Safety Inspections and Measurements in Construction Sites Using Drones

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Abstract

This paper aims to identify the safety management performed by drones in the construction site and understand how it can improve safe work environments. The continuous use of drones at construction sites is expected to continuously accumulate data on dangerous construction sites, ultimately reducing unfortunate accidents, loss of life, and economic loss at the same time. Understanding the concepts of this latest technological advancement will help in making innovations for the future construction market.

Keywords: Drone, Safety & Risk Management, Construction Site.

Introduction

The construction industry is developing rapidly. It is no exaggeration to say that it is one of the industries in constant demand as long as humans exist on Earth. However, it is also a field with a high frequency of fatal industrial accidents, and therefore countermeasures are urgently required. The number of accidents in the construction industry has been steadily increasing since 2014. Why do these happen despite advances in technology? Factors to this problem are always lurking underneath the construction site. Consider a set of construction sites. Heavy equipment is always in operation at construction sites, materials are piled up, and fine dust harmful to the body is scattered within the atmosphere. In addition, construction workers perform rough tasks such as drilling, cutting, welding, and material transport. In addition, Construction sites are noisy, which could be a severe factor of stress. It impairs the concentration of workers, leading to more significant accidents. Moreover, the enlargement of construction sites has been accelerated throughout recent years. The expansion of these construction sites inevitably requires more accurate and precise safety management, which is directly contributing to stable and reliable construction progress. The construction industry has made various efforts for safety and utility. Several new methods have been revised to identify risk factors and use them for construction safety management in line with technological development. However, previous studies have shown that there is a technical limitation. It includes the difficulty of monitoring the entire construction site or failing to inspect the continuously changing construction sites. And these are due to the insufficient number of cameras that cannot monitor the whole area. As a result, these limitations have drawn attention to construction safety management using drones.

Safety Inspection Activity using Drones

Today, drones are contributing a lot to the safety management business. It is not limited to construction sites but rather a more comprehensive kind of safety management. For example, drones are used in searches for missing persons in natural disasters like earthquakes or wildfires. Looking at the DJI RTK300, the Southern Manatee Fire Rescue (SMFR) team has already proved that drones can be effective HAZMAT respondents by showing how quickly they can assess a situation, plan an approach, and reduce the risk of first responders. It can also operate in radioactive places. In 2018, the British RISER drone measured the radiation level of a damaged nuclear reactor in the Fukushima nuclear power plant in Japan. The RISER drone uses lasers to fly within hazardous facilities where GPS signals are hard to reach. It can move freely within complex buildings using its collision avoidance function. In addition, combining the proprietary radiation mapping software makes it possible to measure the radiation dose in the building and outline contaminated areas in a three-dimensional map. After a series of field trials, RISER was deployed into the field on behalf of humans. Information assembled by the drones will be used to determine how to decontaminate and dismantle the nuclear powerplant facility. The same goes for construction sites. Recently, the construction industry has been paying attention to the effectiveness of drones in safety management.

3 Stages of Construction Safety Technology Combined with Drones

There are three stages of technology that are required to combine drones with construction safety. The first stage is the training of professional technicians who operates the drones. Operators film construction sites, combine images and analyze them. As a safety manager on site, you can deliver real-time safety information to managers through your smartphone or adjust the data

transmitted by the drone to be checked at a glance through the 'Situation Board' installed in the construction site. If necessary, managers can check this information and ask field workers to follow safety rules. In the past, attempts to plan safety management with aerial photography experienced failure due to various restrictions. It could be a cloud visibility problem, inaccuracy of flight plans, or even instability of aerial photography. The use of drones overcame all these shortcomings. It flies at low altitudes around 150 feet and is not affected by clouds. The number of surveyable days has expanded, stable and static flight plans significantly improved the quality of real-time information. In an enclosed space, a gas sensor is installed on the drone to detect dangerous situations, such as leaks of harmful gas, and immediately notify workers working on high floors. In cases where it is difficult to evacuate due to smoke, it is possible to lead an escape route through sound alarms and guidance lights mounted on the drone.

The second stage is a technology that precisely analyzes the field by applying mapping technology based on images obtained through drone photography—the location of equipment, materials, and personnel is identified and marked. Stage 2 is more durable than Stage 1 and mainly focuses on precise feedback on the construction site.

The captured images are converted into 3D models using drone mapping technology to figure out the overall condition of the construction site. First, the movement of each object is individually tracked utilizing a program. A particular pixel value is designated to distinguish workers, equipment, and materials. A relatively large pixel is specified into heavy equipment, and small pixels are considered materials and workers. Second, the actual distance of each object is obtained, and the distance between the objects is calculated. The density is calculated based on the distance between pixels. Third and lastly, the risk status for each expected compartment is

calculated numerically. Based on the numerically calculated information, safety training is conducted, and areas to be managed with caution are identified.

The third stage of technology is convergence with high-tech fields. Façade inspection, damage control, and automatic safety monitoring technology for buildings using algorithms is a good example. Currently, an artificial intelligence-based automatic field risk estimation algorithm is being developed. Engineers have been working hard to reduce the risk of the construction site by adopting technological innovations.

These are some examples: Founded in 2017, 'Openspace' creates a 360-degree real-time map of the workplace. The site is 3D rendered using the camera and software attached to the helmet, and it is shared with the owner, contractor, and developer. Likewise, 'Avir' uses laser scanning and AI's deep learning technology to determine which building parts are under construction. It automatically updates and monitors progress as changes occur in the building.

As such, efforts to apply BIM technology in drones are actively taking place. Shortly, it will be possible to automate the management of the entire construction process. In addition, engineers will acquire the precise site risk information through remote drone control without visiting the construction site. Above all, it is expected to create a safe construction site environment by predicting and preventing construction site accidents based on big data.

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