A Process-Aware Drone-Equipped 3D Engine and Wireless Control Measurement Platform for Integrated Management of SOC Facilities

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***Abstract*— Disasters such as earthquakes, floods, landslides, and bridge collapses are socially costly. We intend to integrate facilities management to effectively manage the incidents of these disasters effectively. In order to utilize and automate various IoT technologies at this time, we propose a process-aware drone-equipped 3D engine and wireless control measurement platform for integrated management of SOC facilities.**

***Keyword*— Process-Aware System, SOC, IoT, Sensor, Drone, 3D Engine**

I. INTRODUCTION

In recent years, large-scale earthquakes have been increasing in Korea, and they can cause huge loss of life and economic loss in a wide area when an earthquake occurs, and can cause national disaster such as paralysis of the national neural network. Due to the large scale of disasters, new and complex disasters, the overall disaster risk of society has increased, and the scale of damage has also become larger, and the public's interest in disaster and safety has become very high. The Republic of Korea has established and implemented a 'Comprehensive Plan for Disaster and Safety Technology Development' in order to promptly respond to and recover from disasters and other accidents such as national protection, disaster, accident prevention, and damage, data, etc., there is not enough integrated management system for systematic management and utilization. In addition, it is required to develop interworking technology that collects and analyzes various types of regular and non - disaster data in order to collect the increasing disaster response strategies and to solve the problems. In order to manage various SOC facilities, it is necessary to provide detailed infrastructure information at the member level as well as simple facilities information, which can be solved through the combined virtual space information technology combining 3D model shape information and sensor information. In order to maintain the accurate and efficient facility maintenance, it is necessary to automatically construct a 3-D facility model by using the drone so that it can manage the three-dimensional position in the facility in connection with the field measurement equipment.

Fig. 1 Various Types of Disaster Situations

We propose a smart maintenance management integrated platform for process-aware 3D facility management that can be automated by combining IoT technology with surveillance system (image information, measurement equipment, etc.) for disaster preparedness.

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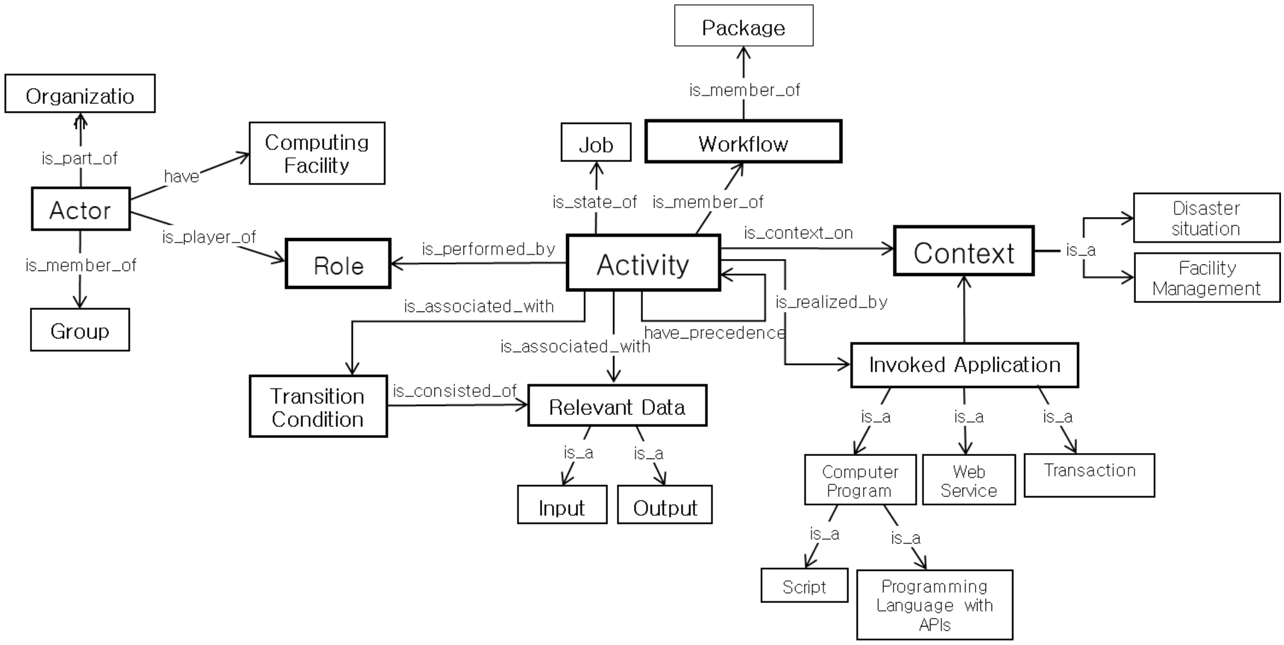


Fig. 2 Process Meta-Model for Proposed Platform

II. Related Works

Our research is based on researches related to drone, wireless and process management technologies. Recently, interest in drones and IoT is very high, and there are many related studies. In particular, [1, 2, 3] are drone studies related to the disaster directly related to this study. [1] is a study that responds to disaster situations. [2] is a study that is for drone applications for supporting disaster management. [3] is a study that is for data management of drone-based 3D model reconstruction of disaster site. We focus on drone-equipped 3D engine for drones, and there are differences from other studies. And, some studies[4, 5, 6] have attempted to extend the application of the workflow model. [4] is a workflow model for data-intensive workflow processing. [5] is a workflow model for IoT processing. [6, 7] are a fairly classic studies with color and fragment concept workflow models that can add new information to workflow models. Based on these various previous studies[4, 5, 6, 7], we will describe an extended workflow model tailored to the disaster situation. In the area of facility management, interest in facility management is very high, and conceptual and experimental researches[8] on the remote facility monitoring field have been continuously carried out. [9] was implemented in a segmented manner with respect to the history and current status of specific facility facilities. Especially, the real-time monitoring part is not able to realize the complete system due to the communication cost problem and performance limit. Facility monitoring[10] that needs to take precautionary measures is difficult to utilize positively by checking the status of fragmentary situation and there is no possibility of data sharing and it is very likely to be expanded to complex accidents and disasters. Therefore, we will try to overcome these problems.

III. A Process-Aware Drone-Equipped 3D Engine and Wireless Control Measurement Platform

We propose a process-aware drone-equipped 3D engine and wireless control measurement platform. Its core is process-aware platform, drone-equipped 3D engine, and wireless control measurement platform, each of which can be described as follows.

A. *Process-Aware Platform*

We propose a platform that introduces process management technology. The platform supports drone-equipped 3D-engine and wireless control measurements. The platform has expanded its process management technology to support those functions. The most important feature of this process management technology consists of modeling technology and execution technology. Because this platform needs the model specific to IoT environment, we want to extend existing workflow model. We will extend ICN[11, 12, 13] among well-known workflow representation methods. In addition, we extend BPMN 2.0[14, 15, 16, 17] standard method for actual system execution.

Process-aware platform technologies

- model: modeling methodologies (ICN, BPMN 2.0)
- process management: process/workflow engines

Fig 2 represents an extended ICN(Information Control Nets) meta-model for disaster management automation. It can be defined by adding new elements for disaster management and facility management automation to original elements. We add context information for disaster situations and situation handling for facility management to appropriately handle invoked applications for execution in the components and components of the main workflow process. And BPMN 2.0, the standard modeling method, can also be extended. BPMN classifies and divides tasks by type to perform unit activities. We can implement this task by adding a task for the proposed situation to this generalized type.

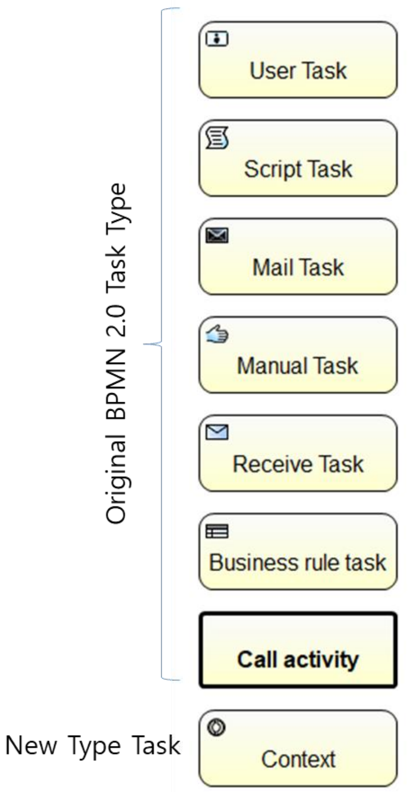


Fig. 3 Extended BPMN Task Types

In order to design processes for proposed platform, we can use a new type task or activity. The defined process is transformed to an executable language in the form of xml for automated execution. An example of a BPMN process and its conversion to an executable language is described in Fig 4.

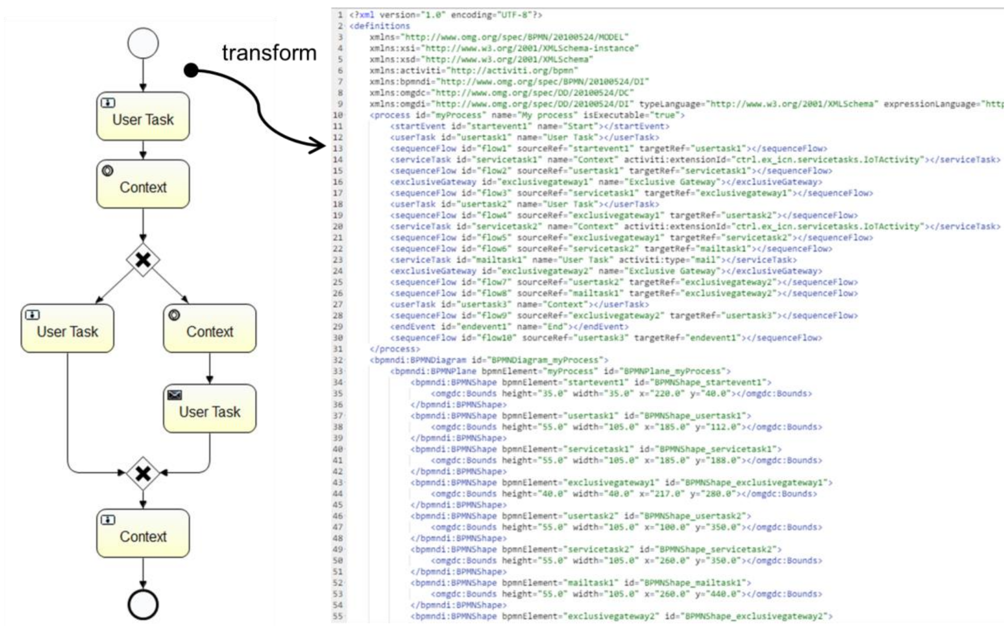
The defined process model can be executed by the process management system. A process-aware platform is basically split into two phases for its definition and execution. The first is the process model described earlier, and the second is the management of the defined process model. The process of creating a model can be divided into build-time, and the process of managing is run-time. The two-step process is described in Fig. 5. The process in build-time means defining the process, and the process in run-time means that the defined process is executed and monitored.

B. Drone-Equipped 3D Engine

Drone-Equipped 3D Engine is a mobile mapping platform which multiple sensors and measurement systems have been integrated to provide three-dimensional near-continuous positioning of the platform's path inspace and simultaneously collected geo-spatial data.

Current drone application techniques are used for a brief topographic survey. In the future, 3D image acquisition technology for management facilities based on drone is a necessary element technology in next generation spatial data scanning field, and it is highly possible to utilize it in various creative ways.

In the case of linear facilities (levees) or large facilities (roads, bridges), it is not possible to perform accurate management using only the GPS location information of facilities. In case of embankment, the distance between starting point and ending point is long and it is not a straight line. Therefore, the 3D engine technology using the drone is essential for accurate maintenance and diagnosis as well as the location of the facilities in the facilities. In the present study, the application part of the drones was developed not only to manage the points of the facility but also to manage the three-dimensional position of the facilities such as the line and the area,



A BPMN Model with New Type Task A BPMN Model with Executable Language

Fig. 4 A BPMN Model Example with Context Type Task and Its Executable Language

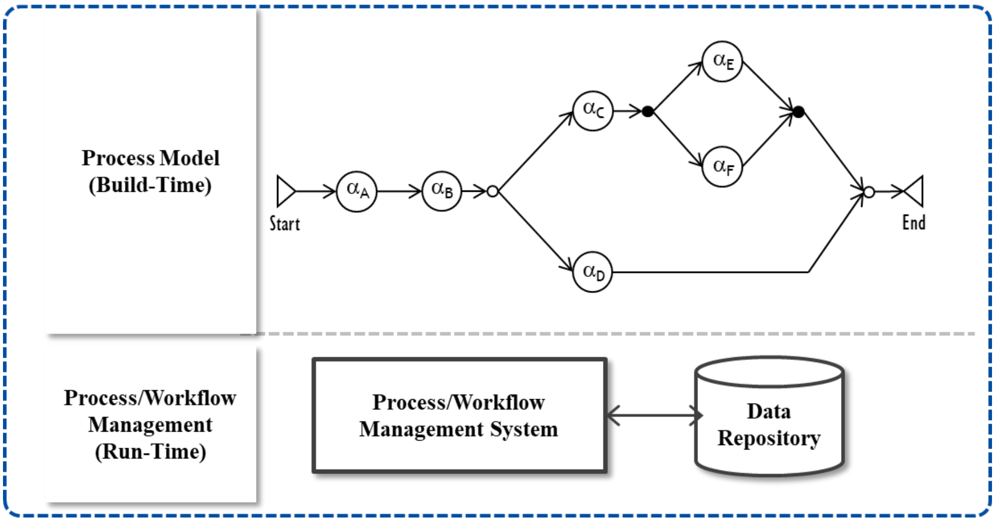


Fig. 5 A Process-Aware Platform Concept

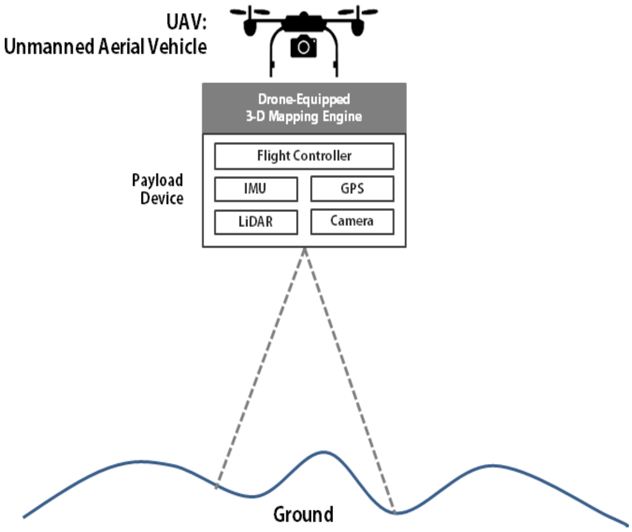


Fig. 6 Drone-Equipped 3D Engine

C. Wireless Control Measurement

Drone-Equipped Wireless Control Measurement is a software system with data-centric language for sensing, capturing and detecting of remote point of interest or sensor device using unmanned aerial vehicle's autonomous and programmable functions.

Data dissemination system that can share the data needed for social safety in real time in relation to the status and status of SOC facilities is also helpful for national safety management. In addition, new applications can be created in conjunction with climate, social phenomena, and traffic. In order to easily and flexibly apply the network structure for real-time control and measurement in various fields, a standard interface is devised so that various facility management subjects can utilize it, and various information can be extracted from a single view through sharing. This technology is interworking with the wireless control metering sensor based on the information from the drones based 3D engine which can manage the position of the sensor information. It is the basic technology for establishing smart integrated maintenance system of SOC facilities. With this

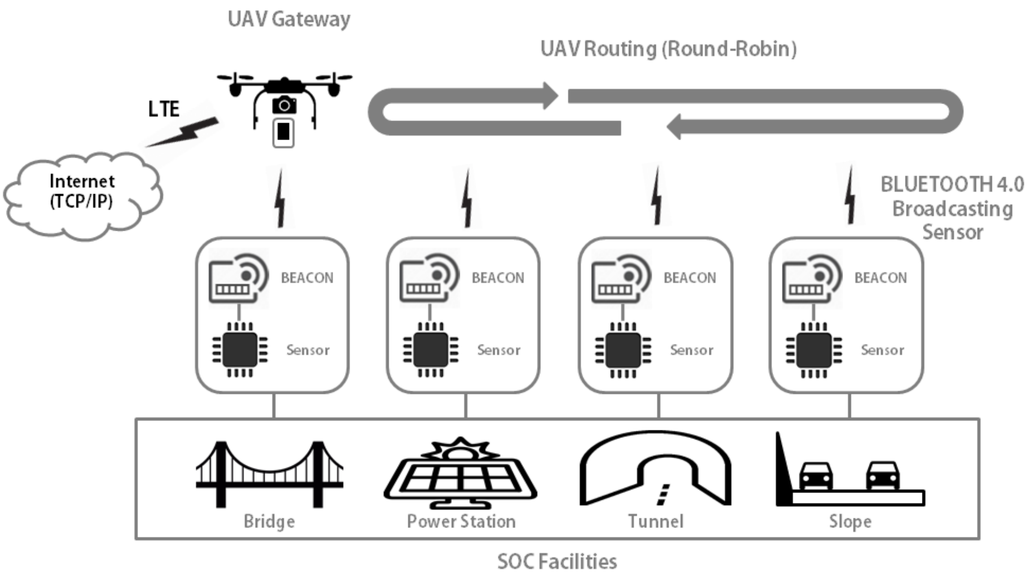


Fig. 7 Wireless Control Measurement

technology, it is possible to make an accurate and quick judgment on a disaster site, and minimize disaster damage.

D. A process-aware drone-equipped 3D engine and wireless control measurement platform

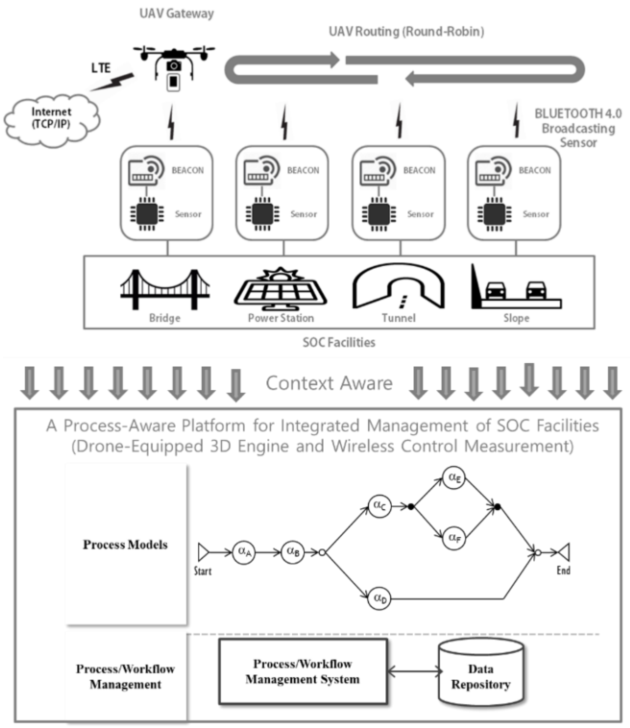


Fig. 8 A Process-Aware Drone-Equipped 3D Engine and Wireless Control Measurement Platform

By changing the recovery-oriented disaster management system into a preventative management system, and by providing a risk definition tool that can author a risk prediction model, especially in the private and public sectors, various facility managers can predict disasters and risks in advance. It can also be automated and processed using process management techniques.

Based on the technology described above, this technology can automate the judgment of a disaster site. Of course, the disposal of the facility management section for the disaster site is divided into unit tasks, and the definition and management can be made flexible because it can be partially or totally automated. Since the contents of the unit work are extended by using the process model defined above, information about the situation is considered now. However, as technology develops in the future, it is possible to have information processing using technologies such as a new artificial intelligence.

IV. CONCLUSIONS

In this paper, we propose a process-aware platform that supports drone-equipped 3D engine and wireless control measurement. We have described a drone-equipped 3D engine and wireless control measurement capabilities and process management functions to automate it partially or fully. Although it is approach from a conceptual point of view, it seems to be meaningful in that it provides the basis of possibility of automated drone-equipped 3D engine and wireless control measurement technologies.

In the future, we will specifically study in detail the core function of the drone-equipped 3d engine, and we need the research on the processing technology for the wireless control measurement. And we will try to automate it using process management technology. It will be scenarioized, one case study will be created, and the completed platform will be applied to the disaster scene.

We strongly believe that this platform will handle the disaster scene quickly and efficiently.

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