The development of Smart Radioactive Waste Management System using new ICT technology

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Introduction

The Radioactive Waste Information Management System (RAWINGS) for the safe management of low- and intermediate-level radioactive waste has been operated in Korea Atomic Energy Research Institute (KAERI) since 2021. From the operation of RAWINGS, KAERI can effectively manage the inventory and history of waste generated at research sites. The system generates information based on data manually input by radiation workers at waste-related sites. This system has the risk of entering incorrect information or missing information during the radioactive waste treatment process. Recently, the Korea Nuclear Safety and Security Commission (NSSC) and the Korea Radioactive Waste Agency (KORAD) have been conducting pre-inspection before transportation of radioactive waste to final disposal site based on waste acceptance criteria (WAC). So, the smart open digital system using new ICT technology for the safety management of radioactive waste is needed to solve the problems of the current system and meet the acceptance criteria of the final disposal.

Materials & Methods

1. Augmented reality for the digital twin and QR code

Augmented reality (AR) technology is used to allow inspectors to check the contents of small packages of radioactive waste without opening drums after packing. Internet of Things (IoT) sensor has been developed to monitor the status of drums in radioactive waste storage facility.
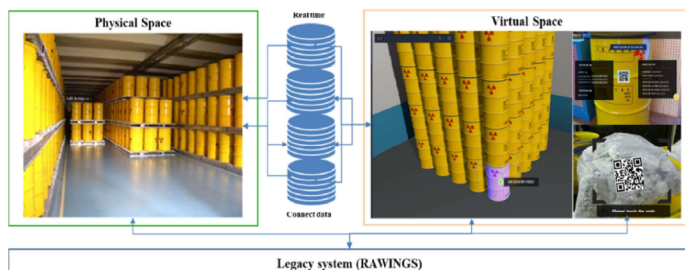

Fig 1. Configuration of Digital Twin includes AR and IoT

2. IoT sensor developed for RAWINGS and DT

The basic data of the radioactive waste used in the AR is processed with RAWINGS including the small packaged waste and repackaged drums. In addition, real-time monitoring of the radioactive waste drums located in the radioactive waste storage facility where they will be stored until their final disposal, was accomplished by sending IoT sensor attached to the drums. IoT sensor signals attached to the drums are being transmitted to digital twin (DT) system.

(1) Sensor location: center   (2) Assembly drum bolt   (3) Inner side on the IoT
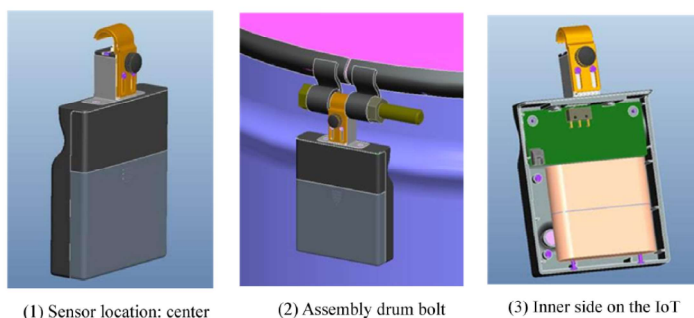
Fig 2. Basic geometry of IoT attached to the drum

Results

Digital Twin system was completed by monitoring the condition of drums using IoT sensors attached to radioactive waste drums, checking small-packaged wastes in the drums using augmented reality technology, and linking data stored in the legacy system (RAWINGS).
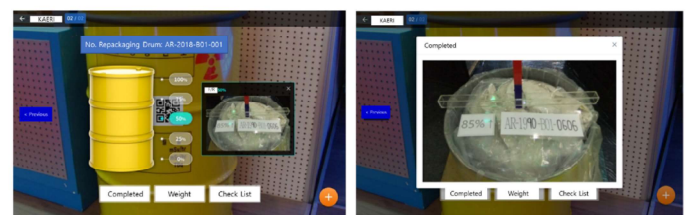

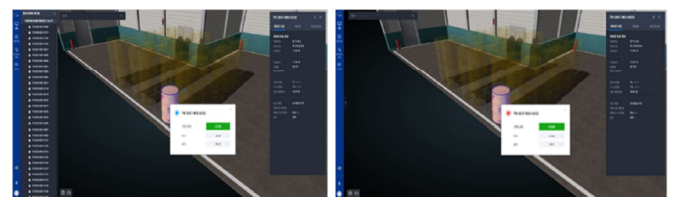Fig 3. Identification of filling rate information within the drum

Fig 4. Monitoring of repackaged drums conditions in DT
(Left-normal, Right-Abnormal)

Conclusions

➢ It is possible to check the radioactive waste contained in the drum from the remote inspection of a digital twin, as well as from the on-site inspection of radioactive waste storage facility.

➢This technology is useful to verify the compliance of radio-active waste with the acceptance criteria required by KORAD.

References

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[2] H.S. Park, "A detailed design for a radioactive waste safety management system using ICT technologies", Progress in Nuclear Energy. 149 (2022) 104251