

Leveraging Drones in the Oil and Gas Industry

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Abstract

Several oil and gas companies are going through digital transformation to optimize operations, boost profitability, and operate safely. Drones are considered among the key Digital transformation technologies that can add value to the Energy industry's operations. This article illustrates the benefits of leveraging drones in oil and gas fields and facilities by showing cases and examples where drones can be effectively utilized. In addition, it explains the challenges of using drones in the oil and gas industry and how to overcome these challenges.

Keywords — Drones, 5G/4G, Oil spill, Electronic Fence, Transponder.

I. INTRODUCTION

This article sheds light on drones in the oil and gas industry by exploring two main topics. The first topic is about deploying Drones in the Oil and Gas Industry to enhance safety and improve productivity. The article explores drones' use during oil spills, emergency incidents and drills, inspection, search and rescue missions, and surveys of landscapes. The second topic is related to overcoming challenges related to utilizing drones in the oil and gas fields. This includes the difficulties of using drones in bad weather conditions and distance limitations to operate drones sufficiently.

II. USES OF DRONES IN THE OIL AND GAS INDUSTRY

Drones can be heavily utilized in oil and gas industries, with huge benefits for drone-makers and oil and gas companies. The continuous evolvement of drone designs expands its usage vector in the oil and gas industry overtime. Below are the current major uses:

A. Oil Spill

The oil spill is the release of liquid petroleum into the environment, especially the marine ecosystem, resulting from an accident or human error. And this is considered as large pollution. The term oil spill is mostly given to marine oil spills, where oil is released into the ocean [1]. One of the most important actions to tackle such incidents is to assess the magnitude of the damage and anticipate the oil spill's maximum limits timely. Drones can be hovered above the area of the incident to provide such assessments initially. In

one of the oil spill drills conducted in Saudi Aramco, drones have been utilized to observe the spill effectively, allowing the response teams to immediately and to the right spots. In addition, utilizing drones can eliminate the need for a plane with a professional pilot to survey and analyze the oil spill, leading to cost-saving.

B. Emergency Incidents and Drills

Nowadays, drones are a key element in any emergency incidents or drills in oil and gas companies. In a real emergency, they play a major role in detecting fire or gas leak exact location. Also, no matter how remote is the incident manager, drones enable him/her to have a clear picture of the emergency. Thus, they enhance the decision-making process for directing response teams located in the field and allocating the resources in the right place. During drills, they allow the incident manager to check how the whole team reacted in the field and drive lessons learned to enhance the team's preparedness for real incidents.

C. Inspection

Newly designed drones are customized by introducing new sensors that enable inspecting the pipelines and the flare stack head safely. They are proved to be beneficial in detecting leaks at early stages and avoid major incidents. In addition to that, relying on drones to do the pipeline inspection minimizes manual checkups, enhancing safety and optimizing cost. It is worth to mention that drones can be integrated with an advanced data analytics tool to conduct predictive maintenance activities [2].

D. Search and Rescue Missions

Several Oil and Gas fields exist in harsh and remote areas that make search and rescue activities to lose employees very dangerous and challenging. The advancements of Drones have resulted in increasing their capabilities to perform a variety of dangerous tasks instead of humans and save lives during search and rescue missions. Newly developed drones equipped with highly advanced cameras, high-speed motors, powerful batteries can scan large areas quickly and efficiently with high definition and thermal visual regardless of environment conditions, providing full and precise survey and mapping in vast and far areas within minutes and with no human effort. This made search and rescue operations much more efficient and effective. Reducing search and rescue time from days to



minutes, delivering supplies, saving lives of missing or injured people, and even saving rescuers' lives when they operate without a direct encounter with dangers in oil and gas fields [7].

E. Survey of Topography:

Uncrewed Aerial Vehicles (UAV), also known as drones, are becoming increasingly important in conducting topography surveys to find any potential area for oil reservoirs and enable the capture of detailed site maps to identify new drilling sites. Benefits are related to cutting costs of sending specialists and maintaining high safety practices compared to utilizing the traditional surveying tools. Equipping drones with advanced sensors and techniques can result in a digital terrain model with highly accurate results ready for analysis [8].

III. OVERCOMING CHALLENGES RELATED TO DRONES IN THE OIL AND GAS INDUSTRY

Many challenges come with using drones in the oil and gas industry. This article discusses two of these challenges and recommends solutions to overcome them.

A. Difficulties of Using Drones in Bad Weather Conditions

Despite being revolutionary in helping people to do difficult jobs, drones face many difficulties. Usually, they are not used in extreme weather conditions like rain, dust, high temperature, and humidity because they might be damaged. Even with some drones' modifications with protective measures like water-resistant or even water-proof schemes, their motor and electrical apparatuses can be in danger. To keep drones in good conditions without any damage, they must be kept clean and dry.

If a drone is exposed to rain, hot weather with high humidity, wind, or dust, it will likely be lost. Water may penetrate the motors, receivers, or the flight controls, burn their boards, damage batteries or cut the control signal. Then, it will not be controllable, or the drone may be lost itself. This happened even with the best police drones [4].

A covering case is one solution to ensure that water or drops of water, condensation in hot weather, won't touch the drone's inner parts. Before buying a drone, one of the things that must be checked is its IP code (International Protection Marking) of the IEC standard 60529, which is the two-digit code on its housing. The first digit represents the protection against ingress of solid objects. The second is the protection against the ingress of water. For instance, IP55 means that it's protected against dust 5 (no harmful deposit) and protected against jets of water 5 (from all directions). Consequently, the higher the rates are, the better the protection is. Thus, oil and gas companies should select drones with the code that fits the environment of a field or facility based on the data in the below table [5]:

IP TABLE (IEC/EN 60529)

1st digit: protection against ingress of solid objects		2nd digit: protection against the ingress of water	
IP	Explanation	IP	Explanation
0	No protection	0	No protection
1	larger than 50 mm (e.g., accidental contact with the hand)	1	Protected against vertically-falling drops of water (condensation)
2	Larger than 12.5 mm le. g. finger of the hand)	2	Protected against drops of water falling at up to 15° from the vertical
3	larger than 2.5 mm (tools, wires)	3	Protected against drops of rainwater at up to 60 from the vertical
4	larger than 1mm (fine tools, small wires)	4	Protected against projections of water from all directions
5	Protected against dust (no harmful deposit)	5	Protected against jets of water from all directions
6	Completely protected	6	Completely protected against jets of water of similar force to heavy seas
		7	Protected against the effects of temporary immersion
		8	Protected against the effects of prolonged immersion under specified conditions
		9k	Protected against jets of water from all directions with significantly increased pressure (vapors)

Note, there is no protection from the hits of a storm or lightning, so drones shouldn't be used during such conditions.

B. Distance Limitations for Drones

Drones are remotely controlled, with the transmitter on the ground communicating with the receiver in the drone through radio signals. However, radio receivers are limited to broadcast within a limited distance. The maximum possible distance of a drone is 5 miles by using a large antenna on the transmitter. Otherwise, it is less than 5 miles for the transmitter using normal antennas. To benefit the most from utilizing drones, long-range communication is needed for various visual line of sight oil and gas operations [9].

To achieve such capabilities, drones can be controlled with a mobile network that is constantly provided all over a field or facility. The availability of 5G or 4G mobile communications base station makes it a more effective and accurate solution for using the drones in a long-range communication system. They are the best alternative to the radio control system to overcome the short distances limitation for controlling a drone. Replacing the standard

radio control feature of drones with a 5G/4G network connection has many advantages for flight, such as extending distance limits and providing a more stable and reliable connection [9].

IV. CONCLUSION

Drones can be extremely beneficial for the oil and gas industries. They can be used in oil spills, emergency incidents and drills, inspection, search and rescue missions, and survey for topography and oil reservoir. However, it is advised to procure protected drones that are capable of performing in bad weather conditions. Also, companies in the oil and gas industry must consider that drones could be misused, and therefore security defenses have to be established. Finally, drones can fly for far distances utilizing the 5G/4G network connection.

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