Introduction to a new use-case based on MPEG-IoMT: time-series temperature data analysis by the flower condition

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***Abstract*— Data capturing from the farm environment helps farmers monitor and optimize crops, as well as adapt to changes in environmental status. The smart farm collects and analyzes data generated by various sensors and attempts to improve productivity by utilizing actuators. MPEG-IoMT is a data format and interface standard for media such as video, audio, and related items. In this study, we introduced a strawberry growth use case that covers both time series data and image data analysis. In addition to this, we proposed an additional class to exchange information between each object based on the MPEG-IoMT standard.**

Keywords—ISO/IEC 23093, MPEG-IoMT, Internet of Media Things, Time-series data analysis

I. INTRODUCTION

By using various agriculture sensors, farmers have gained better control over the process of raising livestock and growing crops. This increases predictability and efficiency in agriculture. However, because there is no appropriate format to deliver the analysis results of individually installed IoT, it is still difficult to integrate and utilize several IoT and the analysis results.

Therefore, we believe that MPEG-IoMT standardization, the ISO/IEC 23093 [1-4] is a key technology to overcome this challenge. For example, cameras can provide information to users through media data; however, the analyzer must connect to and communicate with things, storage, and other analyzers to use various functions of the media thing.

In this study, we introduced one scenario in which a video sensor and environmental sensor analyzer collaborate to improve the growing environment of strawberry farms with MEPG-IoMT. Furthermore, we suggested an additional function required when integrating and utilizing time series data. This study aims to contribute to the smart farm service area by handling multiple time-series data based on the use of the IoMT standards.

II. RELATED WORKS

A. MPEG-IoMT

The Moving Pictures Expert Group (MPEG, ISO/IEC JTC1 SC29) introduced the Media Thing (MThing), which is defined as a thing capable of sensing, acquiring, actuating, or processing media content or metadata related to such content [5]. MPET-IoMT, ISO/IEC 23093 provides an architecture and specifies APIs and compressed representation of data flowing between Mthings. The APIs for MThings can discover, connect MThings, and exchange data between things. MThings related information consists of characteristics and discovery data, setup information from a system designer, raw and processed sensed data, and actuation information.

IoMT specifies input and output data formats for media sensors, media actuators, media storage, media analyzers, etc. [3]. Media analyzers can process sensed data from media sensors to produce analyzed data, and the media analyzers can be cascaded to extract semantic information.

Fig. 1. — Function invocation between MThings

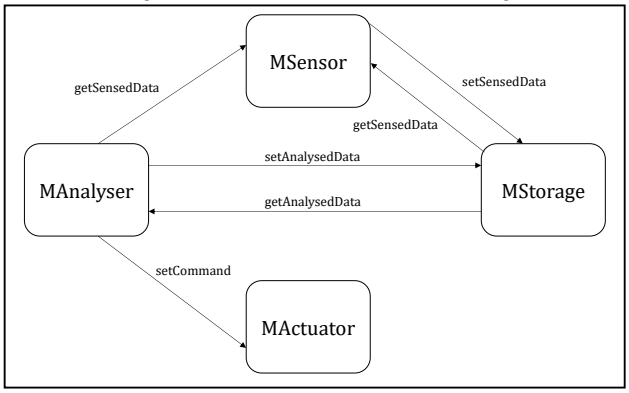

Fig. 1 shows the data communication flow of the main entities in IoMT. MSensor, MActuator, MAnalyser, and MStorage are main entities of IoMT. MSensor sets their information to MStorage to store sensed data. MAnalyzer obtains data from MStorage and stores the result on the MStorage.

B. Time-series Data Application

Time series data is a collection of observations obtained through continuously repeated measurements over time. Therefore, most time-series data are highly correlated over time and include trends, cycles, and seasonality.

Time series analysis is used for many areas, such as economic forecasting, stock market analysis, credit card fraud detection, and abnormal bio-signal detection. To solve this tasks, many approaches, such as anomaly detection, classification, and forecasting, have been studied and implemented.

The time when the data was created or stored is also an important information. Therefore, the function to search time series data for specific time duration and the function to determine whether the data is usable with guaranteed quality are additional necessary functions compared to other data formats.

C. *Environmental Management in Smart Farm*

Smart farm is a generic term for technologies and concepts that allow farms to be more efficient, technologically advanced, greener, and animal welfare oriented. Recently, the concept of precision farming has been widely accepted in the agro-tech area, which involves using IoT-based sensor networks and a machine learning approach for farm applications in a smart farm environment.

To increase the productivity and cultivation efficiency of agricultural products, technologies such as data collection based on IoT sensors, data analysis based on machine learning, and environmental control with IoT actuators can be utilized.

The environment in strawberry farms is generally adjusted to satisfy predefined conditions, such as turning on and off the heater, controlling ventilation, or controlling moisture level.

Despite these efforts to control the environment, problems can still arise. However, it is not easy to change conditions adaptively in an automated smart farm environment where experts do not decide in real time. Because the aim of controlling the environment is to increase the quality and productivity of fruits, it is necessary to control the environment by observing the fruits themselves.

III. USE-CASE BASED ON IOMT

A. *Time-series Temperature Data Analysis by The Flower Condition*

Usually, the condition of strawberry flowers is closely related to the quality and quantity of the fruit. This is because the strawberry fruit grows where the flower withers. If the strawberry flower does not grow properly, it will not produce fruit well.

This use case handles one of such cases. If the center of the newly bloomed strawberry flower turns dark, the quality of the fruit also deteriorates. Temperature is known to cause the darkening of the center of a strawberry flower. This phenomenon usually occurs when strawberry flowers are exposed to low temperatures for a long period of time. Although the temperature of a smart farm is controlled to be suitable for growth, the range of suitable temperatures may change depending on the external temperature and various other factors. Therefore, it is necessary to check the changes of environmental temperature for a certain period in the past when this problem was identified, and to raise the temperature only during the lowest temperature section of the day.

B. *Use-case Data Flow*

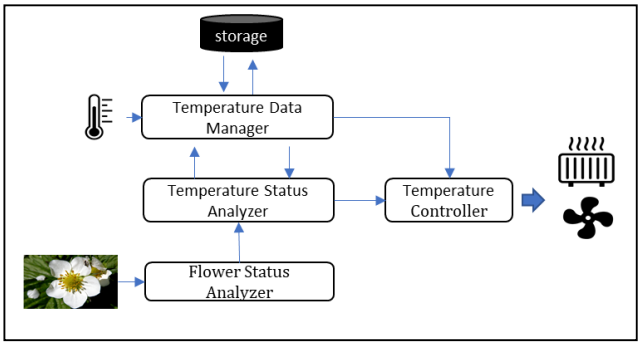

Fig. 2. data flow of use-case

The actors required to comply with the IoMT standard while satisfying the proposed scenario are defined as follows:

- **Camera:** obtains image from flower
- **Thermometer:** senses temperature status.
- **Fan:** operates to decrease the temperature when the temperature is high.
- **Heater:** operates to increase the temperature when the temperature is low.
- **Temperature data manager (TDM):** stores and retrieves temperature data.
- **Temperature status analyzer (TSA):** analyzes temperature history data and finds anomaly time duration.
- **Temperature controller (TC):** controls heater and fan based on temperature status.
- **Flower status analyzer (FSA):** detects flower abnormality.

Fig. 2 shows the data communication flow of main actors and entities based on IoMT structure. In general, TC usually operates fan when the temperature is higher than the appropriate temperature range and operates the heater when the temperature is lower than the appropriate temperature range. However, the scenario that uses complex analyzers (TSA, FSA) based on the IoMT standard is modified as follows:

- FSA monitors the status of flowers.
- When FSA identifies an anomaly in the state of the flower (particularly the center color), it notifies TSA about the state of the flower. If the center of the flower has turned dark, it means that it is a bad sign for strawberry growth. Therefore, the room temperature must be higher than usual.
- TSA requests temperature data from the TDM for the past week.

- TDM sends the temperature data to the TSA.
- TSA analyzes historical temperature data and finds abnormal time intervals where the temperature is relatively low.
- TSA sends time interval information to TC.
- TC operates the heater particularly during the low temperature time intervals.

C. New Extension Class in MPEG-IoMT

Based on the aforementioned use case, each thing can be mapped to each group of IoMT architecture. Cameras and thermometers can be mapped to the MSensor group, two analyzers can be mapped to the MAnalyzer group, and two actuators can be mapped to the MAcuator group. A storage device for storing the collected data may be mapped to the MStorage group.

For the proposed use case, the ability of the analyzer to retrieve sensor data for a specific period from storage should be additionally supported. However, in the existing IoMT architecture, the function to save and retrieve data required from MStorage by condition is not included. Therefore, we proposed MDataManager that handles data input and output between MThing/MAnalyzer and storage. MDataManager manages data input/output between MStorage and MAnalyzer. MDataManager must be able to interpret the time interval and quality scale parameters of the data to be retrieved for the time series data-based analyzer.

IV. CONCLUSIONS

In this study, we proposed a new use case in MPEG-IoMT scenarios for interaction between multiple analyzers and sensors. To grow high-quality strawberries in a strawberry farm, sensors are used to detect abnormal strawberry flowers and analyze the temperature data to adjust the appropriate temperature range for growing strawberries. The temperature in the farm is controlled using a fan and heater according to the adjusted temperature section. Based on the scenario, we proposed MDataManager, which enables selective retrieval and management of data, and can compensate for the structural flaws of Mpeg-IoMT. We plan to extend the interface of IoMT MAnalyzer based on the proposed structure, which can be used as a reference for configuring IoMT-based services.

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