iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** III **Month of publication:** March 2024

DOI: https://doi.org/10.22214/ijraset.2024.58897

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue III Mar 2024- Available at www.ijraset.com

Applications of Drone and Unmanned Aerial Vehicle (UAV) Surveying for Planning For Cities

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Abstract: The field of town planning is one of the many areas in city life where Unmanned Aerial Vehicles (UAVs) and drones could find use. When compared to traditional surveying options, drones may offer planners a more accurate, precise, flexible, and economical means of obtaining information. Unfortunately, current Indian government restrictions around the use of drones, particularly in the town planning sector, are vague and prioritize safety above advancing technology toward a system that is more efficient. To maximize the public benefit from the use of drone technology in town planning, town planners and surveyors require flexible, practical drone regulations that address the numerous concerns surrounding the use of UAVs in urban areas. This research discusses the present applications of UAVs in many areas of urban planning.
Keywords: UAV- Unmanned Air Vehicle

I. INTRODUCTION

Measuring, recording, and evaluating a land area's characteristics is the process of surveying, which aids in the creation of construction plans and maps. Compared to maps created by surveyors a few decades ago, when everything was on physical paper, the map created by the surveyor nowadays is most likely available in digital data format due to the current advancements in technology.

These days, a variety of cutting-edge surveying technologies have been created, including reflector-less EDM devices, digital levellers, digital cameras with photogrammetric capabilities, terrestrial laser scanners, and global navigation satellite systems. By far, every equipment created is able to create surveying standard digital model images.

Fewer than ten years ago, the photo gram metrically capable drones, or unmanned aerial vehicles (UAVs), were first used as survey instruments in the surveying field. The surveyor's job becomes more efficient and economical when UAVs are used.

When hot air balloons were first used in the early 1800s, UAV technology was used naively for the sole purpose of gathering data on the earth's upper atmosphere for weather forecasting.

subsequently in the middle of the 20th century, UAVs changed to resemble pigeons, and they were deployed to deliver messages from the front lines of World War I to soldiers at headquarters. Soon after, a camera was attached to a kite, a rocket, and a tiny hot air balloon using a UAV for surveillance on enemy bases.

Following the end of World War II, unmanned aerial vehicles (UAVs) were used for non-military tasks such environmental monitoring, land surveying, taking pictures, and maintaining infrastructure.

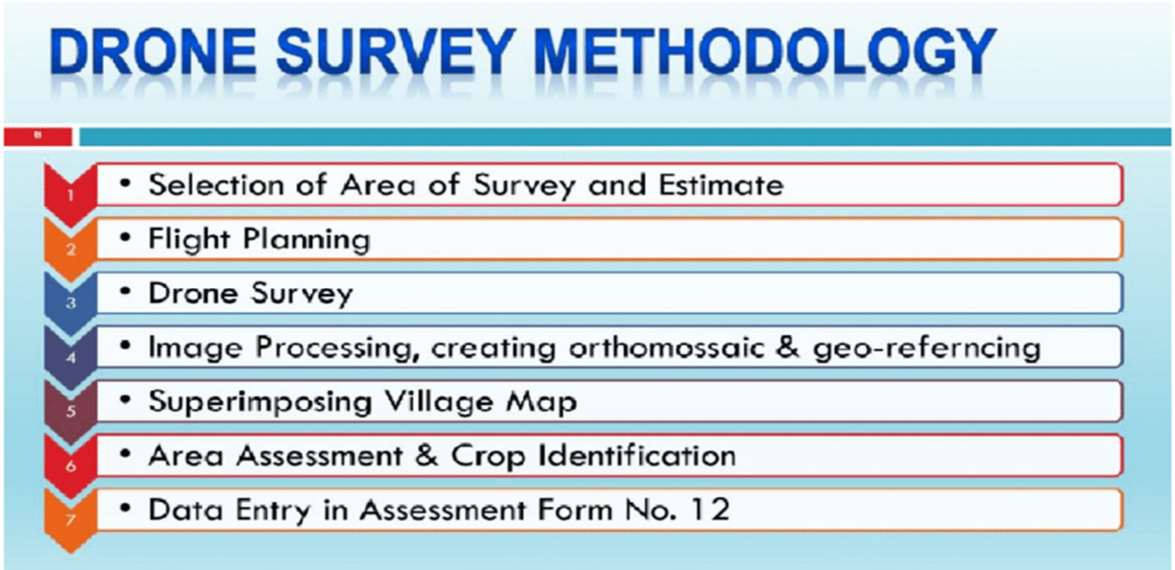
The first few individuals to start experimenting with fixed wing and quadcopters UAVs for land surveys were Przybilla and Wester-Ebbinghaus in 1979. Soon after, as technology advanced, UAVs were more widely accessible to the general public on a commercial basis. This document serves as a template.

A. *Objective*

1) To explore and understand the procedures and technologies utilized in UAV/drone surveying.
2) In order to understand the rules set forth by the government for its use.
3) To determine the different uses of UAVs and drone investigations in the field of planning for cities.

II. METHODOLOGY

After examining appropriate papers and the most recent global and regional developments in drone surveying, the problem was identified. In order to identify the objectives, literature reviews and related publications were examined.



III. NEED OF STUDY

In order to gain a greater insight into this new method and its application in the field of urban planning, I have chosen to focus on UAVs and drones, which are becoming more and more useful as surveying technology advances. When combined with other emerging technologies (like artificial intelligence (AI)), they can do much more than just take pictures; they can also be used to carry out inspections in a cheaper, faster, and safer manner; harvests can be optimized as part of precision agriculture, and surveillance can be completed more quickly and efficiently.

IV. TERMINOLOGIES

1) *RTK (Real-Time Kinematics):* RTK is a satellite navigation method that provides precise positioning when mapping drones. Whereas Base Station RTK depends on a single base station for corrections, Network RTK uses a data network to provide precise location.
2) *Post-processing kinematics, or PPK:* Is an additional method for improving drone mapping accuracy. It involves post-processing the GPS data obtained during the flight.
3) *Oblique Photos:* Unlike nadir (straight-down) photos, oblique photos are taken at an angle and offer a distinct viewpoint. They are frequently employed in 3D modeling and detailed visualization.
4) *Terrain Follow:* During flight, a drone equipped with this feature can automatically modify its altitude to follow the terrain's curves, guaranteeing a consistent ground speed deviation. This is usually useful for mapping places that are hilly or have uneven topography.
5) *LiDAR:* A type of remote sensing technology that measures distances using laser light is called LiDAR (Light Detection and Ranging). LiDAR sensors are used in drone mapping for 3D modeling and terrain mapping. LiDAR is particularly helpful for slicing through vegetation or canopy cover.
6) *Payload:* Any part, piece, or other item aboard an unmanned aircraft that is not necessary for flight or control is referred to as payload.
7) *UAV:* An airplane without a human pilot or passengers is called an unmanned aerial vehicle (UAV). Although unmanned aerial vehicles, or UAVs, are also commonly referred to as drones, they are typically piloted by humans from a distance.

A. *Classification of Unmanned Aircraft*

1) *Nano:* Less than or equal to 250 grams.
2) *Micro:* Greater than 250 grams and less than or equal to 2 kg.
3) *Small:* Greater than 2 kg and less than or equal to 25 kg.
4) *Medium:* Greater than 25 kg and less than or equal to 150 kg.
5) *Large:* Greater than 150 kg.

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V. KEY HIGHLIGHTS OF THE DGCA UAS RULES, 2021

1) UAS are divided into three categories: airplane, helicopter, and hybrid; they are also divided into three subcategories: autonomous unmanned aircraft systems, model remotely piloted aircraft, and remotely piloted aircraft.
2) Unmanned Aerial Systems (UAS) are categorized as nano, micro, small, medium, and large due to their maximum total weight, which includes their payload, which can range from less than 250 grams to 150 kilograms. If a nano UAS exceeds the performance parameters of height and flight speed, it might be placed in the next higher category.
3) It is required that people and businesses get DGCA approval before they can import, produce, sell, possess, or use drones.
4) It is strictly prohibited for micro and small UAS to fly over 60 and 120 meters, respectively.
5) All UAS, with the exception of the nano category, must be outfitted with a 360-degree collision avoidance system, real-time tracking, flight data logging, secondary surveillance radar transponder, and flashing anti-collision strobe lights, among other features.
6) The Global Navigation Satellite System and Autonomous Flight Mode are mandatory for all unmanned aerial systems, including nano category ones. Termination System or Return to Home option, geo-fencing capability and flight controller, among others.
7) The Ministry of Home Affairs has designated certain sites as critical installations or strategic locations, and UAS are not allowed to fly in certain regions. certain areas include border areas, defense airports, airports close to airports, military installations, and military facilities.
8) Nano, micro, and miniature unmanned aerial systems (UAS) are restricted to operating within visible line of sight and are not allowed to deliver items. Delivery of commodities made possible by big and medium-sized UAS.
9) Only after receiving authorization from the DGCA are research and development (R&D) organizations, including as start-ups, authorized UAS manufacturers, and any recognized, accredited higher education institution in India, allowed to conduct UAS R&D.

VI. WORKING FOR THE CITY PLANNING

In general, it's become easier to incorporate technology into urban planning procedures. This is partially due to the abundance of possibilities for new tools that are readily available, many of which can be accessed immediately through smartphones. The inspiration that might arise from observing something used in a recreational situation and realizing its potential to be modified for professional reasons is another significant factor in the use of technology for urban planning.

Today's adaptable and affordable drone technologies mean that using drones to support local and regional operations may result in safer, more affordable, and more efficient public services.

Drones are playing a major part in the shifting landscape of urban city planning. Technology has advanced beyond the conventional methods that were widely employed in the outdated city planning process. These techniques focused mostly on laborious fieldwork, data collecting, and analysis.

The hardest problem was getting data, since there was never a guarantee that the information was real.

With limited funding, cities are progressively able to pursue urban planning and growth thanks to the current sustainability targets. This makes it increasingly necessary to make decisions based on facts.

VII. FLIGHT PLANNING

Several factors are taken into account when organizing a mapping operation.

First, whether the flight will be manually controlled or will it be autonomously piloted between GPS waypoints? In any scenario, it's critical to survey the region in advance of liftoff in order to detect potential hazards including electricity lines, big trees, sensitive places, and other obstructions.

Lastly, it's a good idea to plan a flight using the satellite imaging that is currently available before taking off. Many considerations go into deciding whether to use manual or autonomous control, but maybe the most crucial is making a clear distinction between collecting data to produce a static record, such as a map or 3D model, after the flight is over, and inspecting or monitoring events or conditions in real time.

Both kinds of missions can be flown in either way, or even in a hybrid of automatic and manual control. However, autonomous control is typically more helpful when one is trying to fly in a systematic pattern to create a map, whereas manual control is generally more useful for inspections (like those conducted under bridges) that aim to react to information in real time.

VIII. DESIGNING FLIGHT ROUTE

Software is often used to design aircraft routes. UAV mapping missions often follow a predetermined pattern or path of parallel lines, known as "transects," that are connected to a number of "waypoints." One way to make sure the UAV takes enough pictures that overlap sufficiently so that the processing software can produce an accurate and high-quality map is to use a transect flight pattern. UAV mappers recommend flying two distinct overlapping patterns over the same area, but at different heights, for better quality results. This technique gathers a lot of information and aids in the resolution of elevation variation issues that arise when tall geographic features distort the overall size of the image. The pilot initially establishes a connection with the UAV's flight controller using either a ground control radio connected by USB cable to a computer or tablet, or a direct USB link from the UAV to the computer in order to generate a flight plan including transects using current software such as Mission Planner. It is also possible to create flight plans on a computer and then transfer them to the flight controller at a later time.

The surveyor launches the software, inputs the necessary information, draws a polygon to represent the region to be mapped, chooses the type of camera to be used, the ideal operating height, and the method by which the camera will be activated to take pictures. After entering these parameters, Mission Planner produces.

IX. IMAGE OVERLAP

The design of UAV flight routes and mapping projects have to prioritize the provision of adequate forward and lateral photographic overlap. This will facilitate the identification of common points between individual images by post-processing software. Nonetheless, understanding the following reasoning is helpful. The first thing the mission planning software does is calculate the "footprint" or ground coverage size of the picture. This is based on the height of the UAV above ground, the focal length of the camera, and the size of its sensor. The software uses this ground coverage calculation to establish the number of flight paths required to cover the region the user wants to map with the specified camera. It also calculates the necessary spacing between these flight lines to guarantee sufficient overlap. The software then calculates the minimum number of shots required to cover this area sufficiently and the ideal altitude at which to fly in order to maintain both a crisp ground resolution and sufficient coverage.

X. CONCLUSIONS

1) While it comes to surveying, UAV technology is more advantageous than other traditional approaches. Compared to satellite imagery, the UAV data's superior spatial resolution and DEM produced extremely accurate categorized maps because UAVs often fly near to the ground.
2) UAV technology is evolving quickly in novel ways to offer increased utility. With the use of this tool, planners and surveyors can gather exclusive aerial data to improve their planning and track the advancement of sustainable urban development.
3) Through the use of UAVs to collect tax revenues, we are able to identify each property and assign it a distinct property ID that is connected to the owner's paperwork. Additionally, the database of other departments and agencies will be merged with the property data. The will be helpful in identifying benami properties and in bringing transparency to the entire process. In addition, the system will make it easier for the public to examine property data online, request updates to property information, pay property taxes online, and resolve grievances.

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