AI and IOT Predictive Maintenance in Smart Monitoring System

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Predictive maintenance takes data from multiple and varied sources, combines it, and uses machine learning techniques to anticipate equipment failure before it happens. In the case of operating ICT infrastructures, making sure that ICT operation is seamlessly working uninterrupted is part of business continuity requirement. A monitoring system is usually used to assist the ICT operations using various sensors to enable real-time observation.

AI and IOT can provide high-level overview of the process involved in setting up a predictive maintenance program for any type of high-capital asset, whether heavy machinery, fleets of any kind, manufacturing equipment, and ICT infrastructure (data center, network operation center, security operation center, etc.)
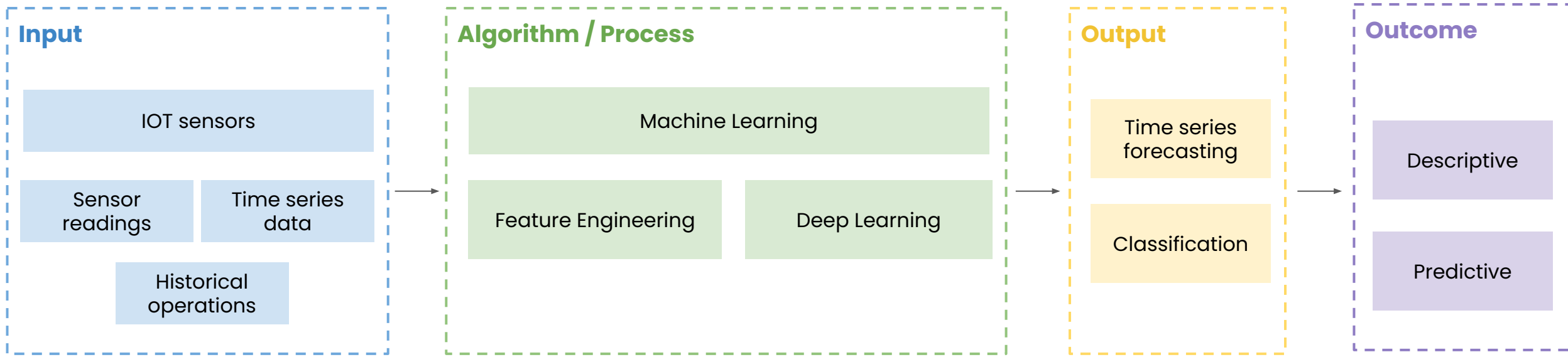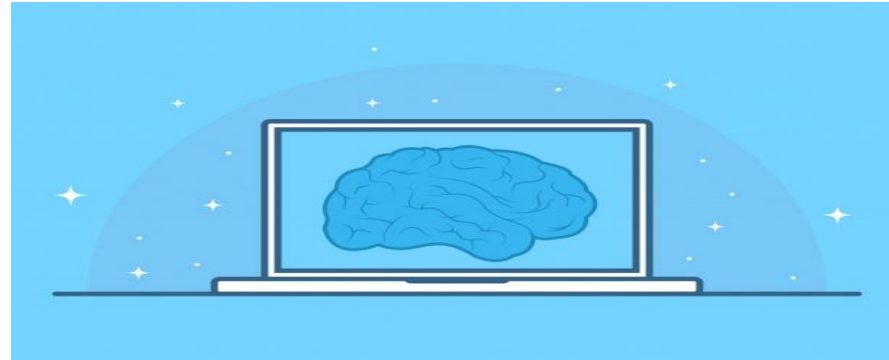
OBJECTIVES

A **smart monitoring system** (AI-driven monitoring system) is developed as a solution to provide the real-time status reading and a predictive indicator of an infrastructure. The key lies in not just simply monitoring the various time series data (which is produced by sensors), but in taking the next step and employing machine learning algorithms to take action from real-time insights.

A classification model is developed to predict the state of the monitoring target (working or failure). The sensor readings are fed into the classification model to predict whether or not the monitoring target will be in failure state in the near future.
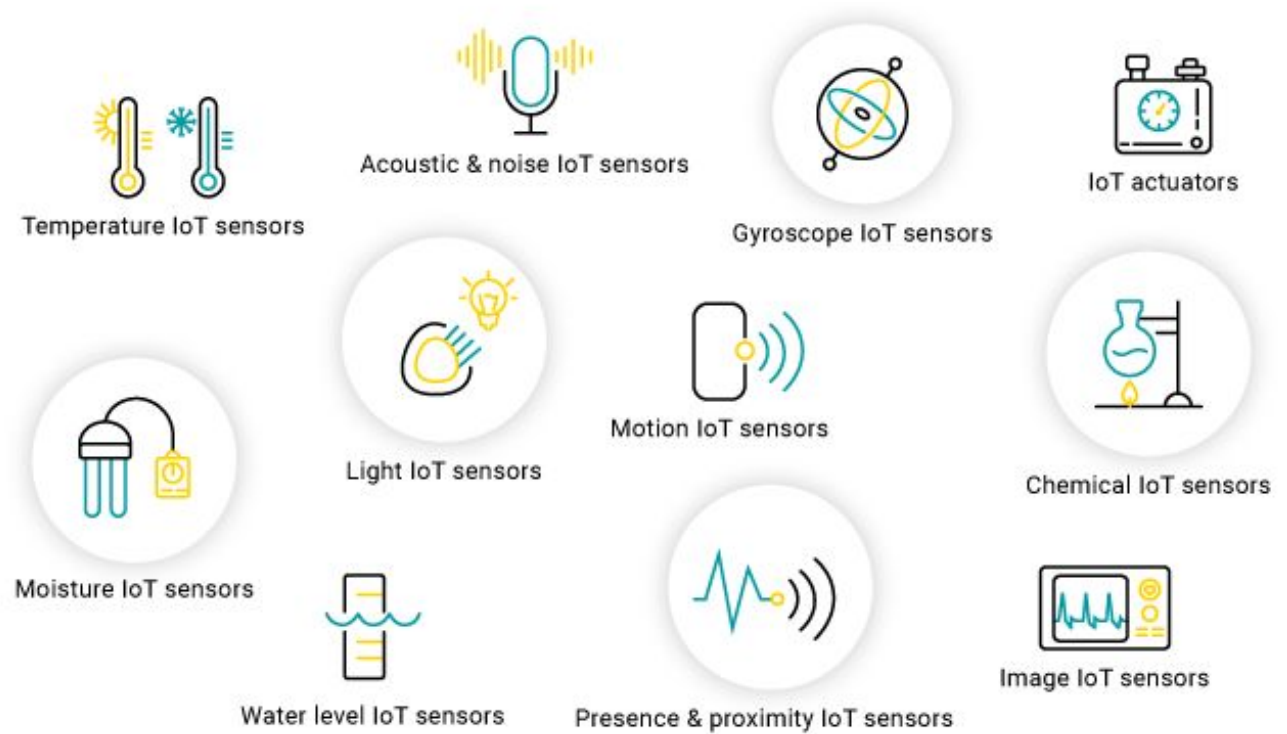
Using time series data, it is possible to predict sensor readings using Supervised Learning models such as Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU).

SYSTEM ARCHITECTURE

Input

- IOT sensors
- Sensor readings
- Time series data
- Historical operations

Algorithm / Process

- Machine Learning
- Feature Engineering
- Deep Learning

Output

- Time series forecasting
- Classification

Outcome

- Descriptive
- Predictive

IOT Sensor Readings

- Temperature
- Humidity
- Voltage

- Power
- Memory usage
- etc.

❖ Color indicator/threshold can be attributed to each sensor

❖ State of the infrastructure/IT operations (working or failure) can be determined based on the number of sensor with red indicator

Temperature IoT sensors
Acoustic & noise IoT sensors
Gyroscope IoT sensors
IoT actuators
Light IoT sensors
Motion IoT sensors
Chemical IoT sensors
Moisture IoT sensors
Water level IoT sensors
Presence & proximity IoT sensors
Image IoT sensors

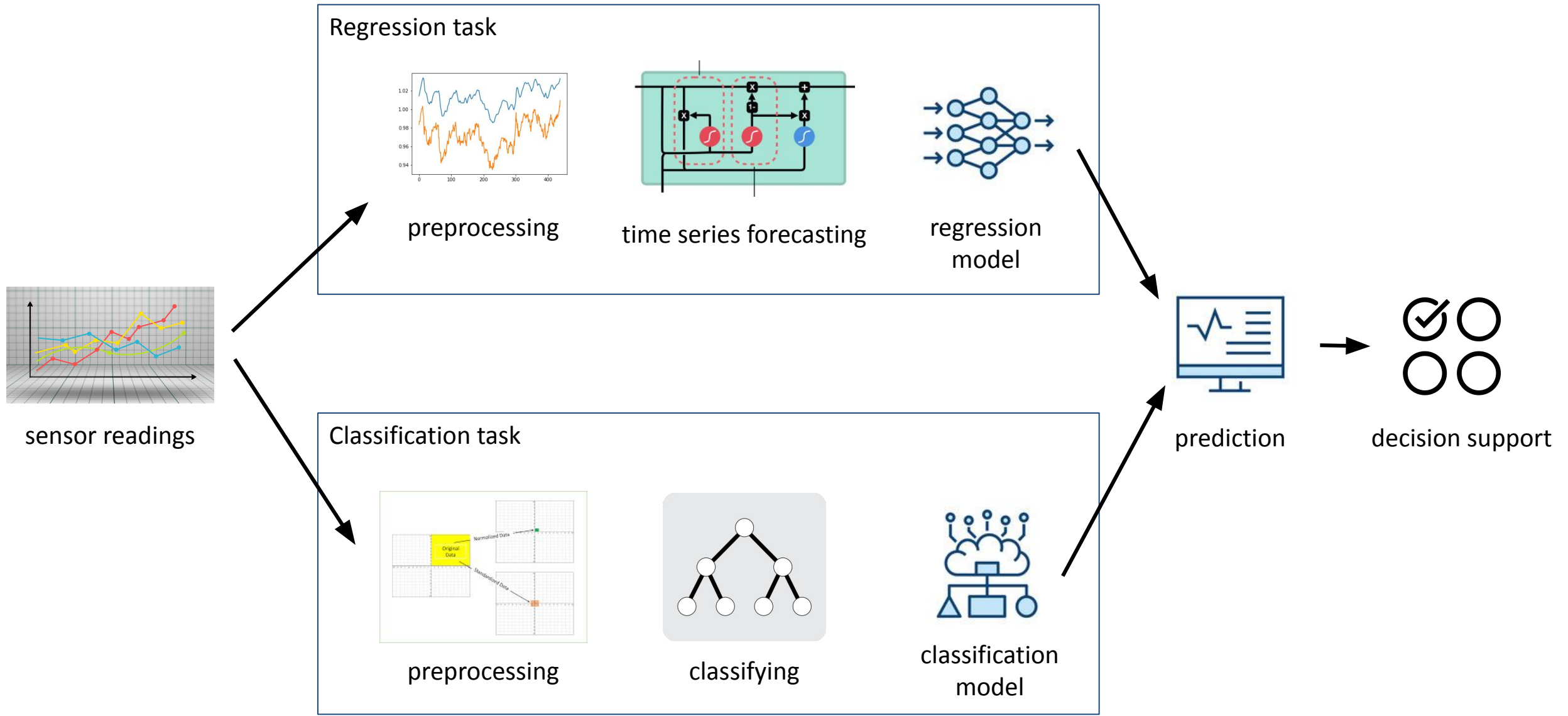|	timestamp	P_Temperature	P_Temperature_indicator	P_Humidity	P_Humidity_indicator	C_Voltage	C_Voltage_indicator	C_Temperature	C_Temperature_indicator	L_Memory	L_Memory_indicator	Red	State
83189	2022-09-17 23:06:29	39.1	yellow	52.2	blue	218.0	blue	31.6	blue	68.0	blue	0	Working
22410	2022-09-17 06:13:30	37.2	yellow	44.0	blue	224.4	blue	24.4	blue	91.0	red	1	Working
27946	2022-09-17 07:45:46	45.2	red	36.0	yellow	208.8	yellow	11.8	yellow	64.0	blue	1	Working
70769	2022-09-17 19:39:29	42.1	yellow	51.1	blue	211.8	blue	22.4	blue	76.0	blue	0	Working
88263	2022-09-18 00:31:03	15.1	blue	32.2	yellow	234.7	yellow	24.7	blue	75.0	blue	0	Working

Algorithmic Machine Learning Process
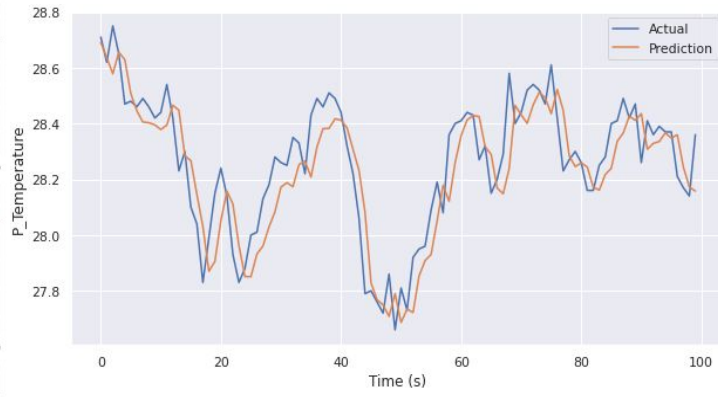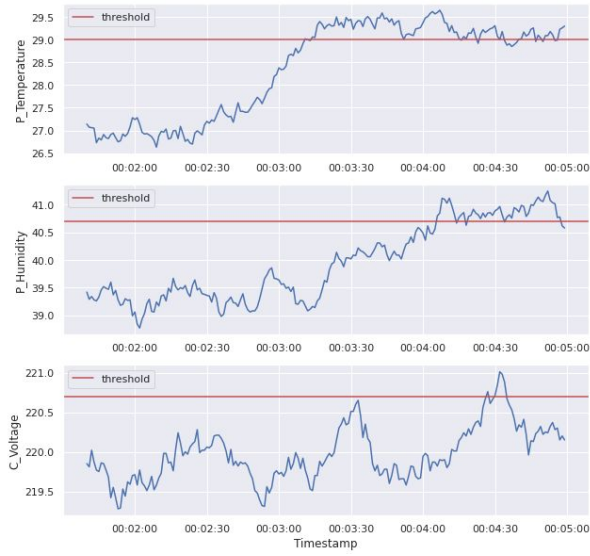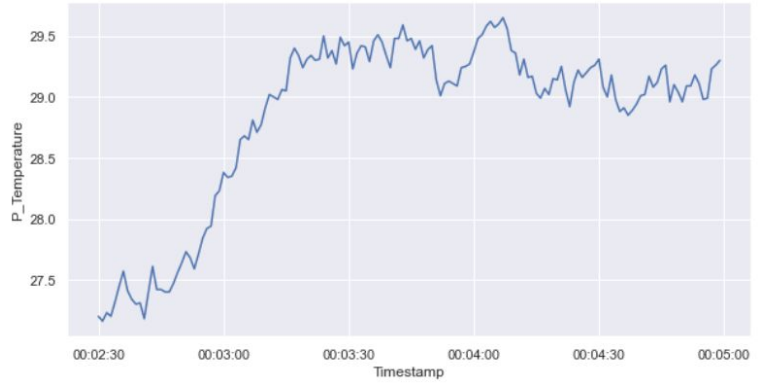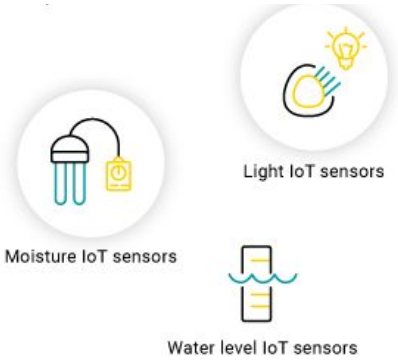
All kind of IOT sensors in ICT operations

Available features include temperature, humidity, voltage, memory usage, and so on.

Initial threshold value for each sensor

Final model can predict sensor readings in the future

Predictive Maintenance Scheme

Regression task
- preprocessing
- time series forecasting
- regression model

Classification task
- preprocessing
- classifying
- classification model

sensor readings

prediction

decision support

Dashboard: AI and IOT Predictive Maintenance

ICT system with intelligent predictive maintenance capabilities will be the mainstream in future operations of various infrastructures (ICT, manufacturing, transportation, maritime industry, etc.)

Combined with ABCD + X technologies (AI, Blockchain, Cloud, Big Data), with X such as Web3, communication protocols, sensors and embedded systems, and especially the 5G technology, then AI and IOT can accelerate innovations in the development of continuous ICT operations.

- Given the resources spent on maintenance across industry today, predictive maintenance is a critical step in reducing costs, increasing productivity, and - ultimately - staying relevant in an era where cutting-edge, data--driven businesses are gaining market share.

- Though the initial cost of implementing a predictive maintenance strategy may be steep, companies today are already proving that the returns in increased productivity plus reduced costs are a valuable return.

- AI IOT Smart Monitoring System is preliminary Use Case for ICT operation, which can be developed through further collaboration among ASEAN partners