

# ***A LoRa and MQTT-Based Monitoring System***

**For Internal and External Beehives**

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

# *Contents*

1. Introduction
2. Background and Requirement
3. System Architecture
4. Video Demo
5. Result and Future Plan

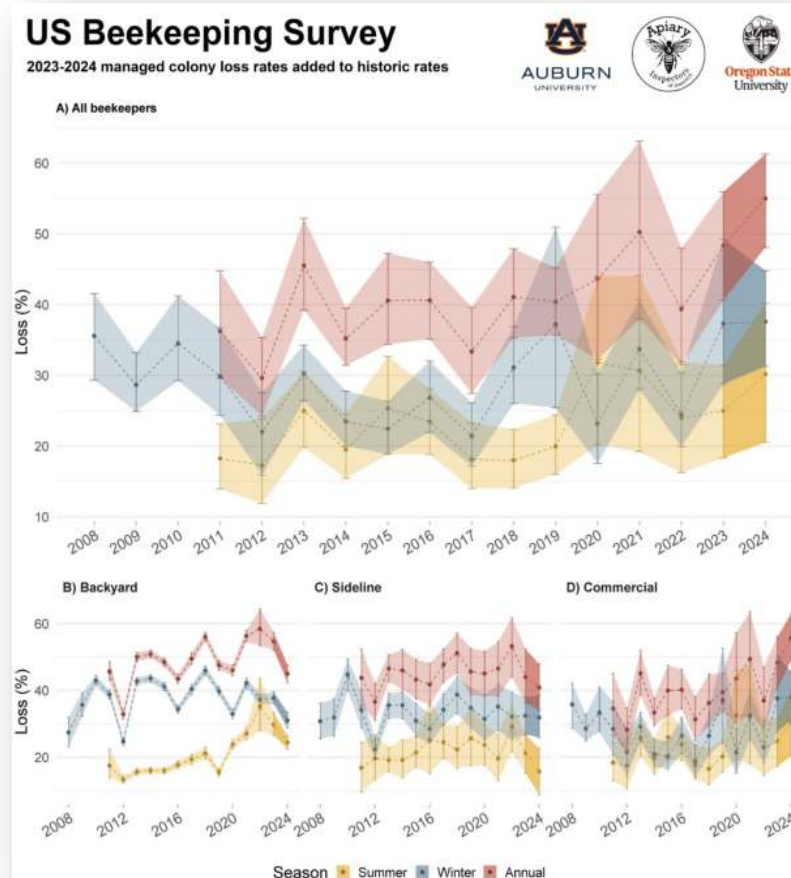
# Introduction

---



Speaker : Minju Jeon

# Introduction



## *Introduction*

**Cost-Effective**

**Compact Design**

# WaggleNet

**Scalable  
Architecture**

**Dual-Scope Environmental  
Monitoring**

# Background and Requirement

---



Speaker : Sewon Kim

## Background: Why External Conditions Matter

 **diversity** 

Article

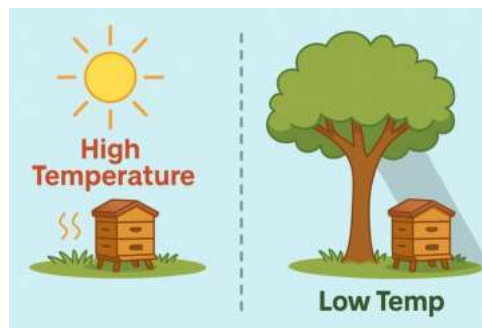
**Exploring the External Environmental Drivers of Honey Bee Colony Development**

Nuno Capela <sup>1,\*</sup>, Artur Sarmiento <sup>1</sup>, Sandra Simões <sup>1</sup>, Sara Lopes <sup>1</sup>, Sílvia Castro <sup>1</sup>, António Alves da Silva <sup>1</sup>, Joana Alves <sup>1</sup>, Yoko L. Dupont <sup>2</sup>, Dirk C. de Graaf <sup>3</sup> and José Paulo Sousa <sup>1</sup>

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

Parul Kamboj <sup>a</sup>, Guramrit Kaur <sup>a</sup> and Garima Gupta <sup>a\*</sup>

<sup>a</sup> 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

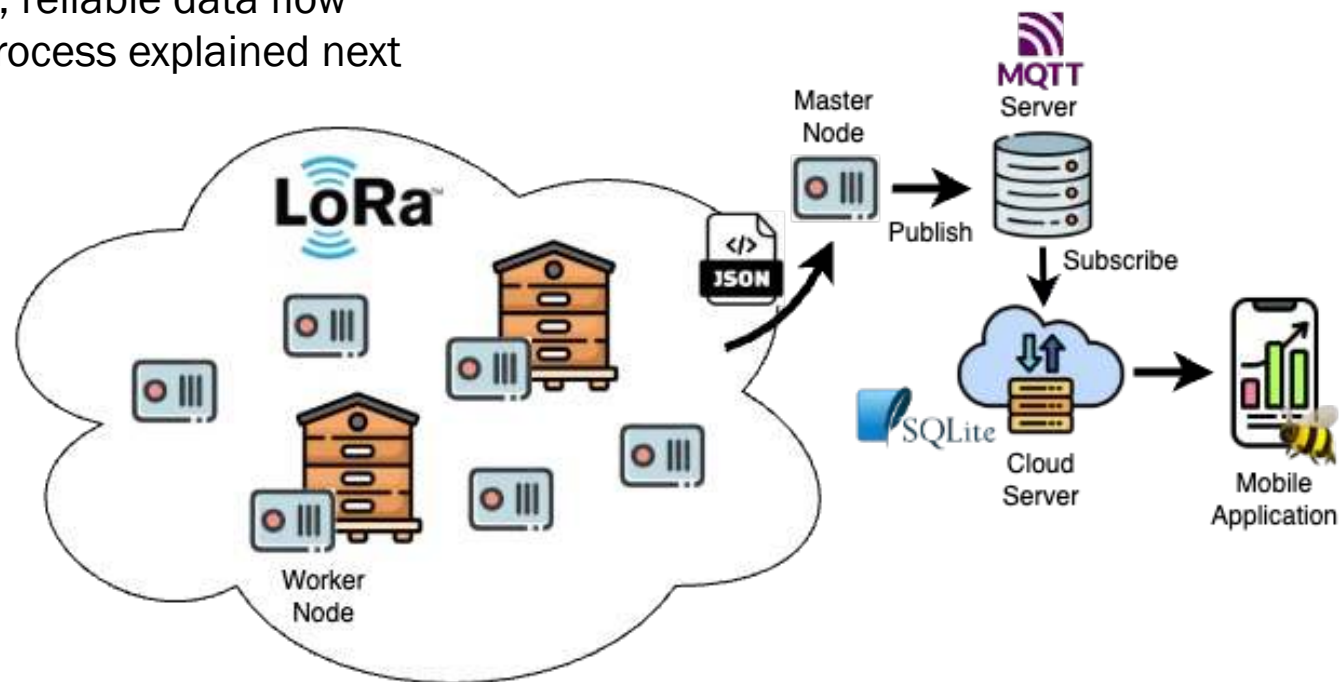
---



Speaker : Sewon Kim

## System Architecture: End-to-End Data Flow

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



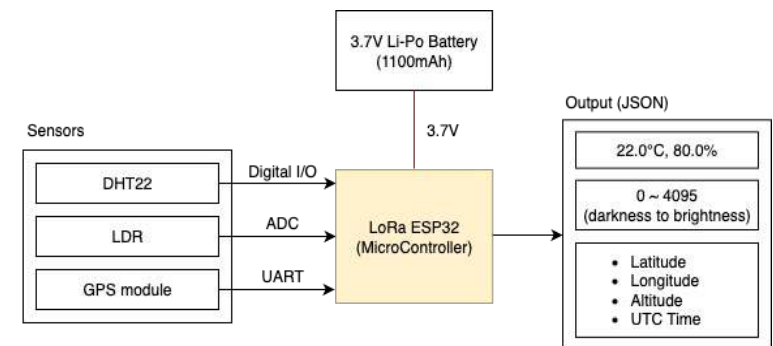
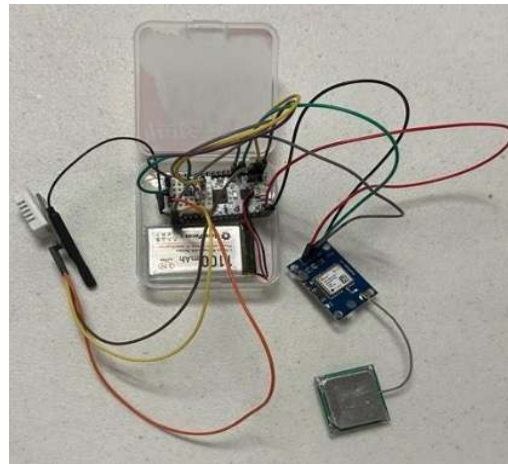
# Hardware

---



**Speaker : Jiyun Kim**

# Hardware



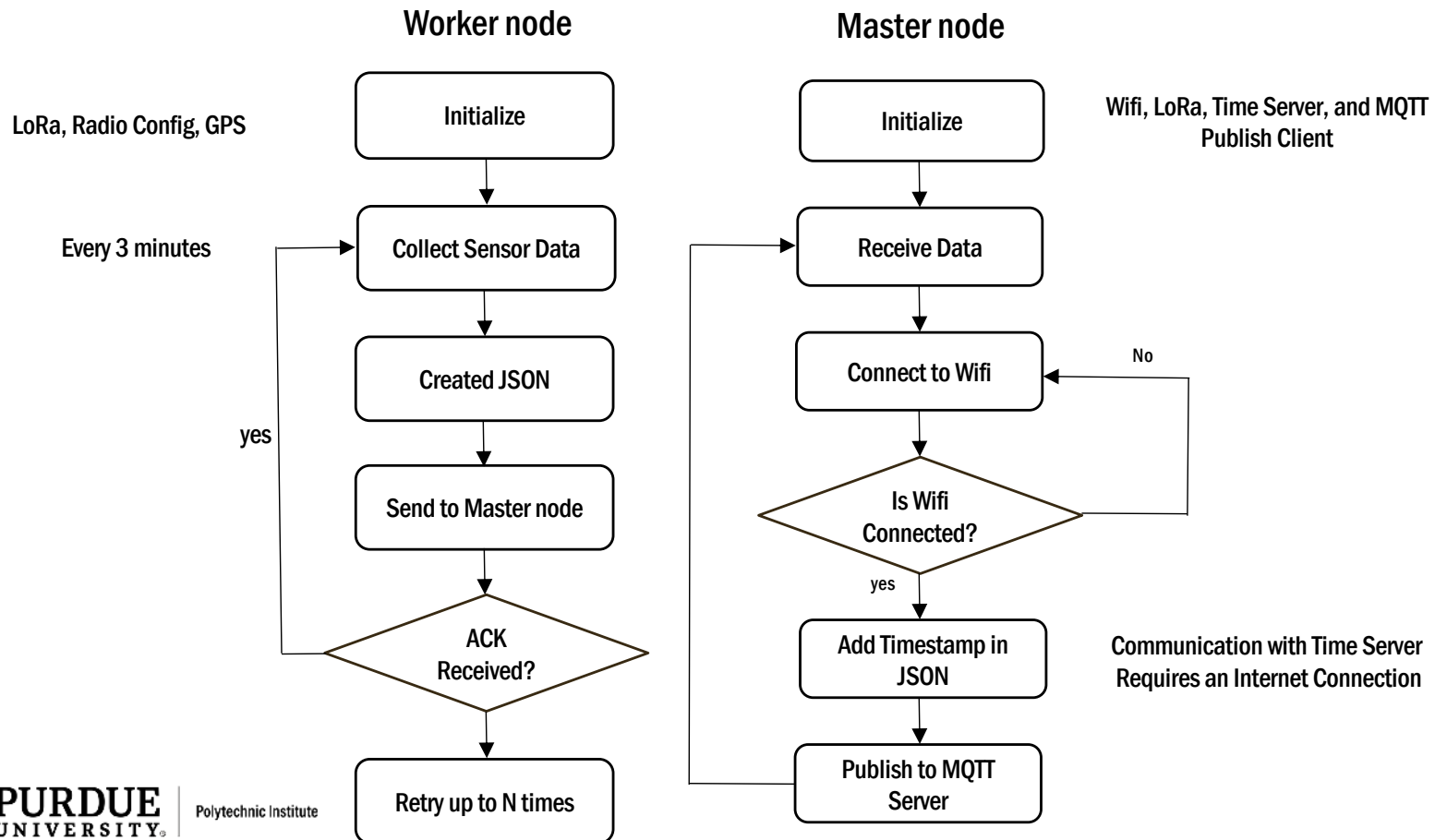
# Software

---



Speaker : Minju Jeon

# Software



# Server



Speaker : Seongmin Park

# Server

## MQTT server

Request

Response Subscribed to 1 topic **Connected**

Messages Visualization

Search All Messages

|             |  |              |
|-------------|--|--------------|
| farm/sensor | {"type":"periodically","source":"sensor/NOD..."} | 13:42:36.853 |
| farm/sensor | {"type":"periodically","source":"sensor/NOD..."} | 13:41:17.665 |
| farm/sensor | {"type":"emergency","source":"sensor/NOD..."}    | 13:41:08.829 |
| farm/sensor | {"type":"periodically","source":"sensor/NOD..."} | 13:39:36.396 |
| farm/sensor | {"type":"emergency","source":"sensor/NOD..."}    | 13:38:08.814 |
| farm/sensor | {"type":"periodically","source":"sensor/NOD..."} | 13:36:38.772 |

## Cloud server

Func API

Old Version Features: Sync API | Async API

Func

**insert\_token**

```
def BEEPROJ_db_related_funcs.insert_token( fcm_token )
ID application.add_token
```

**month\_detail**

```
def BEEPROJ_db_related_funcs.get_month_environment_detail( node_name ,
time_range )
ID month_summary
```

**month**

```
def BEEPROJ_db_related_funcs.get_month_environment( node_name )
ID environment.month
```

**week**

```
def BEEPROJ_db_related_funcs.get_week_environment( node_name )
ID environment.week
```

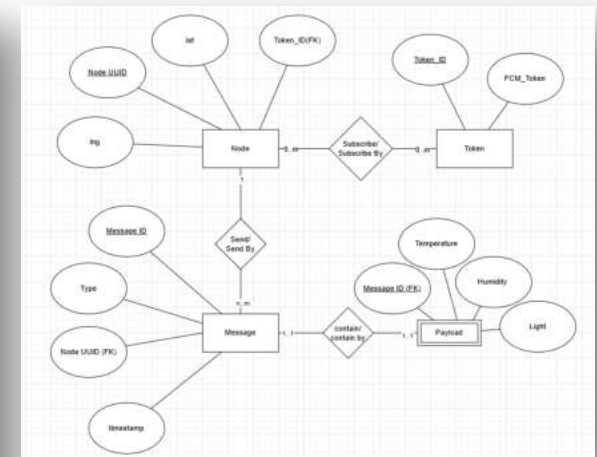
**today**

```
def BEEPROJ_db_related_funcs.get_today_environment( node_name )
ID environment.today
```

**current**

```
def BEEPROJ_db_related_funcs.get_current_environment( node_name )
ID environment.current
```

## Database





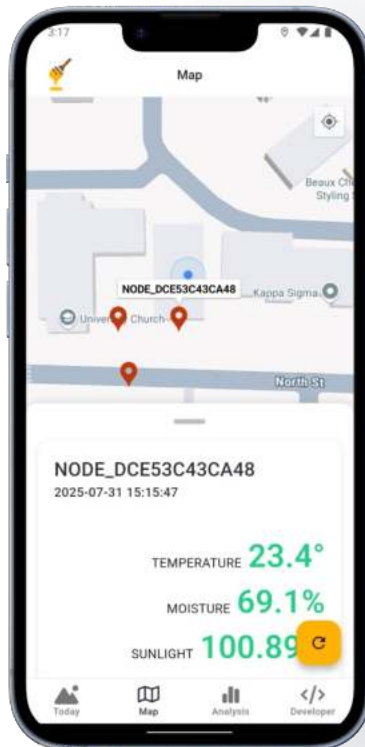
# Mobile Application



**Speaker : Seongmin Park**

# Mobile Application

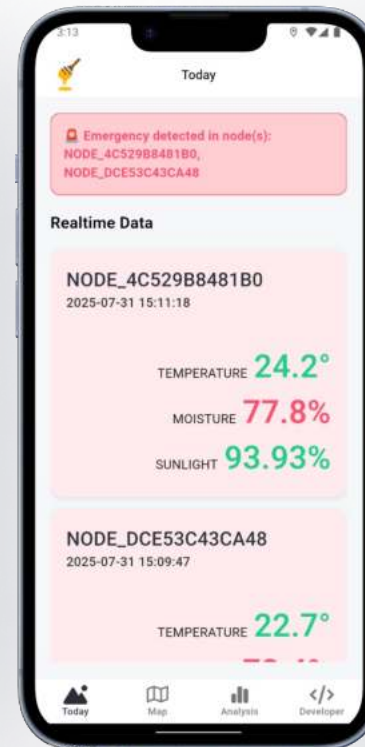
Map Screen



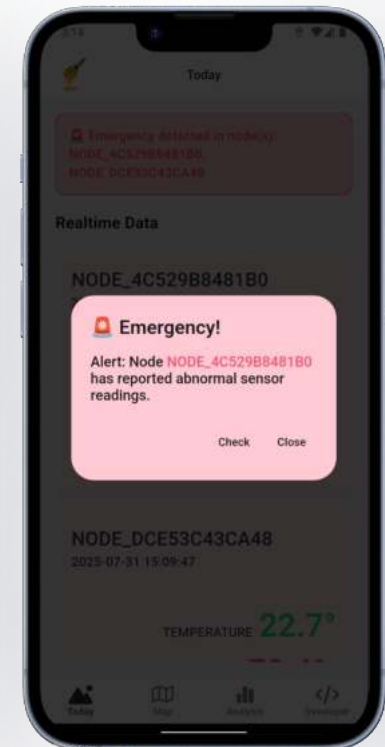
Graph Screen



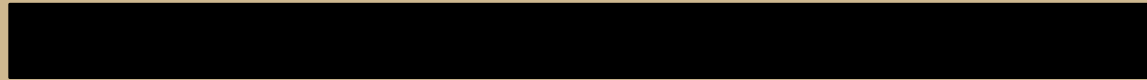
Home Screen



Emergency Alarm



# Video Demo



Speaker : Minju Jeon

## *Video Demo*



# Result and Future Plan

---



Speaker : Minju Jeon

## Result and Future Plan

3:21 100% 423

< NODE\_DCE53C43CA48

Last updated: 15:21:18

| TIME                | TEMP | MOIST | SUN | STATUS |
|---------------------|------|-------|-----|--------|
| 2025-08-04 15:20:29 | 34°  | 50%   | 0%  | Normal |
| 2025-08-04 15:17:29 | 34°  | 50%   | 0%  | Normal |
| 2025-08-04 15:14:28 | 33°  | 50%   | 0%  | Normal |

inside

3:18 100% 424

< NODE\_4C529B8481B0

Last updated: 15:18:48

| TIME                | TEMP | MOIST | SUN  | STATUS  |
|---------------------|------|-------|------|---------|
| 2025-08-04 15:16:36 | 28°  | 88%   | 100% | Warning |
| 2025-08-04 15:13:36 | 29°  | 90%   | 100% | Warning |
| 2025-08-04 15:10:36 | 30°  | 88%   | 100% | Warning |

outside

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

***Thank You***