

Design and implementation of LoRa based environmental parameters

U. Meenakshi¹, Prof. R. Jeevan Kumar^{*2}, Prof. M.V. Lakshmaiah³

¹Research Scholar, Department of Electronics, Sri Krishnadevaraya University, A.P., India.

^{2,3}Professor in Department of Physics, Sri Krishnadevaraya University, A.P., India.

Abstract

Internet of Things (IoT) is mainly Low-cost, low-power device. It is used to make any IoT network solutions in agriculture. In this paper, we have proposed a low-power, low-cost IoT network for monitoring the Temperature, humidity using LoRa technology. LoRa used for Long Range and it is a low-power wireless communication (LPWC) technology. We propose a low-cost and battery-supplied wireless communication (LPWC) technology for fine-grained and long-term data center temperature, Humidity monitoring. The LPWC has been operational receives more than seven million data points, with no losses, for six months without battery recharges. In this paper we are implemented LoRa based environmental parameters monitoring like temperature and humidity. In this process of information processed by Raspberry pi4 and transfer information to LoRa transmitter. Nodemcu, LoRa receiver receives real time data and monitor information continuously by Ubdots clouds. LoRaWAN sensor that measures temperature and humidity, with an incredible maintenance. It is easy to configurable over the air and fit into indoor spaces. Advanced LoRa chipsets reduced size compared to older generation. LoRa and LoRaWAN permit long-range connectivity for Internet of Things (IoT) devices in different types of industries.

Keywords: LoRa WAN, LPWC, IoT, Environmental-monitoring, Raspberry Pi4, SI7021, Ubdots clouds, NodeMCU, Smart phone

1. Introduction

LoRaWAN based on spread spectrum modulation techniques, High-performance computing installations, with derived from chirp spread spectrum (CSS) technology. It implements on basis of web servers and cloud servers as well as supercomputers. Its power consumption generated by the computing nodes. LoRa uses license-free sub-gigahertz radio frequency bands in MHZ. Due to the extraordinary growth of IT (Information Technology) industries, data centers energy consumption has attracted global attention because of their impact on environment parameters change. In past years the overall trend in hardware design field continue to decrease the power efficiency of both processor and memory [1].

2. HARDWARE MODULES DESCRIPTION

A. LoRa Module

LoRa enables long-range transmissions (more than 10 km in rural areas) with low power consumption. The technology covers the physical layer, while other technologies and protocols such as LoRaWAN (Long Range Wide Area Network) cover the upper layers. LoRa devices have geolocation capabilities used for triangulating positions of devices via timestamps from gateways as shown in fig.1. In the proposed network, sensor node which provides low-power communication. Heat allocation in Indoor climate control, building damage prevention, Food monitoring. By evaluated our network with state-of-the-art networks, proposed for Temperature, humidity monitoring and environmental parameters. Power and cost are the two metrics used for evaluation of these networks [2].

B. LoRa interfacing system

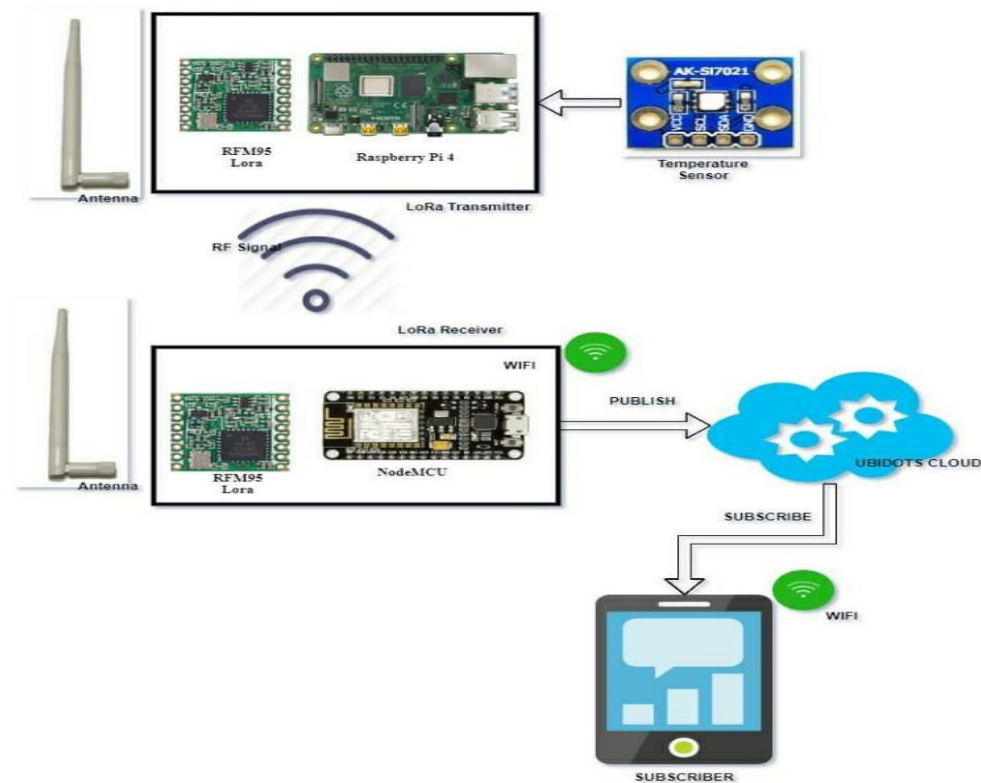


Fig.1. Monitoring of LoRa based Environmental parameters like Temp. & Humidity

C. SI7021:

SI7021 is used for measuring indoor and outdoor environment parameters, and it is easily deployed and configured. It adopts dedicated digital module acquisition technology, which has provided 32 bits of high-speed digital I/O, and features independent input and output scan clocks, hardware and software triggering, and pattern detection/generation.

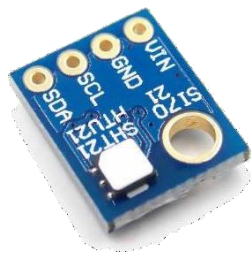


Fig.2. Environmental sensor

Temperature and humidity sensing technology to ensure high reliability and long-term stability of products. SI7021 could be applied to any type of environment, and ideally suited for a wide range of industrial applications such as urban monitoring, air quality, industrial, environmental or farming projects [3].

D. Raspberry Pi4:

Raspberry Pi 4 Model B is advanced model of Raspberry Pi range of computers. It has high speed Processor, internet connectivity, multimedia performance, memory compared to the prior-generation Raspberry Pi 3 Model B+. Raspberry Pi 4 Model B comparable to entry-level x86 PC systems. It has 64-bit quad-core processor, dual-display support at resolutions up to 4K. 4GB of RAM, dual-band 5.0 GHz wireless LAN, Bluetooth, Gigabit Ethernet, USB 3.0, and PoE capability.



Fig.3. Raspberry Pi4 board

E. Node MCU 8266:

NodeMCU 8266 is an advantage of in built wifi and low-cost device. It is an open-source firmware and development kit that helps to build IoT applications. It includes firmware which runs on the ESP8266 Wi-Fi.

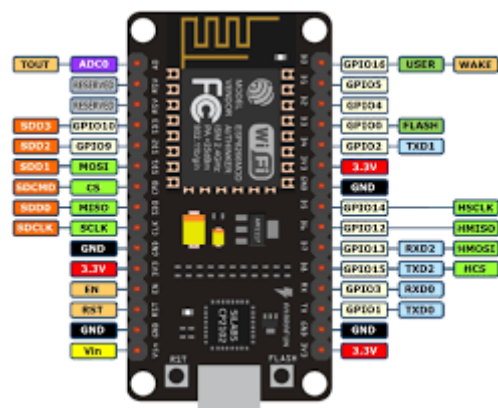


Fig.4. ESP8266 NodeMCU

3. LoRAWAN ARCHITECTURE

LoRaWAN is a media access control (MAC) protocol is low-power wireless communication (LPWC). It is used for wide area networks to communicate throughout the world. It is designed to allow low-powered applications to communicate with Internet-connected applications over long-range wireless connections. LoRaWAN can be mapped to the second data link layer which can maintains different types of data controls and third layer consists of network applications of the OSI model. It is implemented on top of LoRa used in scientific and medical (ISM) radio bands. The LoRaWAN protocols are defined by the LoRa Alliance and formalized in the LoRaWAN arch as shown fig.5 Specification which can be downloaded on the LoRa Alliance website [4].

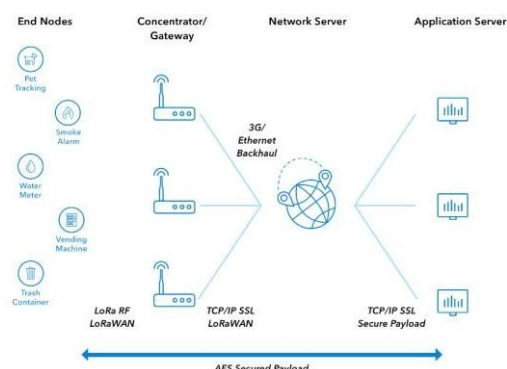


Fig.5. LoRaWAN Architecture

- End to End communication with an embedded low-power communication device.
- It has Gateway antennas it receives broadcasts from End Devices and send data back to End Devices.
- Network Server - servers that route messages from End Devices to the right Application, and back.

- Application - a piece of software, running on a server.

4. IMPLEMENTATION

LoRaWAN device is a low-cost 'IoT node' device with number of inputs and outputs. In this paper we proposed a low-power wireless communication (LPWC) technology designed to monitor in a distributed fashion the temperature, humidity evolution in a data center with the goal to improve cooling efficiency[5]. RFM95 LoRa module, SI7021 with Raspberry pi to communicate with another RFM95 LoRa module with NodeMCU connected.

This method can come in handy at many places since the NodeMCU could act as a Server to fetch data from sensors and send it to Pi over a long distance through LoRa and then the Pi acting as a Client can receive these information and upload it to the cloud since it has access to internet. It is assumed that your Raspberry Pi is already flashed with an operating system and is able to connect to the internet [6].

One of the interfaces is I2C. This is a common interface for a range of sensor chips. It requires temperature probe that is low-cost, low-power and very accurate without requiring any calibration. This probe is ideal to locate inside fridges, freezers, reefers, and even strap to items that you want to monitor the temperature of. The metal 'bullet' housing transfers heat very well to the internal chip sensor, so the reaction time of the sensor is excellent [7].

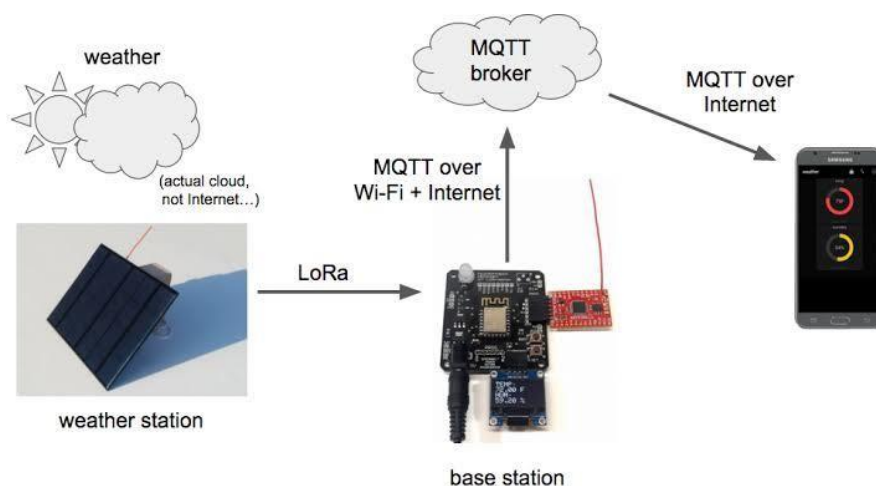


Fig.6. Monitoring parameters in Ubdots Cloud communication

Fig 6 consists in this process environment parameters read by SI7021 sensor and it sends information to raspberry pi4 processor. This information is processed by rasppi4 and then it sends real time monitoring data to LoRa transmitter to LoRa receiver where we can interface nodemcu transfer information to cloud continuously.

5. RESULTS AND DISCUSSION

In this paper it explains cloud-based communication which is based on Sender Side contain raspberry pi4 board interface a temperature and humidity sensor. It measured the environmental humidity and temperature and send the receiver side via a Lora module connected to the raspberry pi board. Receiver/Publisher contains NODEMCU Wi-Fi board is connected via a Lora module and it receives the environmental parameters like temperature and humidity from the sender. After collects the data from the sender and published to the UBIDOTS cloud via internet.

Subscriber contains smart phone mobiles were used to subscribe the topic from the UBIDOTS cloud and display the readings on our smart phones. For subscriber purpose here we install the UBIDOTS explorer APP.

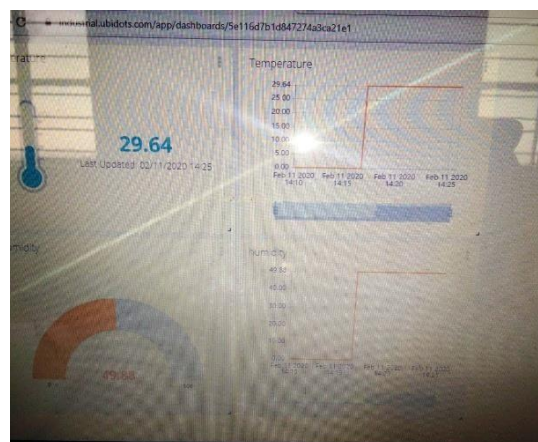


Fig.7. Temperature and humidity monitoring through clouds

6. CONCLUSION

This paper demonstrates that a LoRa wireless sensor nodes can be an effective and low-cost tool for temperature and humidity sensing in a data center [8,9]. In this process we proposed nodes and LoRaWAN WSN can provide reliable data communication for information center's room and environmental monitoring, and control. LoRaWAN network offers the advantage of easy deployment throughout the information center facilities because there is no need of wiring for power and communication. This network has mesh-oriented protocols with sensor module can be placed in locations [10,11]. The wired sensors would be unfeasible for technical or safety reasons and are not constrained to keep specific distance between nodes and routers like other mesh-oriented protocols [12]. In this paper we have implemented LoRa based environmental parameters monitoring like temperature and humidity. This information of the parameters processed by Raspberry pi4 and transfer information through LoRa transmitter to LoRa, nodemcu receiver and monitor information continuously in Ubidots cloud.

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