

Drones: Technology and its Applications

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In a first terror attack of its kind, two low-intensity improvised explosive devices dropped by drones went off in a highly secure Indian Air Force base in Jammu, about 14 km off the International Border. This new avatar of terrorism in the form of a small drone has far more devastating capabilities for which India, at this juncture, is ill-prepared.

In news: India needs drone detection systems

Placing it in syllabus: Science & Technology

Dimensions:

- Drones or UAVs: Technology Involved
- Potential Uses
- Potential Threats
- Suggestions to neutralize threats

Content:

Drones or UAVs: Technology Involved:

- The term “drone” usually refers to any unpiloted aircraft.
- Drones are more formally known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes).
- These robotic UAVs operate without a pilot on board and with different levels of autonomy.
- A drone’s autonomy level can range from **remotely piloted** (a human controls its movements) to **advanced autonomy**, which means that it relies on a system of sensors and LIDAR detectors to calculate its movement.

Technology, features and components

Drones contain a large number of technological components, including:

- **Electronic Speed Controllers (ESC):** an electronic circuit that controls a motor's speed and direction.
- Flight controller
- **GPS module:** typically housed in the nose of a drone. The GPS on a drone communicates its precise location with the controller.
- Battery
- Antenna
- Receiver
- Cameras
- **Sensors:** distance sensors (ultrasonic, laser, lidar), time-of-flight sensors, chemical sensors, Collision avoidance sensors and stabilization and orientation sensors etc
- **Accelerometer:** which measures speed
- **Altimeter:** which measures altitude

Types of Drones:

Single Rotor Drones:

- Single rotor drones look exactly like tiny helicopters and can be gas or electric powered.
- The single blade and ability to run on gas helps its stability and fly for longer distances.
- These UAVs are usually used to transport heavier objects, including LIDAR systems, that can be used to survey land, research storms and map erosion caused by global warming.

Multi-Rotor Drones:

- Multi-rotor drones are usually some of the smallest and lightest drones on the market.
- They have limited distance, speed and height, but make the perfect flying vehicle for enthusiasts and aerial

photographers.

- These drones can usually spend 20-30 minutes in the air carrying a lightweight payload, such as a camera.

Fixed Wing Drones:

- Fixed wing drones look like normal airplanes, where the wings provide the lift instead of rotors- making them very efficient.
- These drones usually use fuel instead of electricity, allowing them to glide in the air for more than 16 hours.
- Since these drones are usually much larger, and because of their design, they need to take off and land on runways just as airplanes do.
- Fixed wing UAVs are used by the military to carry out strikes, by scientists to carry large amounts of equipment and even by nonprofits to deliver food and other goods to areas that are hard to reach.

Indian Drone Industry:

- The Indian drone industry is currently in its nascent stages.
- According to a Forbes report from June 2020, there are “200,000 recreational and commercial drones in the country, each costing anywhere from Rs 200,000 (\$2,600) to Rs 20 million (\$26,000) depending on size and functionality”.
- A July 2018 report by FICCI-Ernst & Young estimated that India’s drone industry will touch nearly \$900 million by 2021.
- Based on their weight, drones can be divided into five categories – nano (weighing up to 250 g), micro (250 g to 2 kg), small (2-25 kg), medium (25-150 kg), and large (over 150 kg).
- All drones except nano require a licensed pilot and permit from the Director General of Civil Aviation

(DGCA). Altitude and speed restrictions also vary depending on the category of the drone.

Potential Uses:

Because drones can be controlled remotely and can be flown at varying distances and heights, they make perfect candidates to take on some of the toughest jobs in the world.

Military:

Probably the oldest, most well-known and controversial use of drones is in the military.

The British and U.S. militaries started using very basic forms of drones in the early 1940's to spy on the Axis powers.

Today's drones are much more advanced than the UAVs of yesteryear, equipped with thermal imaging, laser range finders and even tools to perform airstrikes.

Delivery:

- Delivery drones are usually autonomous UAVs that are used to transport food, packages or goods to your front doorstep.
- These flying vehicles are known as "last mile" delivery drones because they are used to make deliveries from stores or warehouses close by.
- Retailers and grocery chains all over the country are turning to drones as more efficient delivery alternative, instead of relying on delivery drivers with inefficient trucks.
- Amazon, Walmart, Google, FedEx, UPS and many other big brands are all currently testing out different versions of delivery drones.

Emergency Rescue:

- Drones are also used in situations where it's not safe

enough to send humans into a rescue situation due to the scope or severity of the disaster.

- If there's an avalanche, drones are deployed to look for those caught in the snow.
- The **K-MAX**, a pilotless helicopter designed to carry more than 6,000 pounds of cargo, has already been used in China and Australia to assist in fighting fires.

Outer Space:

- NASA and the US Air Force have been testing out unmanned aircraft geared towards space travel.
- The X-37B UAV is the Air Force's ultra-secretive drone that looks like a miniature space shuttle.
- It has been quietly circling the Earth for the last two years, setting a record for longest flight from an unmanned aircraft (more than 719 days).
- The **Ingenuity drone** was sent to Mars with the Perseverance Mission and is the first autonomous aerial platform operated outside Earth's atmosphere.

Wildlife and Historical Conservation:

- Drones are a cheaper and more efficient alternative to wildlife conservation.
- Tracking wildlife populations is nearly impossible with humans on the ground. Having an eye-in-the-sky allows wildlife conservationists to track roaming groups of animals to get a better idea of the health of their species and ecosystems.
- Drones are also being used for reforestation efforts all over the world. These drones scour the forest floors of forests decimated by fires and drop seed vessels filled with seeds, fertilizers and nutrients that will help a tree rise from the ashes.
- UAVs are becoming instrumental in historical conservation efforts. Drones are being used to map out 3D renderings of historical sites like Chernobyl, the

ancient Greek sites of Ephesus, Turkey and Jewish cemeteries all over Europe.

Medicine:

- Right now, unmanned aerial vehicles are being used to deliver emergency medical supplies and cargo to off-the-grid communities in rural Alaska.
- Instead of relying on dog sleds, snowmobiles or ambulances that can't handle snow, Alaskans are relying on drones to quickly receive life-saving medical supplies.
- Drones are also being tapped to deliver donated organs to transplant patients.

According to a 2020 report by the Drone Federation of India (DFI), urban planning, monitoring wildlife and preventing illegal activities in forests, capturing and analysing data for Indian Railways, National Highways Authority of India and state governments for transportation plans, mining, disaster management, agricultural assessments and security and surveillance are some of the ways in which drones are being used in India.

Potential Threats:

Smuggling:

- There have been multiple cases where criminal organizations or individuals have used drones to smuggle illicit material, usually across borders or into prisons.
- Earlier this year, a drone carrying drugs was discovered crashed just south of the U.S.-Mexico border.

Reconnaissance and Surveillance:

- In this scenario, an operator could use a drone to reconnoiter targets for attack or monitor the actions of individuals or law enforcement.
- The utility of off-the-shelf drones for reconnaissance

and surveillance has already been proven in battle spaces like the civil war in Ukraine.

- The rapid spread of hobbyist drones makes this scenario both the most likely threat involving drones and the most difficult to identify.

Privacy Invasion:

- Drones can carry a camera and can record images – and voice – from places inaccessible to a human eavesdropper.
- Variants used by law enforcement could link to facial recognition systems and silently monitor crowds, open-air meetings and pedestrians.
- Militant activists could use them to map out establishments they wish to target.

Kinetic Attack:

- In this scenario, an attacker might strap guns or explosives to a drone and fly it into people or structures to inflict physical damage or loss of life.
- The targets of these attacks may be individuals, buildings, transportation infrastructure such as commercial airliners or military establishments

Cybersecurity:

- Even hobby drones can carry small Raspberry Pi computers. These can be programmed to sniff Wi-Fi signals.
- They have been used by white hat researchers to test the security of remote critical infrastructure establishments – such as power stations – that cannot be accessed directly from the internet.

Targeted Physical Attacks / Asymmetric Warfare:

- Targeted attacks are likely to increase over the next few years.

- The intent will be to harm humans, and could result from any of the existing drivers to cause human harm, whether personal or ideological.
- Recently, a fleet of “military” drones successfully targeted a Saudi Arabian oil production. Yemeni Houthi rebels claimed responsibility.
- Never in history has a weapon system offered so much to the terrorists at so low a cost. More than that it provides anonymity and safety.

Suggestions to neutralize threats:

Upgrading Security Technology:

- Existing military radars cannot pick up the signatures of small drones for which special radars are required.
- Plastic parts and simple autopilot reduces the radio signals to the minimum.
- A host of active countermeasures have been developed like lasers, rapid-fire cannons, protective nets fired from weapons systems to ensnare drones, hunter drones and command/navigation/GPS signal jammers.
- The cost of these systems is still disproportionate to that of the drone.
- Currently, barring adaptation of existing conventional radar and radio jammers, India has no countermeasures in place.

Anti-Drone Systems:

- In the short run, meanwhile, the Jammu incident would invariably act as a catalyst or a ‘bolt from the blue’ to **push a major acquisition drive for anti-drone systems**
- We need to develop technical capabilities in the counter drone domain where technology is used to either detect, identify or kill rogue drones.

Strict Enforcement of Unmanned Aircraft System Rules:

- The Unmanned Aircraft System Rules, 2021, set certain conditions for operating drones. For one, it prohibits the flying of drones in Delhi's Vijay Chowk, areas surrounding strategic locations notified by the Ministry of Home Affairs, central secretariats in state capitals, and eco-sensitive zones.
- Operating drones is also barred within 5 km of international airports at Mumbai, Delhi, Chennai, Kolkata, Bengaluru and Hyderabad, and at a distance of 3 km from the perimeter of any civil, private or defence airport.
- Drones cannot be flown within a distance of 25 km from international borders, which includes the Line of Control, and in the vicinity of military installations or areas where military activities take place (unless clearance is obtained from the local military facility).
- Under the rules, individuals and companies are required to obtain the DGCA's approval to import, manufacture, trade, own or operate drones.

Developing Drone Corridors:

- Drone flights are only permitted in designated drone corridors.
- These are to be pre-determined and the policy lays down a guideline whereby these will be determined in consultation with the Aviation and Navigation Services (ANS), which is under the purview of the Airports Authority of India.

Mould your thought: Critically evaluate the potential uses and threats of drone technology. What can be done to offset the threats in India?

Approach to the answer:

- Introduction
- Define Drones and briefly mention the technology used

- Discuss the potential uses of Drones
- Mention the potential threats of UAVs
- Give suggestions to reduce the threats of drones
- Conclusion