iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VIII **Month of publication:** August 2021

DOI: https://doi.org/10.22214/ijraset.2021.37711

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

Unmanned Aerial Vehicle (UAV)/ Drone Surveying & Its applications in Urban Planning

Sameer Rakte[1], Ms. Shraddha Chavan[2]
[1]M.Tech Town and Country planning Sandip University
[2]Assistant professor, Sandip University

Abstract*: The current advancement in technology of Unmanned Aerial Vehicles (UAV)/ drones has potential use in various sides of urban life, including in the Town planning sector. Compared with other alternatives for surveying, Drones could potentially provide a more proficient and cost-effective, adaptable, and exact information gathering instrument for planners. Presently, however, government regulations on the use of Drones in India, especially in town planning sector, are not precisely defined with a general focus on safety rather than stimulating technology towards a more efficient system. Town planners and surveyors need flexible, realistic; drone regulations that will deal with the complex issues related to the urban use of UAVs, to take the maximum possible public benefit from the use of this technology in Town planning. In this report current use of UAVs in different Urban Planning sectors are discussed.

I. INTRODUCTION

The surveying is the process includes measuring, recording, analysing, attributes of a land area for; helping to prepare a plan or create a map for construction. With the current advancement of technology, the map produced by the surveyor today will most likely be available in digital data format compared to maps put together by Surveyors a few decades ago where it was all on physical paper.

Now, a range of modern surveying technologies has been developed such as Global Navigation Satellite System, Terrestrial Laser Scanner, digital cameras with photogrammetric capabilities, digital levellers, and reflector-less EDM devices. All the instruments developed are far capable of producing surveying standard digital model maps.

In less than a decade an ago, the surveying industry introduced Unmanned Aerial Vehicles (UAV)/ Drones with photogrammetric capabilities as a survey instrument. Use of UAV's make the surveyor's work becomes more proficient and cost effective.

The use of UAV technology started innocently back to the early 1800s in the form of hot air balloons, and their sole purpose is acquiring data on the earth upper atmosphere for weather predictions.

Than in Mid 1900s, UAV evolved into the form of pigeons where it was used to convey messages from headquarters to soldiers in the front line of World War I Soon after, UAV was utilised to spy on enemy basses by strapping a camera onto kites, rockets, and miniature hot air balloons.

After World Wars ended, UAV was utilised for other than military purposes such as land surveying, environmental surveillance, photography, and infrastructure maintenance works. Przybilla and Wester-Ebbinghaus (1979) became the first few people to begin experimenting with fixed wing and quadcopters UAVs for land surveying. Soon after, as technology evolved, UAVs had become more and more commercially available to the public is document is a template. For questions on paper guidelines, please contact us via e-mail.

II. OBJECTIVE

A. To study and understand technology and process used for UAV/ Drone Survey
B. To understand Government regulation regarding its use.
C. To identify various application of UAV/ Drone Survey in urban planning field

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

III. METHODOLOGY

The problem was defined after referring the relevant articles and current drone surveying trends that are occurring around the world and at regional level. Based on that, literature papers and related works were studied to define the objectives

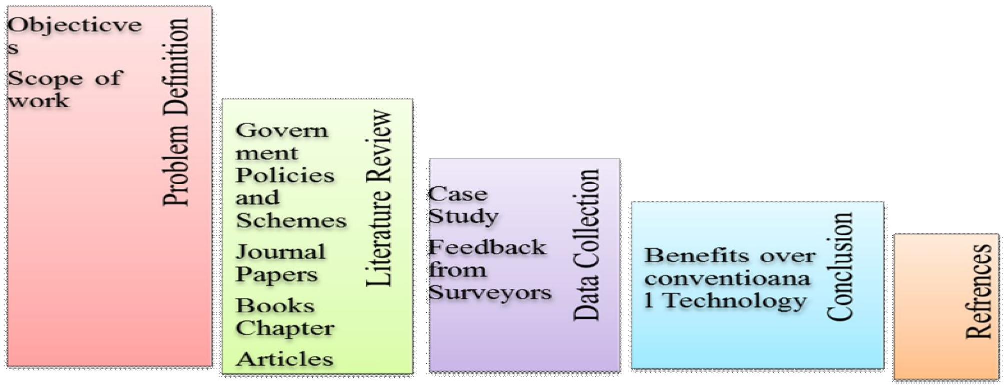


Figure 1 Methodology for this Dissertation

IV. NEED OF STUDY

As the advancement in technology in field of surveying increases, new technology UAV/drones are use they can do much more than take pictures. In combination with other emerging technologies (such as artificial intelligence (AI)), inspections can be undertaken in a cheaper, faster and safer way. Harvests could be optimised as part of precision agriculture and surveillance could be carried out more quickly and efficiently. Drones might be just a tool, but in combination with the right technology and/or equipment (e.g. cameras, sensors), the number of applications is enormous and will continue to grow in the future. So to understand this new method and its application in field of urban planning I have selected this topic.

V. TERMINOLOGIES

1) Orthorectification is the process of removing the effects of image perspective (tilt) and relief (terrain) effects for the purpose of creating a planimetrically correct image. The resultant orthorectified image has a constant scale wherein features are represented in their 'true' positions.
2) Georeferencing means that the internal coordinate system of a digital map or aerial photo can be related to a ground system of geographic coordinates.
3) RGB : The human eye is sensitive to red, green, and blue (RGB) bands of light. Most standard drones come with cameras that capture the same RGB bands so the images they produce recreate almost exactly what our eyes see.
4) Multispectral cameras work by imaging different wavelengths of light. ... The output of the camera is a set of images for that particular wavelength. These sets of images are then stitched together to create geographically accurate mosaics, with multiple layers for each wavelength
5) LiDAR, or light detection and ranging, is a popular remote sensing method used for measuring the exact distance of an object on the earth’s surface. A scanner laser in an aircraft emits pulses towards the ground below and equipment measures the time of flight (time it takes for the laser to fly from the emitter to the object and reflect back to the receiver) for the depth of object.
6) Payload means any component or equipment or any other material on board the unmanned aircraft that is not required for the flight or its control
7) Rotorcraft means a heavier than air aircraft supported in flight by the reactions of the air on one or more power driven rotors on substantially vertical axes.
8) Unmanned Aircraft means an aircraft, which is intended to operate with no pilot on board
9) Unmanned Aircraft Traffic Management means a specific aspect of air traffic management which manages unmanned aircraft system operations safely, economically and efficiently through the provision of facilities and a seamless set of services in collaboration with all parties and involving airborne and ground-based functions
10) Digital Elevation Model (DEM): A digital elevation model is a bare-earth raster grid referenced to a vertical datum. When you filter out non-ground points such as bridges and roads, you get a smooth digital elevation model. The built (power lines, buildings, and towers) and natural (trees and other types of vegetation) aren’t included in a DEM

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

A. Unmanned Aerial Vehicle

A drone is a flying robot that can be remotely controlled or fly autonomously through software-controlled flight plans in their embedded systems, working in conjunction with onboard sensors and GPS

Classification of UAVs as per Directorate General of Civil Aviation, Govt. of India

Drones are classifies ass per their range in size and form and are typically described according to height, endurance, purpose of use, and altitude of operation.

B. Categorisation of Unmanned Aircraft System

1) The unmanned aircraft system is categorised as aeroplane, rotorcraft and hybrid unmanned aircraft system.
2) The aeroplane, rotorcraft and hybrid unmanned aircraft system shall be further sub-categorised as under
a) Remotely piloted aircraft system;
b) Model remotely piloted aircraft system;
c) Autonomous unmanned aircraft system.

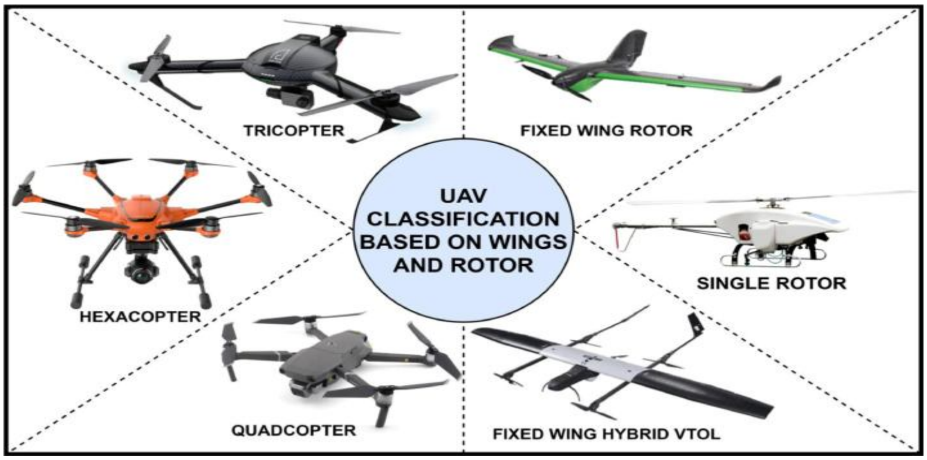


Figure 2: Classification of UAV based on Rotor

C. Classification of Unmanned Aircraft

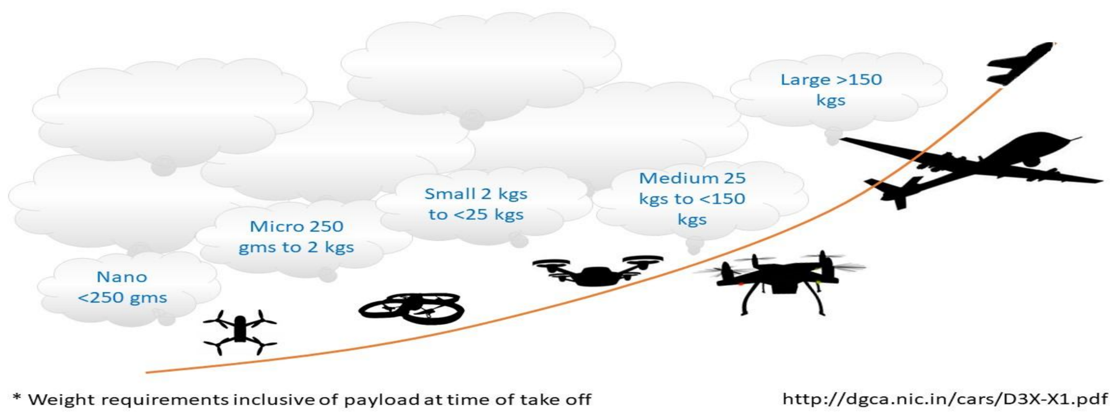


Figure 3: Classification of UAVs

A Nano unmanned aircraft shall be classified in the next higher category, if it exceeds the following performance parameters, namely: –

1) Maximum speed in level flight limited to 15 meters per second; or
2) Maximum attainable height limited to 15 meters and range limited to 100 meters from the remote pilot.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

D. Ground Control Station

Ground Control Stations (GCSs) are stationary or transportable hardware/software devices to monitor and command the unmanned aircraft. GCS are probably as important as the any eventual error on the aerial platform and/or any outcome of the payload sensors shall be sent to and seen within the GCS. As fundamental pieces in UAS, GCS have evolved over the past decades pushed by the parallel improvements in computer science and telecommunications.

Requirements in UAS-GCS communication, commanding devices, the number of monitors and the crew members needed to command a UAV are crucial variables to shape a particular GCS. From the Predators or GlobalHawks GCS, enabling simultaneous control of several platforms and command by up to six crew members, to small portable PC-based GCS such as that in the UX5, from Trimble, down to the software-only GCS, found in SwingletCAM, from SenseFly.

Even though, generally speaking, a commercial UAS such as any of those listed in Table 10 is a non-separable UA-GCS ensemble, there are some generic developments usable as stand-alone solutions, such as the Portable Ground Control Station, from UAV Factory.

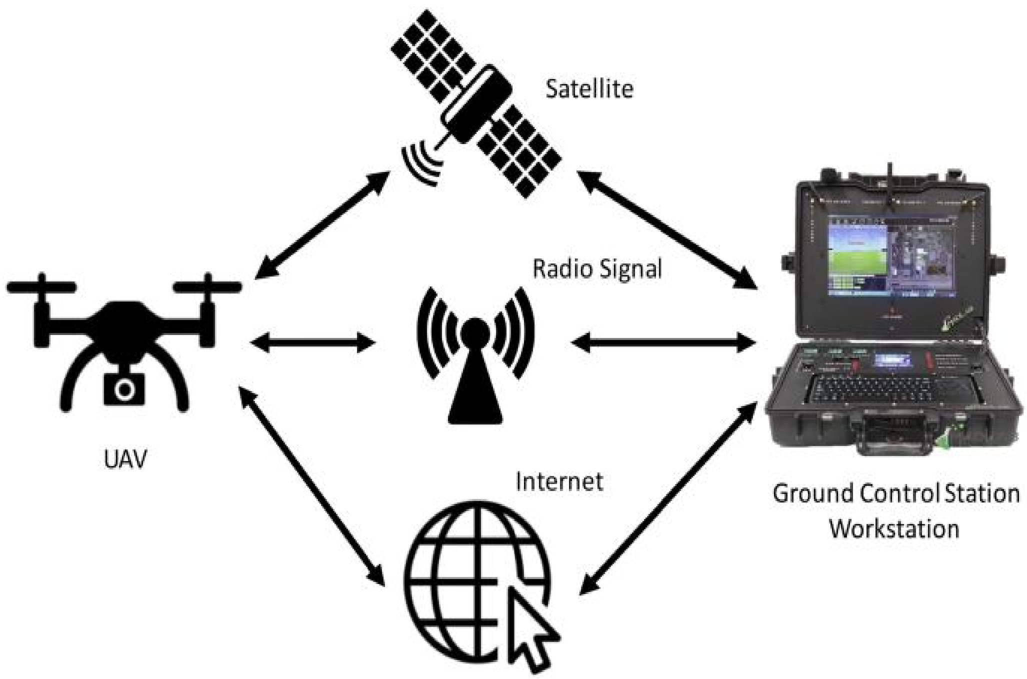


Figure 4: Ground Control Station of UAV

E. Communication

UAS communication plays a very significant role in terms of mission requirements (that is, to command and control the aircraft and eventually screen the payload outcome) as well as safety.

Although unmanned aircraft systems have traditionally been used in segregated airspace where separation from other air traffic can be assured, administrations expect broad deployment of un- manned aircraft systems in non-segregated airspace alongside manned aircraft. The outcomes of the WRC-12, particularly focusing on agenda item, consisted of a new allocation to Aeronautical Mobile Satellite (Route) Service (AMS(R) S) in support of UAS, agreed to in the 5030–5091 MHz band, which is the core band for Microwave Landing Systems (MLS). The ITU Radio communication Sector was instructed to conduct studies to develop technical, regulatory and operational recommendations for the WRC in 2015. As agreed future actions, the ITU-R and WRC-15 will explore whether the Fixed Satellite Service (FSS) can be used to provide UAS command-and-control communications, consistent with the aeronautical safety of flight requirements, and highlighting the need for participation of aviation safety regulators and other aviation interests.

Many communication technologies are used in today's UAS, the most predominant of which in the Mini UAS category is Wi-Fi (usually around 2.4 GHz), as is used by some of the UAS .Yet, other technologies have been considered, such as high-frequency satellite communication as in military systems (Predator, Global Hawk) or Worldwide Interoperability for Microwave Access.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

Key Highlights of the DGCA UAS Rules, 2021

1) UAS categorised as airplane, rotorcraft and hybrid with further categorisation as remotely piloted aircraft, model remotely piloted aircraft and autonomous unmanned aircraft system.
2) UAS classified as nano, micro, small, medium and large unmanned aircraft based on the maximum all up weight including its pay load ranging from <250gram to 150 kilograms. Nano UAS can be classified in the next higher category if it exceeds performance parameters of flight speed and height.
3) Mandatory for individuals and companies to obtain approval from the DGCA to import, manufacture, trade, own or operate drones
4) Micro and small UAS are not permitted from flying above 60m and 120 m, respectively.
5) All UAS, except nano category, have to be equipped with flashing anti-collision strobe lights, flight data logging capability, secondary surveillance radar transponder, real-time tracking system and 360 degree collision avoidance system, among others.
6) All UAS including nano category, are required to be equipped with Global Navigation Satellite System, Autonomous Flight Termination System or Return to Home option, geo-fencing capability and flight controller, among others.
7) UAS prohibited from flying in strategic and sensitive location, including near airports, defence airports, border areas, military installations/facilities and areas earmarked as strategic locations/vital installations by the Ministry of Home Affairs.
8) Nano, micro and small UAS operations limited to within the visual line of sight and are prohibited from delivery of goods. Delivery of goods permitted by medium and large UAS.
9) Research and development (R&D) organisations, including start-ups, authorised UAS manufacturer, any accredited recognised institution of higher education located in India, are permitted to carry out R&D of UAS only after obtaining authorisation from the DGCA.

F. Use in Urban Planning

The ability to integrate technology into urban planning practices is generally becoming easier. In some part this is because of the number of options available for new tools, many of which are accessible directly by smart phones. Another important part of this adoption of technology for urban planning is the inspiration that can come from seeing something used in a recreational setting and recognizing its potential to be adapted for professional purposes.

Due to the adaptive and cost effective options of drone technologies today, the use of drones to assist in regional and municipal operations could potentially provide safer, cheaper, and more effective public services.

Urban city planning is changing and Drones have a decisive role to play. Technology has moved beyond the traditional techniques which were commonly used legacy city planning process. These methods cantered around data collection, analysis and tedious fieldwork. The toughest challenge revolved around the data collection process, where the authenticity of data was always a question. The modern sustainability goals gradually empower cities to go for urban planning and expansion with limited resources. This leaves the need for data-driven decision-making becoming more imperative.

This is where city planners, policymakers are finding the potential of UAVs or Unmanned Aerial Vehicles or Drones to transform the planning and design industry. Here is how the UAV drone technology will reshape the future of Urban Planning- Process of UAV survey:

G. Flight Planning

Many points are considered while planning a mapping mission.

First, whether the flight will be done under autonomous control between GPS waypoints or will be controlled manually. In either case, it is important to analyze the area to be mapped before lift-off to identify obstacles such as power lines, large trees, sensitive areas, or other potential obstacles. Finally, it is good practice to use existing satellite imagery to plot out a flight before takeoff. The decision of whether to use manual or autonomous control hinges on many factors, but perhaps the most important is to distinguish clearly between inspection or monitoring of events or conditions in real time, and gathering information in order to create a static record like a map or a 3D model after the flight is complete. Both types of missions can be flown in either manner, or indeed, in a hybrid of manual and automatic control, however, manual control is generally more useful for inspections (say beneath a bridge) that aim to react to information in real time, while autonomous control is, as a rule, more useful when one is trying to fly in a systematic pattern to create a map.

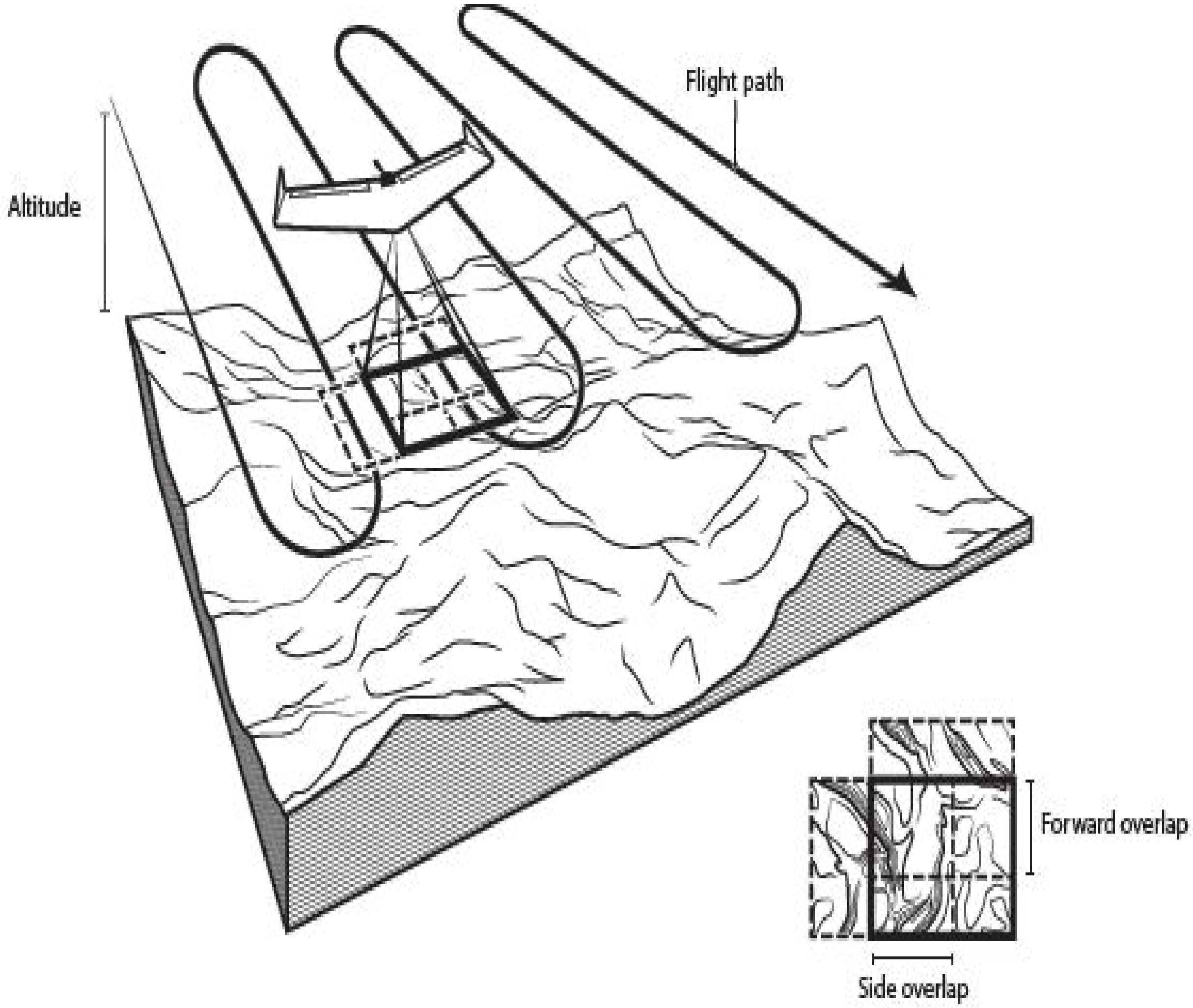


Figure 5: Fight path and side overlap

H. Designing A Flight Route

Design of flight route is usually done using software. UAV mapping missions are usually flown in a specific pattern/path of parallel lines commonly described as "transects," which are connected to a series of "waypoints". A transect flight pattern is a method of ensuring that the UAV captures an adequate quantity of images that overlap to the degree required for the processing software to create a high-quality and accurate map.

For better quality result, UAV mappers suggest flying two different overlapping patterns over the same area but at different heights. This method collects a large quantity of data and helps to resolve elevation variation problems, which result when tall geographic features throw off the scale of the rest of the image.

To create a flight plan with transects using current software such as Mission Planner; the pilot first connects with the UAV's flight controller via either a ground control radio attached by USB cable to a computer or tablet, or a direct USB link from the UAV to the computer. (Flight plans can also be generated on the computer and uploaded to the flight controller later).

The surveyor starts the software enter required details and defines an area to be mapped with a polygon, then specifies the camera model, the desired operational altitude, and how the camera will be triggered to take photographs. Once these factors are entered, Mission Planner generates

A series of transects with waypoints and displays the estimated ground sampling distance, required number of photographs, and other useful information. The user can then change the distance between each photo, the amount that photos will overlap, the altitude of operation, and other parameters. When complete, the mission file is saved to the computer and can also be saved to the UAV's flight controller.

I. Image Overlap

UAV flight paths or mapping projects should be designed to ensure a sufficient amount of both forward and lateral photographic overlap, which will better allow post processing software to identify common points between each image. It is, however, useful to know the following logic. First, mission planning software computes the ground coverage size or "footprint" of the photograph, which is dependent on the camera's focal length, the size of its sensor, and how high the UAV is flying above ground level. From this ground coverage calculation, the software is able to work out how many flight paths will be needed to cover the area the user wants to map with the given camera, and will determine the spacing needed between these flight lines to ensure adequate overlap. The software then determines the minimum number of images needed to adequately cover this area, as well as the most suitable flight altitude to ensure adequate coverage as well as a sharp ground resolution.

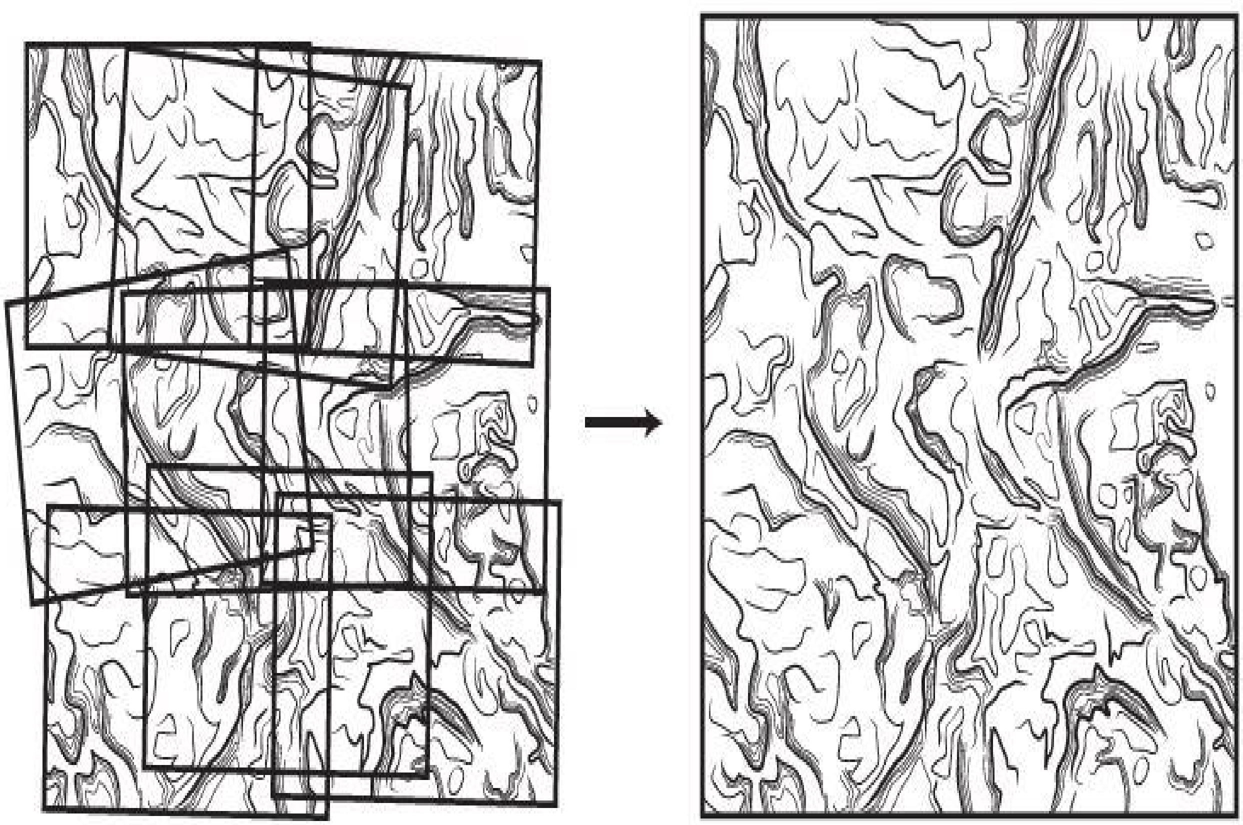


Figure 6: Orthomasic Image

J. Flight Planning For Image Quality

Resolution in aerial photography is measured as ground sampling distance (GSD)—the length on the ground corresponding to the side of one pixel in the image, or the distance between pixel centres measured on the ground (these are equivalent). A larger GSD (10 cm) means that fewer details will be resolvable in the image and it will be of lower quality, while a smaller GSD (5 cm) means the exact opposite. GSD goes up as the drone flies higher and goes down as the drone flies lower. GSD is also affected by the camera's focal length, as well as its pixel size.

GSD = (pixel size x height above ground level) / focal length
Pixel: This is the smallest building block of image.
Resolution: This is refers to the size of the pixel. The smaller the pixel, the higher the resolution
The longer the focal length, the narrower the angle of view and the higher the magnification. The shorter the focal length, the wider the angle of view and the lower the magnification.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VIII Aug 2021- Available at www.ijraset.com

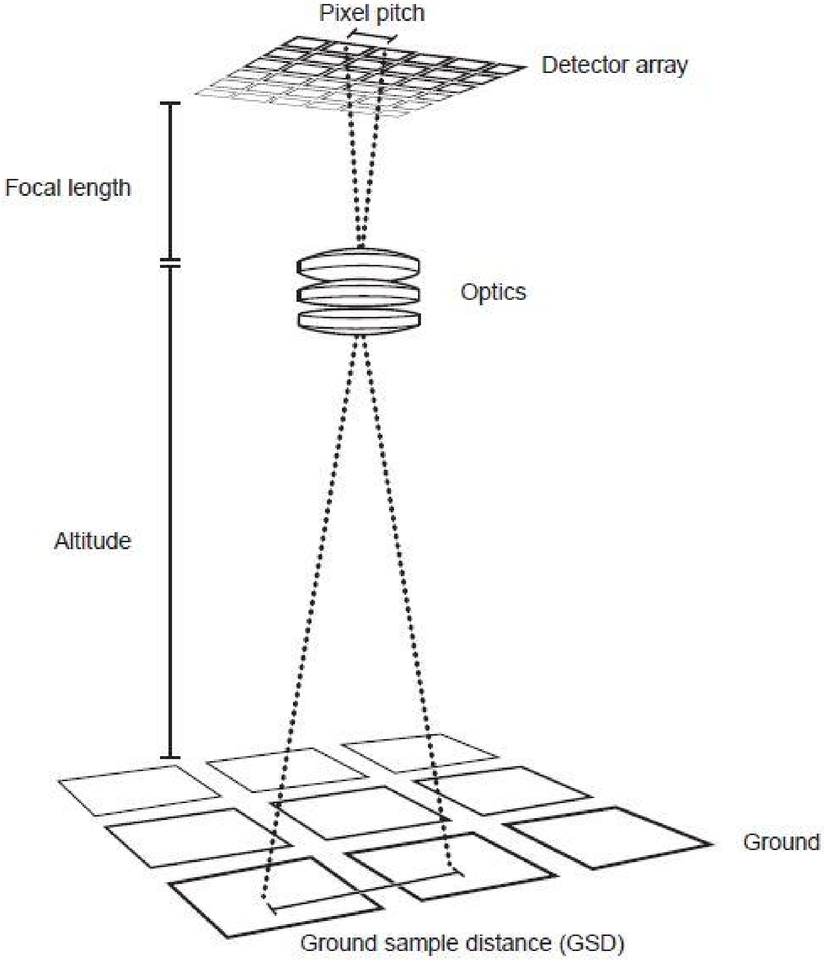


Figure 7: Ground sampling distance (GSD)

Figure 8: Shows Small GSD (Left) and High GSD (Right)

K. Sensors

Most cameras used for preparing UAV mapping are lightweight and can be programmed to shoot pictures at regular intervals or controlled remotely. Some specialized devices that can be mounted on a UAV include LIDAR (light detection and ranging) sensors, infrared cameras equipped for thermal imaging, and air-sampling sensors. GPS-enabled camera are used to create a reasonably geographically accurate image.

The two aerial views most commonly used in UAV mapping are known as nadir (overhead) and oblique. Nadir photographs are shot directly above the subject, with the camera looking straight down. Oblique photographs are taken at an angle to the subject below, rather than from directly overhead. They can be taken from a high or a low angle, collecting information about the landscape.

L. GPS and Georeferencing

Georeferencing is the "process of assigning spatial coordinates to data that is spatial in nature, but has no explicit geographic coordinate system. it'ss not possible to prepare maps without any georeferencing, these maps does not correlate to the real world and can't be used for measurement.

To carry out the process of georeferencing, the image processing software has to know the real-world GPS coordinates of a small number of visibly identifiable locations in the collected aerial imagery. These coordinates are referred to as "ground control points" in the UAV mapping.

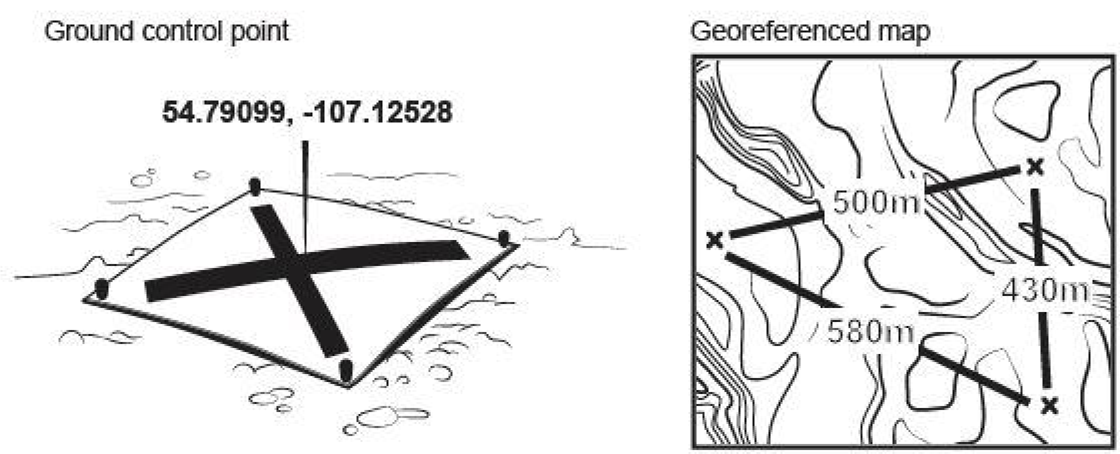


Figure 9: Ground Control Points

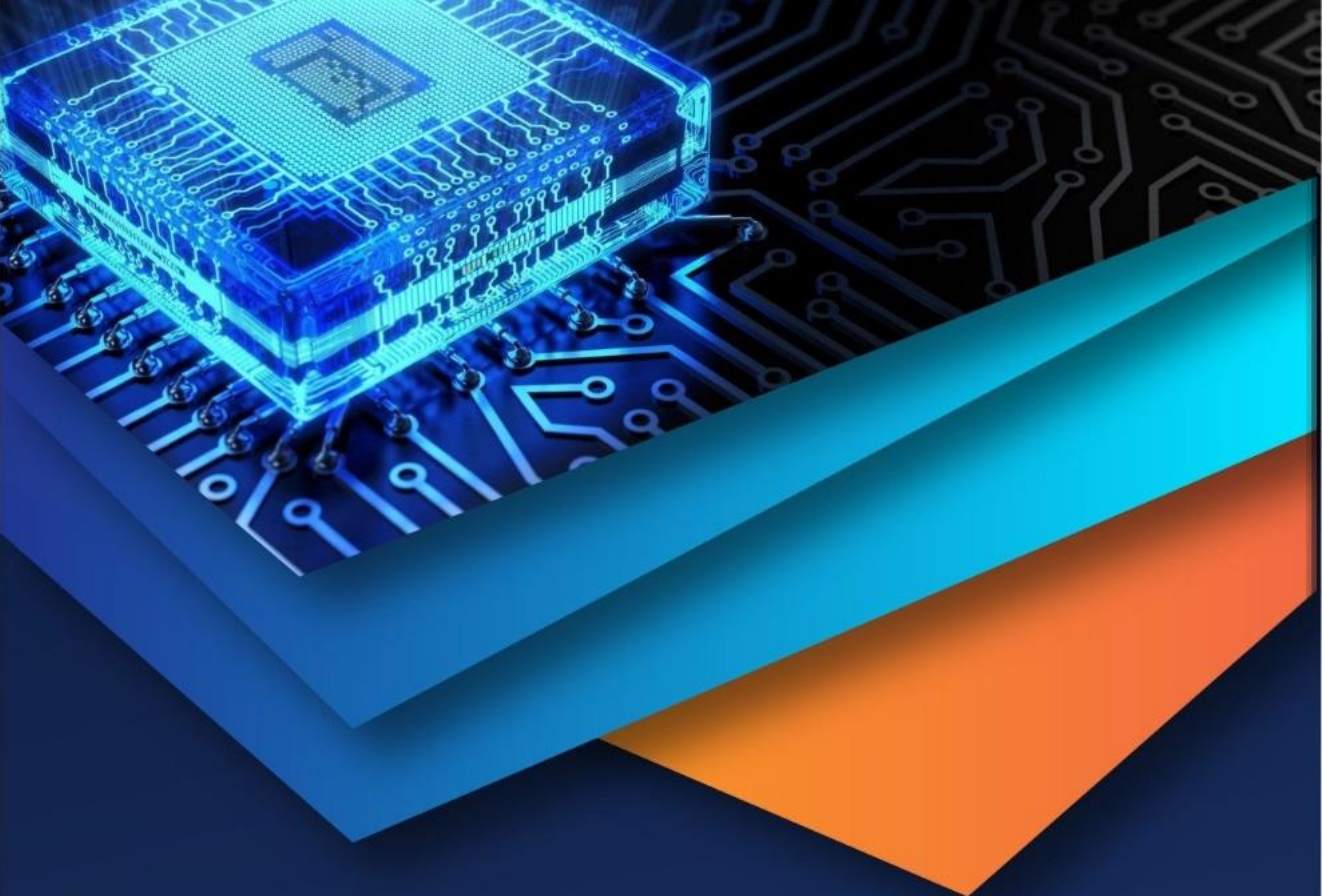
VI. CONCLUSIONS

A. UAV technology has more advantages as compared to the other conventional methods for surveying. The higher spatial resolution, together with DEM, of the UAV data delivered highly accurate classified maps compared to the Satellite imagery because UAV usually flies close to ground
B. UAV technology is rapidly changing in innovative ways to provide greater utility. This instrument give planners/surveyors a source of unique aerial data by which they can do better planning and monitor progress towards sustainable urban development.
C. Property tax collection through UAV we can mark each property and give thema unique property ID which will be linked with the owners documents. Further, the property data will be integrated with database of other departments/agencies. The will help bring transparency in the whole process and will be beneficial in detecting benami properties. The system will also help the public to view their property data online, request property information update, pay their property tax online and reduce their grievances.

REFERENCES

[1] Colomina, I., & Molina, P. (2014). Unmanned Aerial Systems For Photogrammetry And Remote Sensing: A Review. ISPRS Journal Of Photogrammetry And Remote Sensing, 92, 79–97. Doi:10.1016/J. Isprsjprs.2014.02.013
[2] J. Suziedelyte Visockiene,1 R. Puziene,1,2 A. Stanionis,1 and E. Tumeliene1,(2016),' Unmanned Aerial Vehicles for Photogrammetry: Analysis of Orthophoto Images over the Territory of Lithuania', International Journal of Aerospace Engineering Volume 2016, http://dx.doi.org/10.1155/2016/4141037
[3] Dr Ibrahim Motawa and Alexandra Kardakou ' Unmanned Aerial Vehicles (UAVs) for inspection in construction and building industry', 16th International Operation & Maintenance Conference (OMAINTEC 2018), 18-20th November 2018, Cairo, Egypt.

[4] Asniza Md Yunus, Abd Halim Hamzah, Fatin Afiqah Md. Azmi(2020),” Drone Technology as A Modern Tool in Monitoring the Rural-Urban Development', IOP Conf. Series: Earth and Environmental Science, doi:10.1088/1755-1315/540/1/012076
[5] Bradley Garrett, Karen Anderson,(2017),'Drone methodologies: Taking flight in human and physical geography', DOI: 10.1111/tran.12232
[6] Norzailawati Mohd Noor, Ahmad Afiq Aiman Abdullah, Alias Abdullah, Illyani Ibrahim & Saadman Sabeek,(2019),' 3d City Modeling using Multirotor Drone for City Heritage Conservation', Journal Of The Malaysian Institute Of Planners, Volume 17 Issue 1
[7] Greenwood, F., (2015). How to Make Maps with Drones. Chapter 4 in Drones and Aerial Observation.
[8] Norzailawati Mohd. Noor,(2017),'The evolution of UAVs applications in urban planning',
[9] Alexander, N., & Jenkins, L. (2015). An Application of Aerial Drones in Zoning and Urban Land Use. Ryerson University.
[10] Greenwood, F., (2015). How to Make Maps with a Drones. Chapter 4 in Drones and Aerial Observation./
[11] FLEXChip Signal Processor (MC68175/D), Motorola, 1996.
[12] “PDCA12-70 data sheet,” Opto Speed SA, Mezzovico, Switzerland.
[13] A. Karnik, “Performance of TCP congestion control with rate feedback: TCP/ABR and rate adaptive TCP/IP,” M. Eng. thesis, Indian Institute of Science, Bangalore, India, Jan. 1999.
[14] J. Padhye, V. Firoiu, and D. Towsley, “A stochastic model of TCP Reno congestion avoidance and control,” Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.
[15] Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, IEEE Std. 802.11, 1997.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY