

DRONE : A MASTER PIECE INNOVATION IN FIELD OF AVIATION

Although originally built for military purposes to do surveillance, drones have seen rapid growth and advancements and as emerged as one of the Major innovation in the field of Aviation.

Their original idea was to replace manned flights in territories which involved high risk and use them for long endurance surveillance system. As the time progressed the drones were used as weapons, in the form of remotely guided aerial missile deployers. Today, the drones have found a wide range of applications for civilian use, especially in the form of multicopters which are very small in size and are used for commercial use to Hobby flying.

Today, drones are used for a wide range of functions, including monitoring climate change, delivering goods, aiding in search and rescue operations, and in filming and photography.

Of course, UAVs are also an increasingly important part of the military in many countries. American armed forces alone have a fleet of tens of thousands of **drones** today, compared to just a few ten years ago. This is dwarfed, however, by the number of drones in private use. According to the FAA, there were 1.9 million drones registered in the U.S. in 2021 and in India there are more than 1.5 lakhs drone.

What is considered to be a drone?

Drone is "An unmanned aircraft or ship guided by remote control or onboard computers." - Merriam Webster. A drone is, in effect, an unmanned flying object either controlled remotely or operating autonomously.

"A **drone**, in technological terms, is an unmanned aircraft. Essentially, 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."

Recreational RC planes became big during the 1960s

Thanks to breakthroughs in transistor technology at this time, radio-controlled components could now be miniaturized enough to be sold to civilian customers at a reasonable cost. This led to something of a boom in RC planes during this decade.

Planes began to appear in kit form that allowed enthusiasts to build and fly RC craft either indoors or outdoors. A large number of RC aircraft clubs were also started up by hobbyists. This created a cottage industry, which would speed up the development of commercial RC technology.

Assault military drones were seriously beefed up during 1980-1989

In 1982 Israeli forces used unmanned aircraft to gain a victory over the Syrian Air Force with minimal losses. This triggered for a joint project by the U.S. and Israel in 1986 to develop RQ2 Pioneer – a medium-sized reconnaissance aircraft.

1990-2010 was a pivotal period for military and civilian drone development

Mini and micro versions of UAVs were introduced in 1990, and, the famous *Predator drone* was introduced in 2000. This was used in Afghanistan to launch missiles and in the search of Osama Bin Laden. In the following years, a number of small-

sized, fixed-wing surveillance drones such as *Raven*, *Wasp*, and *Puma* were developed by AeroVironment Inc. *Raven* is currently used in a number of countries, with tens of thousands of units deployed.

2006 was another pivotal year in the history of drones. This was the year that the FAA officially issued the first commercial drone permit.

However, consumer applications were slow to start, with very small numbers of people applying for permits in the first few years.

2010-today might just be the "Golden Age" of drones

The last 10 years or so have seen a huge explosion in drone innovation and commercial interest. While prior to this, drones were primarily used for military purposes or hobbyists, beginning in the early-2010s, a host of new uses were proposed for drones, including their use as delivery vehicles.

Equipping drones with cameras is now commonplace in commercial photography and videography. This is the result of a merging of radio-controlled (RC) aircraft and smartphone technology.

The rapid growth in the usage of smartphones reduced the prices of microcontrollers, accelerometers, and camera sensors, which are ideal for use in fixed-wing hobbyist aircraft. Further advances allowed a drone with **4 or more rotors** to be controlled by adjusting the speed of individual rotors.

Improving the stability of multirotor aircraft opened new possibilities for them to be used in a number of ways.

The use of DIY drones is also becoming more popular. Because of their smaller size and portability, DIY drones have the potential to be used by police forces and fire services for surveillance.

Drones in India

India's history of drones' dates to the 2000, Post Kargil War, when the Indian Army acquired unmanned aerial vehicles or UAVs from Israel namely the searcher MK II, and the Indian Air Force and Navy followed suit where IAF purchased both searcher MK II and HERON. However ADA had kick started Nishanth an Indigenous reconnaissance drone with catapult take off way back in 1990 but had not been operationally cleared for flights.



DRDO's/ PSUs Development of UAVs in India

In year 2002 HAL started production of Lakshay which is Remotely Vehicle which is used for target towing. Nearly 30 RPVS are deployed with Indian Armed Forces.



ADE started development of RUSTOM UAV in year 2007 which is similar to HERON UAV of Israel for Medium Altitude Reconnaissance use. This UAV is to be mass produced by HAL which is waiting for orders from Government. ADE has now started working on RUSTOM -II which would be used for High Altitude Reconnaissance use.



HAL in partnership with MALAT, Israel started development of NRUAV for Indian Navy, in Year 2010, However the project has not progressed due various technical constraints.

In year 2017, ADE has started to work on **Ghatak** which is an autonomous unmanned combat air vehicle (UCAV). This UAV would be capable of firing various missiles or rockets over enemies' target.



In year 2019, HAL under Public Private Partnership (PPP) between HAL and an Indian private startup, Newspace R&D has started to develop CATS Warrior will be an autonomous wingman drone capable of take off & landing from land & in sea from an aircraft carrier.



Off late India has procured numerous Israeli military unmanned aircraft to loiter over military targets such as surveillance bases and radar stations. They have been designed to have a minimal radar signature, allowing them to perform stealth operations.

Private Indian companies' development of UAVs in India

Apart from DRDO's several other private Indian companies are making drones and developing UAV technologies.

In year 2007 Idea Forge Pvt Ltd was founded by IIT-Bombay alumni, the organization had started to manufacture quadcopters for Surveillance. Over the last Fifteen years the company has developed many multicopters and Hybrid drones. The company has successfully sold few hundred drones to Indian Armed Forces and paramilitary forces for surveillance.



In year 2014 '1 Martin' way Pvt Ltd was formed in Mumbai which developed drones for using them to tow advertising banners



Post attack on Pathankot, Indian Airforce base in year 2016, the need for long endurance surveillance drones were felt as multicopters were not having endurance and fixed wing drones required skilled operators to fly with limited endurance of 90 to 120 minutes.

To overcome this limitation of flight time, a tethered drone was the only option available. The tethered drone can be airborne for a very long duration. These type of drone manufacturers are just four in the world and they do not share the technology or knowhow.

CyPhySignals India Pvt Ltd (2017 incorporated) a Bangalore based startup in collaboration with IISc, Bangalore (as part of academia-and -private company joint development program) developed an indigenous tethered drone different from how the other tethered drones operate in the world. These drones have cameras which are under surveillance mode during normal operation and can quickly turn towards any area where the intrusion is detected. The camera identifies the number of intruders and gives an option to the ground operator to decide as to whom need to be tracked. Once the person is marked the camera starts tracking him and keeps the person in centre of Field of View. The camera has a slant range of detection up to 1 Kms. This indigenously developed drone has been successfully deployed in Indian Navy through BEL Bangalore..



In year 2017 Drones Tech Lab was founded a couple of years ago and currently offers all the drone-related services you can think of. With its range of surveillance, agricultural drones, swarming software, and counter-drone solutions.

In Year 2018 NewsSpace Research and Technologies Pvt Ltd started working on swarm drones and they won the mehar baba swarm drone competition organised by IAF.



Apart from surveillance the drones are used in agriculture sector. Indian companies like Garuda Aerospace Pvt Ltd (2017 incorporated) and Multiplex drones Pvt Ltd (2017 incorporated) have developed indigenous agriculture drone capable of spraying fertilisers and insecticides over crops, trees etc. They are used for seed dropping too.



Zen technologies is a small-cap drone-tech company incorporated IN 1993 however they started working on drones from 2018 on Heavy Lift Logistics Drones. These drones can lift weight up to 20 Kgs.



In year 2021, Vinata Aeromobility has started working on fully autonomous Air taxis which a drone to transport humans. It is likely to take the skies by 2024.



What is the future of drones?

The future of drones looks highly promising. Gartner predicts that the global drone market will grow substantially over the next few years.

Drone growth will occur across the four main segments namely Military purpose drones, Agriculture Drones, Drones for mapping and photography and lastly the Delivery Drones (including Drone Taxis)

For military applications, drones are expected to become smaller and lighter with much longer battery life and flight times. There will also be developments in improving drone optics and other capabilities further. In the civilian market, developments in improving flight times are allowing them to serve as delivery platforms, for use in emergency services, and for data collection in a number of areas too dangerous for humans, such as in power plants or fires.

Drones have also been deployed for home security and crowd control in some countries. While a worrying development, authorities in some areas are likely to continue the use of drones for this type of surveillance.

Miniaturization is also likely to play a massive role in the future of drones. As components are made smaller and smaller, drones will also be dramatically reduced in size.

It is not inconceivable that micro-drones will become commonplace in military and commercial/industrial applications in the not too distant future. Much like the recent pocket-sized drones recently commissioned in US DOD.

Classification of drones

1. By Weight

- (a) **Nano Drones** which are below 250 Gms



- (b) **Micro Drones** which are below 2 Kgs and above 250 Gms



(c) **Small Drones** which are below 25 Kgs and above 2 Kgs



(d) **Medium Drones** which are below 150 Kgs and above 25 Kgs



(d) **large Drones** which are over 150 kg.



2. **By Operations**

(a) **Surveillance Drones**

(i) **Multi rotor** – Short endurance and short range but quite agile



(ii) **Tethered Drones** – Long endurance suitable for campus monitoring



(iii) **Hybrid Fixed wing with multi rotor** – medium endurance with long range



(iv) **Fixed wing drones** – Long endurance with long range



(b) **Delivery Drones**

(i) **Cargo Delivery**



(ii) Medicine Delivery



(c) Agriculture Drones



(d) Combat Drones

(i) Heavy payload drones



(ii) Swarm Drones- light payload with max damage



Drone Ecosystem In India

Earlier the drones were being imported in India as there was no technology for manufacturing of these drones both in terms of structure or airframe as well as Electronics. With many companies starting up to work on carbon fibre based products, the structure could be now be designed and manufactured completely in India. There are now 3-D printers available which can construct airframe using carbon fibre and glass fibre. There are many start-ups incubated in IISc, IITs at Chennai, Bangalore and Gurugram are making complete carbon fibre based frames. Apart from private players, NAL and ADA also have carbon composite structure labs from where large airframes can be made in India. Some of the major players who are making carbon composite frames are Fabheads India at Chennai, Valdel Group In Bangalore.

However we have not much progressed on electronics as we are dependent of chips from china or Singapore or Taiwan. Though many companies have claimed to have developed their own autopilots and control system, they are still importing the hardware from china and only loading the firmware in India. Recently Ms Cyphysignals have signed an MOU with Ms HCL to develop and indigenous Autopilot which would be a major breakthrough for the

drones. Like wise BLDC motors which are the powertrain also are being imported as Indian manufactures are not able to achieve the required weight vis-a vis with the power being generated. Neodymium magnets are still not available in India which is key to low weight. Even propellers and lithium batteries are being imported which may be manufactured in India over a period of time once we get some breakthrough in production of lithium batteries.

Drone policy in India

The govt has issued new policy on drone usage and certification. This is a very good step towards atmanirbhar Bharath. However, the process of getting drone certification is still not streamlined and there are huge delays in the process. The amount being charged by the certification agency like TQ Cert who on behalf of QCI is entrusted to certify drones are quite high for the Indian companies and starups. Secondly the process should be initially done by academic organisation like IISC which would be a neutral agency and would also define a frame work for certification. Presently the frame work given by QCI is more to do with ground equipment or a proven and production ready product certification rather than for clearance of a newly designed prototype and maturing product certification. This is deterring the manufactures to approach them for certification. However other process of certification like getting a Drone Acknowledgment Number (DAN) are highly streamlined. The DAN and OAN which are issued have not got any use as the complete process is not yet streamlined.

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