A LoRa and MQTT-Based Monitoring System

For Internal and External Beehives

Minju Jeon, Jiyun Kim, Sewon Kim, Seongmin Park, Bo Zhang

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Introduction

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Speaker : Minju Jeon

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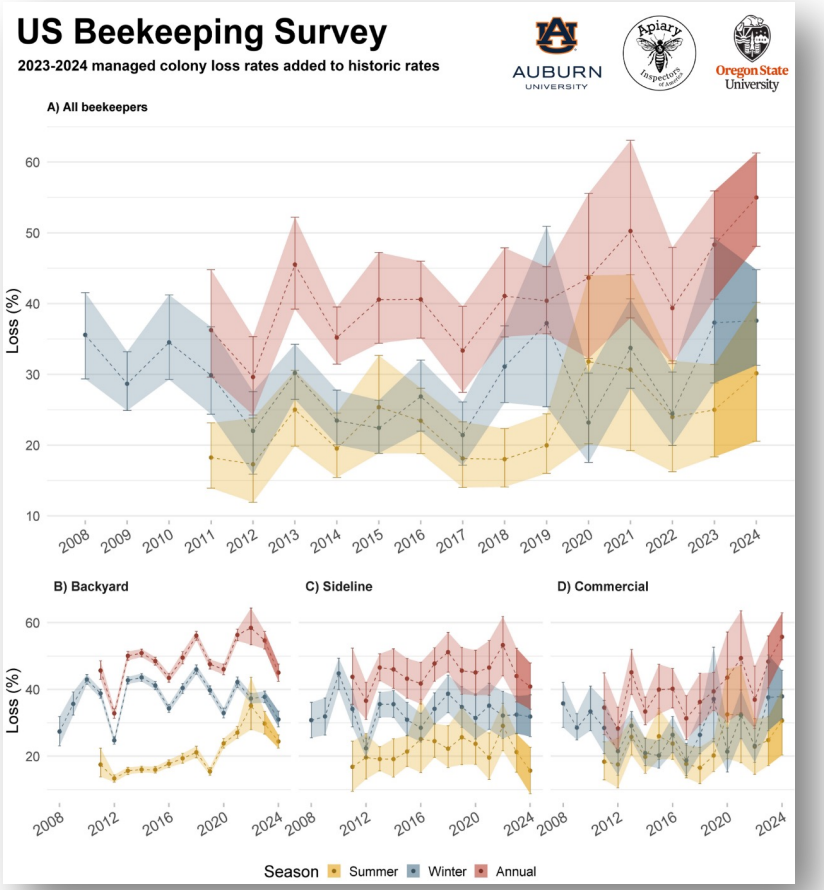
Introduction



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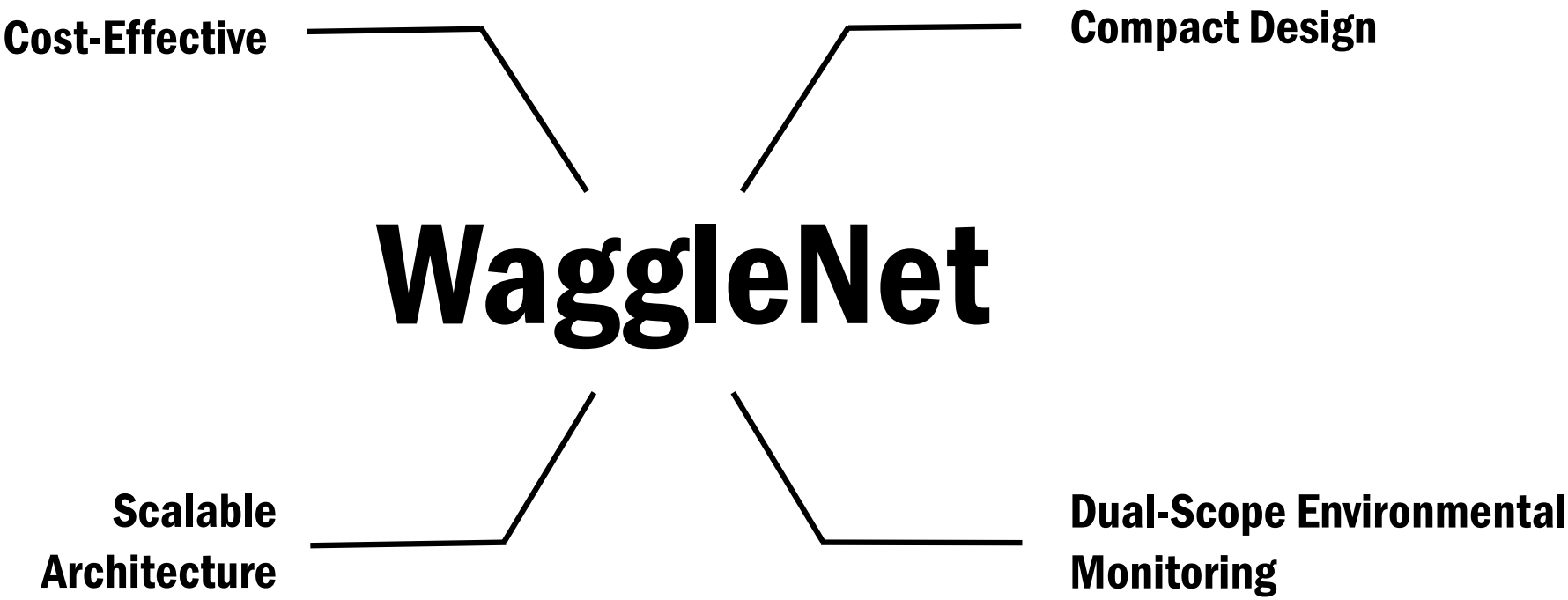
Introduction



Background and Requirement

Speaker : Sewon Kim

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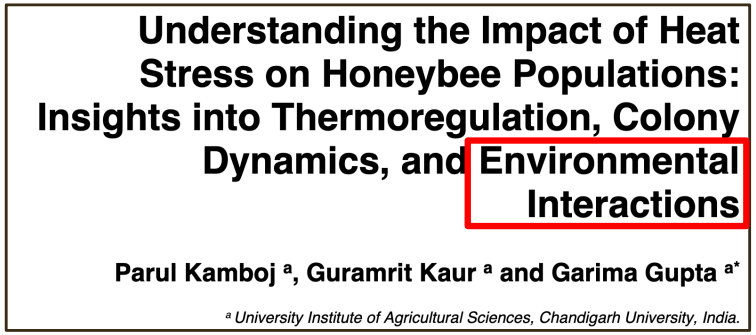
Background: Why External Conditions Matter

diversity

Article

Exploring the External Environmental Drivers of Honey Bee Colony Development

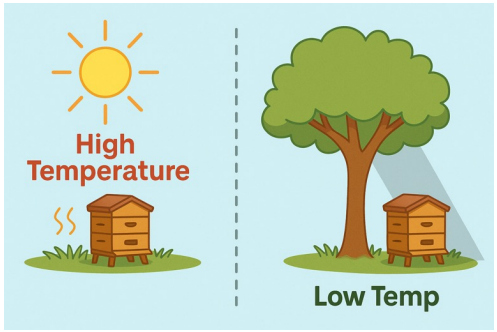
Nuno Capela [1,*], Artur Sarmento [1], Sandra Simões [1], Sara Lopes [1], Sílvia Castro [1], António Alves da Silv
Joana Alves [1], Yoko L. Dupont [2], Dirk C. de Graaf [3] and José Paulo Sousa [1]



Understanding the Impact of Heat Stress on Honeybee Populations: Insights into Thermoregulation, Colony Dynamics, and Environmental Interactions

Parul Kamboj [a], Guramrit Kaur [a] and Garima Gupta [a*]

[a] University Institute of Agricultural Sciences, Chandigarh University, India.



Inside + Outside ➔ Context output

Requirement: What We Designed For

Scalability
Easy node expansion/removal

Accessibility
Real-time mobile app

Comprehensive Hive-Environment Analysis
Internal + External data

Low-Cost Implementation
Uses LoRa, not GSM/ LTE + Cost Low

System Architecture

Speaker : Sewon Kim

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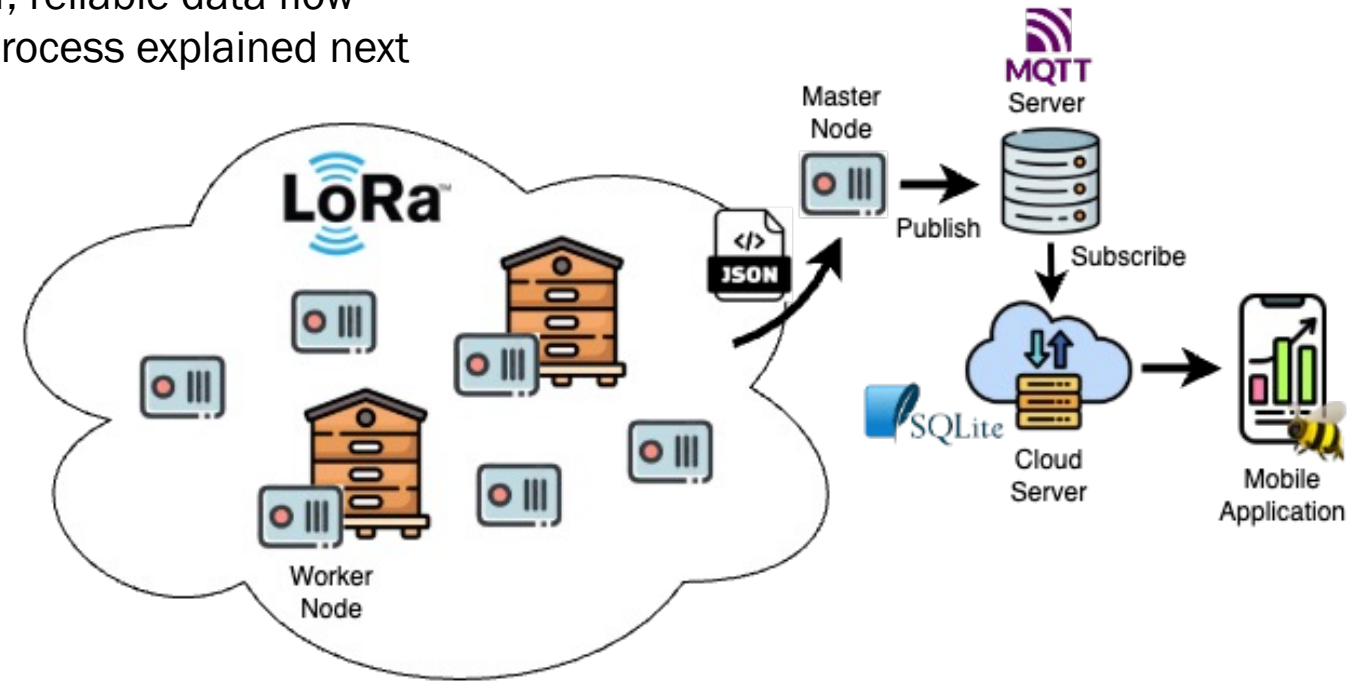
System Architecture: End-to-End Data Flow

LoRa → MQTT → Cloud → Mobile
Low-power, reliable data flow
Detailed process explained next



Hardware

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Speaker : Jiyun Kim

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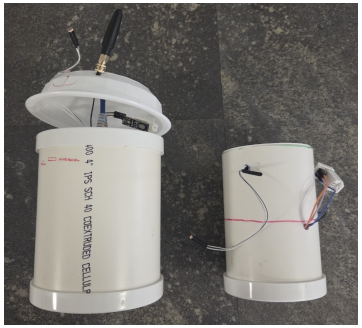
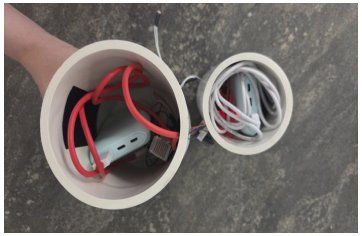
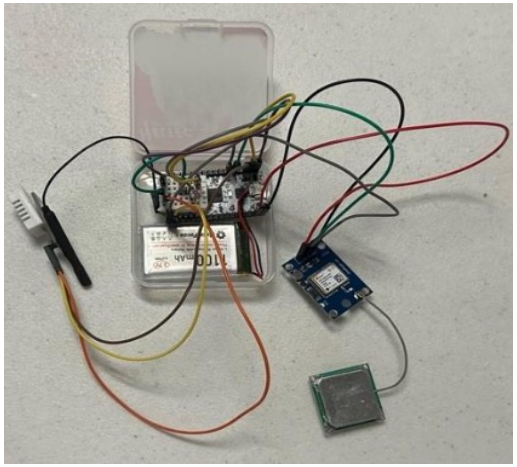
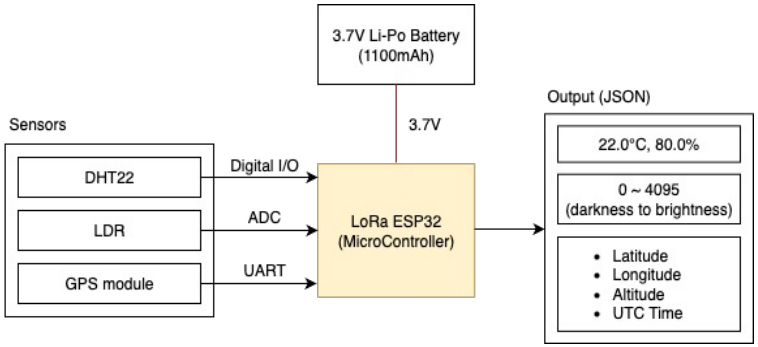
Hardware








3.7V Li-Po Battery
(1100mAh)
3.7V
Sensors
DHT22
LDR
GPS module
Digital I/O
ADC
UART
LoRa ESP32
(MicroController)
Output (JSON)
22.0°C, 80.0%
0 ~ 4095
(darkness to brightness)
Latitude
Longitude
Altitude
UTC Time

Software

[redacted]

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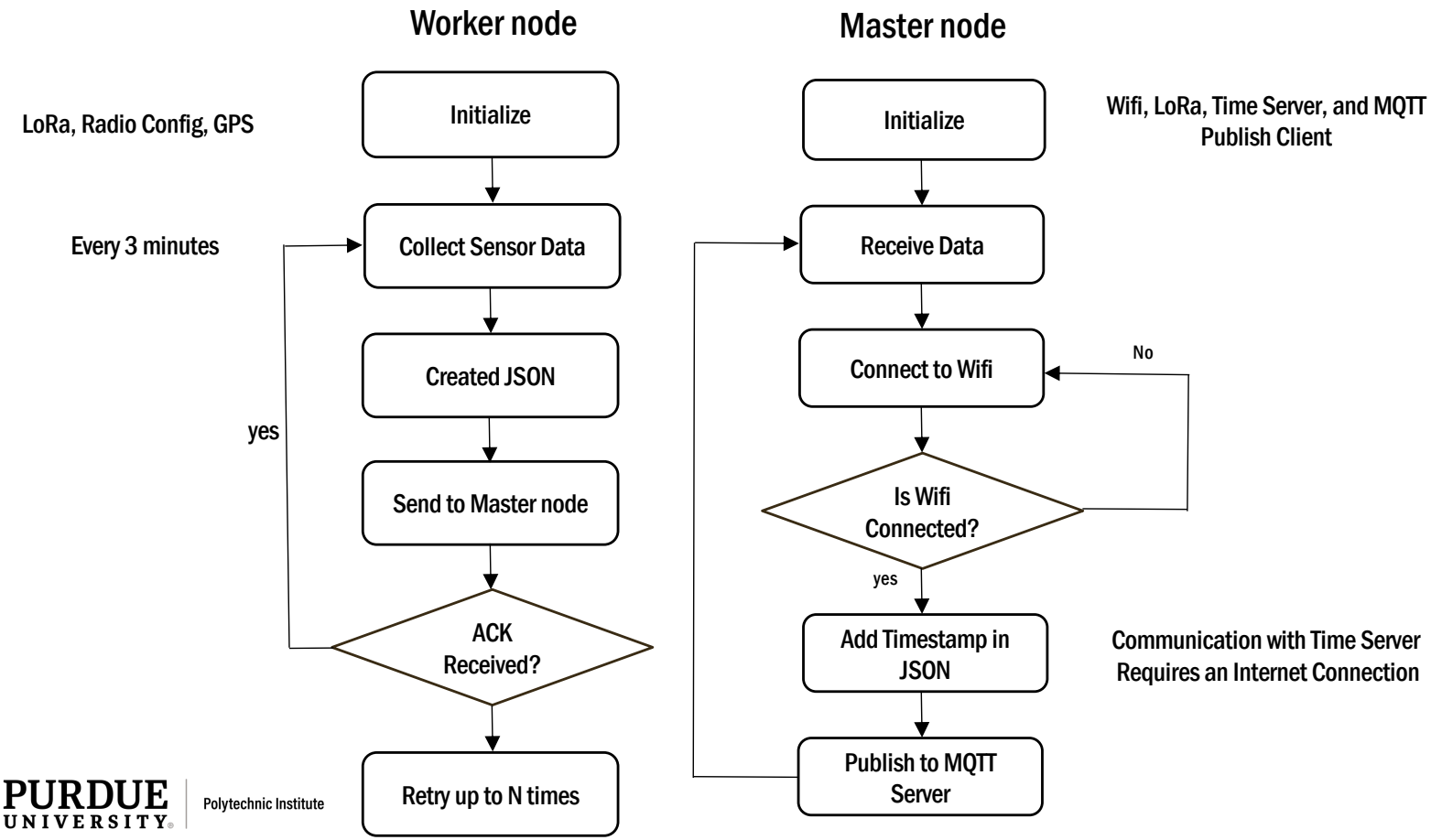
Software


Worker node
Master node
LoRa, Radio Config, GPS
Initialize
Initialize
Wifi, LoRa, Time Server, and MQTT Publish Client
Every 3 minutes
Collect Sensor Data
Receive Data
Created JSON
Connect to Wifi
No
yes
Send to Master node
Is Wifi Connected?
yes
ACK Received?
Add Timestamp in JSON
Communication with Time Server Requires an Internet Connection
Retry up to N times
Publish to MQTT Server

Server

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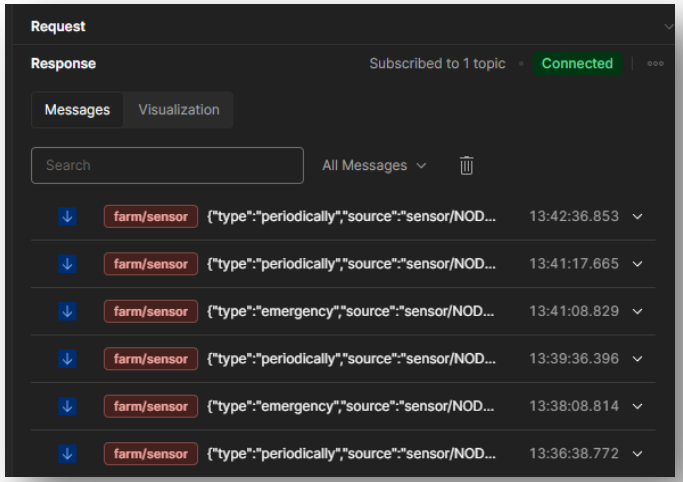
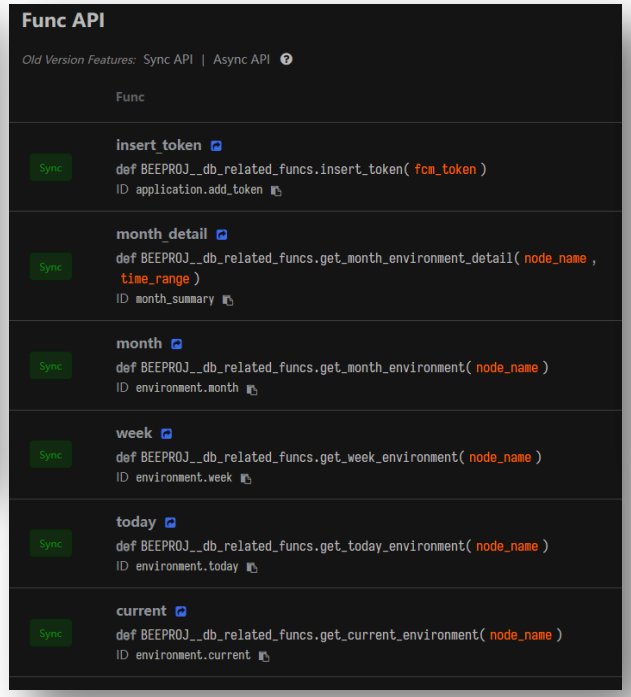
Server

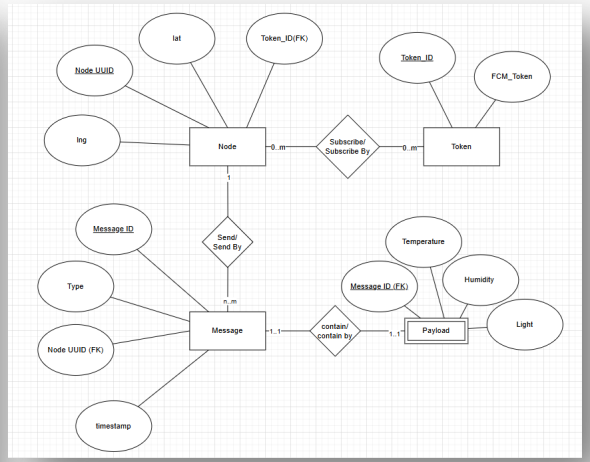
MQTT server



Cloud server



Database



Mobile Application

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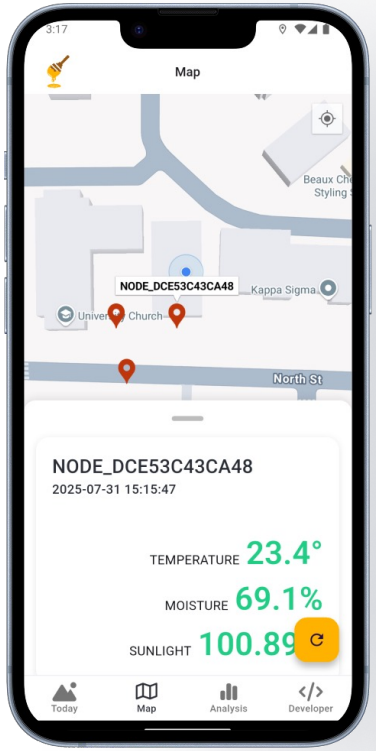
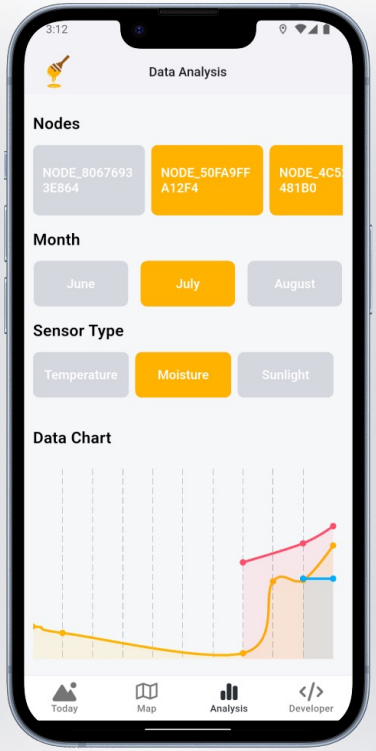
Mobile Application

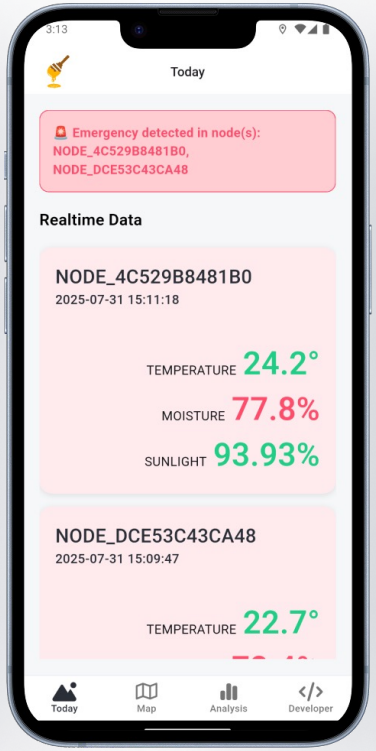
Map Screen



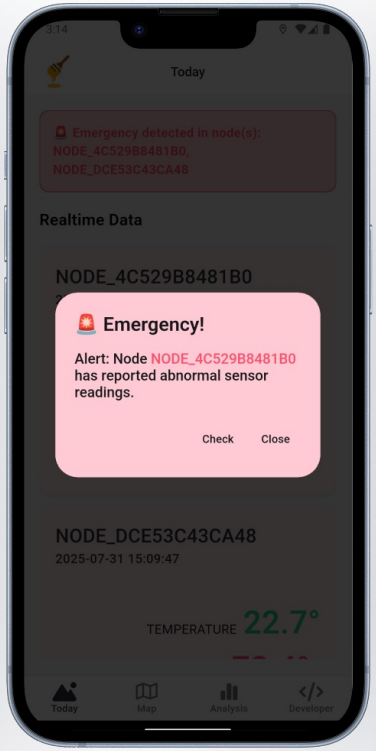
Graph Screen



Home Screen



Emergency Alarm



Video Demo

[redacted]

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Video Demo

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Result and Future Plan

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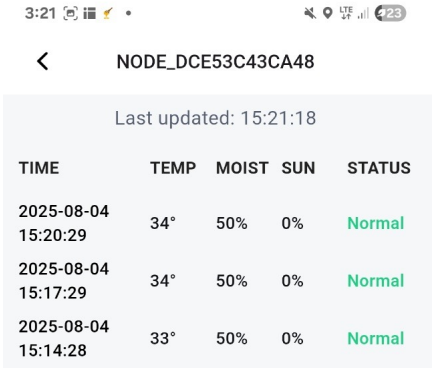
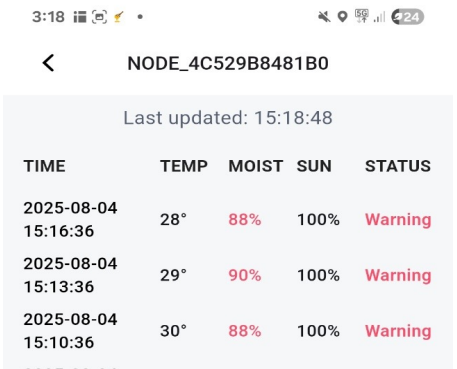
Result and Future Plan



inside



outside

1. Access point
2. Hardware miniaturization
3. AI-based optimal beehive placement recommendation

Thank You

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