LORA AGRI: SMART AGRICULTURAL AUTOMATION AND SECURITY SYSTEM WITH RENEWABLE ENERGY INTEGRATION

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College : *GM Institute of Technology, Davanagere*
Branch : *Department of Electronics and Communication Engineering*
Guide(s) : *Prof. Veena H T*
Student(s) : *Ms. Shaista Jabeen K S*
Ms. Suhana F Kanamani
Ms. Saniya

Keywords:
Smart Agriculture System, Internet of Things (IoT), LoRa Communication, Environmental Monitoring, Soil Moisture Sensors, GSM Alerts, Agricultural Automation.

Introduction:
Agriculture is essential to many economies but faces challenges like environmental monitoring, crop health and field security. This project, “LoRa Agri,” presents a low-power, long-range system using a multi-node architecture with LoRa SX1278. It includes sensor nodes for monitoring soil moisture, fire, temperature, humidity and intrusion, along with a master node for data collection and cloud upload. A GSM module sends alerts during critical events. The system is energy-efficient, scalable and supports smart, safe and sustainable farming.

Objectives:
1. To design a multi-node agricultural monitoring system using distributed sensor nodes.
2. To establish long-range wireless communication using the LoRa SX1278 module.
3. To monitor key parameters such as soil moisture, temperature, humidity, fire and intrusion.
4. To develop a Master Node for data collection and cloud-based monitoring.
5. To implement SMS alerts using the SIM800L module for emergency conditions.

Methodology:
The proposed system is a smart agricultural monitoring solution using IoT and LoRa technology for large and remote farms. It uses ESP8266-based sensor nodes to collect real-time data like soil moisture, temperature, humidity, fire and intrusion, which is transmitted to a master node via LoRa SX1278. The master node processes the data, uploads it to the cloud for remote monitoring and sends SMS alerts through a GSM module during critical conditions.

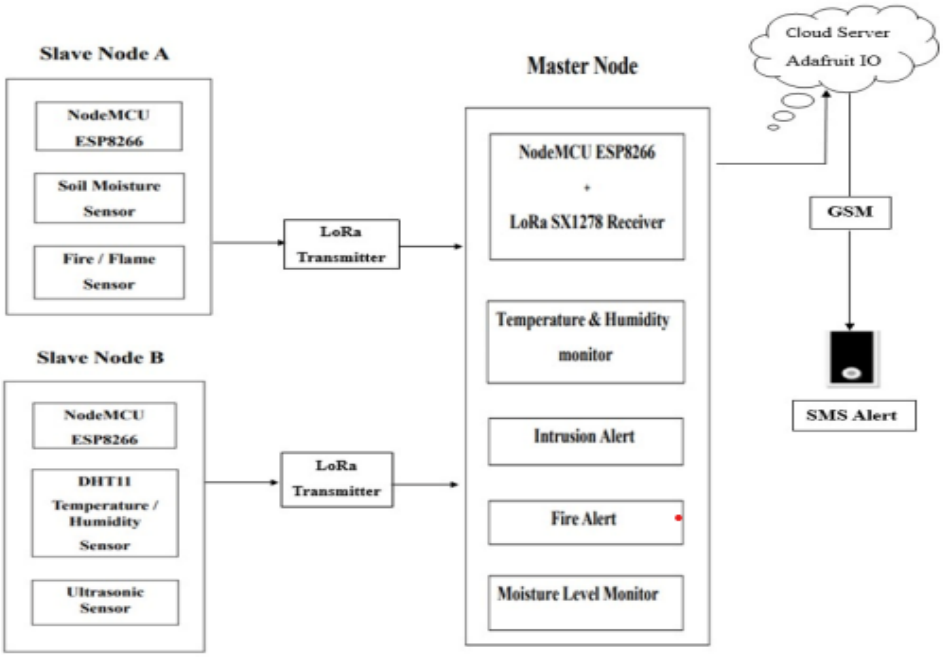
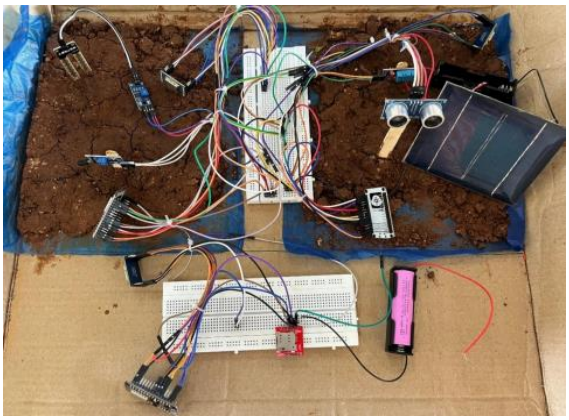


Figure 1: Block Diagram of LoRa Agri

Result and Conclusion:

The system successfully demonstrated reliable long-range monitoring, accurate sensor data collection, and real-time cloud visualization with timely GSM alerts under critical conditions.It reduces manual effort by enabling remote monitoring and quick response to field conditions.The system also shows strong potential for future upgrades toward fully automated smart farming.

Overall,it provides a low cost, energy efficient, and scalable solution that enhances agricultural productivity, safety, and smart decision making.



. Figure 2: LoRa Agri System

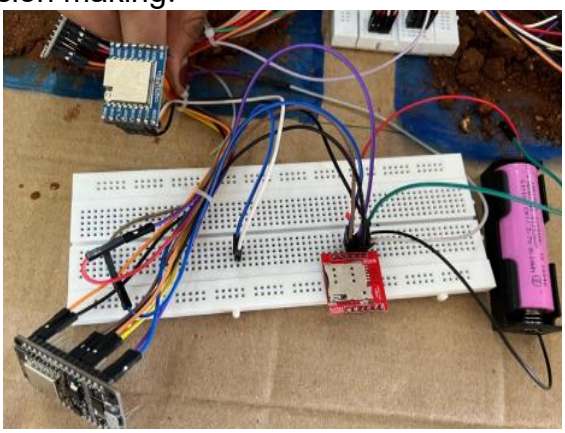
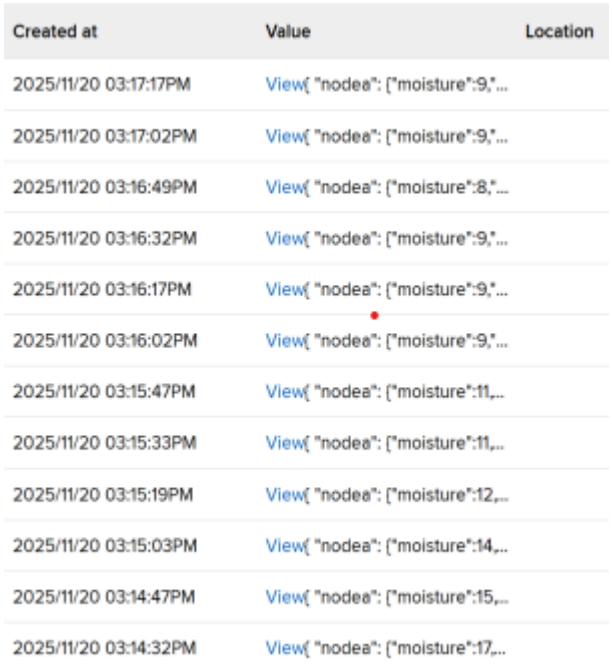


Figure 3: Master Node



Created at	Value	Location
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2025/11/20 03:16:49PM	View{ "nodea": {"moisture":8,"...	
2025/11/20 03:16:32PM	View{ "nodea": {"moisture":9,"...	
2025/11/20 03:16:17PM	View{ "nodea": {"moisture":9,"...	
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2025/11/20 03:15:47PM	View{ "nodea": {"moisture":11,...	
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Figure 4: Combined Node Output

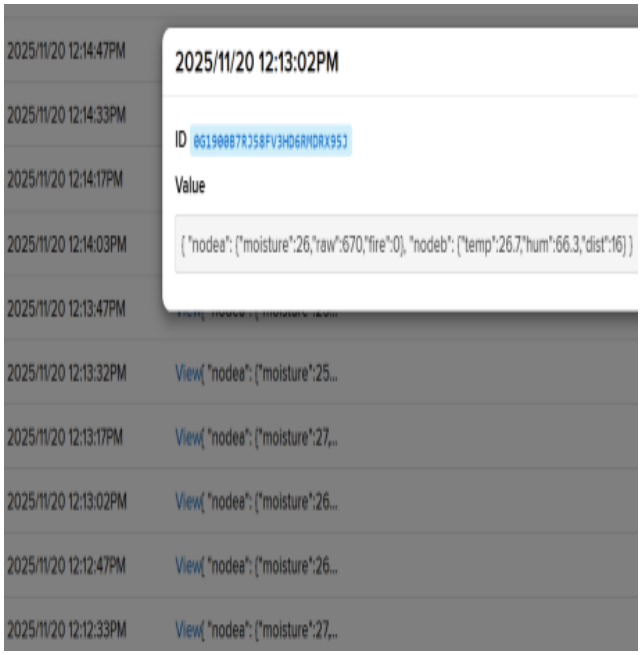

Figure 5: Combined Node Output

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Future Scope:

Although the current system performs effectively, several enhancements can be incorporated in future versions to expand its capabilities and improve performance:

1. Automatic Irrigation System Integration
2. Solar-Powered Operation
3. LoRaWAN Network Expansion
4. Advanced Sensor Integration (pH, Nutrients, CO_2)
5. Machine Learning-Based Prediction Models
6. Mobile Application Development
7. Weather API Integration for Smart Decision-Making