



Smart Lighting in the Campus: The Web Application and Data Analytics

DS3 Presentation | G27-SD2

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Outline

01

Project Concepts

- Introduction
- Motivation
- Typical Usage
- Challenges

02

Requirement Specification

- System Perspective & Description
- System Functionalities
- System Requirements

03

Design Specification

- System Architecture
- Web App / Data Analytics
- Detailed Design
- Web App / Data Analytics
- Model Test Result
- System Deployment



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PROJECT CONCEPT

01

2 Parts We Are Working On

WEB APPLICATION

Dashboard and Interface

For monitoring and controlling devices, visualizing data from sensor and devices.

WebApp APIs

For connecting with CMS API
(The smart street light controlling interface)

DATA ANALYTICS

Prediction Models

To optimize light dimming values based on campus environment data.

Prediction APIs

For sending prediction data and suitable light dimming value to adjust the street light.

MOTIVATION

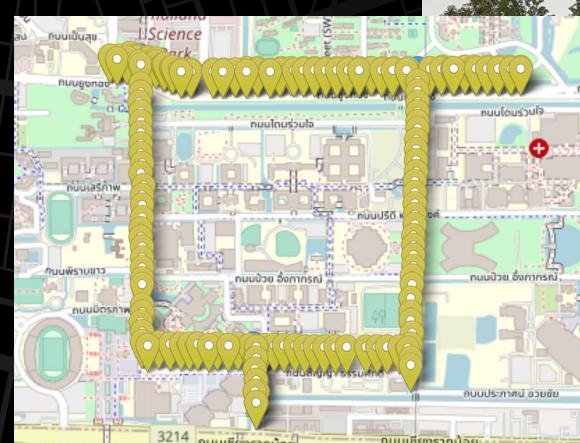
Aim at the **automatic system** to adjust the proper lighting environment for the campus.

- Collect data to predict future condition using AI-assisted ML framework (SparkBeyond).
- Send command to adjust dimming of street lights accordingly.
- Extend current infrastructure toward more intelligent and sustainable system.

Current Infrastructure and Devices

Availability in the campus

- 167 smart lighting devices along 6 main roads.
- 3 Gateways
- 1 Environmental sensor.



USERS AND BENEFITS

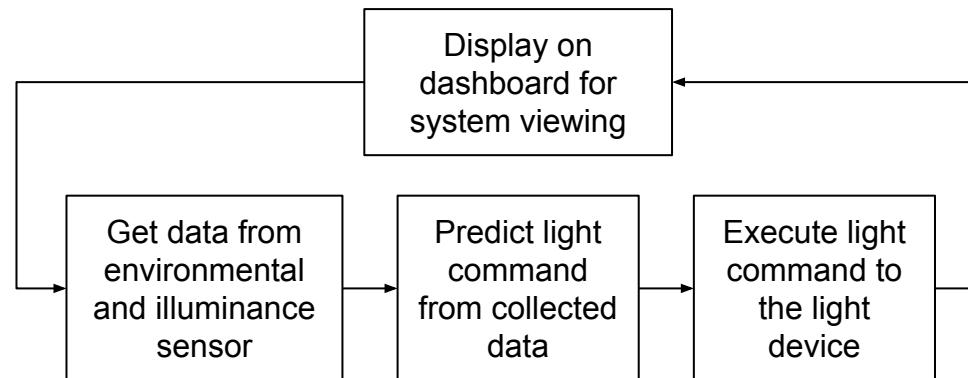
University Students and Residents

- Provide sufficient lighting.
- Improve life security and Quality of Life (QoL).

System and Maintenance Staff (University's building and ground service department)

- Easy-to-use web interface.
- Faster and easier control
- Energy saving and cost reduction
- Future power usage planning

TYPICAL USAGE



MAIN CHALLENGES



WEB APPLICATION

System Instability

Problem related to the connected electrical grid, caused devices to malfunction and data loss from weather condition.



DATA ANALYTICS

SparkBeyond Usage

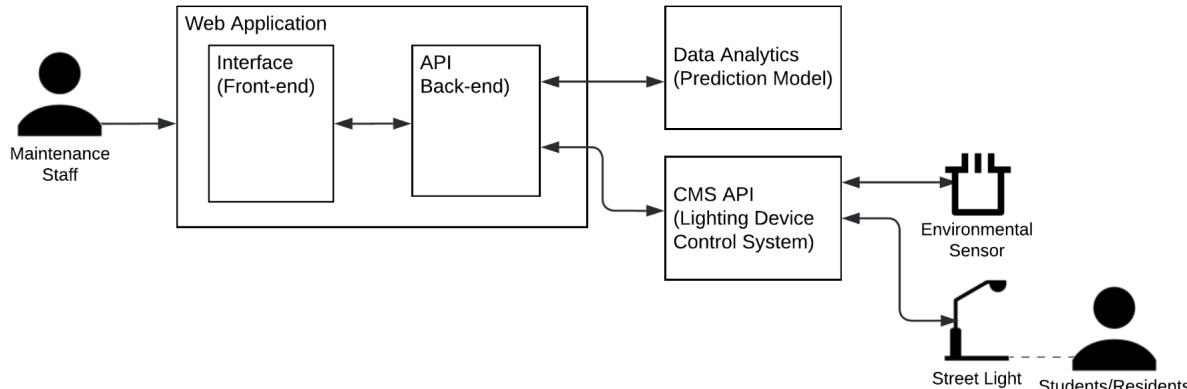
The usage of the SparkBeyond platform to create a prediction model.



REQUIREMENTS SPECIFICATION

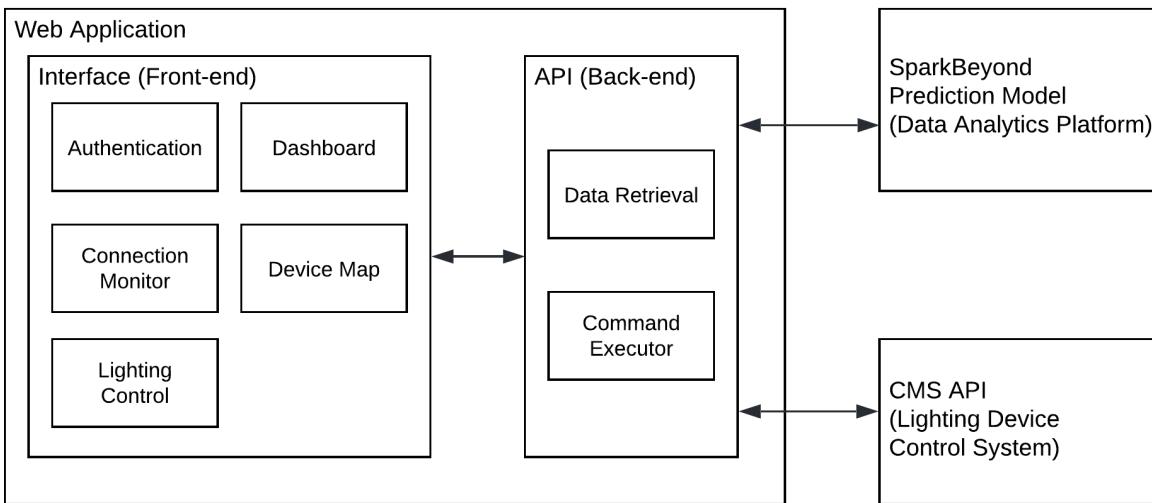
02

SYSTEM DESCRIPTION AND PERSPECTIVE



An automatic light control system that adjusts the light for the future and provide more efficient lighting in the area with web application that provides dashboard to show the data.

FUNCTIONALITIES



SYSTEM REQUIREMENTS

Web Application



- Clear and Easy to use
- Responsive Web Design
- Deploy on Cloud Platform

Data Visualization



- Display collected data from sensors and devices in graph and numerical form

Device Control



- Control light device via the web application
- Display status of devices

APIs



- RESTful API over HTTP
- Collect environmental and power usage data

Data Analytics



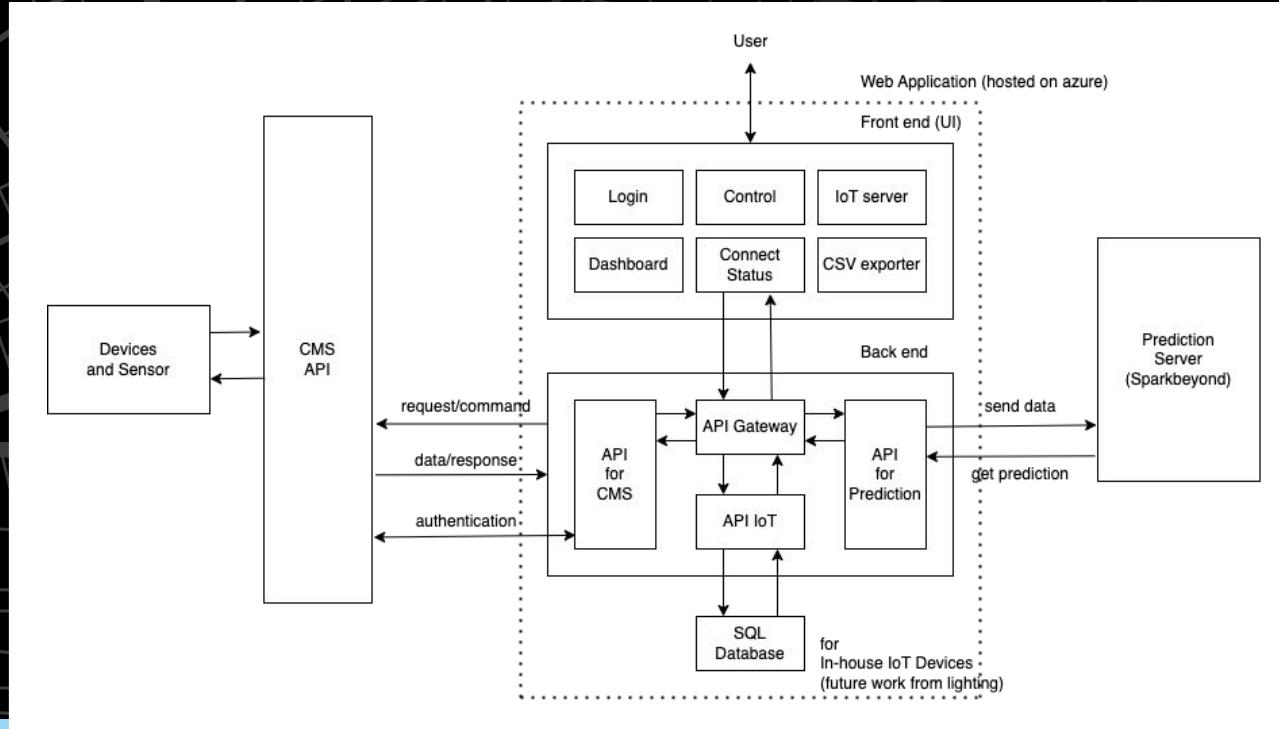
- Prediction model of future illuminance and suggest suitable dimming value



DESIGN SPECIFICATION

03

SYSTEM ARCHITECTURE: Web Application



SYSTEM ARCHITECTURE: Web Application

→ Front-end User Interface

Language: HTML / JavaScript

Bootstrap CSS → Responsive Web Design

jQuery → Event Handler

Chart.js → Data Visualization

Leaflet.js → Interactive Maps



→ Back-end System APIs

Language: JavaScript

Node.js Runtime Environment

Express.js → API Routing

Axios → Communication

SQL Database → Store Data

Azure App Service → Deployment

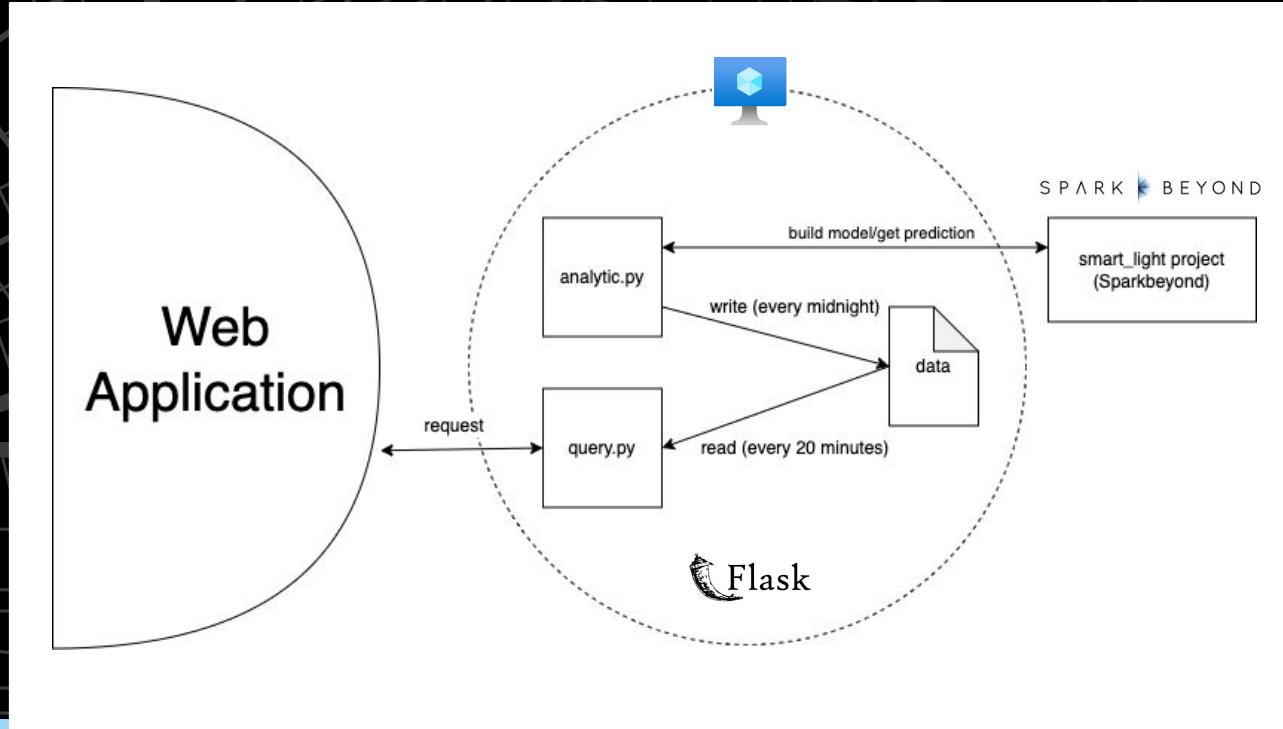


Express

A X I O S



SYSTEM ARCHITECTURE: Data Analytics



DETAILED DESIGN: Web Application

5 Main Sections

- Login + Data Download Page
- System Overview
- Device Control
- IoT Sensor Data Collection
- System and Device Status
- About Us



DETAILED DESIGN: Web Application

Login and Data Download Section

TU Smart Street Light Saturday, 19 November 2022 03:01:27

Log In

Username: virach
Password: 

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 Download Environmental Data as CSV

TU Smart Street Light Saturday, 19 November 2022 20:51:47

 Back to login page

Download Environmental Sensor Data

Download environmental sensor data in CSV format.

กรกฎาคม 2022	มิถุนายน 2022	เมษายน 2022	พฤษภาคม 2022
 Download CSV	 Download CSV	 Download CSV	 Download CSV
ธันวาคม 2022	กรกฎาคม 2022	เมษายน 2022	พฤษภาคม 2022
 Download CSV	 Download CSV	 Download CSV	 Download CSV
สิงหาคม 2022	พฤษภาคม 2022	เมษายน 2022	พฤษภาคม 2022
 Download CSV	 Download CSV	 Download CSV	 Download CSV

Ready to download at 19/11/2022, 20:51:29 | By downloading the data, you agree to the creative common license CC BY-NC-SA 4.0.

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→ Login

→ Data Download Page

DETAILED DESIGN: Web Application

System Overview Section

Saturday, 19 November 2022 03:01:59 Sign out

OVERVIEW

- System Overview
- Zone Overview
- Illuminance Report
- Environment Report
- Illuminance Graph
- Device Maps

CONTROL

- Per Device Control
- Per Zone Control

IOT SENSORS

- Sensor Record

SYSTEM STATUS

- Gateway Status
- Device Events
- Disconnection Log
- CMS Services Status

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System Overview

As of Saturday, 19 November 2022 02:56:22 Refresh

Temperature – No change 25 °c	Humidity – No change 99 %	Wind Velocity ↑ Increasing 0.95 m/s	Wind Direction – 69 °
Illuminance – No change 0.00 klx	Rain Level – No change 0	Ultra Violet A – No change 0.01 W/m²	Ultra Violet B – No change 0.00 W/m²

Temperature in the past 2 hours (°C)

Humidity in the past 2 hours (%)

<https://siit-smart-city.azurewebsites.net/illumination-sensor>

→ System Overview Page

Saturday, 19 November 2022 03:03:25 Sign out

OVERVIEW

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Zone Overview

Please select a zone first

Select Device Zone
1 - Prachasanti

Average Active Energy 🕒 02:50 459.57 kWh	Average Active Power 🕒 02:50 124.98 W	Average V RMS 🕒 02:50 220.3 V	Average Current Power 🕒 02:50 100 %
---	--	--	--

Average active energy in the past 2 hours

Average active power in the past 2 hours

As of Saturday, 19 November 2022 03:03:05

As of Saturday, 19 November 2022 03:03:05

→ Zone Overview Page

DETAILED DESIGN: Web Application

System Overview Section

Sunday, 20 November 2022 18:01:32 Sign out

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Illuminance Sensor Report

Data loaded successfully Refresh

LIGHT_1.2
205 lx

Light ID: B1000026300CEF00
Sensor ID: B1000026300CE500
As of 20/11/2022, 17:47:30

LIGHT_1.6
219 lx

Light ID: B1000026020CEF00
Sensor ID: B1000026020CE500
As of 20/11/2022, 17:47:14

LIGHT_1.12
208 lx

Light ID: B10000262A0CEF00
Sensor ID: B10000262A0CE500
As of 20/11/2022, 17:47:18

LIGHT_2.1
151 lx

Light ID: B1000026090CEF00
Sensor ID: B1000026090CE500
As of 20/11/2022, 17:47:22

LIGHT_2.13
57 lx

Light ID: B1000026190CEF00
Sensor ID: B1000026190CE500
As of 20/11/2022, 17:47:27

LIGHT_2.25
216 lx

Light ID: B1000023570CEF00
Sensor ID: B1000023570CE500
As of 20/11/2022, 17:47:31

LIGHT_3.1
172 lx

Light ID: B100002680CEF00
Sensor ID: B100002680CE500
As of 20/11/2022, 17:47:35

LIGHT_3.15
180 lx

Light ID: B100004F70CEF00
Sensor ID: B100004F70CE500
As of 20/11/2022, 17:47:46

LIGHT_3.29
54 lx

Light ID: B1000026140CEF00
Sensor ID: B1000026140CE500
As of 20/11/2022, 17:48:04

LIGHT_4.1_2
226 lx

Light ID: B100017030CEF00
Sensor ID: B100017030CE500
As of 20/11/2022, 17:47:55

LIGHT_4.8_2
147 lx

Light ID: B1000170430CEF00
Sensor ID: B1000170430CE500
As of 20/11/2022, 17:47:53

LIGHT_5.1_2
201 lx

Light ID: B100017050CEF00
Sensor ID: B100017050CE500
As of 20/11/2022, 17:48:03

Sunday, 20 November 2022 17:43:05 Sign out

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Illuminance Graph

Click this to select zone
2 - Sanya-Thammasak

Illuminance at LIGHT_2.25 in the past 3 hours

Time	Illuminance (lx)
15:47	30,000
16:03	22,000
16:17	20,000
16:32	18,000
16:47	16,000
17:02	12,000
17:17	8,000
17:32	2,000

Sensor ID: B1000023570CE500 / Light ID: B1000023570CEF00

Illuminance at LIGHT_2.1 in the past 3 hours

Time	Illuminance (lx)
15:47	20,000
16:02	16,000
16:17	14,000
16:32	12,000
16:47	10,000
17:02	8,000
17:17	5,000
17:32	2,000

Sensor ID: B1000026090CE500 / Light ID: B1000026090CEF00

→ Illuminance Sensor Report

→ Illuminance Sensor Graph

DETAILED DESIGN: Web Application

System Overview Section

TU Smart Street Light Saturday, 19 November 2022 03:04:32 [Sign out](#)

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Environment Report

Search Range
 17/11/2022 03:03 18/11/2022 03:04

Timestamp	Temperature	Humidity	Wind Velocity	Wind Direction	Illuminance	Rain Level	Air Pressure	Ultra Violet A	Ultra Violet B
2022-11-17 03:06:22	26 °C	91 %	0.50 m/s	29°	0 lux	0	1006 hPa	0.29 W/m ²	0.00 W/m ²
2022-11-17 03:16:22	26 °C	90 %	0.43 m/s	35°	0 lux	0	1006 hPa	0.32 W/m ²	0.00 W/m ²
2022-11-17 03:26:22	26 °C	90 %	0.45 m/s	26°	0 lux	0	1006 hPa	0.32 W/m ²	0.00 W/m ²
2022-11-17 03:36:22	26 °C	91 %	0.55 m/s	16°	0 lux	0	1006 hPa	0.30 W/m ²	0.00 W/m ²
2022-11-17 03:46:22	26 °C	90 %	0.49 m/s	62°	0 lux	0	1006 hPa	0.28 W/m ²	0.00 W/m ²
2022-11-17 03:56:22	26 °C	90 %	0.53 m/s	68°	0 lux	0	1006 hPa	0.28 W/m ²	0.00 W/m ²
2022-11-17 04:06:22	26 °C	91 %	0.56 m/s	60°	0 lux	0	1006 hPa	0.28 W/m ²	0.00 W/m ²
2022-11-17 04:16:22	26 °C	92 %	0.46 m/s	33°	0 lux	0	1006 hPa	0.30 W/m ²	0.00 W/m ²
2022-11-17 04:26:22	26 °C	92 %	0.53 m/s	6°	0 lux	0	1006 hPa	0.29 W/m ²	0.00 W/m ²
2022-11-17 04:36:22	26 °C	92 %	0.52 m/s	10°	0 lux	0	1006 hPa	0.30 W/m ²	0.00 W/m ²
2022-11-17 04:46:22	26 °C	92 %	0.50 m/s	45°	0 lux	0	1006 hPa	0.30 W/m ²	0.00 W/m ²
2022-11-17 04:56:22	26 °C	92 %	0.51 m/s	4°	0 lux	0	1006 hPa	0.33 W/m ²	0.00 W/m ²
2022-11-17 05:06:22	26 °C	92 %	0.53 m/s	11°	0 lux	0	1006 hPa	0.31 W/m ²	0.00 W/m ²
2022-11-17 05:16:22	26 °C	92 %	0.41 m/s	43°	0 lux	0	1006 hPa	0.29 W/m ²	0.00 W/m ²
2022-11-17 05:26:22	26 °C	92 %	0.12 m/s	15°	0 lux	0	1006 hPa	0.20 W/m ²	0.00 W/m ²

→ Environmental Data Report

TU Smart Street Light Sunday, 20 November 2022 19:14:17 [Map Loaded Successfully](#) [Refresh](#)

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Device Map

Device Lists

- [Gateway Devices](#)
- [Environmental Sensors](#)
- [Lighting Devices](#)

→ Device Map

DETAILED DESIGN: Web Application

Device Control Section

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Per Device Control

Device List
 Click this to select zone
 1 - Prachasanti
 Click this to select device
 LIGHT_11

Set New Light Power
 0% 25% 50% 75% 100% 0 Confirm

Current Device Status
 Current Selected Device: LIGHT_11 (Device ID: B1000026B00CEF00)
 Current Connection Status: Connected
 Current Report Timestamp: Saturday, 19 November 2022 03:09:03

Active Energy 461.66 kWh	Active Power 124.76 W	V RMS 210.8 V	Current Light Power 100%
-----------------------------	--------------------------	------------------	-----------------------------

TU Smart Street Light Saturday, 19 November 2022 03:09:57 [Sign out](#) [Refresh](#)

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Per Zone Control
 Please select a zone first

Select Device Zone
 1 - Prachasanti

Set New Light Power
 New light power command will be sent to all devices in the selected zone
 0% 25% 50% 75% 100% 0 Confirm

List of devices in the selected zone

#	Device Name	Device ID	Gateway Used	Active Energy	Active Power	V RMS	Current Power
1	LIGHT_11	B1000026B00CEF00	Mini-GW-SIIT-03	461.66 kWh	125.11 W	211 V	100 %
2	LIGHT_110	B10000262F0CEF00	Mini-GW-SIIT-03	459.9 kWh	125.68 W	236.5 V	100 %
3	LIGHT_111	B10000268C0CEF00	Mini-GW-SIIT-03	462.55 kWh	124.74 W	236.2 V	100 %
4	LIGHT_112	B10000262A0CEF00	Mini-GW-SIIT-03	472.38 kWh	125.59 W	236 V	100 %
5	LIGHT_12	B100002630CEF00	Mini-GW-SIIT-03	456.69 kWh	125 W	210.7 V	100 %
6	LIGHT_13	B1000026B00CEF00	Mini-GW-SIIT-03	461.27 kWh	125.32 W	211 V	100 %
7	LIGHT_14	B1000025F10CEF00	Mini-GW-SIIT-03	464.21 kWh	124.93 W	211.5 V	100 %
8	LIGHT_15	B1000026940CEF00	Mini-GW-SIIT-03	462.52 kWh	125.4 W	237.8 V	100 %
9	LIGHT_16	B1000026020CEF00	Mini-GW-SIIT-03	458.26 kWh	125.32 W	237.2 V	100 %

→ Individual Device Control

→ Individual Zone Control

DETAILED DESIGN: Web Application

IoT Sensor Data Collection Section

S Saturday, 19 November 2022 03:10:10 Sign out

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IoT Sensor Values

As of Saturday, 19 November 2022 03:10:00 Refresh

Timestamp	Temperature	Humidity	Air Pressure	Light Intensity	Infrared	UV Index	Microwave Doppler	V MQ2	V MQ4	V MQ7	V MQ8	PM 1(Env)	PM 1(Stand)	PM 2.5(Env)	PM 2.5(Stand)	PM 10(Env)	PM 10(Stand)
No data recorded.																	

0 records in past 24 hours loaded. Last Updated: Saturday, 19 November 2022 03:10:00

→ Noted that this page is the preparation for future phases of Thammasat University's smart light project.

→ Data Display Page

DETAILED DESIGN: Web Application

Device Status Section

Saturday, 19 November 2022 03:10:22 Sign out

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Gateway Status

As of Saturday, 19 November 2022 03:02:53 [Refresh](#)

Mini-GW-SIIT-01	Status: CONNECTED Disconnected Time: -
Mini-GW-SIIT-02	Status: CONNECTED Disconnected Time: -
Mini-GW-SIIT-03	Status: CONNECTED Disconnected Time: -

Environmental Sensor Status

ENV_SEN_GW_MEASURE

Status: CONNECTED
Last Known Connection Time: 19/11/2022, 02:56:22

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→ Gateway Connection Page

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Gateway Disconnection Log

Gateway disconnection log is sorted from newest to oldest.

Device ID	Log ID	Time Disconnected
DC7A7043A569E600	59	15/11/2022, 00:54:01
DC7A7043A569E600	62	18/11/2022, 03:45:56
DC7A7043A569E600	61	17/11/2022, 02:30:27
DC7A7043A569E600	55	08/11/2022, 01:46:45
DC7A7043A569E600	54	06/11/2022, 13:00:23
DC7A7043A569E600	50	02/11/2022, 02:40:23
DC7A7043A569E600	48	31/10/2022, 11:35:53
DC7A7043A569E600	45	28/10/2022, 13:15:33
DC7A7043A569E600	43	24/10/2022, 21:09:00
DC7A7043A569E600	42	19/10/2022, 10:12:55
DC7A7043A569E600	39	10/10/2022, 10:08:37
DC7A7043A569E600	38	09/10/2022, 13:31:07
DC7A7043A569E600	34	04/10/2022, 01:33:30
DC7A7043A569E600	30	29/09/2022, 10:25:20
DC7A7043A569E600	24	08/09/2022, 11:18:48

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→ Gateway Disconnection Log Page

DETAILED DESIGN: Web Application

Device Status Section

Saturday, 19 November 2022 03:11:05 Sign out

Device Events						
Select Device Zone						
1 - Prachasanti						
#	Timestamp	Event ID	Affected Device	Event Name	Event Severity	Event Code
1	18/11/2022, 17:11:57	240506	BASE_DEVICE_LM_1.6 (Device ID: B100002602000300)	CMS MSG LOST Same Event Counter: 25	⚠ Warning	23
2	18/11/2022, 08:11:50	239553	BASE_DEVICE_LM_1.2 (Device ID: B10000263000300)	CMS MSG LOST Same Event Counter: 129	⚠ Warning	23
3	15/11/2022, 05:03:33	231450	BASE_DEVICE_LM_1.11 (Device ID: B10000268C000300)	CNT SYS RADIO WATCHDOG Same Event Counter: 18	⚠ Warning	25
4	05/11/2022, 08:00:03	207234	BASE_DEVICE_LM_1.11 (Device ID: B10000268000300)	CMS MSG LOST Same Event Counter: 194	⚠ Warning	23
5	23/10/2022, 11:30:28	184272	BASE_DEVICE_LM_1.12 (Device ID: B10000262A000300)	CMS MSG LOST Same Event Counter: 3	⚠ Warning	23
6	07/10/2022, 02:01:21	165334	BASE_DEVICE_LM_1.5 (Device ID: B100002694000300)	CNT SYS RADIO WATCHDOG Same Event Counter: 17	⚠ Warning	25
7	04/10/2022, 05:18:13	158069	BASE_DEVICE_LM_1.2 (Device ID: B10000263000300)	CNT SYS RADIO WATCHDOG Same Event Counter: 16	⚠ Warning	25
8	02/10/2022, 01:47:33	153426	BASE_DEVICE_LM_1.10 (Device ID: B10000262F000300)	CNT SYS RADIO WATCHDOG Same Event Counter: 2	⚠ Warning	25
9	06/09/2022, 04:35:15	96789	BASE_DEVICE_LM_1.1 (Device ID: B10000268000300)	CNT SYS RADIO WATCHDOG Same Event Counter: 19	⚠ Warning	25
10	30/08/2022, 21:01:13	82693	BASE_DEVICE_LM_1.8 (Device ID: B1000026000300)	CNT SYS RADIO WATCHDOG Same Event Counter: 7	⚠ Warning	25

→ Device Event Page

Saturday, 19 November 2022 03:11:52 Sign out

CMS Services Status						
● UP	● Critical	CMS COMMISSIONING SERVICE Version 1.0.18	● UP	● Critical	DEVICEMANAGER Version 1.0.23	
● UP	● Critical	SLMS API SERVICE Version 1.0.17	● UP	● Critical	SLMS AUTH SERVICE Version 1.0.14	
● UP	● Critical	SLMS DEVCONF SERVICE Version 1.0.19	● UP	● Critical	CMS NETWORK MONITOR Version 1.0.16	
● UP	● Critical	SLMS DATA COLLECTION SERVICE Version 1.0.18	● UP	● Critical	CMS AUDITING SERVICE Version 0.0.5	
● UP	● Critical	CMS BATTERY MONITOR SERVICE Version 0.0.5	● UP	● Critical	CMS DAILY REPORT SERVICE Version 1.0.19	
● UP	● Critical	CMS GROUPS SERVICE Version 0.0.14	● UP	● Critical	CMS LICENSE SERVICE Version 0.0.2	
● UP	● Critical	CMS SCHEDULING SERVICE Version 1.0.14	● UP	● Critical	OTASERVICE Version 1.0.10	
● UP	● Critical	SLMS BB NETWORK MANAGER SERVICE Version 1.0.14	● UP	● Critical	SLMS EVENT MANAGER SERVICE Version 1.0.16	
● UP	● Critical	SLMS LIFETIME MONITOR SERVICE Version 1.0.14	● UP	● Critical	SLMS REPORTING SERVICE Version 1.0.17	
● UP	● Critical	CMS NOTIFICATION SERVICE Version 1.0.13				

<https://siit-smart-city.azurewebsites.net/illuminance-graph> CMS DATA ANALYZER SERVICE Version 0.0.10

→ CMS API Service Status Page

DETAILED DESIGN: Web Application

About Us Section

Saturday, 19 November 2022 03:12:07 Sign out

OVERVIEW

- System Overview
- Zone Overview
- Illuminance Report
- Environment Report
- Illuminance Graph
- Device Maps

CONTROL

- Per Device Control
- Per Zone Control

IoT SENSORS

- Sensor Record

SYSTEM STATUS

- Gateway Status
- Device Events
- Disconnection Log
- CMS Services Status

ABOUT

- About Us

 **About Us**

Project Information

Project: Innovative All-around Learning toward Smart Campus Creation under the AI Ready City Networking in RUN Project.
Under the supervision of Prof. Dr. Virach Somrertamvanich, Faculty of Engineering, Thammasat University and Dr. Somruudee Deepaisarn, School of Information, Computer, and Communication Technology, SIIT, Thammasat University.

Generated Paper:
S. Deepaisarn, P. Yiwswi, C. Tantwattanapaikul, S. Buaruk and V. Somrertamvanich, "Smart Street Light Monitoring and Visualization Platform for Campus Management", submitted to The 17th International Joint Symposium on Artificial Intelligence and Natural Language Processing and The International Conference on Artificial Intelligence and Internet of Things, 2022.

[GitHub Repository of this Project](#)

Senior Project Development Information

Under the project Smart Lighting: The Web Application and Data Analytics
DES400 Senior Project Development, Semester 1, Academic Year 2022
Digital Engineering Department, School of Information, Computer, and Communication Technology,
Sirindhorn International Institute of Technology (SIIT), Thammasat University.
Project Advisor: Dr. Somruudee Deepaisarn
Project Members: Paphena Yiwswi, Thanakit Lerttomolsakul, Sirada Chaisawat, and Leeyakorn Cheewakriengkrai

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The financial support provided by the Thammasat University Research fund

→ About Us Page

DETAILED DESIGN: Data Analytics

3 Main Steps

- Data Import and Preprocessing
- Baseline Pipeline Setting
- Context Implementation

SPARK BEYOND

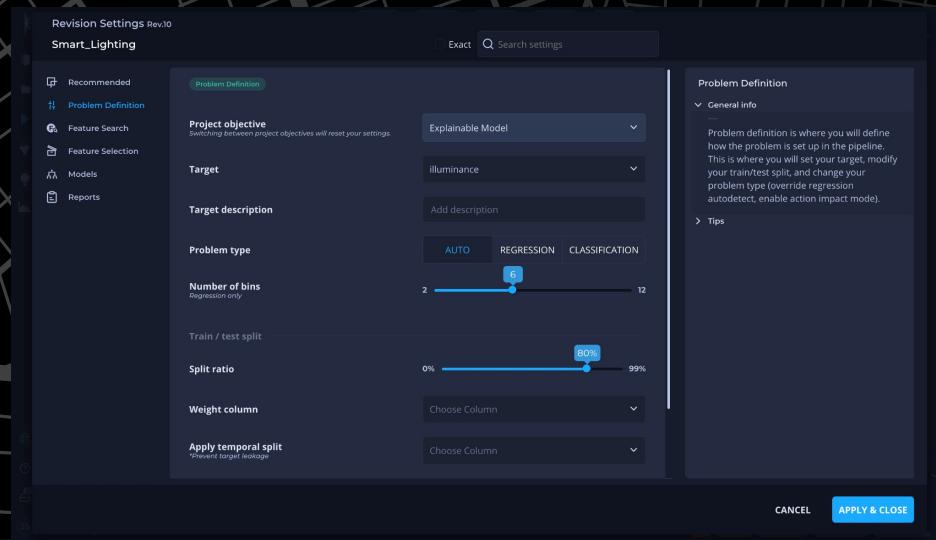
DETAILED DESIGN: Data Analytics

Data Import and Preprocessing

- Import data to SparkBeyond platform using **created API**.
- **JSON** format data, preprocess using Pandas dataframe.
- Unrelated data and dependent data (can cause overfitting) are **excluded**.
E.g. Ultraviolet A and Ultraviolet B
- Only previous **3 months** of data is used in the training set.
- Training parameters: Timestamp, humidity, temperature, air pressure, illuminance, and wind velocity.

DETAILED DESIGN: Data Analytics

Baseline Pipeline Settings



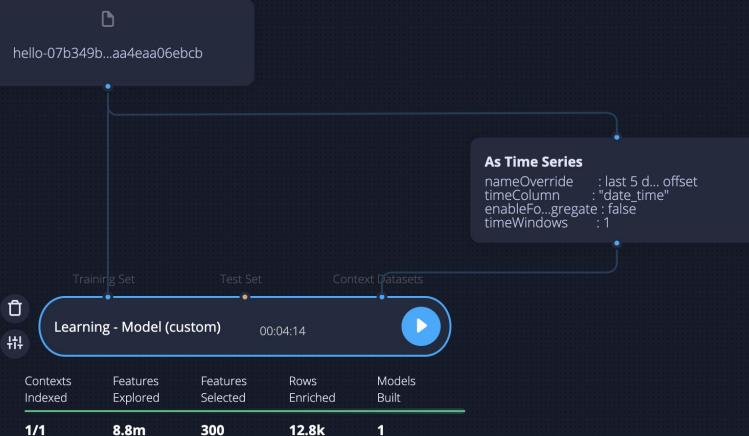
→ Pipeline Settings

Define the problem statement of the prediction model

- Project Objective: explainable model to balance between performance and interpretability.
- Data Split: Train/Test = 80%/20%
- Target: illuminance value
- Number of features: 300 potential features selected from automatic feature extraction.
- Model Selection: Gradient Boosting, XGBoost, Random Forest, Decision Tree. Compare using RMSE.

DETAILED DESIGN: Data Analytics

Context Implementation



Time series context connected

- Timestamp is extracted from the dataset.
- Different time windows size are compared using Correlation coefficient and learning time.

→ Pipeline Diagram

Test Results

- Prediction Model Test Result
 - 1. Performance across algorithms
 - 2. Performance across time window sizes

Test Results

Performance Across Different Algorithms/Models

Model comparison by RMSE (on validation set)

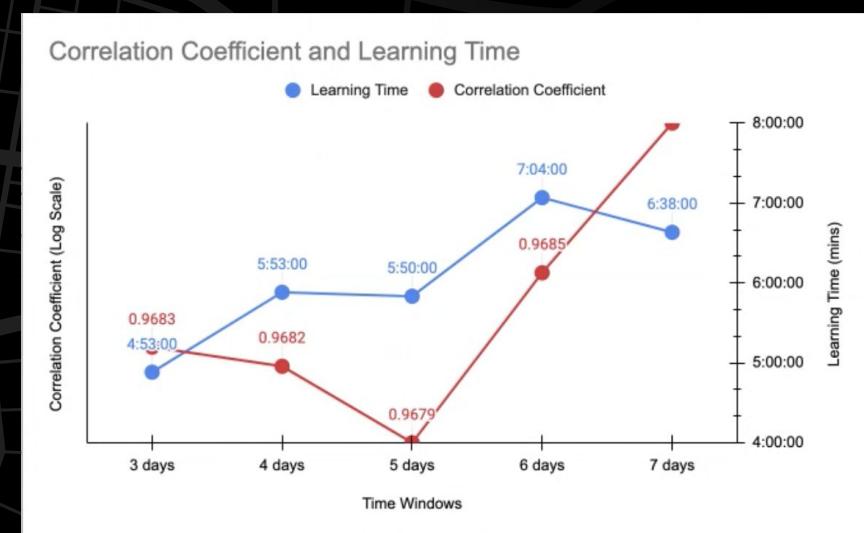
Algorithm \ Features	RMSE
Q	309
SciKitLearnGradientBoosting	9800.429
SciKitLearnXGBoost	9868.188
SciKitLearnRandomForest	10074.933
SciKitLearnDecisionTree	14438.087

→ SciKitLearnGradientBoosting perform the best due to its lowest RMSE.

Test Results

Performance Across Different Time Windows

Time Windows	Correlation Coefficient	Learning Time
3 days	0.9683	4:53:00
4 days	0.9682	5:53:00
5 days	0.9679	5:50:00
6 days	0.9685	7:04:00
7 days	0.9691	6:38:00



- No significant difference in correlation coefficient
- Increasing trend on learning time when time window size increased.
- 6-7 days time windows are selected.

*Log scale graph for correlation coefficient

System Deployment

→ Web Application *PWA/Progressive Web App Supported

<https://siit-smart-city.azurewebsites.net/>

→ Download Data Page

<https://siit-smart-city.azurewebsites.net/csv-download>

→ More Information

<https://github.com/waterthatfrozen/Smart-City>

Smart Street Light Monitoring and Visualization Platform for Campus Management

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Abstract—As a recent trend in urbanization and intelligent technologies, smart lighting systems have been implemented in many major cities to support smart urban environments. This research developed a web application platform for data visualization and lighting device monitoring at Thammasat University, Rangsit Campus, Thailand. This implementation provides administrative and operative staff with an all-in-one platform through a convenient interface for monitoring, controlling, and collecting data from area devices and sensors. Platform development was divided into two sections: back-end application, providing application programming interface (API) endpoints, and front-end application, offering an interface for interacting with on-campus staff. Finally, the web application was deployed on a cloud platform so that responsible persons may access it on any device and acquire data in real time. Given the platform's capabilities, further data analytics may be proposed for building a smarter lighting system.

Index Terms—Smart City, Light, Data Visualization, Internet of Things (IoT), Web Application

1. INTRODUCTION

Nowadays, people tend to migrate to highly dense population areas of the world. The number of people moving to such areas is predicted to account for above 60 percent of the world's population by 2050 [1]. The smart city concept is developed following the idea of the quality of life improvement and socio-economic growth of the society. The concept is based on the implementation of various smart devices such as sensors and the Internet of Things (IoT) [2] and [3]. Giffinger et al. [4] categorize smart cities into six aspects: smart environment, smart mobility, smart people, living, smart economy, and smart governance. In this work, the smart environment

the Amsterdam Smart City (ASC) project contains smart lighting devices which are capable of controlling remotely using sensors to adjust for the surrounding environments presented in the area, including weather conditions and pedestrian flow control. Their implementation of the Smart Lighting system is mainly focused on the improvement of energy saving to reduce carbon emissions [5]. Another example can be seen in Barcelona's solution to the Smart Street Lighting System. These implementation includes an LED lighting system to promote energy efficiency and cost savings [6]. The other advantages presented by the smart street lighting system are the reduction in crime rate, the promotion of life security, and quality of life improvement [7].

The management and data visualization platform is essential to the success of the smart street light system. The system establishment is required to maintain and monitor devices installed and connected in the area. Barcelona, for instance, developed the Application Programming Interface (API) to communicate with the smart lighting management system and other applications such as traffic management to exchange data across the platform [8]. It also integrated the data collection from sensors, such as meteorological data, to increase the knowledge of the city, creating an intelligent system [9].

According to the successful adoption of the smart city concept in many major cities, one of the main strategies is gaining collaboration between the public and the private sectors [10]. Therefore, we applied the strategic plan to implement the smart street light system under the smart city project at Thammasat University, Rangsit Campus, Thailand. The 167 smart light poles are installed throughout the campus with a



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Smart Street Light Monitoring and
Visualization Platform for Campus Management

-Presented on November 5th, 2022

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Thank You

Smart Lighting in the Campus: The Web Application and Data Analytics

DS3 Presentation | G27-SD2

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