Development of Cloud-Edge Cluster Framework based on Microservice Architecture

Jongbin Park
Information Media Research Center
Korea Electronics Technology
Institute
Seoul, South Korea
jpark@keti.re.kr

Abstract— This paper is about a framework technology for building a cluster with cloud and edge devices and performing application services such as federated learning and distributed inference in the built cluster. The complexity of development and management increases to manage heterogeneous edge devices as a DB, organize them into clusters, and provide communication interfaces such as Restful APIs. In addition, the integration of continuous integration/continuous delivery (CI/CD) capabilities has become essential, along with the need for a simplified communication paradigm between cloud and edge nodes, strong data integrity, and hardened security protocols. To effectively solve this multifaceted problem, this paper implements the system in a microservice architecture way. Deploy and manage resources in the cloud and on edge nodes within clusters built using the principles of microservice architecture. And it enables the application of load balancing, resource allocation, and workload distribution strategies that are carefully tailored to meet the unique requirements of high-level application scenarios, enabling service context to adapt to the needs of computing resources and fluctuating network conditions.

Keywords— cloud-edge cluster, microservice architecture, federated learning, distributed inference

Recent Results

Microservice architecture is an architectural style that divides systems into small, lightweight pieces and composes them into smaller services that perform different business functions. It is an evolution of the traditional service-oriented architecture [1]. This paper proposes a cloud-edge cluster framework using microservice architecture. Through this, it builds a cluster for computational processing and performs federated learning or distributed reasoning [2]. Implementations compose modular services with docker-compose. Specifically, the nginx container module constructs a cohesive system while enhancing security by interconnecting modularized services in a reverse proxy manner. Perform training, inference, and monitoring using MariaDB, Restful API modules, Redis DB, Ansible, Grafana, Prometheus, and Node Exporter modules. Figure 1 shows a diagram of the system architecture and an example of monitoring the computational resources of the server.

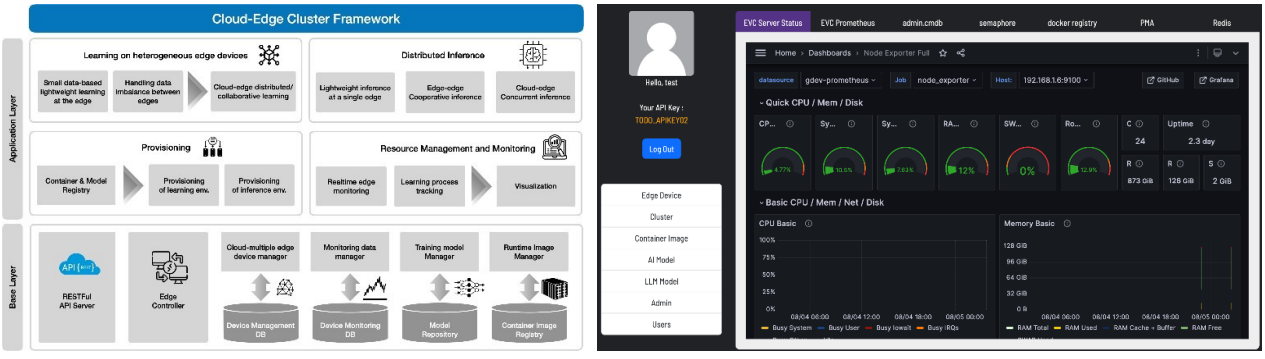

Fig. 1 A diagram of system architecture and an example of front page of the proposed framework

Acknowledgements

This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government (MSIT) (No. 2021-0-00907, Development of Adaptive and Lightweight Edge-Collaborative Analysis Technology for Enabling Proactively Immediate Response and Rapid Learning).

References

[1] N. Alshuqayran, N. Ali, and R. Evans, "A systematic mapping study in microservice architecture," IEEE 9th International Conference on Service-Oriented Computing and Applications (SOCA), pp. 44–51, 2016.

[2] K. Bonawitz, H. Eichner, W. Grieskamp, D. Huba, A. Ingerman, V. Ivanov, C. Kiddon, J. Konecnˇ y, S. Mazzocchi, B. McMahan ` et al., "Towards federated learning at scale: System design," Proceedings of Machine Learning and Systems, vol. 1, pp. 374–388, 2019.