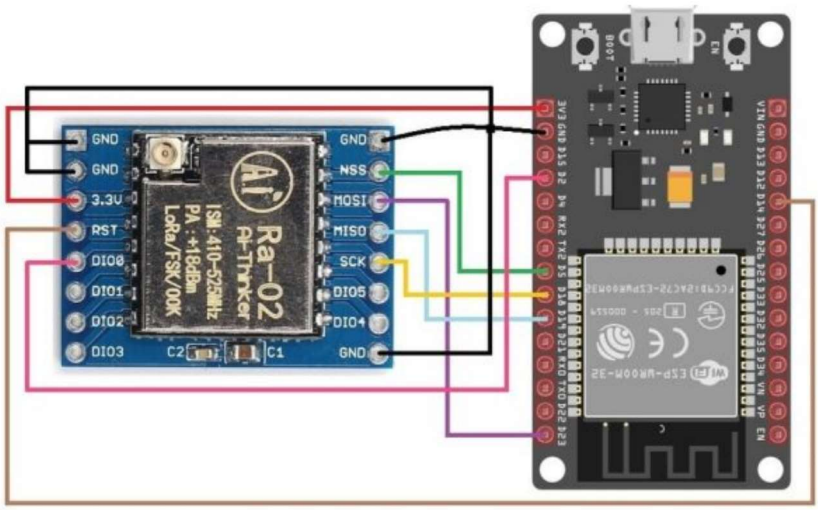


Fig: ESP32 LoRa SX1278 Transmitter & Receiver Circuit

The connection is fairly simple. Similarly, connect the Lora SX1278 & ESP32 as follows.

ESP32 PINS	SX1278 PINS
GND	GND
3.3V	VCC
D5	NSS
D23	MOSI
D19	MISO
D18	SCK
D14	RST

Source Code for Simple ESP32 LoRa SX1278/76 Transmitter Receiver

The transmitter & receiver code is given below. Upload the transmitter & receiver code to both the ESP32 Board.

Transmitter Code

```
#include <LoRa.h>
#include <SPI.h>

#define ss 5
#define rst 14
#define dio0 2

int counter = 0;

void setup()
{
  Serial.begin(115200);
  while (!Serial);
  Serial.println("LoRa Sender");
```

```
    delay(500);
  }
  LoRa.setSyncWord(0xA5);
  Serial.println("LoRa Initializing OK!");
}

void loop()
{
  Serial.print("Sending packet: ");
  Serial.println(counter);

  LoRa.beginPacket();   //Send LoRa packet to receiver
  LoRa.print("hello ");
  LoRa.print(counter);
  LoRa.endPacket();

  counter++;

  delay(10000);
}
```


Receiver Code

```
#include <LoRa.h>
#include <SPI.h>
```

```
{
  Serial.begin(115200);
  while (!Serial);
  Serial.println("LoRa Receiver");

  LoRa.setPins(ss, rst, dio0);    //setup LoRa transceiver mod

  while (!LoRa.begin(433E6))     //433E6 - Asia, 866E6 - Europ
  {
    Serial.println(".");
    delay(500);
  }
  LoRa.setSyncWord(0xA5);
  Serial.println("LoRa Initializing OK!");
}

void loop()
{
  int packetSize = LoRa.parsePacket();    // try to parse pack
  if (packetSize)
  {

    Serial.print("Received packet '");

    while (LoRa.available())              // read packet
    {
      String LoRaData = LoRa.readString();
      Serial.print(LoRaData);
    }
    Serial.print("' with RSSI ");         // print RSSI of pac
    Serial.println(LoRa.packetRssi());
  }
}
```

Once the code is uploaded, you can now open the serial monitor on both port and check whether the data is successfully transmitted or

ESP32 LoRa SX1278 Transmitter Receiver with OLED & DS18B20 Sensor

Now let us make an advanced Lora ESP32 Transmitter & Receiver Circuit. Now we will send the DS18B20 Sensor Temperature value wirelessly. In the transmitter End we will add an extra DS18B20 Temeprature Sensor with Lora SX1278 & ESP32. On the receiver end we will ad an 0.96" I2C OLED Display to ESP32 with LoRa SX1278.

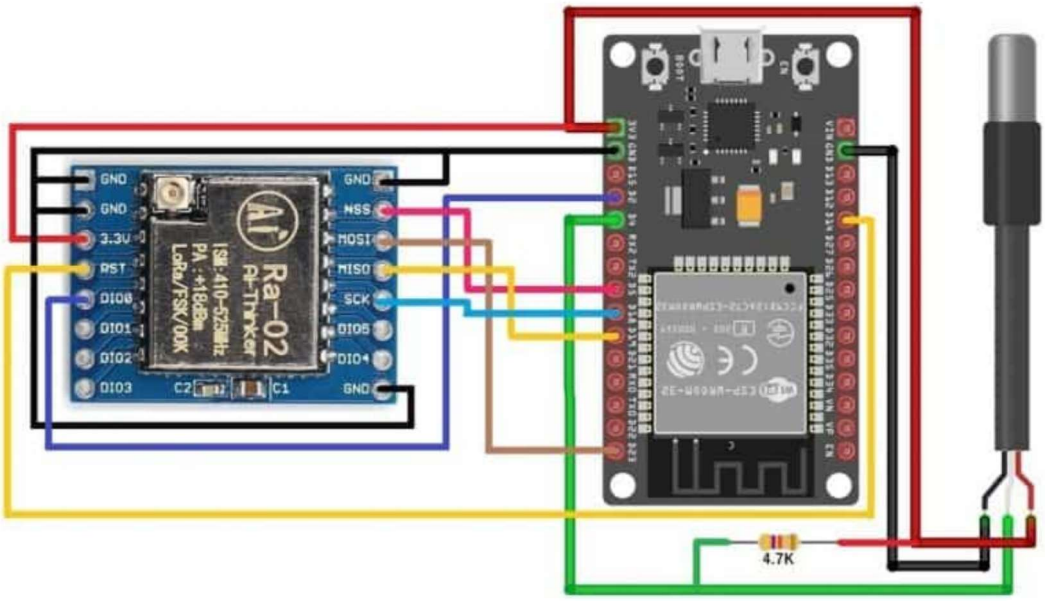


Fig: LoRa SX1278 ESP32 Transmitter Circuit with DS18B20 Sensor

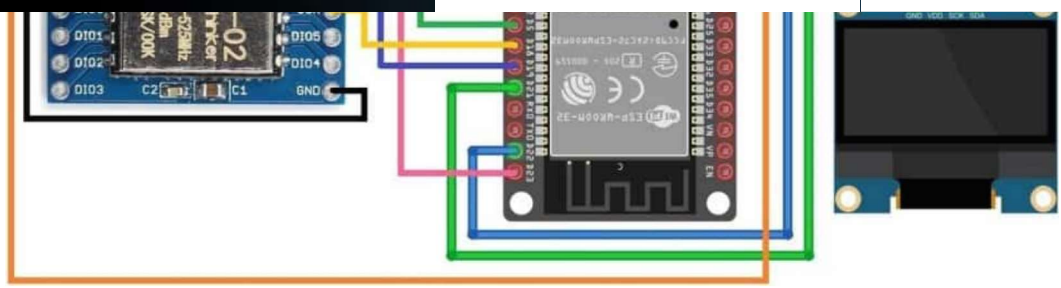
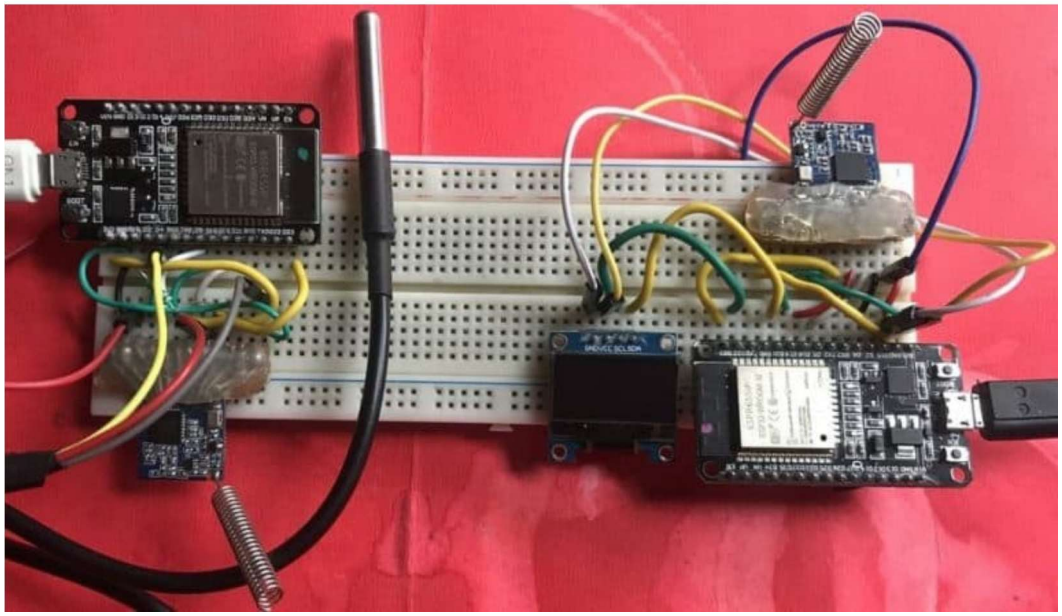


Fig: LoRa SX1278 ESP32 Receiver Circuit with OLED Display

The connection between Lora SX1278 & ESP32 still remains same. But in the transmitter end, we added the DS18B20 Sensor. So, connect its input pin to GPIO4 of ESP32. Supply it with 3.3V VCC. Similarly use a 4.7K resistor as a pull-up resistor and connect it between VCC and digital input pin.

On the receiver side, I added an I2C OLED Display to ESP32 along with LoRa SX1278. Connect the SDA & SCL pin of OLED Display to GPIO21 & GPIO22 of ESP32.



```
#include <LoRa.h>
#include <SPI.h>
#include <OneWire.h>
#include <DallasTemperature.h>

#define ss 5
#define rst 14
#define dio0 2

int counter = 0;

// GPIO where the DS18B20 is connected to
const int oneWireBus = 4;

// Setup a oneWire instance to communicate with any OneWire de
OneWire oneWire(oneWireBus);

// Pass our oneWire reference to Dallas Temperature sensor
DallasTemperature sensors(&oneWire);

void setup()
{
  Serial.begin(115200);
  sensors.begin();
  while (!Serial);
  Serial.println("LoRa Sender");

  LoRa.setPins(ss, rst, dio0);    //setup LoRa transceiver mod

  while (!LoRa.begin(433E6))     //433E6 - Asia, 866E6 - Europ
  {
    Serial.println(".");
    delay(500);
  }
  LoRa.setSyncWord(0xA5);
  Serial.println("LoRa Initializing OK!");
}
```

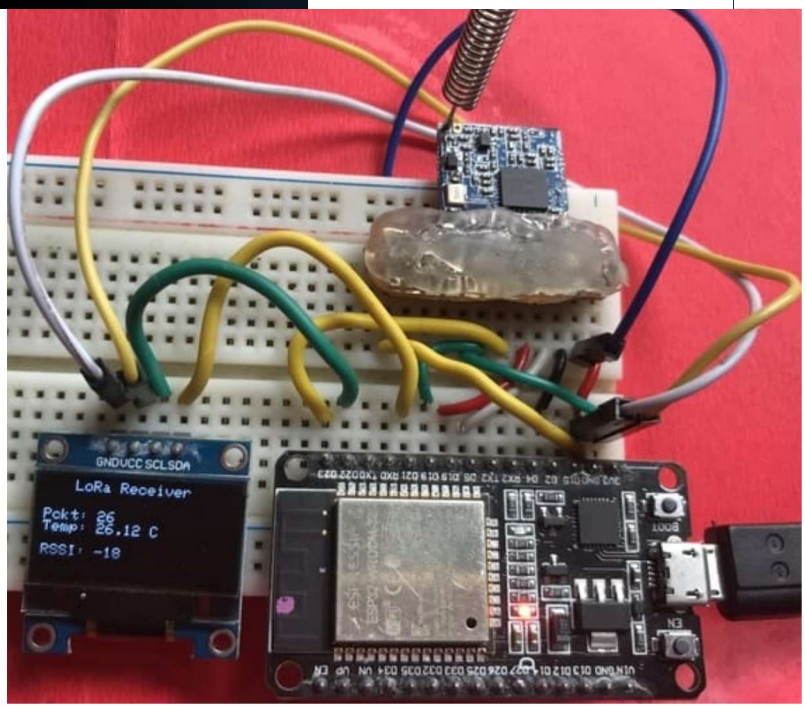
```
  Serial.print("Temperature: ");
  Serial.print(temperatureC);
  Serial.println("ºC");
  Serial.println("");

  LoRa.beginPacket();   //Send LoRa packet to receiver
  LoRa.print("Pckt: ");
  LoRa.println(counter);
  LoRa.print("Temp: ");
  LoRa.print(temperatureC);
  LoRa.println(" C");
  LoRa.endPacket();

  counter++;

  delay(4000);
}
```


Receiver Code

```
#define SCREEN_WIDTH 128    // OLED display width, in pixels
#define SCREEN_HEIGHT 64    // OLED display height, in pixels
#define OLED_RESET -1       // Reset pin # (or -1 if sharing A

Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, O

#define ss 5
#define rst 14
#define dio0 2
String LoRaData;

void setup()
{
  Serial.begin(115200);
  if(!display.begin(SSD1306_SWITCHCAPVCC, 0x3C))
  {
    Serial.println(F("SSD1306 allocation failed"));
    for(;;);
  }
  delay(2000);
  display.clearDisplay();

  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.setCursor(0, 10);

  display.println("LoRa Receiver");
  display.display();

  while (!Serial);
  Serial.println("LoRa Receiver");

  LoRa.setPins(ss, rst, dio0);    //setup LoRa transceiver mod

  while (!LoRa.begin(433E6))     //433E6 - Asia, 866E6 - Europ
  {
    Serial.println(".");
    delay(500);
```

```
{
  int packetSize = LoRa.parsePacket();    // try to parse pack
  if (packetSize)
  {

    Serial.println("Received packet");

    while (LoRa.available())              // read packet
    {
      LoRaData = LoRa.readString();
      Serial.print(LoRaData);

    }
    Serial.print("RSSI: ");         // print RSSI of packet
    Serial.println(LoRa.packetRssi());
    Serial.println("");

    display.clearDisplay();
    display.setTextSize(1);
    display.setTextColor(WHITE);
    display.setCursor(20, 0);
    display.println("LoRa Receiver");

    display.setTextSize(1);
    display.setTextColor(WHITE);
    display.setCursor(0, 20);
    display.println(LoRaData);
    display.print("RSSI: ");
    display.println(LoRa.packetRssi());
    display.display();
  }
}
```

Once the code is uploaded, the transmitter will start and will read the temperature data. The temperature data is wirelessly send using LoRa.



Video Tutorial & Demonstration

ESP32 & LoRa Sensor Data Monitoring ||Sender + Receiver with OLED Display

Watch this video on YouTube.

If you want to send the temperature data to Web Server you can visit this advanced tutorial: ESP32 LoRa Sensor Data Monitoring on Web

One Comment

Documents/Arduino/reciver_lora/reciver_lora.ino: In function ‘void setup()’:
reciver_lora:37:3: error: ‘LoRa’ was not declared in this scope
LoRa.setPins(ss, rst, dio0); //setup LoRa transceiver module
^
Documents/Arduino/reciver_lora/reciver_lora.ino: In function ‘void loop()’:
reciver_lora:56:12: error: ‘LoRa’ was not declared in this scope
while (LoRa.available()) // read packet
^
reciver_lora:58:7: error: ‘LoraData’ was not declared in this scope
LoraData = LoRa.readString();
^
reciver_lora:63:20: error: ‘LoRa’ was not declared in this scope
Serial.println(LoRa.packetRssi());
^
exit status 1
‘LoRa’ was not declared in this scope

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