

Introduction to Chulalongkorn University's Building Energy Management Sys.

Energy Research Institute (ERI)

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University of Tokyo

**Department of Electrical Engineering
Chulalongkorn University**

7 March 2016



Energy Policy
and Planning Office

MINISTRY OF ENERGY



ELECTRICAL ENGINEERING
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Outlines

- ❖ **Project Background**
- ❖ **Project Overview**
- ❖ **Sensors & Meters**
- ❖ **Renewable Energy Integration (towards net-zero bldg.)**
- ❖ **User Interfaces**
 - Public display, Web App & Android App
- ❖ **Demand response test on A/C**

Project Background



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Objectives of the Project

- ❖ **To demonstrate a future building energy management system (BEMS) at the department of Electrical Engineering, Chulalongkorn University (EECU)**
 - To raise awareness of individuals' consumptions
 - An informative, not an automation system
- ❖ **To study/compare people's behavior before and after BEMS installation**
 - Study demand response to control signals

Funding/Budget

❖ **Installation was supported financially by Energy Conservation Promotion Fund (ENCON Fund) under the Energy Policy and Planning Office (EPPO).**

- Supported and sponsored by several partners
- 1-year project: Sep 2013 – Sep 2014

❖ **EE Dept. takes care of**

- O&M
- System expansion
- Data analysis costs.

EECU-BEMS Members

Project Advisor (Director of Energy Research Institute)



Sensor and IEEE1888



Project Advisor (Head of Department of Electrical Engineering)



Smart Meter and Equipment Control System



Project Manager



Renewable Energy Source



System Integrator and Demand Response



Renewable Energy Source



Sensor and IEEE1888



Power Electronics



Supporters/Sponsors

- ❖ **Sensor / IEEE1888** - The University of Tokyo
- ❖ **Smart Meters** – previous projects were sponsored by MEA, PEA & EPPO
- ❖ **Application: Server/Storage/Web Application/Mobile APP**
 - NDR Solution (Thailand) – Home-brew IEEE1888
 - SEIKO Solution (Thailand) – Commercial IEEE1888
- ❖ **PV Modules** - Showa Shell Sekiyu K.K. donated 5kW CIS-type panels
- ❖ **EV Charging Station** - supported partly by Faculty of Engineering, CU

Project Design

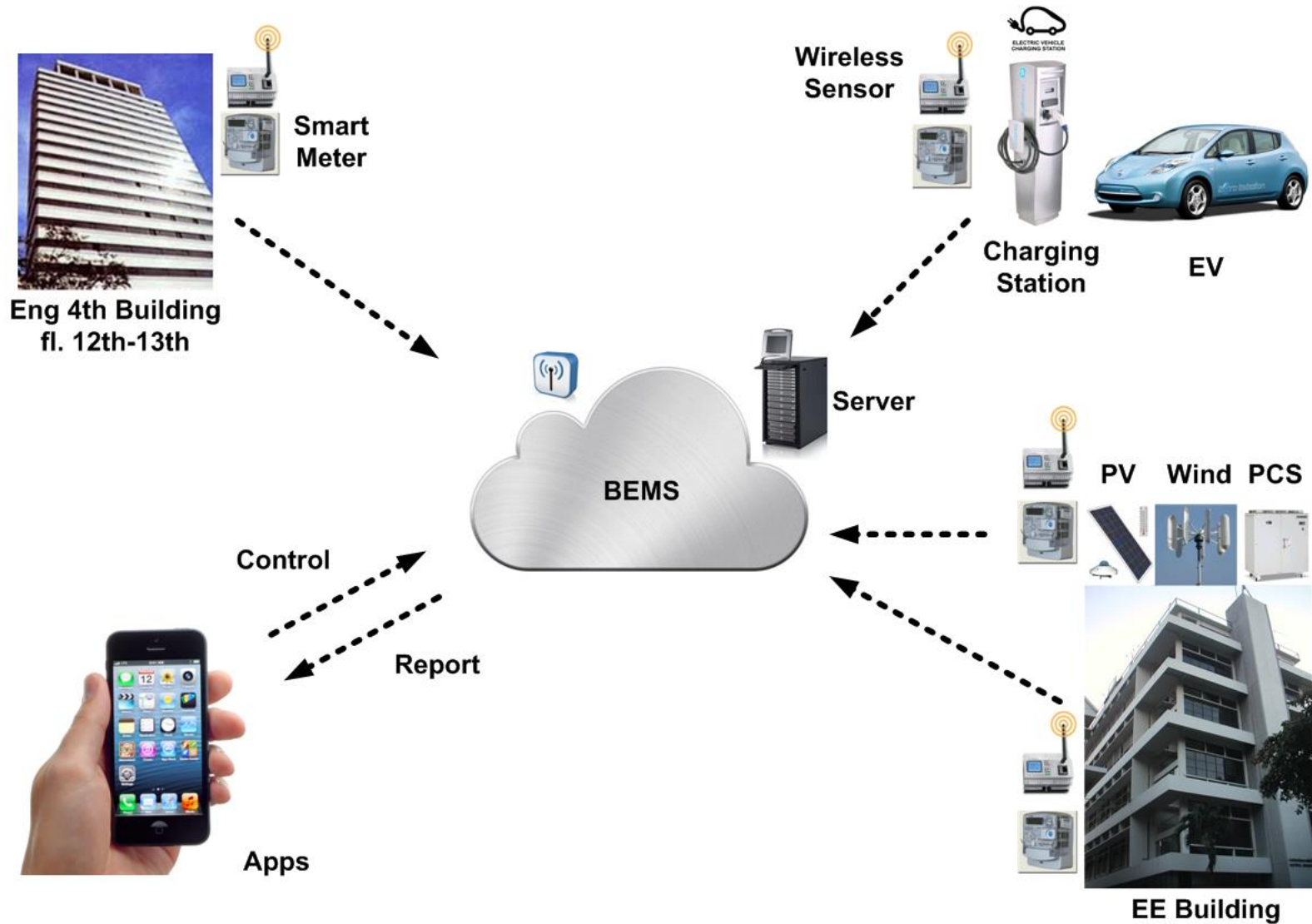


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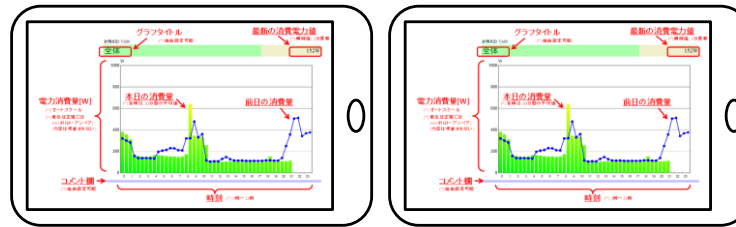
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Components



Communication & IT Architecture

Facility Status and Control
on your smartphones/Tablet



The Internet

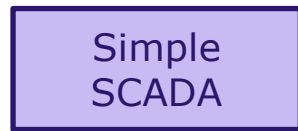


WAN



LAN

Installed by CU with UoT help

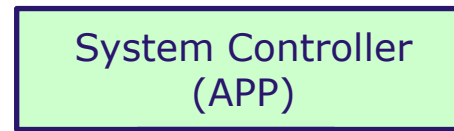


IEEE1888

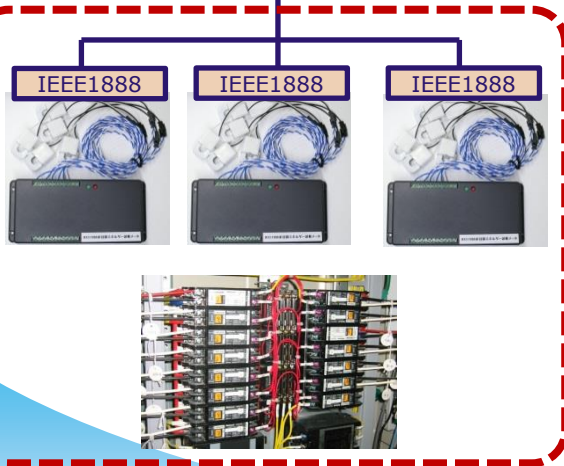


IEEE1888

Designed by CU

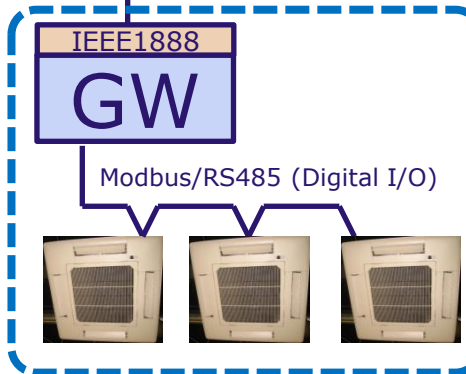


IEEE1888

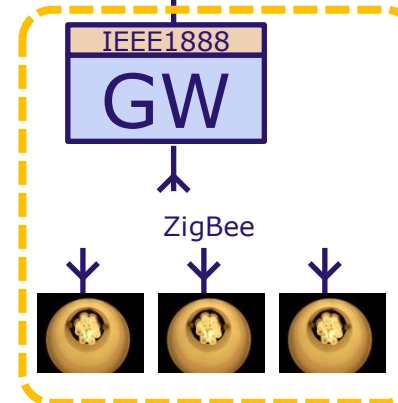


IEEE1888 Power Meters (50A,300A)

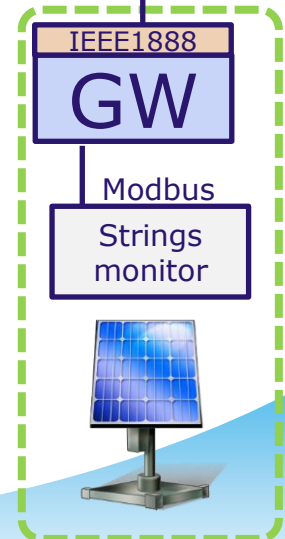
@ Power Distribution Boards



HVAC
(Air Conditioner)



Sensors



PV, Wind, Battery

Characteristics of EECU-BEMS

- Application Protocol – IEEE1888
- Sensors-to-Gateway – ZigBee or 6LoWPAN
- Gateway-to-Server – Wired or Wi-Fi LAN
- Renewable Energy Sources – PV, Very Small Scale Wind, and Energy Storage System (Battery)
- EV Charging station – (EV cars of another project)
 - Battery charge/discharge data will also be stored in the server.
- App – Android only, iOS is under development

Environment Sensors & Energy Meters

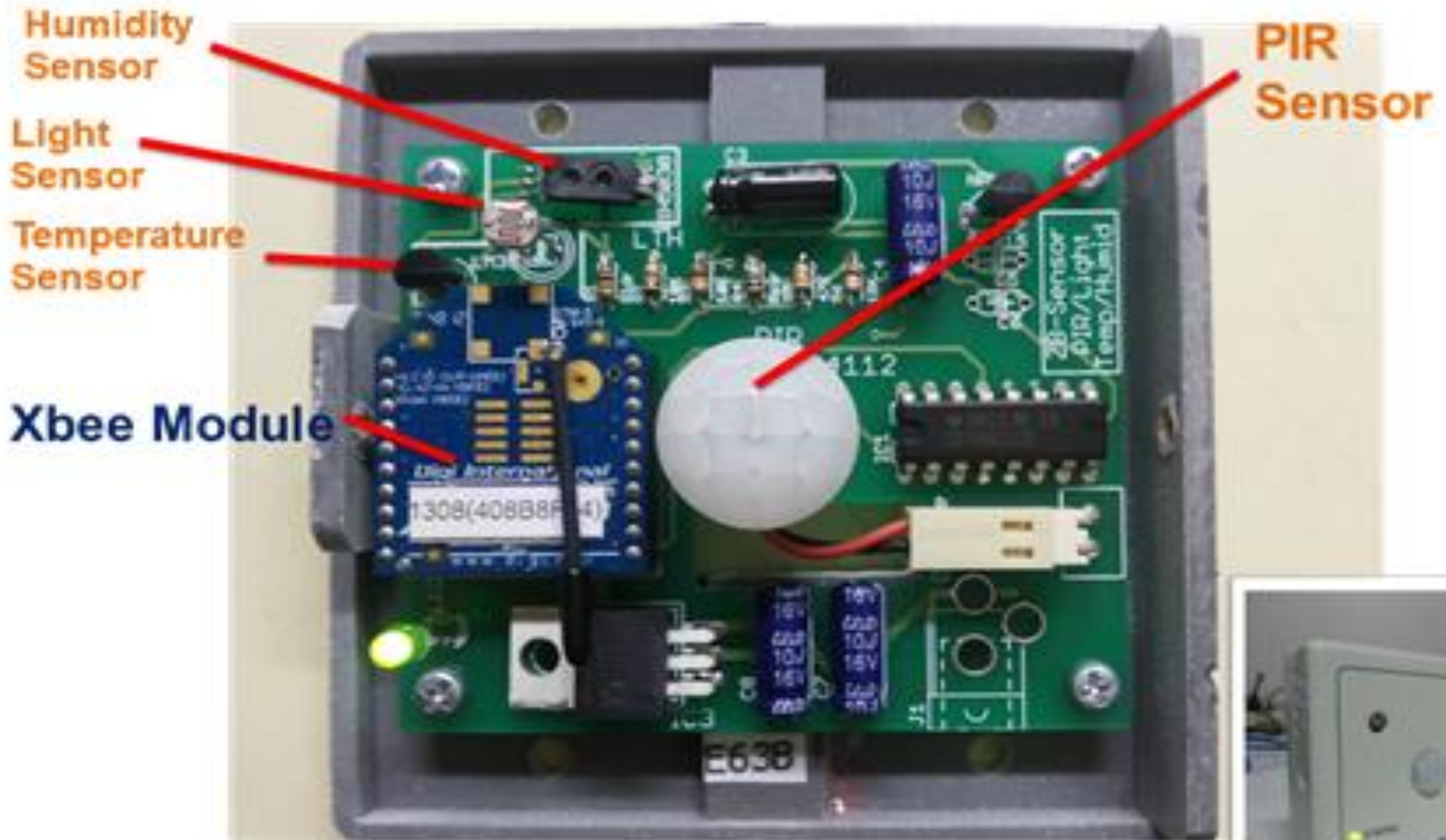


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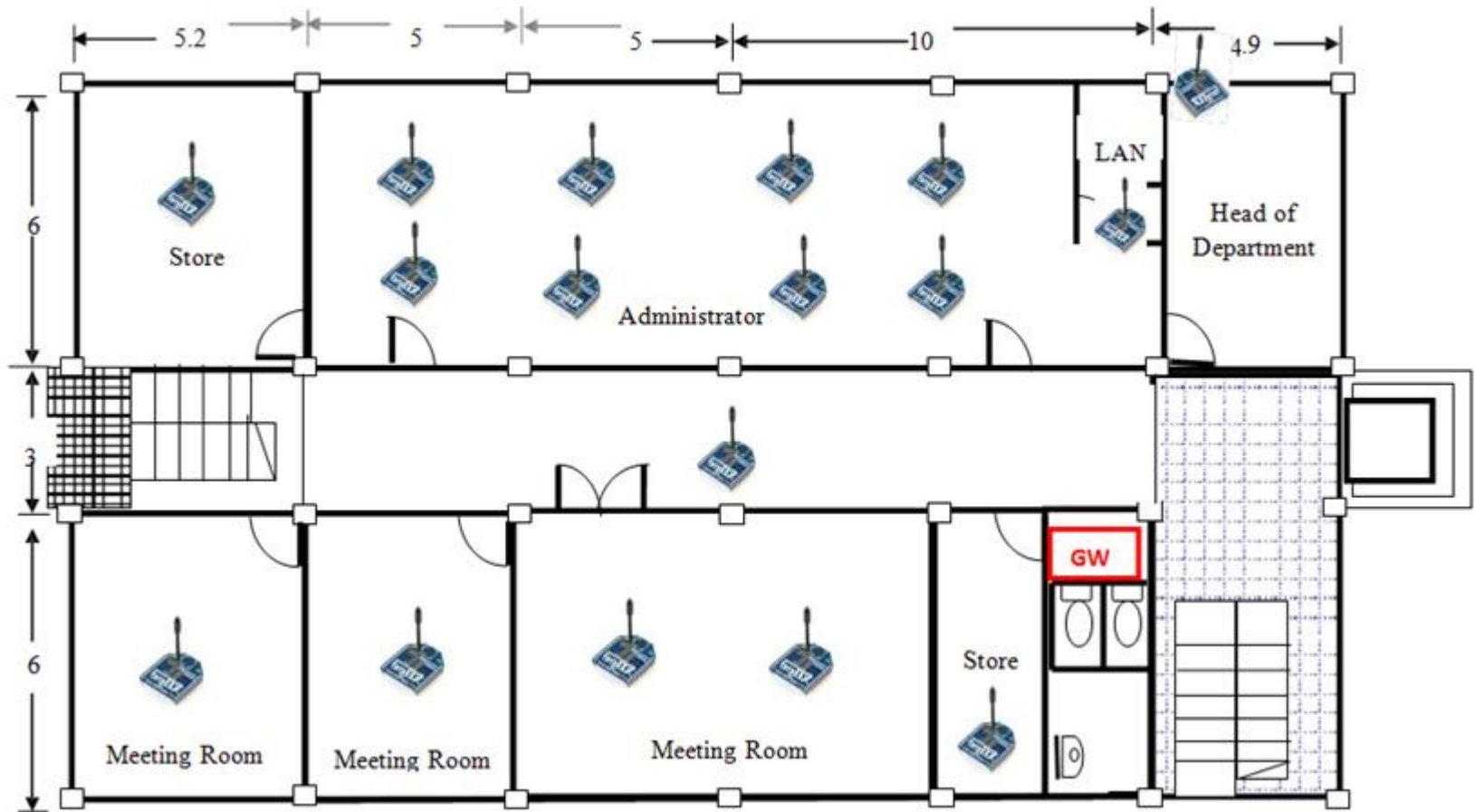
Sensor



Sensor



Sensor



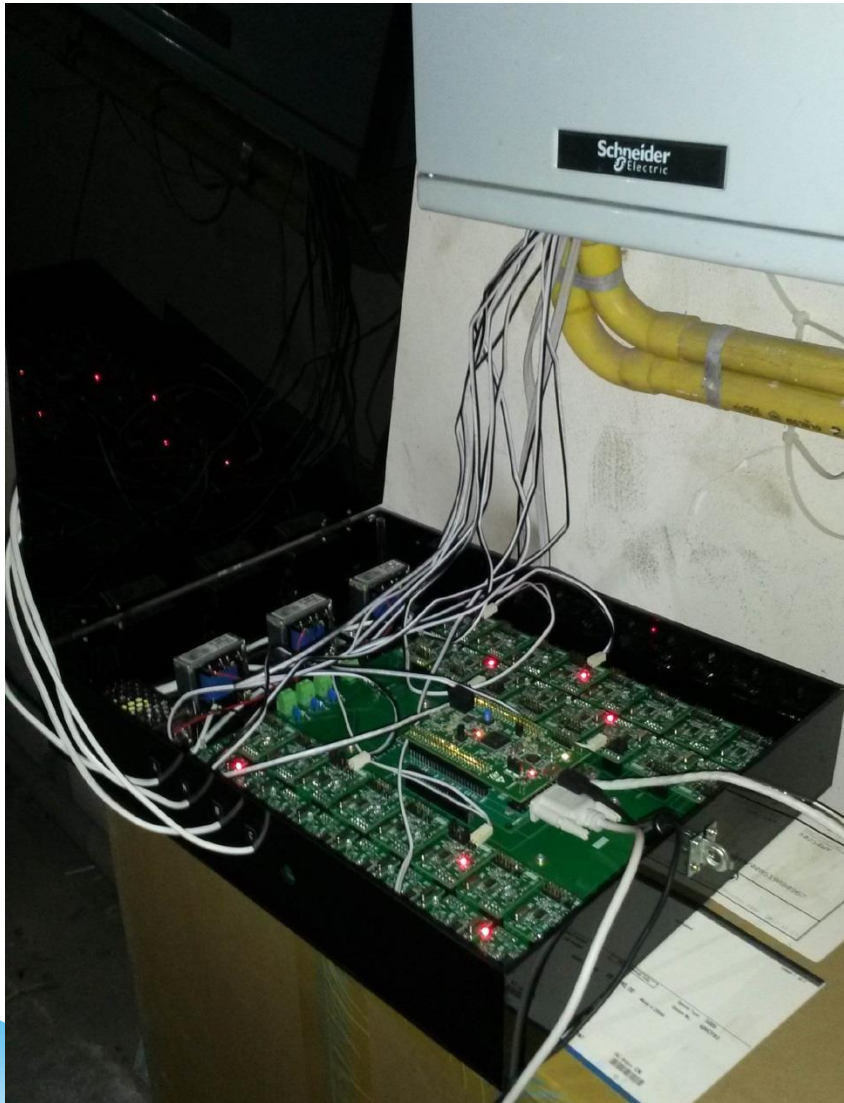
Sensor installed at 2nd floor of EE Bldg.

In-house Submeters



- ❖ With experiences, an Energy Measurement Unit (EMU) was designed.
- ❖ In a small box, there are up to 32 submeters.
- ❖ Need small additional space.
- ❖ A lot cheaper <10x
- ❖ IEEE1888-ready
- ❖ EMU V1 & V2 have been installed more than 1Y.
- ❖ EMU V3 is under development.

EMU V1 & V2



Renewable Sources Integration



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Renewable Energy Sources

PV and Micro & Wind Turbine with batteries



User Interface



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Web Application

CUBEMS

EE STATUS
OVERVIEW

ABOUT US



CUBEMS

Version : 1.2

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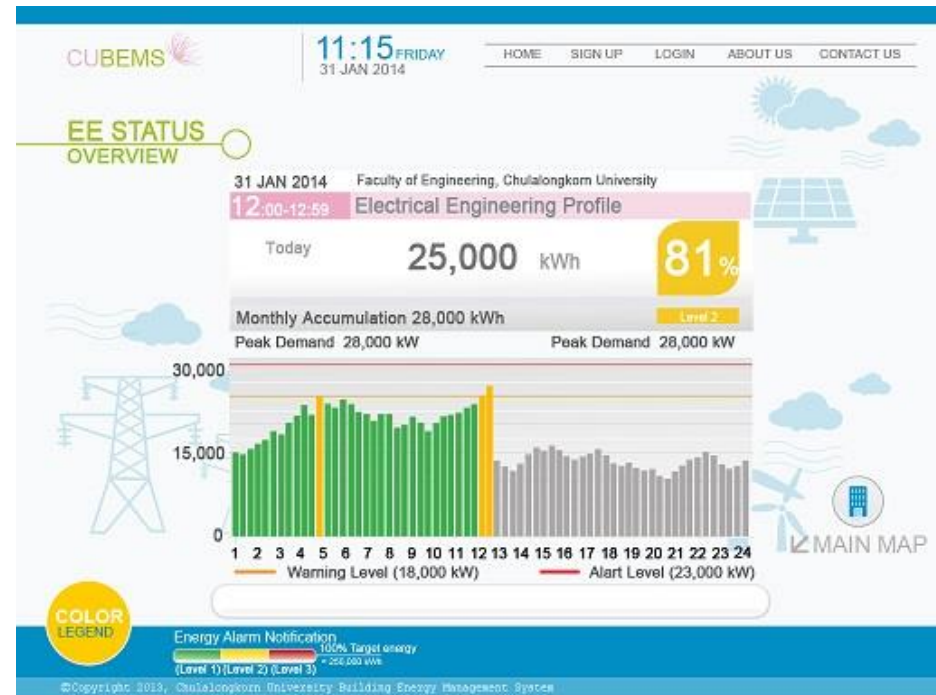
Close

Current Demand 30.2 kW

Peak Demand 32.9 kW

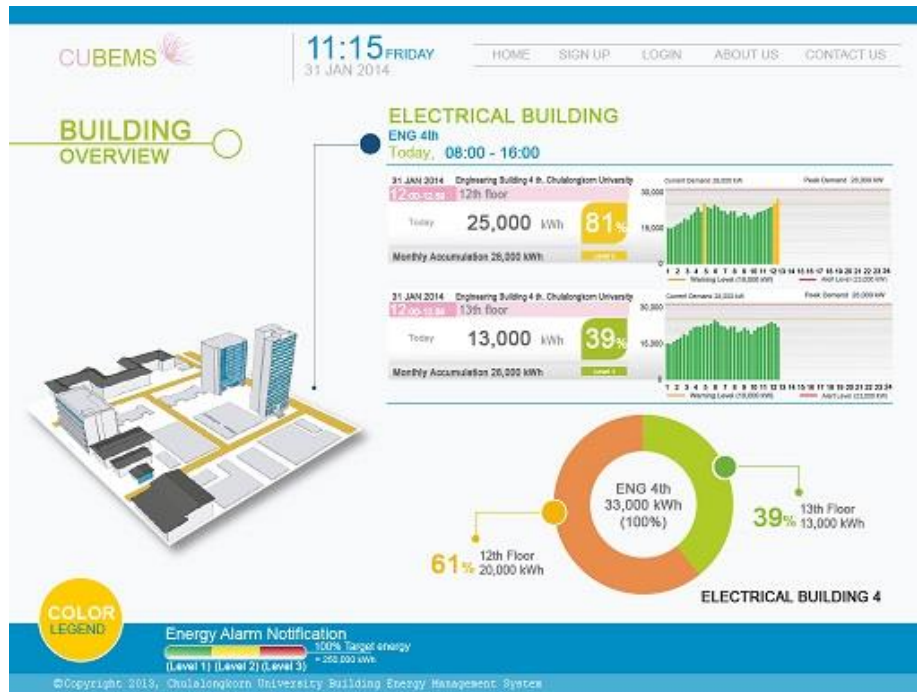


Web Application



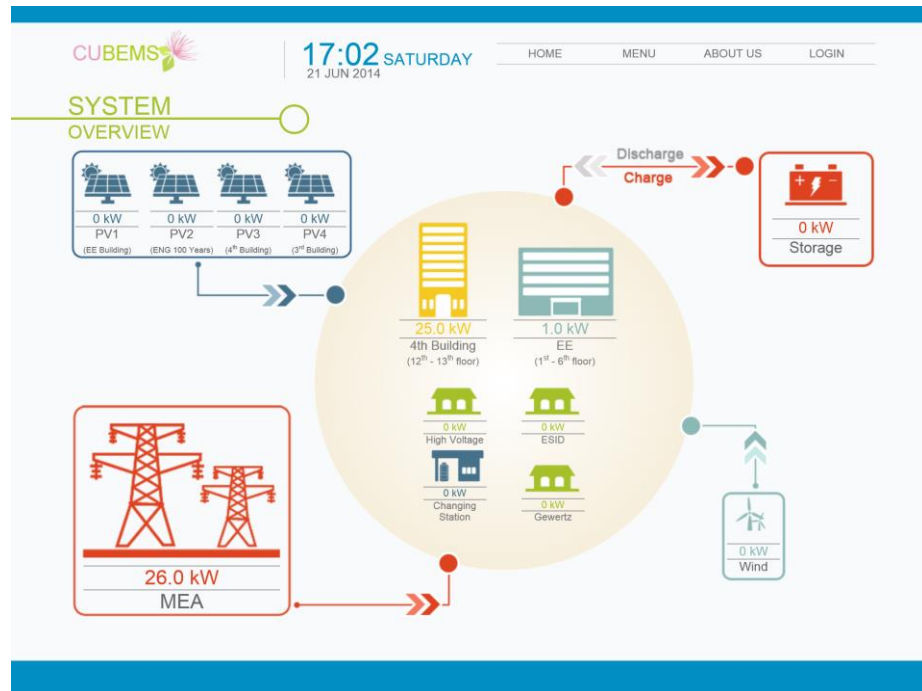
Web Application developed by EECU-BEMS Team

Web Application



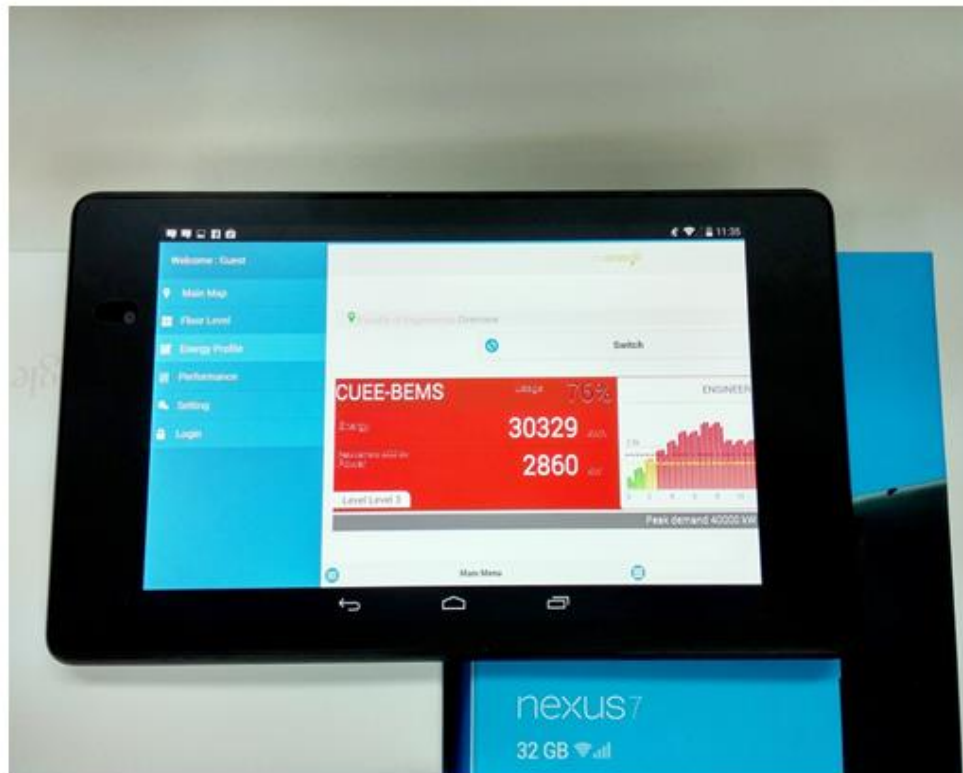
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Web Application

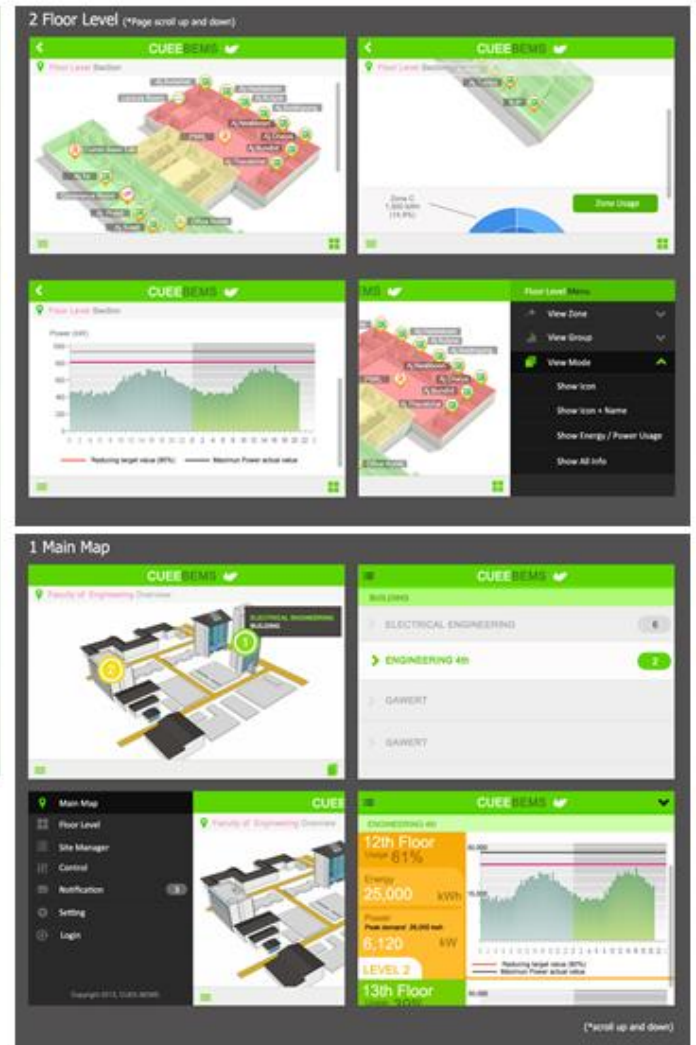


Web Application developed by EECU-BEMS Team

Mobile Application



**Android-based APP developed by
EECU-BEMS Team**



Public Display



Demand Response Trial

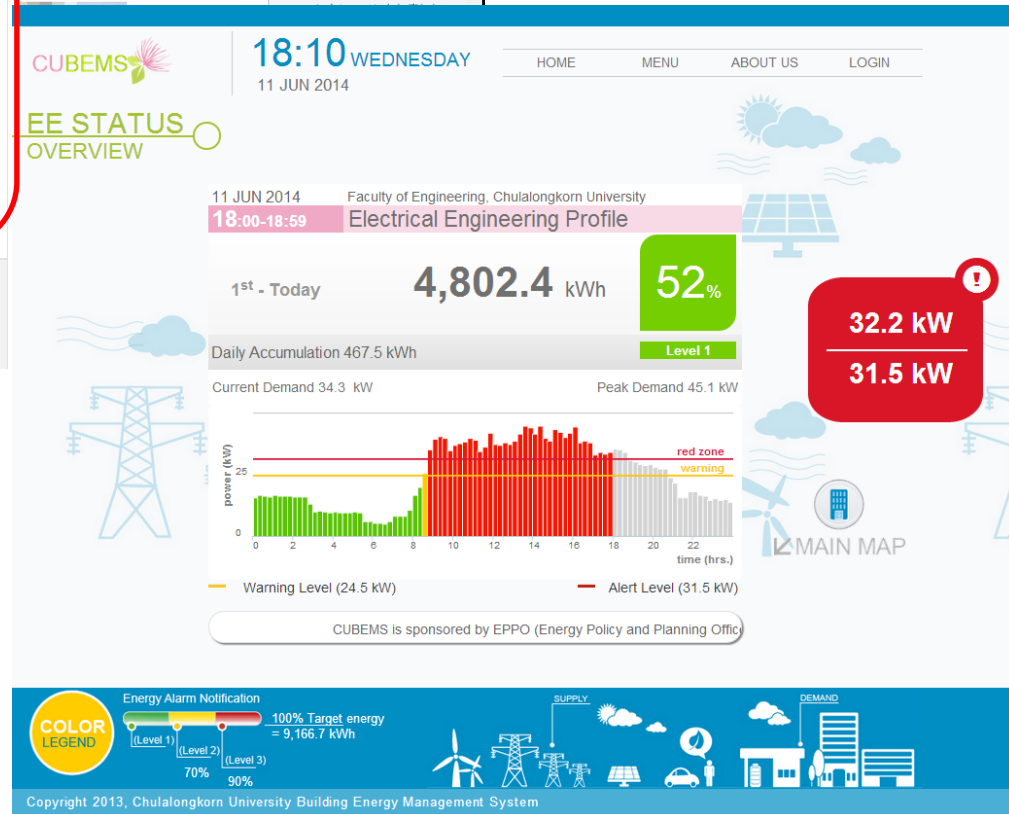


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Notification System – Link with Facebook



5-Mode Split-type AC Control

Device Setting - aircon1

Room Temperature

23.7 °C

Room Power

550 kW

Room Humidity

32 %

Manual BEMS Mode

Set Temperature °C

Min/Max Temperature °C - °C

Fan Speed

Mode

Lock Key Pad

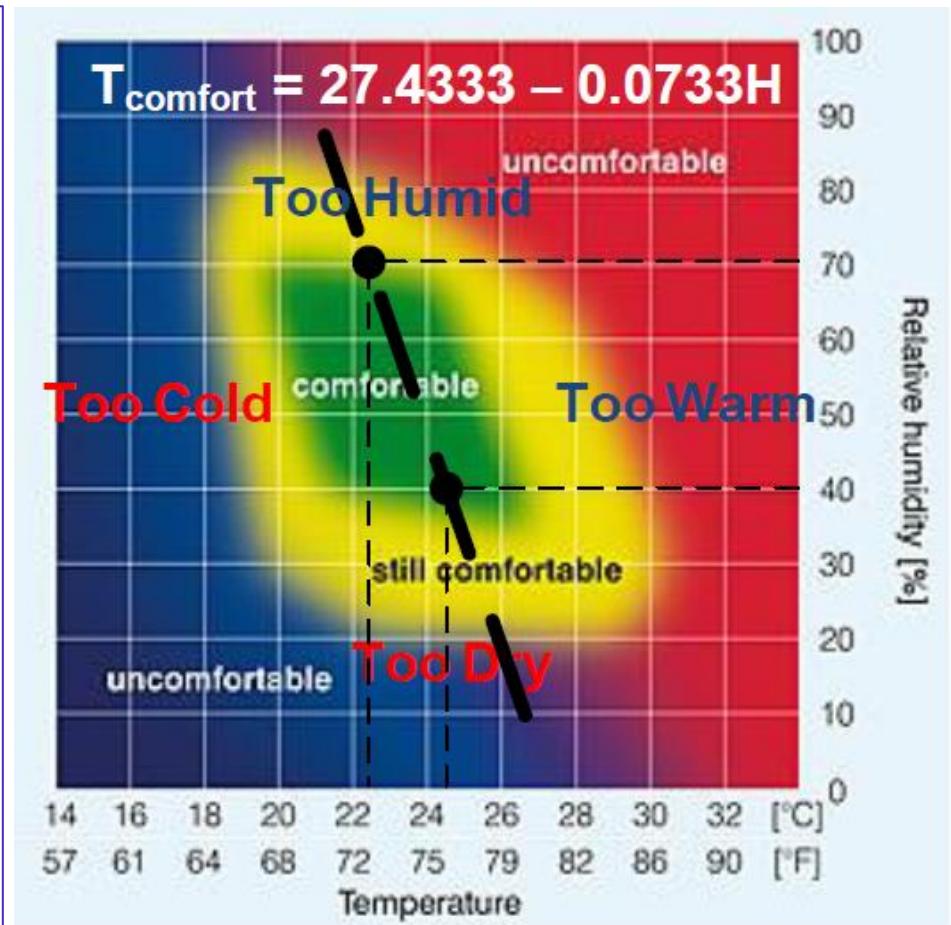
Power

Temp_Set

Fan_Speed

Mode

Power



AC Control developed by EECU-BEMS Team

Thank you



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