IoT Smart Farm as A Service: A Project-Flotta Use Case

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Abstract

Precision Agriculture (PA) with the integration of sensors, information, communication and control technologies is growing day by day. As the precision farmer clients grows, it becomes very difficult to manage and monitor hundreds or thousands of Internet of Things (IoT) edge devices. This paper therefore, presents an architecture showing a use case for Project-Flotta to manage an automated smart farm irrigation system that could be deployed for multiple farmers as a service. The research aims to integrate 5GC, LoraWAN and machine learning for predicting the upcoming period to turn on/off actuators.

Ⅰ. INTRODUCTION

Agriculture in most parts of the world is the main drive of economy in most countries but it faces challenges due to prolonged dry seasons. Manual irrigation systems have been installed on farms which require manual intervention to operate. According to [1] manual irrigation systems do not conserve water. There are many farmers resulting into monitoring and managing thousands of IoT edge devices difficult and require a lot of personnel. Therefore, the design of an architecture of a system which could be used to manage these IoT edge devices from a single point is proposed in this paper. Based on our observation, there are three advantages of the proposed architecture:

- AI enabled smart automatic irrigation system which would ensure irrigating with the right quantity of water only when plants need water.
- LoRaWAN and 5G integration to improve the reliability and availability of LoRaWAN and achieve an ultra-low latency network
- Ease control and management of IoT edge devices from a single point of Kubernetes instance

The rest of the paper is organized as follows: Section Ⅱ presents related work and used technologies, Section Ⅲ describes the proposed architecture and Section IV concludes the paper.

Ⅱ. USED TECHNOLOGIES AND RELATED WORK

In [2], Flotta adds a way to manage all your edge devices from a single point using Kubernetes Custom Resource Definition (CRD) to handle all kinds of device configurations. Study [3] describes 5G as the next and 5th generation mobile network technology. 5G is designed to deliver a fast and ultra-low latency, more reliability, massive network capacity, increased availability network. In [4], LoRaWAN is described as a Low Power, Wide Area networking (LPWAN) protocol designed to wirelessly connect battery operated devices. It has advantages of low power consumption, wide coverage, low-cost and scalability.

There are limited previous works focusing on the integration of 5G and LoRaWAN. Study [5], presents an architecture which utilizes LoRa communication mechanism in an IoT smart farm. Article [6] also conducted a survey for a LPWAN-5G Integration showing challenges and potential solutions.

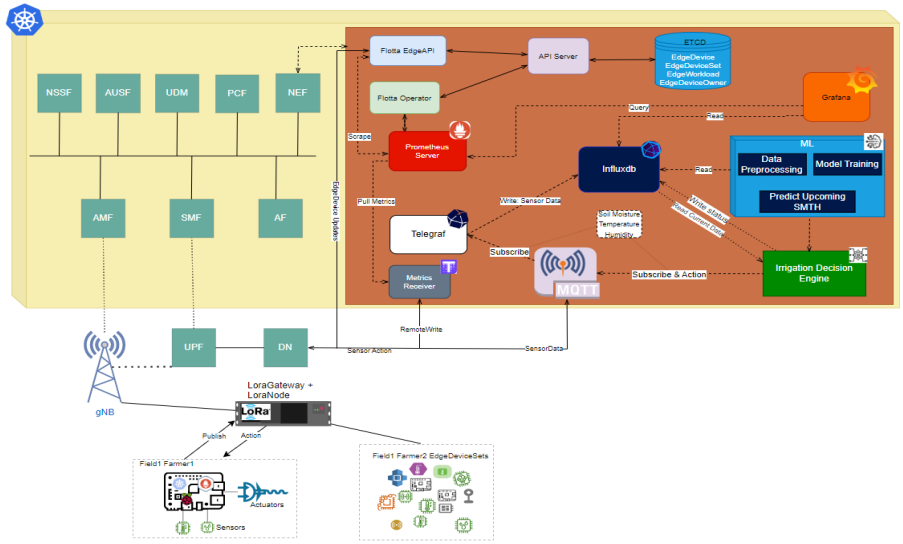

Figure 1. Proposed Architecture

Ⅲ. PROPOSED ARCHITECTURE

In the proposed architecture shown in Figure 1 above, Flotta Operator allows grouping edge devices using CRD EdgeDeviceSets which eases managing many edge devices. Furthermore, the edge devices in our scenario are Raspberry PIs (RPI) coupled with LoRa shields to enable it to communicate with the LoRa nodes. Actuators and sensors connected to the RPI detect soil moisture, temperature and humidity. The LoRa nodes are then connected to a gNB through 5GC to the on the control plane MQTT broker. MQTT is a publish-subscribe standards-based messaging protocol for machine-to-machine communication. Telegraf and the Irrigation Decision Engine subscribes to it for interaction with sensor data and actuation respectively. Machine learning is used to predict upcoming field soil moisture, temperature and humidity. The predicted values are pushed the decision engine to either turn on actuators or not.

IV. CONCLUSION AND FUTURE WORK

This paper describes an architecture for project flotta use case in IoT. In addition to that, the architecture shows an integration between 5G Network and LoRaWAN. For future works, we plan to deploy the system based on the proposed architecture and evaluate the performance.

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