# UAV

A drone, also known as an Unmanned Aircraft System (UAS) or Unmanned Aerial Vehicle (UAV), is any aircraft that flies in the sky without a pilot, whether autonomously or with the assistance of a remote control on the ground.

## UAV Types:

Fixed Wing:
A fixed-wing drone has one rigid wing and is configured to resemble an aeroplane in appearance and operation. Fixed-wing drones are distinguished from other forms by their inability to remain in one position with vertical lift rotors, instead gliding on a predetermined path as long as their energy allows. As a result, they can be much more powerful than the other two major types of drones.

ADVANTAGES:

- The average flight time is a couple hours and can go up to an impressive 16 hours or more if the drone is gas engine powered
- Fixed wings can fly at a high altitude
- They are more forgiving in the air than other models
- And have the ability to carry more weight

DISADVANTAGES:

- Fixed wing drones can be expensive
- Training is usually required to fly them
- In most cases, a launcher is needed to get a fixed wing drone into the air
- They are more difficult to land than the two other categories of drones
- And they can only move forward and can't hover in the air

USES:

- Because fixed wing drones are more data focused in design, they are usually used for commercial purposes such as aerial mapping, inspection, agriculture, construction, security, and surveillance.

Single Rotor
Single-rotor drones are powerful and have a structure and design that resembles that of real helicopters. They have one large rotor that acts like a revolving wing, as well as a smaller rotor on the tail for direction and stability.

ADVANTAGES:

- Single rotor drones are able to hover vertically in the air
- They are built to be strong and durable
- They have a long-lasting flight time, which increases if the drone is gas powered
- And a heavy payload capability

DISADVANTAGES:

- Single rotors are harder to fly than multi-rotor drone types
- They can be expensive

- These drones have a higher complexity
- And can be dangerous because of the heavy spinning blade

USES:

- Research, Aerial LIDAR laser scan, surveying.

Multirotor
The multi-rotor drone is the most common form of drone for having a "eye in the sky." Aerial photography, filming, and surveillance are all common uses for this camera. Because of its compact size and ready-to-fly capabilities, it is used by both professionals and hobbyists.

Multi-rotor drones are also the most cost-effective and simplest to produce. They have many rotors on their bodies and can be categorised further based on the number of them on the drone's platform. Tricopters have three rotors, quadcopters have four rotors, hexacopters have six rotors, and octocopters have eight rotors. The most common multi-rotor drones are quadcopters.

ADVANTAGES:

- Multi-rotor drones are easy control and maneuver
- They have the ability to hover
- They can take off and land vertically
- And are very stable

DISADVANTAGES:

- Multi-rotors have a limited flying time (usually 15-30 minutes)
- They only have small payload capabilities
- And most of the drone’s energy is spent on fighting gravity and stabilizing in the air

USES:

- Aerial photography and video aerial inspection, leisure, agriculture, construction, security.

## GIS, Photogrammetry:

As the name suggests, photogrammetry is a three-dimensional coordinate measuring technique that employs images as the primary tool for metrology (or measurement). Photogrammetry's basic concept is triangulation, or more precisely Aerial Triangulation. So-called "lines of sight" can be established from each capillary by taking photos from at least two separate locations.

So-called "lines of sight" can be created from each camera to points on the object by taking images from at least two separate positions. The 3-dimensional coordinates of the points of interest are calculated by intersecting these lines of sight (sometimes called rays due to their optical nature).

## Remote Sensing

In the same way that photogrammetry gathers information from photography, remote sensing does as well. The word comes from the fact that data is gathered about objects and features without coming

into contact with them. GIS, radar, and softcopy photogrammetry are all examples of photogrammetry techniques. The type of information obtained by remote sensing varies from that collected by photogrammetry, which continues to be dependent on colour variations, so land use and land cover is one of the key outputs of remote sensing processing. Remote sensing was originally conceptualized to exploit the large number of color bands in satellite imagery to create 2D data primarily for GIS. Nowadays remote sensing tools are used with all types of imagery to assist in 2D data collection and derivation, such as slope. Software tools today tend to hold a much wider range of image technologies such as image mosaicing, 3D visualisation, GIS, radar as well as softcopy photogrammetry.

## How Gis/photogrammetry is used?

Photogrammetric survey uses a series of photographs of an object to deduce and accurately model its geometry.

This technique is commonly used to document features with complex geometries or large numbers of inclusions, including walls, pavements, rubble collapse, and architectural elements.

## How Aerial survey and Mapping is done using drone?

Once the drone as per the purpose has been chosen, the next step is the selection of a mapping solution that is a mobile app and a web platform that helps to plan the flight accurately. Mobile mapping automates mapping and photo flights and software creates accurate, high-resolution maps, reports, and 3D models, as well as real-time 2D Live Maps for immediate analysis. For image analysis, transfer the image from storage card to the computer once the data has been captured and upload it to software that will process the data to give final output.

Once the drone and mapping solution has been selected the next step is flight planning. Select the area where you want to do drone mapping along with it ensure safety majors. After finalizing the area, select altitude at which you want to fly the drone. After selecting the area plan the flight using mapping software. For the purpose, log into the software where it will automatically ask to plan a flight. It gives you the satellite image of the area where you just have to click on the square and select it for drone mapping.

After all selection processes next take the drone to the area where you have planned your flight and fly it. For the purpose connect drone to smartphone go to the drone mapping app and tap on the fly. Review the images captured by drone then and there to ensure that only relevant image goes for final analysis.

Once the images have been captured upload the image on the software. For the purpose login to Data Mapper, browse to survey and click on upload survey. Here upload all images and then select output where the image will be processed in form of orthomosaic or 3D point cloud ready to be used for your purpose.

**Agriculture**

For a precision agriculture approach, farmers use UAV technology to closely monitor crops and maximize profits.

AI-driven photogrammetry tools can help farmers quickly assess the biomass of their crops — as well as key factors like drought stress, soil erosion, pests, and disease — by estimating volume and automatically identifying problem areas.

Farmers also use aerial maps to monitor irrigation systems, provide verification for crop insurance claims, and to make better replanting decisions.

**Law Enforcement and First Responders**

In emergencies, time is of the essence. UAV photogrammetry can be used to rapidly document crisis situations, such as natural disasters or traffic accidents.

The resulting maps are being leveraged by first responders to map out evacuation routes, plan tactical responses, assess damage, and improve public safety. Drones can be used to map areas that are too dangerous to access on foot, and mapping technology can provide more accurate measurements that could be critical to search and rescue operations, such as the speed and depth of flood waters.

**Oil and Gas**

In the oil and gas industry, UAVs have been used for some time to replace manned aircraft in surveying large areas for pipeline construction and inspection.

Now, tools like AI object recognition have enabled oil and gas companies to use their aerial maps to automatically identify damage and leaks, accelerating remediation and limiting environmental impact.

Special cameras can even be used to capture damage that's invisible to the naked eye, such as corrosion under insulation (CUI).

**Telecom and Energy**

Electrical and telecom line work is one of the most dangerous jobs in the U.S., with 20.5 deaths per 100,000. Traditional methods for inspecting and repairing cell towers and power lines require dangerous climbs, putting workers at risk for falls and electrocution.

With UAV photogrammetry, these jobs are safer. Accurate 3D models help telecom and energy companies assess the safety of cell and transmission towers *before* sending up workers, so they can implement detailed repair plans and minimize unnecessary climbs.

**Environmental Conservation**

As with agriculture, special cameras and UAV processing technology can be used to record changes in the environment (e.g., landscape features, vegetation, soil erosion, pollution, water levels) in order to help scientists, monitor ecological issues, assess the health of ecosystems, and focus conservation efforts.

In addition, detailed and accurate UAV maps are enabling scientists to perform in-depth assessments of environments that were previously too difficult to access.

**Entertainment**

UAV photogrammetry also has valuable uses in the entertainment industry. The rapid creation of 3D models helps with set design, visual effects, and animation in order to create more realistic, true-to-life experiences in TV shows, films, and video games.

## Advantages, Disadvantages, importance of Aerial Survey and mapping

**1. Reduce costs through efficient, accurate surveying.**
Large scale accurate surveying has an upfront cost but saves money over the length of the project. At the beginning stages of surveying, unmanned aerial surveying is more affordable than the alternative — manned surveying with helicopters and aircraft. Accurate surveys make it less likely that there will be issues and reworks throughout the commercial project, which will save both time and money. By ensuring that the project is built on accurate data, an unmanned aerial survey can also ensure that the project doesn't encounter roadblocks throughout construction. As surveying occurs at the very beginning stages of a project, a delay in surveying could mean a delay on the project completion date.

**2. Make simulations and models for building, repairs, and renovations.**
Advanced software solutions can be used to take surveying data and make simulations and models. These models can be used for everything from initial project development to future repairs and renovations. Large scale commercial projects aren't just about building a project site — they're also about the long-term maintenance of the project.

**3. Scan everywhere from busy commercial areas to over-grown lots.**
Commercial areas can be complex — as can lots that have fallen into disrepair. Regardless of where the aerial survey is being completed, UAV scanning can be used to produce accurate and high-quality images ad point clouds. UAVs can get closer to the ground than manned vehicles and can use advanced technologies, such as LiDAR, to map the ground even when it isn't visible. On foot or manned scanning will not be able to get the high-resolution information that a commercial project needs — at least, not without significant cost and personal risk. If your commercial project is on an area that requires accuracy and complexity, UAVs will be the preferred method of surveying.

**4. Cover large areas in a minimal amount of time.**
The faster flights on aa commercial project can begin, the more successful it will be. It can take a long time for a ground survey to be completed, during which time you may not be able to begin your project. UAVs can cover exceptionally large areas in a minimal amount of time — and, as noted above, these large areas can be over-grown or complex, and the surveying and scanning will still be done with accuracy. And though manned aerial vehicles can survey large plots of land, they are not generally able to get *close enough* to get the high-resolution that an aerial survey drone can provide.

## Disadvantages of Aerial Survey

1. It is costly and requires more training to interpret than a map.
2. It lacks marginal data.
3. Ground features are difficult to identify or interpret without symbols and sometimes obscured by other ground details such as buildings in wooden areas.
4. The scale of aerial photography is not uniform.

5. It has many distortions such as relief displacement, vertical exaggeration. Hence, distances, directions, and areas can not be measured directly from aerial photographs without removing this distortion.

## Photogrammetry Software

Here are the top 12 photogrammetry software for building 3D maps and models using drones on the market. These photogrammetry software solutions work with both ground based and drone aerial images.

- DroneDeploy 3D mapping mobile app
- Pix4D Mapper photogrammetry
- DroneDeploy Enterprise 3D Map
- AutoDesk ReCap photogrammetry
- SimActive Correlator3D™ software
- Maps Made Easy orthophoto and 3D models
- 3DF Zephyr photogrammetry software
- Agisoft PhotoScan photogrammetry
- PrecisionHawk 3D map software
- Open Drone Map photogrammetry
- ESRI Drone2Map for ArcGIS
- Agisoft Metashape 3D software

## Limitations of aerial photogrammetry

- Visibility constraints such as rain, fog, or dense vegetation cover can block the camera's line of sight or limit light required for clear photography
- Poor weather conditions such as precipitation or wind can affect image capture and quality
- Altitude of flight required to achieve high image resolution and accuracy may be restricted by terrain or the built environment
- Difficulty matching points between images with low-contrast or uniformly textured surfaces e.g. sand, dense vegetation, short grass, tight crops, water bodies.