



PROPOSAL

Comprehensive Air Side IoT Monitoring and Control System

Wish Ref No.

W-0209

Date

30 September 2019



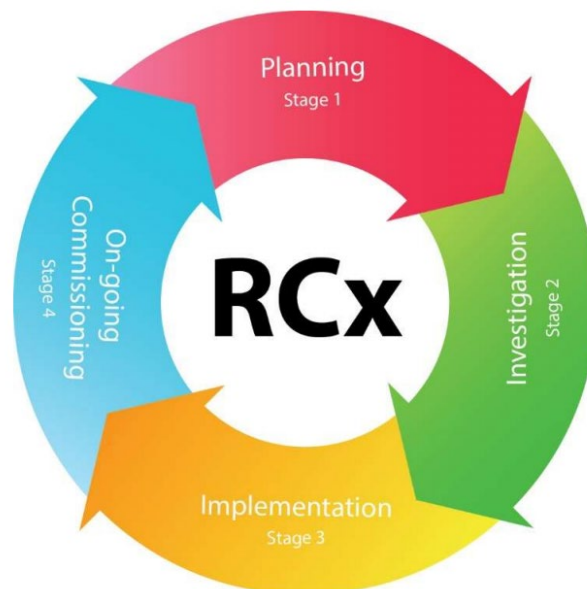
Introduction

Engineering Application Development and Services ("EADAS") is a company dedicated to providing software and integrated solutions for technological problems. EADAS is part of LR group of companies including LR Construction Technologies, LR IoT, and LR Construction and Consultancy. EADAS along with the LR group, provides comprehensive end-to-end solutions from IoT hardware to cloud based data analytics to mobile software application.

Project proposal

This proposed project is to leverage retro commissioning into air side system for an existing building. Based on the project outline, the ultimate objective is to provide a methodology utilising AI data analysis to predict air side system's need such that energy consumption can be reduced while maintaining occupants' comfort in the indoor space.

Several key performance indicators can be isolated in evaluating this project. One key metric is the power consumption of the space before and after implementation of AI based algorithms. The other is the over temperature moderation and control with the system after the implementation of the AI based algorithms. Third is the overall occupants' comfort level based on surveys and feedback from the occupants.



Leveraging the retro commissioning scheme of EMSD we propose the following for the 4 stages of this project:

Stage 1 – Planning

Prior to any further investigation or implementation, additional information must be gathered and a plan designed for full implementation.

Additional information that are required for the building of the AI and information that can improve the analysis are listed below:

General conditions

- Operating hours of the building
- Hong Kong Observatory data for the closest observation point to the building (Temperature / Humidity)
- Various specifications on the water chiller and machines related to the air side system



Indoor space conditions

- Air side system current programming and operating design
- Floor plan and size of the space
- Typical working hours of the staff in the space
- Flow of occupants in the space during the work hours, min / max occupancy and corresponding time
- Air distribution unit placement within the space
- Current monitoring and control points
- Current consumption of power within the space (aggregate and individual)

Plans for additional information

- Design questionnaire / survey for the occupants with respect to the comfort levels and area of improvements
- Potential placement of IoT devices to capture high resolution data of the indoor space
- Potential modelling of air flow based on the placement of air units and the indoor space

Stage 2 – Investigation

Investigation part of this project is to increase the quantity and quality of data for indoor space. The increase in data quantity and quality will help with the development of the AI predictive models resulting in cost/energy savings while improving occupants' comfort.

The investigations will focus mainly on the following parts:

Initial occupants' conditions

- Driven primarily based on feedback from the occupants in the indoor space
- Primarily quantitative results based on temperature, humidity, light
- Actual location within the space

Initial indoor space conditions

- Driven primarily based on IoT devices monitored conditions
 - o Leverage LR Construction Technologies IoT based AQ monitoring devices (Please see attached Appendix)
- High frequency data providing minute to minute change in monitored data in the indoor space
- Monitored data would be: Temperature, Humidity, CO2 level, PM2.5 and TVOC
- Coverage of the air quality sensors would be every 10 square metre

Historic data processing

- Based on the historic data provided, analyse the information and segregate into relevant to the AI model
- Based on 2 years of historic data provided by EMSD, various potential AI models will be utilised against the data set

Model selections

- Various AI models will be selected to process the historic and IoT data.
- Top 3 models showing greatest potential savings will be selected for further on-going testing



Stage 3 – Implementation

Implementation part of this project is to analyse the data and to actuate upon the predictive models. From the selected models in the investigation stage, the implementation will be separated into two main parts.

Part 1 – On going testing of the predictive models

Based on the select AI models from the investigation stage, on-going testing and back testing of the models will be conducted. Data will be back tested to verify model validity.

Part 2 – Implementation based on the predictive model

From the best predictive models, IoT actuation devices will be incorporated into the indoor space to implement the predictive model results. Different predictive models can be tested; however the implementation should focus on a longer term study.

The actual testing of the predictive model along with monitored environment and energy factors will be used as part of the evaluation of the success of the system. Additional information from the occupants will be collected to ascertain the improvement captured by the system.

Stage 4 – On-going commissioning

On-going commissioning will depend on the improvement from the predictive models. It is envisioned that general cases can be captured with the development of the AI predictive models. As such, other EMSD / governmental air-side systems can be retro fitted for energy and comfort improvements.

EADAS Advantage

EADAS along with LR group of companies provide numerous advantages to ensure the success of this project. Leveraging existing LR's Pyxis' Polaris cloud platform, implementation of IoT devices with real time data is turnkey in nature. Furthermore, Pyxis allows customize API points for EADAS to provide additional AI analytics to derive the potential AI based predictive models.

Another key advantage of Polaris is providing information on the system to keep stakeholders up to date without overwhelming them with data is critical to a project success. Periodic reports with the automated report system can generate customized reports. This ensures the stakeholders are informed of the salient conditions of the system.

The combined group of companies also allows for further customized development of devices for machine actuation. This allows the greatest flexibility in tackling differ systems and can realize the potential savings afforded by the AI predictive model.

Additional information on the IoT devices and the system is attached.

SAQ-IEC

Integrated Air Quality Device

The SAQ-IEC series of integrated air quality sensor suite devices consist of various combinations of electro-chemical pollutant gas sensors assorted for measurement of pollutant gases concentrations in the air. A forced air stream over the sensors enables faster response to concentration changes of various gases in the air. With “Polaris”, LRCT’s IoT Monitoring System, concentrations of various pollutant gases can be measured at pre-set time intervals and the encrypted readings are sent to cloud server for further processing or viewing in real-time by users on local pc or mobile devices.

Key features

- Cloud-based web access to real-time data
- Low power consumption
- Easy and rapid deployment
- High reliability network and data transfer
- Remotely controllable data reading and reporting rates
- Customizable for selected gases and gas sensors
- Versatile sources of power supply
- Suitable for both indoor and outdoor air monitoring

Application

- Monitoring of air quality in construction site
- Monitoring of toxic gases in confined space
- Monitoring of indoor air quality
- Monitoring of outdoor air quality
- Monitoring of air quality in laboratory and workshop



Measurable quantities

- Gases: CO, CO₂, NO, NO₂, O₃, SO₂, H₂S, CH₄, ethanol, combustible gases
- Total Volatile Organic Compounds (TVOC)
- Particulate matter (PM_{2.5}, PM₁₀)
- Temperature, relative humidity, barometric pressure

Specifications

DIMENSIONS	
Length	200 mm
Width	120 mm
Depth	80 mm
POWER	
Excitation voltage	USB Power (5 V, 1 A) – USB Mini Receptacle
MECHANICAL	
Enclosure material	Plastic
Weight	0.75 kg (with rechargeable battery) 0.50 kg (without battery)
Installation/mounting	Customizable mounting option available
COMMUNICATIONS	
Standard	3G / 4G LTE to “Polaris”
Data transmission security	End-to-end AES256 encryption for security and retransmission with CRC32 for data integrity
Collection rate	MCU-controlled automatic collection of data from sensors based on user-selected data reporting rate.
INTEGRATION	
Software	LRCT Monitoring System – Polaris (Web based)
ESD RATING	
IEC-61000-4-2, Contact discharge	30 kV
MIL-STD-883 Method 3015 (HBM)	30 kV
OPTIONS	
Battery - Internal (Optional)	USB-rechargeable 12,000 mAh battery 48 Hours of standalone operation @ 1 min reporting rate
Battery - External (Optional)	Large capacity rechargeable 72,000 mAh battery 12 days of uninterrupted operation @ 1 min reporting rate
External enclosure with solar power (Optional)	External stainless steel enclosure with photovoltaic panels enabling year-round self-sustainable operation with large capacity rechargeable 72,000 mAh battery 12 days of uninterrupted operation @ 1 min reporting rate without sunlight

Sensors Specifications

TYPE	MEASUREMENT PRINCIPLE	RANGE	PRECISION	RESOLUTION	RESPONSE TIME	OPERATING CONDITIONS		MEASUREMENT INTERVAL	
						TEMP	RH		
PM2.5	Light scattering	0 to 1000 µg/m ³	1 µg/m ³	-	6s	-10 to 50 °C	0 to 95%	As fast as 10s to user-defined interval	
Carbon monoxide (CO)	Electrochemical	0 to 1000 ppm	± 2% of reading ¹	100 ppb	15s initial, < 100ms thereafter	-20 to 40 °C	15 to 95%		
Carbon dioxide (CO ₂)	NDIR	0 to 5000 ppm	± 3% of reading	-	600s initial, 5s thereafter	-10 to 60 °C	0 to 95%		
Nitrogen oxide (NO)	Electrochemical	0 to 100 ppm	± 1.5 ppm ¹	100 ppb	-	-20 to 50 °C	15 to 95%		
Nitrogen dioxide (NO ₂)	Electrochemical	0 to 20 ppm	± 3% of reading ¹	20 ppb	100s initial, < 100ms thereafter	-20 to 40 °C	15 to 95%		
Ozone (O ₃)	Electrochemical	0 to 20 ppm	± 3% of reading ¹	20 ppb	15s initial, < 100ms thereafter	-20 to 40 °C	15 to 95%		
Total volatile organic compound (TVOC)	MEMS	125 – 600 ppb	-	-	300s initial, 11s thereafter	0 to 50°C	5 to 95 %		
Hydrogen Sulphide (H ₂ S)	Electrochemical	0 to 50 ppm	± 3% of reading ¹	< 5 ppb	< 15s	-30 to 55 °C	0 to 100%		
Ethanol (EtOH)	Electrochemical	0 to 1000 ppm	± 3% of reading ¹	< 5 ppb	< 180s	-30 to 55 °C	0 to 95%		
Temperature	MEMS	-20 to 105 °C	±0.015 °C	0.0078 °C	240ms	-20 to 105 °C	-		
Relative Humidity (RH)	MEMS	0 to 100% RH	± 0.1% RH	± 0.1% RH	15s initial, < 100ms thereafter	-20 to 70 °C	0 to 100%		
Atmospheric Pressure	MEMS	260 hPa to 1260 hPa	0.01 hPa	0.01 hPa	< 100ms	-30 to 105 °C	260 to 1260 hPa		10 mins

1. 24-bit ADC precision.

© 2018 LR Construction Technologies Limited. All Rights Reserved.

All data, product, and specifications are subject to change without notice to improve functionality, reliability, design or otherwise.

Revision: 2018(2)

POLARIS

LRCT's IoT Monitoring System

POLARIS is a software platform in the LRCT's IoT Monitoring System. It is designed for comprehensive real-time monitoring of the conditions and status at any site. Relevant data are collected by IoT enabled sensors of various types, encrypted and transmitted via internet to cloud servers where the data are stored and analysed. The software platform enables the entire process to be conducted smoothly with minimum human intervention and maximum cost benefit. It is particularly suitable for carrying out monitoring work in construction sites.



Key features

- Real-time data of IoT devices anywhere and anytime
- User friendly management interface
 - add / remove users
 - add / remove devices
 - setup warning levels
 - modify data capturing intervals
 - modify data reporting intervals
 - setup reports
- Notification to users when abnormal readings are detected
- Full integration with mobile devices
- Alerts can be configured to be device notification or email or SMS
- User can request real-time reports
- Simultaneously manage multiple projects
- Global management of projects made easy
- Add-on analytical programs for further data analyses

