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LoRa based Data Trans-Receiver System

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Abstract:

The internet of things technology is commercialized by the demand for long-range, low-power, and high data transmission date. However, the technology regarding wireless communication systems is increasing every commercial outlook to enrich in the potential market. Out of all communication technologies, LoRa has long-range and low power communication to transfer data. In this paper, the data transmission of LoRa from a transmitter to receiver is observed by maintaining the time latency using Arduino. The experimental results focus mainly on the speed of data transmission from one node to another node.

***Keywords**: LoRa, Data Transmission, Internet of Things.*

I. INTRODUCTION

Internet of things is a network of interconnecting the things with the help of the internet. The interconnection network also provides intellectual services on the bases of communication property. IoT Technology has also integrated with mobile applications, big data, and cloud computing for the analytics carried on the application in real-time. To transfer the data through IoT , the system rely on the connectivity and new sloutions insights can turn into the action. LoRa (short for long range) is the latest unique RF technology that can collect the information at the sensors/ actuators and transmit the data to the edge/end-user or the cloud for analytics [1].

A wide variety of radio frequency (RF) technology enabling the low-power wireless data transmission within long distances has emerged over the past years. Ultra-narrow band technologies including Sigfox and Weightless-N are involved, in addition to unfold the spectrum technologies inclusive of LoRa, allowing the communicatinon up to few kilometers (kms) range and to accumulate low-strength wide region networks (LPWANs) that do not require any protectionfor complex multi-hop topologies[2].

The important feature of LPWAN technology is to change the capacity range of the throughput and viceversa, i.e to select the sensitive setting configuration on the physical layer (PHY) to allow the long distance communication. The cellular technologies such as 2G,3G has the wider coverage of transmitting data but consumes more energy.The benefits of using the LPWAN technology for IoT Applications is to transmit the small data over wide area with low power and also at the dense locations such as cities or big buildings[3].

The latest protocol designed to stand for long range, and to maintain low energy standards for power saving is the LoRa technology. On the bases of the requirements for Machine-to-Machine and Internet of Things, LoRa (long range low power wireless standard) is designed . This communication is operated at the frequency bands of 433MHz, 868MHz and 915MHz and widely used in the portable devices in the unlicensized application sectors of Industria Scientific and Medical (ISM) bands. Due to the low power maintainance, this

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device deployed with the LoRa can run for years. Hence it is properly utilized in the Internet of Things (IoT) applications.

LoRa Technology

LoRa is an advancement of LPWAN and it is developed by the Semtech, USA. The LoRa (short for long range) is based on the spread spectrum modulation technique derived from the chirp spread spectrum (CSS) technology[4]. Enabling the Internet of Things technology across the world, the long range and low power has high quotes of utilities in the devices developed in the potential market at large scale. The major key benefits of using the LoRa technology is due to the long range;as it connect devices upto 30miles in rural areas, Low power; lifetime upto ten years with the prolonged battery, Secure; has end to end Advanced encrypted standard 128 bit (AES128), device interopability and has high capacity for transferring data.

The technology utilizing the standard AES encryption allows the secured transmission of the data for better mobility and battery optimization. The LoRaWAN is also a low powe wide area network technology enables LoRa devices to be connected with the wide area networks. These networks are beneficial for the long distance coomunications [5].

II. Methodology

The architecture of the system consists of two nodes which act as transmitter and receiver for the gateway. The methodology is shown in Fig.1. The transmission node collects the data from the sensors. The data is gathered from the input sensors are light, humidity and temperature sensors. The microcontroller acting as a gateway, digitized and averaged. The receiver node also has the connection of the gateway which acts as a receiver.

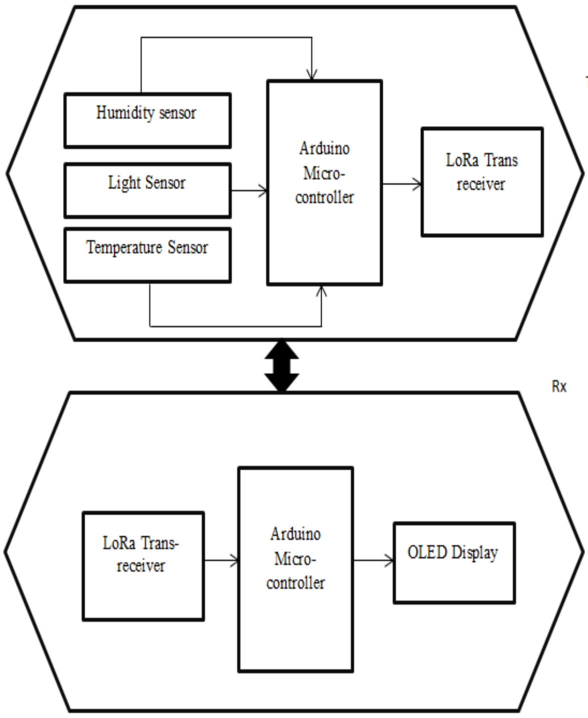

Fig.1. Methodology of the proposed System

III. Hardware/Software Co-Design

In this paper, the LoRa modules are used for the data trans-receiver observations which can be forwarded for using in Internet of Things (IoT) implementation. As IoT devices are generally powered by the use of batteries, LoRa modules have low energy consumption and long transmission range. Two low-cost LoRa transceiver modules consisting of NRF24l01 are tested using Arduino.

a) Arduino Nano:

Arduino Nano is a microcontroller based on AT mega 328p. The Arduino nano has total 22 input/output pins in which 14 digital pins and 6 PWM pins among digital pins and also 8 analoguw pins. The Arduino nano has 16MHz crystal oscillator and supports the protocols of SPI, I2C and serial. Using Arduino Integrated development environment (IDE) open source platform, the sensors are coded with the Arduino nano board.

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Fig.2. Arduino Nano

The Arduino microcontroller source code is developed in the software of Arduino IDE by the serial USB, the program is dumped in the microcontroller. The Arduino Nano is shown in Fig.2.

b) NRF24l01 Module

The NRF24L01 chip is developed from the NORDIC Corporation and it is a RF Trans-receiver compounded with the frontend tag. The chip is designed to be the ultra low power and works with frequency of the 2.4-2.5GHz ISM Band. The chip is completely integrated with all physical link and data link layer operations such as modulating and demodulating, encoding and decoding, transmitting and receiving. The RF modules are commonly used in the Arduino tinkerers. For Wireless control, these NRF modules are used [6].

Fig.3 NRF24l01 Module

c) DHT11 sensor:

The DHT11 is used to measure the digital humidity and temperature from the water level area is shown in the Fig.4. By the temperature of the water, the increase and decrease of the harmful substrates are observed.

Fig.4. DHT11 sensor

d) Light Sensor

The Light Dependent Resistors (LDR) has a variable resistor which senses the light intensity, as it falls upon it. It works on the principle of photo conductivity. The resistance of the resistor changes according to the light intensity.

IV. Experimental Setup & Results

In this proposed experimental setup, the transmission node includes the DHT11 sensor which gathers the light, humidity and temperature reading. The input sensors are connected to the Microcontroller Arduino and the sensor records the sensing input values. DHT11 are connected the digital input (DI) and the LDR is connected to the analog input (AI) The LoRa transceiver is connected throught the Serial Pheripharal Interface (SPI) protocol with the gateway of the Arduino device[6]. The experimental setup of the entire system is shown in Fig.5.

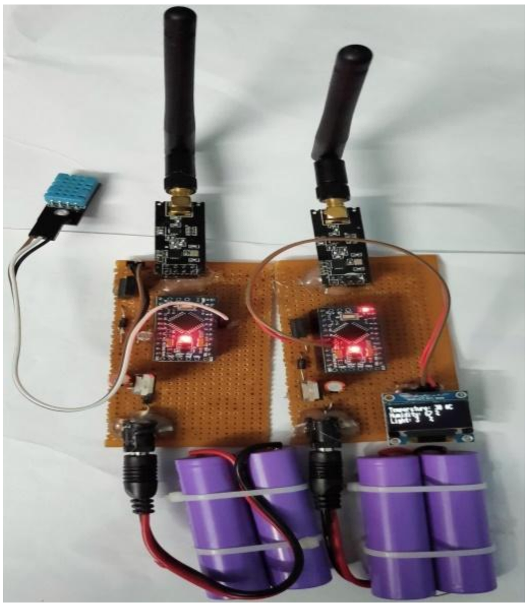

Fig.5. Experimental setup

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Fig.6. Serial Console Data transmission

The Gateway/Microcontroller attached to the receiver does not have any sensor attached at the end. The incoming data from the sensor node handles the data to convey from the microcontroller as a transmitter. At the receiver end, the lora connected to the Arduino will receive the data which is displayed in the OLED Screen. The serial monitoring display of the Arduino regarding the data transreceiving system is shown in the Fig.6. The experimental results are also shown in Fig.7.

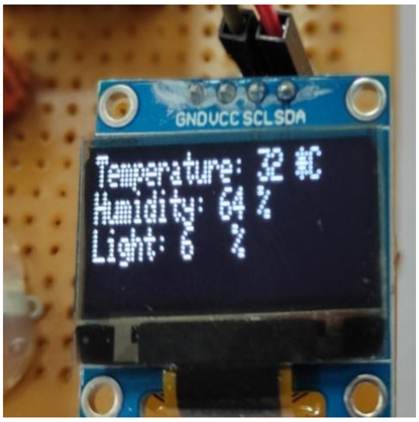

Fig.7. Display of data Received

V. Conclusion

The experimental system results carried out by the LoRa module NRF24LO1 to analyze the power transmission operation period. On the bias of data transferred, the average power transmission varies by 14-18% lower. The data transmission observed at outdoor conditions, the range of distance is 1Km and the Indoor observation range is 400m.

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