



# APPLICATIONS OF UNMANNED AERIAL VEHICLES (UAVs) IN CONSTRUCTION INDUSTRY: AN OVERVIEW

**Omar Al-Nuaimi**

Sharjah Research Academy

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# Introduction

Recently, many new technologies have appeared to enhance productivity, reduce the cost and time of building inspection in the construction activities.

UAVs, also known as Drones has been interfere in the construction industry and recently in building inspection and a varied range of other sectors.

In the last decades, many researchers have concentrated on UAV applications in different areas of the construction industry.

This paper presents an overview of photogrammetry and UAVs and its applications in the monitoring and evaluation of structures and infrastructures.

# History of Drones

Part 1

1782

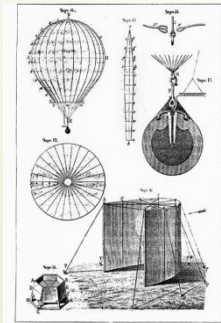


The Montgolfier brothers in France use unmanned balloons

Austria mounts bombs on two hundred pilotless balloons as part of a secret attack against Venice



1848

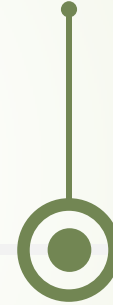


1862



A patent for a flying machine that can hold bombs was lodged in Massachusetts

American Armed forces use a kite with a camera attached to it for reconnaissance during the Spanish-American war, Tesla demonstrates the Automaton at Madison Square Garden



1898



1911



The Italians use drones when they attacked Libya

# History of Drones

Part 2

1930's



1930 the U.S Navy began experimenting with radio-controlled aircraft resulting in the creation of the Curtiss N2C-2 drone in 1937

Lightning bug and Ryan Firebee – jet propelled drones used as remote combat aircraft.



1960's



1980's



In 1980 The U.S created the Pioneer drones  
In 1986 Israel and American military start using the Pioneer



Technologies have been improved and drone used for military purposes



1990's

2000



Drone were used in many sectors such as construction

# UAVs (Drones) and its Components

Drone in a technological context, is an unmanned air vehicle (UAV) as shown below, which is either operated by human remotely or can fly autonomously through software-controlled flight plans.

The architecture of a commercial drone mainly consists of the control, data processing, monitoring and landing systems. The interior system runs a variety range of functions ranging from navigation to data transfer to ground. Before designing a drone for commercial and civilian applications, it is important to figure out the specifications that must satisfy certain needs for their owners.



## UAVs in Construction

Drone technology is used for different reasons in the construction industry. As a tool that improves communication, safety, and marketing, the use of drones in construction can offer many advantages; capturing real-time images from the field.

With their real-time data recording and unique aerial advantage, drones can improve efficiency, cut costs, and streamline workflow. Here are some of the ways drones are used in construction:

1. Topographic Mapping and Land Surveys
2. Equipment Tracking and Automating
3. Remote Monitoring and Progress Reports
4. Security Surveillance
5. Personnel Safety
6. Structure Inspection and Photography

## Applications of Photogrammetry and UAVs

The applications of photogrammetry and UAV in civil engineering is almost unlimited.

It could be used as a standalone system or jointly with other non-contact imaging data methods such as radar, LIDAR, holography and remote sensing.

It could be used in architectural photogrammetry, information systems such as GIS and building information modeling (BIM).

Deformation measurement and cracks opening during laboratory tests on structure and structural elements, crack measurement and monitoring, obtaining detailed geometries for computational structural models and visual documentation and modeling of actual symptoms (fissures, breaking, cracks or collapse) measurement of geometric and structural elements in bridge routine inspection Close range photogrammetry is employed for historic bridge documentation and routine inspection in bridge management



	Applications of photogrammetry
1	3D Modeling
2	Safety Monitoring
3	Surveying
4	Project Progress Control
5	Damage Assessment

# 1. Aerial Photogrammetry

- ▶ Photogrammetry is “the science of measuring in photos” and belongs to the field of remote sensing. With photogrammetry it is possible to determine size, shape and location of depicted objects by measuring in images, this without a need of physical contact to the object.
- ▶ Aerial photogrammetry consists of using the imagery gathered in the air by UAVs to create computer-generated 2D and 3D models. These models are topographical in nature, meaning they represent the dimensions and physical features of the area of land, and in stunning accuracy. These models can be rotated and zoomed. Because they are created entirely from images of the real locations as captured by a UAV, they will show every last photographic detail that exists in those photos.

# Drone with Aerial Photogrammetry



## Less Expensive

It can cost 5 times as much to achieve same shots with a full-scale alternative



## More Convenient

By purchasing one or hiring professional to help capture photo/ video with drone this save effort of using another more time consuming.



## Environmentally Friendly

Drone release 0% carbon exhaust comparing with traditional manned aircraft



## Essay and Fast set up

The average setup of drones is 10 min



## Less Intrusive

Include mutable datasets within single chart

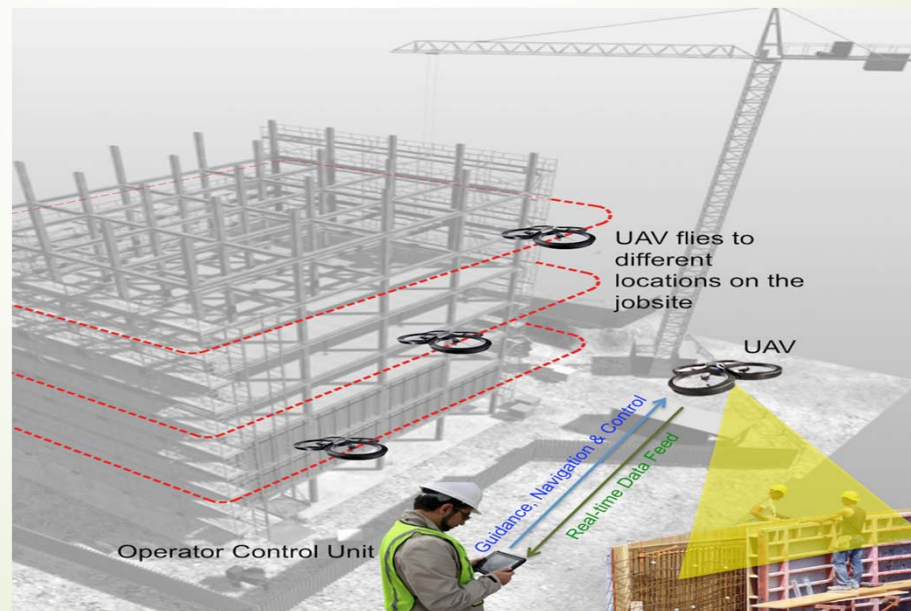


## Safe and Reliable

Drones can operate with high temperature and freezing climate. Built in GPS system so it can be found easily even if signals lost

## 2. Surveying

UAVs provide an economical platform for obtaining survey data. Equipped with proper sensors and camera technologies, surveying services providers use GPS enabled UAVs that automatically follow a GPS controlled and calculated flight path in advance.



## 3. Inspections

It has been validated by many industries that using UAVs can quicken the inspection process and enhance safety by reducing worker exposure to harsh conditions in extreme climates.

In term of commercial construction, a CEO of UAV services company describes a scenario in which a fifteen-story building has a water leak on one of the higher floors. A window frame is suspected to be the source of the leak. The building is bordered by a busy highway, making access even more difficult. A UAV is able to capture numerous photos from various angles and zoom settings in a matter of minutes. The entire operation is conducted without road closures, at a greatly lower cost than alternative inspection techniques, and with very little safety risk



## 4. Safety/Security Monitoring

Using a UAV allows the safety manager to communicate with employees anywhere within the construction site.

Images and video captured by the UAV gives the safety manager valuable documentation of jobsite conditions in cases where accidents do occur, and the UAV provides him a tool to cover a larger area of the construction site in a shorter amount of time.

Security of construction sites can also be enhanced using UAVs. the UAV is deployed and hovers above the construction site to capture video of what is happening. The high definition camera will have the capability to identify individuals or vehicles within its view, and the video can be viewed from a smartphone. The UAV will also have the ability to be programmed for periodic security sweeps, and it will return to its rooftop station automatically

## Challenges in Drones Applications

Despite so many benefits of drones there are some serious challenges that need to be highlighted. The unwelcome consequences of drones discussed below

- ▶ **Safety**

Drones deployed in highly dense cities for various civilian applications raises serious safety issue as huge damage can be caused due to the crashing of drone. This may be the result of technical malfunction or inadequate maintenance of equipment or misuse by its operator.

Severe weather conditions such as turbulence, lightening and battery life lift capacity has also triggered concerns about the falling of drones on public property. Furthermore, due to sharing of the airspace with other commercial planes in larger cities, there is also a serious risk of airborne collisions leading to widespread destruction



## Challenges in Drones Applications

### ► Security

The biggest security concerns of using commercial or civilian drone is not the drone itself, but the technology inside of it. The technologies which equip the drones could be hijacked or destroyed by attackers, causing the disruption of services they provide.

Drone navigation and communication modules are vulnerable to different kinds of security breaches. like Wi-Fi Jamming which could cause the loss of control of the drone's communication system with serious consequences for nearby people.



## Challenges in Drones Applications

### ► Privacy

Privacy is one of the major concerns related to the use of commercial drones. Drones carrying high-precision cameras, sensors and recorders that can be remotely controlled to perform surveillance tasks precisely. However, they bring with them concerns about privacy and personal data protection. Malicious software can be installed on a drone to data and to track and profile individuals using wireless localization technique.

## Conclusion

UAV regulations are under development in many countries around the world, and there is need to propose new regulations to make use of its different applications.

It is envisaged that drones will not only be used in monitoring activities, where as it could do more of small maintenance activities using a Snap-On gauge on the drone such as sealing cracks and minor repair works.

Thank you 😊