Edge Intelligence for the Next-generation IoT Systems

Lecturer: Giancarlo FORTINO, Ph.D. & Dist. Professor

The Distinguished Lecture was delivered at Wuhan University of Technology at 9:00 in the morning of Apr. 1, 2024. It attracted over 70 IEEE and non-IEEE members across the section and postgraduate research students. Figure 1 is on-site view. The topic of the lecture is “Edge Intelligence for the Next-generation IoT Systems”. Here is a brief introduction of the lecture.

The Edge Intelligence (EI) paradigm has recently emerged as a promising solution to overcome the inherent limitations of cloud computing (latency, autonomy, cost, etc.) in the development and provision of next-generation Internet of Things (IoT) services. Therefore, motivated by its increasing popularity, relevant research effort was expended in order to explore, from different perspectives and at different degrees of detail, the many facets of EI.

In such a context, the first part of this lecture was to analyze the wide landscape on EI by providing a systematic analysis of the guidelines of the PRISMA methodology. In this direction, this lecture presents the definition and the first implementation of Opportunistic Digital Twin (ODT), a novel concept at the confluence of Digital Twin (DT), synthetic sensing, and EI aimed to simplify the (re)engineering of large-scale distributed smart systems by moving complexity from hardware infrastructure to the software layer. The key building blocks of this approach are introduced, which are highly innovative since bottom-up, data-driven, and multidisciplinary.

Next, the lecture used the Horizon Europe project "MLSysOps" as a case study to further explain the practical application and theoretical exploration of EI. The main objective of MLSysOps is to design, implement and evaluate a complete AI-controlled framework for autonomic end-to-end system management across the full cloud-edge continuum. MLSysOps employ a hierarchical agent-based AI architecture to interface with the underlying resource management and application deployment/orchestration mechanisms of the continuum. The framework will be evaluated using research testbeds as well as two real-world application-specific testbeds in the domain of smart cities and smart agriculture, as shown in Figure 1, which will also be used to collect the system-level data necessary to train and validate the ML models, while realistic system simulators will be used to conduct scale-out experiments.

Finally, the lecture introduced “The EdgeMiningSim Methodology for EI-driven IoT Systems”, a simulation-driven methodology inspired by software engineering principles for enabling IoT Data Mining. Such a methodology drives the domain experts in disclosing actionable knowledge, namely descriptive or predictive models for taking effective actions in the constrained and dynamic IoT scenario. A Smart Monitoring application is instantiated as a case study, aiming to exemplify the EdgeMiningSim approach and to show its benefits in effectively facing all those multifaceted aspects that simultaneously impact on IoT Data Mining.

Fig.1. on-site picture

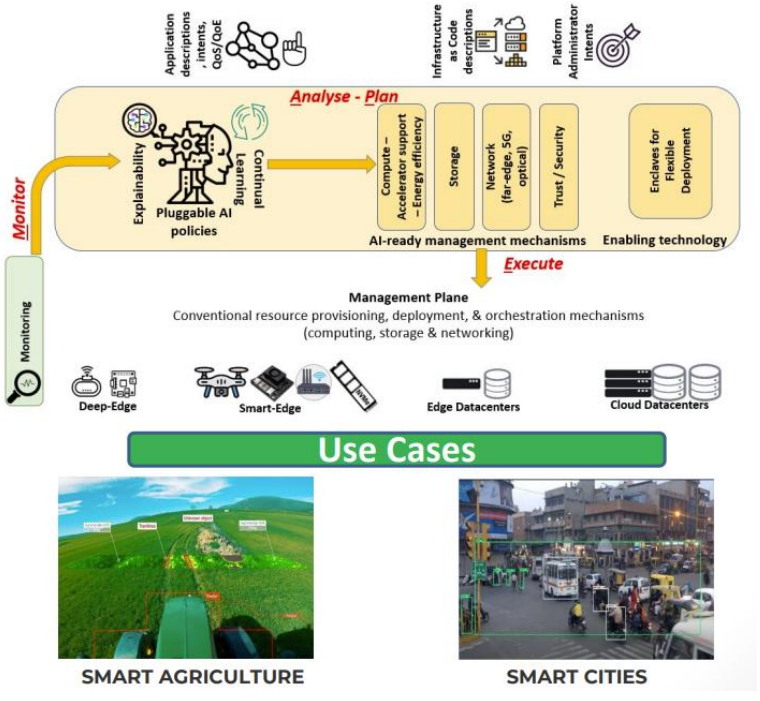

Fig.2. MLSysOps project diagram