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SMART AGRICULTURE USING LORA SYSTEM: A REVIEW

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ABSTRACT

Given the world's population, it is critical touse water resources wisely and increase the quantity and quality of agricultural goods. Smart systems offer intriguing solutions to the mentioned problem. Wi-Fi modules and GSM-supplied smart irrigation systems have been published in literature. But while GSM-enabled smart irrigation systems struggle with power consumption, Wi-Fi- enabled smart irrigation systems struggle with a constrained coverage area. In addition to having a great coverage range, LoRa uses little power and can run for up toten years on a single battery. To improve thequality of irrigation systems, a smart irrigation system with LoRa connectivity hasbeen proposed in this study.

I. INTRODUCTION

In recent years, agriculture has witnessed a transformation driven by advancements in technology, particularly through the integration of Internet of Things (IoT) solutions. These technologies offer unprecedented opportunities to optimizeagricultural practices, improve resource management, and enhance productivity. One such innovative approach is the implementation of a smart agriculture system utilizing LoRa (Long Range) technology.

Traditional agricultural methods often rely on manual labor and periodic assessments, which can be inefficient and prone to inaccuracies. With the global population expected to reach 9 billion by 2050, the pressure on agriculture to increase yieldssustainably is greater than ever. Smart agriculture addresses these challenges by harnessing the power of IoT to monitor, analysis, and control agricultural processes in real time.

The main idea behind this project is to use LoRa technology, which is well-known for its low power consumption and long-range wireless connectivity, making it perfect for large-scale agricultural applications. Farmers may learn important characteristicslike soil moisture levels, temperature fluctuations, humidity levels, and light intensity by installing a network of LoRa- enabled sensors throughout the farm. A centralized LoRa gateway receives wireless communication from these sensors, gathers data, and sends it to a cloud-based platform for analysis and storage.

The data collected from these sensors empowers farmers to make informed decisions promptly. For instance, by adjusting irrigation schedules based on real- time soil moisture readings or deploying pest management strategies in response to environmental conditions. This proactive approach not only optimizes resource usage but also enhances crop health and yield.

II. LITERATURE REVIEW

LoRa Farm: A LoRa WAN-Based SmartFarming Modular IoT Architecture" - This paper discusses a modular IoT platform based on LoRaWAN for smart farming. It focuses on collecting and analyzing environmental data (like soil and air temperature, and humidity) to improve farmmanagement. The platform was tested in a real farm setting, demonstrating its potentialto enhance agricultural processes.[1]

"Smart Irrigation System for Farm Application Using LoRa Technology" - This research reviews the implementation of asmart irrigation system utilizing LoRa technology. It highlights how the system canoptimize water usage by monitoring soil moisture and adjusting irrigation accordingly, promoting efficient and sustainable farming practices.[2]

"LoRa-based Novel System for Smart Agriculture" - This paper presents a system that uses LoRa technology to improve agricultural productivity and sustainability. It discusses the integration of sensors and IoT devices to monitor various parameters such as soil moisture, temperature, and crophealth.[3]

"Design, Implementation, and Empirical Validation of an IoT Smart Irrigation System for Fog Computing Applications Based on LoRa and LoRaWAN Sensor Nodes"- The system is designed to optimize water usage in agriculture, ensuring efficient and sustainable irrigation practices. The study covers the architecture,

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implementation, and empirical testing, demonstrating the system's capability to provide reliable communication over long distances with minimal energy consumption. By integrating various sensors and leveraging fog computing, the system can process and analysis data locally, reducing latency and improving decision- making in irrigation management. The results indicate significant potential foragricultural applications. [4]

"An Intelligent LoRa-Based Wireless Sensor Network Mesh Architecture to Improve Precision Agriculture" The study aims to demonstrate how the convergence of multiple parts of agricultural demands works together to synchronize computational capabilities offered by ML models and data created through the use of IoT sensors, which are exchanged across LoRa-based WSN networks. This research presents a three-tier architecture-based integrated system that uses ML and IoT systems to process data for yield prediction and then generates a visual representation ofthe outcome. [5]

"An IoT-Based Smart Irrigation System" Created a prototype system using Arduino microcontrollers and a Raspberry Pi. When compared to a timer-based system, the smart system used less water and made it easier to maintain a target soil moisture level.[6]

"LoRa Based IoT Platform for Remote Monitoring of Large-Scale Agriculture Farms in Chile" Using LoRa WAN technology, the suggested methods for remote plant, soil, and environmental condition monitoring have been developed, put into practice, and assessed. The platform may be used to collect useful real- time monitoring analytics that facilitate decisions and actions like controlling the irrigation system or setting off alarms, according to results from simulation and experimental validation. This work's contribution is the proposal of a modular hardware and software platform based on LoRa WAN technology that is intended for agricultural farm monitoring at variousscales.[7]

"LoRa Network Based Multi-Wireless Sensor Nodes and LoRa Gateway for Agriculture Application": This paper included three wireless sensor nodes and a single LoRa gateway According to the experimental results, the sensor node can detect environmental changes and send data to the gateway. The environmental data of soil moisture under the ground surface at 20cm ,40cm, and 60cm were more than 90% accurate when compared to the standard instrument. Furthermore, the LoRa transmitter range is roughly 600 meters (NLOS), and the LoRa gatewayautomatically transmits environmental data to cloud storage every 15 seconds.[8]

"LoRa based intelligent soil and weather condition monitoring with internet of things for precision agriculture in smart cities": The function, potential, and differentaspects of smart cities, urban farming, communication technologies, IoT, andmachine learning in agriculture are all thoroughly examined. The construction of an intelligent irrigation system based on weather and soil characteristics is explainedin the article. Theselection of the soil and climatic parameters is based on research articles in ML and Agriculture 4.0. For local weather monitoring, the method suggested in this article offers an innovative and reasonablypriced option.[9]

III. COMPARISON OF LORA WITH OTHER TECHNOLOGY

Widely used wireless communication technology called LoRa (Long Range) is designed for low-power, low-data-rate, long-range Internet of Things applications. This isa comparison of LoRa with various wireless technologies, like NB-IoT, Zigbee, and Wi- Fi, that are frequently used in Internet of Things and M2M (machine-to- machine) communications.

Features	LoRa	NB-IoT	Zigbee	Wi-Fi
Frequenc yband	ISM Band(800 - 900MHz)	LTE	2.4 GHz	2.4 - 5 GHz.
Range	2-15 km	35 km	10-100 m	50-150 m
Power consumption	low	low	low	High
Data rate	50kbps	250 kbps	250 kbps	1Gbps
Latency	Medium	low	low	Very Low
Scalability	High	high	Medium	Low
Security	AES-128 encryption	High (cellular encryptio n protocol)	AES-128 encryption.	WPA/WPA2 encryption.

IV. SYSTEM FLOWCHART

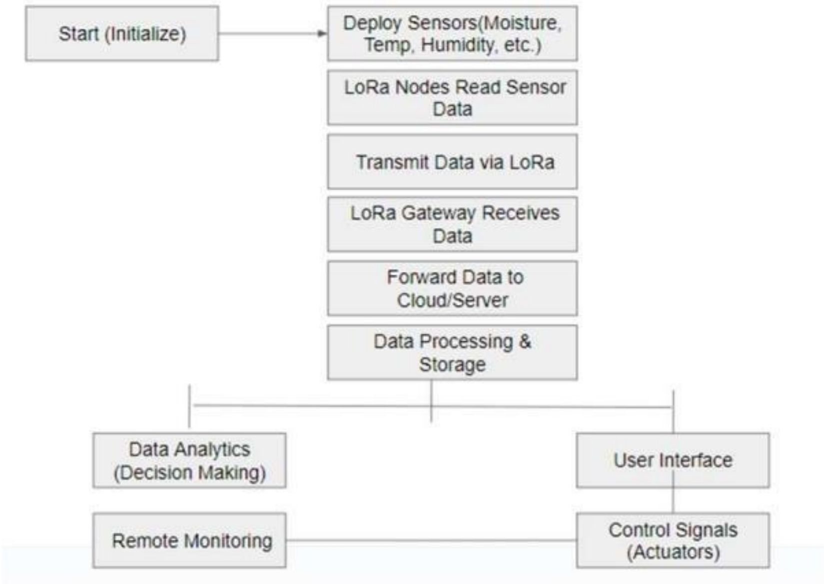

Fig: 1 System flowchart

After deploying the sensors in an agriculturalfield, you power on the system. The parameters that are measured by thesensors include soil moisture, temperature and humidity. LoRa nodes aggregate the sensor data and prime it for transmission. The LoRanodes send the data they collectto a nearby LoRa gateway via the protocol. This gateway will collect information from multiple nodes and send it to the cloud serveror local server. Data received by the IoT platform or server is processed, stored and possibly used to run analytics or initiate a process on an algorithm (e.g. decide if irrigation should be performed). It allows farmers to see real-time data on a dashboardor mobile app. With this data analysis, control signals can be sent to actuators such as irrigation pumps, cooling systems etc. This user interface can monitor and control the status of the farm from anywhere.

V. APPLICATION

IoT technology for agriculture allows efficiencies that minimize costs, maximize productivity, and reduce environmental impact, from production to tracking livestock health indicators. Use cases for LoRa-based agriculture have shown notableadvancements, including a 50% reduction in water usage for commercial farms. Because of the long-range, low-power wireless capabilities of LoRa technology, data from farms may be sent to the cloud for analysis to enhance operations using inexpensive sensors.

VI. CONCLUSION

The way farmers monitor and manage their crops, farm animals, and resources was completely transformed by the addition of LoRa technology into smart agriculture. The potential of LoRa-based systems to improve agricultural productivity, efficiency, and sustainability has been highlighted in this review paper.

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