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IoT Enabled Wind Turbine Data Monitoring System using LoRa

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ABSTRACT: The Proposedsystem investigates the utility and reports our experiences of deploying a prototype wind-turbine monitoring solution based on the recently developed low power wide area network (LPWAN) technology named Lora WAN. When it comes to machine-to-machine communication having a Wireless Sensor Network (WNS) is the best option. Network should be able to support longer distance with less power consumption otherwise system becomes more economical. The proposed system has been implemented using LoRa chips having 433 MHz frequency range, these chips can't be programmed directly hence they are interfaced with ESP32 development board, these boards have all facilities to develop prototype, they have GPIOS, Wi-Fi module, dual core processor, along with LoRa chips sensors too connected to ESP boards, sensors gives the information such as voltage, current, temperature to board, these information are sent by means of packets to receiver located at distant place, while communicating open frequency band is used, the information packets after being processed at receiver dumped to centralized server which is later displayed to concerned authorities for monitoring purpose.

KEYWORDS: LPWAN, LoRa WAN, Data Monitoring, Wind Turbine.

I. INTRODUCTION

The proposed project is aimed to make use of new trends, cost effective, reliable wireless technology in the wind power plant, the new wireless transmission technology called LoRa which stands for Low Power and Long range being used to transmit various parameters such as wind speed, voltage, current, temperature etc. to the base station which is monitored by the concerned authorities to take proper actions. The system has two main components called Transmitter and Receiver, various sensors are connected to Transmitter module, LoRa transmitter chip interfaced with ESP32 module, having read the parameters with the help of sensors, information packets of LoRa are formed and sent securely through the receiver, the receiver which is interfaced with the base station receives the information packets, computing them and uploads all the read information to centralized server so that concerned authorities can monitor from any place without location barrier.

The checking framework proposed of the project can be applied to the future energy IoT framework as a result of the simplicity of usage, decreased improvement cost and assortment of uses.

Energy IoT monitoring system consists of three parts. The First is an energy IoT node that collects power generation status data from energy device, second is IoT gateway that receives and stores data from nodes at remote site, and the last is the low cost LoRa network which is support wide area networking and low cost wireless solution.

II. LITERATURE SURVEY

[1]. G. Sahitya, N. Balaji and C. D. Naidu, "Wireless sensor network for smart wind monitoring station," 2016 2nd International Conference on Applied and Theoretical Computing and Communication Technology, Bangalore, 2016, pp. 488-493. Presently developing yields are turning into an extremely tumultuous errand for the ranchers on account of the monitoring wind station. Due to operation and monitoring cost is too high. So as to beat this situation we need to receive a plan methodology which ought to be viable. The answer for this issue is by following the procedures of exactness wireless communication system.

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Wireless communication reduces the cost of material such as OFC cable and wired communication device cost.

[2]. M. Saari, A. M. bin Baharudin, P. Sillberg,S. Hyrynsalmi and W. Yan, "LoRa — A survey of recent research trends," 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2018, pp. 0872-0877.

Wireless Sensor Networks (WSN) have created at a quick pace as of late and have additionally been one of the major focal points of research in remote innovation. This fast advancement has been encouraged by the advancement of gadgets scaling down, development in execution, remote innovations, vitality proficiency, and the improvement of conventions. The sensors that gather natural data from the environment have been scaled down gratitude to the quick execution, enhancement, and scaling down innovation of the equipment. The improvements of new remote correspondence advancements and falling costs have empowered fresh out of the plastic new uses for remote sensor organize gadgets.

[3]. Tamoghna, M. Sudip, R. N. Singh, "Wireless sensor networks for agriculture: The state- of-the-art in practice and future challenges," Ad Hoc Net., Vol.4, pp.669-686, November 2006.

The emergence of Wireless Sensor Networks (WSNs) impelled another heading of research in horticultural and cultivating space. As of late, WSNs are broadly connected in different rural applications. The potential WSN applications are checked on, and the particular issues and difficulties related with conveying WSNs for improved cultivating. To concentrate on the particular prerequisites, the gadgets, sensors and correspondence strategies related with WSNs in rural applications are dissected exhaustively.

[4]. A. Augustin, J. Yi, T. Clausen, W. M. Townsley, "A Study of LoRa: Long Range & Low Power Networks for the Internet of Things," Sensors (Switzerland), Vol.16, pp.1-18, September 2016. LoRa is a since quite a while ago run, low-control, low-bitrate, remote-control or remote correspondences structure, progressed as an establishment answer for the Internet of Things: end-devices use LoRa over a lone remote ricochet to pass on to gateway(s), related with the Internet and which go about as direct expansions and move messages between these end-contraptions and a central framework server.

[5]. O. Georgiou U. Raza "Low Power Wide Area Network Analysis: Can LoRa Scale?" IEEE Wireless Communications Letters vol. 6 no. 2 pp. 162-165 2018.

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[6]. U. Raza, P. Kulkarni, and M. Sooriyabandara, "Low Power Wide Area Networks: A Survey,"LPWA systems work in0the0unlicensed0ISM groups at 169, 433, 868/9150MHz, 0and02.4 GHz relying upon0the0locale0of activity.

[7]. U. Raza, P. Kulkarni, and M. Sooriyabandara, "Low Power Wide Area Networks: A Survey," arXiv preprint arXiv:1606.07360, 2016. Most LPWA systems work in0the0unlicensed0ISM groups at 169, 433, 868/9150MHz, 0and02.4 GHz relying upon0the0locale0of activity. The0absolute most0articulated LPWA0applicants0are0SigFox, LoRa, 0Weightless, 0and0Ingenu.

[8]. Margelis, R. Piechocki, D. Kaleshi, and P. Thomas, "Low through put networks for the IoT: Lessons learned from industrial implementations," in Internet of Things (WF-IoT), 2015 IEEE 2nd World Forum on, pp. 181–186, IEEE, 2015. The emphasis is on LoRa 0(Long Range), a standout amongst0the best encouraging wide-zone IoT advances proposed by Sem-tech and further advanced by the LoRa Alliance.

III. WORKING

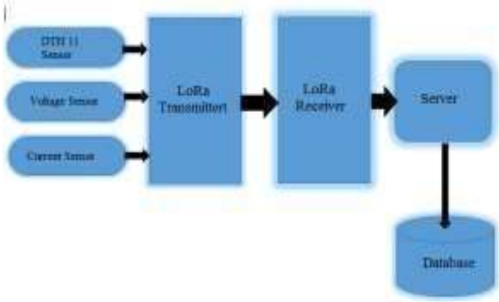

Fig 1: System Architecture

The Fig 1 shows the architecture diagram. DHT11 sensor fetches the temperature and humidity values, Voltage sensor gives the value of voltage in volt, current sensor gives the value of current in Amps. This in turn sends the data to LoRa devices create a wireless data communication network. Further a server can be used to dump the data into the database.

The system has two main components called Transmitter and Receiver, various sensors

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are connected to Transmitter module, Lora transmitter chip interfaced with ESP32 module, having read the parameters with the help of sensors, information packets of Lora are formed and sent securely through the receiver, the receiver which is interfaced with the base station receives the information packets, computing them and uploads all the read information to centralized server so that concerned authorities can monitor from any place without location barrier.

IV. COMPONENTS

ESP32 MODULE:

It provides power supply is of about 5V through USB. The ESP32 is good option for peer-to-peer connection without the need of an access point supports Wi-Fi Direct as well.

V. IMPLEMENTATION

1. LoRa sending kit which shows the interconnection between LoRa device, ESP 32, DHT11 sensor and voltage and current sensor.

Fig-1 LoRa sending kit

2. LoRa receiving kit which shows LoRa device connected with ESP32 device.

Fig-2 LoRa receiving kit

3. Complete Model which is showing Wind turbine data monitoring.

Fig 3- Implementation Final Model

ADVANTAGES:

- Since open frequency band is used for communication,it does not cost anything hence it's economical.
- Maintenance of wireless media does not require any extra resources when new base station is added.
- Lora consumes less energy and supports longer range of communication.
- It has web enabled dashboard to display plants parameters, which helps authorities to take right decisions based on the parameters.

DISADVANTAGES:

- This system doesn't support longer distance more than 1km unless WAN is used.

VI. RESULT SNAPSHOTS:

Fig-1.Serial monitor screen showing the packets sent by LoRa sender.

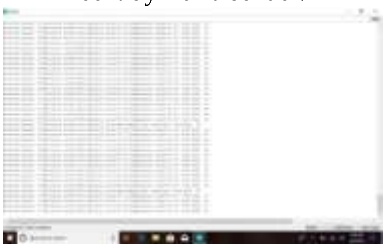

Fig-2.Serial monitor screen showing the packets received by LoRa device.

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Fig -3.Android application screen

which shows various parameters details being fetched from sensors.

VII. CONCLUSION:

The proposed prototype makes use of LoRa technology to share sensor data via wireless network, it finds useful in the field where machine to machine communication by sharing data plays important role. The proposal project reads the parameters such as voltage, current, temperature, humidity from wind turbine and updates all information to base station which is associated with LoRa Transmitter. Further data is sent to the Receiver at 433MHZ frequency by means of encoded packets, these packets are decoded at receiver and populated to database for further decision.

REFERENCES:

[1] G. Sahitya, N. Balaji and C. D. Naidu, "Wireless sensor network for smart wind monitoring station," 2016 2nd International Conference on Applied and Theoretical Computing and Communication Technology, Bangalore, 2016, pp. 488-493.

[2] M. Saari, A. M. bin Baharudin, P. Sillberg, S. Hyrynsalmi and W. Yan, "LoRa — A survey of recent research trends," 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2018, pp. 0872-0877.

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[6] U. Raza, P. Kulkarni, and M. Sooriyabandara, “Low Power Wide Area Networks: A Survey,” arXiv preprint arXiv:1606.07360, 2016.

[7] G. Margelis, R. Piechocki, D. Kaleshi, and P. Thomas, “Low throughput networks for the IoT: Lessons learned from industrial implementations,” in Internet of Things (WF-IoT), 2015 IEEE 2nd World Forum on, pp. 181–186, IEEE, 2015.

[8] L. Vangelista, A. Zanella, and M. Zorzi, “Long-Range IoT Technologies: The Dawn of LoRa,” in Future Access Enablers of Ubiquitous and Intelligent Infrastructures, pp. 51–58, Springer, 2015.