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LoRa based Wireless Weather Station

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Abstract: ***In this Project we develop a prototype of "LoRa Based Wireless Weather Station". Where LoRa is a wireless network technology supporting the internet of things (IoT) system. This technology is an elective to other wireless network modules that have already been well known such as GSM modules, Wi-Fi Modules and Bluetooth Modules. The utilize of the LoRa network serves to increase the range of wireless cells that can reach distances of up to 8 kilometres whereas still having low power utilization. Weather parameters that we are measured in this project are Temperature, Pressure, Dew point, Altitude, Rainfall, Humidity and Light Intensity. In this prototype we use Arduino UNO, Barometric Sensor, Rain Sensor, Light Intensity Sensor and LoRa modules. And Thingspeak Web application for sharing data to the users. This system has the potential to be executed in urban and rural zones with different sorts of sensors associated to it. This project can be overseen to form a Low Power-Wide Area Network as a more extensive sensor network.***
Keywords: LoRa, Wi-Fi, IOT.

I. INTRODUCTION

Climate is related to the conditions of temperature, humidity and wind in a place for a certain period. The climate is for the most part continuously changing. In some cases, there's a wet season, rain, when snowfalls and dry seasons. The weather is for the most part influenced by three elements specifically the sun, water, and wind. Daylight produces energy that can control the water cycle. The wind carries the clouds that contain water vapor in it moving towards different places with lower pressure. The air and clouds shrink to ended up heavier and drop to the ground so that it rains. Climate conditions are exceptionally powerful in human action so it is exceptionally vital to measure climate conditions in real-time. The climate information will be utilized for weather prediction and agricultural planning, wellbeing, tourism, and so on. In the process of climate perception, a set of instruments is required to be set in a certain location to represent the natural conditions of the surrounding area. A weather station could be a set of instruments utilized to watch conditions or changes in weather, climate, and climate in a region and record it within the form of data. After being recorded, the information is stored in a data logger and in this way to be studied by users or researchers. An automatic climate station is an instrument that measures and records meteorological parameters utilizing sensors. This sensor serves as a measuring apparatus to measure any changes in the weather. After the measurement information from the weather station is collected, the process can be carried out locally at the area of the climate station or the data can moreover be collected at the acquisition information centre unit, which afterward the data collected is consequently sent to the data processing centre and after that processed as required. There have been many improvements of IoT-based climate stations with GSM, Wi-Fi, Bluetooth, Zigbee modules. But there are still rarely examined in Indonesia that examines the utilize of LoRa technology. LoRa is distinctive from other innovation modules such as GSM, Wi-Fi, Bluetooth and Zigbee modules. In brief, LoRa could be a lower control than GSM / LTE modules and LoRa features a long range of up to 8km advance than Wi-Fi, Bluetooth and Zigbee This study creates a model of a weather station network with wireless Long Range (LoRa) Module infrastructure/system. Weather parameters measured include air temperature, air humidity, air pressure, rainfall and wind speed. The number of end-nodes within the model created is two. But in practice later in case required it can be increased by handfuls of end-nodes. End-nodes comprising of different sensors will be set in a region inside the reach of LoRa to handle weather monitoring comes about in that region. Information gotten from these sensors will at that point be transmitted wirelessly through LoRa gateway device connected to server

II. LITERATURE SURVEY

Previous systems that existed are as it were on collection of climate information or transmission of these information utilizing ZigBee or GSM or Wi-Fi or some remote mechanism/working. All these systems, in spite of the fact that they measure the same parameters but they need one common thing which is accuracy. Individuals require exact climate condition of the range they live in. They have to be known the climate so that they can thrive and adapt according to it. Other systems collect information and anticipate tomorrow's climate information similar to that. No patter, no perception is made. This makes the prediction error inclined. This strategy is appropriate as it were to places where there are not so numerous climate variances happening within the area i.e., it is steady all through. Since ordinary prediction would fall flat when the exceptions are more.

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Nowadays, weather station utilizes overwhelming instruments to decide the climate of the city. These instruments cost high and their accuracy is not as well much to depend on.

III. PROPOSED SYSTEM

In the proposed system, the sensors are attached to the Micro-Controller which is connected to LoRa. We designed and developed the entire idea into a device, where we integrate all the required components into a single unit. The Sensors which are connected to the Micro-controller it will detects the weather parameters-like: Temperature, Humidity, Air-Pressure, Dew-Point, Rainfall, Altitude and displays it Serial monitor and in Web-Server. Where we connect the receiver LoRa/Gateway Lora to the NodeMCU or ESP32 where it uploads the information/data to the Server.

A. To provide greater accuracy for agricultural land area at that particular region.
B. To view the climatic conditions in real-time of particular region from far.
C. To make a Low-cost effective system to monitor the Weather-conditions.
D. With real-time data users can get idea about climate and they can plan their works accordingly.
E. To make the System automatic and Wireless.
F. The aim is to automate and make a system that provides a real-time Weather forecasting for a long-range.
G. Thus, Monitoring Weather-Station are being developed with greater accuracy, which will be available at low cost

IV. WORKING

The below block diagram essentially shows the working of the venture wherein different parts are associated with Micro Controller and different sensors
are associated with it. Here it is a Sensor-Node block diagram, where we connect different sensors to get weather readings from atmosphere. And all this data is transmitted through LoRa to get transmitted to Gateway-Node

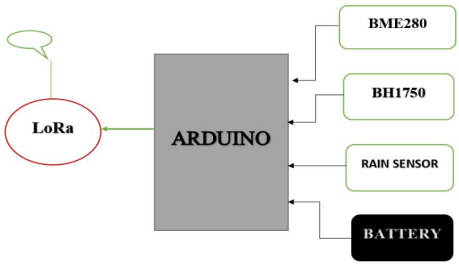

Fig.1.Sensor-Node Block Diagram

The above block simply shows the functioning of the project for the first half. That is in this Project the work is divided into two parts:

1) *Sensor Node:* In which various components are connected to Micro Controller-Arduino and various sensors are connected to it. Here these sensors collect the data from atmosphere i.e., Climatic conditions using respective sensors and sends all the data to MCU-[Arduino]. Where the MCU-Arduino will transmit this data to Receiver module using LoRa component. And this whole system gets power supply from the battery we have fixed with Arduino. This block of components needs to be covered. As, this part of device will be placed elsewhere in the environmental place to get all those weather readings. With this the circuit may gets wet with rainfall. So, we need to place rain sensor out of the cover and remaining components get to be covered.

Fig2. Gateway-Node Block Diagram

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2) *In Gateway:* Node Block Diagram we have only two components- Esp32 and Lora. Where the transmitted data from LoRa-Sensor Node will be received by Gateway-Node LoRa and it is sent to web by means of ESP32.Here with Web browser or Thingspeak the user can check/observe the data.

LoRa Based Weather Station requires Sender and Receiver circuit to communicate wirelessly. So, the Sender Circuit is called as Sensor-Node and the Receiver Circuit is called as 'Gateway'. We can keep the Weather Station system on the roof of your house or any farther area just a few kilometers away from your location. With the sensor like BME280-Barometric Pressure Sensor along with a BH1750-Light sensor and also a Rain Sensor. Essentially, this weather station can monitor the Environment parameters like Temperature, Humidity, Pressure, Altitude, Dew Point, Rainfall & Light Intensity.

a) Here Arduino is controller circuit for Sensor-Node, where we connect all sensors: BME280, BH1750, Rain Sensor, LoRa module to Arduino as per Circuit Diagram.
b) BME280 sensor gets the climate readings of Temperature, Humidity, Atmospheric Pressure from Atmosphere and sends the data to Arduino [MC].
c) Then, BH1750 sensor gets the Light Intensity in units of lux and sends the data to Arduino
d) Rain Sensor FC-37 will give the percentage of rainfall in that particular area. And 0% for no rainfall.
e) All this data from Arduino will get transferred to LoRa module and transmitted to Receiver LoRa module.
f) And ESP32 is controller circuit for Gateway-Node, where LoRa Receives the data from transmitter LoRa at sensor-node.
g) This data will be processed to Web via Thingspeak and web local server.
h) A URL will be generated in this process; this will be used to monitor the Weather readings as shown in results
i) And a chart/graph will be created in Thingspeak with all these readings

V. DESIGN & IMPLEMENTATION

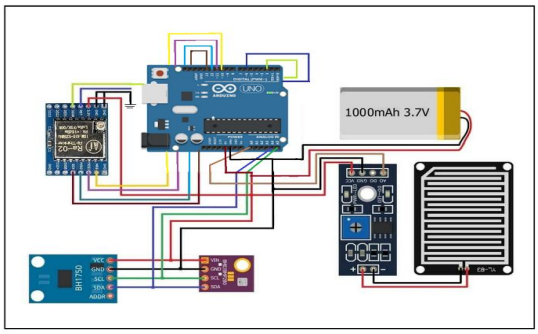

Fig.1: Circuit Diagram-Sensor Node

In this Circuit we connected Micro-Controller to all the required components using Jumper wires on the bread board. Where power supply for this circuit is driven from Battery. And this circuit is not Waterproof, so we need to cover this circuit from rainfall. All the connections were connected tightly by soldering all the wires.

As loose connections lead to errors in the data which was retrieved from Sensors. So, they need to be tight.

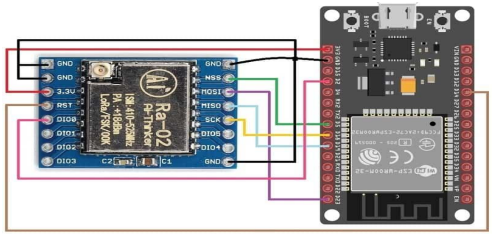

Fig.2: Gateway Node-Circuit Diagram

In this Circuit we are using LoRa with ESP32 for collecting data from transmitter LoRa i.e., as receiver we are using LoRa module with ESp32 development board. Here ESP 32 which have in-built Wi-Fi module and BLE-Bluetooth module in it. So, we are using Wi-Fi module in it to transfer data to users through WEB server or Thingspeak or we can utilize Blynk Application.

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VI. RESULTS & DISCUSSIONS

A. Circuit Connections Practically

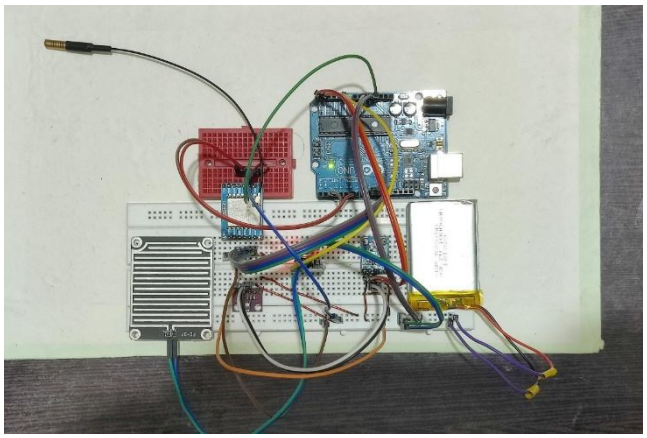

Fig.1 Sensor-Node Circuit

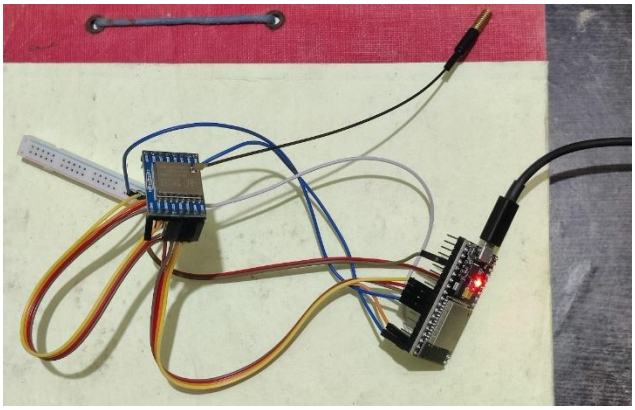

Fig.2 Gateway-Node Circuit

B. Webserver Page

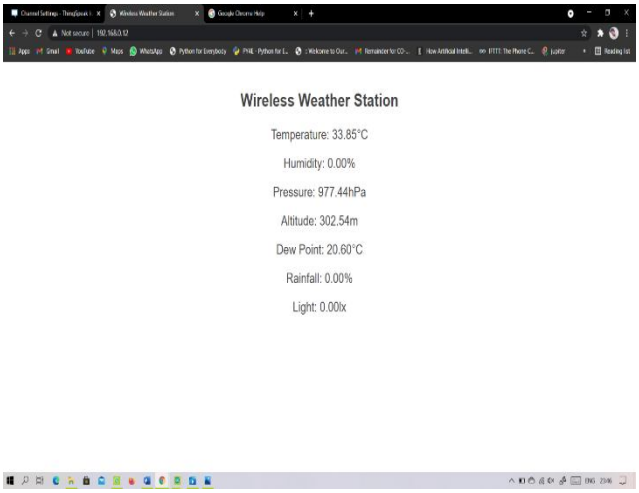

Fig. 3: Web-Server Page

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C. Thingspeak Application

Fig.4. Field Charts of Weather-thingspeak

D. Blynk Application

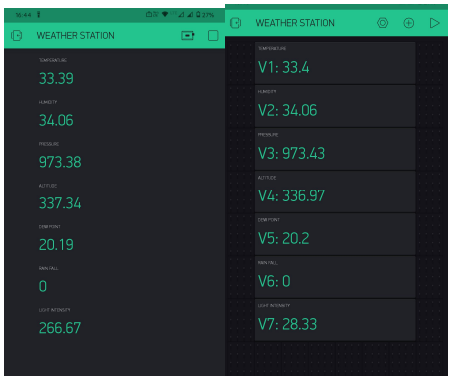

Fig 5. Blynk Mobile Application

VII.FUTURE SCOPE

For the future work we advise to use long-range communication method to increase the range of distance for sending data. Also, we advise using the weather station to make predicates about the weather for incoming days not only the current time. we need to continue, to improve the hardware system to enhance energy saving and increase transmission distance. We also need to add functions of remote actuator control to the management software. And we require a more flexible interface design for future weather stations, and also more flexible additional modules that can be arbitrarily combined according to the configuration.

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VIII. CONCLUSION

As the conclusion this project have cleared the objective that to construct a system that can monitored weather parameter by wireless system and IoT. The Sensor station and Weather station will be communicated by Wi-Fi and it is limited in areas covered but still way better in communication via wireless. With wireless monitoring network devices, the people can check online on the web page the weather condition to take certain steps and issues even in worst case for monitoring the weather parameters. The results that are obtained by the sensors send and display to ThingSpeak for user viewing. This will make monitoring weather parameter more easily with the Wi-Fi connection this system will start and ThingSpeak start displaying sensor data by graph. and also all this data can be analyzing in thingspeak

IX. ACKNOWLEDGEMENT

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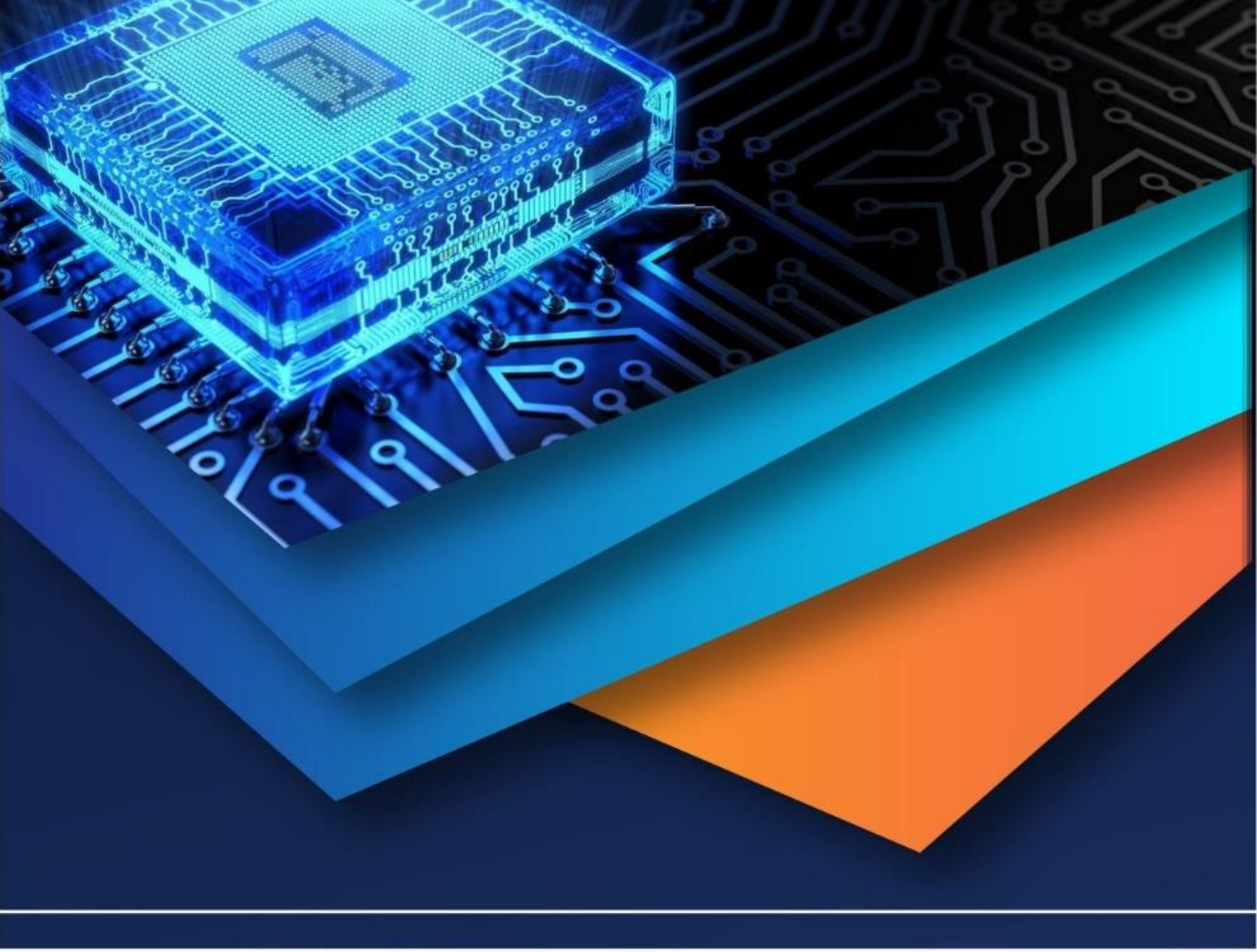

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