Smart Farm Data Monitoring Using IoT, Kafka, and Spark

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Abstract

Smart Farming is a development that emphasizes the use of information and communication technology in the cyber-physical farm management cycle. New technologies such as the Internet of Things and Cloud Computing are expected to leverage this development and introduce more robots and artificial intelligence in farming. This is encompassed by the phenomenon of Big Data, massive volumes of data with a wide variety that can be captured, analyzed, and used for decision-making. Our project can be used for decision-making in purpose to increase production to offer higher quantities while ensuring higher-quality products. This paper presents a description of our smart farm project and related work.

1. Introduction

The strength of data no longer needs to be proven. In parallel intelligent/smart decision-making becomes crucial in every industry including agriculture, which has not been suitably favored by new advancements in Computer Science and Electronics, unlike the other industries. Agriculture has always been a pivotal part of human civilization and crucial for the evolution of every human society. And the only key to improving the agriculture efficiency is the new advanced technologies.

Researchers proposed various techniques to handle different problems related to agriculture, also to replace traditional farming practices with smart ones, whose big data IoT technologies are strongly present and designed to establish a decision-making and knowledge-sharing system for farmers. The idea is to allow objects to be connected all over the place, with anything, anytime, and based on any communication service [2].

This paper is organized as follows: Section 2 presents related work. Section 3 presents a description of the project. Section 4 concludes the paper.

2. Related work

Fuse [4] is one of the solutions used in precision agriculture where farmers can gain access to relevant data to make informed decisions, leading to the enhancement of their business's productivity and profitability. This solution is designed for the entire process of the crop cycle starting with enterprise planning up to planting, harvesting, and storing.

The Smart Agriculture solution from Hexagon [5] addresses the entire lifecycle of the agriculture process and assists in crop management through digital workflows created from geo-enabled data.

3. Project Description

The development of IoT is providing farms with massive data that can be accessible in real-time and batch. In this project, we worked with data that came from Kaggle and it contains different values that help decision-makers to increase the production of apples (soil potassium, nitrogen, ph, humidity, temperature...), after that, we use Kafka as an IoT data producer to send this data to a local server (consumer of Kafka) and the edge computing to store each day. We use Spark to process this data before handing it to the time-series database., so we divide it into 2 sets, a set that contains normal values and another which contains alert values, after that, we store it all in a MongoDB database to visualize it in Grafana. The architecture diagram for the smart farm monitoring Application is illustrated in Figure 1 below.

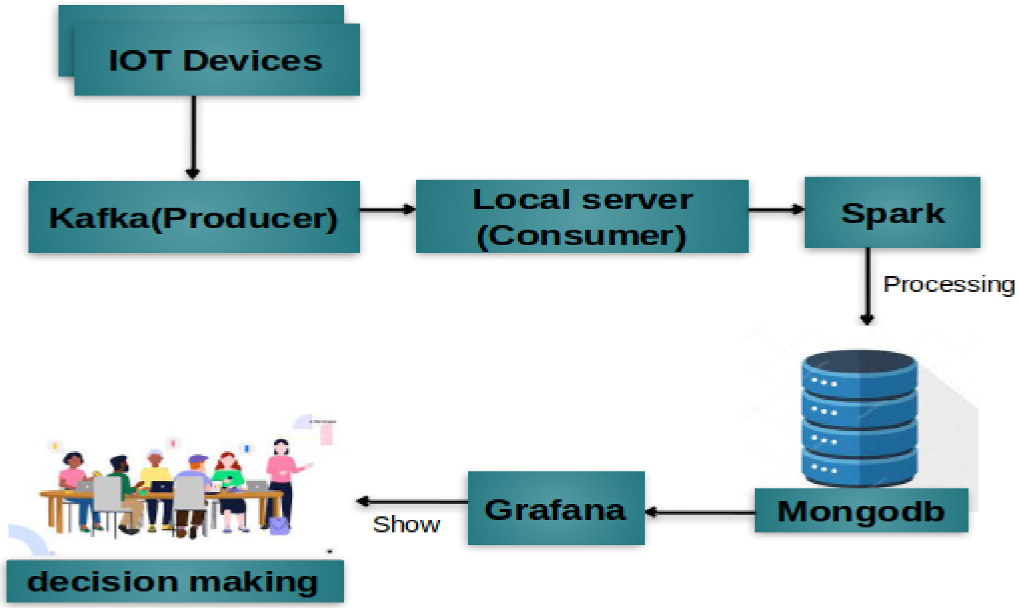

Figure 1: smart farm monitoring architecture

The data visualization and monitoring platform Grafana takes the data stored in MongoDB and runs queries to show meaningful and concise graphs to users.

Figure 2: Soil with healthy values of calcium phosphor and nitrogen

Figure 2 visualize the healthy values of calcium phosphate and nitrogen and figure 3 below visualizes the unhealthy values.

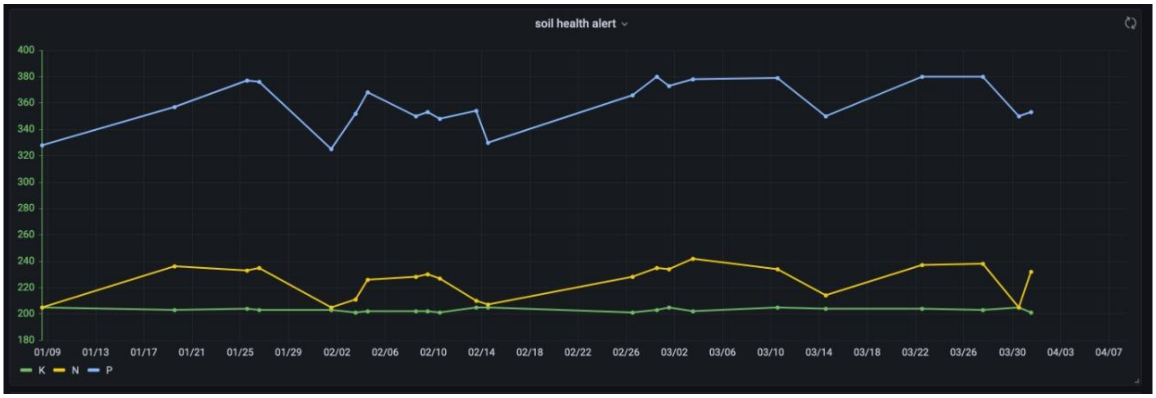

Figure 3: Soil with unhealthy values of calcium phosphor and nitrogen

Figure 4: The mean value of PH, calcium, phosphor, nitrogen, potassium, and humidity.

Figure 5:The last value of PH, calcium, phosphor, nitrogen, potassium, and humidity.

Figure 4 shows the mean value, and figure 5 visualizes the last value of PH, calcium, phosphor, nitrogen, potassium, and humidity. We note that the colors and their graduation here have a clear indication. The green indicates that the values are normal, the orange gives a warning and the red indicates that the values are unhealthy.

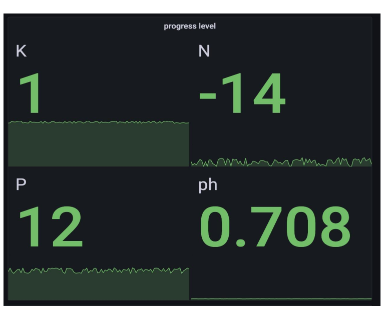

Figure 6:The difference in values of calcium, phosphor, nitrogen, and PH between today and yesterday.

Figure 7: The healthy value of rainfall, temperature, and humidity.

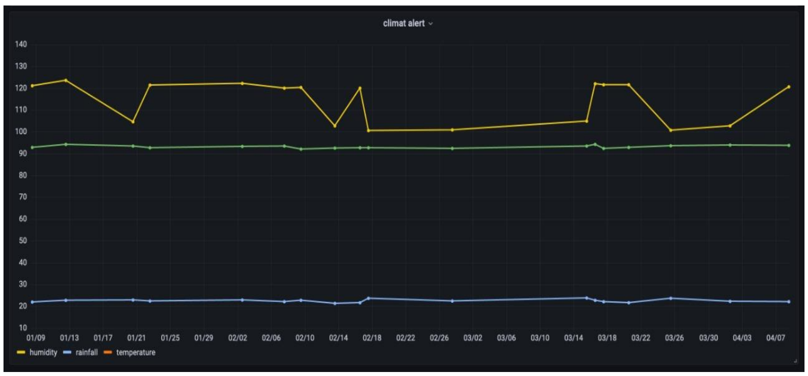

Figure 8: The unhealthy value of rainfall, temperature, and humidity.

We have in this project more graphs that help users in decision-making to monitor and increase the production of apples. note that we show the alerts in case the values of gas and climate are unhealthy like PH must be between 5.5 and 6.5, potassium between 125 and 135 and calcium between 100 and 200 [6].

4. Conclusion

IoT is now constituting a viable data source in many domains of agriculture. Researches have been made to take advantage of big data technologies to handle the massive amount of data in many agriculture fields. In this article, we proposed an architecture to collect data from sensors and manage it using popular frameworks, then display it to users in a dashboard using meaningful graphs for decision-making.

5. References

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