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Platform Development for Drone Utilization in the Architectural Field

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1 Introduction

In Japan, building health diagnosis and maintenance have become urgent issues, and the use of drones is expected to increase in the field of building inspection. In this paper, we (i) report on drone-related trends and technology levels in the architectural field, (ii) present demonstration experiments related to drone inspections and (iii) discuss future prospects.

2 Trends in the Use of Drones in the Architectural Field

The drone service market is expanding; in the architectural field, drones are used in the areas of inspection, disaster surveys, urban/regional planning, environmental measurement, construction, cultural heritage and transportation, as shown in Table 1. In 2016, the Architectural Institute of Japan (AIJ) established “WG on Application Guide of UAV to Building Performance Survey”. In May 2017, the first architectural drone symposium hosted by AIJ was held. In industry, the Japan Architectural Drone Association was established in 2017 to develop human resources that can utilize drone technology across various sectors of the architectural field, as well as provide technical support and standardization.

Table 1. Research topics with keyword “Drone and UAV" in AIJ annual paper.

Uses of drones in the architectural field	Year						Total
	2012		2015	2016	2017	2018	
Inspection	0		0	3	6	11	20
Disaster	0		0	0	3	3	6
City/Region	0		3	0	1	0	4
Construction	0		0	1	1	1	3
Environmental measurement	0		0	0	3	0	3
Transportation	0		0	0	1	1	2
Cultural heritage	1		0	0	0	0	1
Total	1		3	4	15	16	39

3 Evaluation of Building Inspection Using Drones

In this chapter, field tests relating to building inspection using drones were carried out and the results were discussed, as follows.

(1) Regarding cost and time requirements during building inspection, drone photography can be implemented at a lower price than can high-level manual inspection work, as shown in Figure 1. However, the cost and time requirements for image processing after taking such photographs will be greater for a drone approach.

(2) To evaluate inspection accuracy, we conducted a drone photographing experiment targeting the deterioration of buildings using a camera with the highest resolution of 100 million pixels. As a result of the experiment, at a shooting distance of 5 m, it was possible to visually check cracks down to a width of about 0.25 mm.

(3) A detection test on the peeling of tiles from an exterior wall was carried out using a drone-mounted infrared ray camera. When environmental conditions, such as solar radiation and temperature, as well as the performance of the applied infrared camera were appropriate, the detection rate of tile peeling was high.

(4) A drone system with Simultaneous Localization and Mapping (SLAM) for estimating self-position based on camera image information was used. The effectiveness of this system was demonstrated in a field test using an experimental building.

(5) The field test was conducted to record and preserve/archive deterioration information for a waterproof sheeting on the roof of the building. As shown in Figure 2, it was possible to simultaneously record the entire roof surface, the area around the drain, cracks in the waterproof sheet and the repair status.

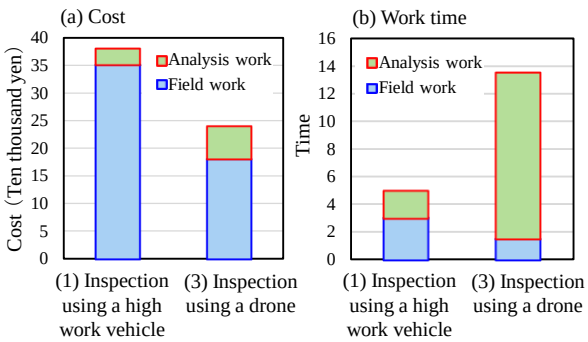

Figure 1. Comparison of cost and time in high-level work and drone photography inspection.

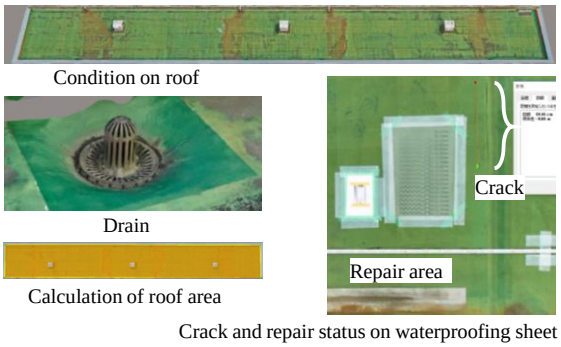

Figure 2. 3D model of degradation information from a drone-mounted 100-million-pixel camera.

4 Conclusions

In this study, we investigated drone trends in industry–government–academia for application to the architecture sector. In addition, drone flight safety, cost and labor reductions, inspection accuracy, suitability for archiving and inspection automation were tested on site and the effectiveness of drone utilization was demonstrated.

In the future, it will be possible to create a new building drone platform by strengthening connected industries in cooperation with technologies such as AI, AR, and the cloud in the fields of building inspection and disaster survey.

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