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UAV/Drone: Unmanned Aerial Vechicle is an airborne system or an aircraft operated remotely by a human operator or autonomously by an onboard computer.

They can be classified based on sizes(very small,small,medium,large),range(Close range,short range,mid-range), their endurane in the air and also on areas where the drones are deployed into.

Based on aerial drone platforms

Multi-Rotor- Quadcopter is the common in this segment. Tricopter,Hexa and Octo Copters are the other members of the family. They have motors with each motor/propeller spinning in the opposite direction from the two motors on either side of it. They control the pitch and roll by increasing the speed of the motors. THey can also control yaw by speeding up two motors which are diagonal across.

They are the easiest and cheapest all of the drones available. They have limited endurance and speed.

Fixed Wing:Fixed-wing drones use a wing like a normal aeroplane to provide the lift rather than vertical lift rotors. Because of this they only need to use energy to move forward.

Because of its design advantage, the drone is able to cover longer distances and has greater efficiency. Disadvantages are higher cost, its difficult to learn.

Single-Rotor Drones: They have the design which resembles a helicopter. It has a main rotor and one tail rotor to control its heading. Hovering with a payload is possible with this drone design and also they are highly efficient. Downsides are complexity, cost,vibration, and danger of large spinning blades.

GIS,PhotoGrammetry:

It is a tech of obtaining info about objects and environment through recording and measuring and interpreting images and patterns of Em radiated. It is based on digital imagery and computer vision. Works on the principle of triangulation, stereoscopic vision. Input is photographs and output is a map,3d model of real world object.

The basic principle behind all photogrammetric measurements is the geometrical–mathematical reconstruction of the paths of rays from the object to the sensor at the moment of exposure.

Using multiple photographs, we can compute the position of a point in 3D space by simple geometry if we know:

- where the point is imaged on each photo,
- the parameters of the camera (focal length, lens distortion, etc.) from camera calibration, and
- the relative positions and angles of the camera when the photos were captured.

Types: Terrestrial and Close Range Photogrammetry:

- Used for Drawings,3D models,mesaurements.
- Model and measure buildings,forenisc and accidental scenes, mines,archaeological artifacts.
- Used for making measurements of 3D objects and terrain features from 2D photographs.

Applications/Useage:

- Measuring coordinates,preparation of topographic maps ,digital
- Elevation models and orthophotographs,medicine,video game production

GIS: A geographic information system (GIS) is a framework for gathering, managing, and analyzing data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations—helping users make smarter decisions.

Example: retailers use Gis to stock items in the store according to local customer needs, to find patterns in criminal activity in an area.

Remote Sensing: It is a process of obtaining information about objects and features by collecting without coming into contact with them. Where remote sensing differs from photogrammetry is in the type of information collected, which tends to be based on differences in color, so land use and land cover is one of the primary output of remote sensing processing.

Drone Survey and Mapping: A drone survey refers to the use of a drone, or unmanned aerial vehicle (UAV), to capture aerial data with downward-facing sensors, such as RGB or multispectral cameras, and LIDAR payloads. During a drone survey with an RGB camera, the ground is photographed several times from different angles, and each image is tagged

with coordinates. From this data, a photogrammetry software can create geo-referenced orthomosaics, elevation models or 3D models of the project area. These maps can also be used to extract information such as highly-accurate distances or volumetric measurements. Unlike manned aircraft or satellite imagery, drones can fly at a much lower altitude, making the generation of high-resolution, high-accuracy data, much faster, less expensive and independent of atmospheric conditions such as cloud cover.

Applications of Drone surveying?

- Land surveying / cartography : Survey drones generate high-resolution orthomosaics and detailed 3D models of areas. They thus enable high-accuracy cadastral maps to be produced quickly and easily, even in complex or difficult to access environments. Surveyors can also extract features from the images, such as signs, curbs, road markers, fire hydrants and drains.

- Land management and development : Aerial images taken by drones greatly accelerate and simplify topographic surveys for land management and planning. This holds true for site scouting, allotment planning and design, as well as final construction of roads, buildings and utilities.

- Slope monitoring: With automated GIS analysis, it is possible to extract slope measurements from drone imagery. Knowing the steepness of the ground's surface, the areas can be classified and used for slope monitoring purposes, including landslide mitigation and prevention. With orthomosaics taken at different times, it is possible to detect changes in earth movement and to measure its velocity. This data can help predict landslides and prevent potential damage to roads, railways and bridges.

- Urban planning: The development of increasingly dense and complex urban areas requires intensive planning and therefore time-consuming and expensive data collection. Thanks to drones, urban planners can collect large amounts of up-to-date data in a short period of time and with far less staff.

Benefits drones surveying:

- Reduce field time and survey costs :Capturing topographic data with a drone is up to five times faster than with land-based methods and requires less manpower.

- Provide accurate and exhaustive data: Total stations only measure individual points. One drone flight produces thousands of measurements, which can be represented in different formats (orthomosaic, point cloud, DTM, DSM, contour lines, etc). Each pixel of the produced map or point of the 3D model contains 3D geo-data.

- Map otherwise inaccessible areas :An aerial mapping drone can take off and fly almost anywhere. You are no longer limited by unreachable areas, unsafe steep slopes or harsh terrain unsuitable for traditional measuring tools.

PhotoGrammetry Software: 3D scanning could be useful for various applications. It can be used to get a viable 3D model and make the most of the 3D printing technology using an online 3D printing service . But having a great 3D design is also an amazing tool for visualization.

- Agisoft Metashape
- MicMac
- Meshroom
- 3DF Zephyr
- Visual SFM
- Colmap
- Regard 3D
- Open MVG
- iWitness Pro

DrawBacks of Software Tools: Expensive, Takes time to get accustomed to interface and functions, models do not always turn out to be high quality.

Types of Data Captured from Drones:

- Aerial Photos and Videos
- Orthomosaic Map
- Digital Elevation Model
- Elevation contours
- Multi-spectral imagery
- Thermal Imagery
- Gas/Air and Water Sampling

Orthomosaic Map: an orthomosaic map is a detailed, accurate photo representation of an area, created out of many photos that have been stitched together and geometrically corrected so that it is as accurate as a map.

Topography: A topographical map is one that shows the physical features of the land. Besides just showing landforms , the map also shows the elevation changes of the land. Elevation is shown using contour lines. Every point on the map touching the line should be the same elevation. On some maps, numbers on the lines will let you know what the elevation is for that line. Contour lines next to each other will represent different elevations. The closer the contour lines are to each other, the steeper the slope of the land

A DEM (Digital Elevation Model) : repsents the bare-Earth surface, removing all natural and built features.Used Extensively in Hydrology,land and land use planning.

A DSM (Digital Surface Model) :captures both the natural and built/artificial features of the environment.USed in aviation, vegetation management and also in urban planning.

A DTM (Digital Terrain Model): typically augments a DEM, by including vector features of the natural terrain, such as rivers and ridges. A DTM may be interpolated to generate a DEM, but not vice versa.It Strengthens DEM by adding linear properties to bare soil terrain.

For most LiDAR applications, focus is placed on the DEM and DSM, while DTMs are more applicable for GIS and cartographic representations.

Point Clouds: They are datasets that represents objects and space. It collates a large number of single spatial measurements into a dataset that can then represent a whole. Point clouds are most commonly generated using 3D laser scanners and LiDAR.These scans are then stitched together, creating a complete capture of a scene, using a process called 'registration'.