Unlocking the potentiality of UAVs in Mining Industry and its Implications

Indresh Rathore [1], N. Pavan Kumar[2]

Senior Subject Matter Expert, Cyient Ltd., Plot No.11, Software Units Layout, Infocity, Madhapur, Hyderabad,

Telangana, India[1]

Team Lead, Cyient Ltd., Plot No.11, Software Units Layout, Infocity, Madhapur, Hyderabad, Telangana, India[2]

ABSTRACT: Technology plays a key role in shaping the future of mining industry. Number of technologies is debated nowadays and Unmanned Aerial Vehicles (UAVs), so-called Drones, is one among them which is picking faster. UAVs are systems for intelligence, surveillance, reconnaissance and are powered aerial vehicles with no human operator on board and can fly autonomously or be piloted remotely with expendable or recoverable and can carry surveillance equipment. UAVs are smaller than manned aircraft and can carry cameras, sensors, communications equipment. For next generation technologies, UAVs can transform across multiple segments like defence, communications, aviation, health, agriculture, transportation, remote sensing, oil, gas and mining industry. For mining industry drones are relatively new and presently limited applications of drones are known in the mining space. Their uses are somewhat restricted to capturing terrain/outcrops photos from multiple angles. But plenty of space exists for drone technology in mining prolonging from productivity to safety and security areas. In this paper, an attempt has been made to unlock the potentiality of UAVs in mining industry and its implication towards 'Future of Mining".

KEYWORDS: Unmanned Aerial Vehicle (UAV), Drone, Mining, Technology.

I. INTRODUCTION

Unmanned Aerial Vehicle (UAV), also known as Drone, is referred to an unpiloted aerial vehicle mainly deployed for military operations in situations where the risk factor of sending a human piloted aircraft is unsafe, or the situation makes using a crewed aircraft impractical. But in the recent years the increase in awareness and mission capabilities of UAVs are spread across multiple sectors like communication, agriculture, remote sensing, transportation, mining and so on. In mining sector, UAV-based technology has huge potential to reduce manual efforts in surveying, mapping, data capturing, sample collection, pipe line and conveyor belt inspection, aerial mapping of mineral prospect zones, disaster management and monitoring, machinery tracking, infrastructure monitoring, safety and security surveillance of mines and mills [1].

II. LITERATURE SURVEY

Desktop base study is carried out to understand and analyse the areas where drone technology may be applicable. There are different types of UAVs that are designed for different purposes like micro UAVS (small, extremely portable devices), Low altitude and long endurance UAVs, High altitude and long endurance UAVs employing a conventional design, High altitude and long endurance UAVs using a low observable design. Some UAVs use a blimp design suitable to carry large amounts of cargo [2]. The below Table 1 represent types of UAV with mass, range, altitude and endurance.

Type of UAV	Mass [kg]	Range [km]	Flight altitude [m]	Endurance [hours]
Micro	< 5	< 10	< 250	1
Mini	< 25/30/150	< 10	150/250/300	< 2
Close Range	25 - 150	10 - 30	3000	2 – 4
Medium Range	50 - 250	30 - 70	3000	3 – 6
High Alt. Long Endurance	> 250	> 70	> 3000	> 6

Table 1: Different Types of UAVs with Mass, Range, Altitude and Endurance [2]

Fig. 1 – Sample snapshot of Micro and Mini UAVs [3] – [5]

These devices are safe, easy to use and carry anywhere. Alongside, cost is one of the biggest benefits of drones as they are relatively cheaper than traditional helicopters and can provide better results for a fraction of the cost for surveying new areas for mining companies. And eventually they are going to reshape the future of mining operations.

III. UAVs IN MINING INDUSTRY

The mining industry is explicitly complex because of the extent and nature of work. Mining and exploration companies often face challenge in accessing remote and unsafe topography. The inaccessibility results in no information of the area, unavailability of data and lastly remains unexplored. UAVs are turning the mining sector into an emerging frontier for new technology. In recent years, these miniature helicopters have helped the industry find cheaper and safer ways to map deposit sites and explore for minerals via remote control. "A decade ago it was very difficult to convince mining professionals to take a UAV on", says Helimetrex CEO Ray Gillinder. "These days it seems to be a lot more acceptable." [6]

The potential usages for the application of drones in mining are seemingly endless. Drone aerial surveys, field mapping, and monitoring can be done in real-time, depending on the system [7]. Most importantly, drones can provide access to areas that are hard to reach and/or dangerous, such as dense forest, vertical cliffs or hills, unstable volcanic areas and historical war zones with unexploded bombs. They can be used to survey disaster areas during and after events in mining operations. The potential usage of drones can be enhanced by developing or modifying applications to collect data such as weather data, geological data, thermal imaging, sample collection, risk hazard data etc.

Many organizations and research institutes are working on to develop advance supplication for drones. Currently, to some extent, limited applications of drones are known in mining industry and their uses are limited to capturing terrain/outcrops/plants/mines photos. Drones are used to take photos from multiple angles and developing 3D model from the photos. It provides a comprehensive coverage of the area[8].

Recent development with this technology is keeping pace. For instance, software firm DroneMetrex Pty Ltd., maker of the TopoDrone-100, has developed an aerial, mapping system that captures digital imagery with an elevation accuracy

of 25 millimeters to use as survey data for creating digital terrain models (DTM). TopoDrone-100 captures data from large areas for DTM generation. DroneMetrex is also providing aerial mapping services with its TopoDrone-100 UAV system for a new recycling and waste management client in Australia (Fig. 2) [9] and (Fig. 3) [10].
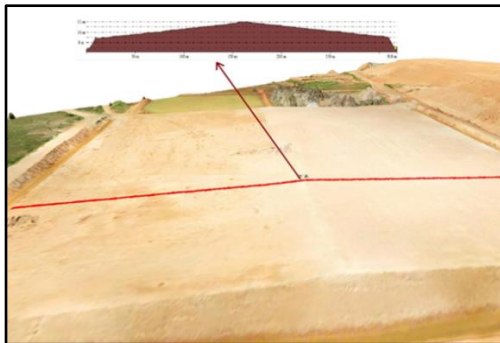

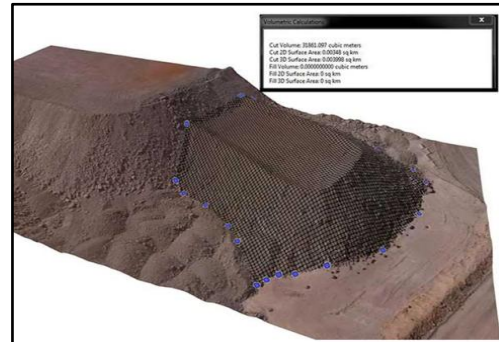Fig. 2 – Aerial mapping with TopoDrone-100 UAV system [9]   Fig.3 – Volumetric calculation of stockpile using UAV [10]

IV. RESULTS AND DISCUSSION

In this paper we tried to explore the possibilities and further areas of development of UAV technology. We propose following areas where UAV technology can play a substantial role in shaping the future of mining concept:

i.   Safety and security – With specific applications drones can be used in identifying risks and hazards zones in an operational mine (misfire, wall damage etc.), exploration and drilling sites, abandoned pits, and processing plants. Surveillance and monitoring of pipelines, conveyor belts, and fleet management in mine is possible through this technology. Besides it can also be very useful in search and rescue, confine space information, landslide zone assessment, incident root cause analysis and investigation in an operational environment.

ii. Productivity – This is another area in mining operation where drone technology is highly applicable and valuable viz. mine mapping, stockpile mapping, optimised blast design, reconciliation and time lapse photography, high resolution photography, detection of fractures in mine faces/ hanging wall.

iii. Survey and mapping – Survey and mapping could be performed in a cost effective way with aid of UAV system and of course with accuracy too. Mapping of mineral deposit, exploration target survey, explore of minerals via remote control, outcrop and stockpile yard mapping, infrastructure mapping for mine development, no-go areas survey is possible using drones.

iv. Field data collection – With development of specified application of UAV, field data (e.g. geoscientific) and sample collection is also imaginable. The specified application should enable base map, GPS ground control points which can fit to sensors and system should be compatible to pick samples from the ground on command. For example, geological rock sample collection in exploration projects and unapproachable locations is just to name few in this regard.

Key Advantages of UAVs

The key advantages of UAVs are,

- Light weight and easy to transport from one place to other
- Low cost
- Can fly at different altitudes
- Can reach areas which are not accessible
- Capture high definition images and record video clips

Key Challenges with UAVs

In addition to all the potentiality of UAVs, there are some challenges as well which is essential to mention here. Few to narrate are safety and security issues, software and maintenance, short flight endurance, chance of collisions, limited payload such as laser scanners and establishment of high quality reference data etc. Apart from these, regulatory restriction is another big challenge to note which varies from country to country. Before flying drones it is advisable to check the local rules and regulations. Obtain necessary permit from regulatory bodies to comply with guidelines. Sometimes it may linger depends on functionality, area and/or scale of project. For instance, in USA only public agencies can fly drones whereas in Canada operators should apply for regulatory waivers [1] – [5].

V. CONCLUSION

The advance technology of UAVs is highly beneficial in shaping the "Future of Mining" concept. It can assist future-of-mining automated technologies for competitive advantage, cost-effectiveness, safety and security compliance. UAVs can make a major impact in the mining industry in terms of productivity, cost and efficiency in coming years. It has potential benefits across the mining value chain with endless counts. This technology is pretty much known now in developed nations like USA, Canada, Australia and moving rapidly to other countries also. Many organizations including research institutes are developing advance application of UAVS which will provide more solutions and add value to the mining industry.

VI. ACKNOWLEDGEMENTS

REFERENCES

[1]   Ben Hagemann, "Drone survey tech investments take off", Mining Australia news, 25 Feb 2014.
[2]   UVS International, http://uvs-international.org/
[3]   http://www.bitcraze.se/crazyflie/
[4]   https://www.aibotix.com/
[5]   http://www.dji.com/product/phantom-2-vision-plus
[6]   Robert Spence, "The Mining Sector puts Drones to work", Mining Global Tech, 1167, 24 Sept, 2014
[7]   Jordan, Benjamin R., Department of Biochemistry and Physical Science, Brigham Young University Hawaii, 55-220 Kulanui Street, BYUH #1967, Laie, HI 96762. 2014 GSA Annual Meeting in Vancouver, British Columbia, pp 34-1, 19–22 October 2014.
[8]   Louise S Durham, UAV Research: "Making a geologic tool even better", AAPG Publication News Explorer, Article 127, Nov 2013.
[9]   Shepard News team, DroneMetrex conducts UAV mapping operation, Shepard Media, uv-online, 1st Oct 2013.
[10]   Sparpoint Group News, Maptek now owns 50% of UAV mapping co., Geospatial article.