LoRa Based Green House Monitoring and Control System Using IoT and Fertilizer Recommendation

Project Supervisor

Prof. V. Vidhya Gowri ,
Department of ECE

Team Members

711121106059 - Paduchuri Dattukumar
711121106066 - Pranesh S
711121106069 - Priyadharshini S
711121106074 - Ramabathina Dinesh

Problem Statement : How might we develop a solution to reduce pesticide and fertilizer usage by integrating Soil Health Card data, weather data, and the Leaf Color Chart method? This app should provide farmers with precise, location-specific to optimize input usage recommendations, enhance crop health, and promote sustainable agricultural practices.

Project Guide : Prof . V. Vidhya Gowri

Team Members : 711121106069 - Priyadharshini
711121106066 - S. Pranesh
711121106059 - Paduchuri Dattukumar
711121106074 - Ramabathina Dinesh

Team Name : Agro-Optimizer

Abstract

This project proposes a distributed, multi-span greenhouse monitoring and control system using LoRa communication and IoT technology to enhance agricultural productivity. Greenhouses provide a controlled environment for optimal plant growth while protecting crops from extreme weather conditions. The system continuously monitors key environmental factors such as temperature, moisture, lighting, pressure, and humidity. Automated control of devices like exhaust fans, sprinklers, and lighting systems is implemented based on predefined logic and climate conditions. Smart Alerts notify farmers of environmental stress or hardware failures through real-time app notifications. Additionally, Automated Contingency Protocols and Weather-Linked Automation ensure proactive responses to emergencies, minimizing risks. By integrating real-time monitoring and intelligent automation, this system optimizes crop growth, improves resource efficiency, and enhances resilience against environmental uncertainties.

Literature Review

No	Journal name	Observation	Future Scope
1	LoRa WAN-based Intelligent Multi-Greenhouse Monitoring and Control (*Abdelkader Mezouarietal – 2023*)	The system uses LoRa WAN to monitor multiple greenhouses remotely, focusing on environmental conditions.	Expand the system to support AI-based predictive analytics and real-time decision-making for enhanced precision farming across larger areas or diverse crop types.
2	Monitor and Control Sensors in the Greenhouse Using LoRa Technology (*Channamma-2021*)	Implementation of LoRa technology to wirelessly monitor and control greenhouse sensors with low power usage.	Integration of machine learning algorithms to predict environmental changes and automate decision-making, improving crop productivity and resource management in diverse climates.

Literature Review

No	Journal name	Observation	Future Scope
3	Intelligent Agriculture Greenhouse Environment Monitoring System Based on IoT Technology (*LIU Dan, Cao Xin – 2015*)	This system utilizes IoT technology to monitor key environmental parameters like temperature, humidity, and soil moisture in real-time, allowing for better control of greenhouse conditions.	Future development could include integrating predictive analytics using machine learning algorithms to forecast environmental changes, automating control systems, and expanding scalability to larger agricultural fields.
4	Leveraging LoRa WAN Technology for Precision Agriculture in Greenhouses (*Ritesh Kumar Singh – 2020*)	Focused on using LoRa WAN to improve data transmission reliability for real-time monitoring in greenhouses.	Integrate weather forecasting models and AI-based decision systems to proactively control greenhouse conditions, optimizing agricultural outputs and reducing resource consumption.

Existing Method

- Existing methods for addressing challenges in greenhouse farming include manual monitoring, where farmers check environmental conditions themselves, and traditional sensors that provide basic data on temperature, humidity, and soil moisture.

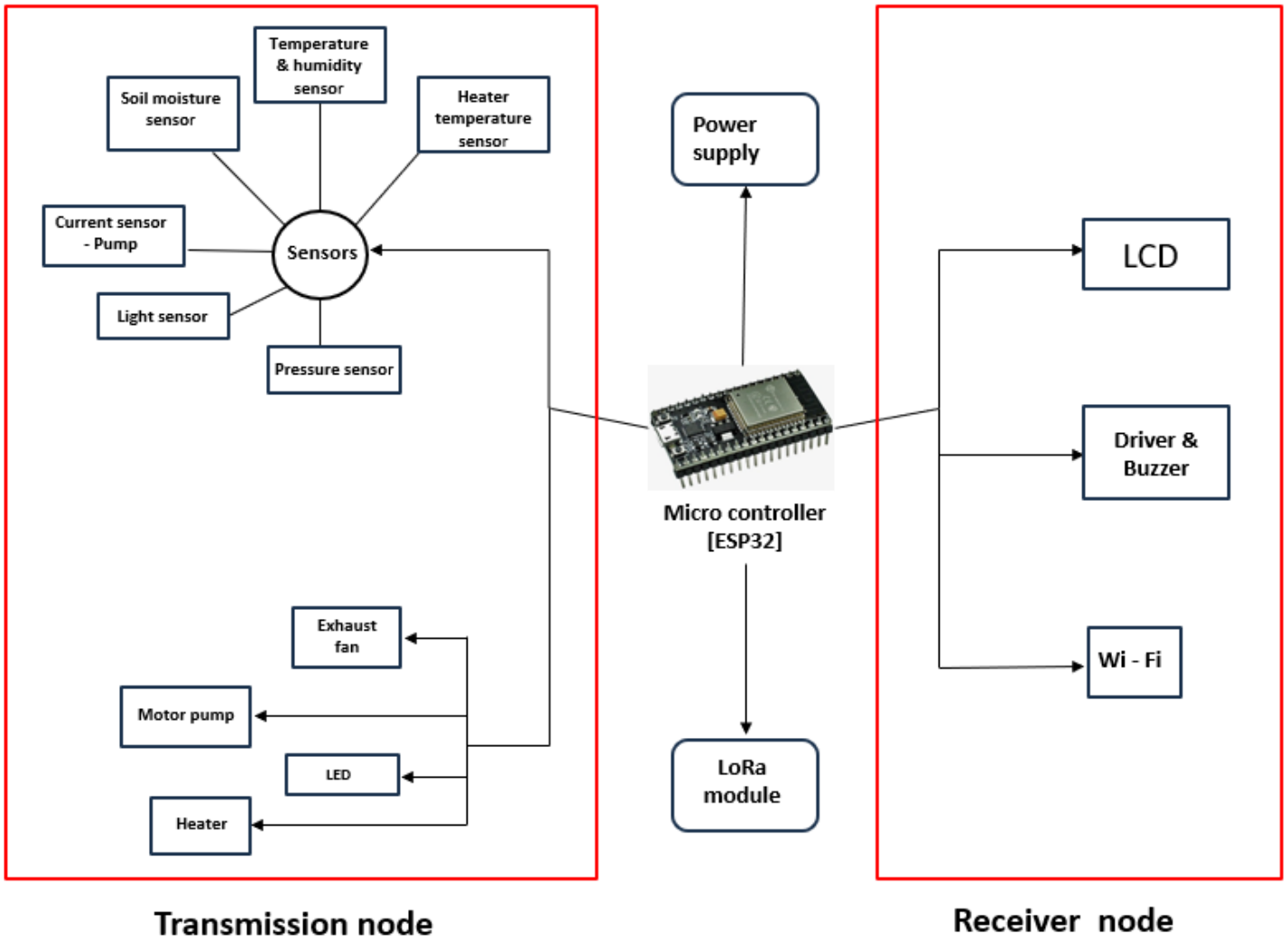
- Automated control systems can adjust conditions based on preset thresholds but often lack integration with weather forecasts. IoT-based monitoring allows for real-time data collection, though many systems do not leverage predictive analytics. Weather data integration provides some support for adjustments, but it typically relies on basic forecasts.

- Cloud-Dependent IoT Systems: Some IoT-based systems rely heavily on cloud processing for decision-making, which can cause delays and inefficiency, especially in areas with unreliable internet connectivity.

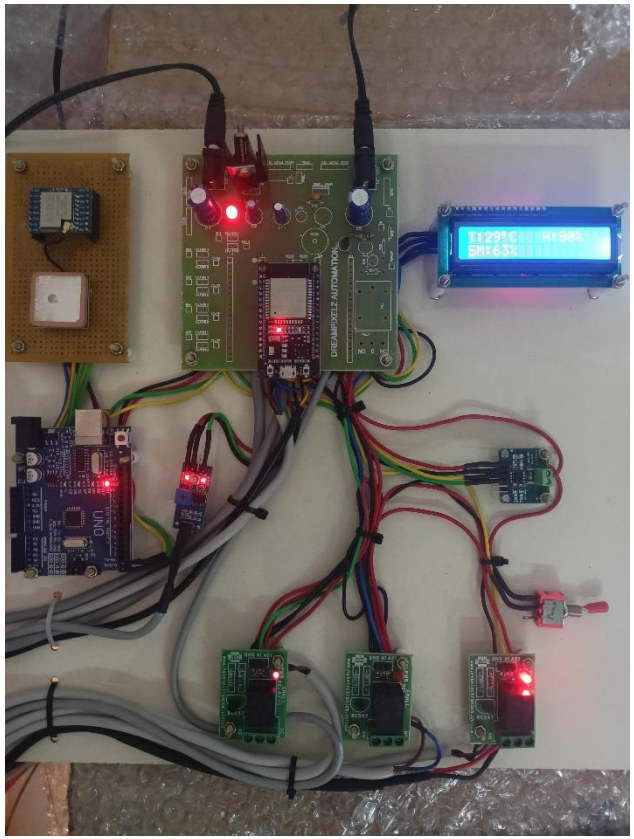
Proposed method

This LoRa-based Smart Greenhouse Monitoring and Control System leverages IoT technology to enhance agricultural productivity through real-time environmental monitoring and automated control. The system consists of a Transmission Node embedded with multiple sensors—temperature, humidity, soil moisture, light, and pressure—that continuously monitor greenhouse conditions. An ESP32 microcontroller processes these sensor readings and operates actuators such as the exhaust fan, motor pump, heater, and LED lights based on predefined thresholds. The LoRa module ensures long-range wireless transmission of data to the Receiver Node, where the information is displayed on an LCD screen for real-time observation. Additionally, Wi-Fi connectivity enables cloud-based remote monitoring, while an integrated buzzer and alert system notify farmers of critical environmental changes. With Automated Contingency Protocols and Weather-Linked Automation, the system proactively adapts to climatic conditions, optimizing resource usage, reducing manual intervention, and fostering sustainable smart farming practices.

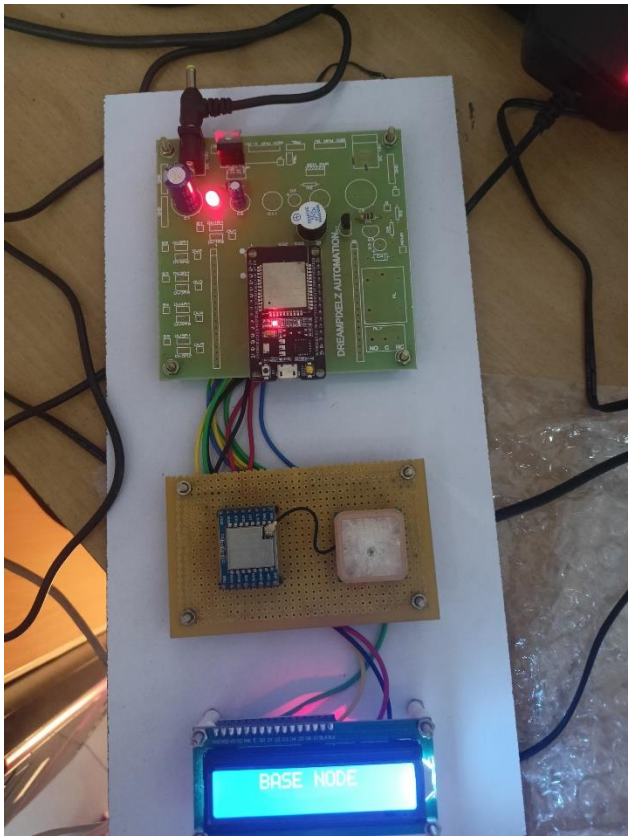
Block Diagram



HARDWARE DESIGN



Transmitter Node



Receiver Node

HARDWARE SIMULATION RESULTS

Transmitter Node

Showing data's which is received from sensor

Showing status of Actuators

Showing Failure status of Actuators

The transmitter node is sending a data collected from sensors and actuators to receiver node

HARDWARE SIMULATION RESULTS

Receiver Node

Receiving data from Transmitter Node

Showing the data's which is received from Transmitter node

Indicating the failure happened

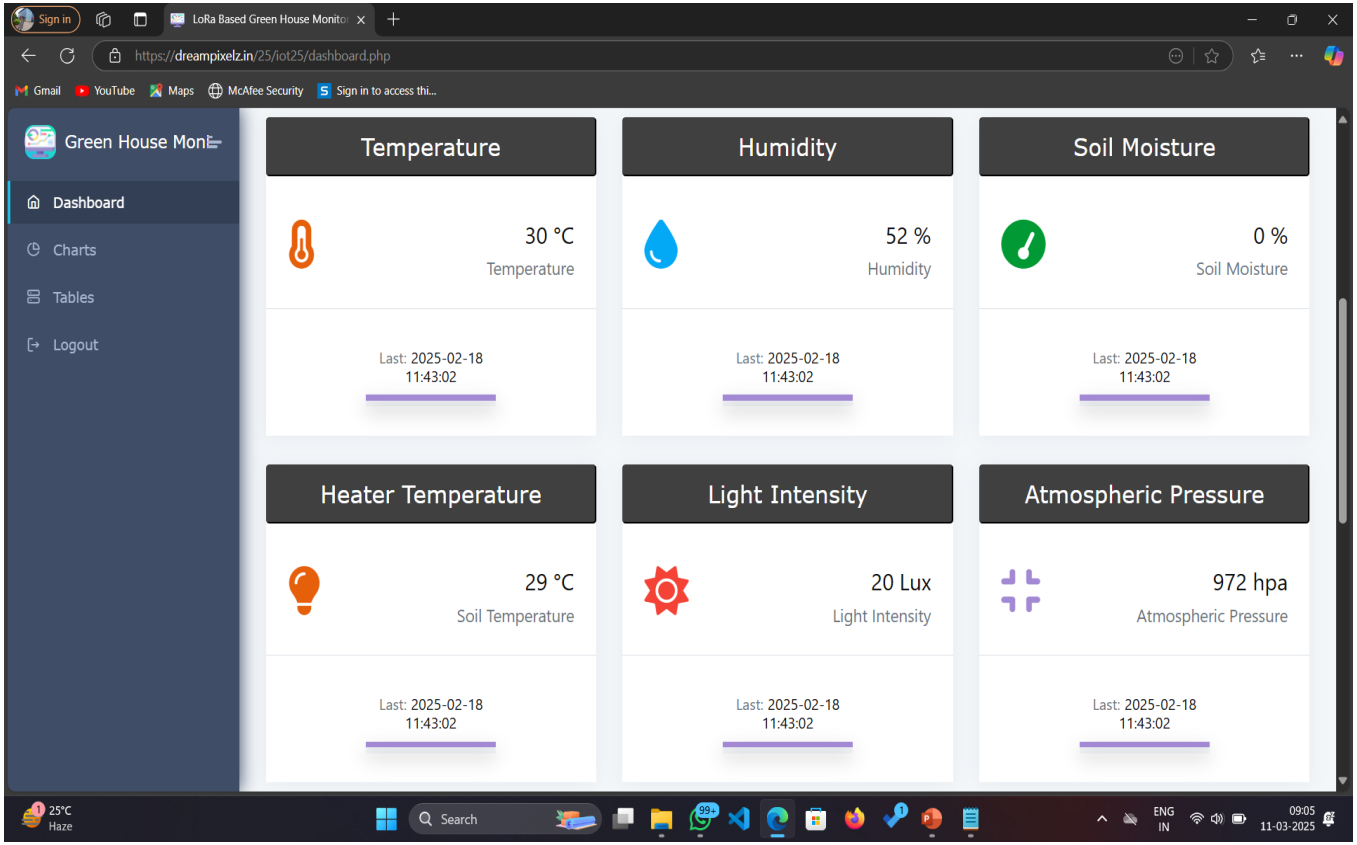
Sending data to the cloud for taking decisions

Predicted that whether temperature is zero from cloud

Sending an evaluated decision to transmitter node for processing

SOFTWARE DESIGN

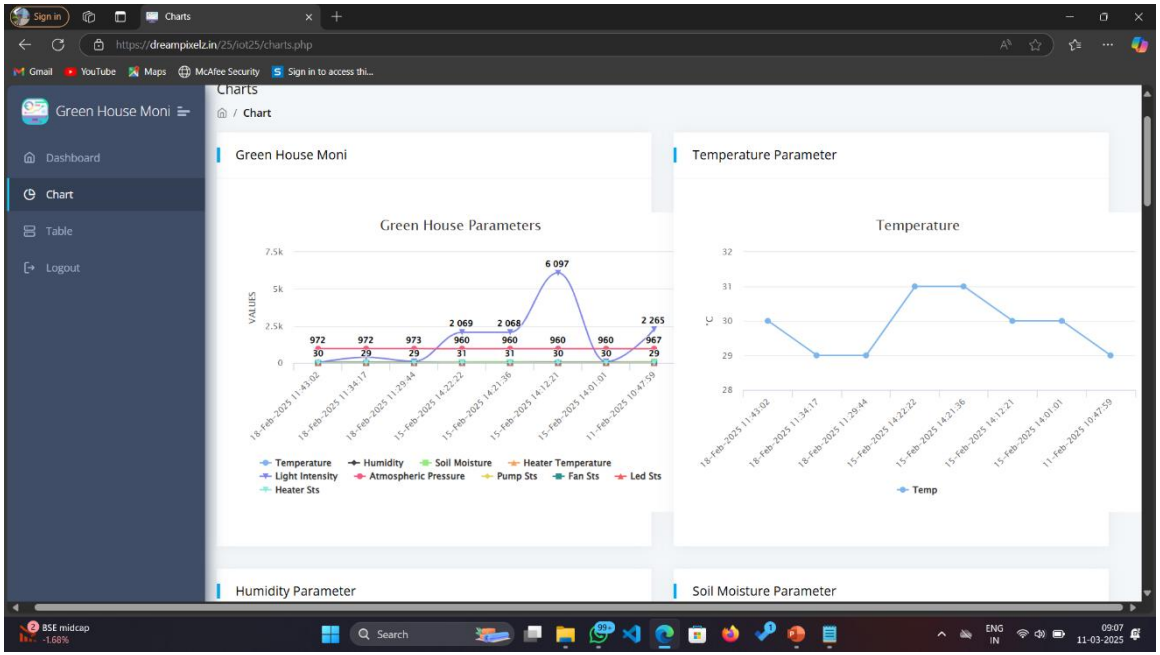
(Cloud interface)



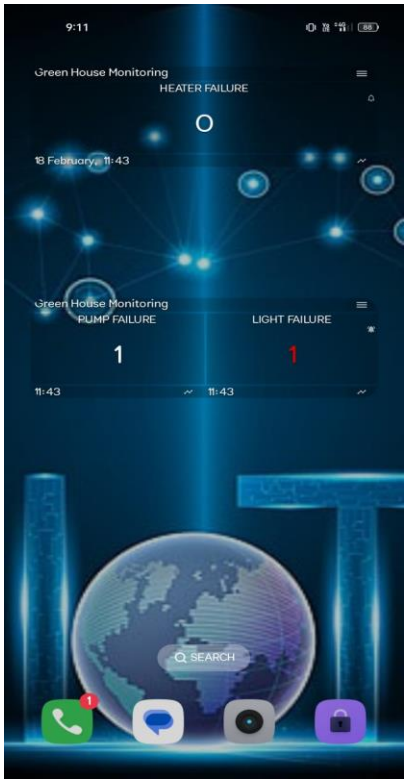
https://dreampixelz.in/25/iot25/dashboard.php

SOFTWARE SIMULATION

(Cloud interface)



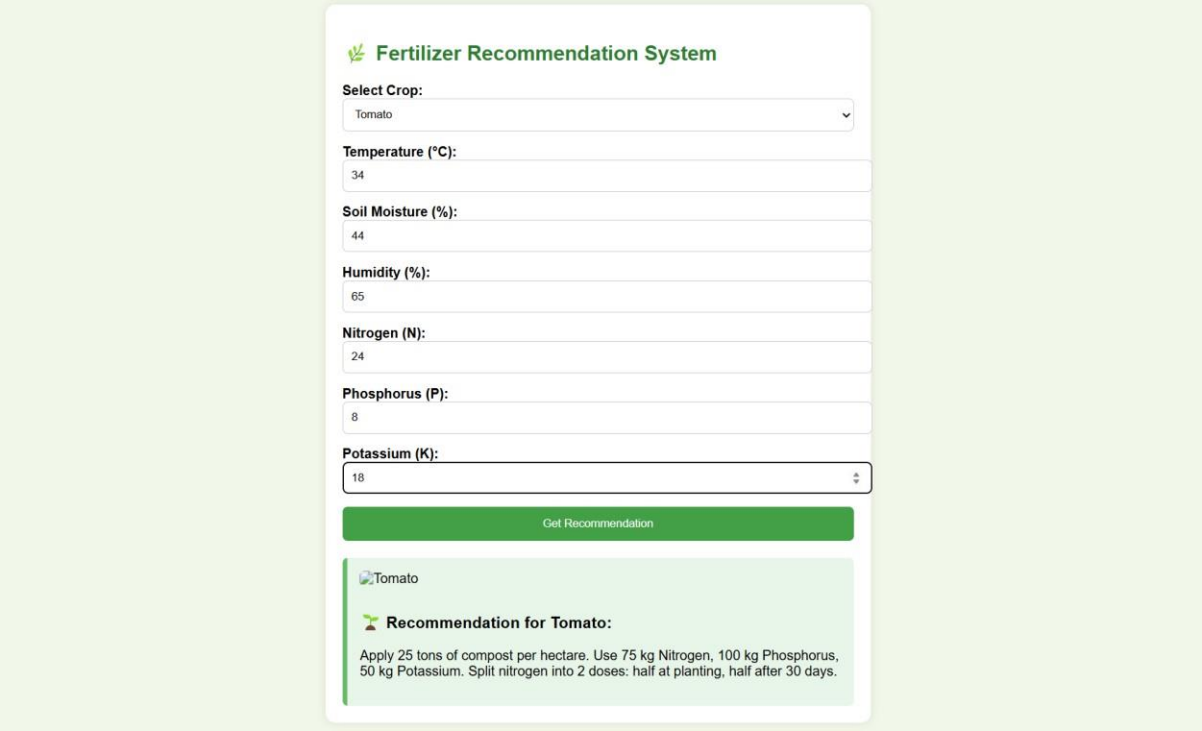
Monitoring and controlling by website



Thing-Speak Widgets – for smart alerts

SOFTWARE SIMULATION

(Cloud interface)



Fertilizer recommendation result

CONCLUSION

The proposed LoRa-based Greenhouse Monitoring and Control System integrates IoT technology to improve agricultural output in an effective manner. Through continuous monitoring of vital environmental factors like temperature, humidity, moisture in the soil, light level, and pressure, the system maintains ideal conditions for crop growth. Automation of vital operations like ventilation, irrigation, and heating minimizes human interference and maximizes resource allocation. Smart warnings and instant data transmission facilitate pre-emption in decision-making processes to improve efficiency and make operations more sustainable. LoRa technology's low power consumption and extended range make it suitable for mass-scale greenhouses to provide secure data transport even in far-flung agricultural lands.

FUTURE SCOPE

- AI-Based Predictive Analytics
- Enhanced Sensor Network
- Energy Efficiency Upgrades
- Blockchain for Data Protection
- Scalability for Multi-Greenhouses Network

References

- LoRaWAN-based intelligent multi-greenhouse monitoring and control *(Abdelkader Mezouari - 2023)* - The system uses LoRa WAN to monitor multiple greenhouses remotely, focusing on environmental conditions.

- Monitor and Control Sensors in the Greenhouse Using LoRa Technology *(Channamma-2021)* - Implementation of LoRa technology to wirelessly monitor and control greenhouse sensors with low power usage.

- Intelligent Agriculture Greenhouse Environment Monitoring System Based on IoT Technology (*LIU Dan, Cao Xin – 2015*) -This system utilizes IoT technology to monitor key environmental parameters like temperature, humidity, and soil moisture in real-time, allowing for better control of greenhouse conditions.

- Leveraging LoRa WAN Technology for Precision Agriculture in Greenhouses (*Ritesh Kumar Singh – 2020*) - Focused on using LoRa WAN to improve data transmission reliability for real-time monitoring in greenhouses.

Thank You