iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VIII **Month of publication:** August 2020

DOI: https://doi.org/10.22214/ijraset.2020.30895

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VIII Aug 2020- Available at www.ijraset.com

Survey of LoRa Technology in Agriculture IoT

Sayali Makone[1], Dr. D. G. Khairnar[2], Trupti Wagh[3]
[1, 2, 3]*Department of Electronics and Telecommunication, D.Y.Patil College Of Engineering, Akurdi, Pune, India.*

Abstract: ***Wireless signals have proved to be vital part in the field of Internet of Things (IoT). Various smart applications can be developed using wireless sensors and equipment for making the systems remotely accessible. Mobile signals, data transmission application and specific wireless protocol are playing important role in IoT applications. Wireless technology helps us for Smart home automation, Industrial Automation, Automobile automation, Smart Agriculture etc. In smart agriculture systems, various field sensors such as soil sensor, moisture sensor, sprinkler system, temperature sensors etc are implanted throughout large field area. In such cases the wireless sensors and data transmission plays vital role in saving time and energy, monitoring the large area without physical contact. Various processors can be used to detect, analyse and process this sensor data. However, it is necessity of the time to get reliable, low cost and effective communication network. In remote or rural areas, for effective communication proper wireless protocol is basic requirement. At present Bluetooth, ZigBee, RFID, Wi-Fi, LoRaWAN and many more application specific wireless protocol are available in the market. The survey of latest wireless communication technology that can be used with IoT i.e. Features of LoRa technology and comparative study of similar wireless technology has been proposed in this paper.***

Keywords: Bluetooth, ZigBee, Wi-Fi, LoRaWAN, LPWAN, IoT, Sensors

I. INTRODUCTION

The availability of wireless protocol has enhanced the feasibility of smart systems in the field of automation. The wireless protocols are used in a wireless sensor network system for the transmission of data signals to and from sensors and actuators to main controller. Smart Agriculture is a system where different types of sensors and controllers (IoT) data is collected to manage crop and field parameter monitoring sensors effectively and precisely. Numerous and different field implanted sensors are required to be monitored in the farm.

The value determination by field sensors is so precise that human intervention and experiment can take much longer time to match such kind of data accuracy that to with traditional methods. The IoT system can be controlled remotely through cloud platform, webpage, android application or processor connected compatible device. The data can be collected, examined and even the actuators on field can be controlled through such systems. In the system described here, data from several nodes is transmitted and received multiple times through specific wireless protocol.

Sending the data at a long distance using any of the wireless technology plays vital role in applications such as smart parking sensors, wireless drones, traffic signal monitoring, automated water meter reading, home automation, security systems and surveillance systems, Industrial monitoring and control.

In fact, any application that uses internet for data transfer, needs low power long range wireless technologies which will be beneficial for IoT Applications. However, for the farming areas which are generally based in rural or remote locations it is necessary to get reliable network at low cost. Conventional RF transmission techniques using AFSK and ASK, Zigbee and wifi, are being used for such kind of smart agriculture system.

These technologies have promising data transfer rate and long transmission range however they require efficient and high-power backup as compared to LoRa or LoRaWAN transceiver modules, GSM module or LTE are few more options however farmer can't rely on these options in India, due to poor network connectivity and high network maintenance cost. The main limitation here is the dependency on the network service provider and operator charges.

These limitations are not favourable for an application of data transfer with low power, long range wireless data transmission where devices are operated on battery or discrete power supply. Significant output has been shown by LoRaWAN in recent studies for constructing such IoT systems with low power network.

II. LITERATURE SURVEY

A. D. Davcev, K. Mitreski, S. Trajkovic, V. Nikolovski and N. Koteli, *"IoT agriculture system based on LoRaWAN," 2018 14th IEEE International Workshop on Factory Communication Systems (WFCS), Imperia, 2018, pp. 1-4, doi: 10.1109/WFCS.2018.8402368.*

Innovative, power efficient and highly scalable IoT agricultural system has been proposed in this system. LoRaWAN network has been used here for long range and low power consumption data transmission from the sensor nodes to the cloud services. For analytics purposes data stream has been utilized by the system of cloud services which are highly scalable. This paper shows the useful methods that can be used in smart agriculture system with the help of LoRa technology. The sensor nodes are connected with LoRa modules in order to transfer the sensor data to the processing system, in order to upload it on cloud platform.

B. *C. Bouras, A. Gkamas, V. Kokkinos and N. Papachristos, "Using LoRa Technology for IoT Monitoring Systems," 2019 10th International Conference on Networks of the Future (NoF), Rome, Italy, 2019, pp. 134-137, doi: 10.1109/NoF47743.2019.9014994.*

Rescue monitoring system has been proposed here which dies the comparative study of various scenarios for IoT.WiFi & LoRa as wireless technologies have been compared initially, however the end devices require high power consumption for processing and thus there is requirement of low power network technologies. LoRa based gateway and WiFi Router is used to connect the end-devices have been connected by using used in our scenarios to the Internet. Experiments carried out on real time basis indicate that LoRa could be an ideal option for building smart rescue monitoring. For building the ecosystem with rescue concepts this study is beginning of development and use of LoRa technology in this area, by making combine use of various software and hardware.

C. *S. C. Gaddam and M. K. Rai, "A Comparative Study on Various LPWAN and Cellular Communication Technologies for IoT Based Smart Applications," 2018 International Conference on Emerging Trends and Innovations In Engineering And Technological Research (ICETIETR), Ernakulam, 2018, pp. 1-8.doi: 10.1109/ICETIETR.2018.8529060.*

This paper explains the importance and use of recent wireless technology, LPWAN. LPWAN which is Low Power Wide Area Networks has proved to be beneficial in designing various IoT systems.The concept of IoT is kept in mind while designing the new devices these days, due to increase in it's demand by the people. The requirement of an automation has been understood and preferred by people which has increased the need of development in this field. This gave rise to study of wireless technology evaluation.

This paper shows the WAN technology study, of LPWAN which uses wireless network and requires very low power supply. It also provides the long range communication, providing low bit rate and using low bandwidth. The usage of Internet of Things (IoT) technology in device designing is increasing rapidly. (LPWAN) is popular and leading technology created for IoT networks. LPWAN is wireless based WAN technology that enables Low power consumption, long range, lower bandwidth with low bit rates.

The leading low power technologies with wide area network such as LoRa, sigfo x, NB-IoT, LTE-M are useful for developing IoT networks. By keeping these technologies as reference, the comparison study has been presented in this paper. The parameters such as network coverage, cost of maintenance, life span of battery, security of network and network range have been discussed thoroughly.

The virtues and limitations also have been presented of LPWAN technology. The real time scenarios have been considered while presenting this study and the details of the best technology among the compared ones has been also given by the author for IoT smart applications.

D. *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, doi: 10.23919/MIPRO.2018.8400161.*

This study focuses on the new communication technology called LoRaWAN. Evaluation of the LoRaWAN technology in the field of IoT has been done, and especially in sensor network solutions. systematic literature review has been presented in this case study, in the methodology section. More than fifty suitable research papers were identified. Certain questions based on LoRaWAN study were formulated. Most recent and practical applications of LoRa have been revealed. This study has given give recommendations to the researchers and practitioners on how the LoRa-based technologies are beneficial and can be exploited fully in enhancement of IoT solutions and development of IoT systems.

E. A. Lavric and V. Popa, "Internet of Things and LoRa™ Low-Power Wide-Area Networks: A survey," 2017 International Symposium on Signals, Circuits and Systems (ISSCS), Iasi, 2017, pp. 1-5, doi: 10.1109/ISSCS.2017.8034915.

Review of the challenges and the obstacles has been presented in this paper regarding LoRa technology with reference to IoT systems. Lot of effort has been put on the study of high-density sensor networks which are used as part of the IoT (Internet of Things) concept and new solutions have been analysed related to it. Long-range transfer of information is enabled by LoRa modules, with a low transfer rate. Considering the requirements this paper presents the evaluation of the LoRa technology in the field of IoT.A discussion of main obstacles faced during IoT development is done here. The details of challenges faced and requirement of solution for various problems in WSN research have been discussed. Architecture requirements of LoRaWAN communication protocol have been discussed along with the evaluation of LoRa modulation performance.

III. LITERATURE OVERVIEW

The literature survey done from all the above-mentioned research papers, indicates that there is wide scope of using LoRa technologies in various smart IoT systems. It also indicates that LoRaWAN is beneficial low power protocol that can be implemented for smart agriculture IoT systems. The study proves that LoRa technology is comparatively rapid and secure as compared to other technologies and can be used over long distance. Specific modules have been considered here for comparative study of these technologies. Parameters like Transmission Range, transmission rate, transmission power, sleep power and Cost have been considered for study purpose.

TABLE 1 – COMPARISON OF WIRELESS TECHNOLOGIES

	Tx Range	Tx Rate	Tx Power	Sleep Power	cost
Bluetooth (FBT06)	15 m	3 Mbps	20 mA	16 uA	low
Wifi (CC3200)	150 m	3 Mbps	75 mA	3.5 mA	high
3G/4G (U8300)		14 Mbps	800 mA	50 uA	high
ZigBee (REX3DP)	100-200 m	250 Kbps	200 mA	0.4 uA	low
LoRa (SX1278)	3000 m	2.4 Kpbs	110 mA	2.0 uA	low

IV. PROPOSED METHODOLOGY

Recently many researchers have proposed smart agriculture systems using LoRa or LoRaWAN technologies. Here we are going to study the benefits of using LoRa technology in various IoT systems and will learn the limitations as well in order to overcome them in future studies. The improvement in connectivity of smart agriculture devices can be achieved using observation and comparison.

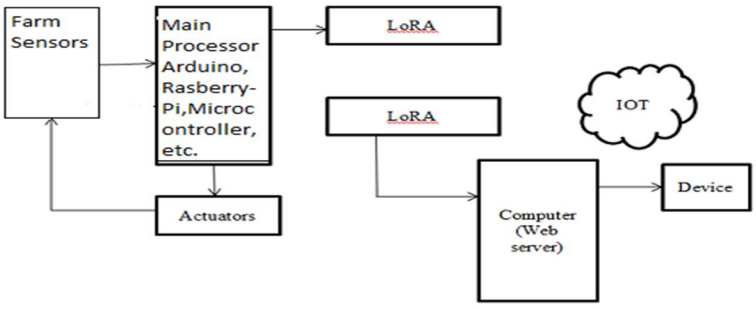


Fig.1 Block Diagram of Agriculture IoT System

The LoRaWAN communication enables transmission and reception of data from sensors to webpage and from webpage to actuators. This is where LoRaWAN plays its vital role. We are using LoRaWAN to make sure that the sensor data from field is successfully uploaded on cloud platform, which is here reliably done by LoRaWAN and thus remote access and controlling of this smart agriculture system is possible through IoT.

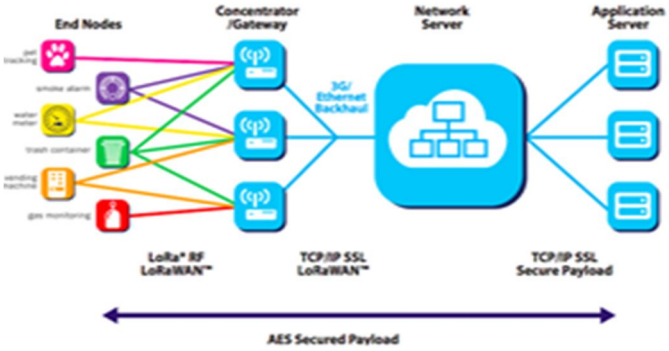


Fig. 2 LoRa in IoT system

The end nodes are various types of sensors which collect data from field area. The connector or gateway are the ones which receive sensor data which are embedded or connected to our LoRaWAN transceiver module. Network server can distribute this data received at gateway throughout the web network by using either LoRa or any kind of internet connection. Certain application servers are able to analyse and process data for display and further use of controlling the end nodes. This can be achieved by applying different techniques of machine learning and artificial intelligence. This is how the LoRa based Iot system works. The data is secured by AES algorithm. Lora uses free range RF frequency between range of 865MHz-867 MHz.

V. RESULT AND ANALYSIS

Using LoRa based Iot systems in agriculture can solve the limitation of poor internet network in affected areas. Also the maintenance cost of system decreases due to selection of economical and reliable LoRa technology Various modules are available in the market at affordable price which makes the system economical as well. From literature review we can learn various features of this technology and can build the IoT system accordingly. Comparison result indicates various aspects of wireless protocol and for low power application such as data reception from sensor, LoRa technology is preferable.

TABLE 2 – LORA TECHNOLOGY FEATURE

Sr. No.	LoRa and LoRaWAN feature	LoRa and LoRaWAN Feature Details
1	Low Cost	Reduction of cost by3 ways: infrastructure investment, operating expenses, end node sensors.
2	Standardized	Enhanced speed adoption of global interoperability and roll out of LoRaWAN based network and IoT Applications.
3	Low Power	Designed for low power consumption to extend battery lifetime upto more than 10 years.
4	Secure	End-to end AES128 encryption is embedded.
5	High Capacity	Can support millions of messages per base station.
6	Long Range	Can connect upto 2-5 km in dense areas and upto 10km in suburb area.

VI. CONCLUSIONS

The use of LoRa technology in IoT systems can bring positive difference in the efficiency of systems by reducing its maintenance cost and ensuring the sensor data transmission the to cloud platform without major network issues. The possibility and ease of setting up such smart systems in remote areas can become more easier by using the compatible modules of LoRaWAN and LoRa technolgy. According to the comparative study done, LoRa technology has many benefits over similar type of technologies such as Wifi, bluetooth, GSM etc. due to its low cost and long-range data transmission capacity. Use of IoT system in agriculture can enhance the crop yield of farmer and reduce tremendous efforts related to field monitoring.

REFERENCES

[1] D. Davcev, K. Mitreski, S. Trajkovic, V. Nikolovski and N. Koteli, "IoT agriculture system based on LoRaWAN," 2018 14th IEEE International Workshop on Factory Communication Systems (WFCS), Imperia, 2018, pp. 1-4, doi: 10.1109/WFCS.2018.8402368.

[2] Haxhibeqiri, Jetmir & De Poorter, Eli & Moerman, Ingrid & Hoebeke, Jeroen. (2018). A Survey of LoRaWAN for IoT: From Technology to Application. Sensors. 18. 3995. 10.3390/s18113995.

[3] C. Bouras, A. Gkamas, V. Kokkinos and N. Papachristos, "Using LoRa Technology for IoT Monitoring Systems," 2019 10th International Conference on Networks of the Future (NoF), Rome, Italy, 2019, pp. 134-137, doi: 10.1109/NoF47743.2019.9014994.

[4] A. Lavric and V. Popa, "Internet of Things and LoRa™ Low-Power Wide-Area Networks: A survey," 2017 International Symposium on Signals, Circuits and Systems (ISSCS), Iasi, 2017, pp. 1-5, doi: 10.1109/ISSCS.2017.8034915

[5] 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, doi: 10.23919/MIPRO.2018.8400161.

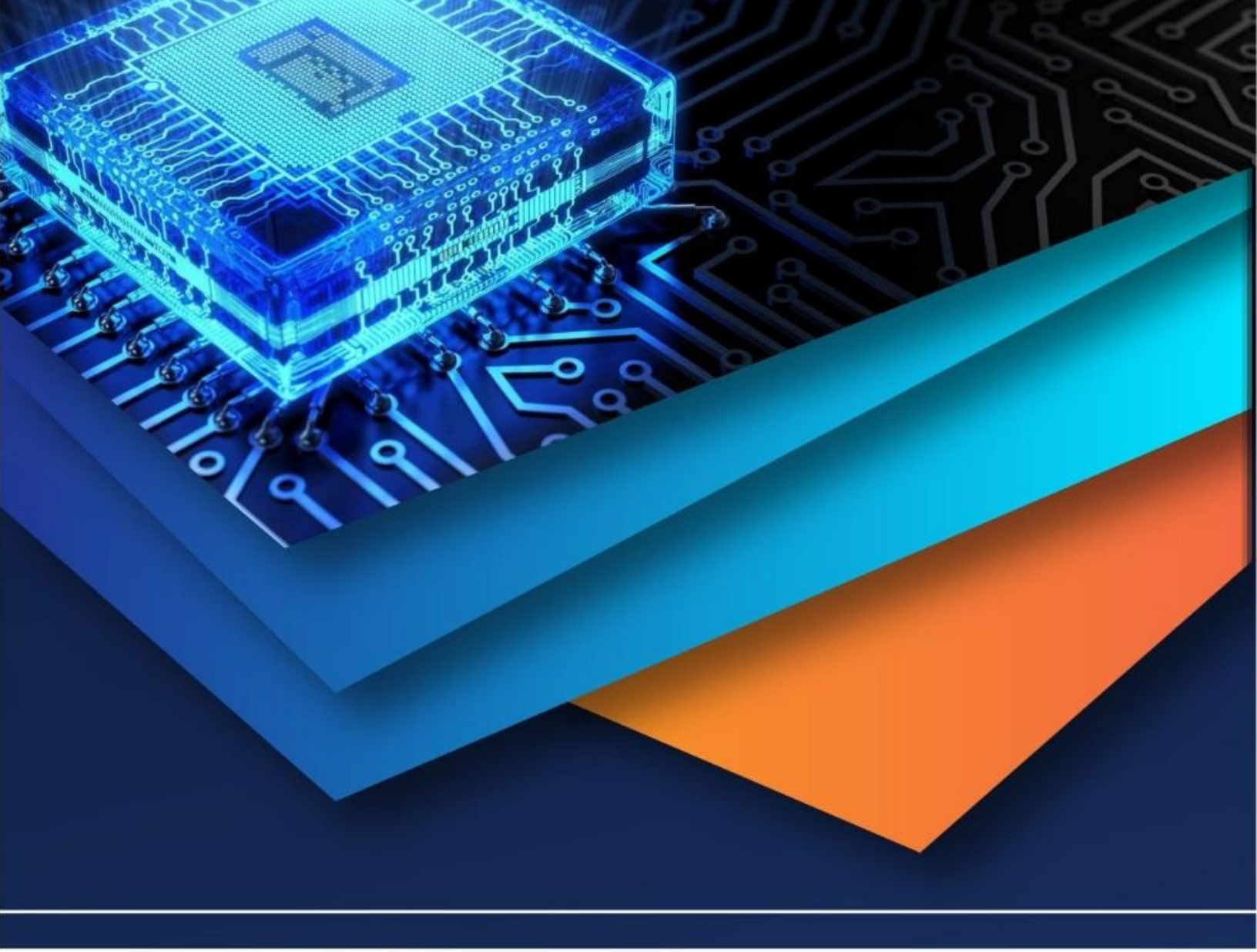
[6] Dr. M. Newlin Rajkumar, S. Abinaya, Dr. V. Venkatesa Kumar "Intelligent irrigation system – an iot based approach" IEEE International Conference on Innovations in Green Energy and Healthcare Technologies (ICIGEHT'17), 978-1-5090-5778-8/17/$31.00©2017 IEEE. [4] Shweta Bhatia, Sweety Patel, "Analysis on different Data mining Techniques and algorithms used in IOT", ISSN: 2248-9622, Vol. 5, Issue 11, (Part - 1) November 2015, pp.82-85.

[7] Nguyen Cong Luong, Dinh Thai Hoang, Ping Wang, Dusit Niyato, Dong In Kim, and Zhu Han "Data Collection and Wireless Communication in Internet of Things (IoT) Using Economic Analysis and Pricing Models: A Survey" arXiv:1608.03475v1 [cs.GT] 11 Aug 2016.

[8] Dr. N. Suma, Sandra Rhea Samson, S. Saranya, G. Shanmugapriya, R. Subhashri "IOT Based Smart Agriculture Monitoring System" IJRITCC | February 2017.

[9] Prof. D.O.Shirsath, Punam Kamble, Rohini Mane, Ashwini Kolap, Prof.R.S.More, "IOT Based Smart Greenhouse Automation Using Arduino", International Journal of Innovative Research in Computer Science & Technology (IJIRCST) ISSN: 2347-5552, Volume-5, Issue-2, March 2017 DOI: 10.21276/ijircst.2017.5.2.4

[10] Prof. K. A. Patil, Prof. N. R. Kale "A Model for Smart Agriculture Using IoT" IEEE | December 2016.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY