Drone Technology – Drones and UAVs Types, Advantages

July 10, 2026 • vajiramandravi.com

Unmanned aerial vehicles (UAVs) are aircraft that operate without **onboard crew or passengers**. They can function as automated **'drones'** or be controlled remotely as piloted vehicles (RPVs). Originally developed for military reconnaissance and combat operations since World War 1, the rapid technological advances have enabled the evolution of drones towards diverse civilian and commercial applications. Drones are now providing innovative solutions for sectors like **agriculture, infrastructure, transportation** and **disaster response.** India too aims to become a drone superpower, making and using drones for social and economic development.

Types of UAVs

Depending on the specific application or problem at hand, different types of drones can be utilised.

Types (based on rotors)

Multirotor UAVs	- Ideal for tasks like crop inspection - Have more than two rotors - Allow efficient lift generation by adjusting rotor speeds
Single-rotor UAVs	- They resemble helicopters in both design and structure. - Have a longer flight time and can hover in place for aerial imaging and precision spraying. - They are usually powered by gas engines.
Fixed-wing UAVs	- They are like normal aircraft and do not require as much energy to stay in the air because they cannot hover in one place. - Fly for longer periods and capture images across a large area of the field
Fixed-wing Multirotor Hybrid UAVs	- They are a hybridisation of fixed-wing and multirotor UAVs. - Ability to not only perform the vertical takeoff and land but also to perform - It has a longer flight time and can stay in the air much longer.
Flexible Membrane Wing UAVs	- These can perform the targeted flight in severe and windy conditions. - These UAVs are made up of flexible membrane wings. - They can carry a larger load, easy storage capacity, better control, and manoeuvrability.
Types (based on altitude)	
Low Altitude Deep Penetration (LADP)	**- Altitude:** 0.5–1 km **- Endurance:** Can fly for approximately 4 minutes and 10 seconds. **- Purpose:** Suitable for missions requiring low-altitude, long-range, and high-speed penetration. **- Examples:** UAV Model X1, UAV Model Y2
Medium-Altitude Long-Endurance (MALE) UAVs	**- Altitude:** 3 km–9 km **- Endurance**: Can fly for more than 24 hours. **- Purpose:** Primarily used for surveillance, reconnaissance, and strike missions. **- Examples:** Predator, MQ-9 Reaper.

High-Altitude Long-Endurance (HALE) UAVs	**- Altitude:** Above 15-20 Kms. **- Endurance:** Can fly for more than 24 hours continuously. **- Purpose:** Primarily used for surveillance, reconnaissance, and communication tasks for long-duration missions. **- Examples:** Global Hawk, RQ-4 Global Hawk.
Types (based on Size)	
Micro and Nano UAVs	**- Range**: Less than 10 Km, low altitude and for less time (< 1 hour) **- Weight:** nano (up to 250 g), micro (250 g to 2 kg) **- Purpose: Intelligence gathering,** but **less as military drones** (due to lack of AI and machine learning ability), **in the fleet of swarm drones** (very dangerous as there are currently no effective countermeasures), etc. **- Examples:** AeroVironment Nano Hummingbird, DelFly MAV, etc.
Small UAVs	**- Size**: Between **2 to 4 metres** in length **- Weight:** Typically between **25 to 150 kg** **- Purpose:** Versatile for various applications including aerial photography, mapping, and monitoring. **- Examples:** DJI Phantom series, SenseFly eBee.
Medium UAVs	**- Size:** Between 4 to 6 metres in length - **Weight:** Ranges from 150 to 600 kg - **Purpose:** Capable of carrying heavier payloads for longer endurance missions. - **Examples:** General Atomics MQ-1 Predator, Elbit Hermes 900.
Large UAVs	**- Size:** More than 6 metres in length **- Weight:** Exceeding 600 kg **- Purpose:** Designed for long-endurance missions with heavy payloads such as military surveillance or cargo transport. **- Examples:** Northrop Grumman RQ-4 Global Hawk, General Atomics MQ-9 Reaper.

Properties of Unmanned Aerial Vehicles (UAVs)

Unmanned Aerial Vehicles (UAVs) possess diverse properties such as autonomous operation, hovering, vertical landing (in some types), multiple power sources, and payload versatility, enabling wide-ranging civilian and military applications.

- **Vertical Landing Capability**: Not all UAVs can perform vertical landings. This capability is specific to certain types, such as rotary-wing drones (e.g., quadcopters, helicopters) and VTOL (Vertical Take-Off and Landing) drones. Fixed-wing UAVs typically require runways for takeoff and landing and cannot perform vertical landings.
- **Automated Hovering**: Only rotary-wing UAVs, like quadcopters and helicopters, can hover in place. Fixed-wing UAVs are designed for forward flight and cannot hover.
- **Power Sources**: UAVs utilise various power sources. While many smaller drones rely on batteries, others use gasoline engines, hybrid systems, or alternative energy sources like fuel cells and solar power.
- **Autonomous Operation**: Modern UAVs often feature autonomous capabilities, including GPS navigation, obstacle avoidance, and automated flight paths, reducing the need for constant human control.
- **Payload Versatility**: UAVs can carry a variety of payloads, such as cameras, sensors, or delivery packages, making them versatile tools for applications ranging from aerial photography to logistics.

Applications of Drone Technology

Drones nowadays have applications for both military and civil purposes. Some of these applications are described below.

Military Applications

Military drones can change the nature of warfare, making it more economical, precise, and efficient. This was observed in the Ukraine-Russia conflict. They can perform tasks such as:

- **Surveillance and Reconnaissance:** These drones can conduct surveillance missions by hovering over an area for an extended period. They provide real-time information on targets' positions, terrain, and enemy movements.
    - The **Israeli-made Heron** drones used by the Indian Army can loiter for over 24 hours facilitating strategic monitoring of sensitive areas.
    - Drones, like the **Nishant UAV** used by the Indian Army and the **MQ-1 Predator UAV** used by the United States, provide real-time information on targets and terrain.
- **Unmanned Combat Aerial Vehicle (UCAV):** These are the UAVs that are designed for combat operations, such as air-to-air and air-to-ground attacks. They can carry weapons such as missiles, bombs, and guns.
    - **Examples:** Shahed 129 (Iran), Ghatak (upcoming Indian UCAV), USAF Hunter-Killer (USA), etc.
    - **Swarm drones** are a fleet of UAVs that work together to achieve a specific goal.
        - **Examples:** Use by Israeli Defence forces in Gaza and by Houthi rebels against Saudi Arabia’s Aramco installations.
    - **Kamikaze drones:** These are drones that are loaded with explosives and crash into their targets, causing damage and destruction. They are also known as loitering munitions or suicide drones.
        - **Examples:** Use of kamikaze drones in the Ukraine-Russia conflict.

Civil Applications

UAVs are also used for non-military purposes, such as:

- **Aerial Surveying and Mapping:** Fixed-wing UAVs like the **Dhaksha** (Indian multipurpose drone) offer high-resolution area imaging at **40% lower costs** than satellite mapping for agriculture, disaster management, mining, forestry and urban planning.
    - For instance, the Odisha Government conducted drone surveys of Puri's destruction following **Cyclone Fani.**
- **Law enforcement and crowd management:** Drones can be deployed for crowd monitoring and crime scene analysis as a means of smart policing, as used by the Mumbai Police.
- **Medical and Healthcare:** Drones facilitate contactless delivery of medicines, vaccines, blood samples and organs in remote areas where road connectivity is limited.
    - India's **'Medicine from the Sky' projects** in Telangana and Arunachal Pradesh use drones to improve access and deliver medicines to primary healthcare facilities.
- **Agriculture:** Agricultural drones, equipped with multispectral sensors, are revolutionising farming by mapping soil and crop health at high resolutions.
    - Trials by **Mahindra Agri Solutions** and **Marut Drones** increased yields and lowered cultivation costs for smallholder farmers in Punjab and Karnataka highlighting drones' productivity potential.
- **Environment:** Drones can significantly contribute to environmental conservation.
    - For instance, drones have been used for **data collection** in the **Panna Tiger Reserve** and **Kaziranga Forest,** aiding in **wildlife tracking** and **poaching prevention.**

Challenges of Drone Technology

As an emerging technology, drones bring forth a series of growing challenges that demand holistic solutions.

- **Privacy:** Drones have high-resolution cameras that capture images and videos from great heights and can invade personal spaces and record without consent.
- **Ethical concerns:** Drone applications in conflict zones provide tactical advantages, including **precise strikes** and reduced risk to **military personnel.**
    - This trend leads to discussions concerning the ethics of remote warfare when humans do not directly engage in battle.
- **Environmental impact:** Drones, especially fossil fuel-powered ones, contribute to **carbon emissions** and worsen climate change.
- **Airspace issues:** Since drones occupy airspace, with many able to reach heights rivalling those of a jet, concerns have been raised about drones causing disasters and emergencies.
- **Legal and Regulatory:** The advancement of drone technology has surpassed the development of legal and regulatory frameworks. Governments claim that targeted killings by drones are justified under international law.
    - The absence of clear **guidelines** raises questions about **accountability** and **transparency**.

Drone in India

India’s journey with UAVs began with the acquisition of the Israeli **Searcher Mark 1 in 1998.** Most of the UAVs of the Indian armed forces are procured from Israel and the USA. The drone market in India reached **₹29 billion ($370 million) in 2020** and is estimated to grow to **₹1.5 trillion ($19 billion) by 2026.**

Initiatives in India

India aims to become a **drone superpower by 2030**, with a focus on indigenous development and manufacturing. The Indian government has launched several initiatives in this direction.

- **Make in India Initiatives:** It encourages domestic manufacturing and investment in the drone sector within the broader context of promoting indigenous manufacturing.
    - **Production-Linked Incentive (PLI) Scheme** provides financial aid to Indian drone manufacturers and covers drone-related software, aiming to boost domestic production.
- **Drone (Amendment) Rules 2022:** This simplifies regulations and licensing requirements for drone operations, reducing the number of permits and approvals.
    - Due to new rules, the remote pilot certificate (licence) will not be required from the Director General of Civil Aviation for flying micro and nano drones in India for non-commercial purposes.
    - All other drone activities are permitted only after receiving the prior approvals.
- **Digital Sky Platform:** It enables online applications for licensing to fly, manufacture, and other activities; and provides information on drones.
- **Standard Operating Procedure (SOP) for Agricultural Drones:** These SOPs guide the safe and effective use of agricultural drones, ensuring that they are used in compliance with regulations and best practices.
- **Private Investments and Startups:**
    - **Drone Shakti Scheme** promotes drone technology and applications in India, encouraging startups to offer drone services.

Indigenous Drones

India has made significant progress in developing indigenous drones. Here are some examples:

Product/Location	**Role**
DRDO Abhyas (ADE, Bengaluru)	- A cost-effective supersonic missile demonstrator developed by DRDO for training purposes.
DRDO Ghatak (ADE, Bengaluru)	- A lightweight missile designed to target and destroy enemy tanks. - It is also called **SWiFT.**
HAL CATS (HAL and Newspace R&D)	- A cooperative flight testbed developed by HAL and Newspace R&D for demonstrating avionics technology.
Rustom-1 and 2 (ADE, Bengaluru)	- An indigenously developed UCAV for surveillance and reconnaissance missions.

TAPAS-BH-201(ADE, Bengaluru)	- A multi-role light combat helicopter for various military operations.
DRDO Imperial Eagle (DRDO’s ADE and CSIR’s National Aerospace Laboratory)	- An advanced trainer jet for training pilots.
DRDO Lakshya (ADE, Bengaluru)	- A subsonic cruise missile for long-range strikes.
DRDO Netra (R&DE and IdeaForge)	- An AEW&CS for surveillance, tracking, identification and classification of airborne and sea surface targets.
DRDO Nishant (ADE, Bengaluru)	- A tactical UAV for surveillance and reconnaissance operations.
NAL/ADE Golden Hawk (DRDO’s ADE and CSIR’s NAL)	- A basic trainer aircraft for training pilots.
NAL/ADE Pushpak (DRDO’s ADE and CSIR’s NAL)	- A utility transport aircraft for various transport operations.

Drone Technology - Drones and UAVs UPSC PYQs

Question 1: Who/What are the following and why have they been in the news recently? - ‘Predator’ drones **(UPSC Mains 2010)**

Question 2: With reference to Unmanned Aerial Vehicles (UAVs), consider the following statements: **(UPSC Prelims 2025)**

1. All types of UAVs can do vertical landing.
2. All types of UAVs can do automated hovering.
3. All types of UAVs can use battery only as a source of power supply.

How many of the statements given above are correct?

a) Only one

b) Only two

c) All the three

d) None

Ans: (d)
