

Development of Bridge Inspection Support System using Unmanned Aerial Vehicle

*Jae-Bong Park¹⁾, Kyung-Soo Park²⁾, Chul-Min Kim³⁾ and Tae-Jin Lee⁴⁾

^{1),2),3)} *Research Institute for Infrastructure Performance, KISTEC, Ena-ro 128, Jinju-si, Korea*

⁴⁾ *BROADWAVE Corp, Magok-jungang-ro 165, Gangseo-gu, Seoul, Korea*

¹⁾ jbpark@kistec.or.kr, ²⁾ kspark@kistec.or.kr, ³⁾ kcm0555@kistec.or.kr,

⁴⁾ LTJ@broadwave.co.kr

ABSTRACT

In this study, a bridge inspection support system using Unmanned Aerial Vehicle (UAV) is under development. The system consists largely of two parts: one is the UAV operation guideline for bridge inspection, and the other is UAV bridge management system (U-BMS) to rapidly utilize the data collected by UAV in bridge inspection. The guideline consists of essential considerations for the operation of UAV, i.e. basic requirements for UAV, operating scenarios, relevant laws and regulations, etc. And the U-BMS contains essential considerations in the bridge maintenance, i.e. bridge information, inspection history, current information of bridge condition, evaluation module, etc. This system is expected to help in the practice of bridge maintenance, including efficient inspection of blind spots where access to personnel is difficult and dangerous.

1. INTRODUCTION

A drone is a representative equipment of advanced technology and is used in various industrial fields such as military, disaster response, lifesaving, exploration and agriculture. Recently, many studies have been carried out to utilize drones in the facility inspection (KAIST 2016), and the government is also making efforts to prepare a legal system for drone utilization.

This study proposed a bridge inspection support system for efficient use of UAVs in bridge inspection. The system consists of a guideline for operating UAVs during bridge inspection and a UAV based bridge management system for efficiently storing and managing data. The main framework of the system was developed based on the

¹⁾ Senior Researcher

^{2),3)} Researcher

⁴⁾ CEO

current detailed guidelines for safety and maintenance of facilities (MOLIT et al. 2018), bridge maintenance manual (MOLIT et al. 2014) and the opinions of many experts in related fields.

2. UAV OPERATION GUIDELINE FOR BRIDGE INSPECTION

2.1 Guideline framework

The guideline consists of essential considerations for the operation of UAV, i.e. basic requirements for UAV, inspection type and scenarios, relevant laws and regulations, preflight checklist, etc. as shown in Table 1.

Table 1. Guideline framework for UAV aided bridge inspection

	Classification	Contents
1	Introduction	Purpose, Scope, Definition
2	System Configuration, Basic requirements for UAV	Basic function, Electronic equipment, Sensor, GCS, Software license, Operating personnel and training, Asset management
3	Type of Inspection	Periodic safety inspection, Precision safety inspection, Emergency safety inspection, Precision safety diagnosis
4	Environmental Requirements	Environmental conditions, Accident action order Pedestrian & vehicle safety measures, Pre & post action for communications interruption, Emergency landing, Response to GPS shading,
5	Safety Inspection Procedures	Inspection scenarios, Preparation stage, Flight & filming, Video analysis processing, Bridge condition assessment criteria, Damage history management, Bridge member ID assignment method
6	Utilization Priority	UAV utilization priority due to the location of bridge or bridge type
7	Laws & Regulations	Aviation law, Propagation law, UAV registration & certification, National certification system for UAV pilot, Regulatory rationalization plan
Apx. 1	The text of the relevant laws	
Apx. 2	Compliance and safety rules for UAV pilots	
Apx. 3	UAV accident action guideline	
Apx. 4	UAV preflight inspection log	
Apx. 5	Insurance systems and products	
Apx. 6	Airspace identification information source (Application)	
Apx. 7	Advanced technology applicable to safety inspection of bridge	

2.2 UAV based bridge inspection scenarios

The procedure for inspecting a bridge using UAV is carried out in accordance with five steps as shown in Fig. 1.

Main scenarios Preparation stage → Flight and video collection → Processing video analysis → Condition assessment → History management of damage information

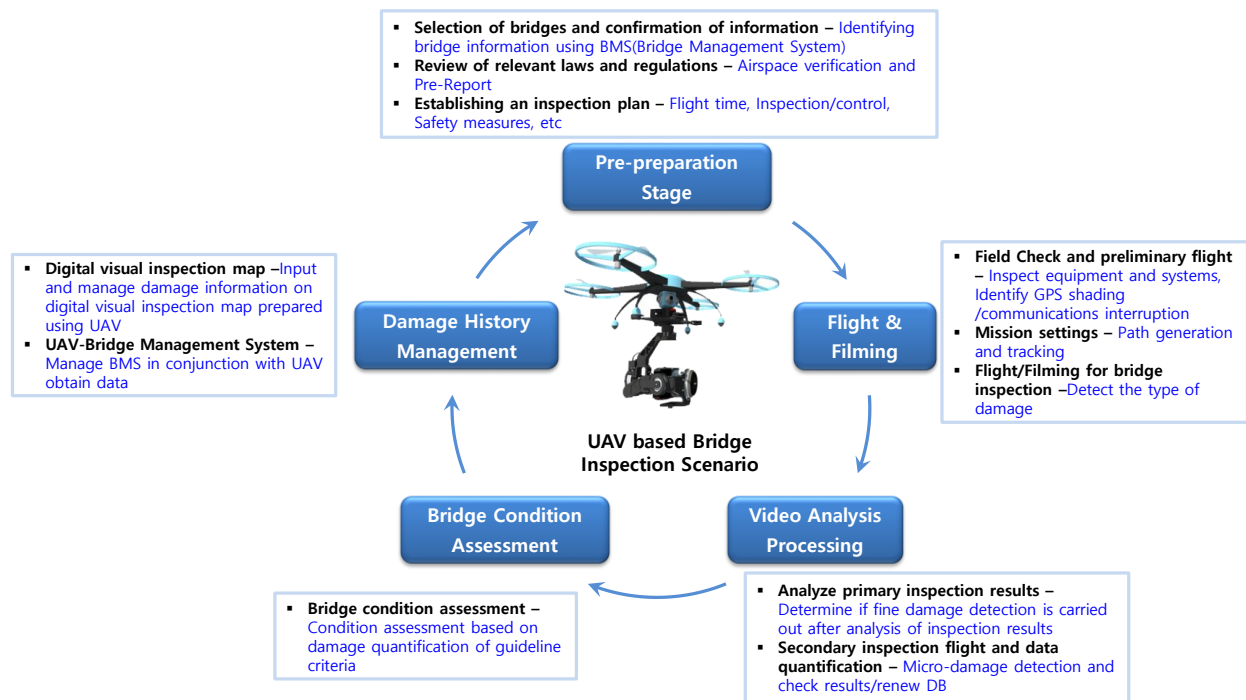


Fig. 1 UAV based bridge inspection scenarios

3. UAV BRIDGE MANAGEMENT SYSTEM (U-BMS)

In this study, the UAV Bridge Management System (U-BMS) was developed to diagnose, evaluate and manage bridge structures through data obtained during the UAV-based bridge inspection. The U-BMS consists of U-BVA(Bridge Video Analytics), U-BIM(Bridge Information Management) and U-BI(Bridge Inspection) as shown in Fig. 2.

The U-BVA analyzes images taken from UAV, classifies damage type using AI technology, and quantitatively extracts bridge damage information. The extracted information is automatically generated and registered in the U-BIM.

The U-BIM manages damage information of bridges based on location, supports management of damage information during bridge inspection, and provides convenient service environment through user-based UI (User Interface) and responsible WEB technology. In addition, it has a function to evaluate the condition of a bridge, so it is possible to check the bridge condition quickly.

The U-BI is a mobile-based service to check bridge condition in the field, allowing bridge inspectors to easily browse the specifications and damage history of bridges in a mobile interface, and also provides the function to check safety grade of bridges.

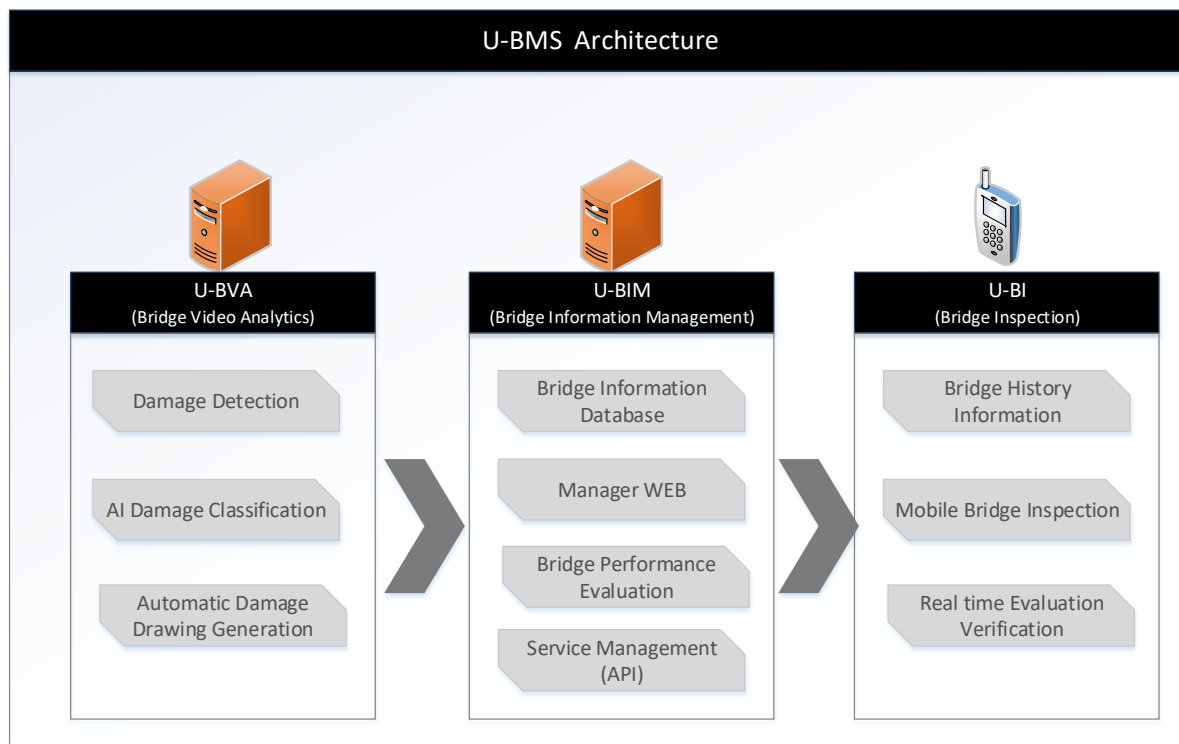


Fig. 2 U-BMS Architecture

4. CONCLUSIONS

In this study, bridge inspection support system using UAV was proposed as a way to enhance work efficiency. The proposed guideline and U-BMS are currently in the empirical stage for experts and some problems such as inspection blind spots and errors in quantifying damage could be solved.

REFERENCES

- KAIST (2016), "Development of a large structure diagnosis and remote management system using unmanned inspection equipment".
- MOLIT(Ministry of Land, Infrastructure and Transport) and KISTEC(Korea Infrastructure Safety and Technology Corporation) (2018), "Detailed guidelines for safety and maintenance of facilities".
- MOLIT(Ministry of Land, Infrastructure and Transport) and KISTEC(Korea Infrastructure Safety and Technology Corporation) (2014), "Bridge Maintenance Manual".