Applications of Unmanned Aerial Vehicles In the Automated Construction Industry

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Drones and Their Role in Construction

In recent years, a new construction process known as automated construction has played a key role in shaping the future of commercial construction. Automated construction is defined as the use of machines and other operating equipment to aid in the construction of complex structures and development of commercial sites. Some of the most commonly used machines in automated construction are unmanned aerial vehicles, better known as drones. The use of various forms of drones dates back to the U.S. Civil War, and these machines currently serve as important tools in ensuring the safety of designs. Automated construction has become so popular that many commercial construction clients require design teams to utilize drone technology when working on a project.

With the increased usage of drones in automated construction, it is important for users to understand the internal parts of the drone in order to gain confidence when flying and ease any troubleshooting process that may occur. Some of the main internal components of many commercial drones include:

* Propellers- Carbon-fiber “pusher” propellers move the drone through the air and provide added stability the drone’s base.
* Motors- Brushless electric motors, common in many current drones, are crafted with attached magnets to increase the efficiency of runs.
* Landing Gear- For drones that do utilize landing gear, retractable wings allow for full 360 degrees images without interfering with the photos being taken.
* Main Body- Houses the battery, main boards, processors, sensors, and cameras within the drone itself.
* Controllers- The Electronic Speed Controller (ESC) controls the motor’s speed, while the flight controller acquires input from the receiver and sensors.
* Cameras- Compact high definition video and picture units, such as GoPros, allow for real-time photos and time-lapse videos

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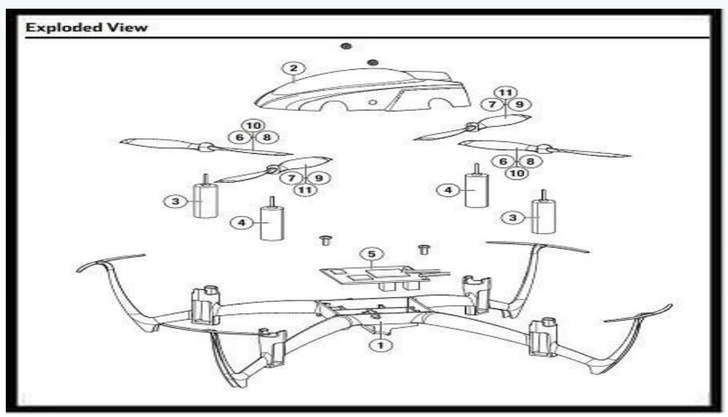
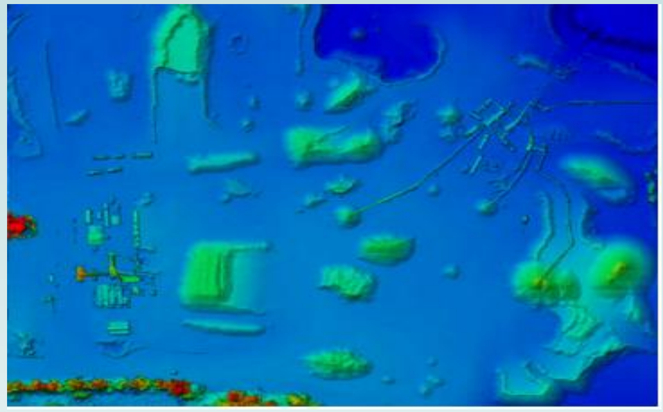
Exploded View of a Drone



LiDar Mapping from a Drone



Mapping with Drones

Drones are currently being used widely throughout the automated construction industry in order to survey land and monitor construction sites. Methods involving drones have been used as a supplement to traditional construction techniques and have sometimes even been used in place of them. Specifically, drones have been used in applications for corridor and cadastral surveying. Cadastral surveying is the establishment or changing of property boundaries, and is by far the most widely known and practiced sub-field of surveying. Corridor surveying focuses on the establishment of road, highway, and railway boundaries, and it is used mainly in the transportation industry.

Surveying and Mapping Process

Ground control points are established by pilots that map out a path for the drone to fly. The drone then follows this path while using its many features such as LiDar and high resolution cameras to capture many angles in three dimensions. The data from these scans is then uploaded to computers capable of compiling the images into an orthomosaic map, which is a large, detailed representation of an area that is also to scale. After this is complete, crews can use photogrammetry software to take exact measurements of a site within centimeters of accuracy. Data collected from these drone scans can also be used to create digital elevation models of terrain and materials, allowing for accurate volumetric measurements. This allows construction crews to keep an accurate record of available material volumes in stockpiles, as seen in the figure below.

Site Monitoring

Considering that this mapping process is very efficient and cost effective, it can be carried out almost an indefinite amount of times on a construction site. This allows for site managers to keep and accurate record of progress in extreme detail, from many angles and perspectives.

Physical Construction With Drones

The physical masonry aspect of automated drone construction involves the implementation of drones as laborers, transporting and laying materials to create structures. Automated construction using drones is unlike any other form, such as CNC machines and 3D printers, which require refined work spaces with highly regulated, specific conditions that often aren’t feasible on the job site. Drones, however, can be put to work along side construction crews, on the site, saving time for the progression of projects and allowing for unique, brick-based structures. Research into the materials that are able to be used by the drones has led to a practical future of full-scale drone-based masonry. The software utilized in these constructions relies upon systems of pairs of drones, fully capable of recognizing where the other drone is at all times of its flight. Structures such as the “Flight Assembled Architecture” from the 2014 Fonds Régional d'Art Contemporain in Orleans were able to be executed in full. The result of this project was a 6-meter tall strucure with remarkable accuracy. The Flight Machine Arena model was able to function in a way that the final structure had precision below twenty-five millimeters of variance between the design and the actual structure.

From “Flight Assembled Architecture”