LORA BASED WIRELESS WEATHER STATION WITH WEB SERVER

R. Vyshnavi[1], B.Ishwarya[2], P. Jahnavi[3]

[1]Assistant Professor, Department of ECE, Bhoj Reddy Engineering College for Women, Hyderabad, India

[2,3,]UG scholar students Department of ECE, Bhoj Reddy Engineering College for Women, Hyderabad, India

Abstract: This abstract presents an efficient control system LoRa based wireless weather station using Arduino Nano & ESP32 Wi-Fi module. We can keep the weather station node on the roof of your house or any remote location just a few kilometers away from your home. We can use the sensor like BME280 barometric pressure sensor along with a BH1750 light sensor and also a rain sensor. Basically, this weather station can monitor the environment parameters like temperature, humidity, pressure, altitude, dewpoint, rainfall & light intensity. Using the LoRa module SX1278/RFM95 you can monitor the data from a few kilometers distance. The device operates on a battery and power consumption is low. The gateway can be placed indoors inside the house or can be placed at a certain height to achieve a long distance. The gateway is made using LoRa SX1278/RFM95 and ESP32 Wi-Fi module. The receiver collects the data from the sender or sensor node and uploads it to the server.

Introduction

Weather refers to the atmospheric conditions, including temperature, humidity, and wind, that exist at a certain location during a particular time period. The weather is ever fluctuating. Periodically, there is a period of low precipitation, followed by rainfall, and eventually snowfall. The weather is primarily controlled by three key factors: the sun, water, and wind. Solar radiation generates energy that has the capacity to regulate the water cycle. The weather data will be used for weather forecasting and agricultural strategizing, as well as for health, tourism, and other related purposes. Weather observation requires the placement of a certain collection of equipment at a particular position to accurately portray the environmental conditions of the surrounding region.

A weather station is a collection of instruments used to monitor and document weather, climate, and atmospheric conditions within a specific region. Once captured, the data is saved in a data logger and then analyzed by consumers or academics. An automated weather station is a device that utilizes sensors to monitor and record meteorological information.

Once the measurement data is gathered from the weather station, it can be processed either on-site or at the acquisition data center unit. Subsequently, the collected data is automatically transmitted to the data processing center for further analysis and processing.

This wireless weather station effortlessly combines a variety of sensors specifically intended to detect essential environmental factors such as temperature, humidity, air pressure, and precipitation. This online interface guarantees accessibility across several platforms, providing users with a thorough comprehension of both

current weather conditions and historical patterns.

The integration of LoRa technology with a web server allows for the creation of a dynamic platform that enables data display and analysis. This online interface not only allows for immediate monitoring but also enables customers to remotely retrieve past weather data.

The integration of LoRa technology with a web server allows for the creation of a dynamic platform that enables data display and analysis. This online interface not only allows users to monitor weather conditions in real-time, but also enables them to remotely retrieve past meteorological data. The combination of long-distance communication, low energy use, and internet-based accessibility establishes the LoRa-based wireless weather station as a potent instrument in several fields, ranging from precise farming to disaster control.

The integration of LoRa technology with wireless weather stations, together with web servers, creates an advanced and robust system specifically built for collecting and analyzing meteorological data remotely.

LoRa enables efficient and uninterrupted communication between the sensor nodes of a weather station and a central gateway, allowing data to be sent across long distances without any loss in efficiency. In addition to the hardware components, the incorporation of a web server provides a user-friendly and easily available interface for seeing and analyzing data. This online platform serves as a centralized hub, gathering real-time meteorological data broadcast by the LoRa-connected weather station. Users have the ability to remotely access this information from different devices, allowing them to get a full picture of both present situations and past patterns. The use of LoRa technology and a web server provides several significant benefits.

Overall, the integration of LoRa-based wireless weather stations with web servers signifies a substantial advancement in the realm of remote environmental monitoring. This cutting-edge system effectively tackles the issues associated with long-distance communication, minimal energy use, and immediate data availability. These weather stations use the capabilities of LoRa technology to provide dependable and effective transmission of data from various and sometimes difficult areas.

Literature Survey

P. R. Karn, H. E. Price and R.J. Diersing, published a paper "Packet Radio in the Amateur Service," in Institute of Electronics and Electrical Engineering (IEEE). This paper presents an idea on the packet radio system typically involves a terminal node controller, which interfaces with a radio transceiver to encode and decode digital signals.

P. Susmitha, G. Sowmyabala, published a paper "Design and Implementation of Weather Monitoring and Controlling System," in International Journal of Applied Engineering Research (IJAER). This paper concludes that the system involves the integration of various sensors to monitor critical weather parameters such as temperature, humidity, air pressure, wind speed, and precipitation.

Adil Hamid Malik, Aaqib jalal, Bilal Ahmed Par ray, Meena kohli, published a paper "Smart City IoT Based

Weather Monitoring System, " in International journal of embedded and software computing (IJESC). This paper presents an idea on the sensors which communicate wirelessly with a central hub or server, forming a cohesive network that continuously gathers and processes weather information.

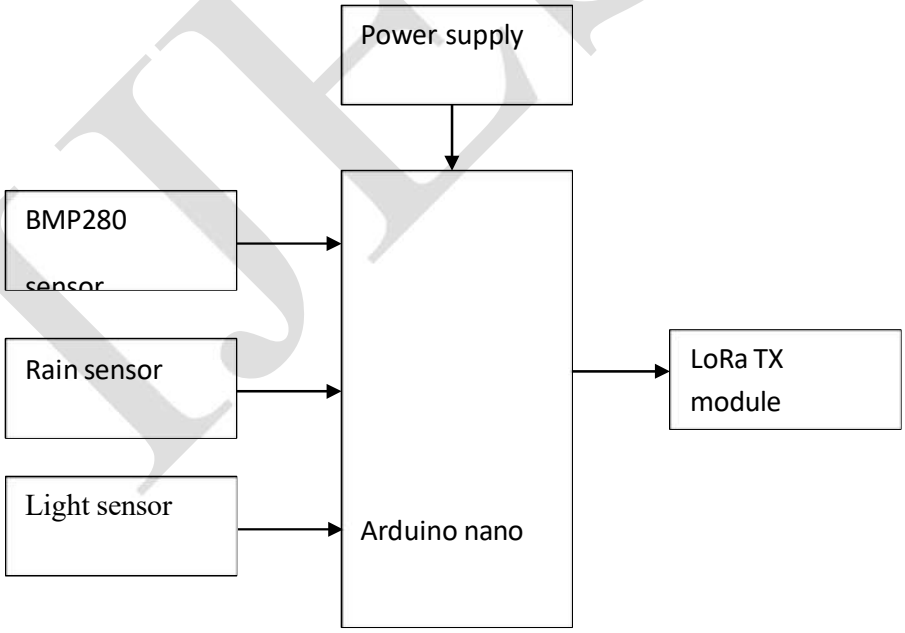
Parijit Kedia, published a paper "Localised Weather Monitoring System," in International Journal of Engineering Research and General Science (IJERG). This paper presents an idea on weather conditions within a specific and confined geographical area.

Ashish Sharma, T Gaurav, Durvijay Singh, published a paper "Low cost Solution for Temperature and Humidity monitoring and control System using Touch Screen Technology, " inInternational Journal of Latest Research in Engineering and Technology (IJLRET). This paper presents an idea on the system employs sensors to measure temperature and humidity levels, and a touch screen interface provides an intuitive platform for users to monitor and control these parameters.

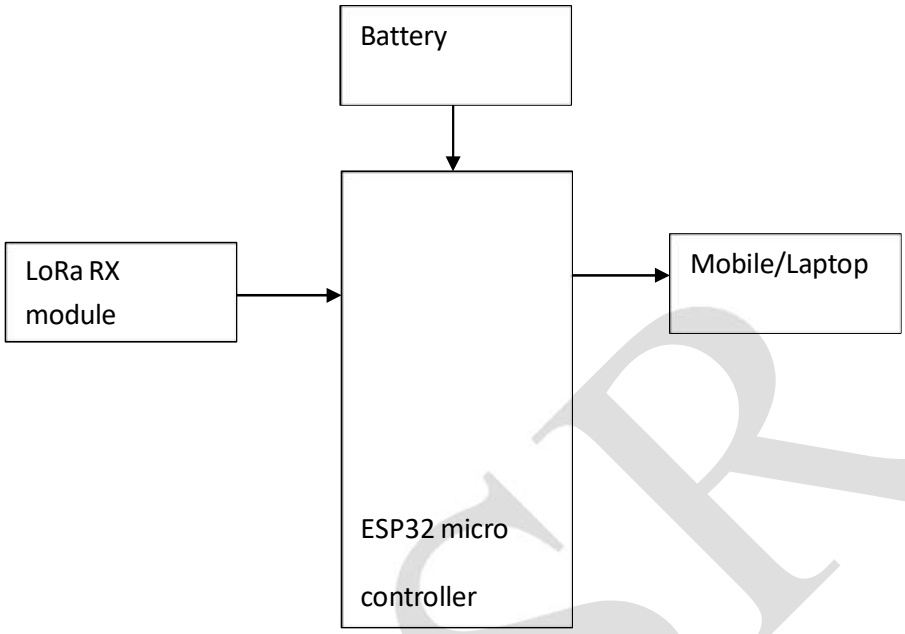
Tarun Kumar Das, Yudhajit Das, published a paper "Design of A Room Temperature And Humidity Controller Using Fuzzy Logic, " in American Journal of Engineering Research (AJER). This paper presents an idea on creating an intelligent and adaptive system for maintaining optimal indoor environmental conditions. Fuzzy Logic is employed to model and control the uncertainty and imprecision associated with human comfort and varying environmental factors.

BLOCK DIAGRAM EXPLANATION

. Stage 1: Transmitter



Stage 1: Receiver



LoRa module integration

The efficiency of a wireless weather station is directly proportional to the degree to which LoRa transceiver modules are included into the system. The weather sensors and the central processing unit are able to be connected using these modules, which act as the communication backbone. This allows for data transfer over long distances and with minimal power consumption. The selection of suitable LoRa modules is an important choice that will need careful consideration of a variety of criteria, including frequency range, modulation methods, and compatibility with the microcontroller that will be used. Following the identification of the LoRa modules, the process of integration entails the establishment of communication channels that are seamless between the transceivers and the weather sensors. The microcontroller is responsible for collecting sensor data, which includes information on temperature, humidity, wind speed, and rainfall, and then formatting this data into data packets that are compatible with LoRa radio technology. The use of this data packing guarantees that the LoRa modulation approach is used effectively, which optimizes the transmission over wide ranges while maintaining a low level of energy consumption. Not only does the integration include the packing of data, but it also involves the development of rigorous error-checking systems in order to improve the dependability of data while it is being sent. Because of its resistance to interference and its capacity to function in difficult environmental circumstances, LoRa is especially well-suited for applications that include distant weather monitoring.

Further, power management measures are used in order to optimize the battery life of the wireless weather station. This ensures that the station can continue to function independently and for an extended period of time in tough deployment settings or when it is not connected to the grid. In order to overcome geographical limitations that conventional communication technologies may have difficulty addressing, the integrated LoRa

transceiver modules make it possible to construct a wireless communication network that is both dependable and scalable. Not only does this integration make the weather station more accessible, but it also makes a contribution to the total energy efficiency of the station, which makes it a perfect option for situations that are not just resource-constrained but also distant.

Web server integration

When it comes to bridging the gap between the acquired environmental data and user accessibility, the integration of a web server into a LoRa-based wireless weather station is an essential component. Data is saved, processed, and displayed to users in a way that is understandable via the web server, which acts as the primary hub for all of these activities. It is impossible to overestimate the significance of a web server in the context of Internet of things (IoT) applications. This is because a web server offers a user-friendly interface for the viewing and analysis of real-time weather data.

The choice of an appropriate web server technology is an important decision that is determined by a number of aspects, including compatibility with the microcontroller that is selected, scalability, and security. The process of integration begins with the selection of the web server, and then continues with the establishment of communication protocols between the microcontroller and the remote server.

It is the web server that is responsible for capturing and processing the data that is received from the sensors and is transferred over the LoRa transceiver. The activities that fall under this category include the validation of data, the storing of data in databases, and the development of dynamic web sites or dashboards enabling data interaction with users.

In web server integration, the most important features are the efficient processing of data and display of that data. Through the use of a web-based dashboard, users are able to remotely access the data that the weather station provides, which enables them to monitor both the present conditions and trends. A better capacity to analyze the data is achieved via the use of visualization tools such as graphs and charts. In addition, the integration guarantees that the web server is able to manage several requests from users at the same time, which offers a scalable option for increasing accessibility to a wider audience.

Results and Discussion

Schematic Diagram

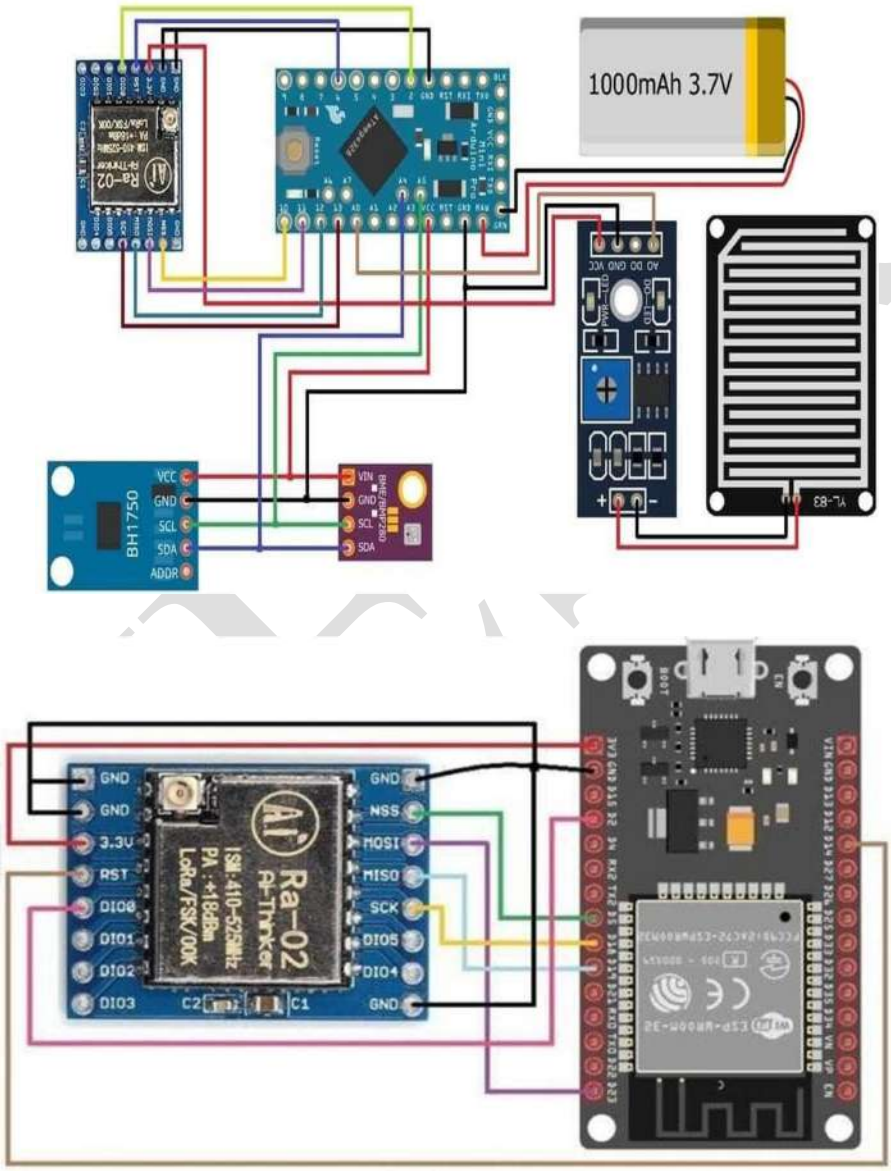


Figure 5.1 Schematic Diagram of transmitter and receiver

Results

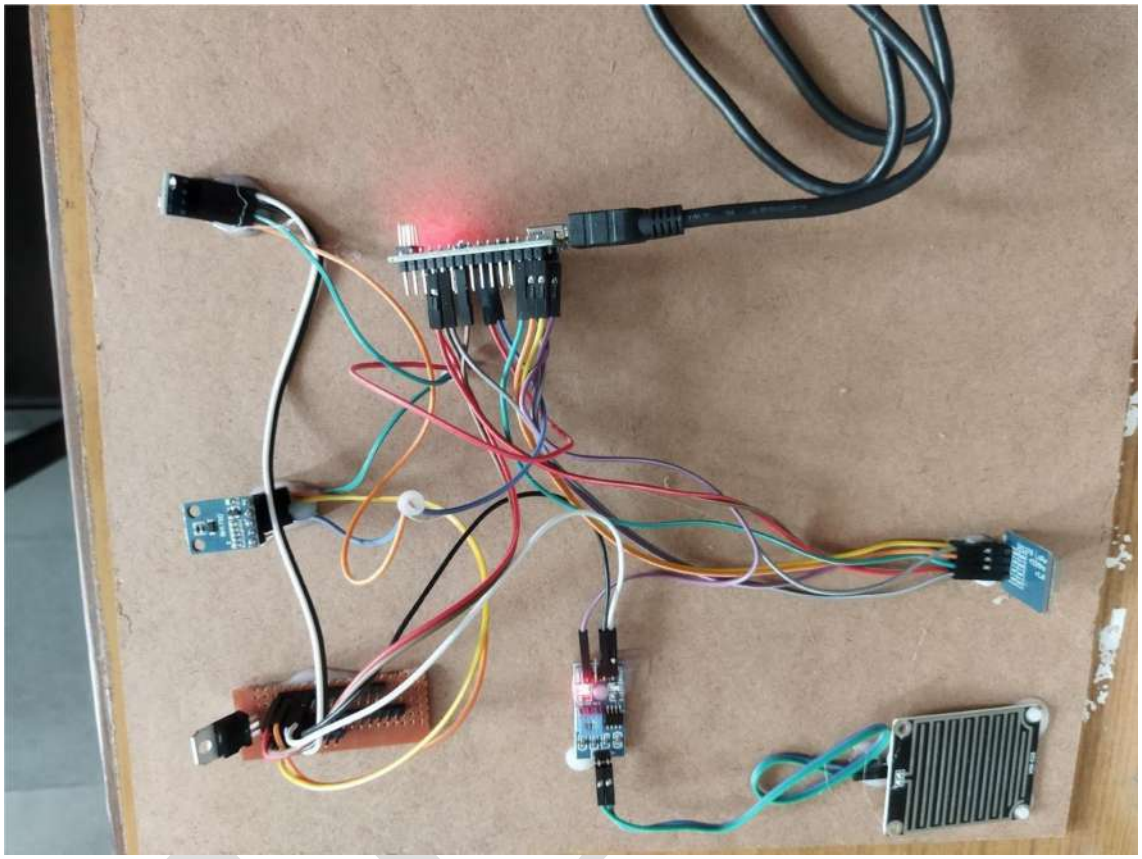


Figure 5.2: LoRa Transmitter

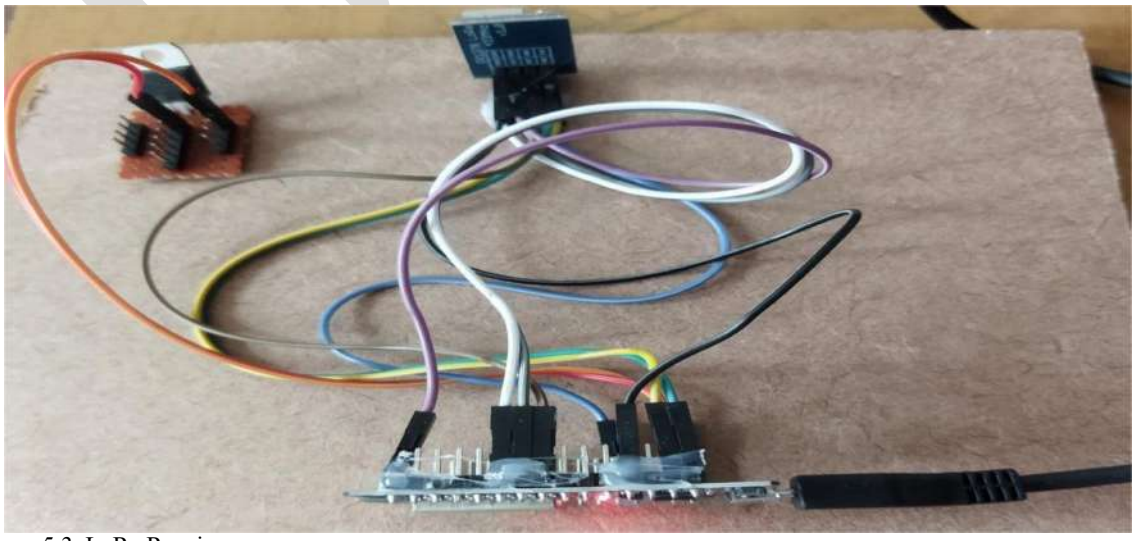


Figure 5.3: LoRa Receiver

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