Application of Advanced Technologies in Construction Project Management using Drones

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Abstract— **The regular inspection and maintenance of construction is the basic need for any construction Projects. For years, this process is being done by site engineers, site inspectors, quality managers and project managers personally. This is very time consuming and also involves many safety concerns. This is one of the area where it is time to adopt advanced and innovative technologies. In this study, an attempt is made to understand the application of one such technology n construction management process using Drones. For this study, few articles were reviewed which reveal the applications and importance of drones in the construction industry. Few such are, aerial surveying, asset tracking, managing the construction process, security surveillance, and more. It has been observed in this study that various places drones are being used and also there is tremendous scope for further applications in various areas of construction industry.**

Index Terms— **Advanced Technology in Construction, Construction Project Management, Drones application in construction industry**

I. INTRODUCTION

The regular inspection and monitoring of construction projects such as roads, sewer lines, commercial complexes like malls, and many other large projects is difficult to manage with day to day activities. Application of advanced technologies and innovative methods using Internet of Things (IoT) and Machine Learning (ML) became mandatory these days.

The regular inspection of construction projects is generally done manually which is a very slow process and requires to put a lot of effort by the person who is inspecting. In addition to this, the information collected on the site need to be transferred to the office manually at the end of the day or once in a week, depending on the location of the site from the office. In some cases, where the construction site is in remote areas, it will be further delayed. This may have impact on monitoring the progress of the construction process and necessary timely interventions to improve the quality and schedule of the project. With the current advancements in technology and its applications in construction industry, the quality inspection and construction progress can also be monitored/ managed through innovative technology applications. For effective management of construction process, there are many such applications which can be used. Some of them include: GPS monitoring, GIS monitoring and IoT based applications. Similarly, in this study, an attempt is made to understand the application of drones for enhancing construction project management. This is one of the evolving technology which is providing a constructive impact on safe performance.

A drone is defined as a recognizable aircraft, with solid and dense design generally varies in size- from fist up to size of mini-craft. Drones are also named as "Unmanned Aerial Vehicles" or "Autonomous Equipment". This autonomous equipment saves time, cost and energy, increases speed, safety and also the data can be accessed by multiple users at the same time. Drones collect the required information and then send to the software to get datasets. They provide us information even in hazardous situations and also when the area is large, it gets us information quickly.

Drones helps in reducing the occurrence of accidents at the site by eliminating elevated inspections. The main advantage of using drone is reaction time will be reduced. A drone can be controlled remotely by a person or it can be controlled using Radio waves. They do not have any specific size. They provide accurate, real time and quick data than the crew hired for inspection and are cheaper than aerial imaging (Anwar, Izhar, and Najam 2018). The high-resolution cameras create 3D maps and take volume measurement.

The main objective of this study is to demonstrate some of the major capabilities of Drone in various disciplines. Some of the valuable advantages of application of drones are: Drones prevent occurrence of expensive mistakes, provides clearer, real-time and sensible updates of the project, improves security and collaboration of all the stakeholders, reduces the probability of risk, improves and speeds up the process of inspection, surveillance and remote monitoring, tracking of equipment and many more (Autodesk BIM 360^0 2018). The Drones are used in various platforms like mapping, sales, marketing, planning, survey, etc. which are discussed in detailed in the next sections. It was observed that in future the usage of drones will be increased a lot and more technologies like artificial intelligence and Internet of things will be used to make it more developed.

II. APPLICATION IN CONSTRUCTION PROJECT MANAGEMENT

Based on the statistics, the construction field is considered as one of the most exclusive, responsive and hazardous workplace around the world. Drones are one of the evolving methods with many advantages to make the work easy and safe in construction site. Now a days, the usage of Drones is becoming popular and widely spread in construction projects, with about a rise of 200% percent use every year (Big Rentz 2018). Many construction companies are already implementing the use of drones for their projects for various purposes. One of such applications of drones is, carrying out inspections to make sure all the construction works are being done in a safe and productive manner. Using this Autonomous Equipment, the whole area can be surveyed in just few minutes, whereas it would take some weeks in the past to do by the crew to go to the proximity of the site.

The deterioration of structures is a critical issue which occurs due to the impact of heavy loads, weather changes, internal impacts etc. (Ciampa, De Vito, and Pecce 2019). The maintenance of such structures is a big challenge to the civil engineers. For such structures, a regular monitoring should be done to schedule maintenance works, detection of deterioration of any parts, etc. and this can be done easily using drones. This method is also useful for structural team to perform various tests like nondestructive test.

Developments in these type of equipment helps in minimizing accidents, injuries, deaths, electrical hazards, equipment damage, theft, etc. at the construction site. Apparently, this technology will save lot of money for the companies by its accuracy, precision, quickness and less requirement of manpower.

III. VARIOUS APPLICATIONS IN CONSTRUCTION FIELD

Based on their advantages of giving efficient and real time information, drones are found to be beneficial in the Civil engineering sector. An attempt is made to look into effective applications of drones in construction industry as shown below:

A. Topographic Mapping and Surveying

To construct large scale and complex projects, Topographic maps are to be examined properly. Generally, these maps are complicated and takes a lot of time to give the data. So, most of the companies do not use this maps. To resolve this issue, Drones are used to obtain the data faster and accurate which will ensure the project cost is within the planned budget. The superior quality images obtained from drones provide 3D models which can be compared with the actual design plans to know the accuracy of construction progress, thus saving time and cost (Tatum and Liu 2017). This investigation helps in identifying the errors which can be rectified before the construction starts. The Drones can also be very handy for government organizations to identify illegal constructions by aerial surveillance and take appropriate actions.

B. Remote Monitoring

This is one of the most impressive, useful and valuable applications of Drone, in which the live updates in the construction site can be shown to the client or any person required, even if they are far from the site. By this process, the client feels secure and satisfied for the money he spent. The Drones generate remarkable viewpoints to get the clear vision and perfect scenario from the top view. The data obtained can be further accessed by all the crew members: - engineers, managers, owners, clients, design team, etc., at the same time. This information acts as an input to prepare periodic progress reports of the construction process at site.

C. Safety Management

Safety is the topmost priority at any construction site. Most of the accidents occur during working at heights, climbing scaffolding, working at hazardous places, taking measurements at corners of structure, etc. According to a survey, about 40% of accidents are due to falling from heights (Kardasz et al. 2016). The safety inspector can use drones to ensure that all safety measures are in place related to the safety of employees during the construction process at site. For instance, he can check the construction site to see whether the equipment is in safe place and workers are maintaining proper balance while working at heights. If there is any mishappening or accident occurs, using drone he can quickly identify the location and intensity so that he can take an appropriate action.

D. Asset Tracking

Risk of equipment and materials theft are the major troubles in the construction industry all over the world. An equipment of worth more than $350 million is being stolen annually. This has become a big challenge to each Project Manager to keep an eye on all the equipment, located in different positions at the site. A worker can be hired for the security of the site but, he cannot look at the whole site if that is a massive project. So, instead of hiring a number of security guards, a drone can be replaced to do all the inspections and give live record to the owner. Drones make this inspection easy, quick and clear. The drone can also record the equipment failures or breakdowns, which aids in communicating with the concerned persons quickly and take the required action.

E. Maintenance of Structures

Furthermore, drones can be flown around a structure to check the condition, its stability and deterioration data. The sensors which are present in the drone system can detect any change in the interior part of structure like cold spots, electric shots, heat etc. The drones can be majorly used to inspect large structure like bridges, reservoirs, towers, large buildings, etc. Usually, this survey is done by a team of members by visiting the site, which would take lot of time, traffic and safety related issues in case of bridges. On the other hand, while using drones for inspections, the people in the traffic will not be having any interruption and the required data can be obtained in an effective manner within few hours.

F. Transportation of Goods

Drones can be used for advanced practices like aerial delivery of tools and materials for employees working at remote areas or at difficult heights (Mosly 2017). Drones are also expected to guide and trace automatic equipment in the near future, which will become a turning point in the industry. Due to their compacted size, they can easily move through difficult terrains and incomplete terrains to give certain crucial information.

IV. REGULATIONS TO BE FOLLOWED IN ORDER TO FLY A DRONE

However, with respect to the above-mentioned advantages, it is also important to realize that the usage of drone is subjected to local government laws and regulations. Any violation of rules may result in complications and penalties levied by Government authorities. Some of the rules to be followed strictly are mentioned below (Construction Placements 2020):

1) Drones are suggested to fly in good weather and in daylight to keep a better track of it in the air.

2) Always fly the drone within the reach of sight which is termed as Visual Line of Sight (VLOS) and should not fly near aircrafts or airports.
3) Continuously watch the signal broadcast because sometimes there may be interference of signal due to blockage.
4) Do not carry any hazardous or illegal materials.
5) Do not fly a drone from a moving vehicle.
6) Based on the type of drone, the maximum height from the ground is fixed. So, one should check this data for safety.
7) Take permission from police before flying drone and inform the concerned authorities in case of any accidents.
8) Be aware of drone restricted or military areas and respect the privacy of people.

V. FUTURE TRAJECTORIES OF USING DRONES

This technology increasing the digital data usage by transforming the entire working and broadcasting methods. An inclusive and wide-rage overview of internal and external data can be obtained, thus developing innovation. It is expected to have a growth in safety facets and risk diminishing.

VI. CONCLUSIONS

The utilization of advanced methods like drones in the construction sector develops many aspects in the industry. In this paper, major importance is given for the study of its applications, regulations to use drone, future uses, etc., in the construction project management.

It is observed from the study that, at present the drones are used for photography, inspection, surveying, progress tracking, monitoring etc. The advantages in using drone reveals that there is a great scope in the market for drone developers to enlarge its services in the construction industry. Since this is a new technology, it needs more research on various aspects of applications in construction project management.

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