

Photogrammetric Data Acquisition & Processing, Geomatic Applications in Construction Industry

Apurwa Masook¹, Sahasransu Purohit²

U.G. Student, Department of Civil Engineering, Veer Surendra Sai University of Technology, Burla, India¹

U.G. Student, Department of Civil Engineering, Veer Surendra Sai University of Technology, Burla, India²

ABSTRACT: In this convoluted and sophisticated world, where every man-power activity is turning machine-operative; engineers took an initiative to make the job of surveying and construction industries easier, efficient and economical. An innovative approach of using a flying remote controlled, light weight aircraft (referred to as Drones or Unmanned Aerial Vehicle) with an on-board camera associated with special GPS technology for survey of large areas, gave way to better analysis of the topographic surveys prior to the construction job.

KEYWORDS: Data Acquisition, Geomatics, Photogrammetry, Remote Sensing, Surveying, Topography

I. INTRODUCTION

Technically, aerial mapping can be defined as the procedure of drawing planimetric maps, contours and features that are extracted from the aero-triangulated aerial imagery. With the increasing demands for accuracy and sustainability, Drones or UAVs are being employed in greater numbers to simplify the task of construction managers and builders; thus in turn establishing an improvised economical outcome from the architectural projects. Blooming onto a number of useful applications, the aerial mapping drones have proved to be the most efficient ones in the field of construction and building works. It performs various important tasks, which further includes the aerial monitoring through the power line net-work to have a regular check on the vegetation growth and to detect the damaged areas and the 3D mapping through which one can generate detailed 3D images of the worksites to introduce proper planning, designing and evaluation of the distances of installations.

Drones can be also used for stock-pile monitoring by the use of volumetric calculations to measure the extraction area and other stockpile dimensions in addition to the traffic monitoring applications for efficient transport and communication. The advanced use of the UAVs or Drones have revolutionized and welcomed tremendous progress in the construction industries. In the stepwise procedure of construction works, the drones find its primary application in the topographic surveying of the site prior to the job of construction. Thus with an overall inspection of the construction work and the jobsite, drones or UAVs promote efficient completion of the jobs indicating their crucial necessity in the field of construction industries and civil engineering.

The overall 3D mapping and 3D modeling market size is expected to grow from USD 1.90 Billion in 2015 to USD 16.99 Billion by 2020, at an estimated Compound Annual Growth Rate (CAGR) of 55.0%. The 3D mapping and 3D modeling market can exist independently, but the playing fields are still the same. 3D mapping applications nowadays are gaining traction and are being adopted by the end users on a large scale. [3]

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

II. PHOTOGRAMMETRY

Photogrammetry can be referred to as the science of measurement in photos. It is a part of geodesy, belonging to the domain of Remote Sensing. It helps to reconstruct the position, orientation, shape and size of objects from pictures. It allows the analysis of the characteristics of the object, without any physical contact to it. Its principal application lies in the production of topographic maps. It helps to record substantial geodata, which is fed to a comprehensive Geoinformation System (GIS). [1], [2]

Photogrammetry is based on perspective geometry. At the simplest level, a camera lens can be a perspective centre and light rays traveling in straight rays from a point in the scene, through the perspective centre, to the image of the point. If the camera is calibrated, i.e., we know the principal distance (focal length), we can determine the angles between light rays from various points. Given at least 3 points in the scene with known 3D coordinates in some coordinate system, we can determine the position of the perspective centre and the orientation of the image with respect to that coordinate system.

Stereoscopic viewing:

By simply understanding the properties of human vision, where we see objects in a spatial manner. We at all times, receive slightly two different images, due to the different positions of our left and right eye. This principle is referred to a stereoscopic viewing, which is used to extract three-dimensional information in photogrammetry. So if we have multiple images of the same object, taken from different positions. I.e. different perspectives we can calculate three-dimensional coordinates of the points, represented in the images. This helps us to digitize points, lines and calculate distances, areas, slopes volumes, etc. [2]

III. PROPOSED METHODOLOGY

A self-made unmanned aerial vehicle (quad copter) is used for the purpose this thesis. The Drone was assembled in the IDEA LAB of VSSUT, Burla. A maxx 4k 16mp ultra HD Wifi action camera was used for taking aerial images, with a significant overlap ratio of 80%. A brushless camera gimbal with motor controller is used for holding the camera in UAV and to operate it. A Mini Ublox 7M GPS module is used to get the exact coordinate of the drone. An Altimeter is used to measure the height of flight of the drone. The Quadcopter was deployed over the site to be mapped, and the pictures were received from the aerial analysis. Primarily Agisoft software was used to process the images to get the 3d maps.



Fig. 1. Quadcopter developed in IDEA LAB of VSSUT, Burla and a test run

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

IV. WORKFLOW

Few preliminary checks are made, and the entire Drone system is accounted for. After the Flight Planning is completed, the RC drone is deployed at the site to be mapped. Various parameters such as altitude, wind speed, battery level, GPS coordinates are monitored all the time during the complete flight. The flight is made in such a way to get 360-degree view of the complete site, keeping in mind the 80-90% overlap ratio, so that the frames can be stitched into complete Raster Data. Regulatory concerns include proper Permissible flight approval from relevant authority (AAI), vertical flight limit and line of sight at all times. The Limited Battery life (15-25 minutes) should be also taken into consideration and additional battery may be kept ready for next flight. Flight should be delayed during unpleasant weather conditions such as rain, fog, wind, etc. During the Project work for this thesis, 2 different sites were aerially mapped using the proposed methodology.

Site 1:

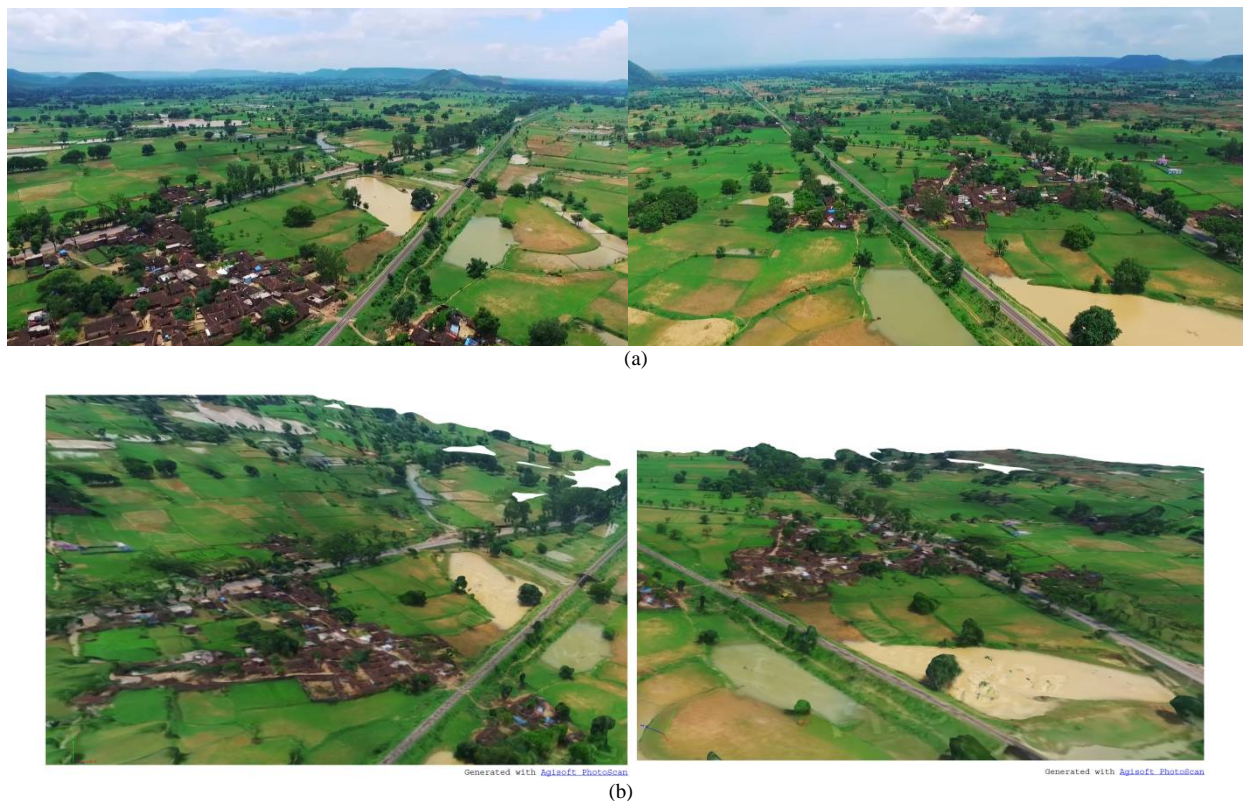


Fig.2 Data Acquisition and processing (a) Original Raw Images taken by drone (b) 3d Map rendered in Agisoft

In Agisoft, first the photos are feeded into the Workflow. The software renders it into a point cloud generating thousands of points, and indicating camera locations. It is set of data points that indicates coordinates in a three-dimensional system. Next a Dense cloud is generated which itself is the 3d modelling that places the objects in the scene. This Dense Raster data is used to create a 3D Mesh, the Photoscan interpolates the data from the cloud to a solid model web of Triangulated Irregular Networks. A texture can then be added for a better finish. Similarly, a Digital Elevation model (DEM) can be created from the Raster data, a final 3d representation of the terrain.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Site 2:



Fig.3 Data Acquisition and processing (a) Original Raw Images taken by drone (b) 3d Map rendered in Agisoft

V. APPLICATIONS

Drones, more accurately described in a business context as unmanned aerial vehicles (UAVs), present increasingly attractive opportunities for achieving several goals. UAVs can take different forms, with different levels of controls and the capacity to carry a very wide range of payloads. We can mount a High resolution camera, or Thermal Camera, or Multispectral Camera, or Hyperspectral Camera, as we deem fit for our purpose. We have so many sensors at our disposal, to use along with the drone. Namely to monitor, Light Intensity, Pressure, Frequency, Radiation, Cell Reception and so on. The UAVs can be remote controlled or semi to fully autonomous. There is no limit to customization it offers. It helps to automate simple tasks and hence reducing Labour costs significantly. [4] It can be used for surveillance of Transmission Line Network, Stockpile Calculations, Smart City Traffic Monitoring, Use of thermal imaging for monitoring gas emissions, and GIS applications.

VI. CONCLUSION

Given their flexibility, user-friendliness and relatively low-costs, the potential technical applications of drones in the Construction industry are numerous and continuously increasing, following the development of this technology. These tools allow the Designer to acquire basic data autonomously thereby speeding up the whole design process. This aspect is extremely important especially within the framework of Construction Industry [5]. Once Drone technology and autonomous flights prove reliable and economical we will see a dramatic increase in the use of Drones for GIS

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

mapping applications. This will disrupt the existing GIS data collection process. Collateral industries will also be affected (drone and sensor manufacture, sales, repair, etc.). Software industry will adapt (Drone2Map from ESRI, AgiSoft, Pix4d, etc.) [6]. The range is incredible. As with GIS, almost any use case can benefit from higher-resolution, self-service imagery and 3D point cloud data.

VII. ACKNOWLEDGMENTS

This work was supported by Idea & Innovation Cell, VSSUT, Burla. Sincere thanks to Sudarshan Samal, Sovan Panda for contributing information and assistance to the article. And to all those who are directly or indirectly involved for drafting the paper.

REFERENCES

- [1] K. Kraus, Photogrammetry: Geometry from Images and Laser Scans, Volume 1, second Edition WDeG, pp. 1-3.
- [2] W. Linder, Digital Photogrammetry: A Practical Course, fourth Edition Springer, pp. 1-3.
- [3] 3D Mapping and 3D Modeling Market, Press Release, Markets and Markets
- [4] Drones in Engineering and Construction, Report by Accenture
- [5] G. Pietrangeli, G. Pittalis, V. Millesi, R. Cifra, Innovative Applications of Drone Technology in the Engineering of Large Dams
- [6] Jeff Tolhurst, Drones in GIS, Ph.D. Columbia College GIS Program Sonora, CA