| Hideya Ochiai, Ph.D., Associate Professor | Hongo Campus | Decentralized AI, IoT, Security, Energy |
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Ochiai laboratory studies IT systems for the new age. The year 2010s were the age of Big Data -- whereas the research demand for the new age is raising toward (1) Decentralized AI, (2) IoT Control System by AI with the advancement of AI system on chip technology. The demand for (3) IoT/LAN security is also increasing.

## 1. Decentralized AI – Fully Autonomous and Collaborative ML

Machine learning originally used the user data collected at a central server and trained a model, which is now getting possible to train a global model without extracting data from the local devices of users, as federated learning does. Ochiai laboratory has successfully made it fully decentralized as a peer-to-peer distributed AI. There are many machine learning models, which should be targeted for decentralization in our laboratory, in the future.

Please also refer to: https://github.com/jo2lxq/wafl/

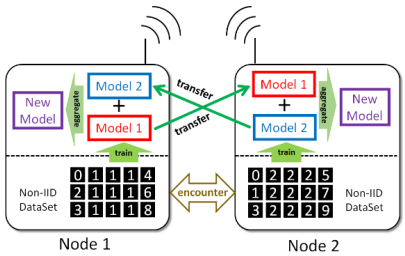


Fig. 1: The Most Basic Peer-to-Peer Federated Learning

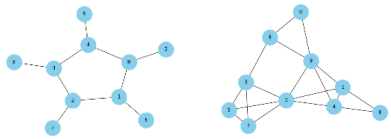

Fig. 2: Topologies for Peer-to-Peer Federated Learning

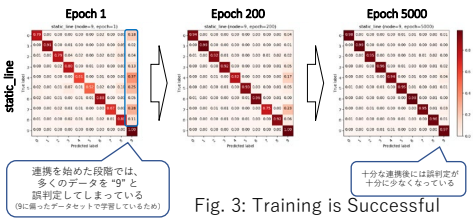


Fig. 3: Training is Successful

## 2. IoT Control System empowered by AI

The evolution of AI also exhibits its ability in controlling our physical worlds (in the context of cyber-physical systems). Ochiai laboratory studies “logic free automation system”, which allows system control without pre-defined logic.

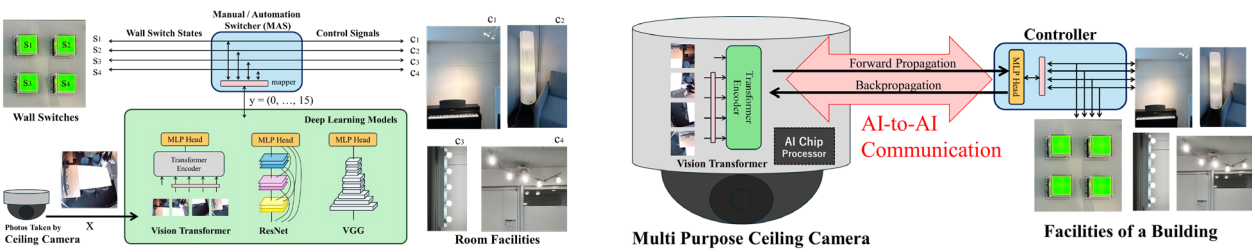


Fig. 4: Logic Free Building Automation (Left), and it’s distributed form (Right)

## 3. IoT/LAN Security

A local area network (LAN), an edge of computer networks, has varieties of connected devices including IoT devices. We have seen suspicious activities in LANs caused by sophisticated cyber attacks dwell in the complex computer systems. By constructing a collaboration scheme with the universities around ASEAN-region from 2018s, we collect such suspicious activities made in LANs, and develop a taxonomy of suspicious device-to-device communications inside a LAN. We also develop a detection system against the attacks to operational technology (OT) systems.

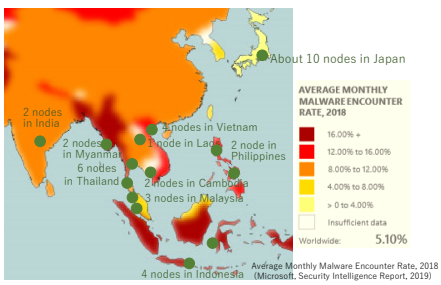


Fig. 5: Security Observatory Network Developed in ASEAN-Region

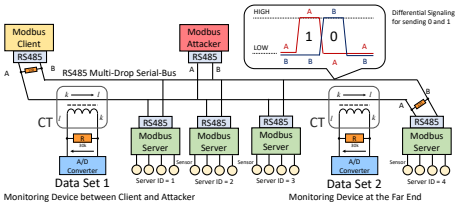


Fig. 6: OT-Security Management System