

Emerging Trends in Drones Across Multiple Sectors

Sandeep Mishra^{1*}, Kaustubh Kumar Shukla²

Abstract

Drones, also known as unmanned aerial vehicles (UAVs), have become increasingly popular for their adaptability, affordability, and advanced functionalities. Originally developed for military purposes, they are now widely utilized across diverse sectors such as agriculture, filmmaking, and search and rescue missions. The impact of drones has been significant in various domains, such as reducing human casualties, providing more accurate information, increasing efficiency and cost reduction, and improving crop yields. Nonetheless, privacy and safety concerns have prompted the implementation of regulations and limitations on their operation. The latest developments in drone technology include AI and autonomous drones, swarm drones inspired by natural swarms, 5G connectivity, smaller drone sizes and efficiency, and emerging applications like drone delivery services, agriculture, environmental monitoring, construction, and security. Future possibilities include urban air mobility, medical applications, space exploration, and renewable energy support. However, challenges and considerations include regulatory concerns, battery life and power supply limitations, and cyber security. Governments are working on creating frameworks for safe drone operation, while researchers are exploring alternative power sources like hydrogen fuel cells and solar panels to extend drone flight times. With increased connectivity, drones are exposed to potential hacking and cyber-attacks, highlighting the importance of safeguarding data and ensuring the secure operation of autonomous systems. In conclusion, drones are transforming industries with their versatility, cost-effectiveness, and innovative capabilities. However, overcoming regulatory, security, and power challenges will be crucial for large-scale adoption.

Keywords: Drones, robotics, mechanical, artificial intelligence, sensors

INTRODUCTION

Drones, also known as unmanned aerial vehicles or UAVs, have become a revolutionary technology with wide-ranging implications across various industries [1]. Advances in electronics, miniaturization, and commercial popularity have driven their development and widespread use. Drones are flying robots controlled through programming-controlled flight plans in their embedded structure [2]. They have been used in various non-military applications, including search and rescue, surveillance, traffic checking, environmental detection, firefighting, private robots, robot photography, videography, and agriculture [3]. The first plane with a reusable radio control system was made in the 1930s, and military drones were later made with sensors and camera units [4]. Companies like Google and Amazon are working on developing drones that can transport groups from the air without a significant stretch [5]. Drones are also used in the entertainment world for information transfer from closed-off areas [6]. With the help of Figure 1, a block diagram of the proposed system has been shown.

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Received Date: October 21, 2024

Accepted Date: October 28, 2024

Published Date: November 08, 2024

Citation: Sandeep Mishra, Kaustubh Kumar Shukla. Emerging Trends in Drones Across Multiple Sectors. International Journal of Mechanical Dynamics and Systems Analysis. 2024; 2(2): 29–35p.

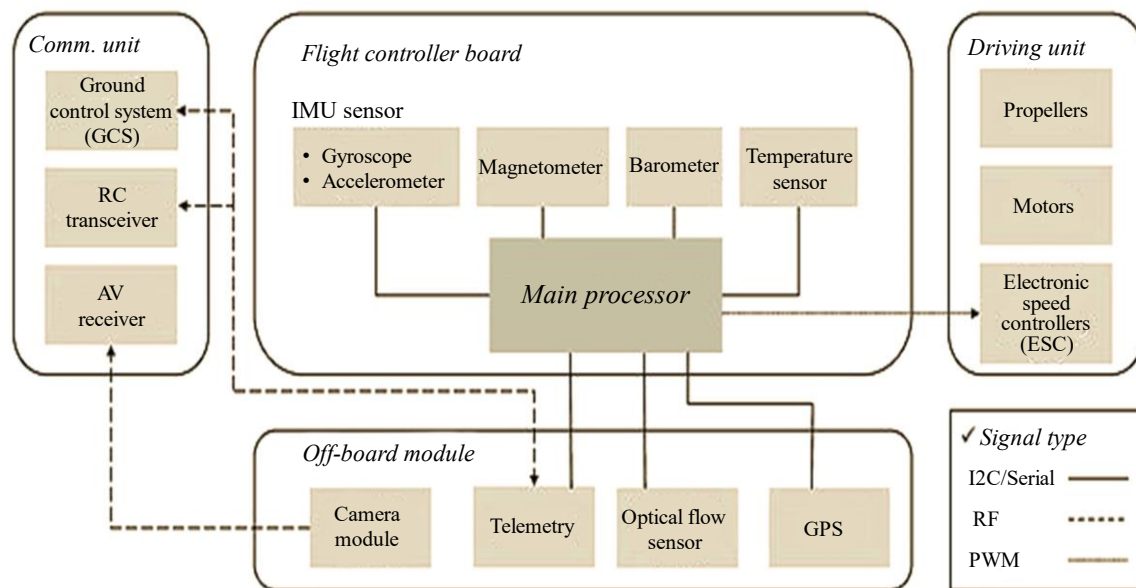


Figure 1. Block diagram of the proposed system.

LITERATURE SURVEY AND BACKGROUND

Drones, or UAVs, have been around since the mid-20th century, with their first recorded use in 1918. They have undergone significant advancements in technology, with the first radio-controlled airplane being developed in the 1930s. The United States, Japan, and Germany continued to explore drone technology, with the 1960s seeing the introduction of plane-powered drones for observation purposes [7]. The 1970s saw the development of drones with satellite control, which led to their use in military activities like the Vietnam War. The 1990s saw a significant shift in drone usage for business and sports, with the introduction of remote-controlled quad copters. The 21st century saw a significant shift in drone usage, with advancements in technology allowing them to carry heavier payloads and perform a wider range of tasks. In 2002, the US military began using drones for targeted strikes in Afghanistan, continuing the use of drones in the War on Terror. Drones are now used in disaster relief projects, search and rescue missions, and environmental observation [8], as well as in films and TV shows. However, concerns about safety and health arise with the increasing use of drones. State-run governments worldwide are working on guidelines to ensure the safe and reliable use of drones [9].

With the headways in innovation, there are currently different sorts of drones accessible on the lookout, each intended for a particular reason. Drones have evolved significantly over the years, with various types available for various purposes. Fixed-wing drones, designed to resemble planes, are commonly used for business purposes like aerial photography, planning, and reviewing [10, 11]. They can be equipped with high-performance sensors and cameras for precise information collection. Rotational drones, also known as multi-rotor drones, are the most commonly used type, with rotors connected to a focal point for vertical take-off and landing (VTOL). Crossbreed drones combine the elements of both types, making them suitable for both short and long-range missions. Single rotor helicopters are larger and more complex, suitable for complex missions like freight transportation, observation, and search and rescue. Flapping wing drones mimic bird and insect flight patterns, used for surveillance and research purposes. Fixed-wing VTOL drones have the added capability to take off and land upward, making them suitable for restricted spaces and military activities. Sunlight-powered drones use sun-oriented energy as their primary power source, making them ideal for natural checking and long-haul observation missions. Hydrogen power module drones use hydrogen gas as their primary power source, offering longer flight times and heavier payloads.

In Figures 2 and 3, real drone and different types of drones have been shown which cover almost all the sectors of engineering.

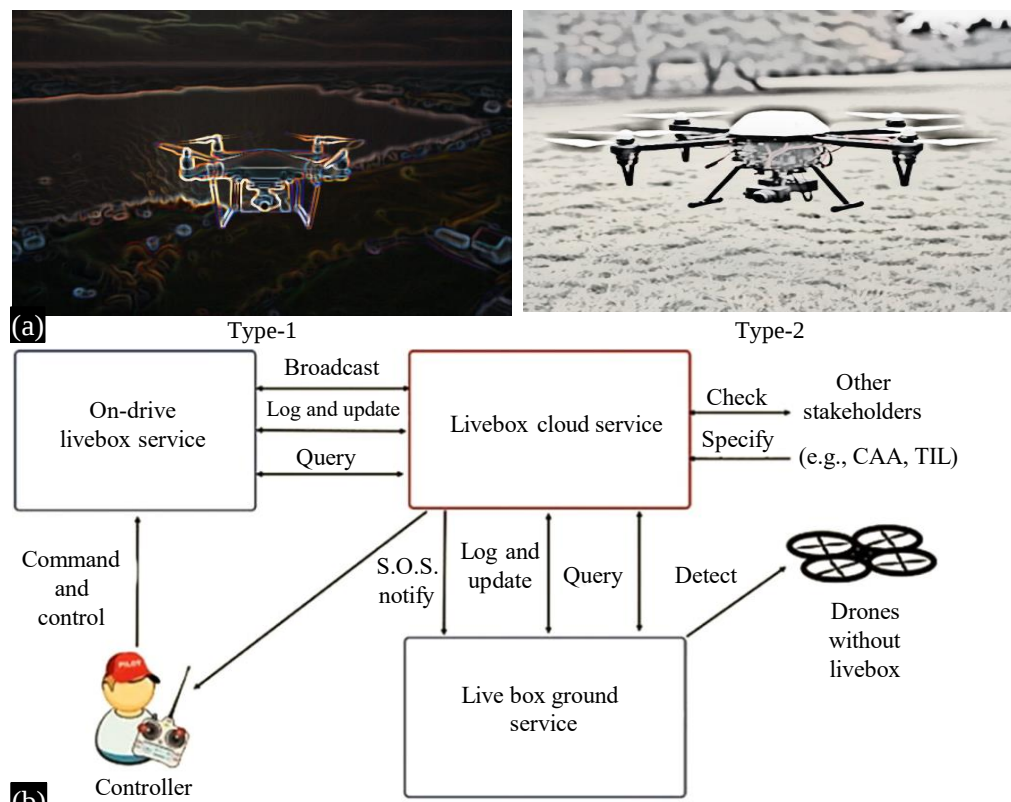


Figure 2. (a) Real-time device (drone). (b) control process of drone [12].

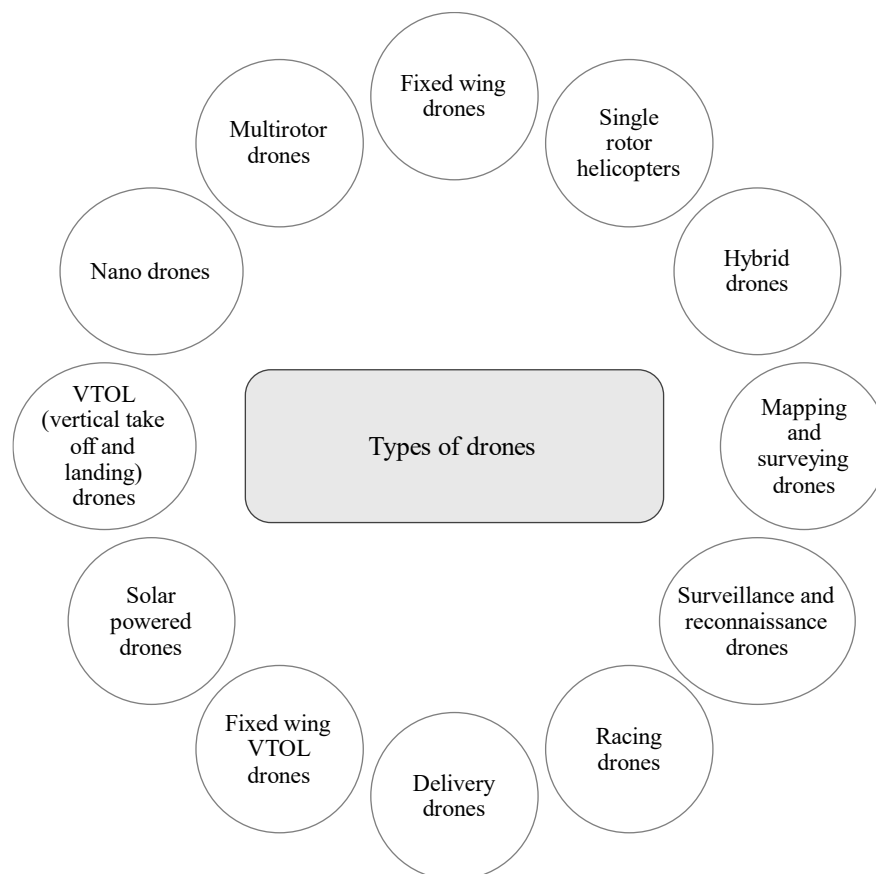


Figure 3. Types of drones.

DESIGN AND WORKING

Drone design involves defining the drone's purpose, requirements, features, performance specifications, budget, drone type, components, electrical system, software development, assembly and testing, and obtaining certifications. It is shown in Figure 4. The process begins with defining the drone's target audience, desired features, performance specifications, and budget. The drone type is chosen, such as multi-rotor, fixed-wing, or hybrid. Components are chosen based on durability and weight, motors and electronic speed controllers (ESCs), propellers, battery capacity, flight controller, sensors, and optional payload. The electrical system is designed, including power distribution and battery management systems. Software development includes flight control algorithms, payload integration, and ground control stations. The drone is assembled, tested, calibrated, and fine-tuned for optimal performance. If necessary, certifications or licenses are obtained [13].

Although drone designs might vary depending on their intended use [14], the following components make up the drone's primary body:

1. *Frame*: The edge is the UAV's basic design, which maintains the integrity of its many different components. Depending on the type and size of the robot, it may be constructed from a variety of materials, such as plastic, aluminum, or carbon fiber.
2. *Motors and propellers*: Electric engines power the propellers of drones, creating lift and push. The drone's weight and dimensions determine the quantity and size of its engines and propellers. Generally speaking, larger drones will have more powerful engines and larger propellers to support their greater weight.
3. *Battery*: The drone's primary power source is the battery. It provides the essential energy needed for engines and other electronic components to function. The size, weight, and flying duration requirements of the drone will determine the type and amount of battery.
4. *Flight regulator*: The drone's brain is the flight regulator. It interprets commands from a nearby PC or the controller and translates them into specific drone developments. In order to keep the drone level and in control, it also adjusts the engines' speeds.
5. *Sensors*: To gather data regarding their direction, speed, and area, UAVs are equipped with a variety of sensors, including gyrotors, accelerometers, and magnetometers. The flight regulator uses this information to maintain stability and control the drone.
6. *Camera and gimbal*: To capture high-quality images and recordings, a great number are equipped with cameras and gimbals. A gimbal, a settling component that maintains the camera's consistency while the robot is moving, holds the camera in place.

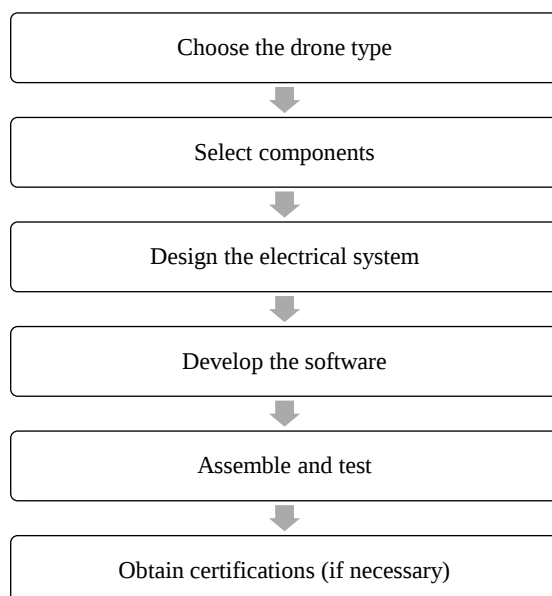


Figure 4. Design steps of drones.

The drones' operating rules are based on the same trip requirements as regular airplanes. Drones balance the force of gravity and stay in the air by using the lift generated by the propellers. They also manage their development and bearing by using the criteria of streamlined characteristics [15]. To achieve the desired development, the flight regulator modifies the engines' speed and propellers' direction based on input from the pilot or an installed PC. A controller or an installed PC is used to remotely operate drones. Through the controller, the pilot gives commands to the robot, which responds accordingly. Additionally, some drones are autonomous, meaning they can fly and run tasks without assistance from humans.

MULTIDISCIPLINARY NATURE AND APPLICATIONS OF DRONES

Drones can be used for many different purposes. The following are likely the most well-known uses of UAVs:

1. *Airborne photography and videography:* To capture stunning high-altitude pictures, the film and media industries typically use drones equipped with top-notch cameras and gimbals. They are also used in sports broadcasting, event inclusion, and land photography.
2. *Farming:* In horticulture, drones are used to collect data about crops, such as soil moisture content, plant health, and anticipated yield. This information helps ranchers make well-informed decisions on the water system, board preparation, and harvest.
3. *Military:* Drones have been used for designated assaults, knowledge gathering, and observation in the military.
4. *Conveyance services:* Companies such as UPS and Amazon are investigating various options for using drones to transport packages. In areas with heavy traffic or problematic terrain, drones can transport bundles more quickly and efficiently.
5. *Disaster board:* To search for survivors and assess the damage in hard-to-reach areas, executives use drones equipped with thermal imaging cameras and various sensors.

FUTURE IMPLICATIONS

Figure 5 shows the study report and future prediction of drone. The potential uses and recommendations for drones are growing along with the creativity underlying them. In addition to the businesses mentioned above, drones are also being researched for therapeutic and practical uses. Robots can be used in the clinical field to transport organs and therapeutic supplies, particularly in remote or rural areas. Drones can be used in humanitarian efforts for disaster response, delivering medical supplies and assistance to affected areas. Future applications of drones might also include freight and passenger transportation. Drone taxicabs and freight drones are now being developed by companies such as Uber

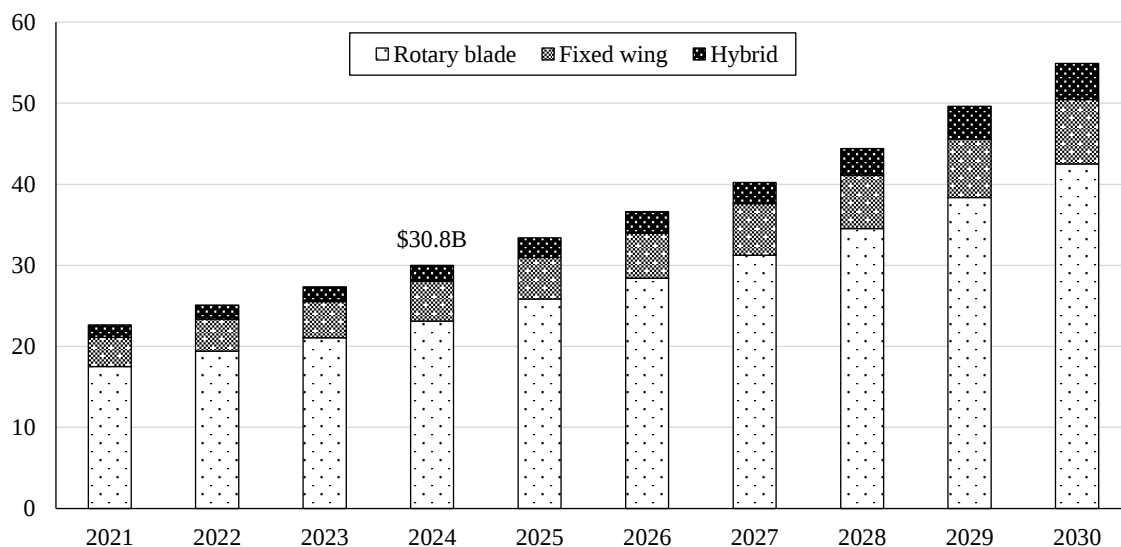


Figure 5. Future prediction of drones.

and Airbus. This advancement has the potential to change transportation, but it also brings up concerns about safety and regulations. Furthermore, the widespread use of drones may also raise health issues. There is a greater chance of accidents and collisions as more UAVs take to the skies, especially in densely populated areas. To reduce these risks, drone administrators urgently need proper planning and procedures. Overall, drones will have a huge impact on the future and have a lot of promise for various industries. In industries including development, farming, transportation, and conveyance, they can enhance production, well-being, and supportability. In any event, strict regulations and ethical considerations should be taken into account to ensure that the use of drones does not have detrimental effects on safety, security, and well-being. As innovation continues to advance, it is critical to carefully analyse and resolve the potential implications of drones in order to maximize their positive effects and minimize their negative ones.

CONCLUSION

Drones are revolutionizing industries with their versatility, cost-effectiveness, and innovative capabilities, but regulatory, security, and power challenges remain to overcome for widespread adoption. Drones have expanded since the 1980s, benefiting industries like film, agriculture, and delivery. However, they pose potential risks and require regulations. As technology advances, the future implications of drones are vast, impacting society. Balancing benefits and risks is crucial for safe and responsible use. With advancements in technology, drones may become more adaptable, but concerns about safety and security must be addressed to ensure responsible use. In conclusion, drones' adaptability, effectiveness, and technological developments are drastically changing a wide range of sectors. Drones are expanding beyond their original military application into industries like logistics, agriculture, environmental monitoring, and even urban air mobility, thanks to artificial intelligence-powered autonomous systems and integration with 5G networks. Their prospective uses in fields including space exploration, building, and medical emergencies demonstrate how profoundly they could impact future innovation. Even while there are many opportunities, there are still issues with things like cyber security, power supply, and regulation. Drones have the potential to revolutionize industry and daily life as research and technology advance, opening up exciting new avenues for the future.

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