Application of UAV Drone Technology in Mining Industries of Nepal

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Key words: UAV, Mining, Surveying, Mapping

SUMMARY

Nepal is the one of the most topographically variation country as altitude varies from 59m to 8848.86m above mean sea level. The most of the mines and minerals lies in mountain areas of Nepal and were mined extensively in the past before Second World War II.

The mountain areas have very high topographical range, steeply slope, and cliff areas so it is not easy to use for mining surveying and mapping with human. Mining is an important activity of the primary sector with strong economic development of Nepal. The human mine surveying and mapping one of the most challenging parts all over the world because mine is an incredibly dangerous industry. So, UAV drone technology is easy to use for surveying and mapping in mining industries in Nepal.

The main objective of this paper is UAV drone technology to use image capturing for surveying and mapping of open caste mining and surface area of the industries of Nepal. GIS and photogrammetry software used for image processing, mapping of mining area. The contribution of this paper is to low cost and easy to use for supporting mining industries with better than 10cm spatial resolution multispectral imagery with land cover details map. After image processing we can get Orthophoto, contours, digital terrain model, digital surface model and 3D model of the survey area. The resulting map /data indicates the quarry area, mines area and lease area, dump site, stock yard and top soil yard as well as land cover map.

In this article, it is briefly described the use the UAV drone on mine survey in Nepal which is fast, safe, reliable, more accurate, easy to calculation of volume, analysis and interpretation from the continuous image data.

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1. INTRODUCTION

Nepal is the one of the most topographically variation country lies as altitude varies from 59m to 8848.86m above the mean sea level. Nepal has divided in 21 districts in Himalayan region and 28 district lies in mountain region. Most of the mine and minerals lie on Himalayan and mountain regions. There are very high topography range, steeply slope and cliff area in these regions. So surveying and mapping is not easy task by human in this areas. The mine surveying and mapping is the most challenging and incredibly dangerous industries in Nepal as well as in the world.
The drones are utilized in a vast range of applications such as surveying, mapping, search and rescue, monitoring, urban planning and management. In the recent time drones have been successfully used in different industries like as photography, videography, delivery services, agriculture, oil and gas, construction, environmental protection, mining etc. Recently the mining industry has shown increased in the use of drone for routine operations in surface and subsurface mining. This study aims to conduct the review of surveying and mapping application of UAV drone technology in the mining industry. For this purpose, previous study, news, articles, works and information from the different persons, companies provide the usefulness of drones for mining industries. In this paper, application of UAV drone technology in surface and open cast mining surveying and mapping. Applications of UAV drones in surveying and mapping, commonly use in surveying and mapping, challenges and benefits of UAV drone technology in mining industries are discussed.

The following maps will show the Figure 1: Prospecting License issued and Figure 2: Opening license issued by Department of Mines and Geology (DMG) (Map Source: DMG):

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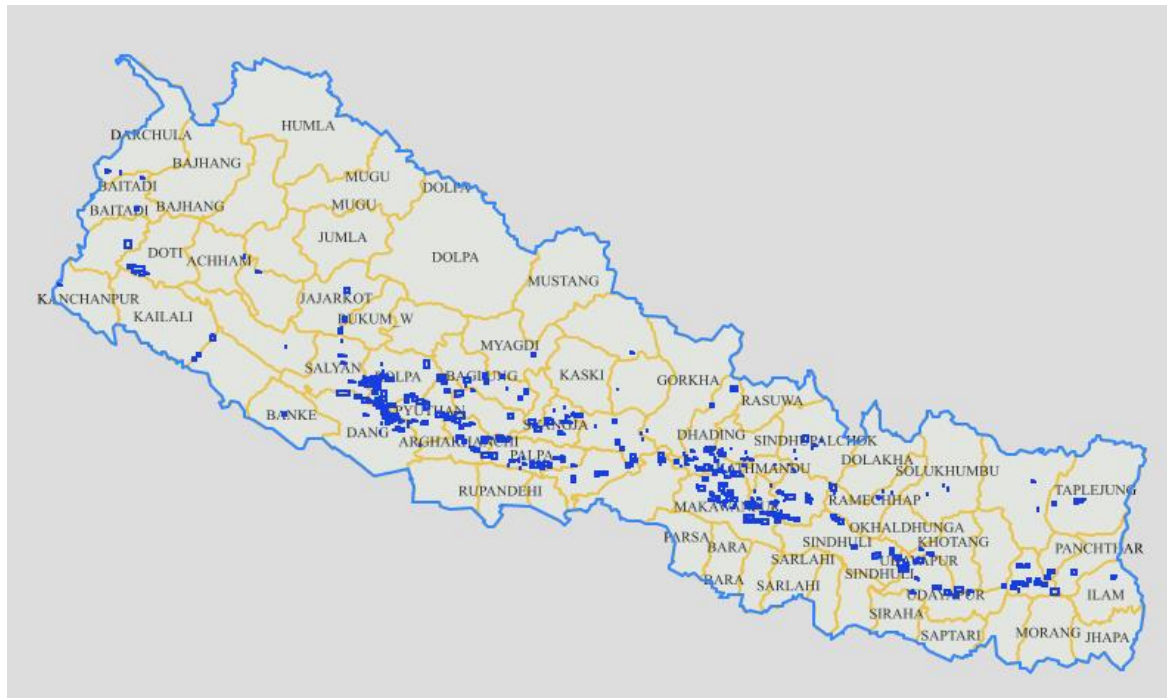Warsaw, Poland, 11–15 September 2022

Figure 1: Prospecting license issued by Department of Mine and Geology (DMG) (Map Source: DMG)

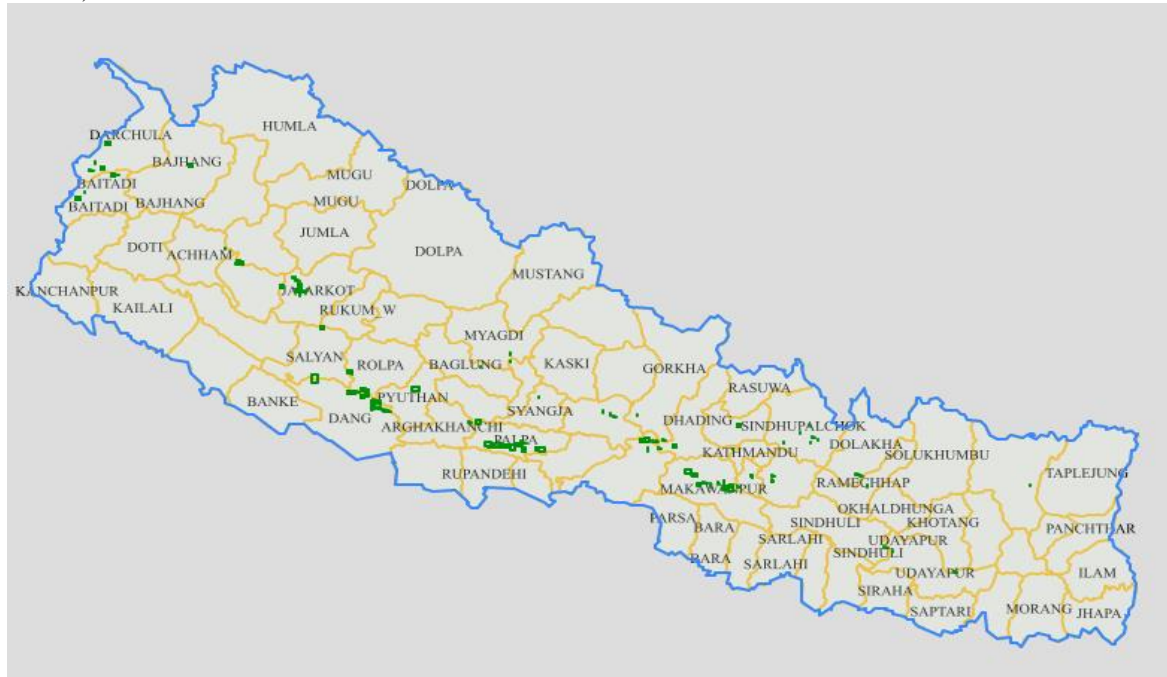Figure 2: Opening license issued by Department of Mines and Geology (DMG) (Map Source: DMG)

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2. UAV DRONE TECHNOLOGY APPLICATIONS IN THE MINING INDUSTRY

UAV drone technology can perform a wide range of mining application to exploration, surveying and mapping to maintaining safety and enhancing security, and they have shown exceptional results by facilitating greater data collection, improving safety and enhancing productivity. In the recent year drone are more popular in mining industries to investing of the mining site using drone technology. Drones in mining provides accurate and comprehensive information on quarry and mine conditions in a short time as well as enhancing the efficiency of large mine sites and quarries. There are two main advantages of using drones in mining industry operations. The first drones can conduct a quick inspection of an area in the case of emergency situation and hazard identification. The second drone can conduct the blockage inspection, explosive and unblocking of blocked box-holes and ore-passes. According to Lee and Choi categorized the applications of drones in the mining industry in surface mining as mine operation, 3D mapping, slope stability, mine safety, construction monitoring and facility management.

Figure 3: Surface mining area in mountain of Nepal from Google Earth image

3. APPLICATION OF UAV DRONE TECHNOLOGY IN SURFACE MINING/OPEN CAST MINING

Generally mines are located in mountain and Himalaya region in Nepal. This area are vast, remote, cliff and steeply slope in mountain and Himalayan region. Therefore, mine monitoring, surveying and mapping by traditional methods are time, cost and manpower consuming. So, UAV drone

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technology can be beneficial in surveying, mapping and monitoring of mining industry as well as topography changes. The use of the UAV drone technology in mining industries are as Teklite, GoSurv, Swamp, Quardcopter, Phantom etc.

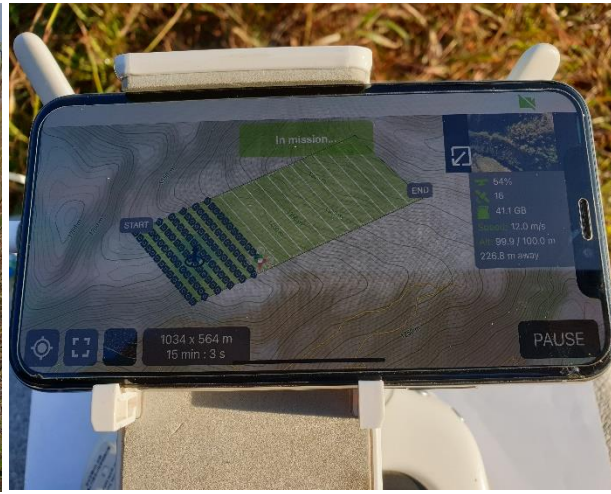

Figure 4a: Phantom 4 Pro drone | Figure 4b: Flight planning and image capturing

4. APPLICATION OF UAV DRONE TECHNOLOGY IN SURVEYING AND MAPPING

Control points are monumented, signalized which are established by DGPS, RTK or total station survey connecting to national control networks. In the recent days the UAV drone technology is widely used in surveying and mapping sector. Nowadays, UAV drone technology in used in mining industries in Nepal. The required data of the mining surveying are as topographical map for location finding and planning the before drone flight and DGPS data for geo-referencing for high accuracy map. The UAV drone capture the continuous stereo image data of the mining sites. The collected image data all the mining areas using UAV drone, and checking the data collection then the image processing will be conducted using Pix4D, Drone Deploy, Simactive, Agisoft, Bentley etc. as well as photogrammetry software. The Digital Terrain Model, Digital Elevation Model, Orthophotos, Land Use Land Cover, 3D Map, as well as contour map with the help of ArcGIS software will be generated.

The following photographs will show the Figure 5: Photographs of Surface Mining area and Figure 6: Drone image Processed Ortho Photomap of Surface Mining Area:

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Figure 5: Photographs of surface mining area
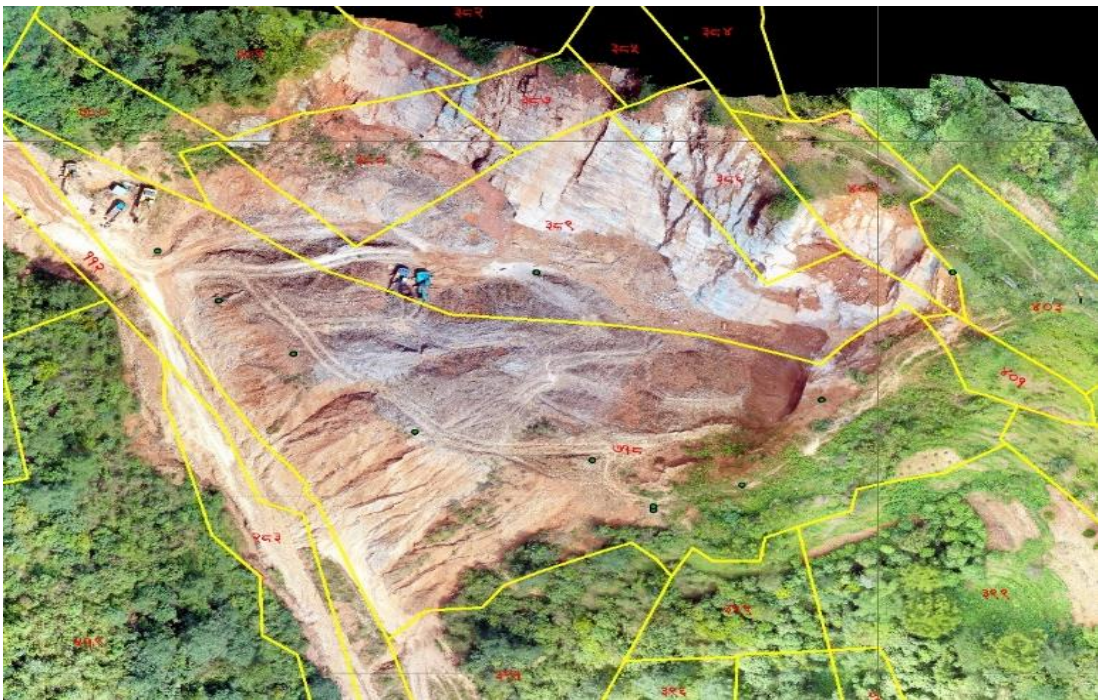

Figure 6: Drone image Processed Ortho Photomap of Surface Mining Area

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5. CHALLENGING OF UAV DRONE TECHNOLOGY USING IN MINING INDUSTRIES

One of the most challenges in the mining industry is collecting geotechnical data from difficult or impossible to access regions. The drone mapping image gap or discontinuity capturing is the challenges of mining. The challenge in the mining industry is engineering geology mapping of the site. The engineering geological mapping covers strikes, dips, features notation, type of rocks, faults etc. The challenges and repeated work of the mining industries is blasting. Blasting is the always involved with the safety risks which could be inspected and controlled by drones. Dust particle of the mining activities are the significant environmental issues as well as neighboring environmental issues. The drone can be used to reduce, control and management the mining dust and moisture.

6. BENEFITS OF UAV DRONE TECHNOLOGY USING IN MINING INDUSTRIES

The benefits of the UAV drone technology in mining surveying and mapping sector are as below;

6.1 High Resolution Data Capturing
The drone imaging carried out by drone offers precise and high resolution photographs and videos as opposed to ground based traditional inspections and mine surveying and mapping.

6.2 Quicker Data Collection
Drone surveys for mine sites enable to more rapid data collection, nearly 30x faster than traditional survey carried out by personnel.

6.3 Increase work Efficiency
The use of drone image data and mining operation have become more productive and efficient. Workers depend upon the accurate information presented by drones and make well-informed decisions quicker. The time utilized to inspect mine sites in traditional processes is now implemented in other significant mining operations by workers.

6.4 Economy (Cost Effective Approach)
Drone surveying and mapping technology is saving several costs, resources and time investment to comparing a ground based survey.

6.5 Higher Accuracy
UAV drone capturing the image with high accuracy comparing to traditional surveying. Drone technology encourage to mining industry to procure more accurately and systematic image data collection for mining operations such as volume estimations. According to drone specification there are +- 10 cm accuracy in image data capturing.

6.6 Worker Security

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Mine surveying and mapping, inspection and monitoring using UAV is entirely remote area doesn't demand crew members to be present at the cliff, mountain area and hazardous site.

7. CONCLUSION

UAV drone technology is a common technology in surface mining industry used for surveying and mapping, monitoring, ore control, rock discontinuous mapping, 3D mapping, blasting management. Fixed-wing and rotary-wings drones are the most commonly used drones in the mining industry as well as research and commercial applications. Nepal has a various altitude with High Mountain and Himalayan region, so there are so many difficulties survey and mapping by human manpower. UAV drone technology using in surveying and mapping in the mining industry then save time and money as well as human life. The GNSS and UAV drone technology used then cm accuracy maps will be prepared in mine surveying and mapping. The drone image processing software able to make 3D modelling of the quarry area, contour map, offline inspection and volume calculation. So UAV drone technology is the best method over the traditional surveying and mapping in mining industry in Nepal as well as in the world.

ACKNOWLEDGEMENT

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BIOGRAPHICAL NOTES

Mr. Ashim Babu SHRESTHA holds a MSc in Geographical Information Science and Systems (GIS) from University of Salzburg, Austria in 2016 and BE in Geomatic Engineering from Purbanchal University, Nepal in 2012. He works on a Department of Mines and Geology, Mineral Resources Division, Mining License Administration Section, Lainchaur, Kathmandu, Nepal since 2015. He is currently affiliated to Nepal Geomatics Engineering Society (NGES), Nepal Remote Sensing and Photogrammetry Society (NRSPS), Nepal Surveyors Association (NESA), Diploma

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Engineers' Association, Nepal (DEAN), Nepal GIS Society, Nepal Engineers' Association (NEA), and Nepal Engineering Council (NEC).

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