

# *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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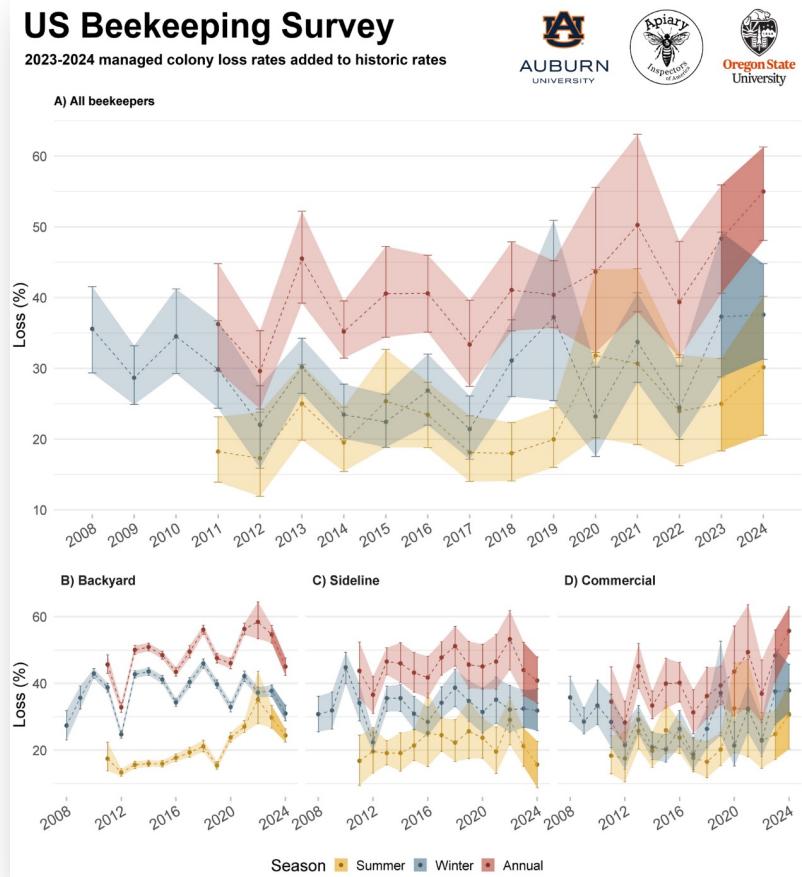
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# Introduction



Speaker : Minju Jeon

# Introduction



## *Introduction*

**Cost-Effective**

**Compact Design**

# **WaggleNet**

**Scalable  
Architecture**

**Dual-Scope Environmental  
Monitoring**

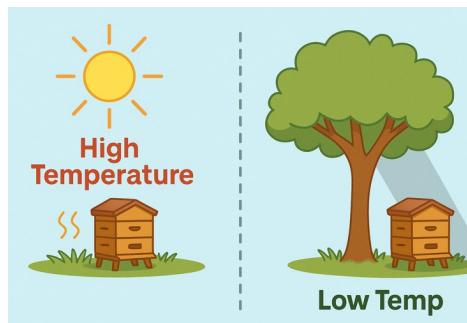
# Background and Requirement



Speaker : Sewon Kim

## Background: Why External Conditions Matter

The screenshot shows a journal article titled "Exploring the External Environmental Drivers of Honey Bee Colony Development". The title is highlighted with a red box. Below the title, the authors listed are Nuno Capela, Artur Sarmento, Sandra Simões, Sara Lopes, Sílvia Castro, António Alves da Silva, Joana Alves, Yoko L. Dupont, Dirk C. de Graaf, and José Paulo Sousa. The main heading of the article is "Understanding the Impact of Heat Stress on Honeybee Populations: Insights into Thermoregulation, Colony Dynamics, and Environmental Interactions". The authors listed below this are Parul Kamboj, Guramrit Kaur, and Garima Gupta. A small note at the bottom indicates they are from the 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*

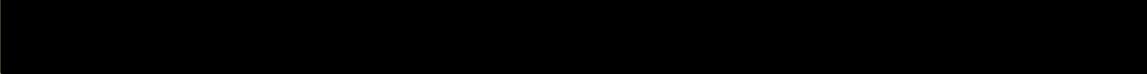
### **Comprehensive Hive-Environment Analysis**

*Internal + External data*

### **Low-Cost Implementation**

*Uses LoRa, not GSM/ LTE + Cost Low*

# System Architecture



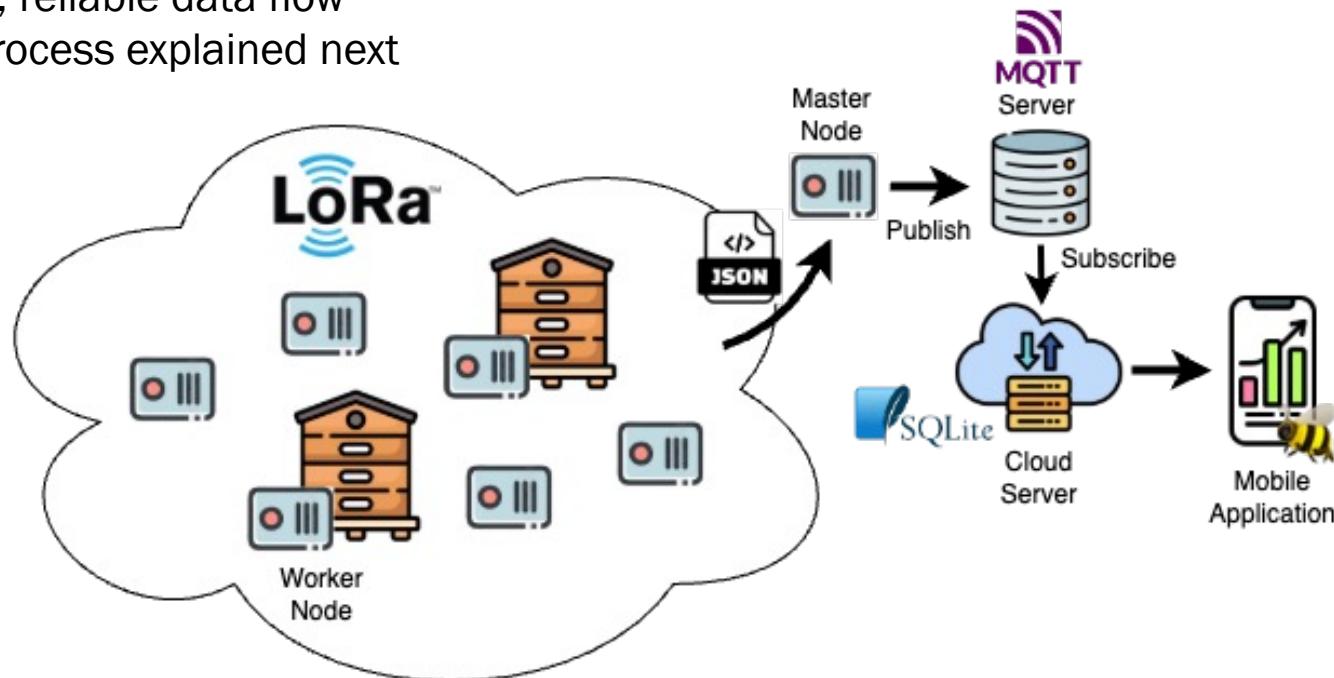
Speaker : Sewon Kim

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

LoRa → MQTT → Cloud → Mobile

Low-power, reliable data flow

Detailed process explained next

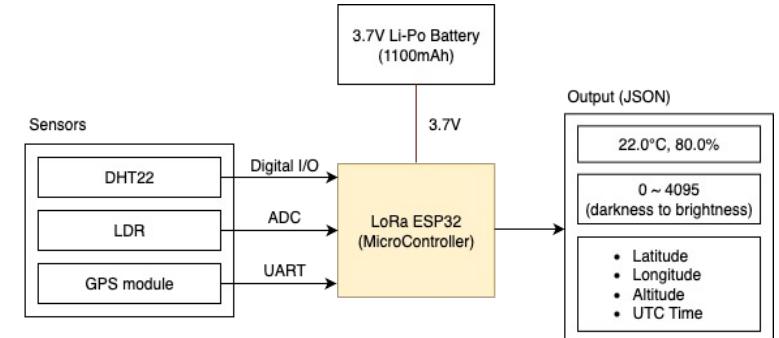
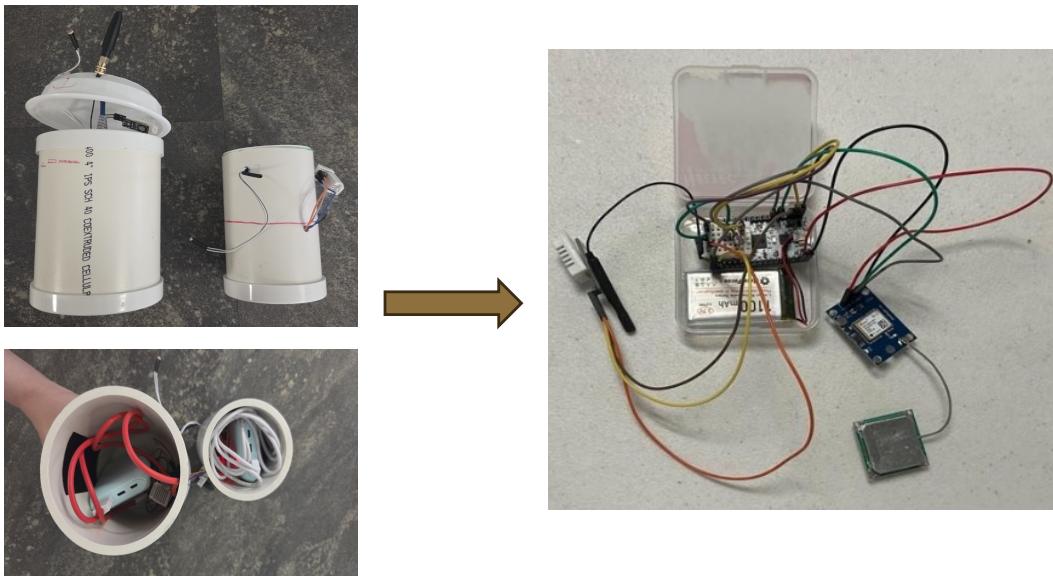


# Hardware



Speaker : Jiyun Kim

# Hardware

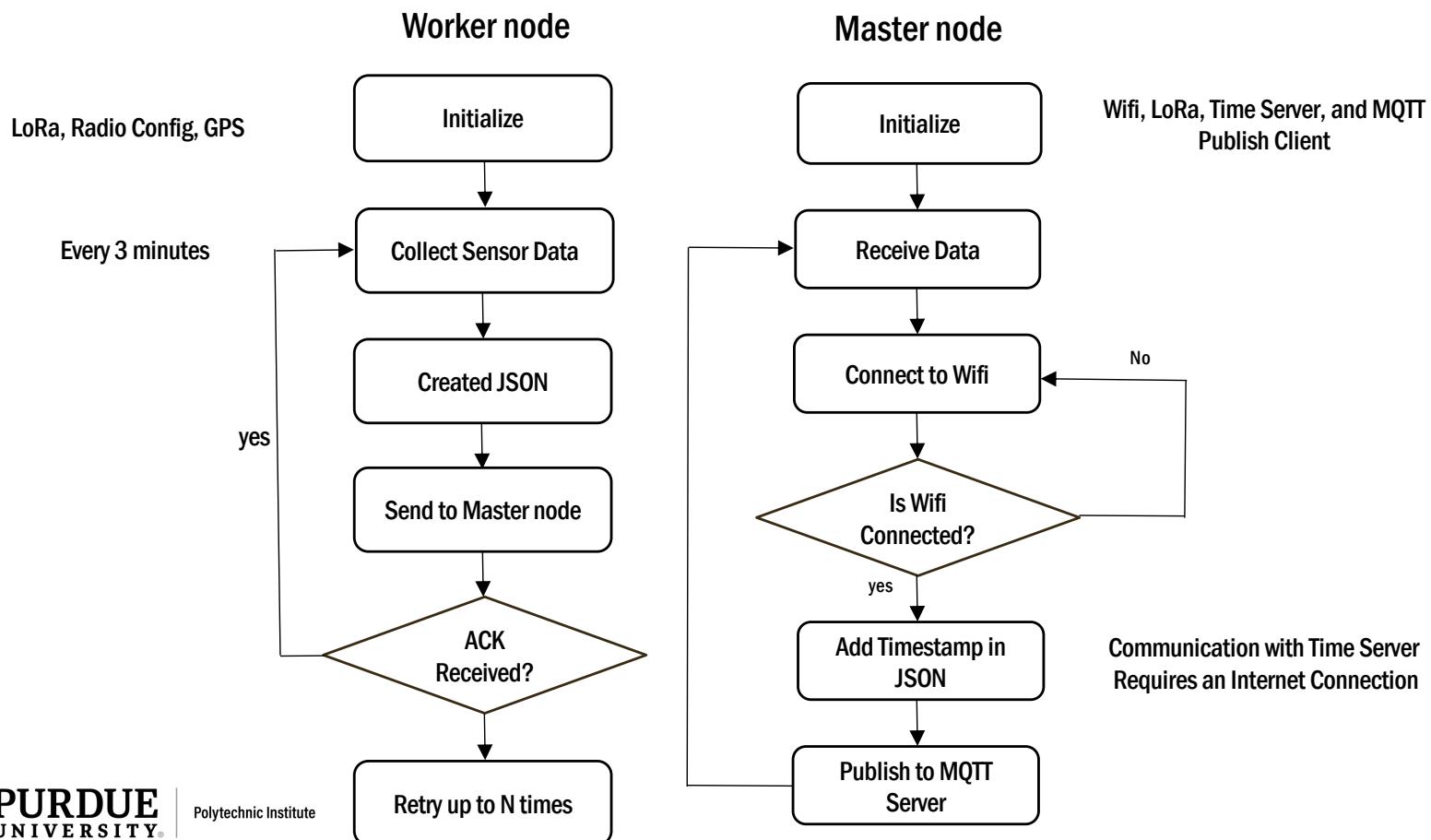


# Software



Speaker : Minju Jeon

# Software



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# Server



Speaker : Seongmin Park

## **Server**

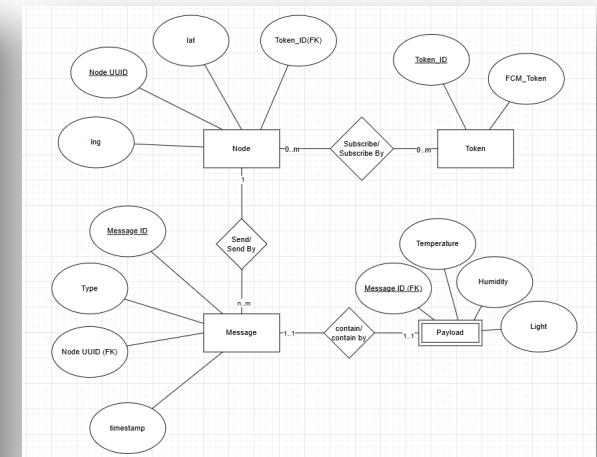
## MQTT server

Request	Response	Subscribed to 1 topic	Connected
			...
Messages Visualization			...
<input type="text" value="Search"/> All Messages <span>▼</span> <span>Filter</span>			...
<span>▼</span>	<span style="background-color: #f08080; border-radius: 5px; padding: 2px 10px;">farm/sensor</span> {"type": "periodically", "source": "sensor/NOD..."} 13:42:36.853	...	▼
<span>▼</span>	<span style="background-color: #f08080; border-radius: 5px; padding: 2px 10px;">farm/sensor</span> {"type": "periodically", "source": "sensor/NOD..."} 13:41:17.665	...	▼
<span>▼</span>	<span style="background-color: #f08080; border-radius: 5px; padding: 2px 10px;">farm/sensor</span> {"type": "emergency", "source": "sensor/NOD..."} 13:41:08.829	...	▼
<span>▼</span>	<span style="background-color: #f08080; border-radius: 5px; padding: 2px 10px;">farm/sensor</span> {"type": "periodically", "source": "sensor/NOD..."} 13:39:36.396	...	▼
<span>▼</span>	<span style="background-color: #f08080; border-radius: 5px; padding: 2px 10px;">farm/sensor</span> {"type": "emergency", "source": "sensor/NOD..."} 13:38:08.814	...	▼
<span>▼</span>	<span style="background-color: #f08080; border-radius: 5px; padding: 2px 10px;">farm/sensor</span> {"type": "periodically", "source": "sensor/NOD..."} 13:36:38.772	...	▼

## Cloud server

Func API	
<i>Old Version Features:</i>	<a href="#">Sync API</a>   <a href="#">Async API</a>
	<a href="#">Func</a>
Sync	<b>insert_token</b> <code>def BEEPROJ__db_related_funcs.insert_token( <b>fcmtoken</b> )</code> ID application.add_token
Sync	<b>month_detail</b> <code>def BEEPROJ__db_related_funcs.get_month_environment_detail( <b>node_name</b> , time_range )</code> ID month_summary
Sync	<b>month</b> <code>def BEEPROJ__db_related_funcs.get_month_environment( <b>node_name</b> )</code> ID environment.month
Sync	<b>week</b> <code>def BEEPROJ__db_related_funcs.get_week_environment( <b>node_name</b> )</code> ID environment.week
Sync	<b>today</b> <code>def BEEPROJ__db_related_funcs.get_today_environment( <b>node_name</b> )</code> ID environment.today
Sync	<b>current</b> <code>def BEEPROJ__db_related_funcs.get_current_environment( <b>node_name</b> )</code> ID environment.current

## Database



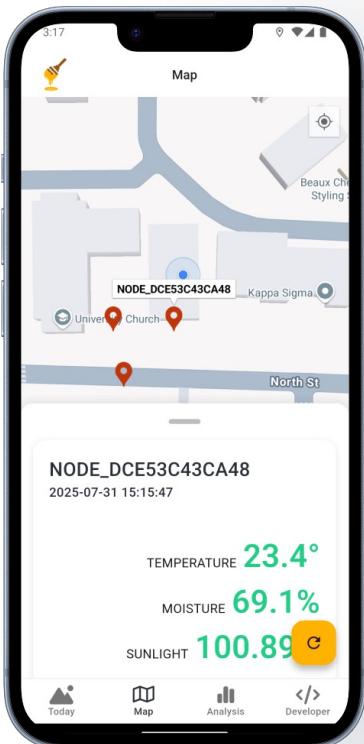
# Mobile Application



Speaker : Seongmin Park

# Mobile Application

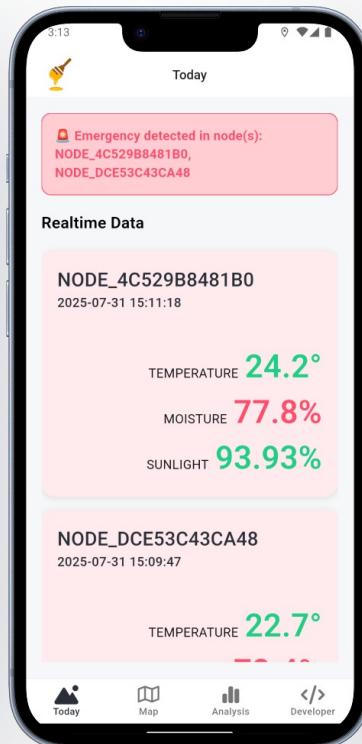
Map Screen



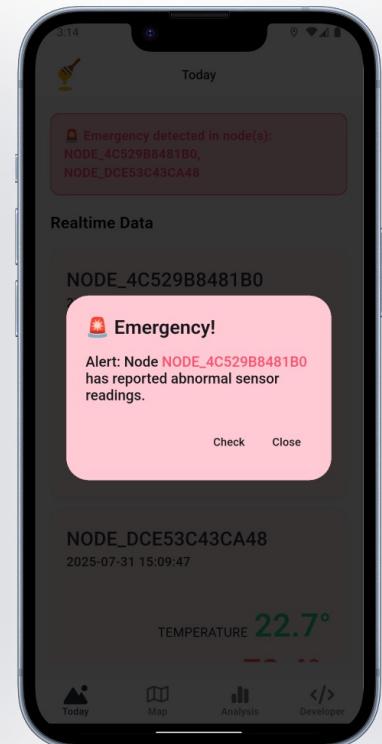
Graph Screen



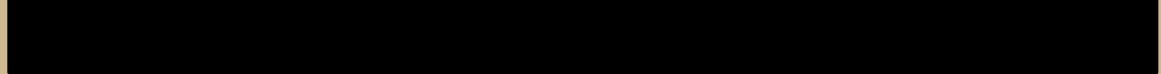
Home Screen



Emergency Alarm



# Video Demo



Speaker : Minju Jeon

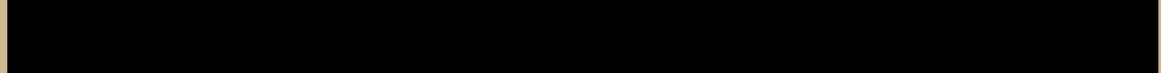
## *Video Demo*



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# Result and Future Plan



Speaker : Minju Jeon

## *Result and Future Plan*

The image shows two side-by-side mobile phone screenshots. Both phones have a black header bar with signal strength, battery level (23% and 24%), and a back arrow icon. Below the header is a white card-like interface.

**Left Phone (inside):**

Node ID: 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

**Right Phone (outside):**

Node ID: 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

**Labels:** The word "inside" is centered below the left phone, and the word "outside" is centered below the right phone.

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

# *Thank You*



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