

INSPECTION OF VERTICAL INFRASTRUCTURAL USING UAV

ABSTRACT

Drones are designed for easy use, quick deployment and intense accuracy. It is used for accurate and risk-free inspection Industrial plants, factories and workshop buildings, elevated tanks, bridge construction, wind turbines, pylons, technical building infrastructure, leisure and tourism facilities, sport facilities are subject to strict safety and maintenance and must therefore be inspected regularly. These plants are difficult to view or reach due to the size and infrastructure. Entire area can be inspected quickly and accurately for damage (i.e. cracks, corrosion and rusted materials) or maintenance requirements with the help of UAVs. UAV for inspection has become a trend not just due to low cost and efficiency but also because of the lower risk involve when compared to traditional methods.

INTRODUCTION

The workflow to define an infrastructure inspection mission involves a client/user, who will benefit from an aerial view, and a pilot, who can actually fly the drone following the requirements imposed by the client. A flight plan is a time-ordered list of orders that a drone has to complete to fulfil the designed mission (i.e. take off, go take a waypoint, then hover to take a picture, then reach a second waypoint, then hover again to take a picture... finally land)

UAV for inspecting offshore oil and gas towers and flares. The offshore environment is often regarded as tough and demanding, where it is vital to keep faults as well as loss of production and the inspection to

the minimum. Monitoring of gases for risk assessment at factories and industries (gas leak, fire e.t.c) may require long period of observation and large number of sensors. For this purpose, an UAV has to be equipped with sensors capable of determine volatile chemical concentrations and detect gas leakages. Drone inspection enables both the pilot and personnel to distance themselves from the danger zones, making safe inspection of high risk areas possible. Furthermore, detailed images of critical components can be obtained. The drone collects images or thermographic data of critical components on the flare and the tower, while production continues unaffected.

Bridge inspection by UAV. Drone is capable of viewing an item at any angle between 45 degrees up and 90 degrees down. Flying underneath the bridge and inspecting for corrosion etc. without the cost of using traditional methods. In the field of public safety, new sensors are being adapted for drones, such as the ones used in X-ray camera, IR camera and metal detectors. During the aerial inspection, a pilot operates the drone and usually operate the camera, record video, points the special interest and views different angles of the infrastructure.

UAV for inspecting Refineries – Storage tanks. Drone inspection of boilers, fuel storage and power plants, refineries and other industrial structures will be an advantage as it is often too expensive or time consuming to set up scaffolding, or too hazardous for physical inspection. The pilot mount high resolution cameras, which achieve a resolution of ½ mm per pixel. Using a sensor technology, the smallest damage (spores, holes) can be detected with the help of drones. With RGB and infrared cameras, damage can be found in areas which are difficult to access and to some extent, invisible to the human eye. The data provided by the drone inspection can improve the maintenance planning, as it can be used to reduce costs and time.

UAV for inspecting cell tower inspection. By working with a UAV, the pilot can initiate an automatic scanning process of the tower without having to place anyone in harm's way and without requiring expensive equipment. A drone can help identify potential climbing hazards, find structural damage and help tower inspectors understand the tools they need prior climbing. Once the drone collected. Clear and accurate visual data on the state of a cell phone tower is displayed for the client.

FACILITIES THAT CAN BE ASSESSED BY UAV



A



B



C



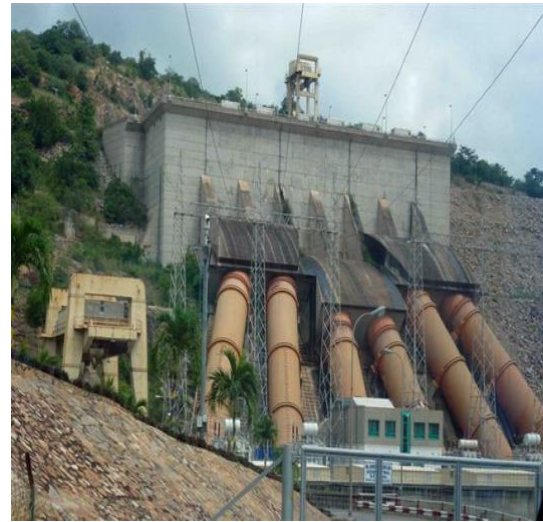
D



E



F



G



H

And more.....

Goal: Collect highly detailed visual data regarding the condition of the vertical infrastructure.

The heavy workload lies in the analysis of the collected data, and the picture taken by the drones to obtain the full value of the inspection.

In order to closely map this unclimbable structure, a professional quadcopter drone is used. The DJI Mavic is portable, it has 12MP camera that is capable of shooting 4K videos at 24 frames per second and 96 FPS when shooting in 1080p. The quadcopter hovers around the tower, with a flight plan consisting of several vertical columns approximately 13 meters away from the tower.

Electromagnetic wave interference and other environmental hazards can be a challenge for operating near vertical infrastructures, but the pilot will be able to fly close to the structure, capturing images with over 80% of overlap and getting a high ground sampling distance of 0.2 centimeters. Roughly over 400 images will be taken, which provide detailed information of the antenna, microwave, the clamp and other features of the structure which will take less than a day to acquire the images and process them into a precise, dense 3D point cloud which focuses on the rusted and worn out parts of the infrastructure.

Photoscan output can then be integrated with CAD software for final analysis.

Drone provides clear, accurate visual geospatial data on any vertical infrastructure. Using a camera that allows for high accuracy while zooming and the flight mode method will be around, side by side or up and down movement depending on how the structure is and I will process the images with software's like agisoft photoscan for aligning, stitching, building dense cloud, texture, DEM and orthomosaic, QGIS

software for digitization of the processed images and for other reasons, I will introduce Adobe Photoshop to crop and display the interested portion of the rusted structure.

Deliverables: Processed visual data in 2D maps, 3D models or any form as prescribed by the client will be use to analyze the condition of the vertical infrastructure for either reconstruction or further planning.

Why Should I Go for Drone Instead of Traditional Method???

- HIGH RISK:** Climbing vertical infrastructures is considered as the most dangerous jobs in the world due to the risk involve. Environmental hazards can disturb or attack a person on a structure will can result in injury or death. The less time a person is on a structure, the better.

- TIME INEFFICIENT:** Climbers spend a lot of time on infrastructures during inspection and sometimes spend more days to achieve their goals.

- COSTLY AND INEFFECTIVE:** Liability insurance is expensive, and so are the personnel costs associated with training someone to do a manual tower inspection, as well as the hours required to actually do the inspections.

- INCONSISTENT DATA:**

- ENVIRONMENTAL RESOURCES ARE DESTROYED**

Summarizing the benefits of using a UAV in Vertical Infrastructure Inspection

- Improves safety no need to put people in unsafe situations
- Saves time, reduces costs
- Ability to view live video feeds
- You can direct the UAV operator to specific areas of interest
- View back videos to identify defects and abnormalities for instant analysis
- Transportable and flying within minutes

NB:

Flight Paths and Safety Concerns for Guyed and Other Towers

When surveying a guyed tower (this is a tower supported by wires leading diagonally to the ground), make sure to fly vertically up one face at a time, keeping between the guy paths.

Electromagnetism and Distance from the Tower

AM towers, FM/TV antennas, and even cellular and microwave antennas, can all emit powerful electromagnetic fields at close range. These fields could interfere with your control signal, and can cause your drone to malfunction and crash.

Make sure to stay a safe distance away from the tower throughout your flight, and you should be good to go.

Battery Life

Many towers are so tall that it might take two to three minutes of flight time to reach the top.

Make sure to use realistic time projections when planning your flight, and use a battery with a long enough life for the mission you're planning.

Use a Visual Observer (VO)

Whenever possible, use a Visual Observer(VO) to help you maintain a safe distance from the tower and from any passer-by.

Although this isn't always possible, it is certainly a helpful thing to have a second set of trained eyes on hand.

Hardware Considerations

The DJI Mavic Pro is a small yet powerful drone that turns the sky into your creative canvass easily and without worry, helping you make every moment an aerial moment. Its compact size hides a high degree of complexity that makes it one of DJI's most sophisticated flying cameras ever. 24 high-performance computing cores, an all-new transmission system with a 4.3mi(7km) range, 4 vision sensors, and a 4k camera stabilized by a 3-axis mechanical gimbal, are at your command with just a push of your thumb or a tap of your finger

Software Considerations

Airspace / Scene Research

Do the research ahead of time to ensure the tower you'll be surveying isn't located in restricted airspace. Also, look at the scene where the tower is located ahead of time to identify any potential obstacles or hazards before you fly.

Other Permissions / Notifications

Make sure to secure permission from the tower owner before flying a mission. And while not required, you are also required to notify all property owners within 500 feet prior to your mission

Summarizing the step involve in using a UAV for Vertical Infrastructure Inspection

- Select the drone for inspection: The DJI Mavic is portable, it has 12MP camera that is capable of shooting 4K videos at 24 frames per second and 96 FPS when shooting in 1080p
- Select the drone mapping ecosystem: pix4Dcapture
- Planning flight: consider altitude, angle and pixel
- Take off: App to control the UAV
- Review the photos : The heavy workload lies in the analysis of the collected data, and the picture taken by the drones to obtain the full value of the inspection.
- Upload the images for processing : Agisoft and Pix4D mapper

References:

<http://www.dronepilotgroundschool.com/tower-surveying/>

<http://www.flybase.com/remote-inspection>

Robert Erdt , Ryka UASs

<http://www.ciencedirect.com/>

<http://www.microdrones.com/en/industry-experts/inspection/>

<http://www.spectair.com/en/applications/inspection/industrial-plants/>

<http://www.forcetechnology.com/en/services/drone-inspection-offshore-oil-gas-constructions>

<http://www.mdpi.com/journal/sensors>

spm-presentation-mark-property-asset-solutions-

Dronedeploy.com

Aleks Buczkowski