

WORKING PRINCIPLE OF A DRONE

Unmanned aerial vehicles, also known as drones, are miniature robots that are capable of flying with the help of a remote-control system.

One of the most common and popular flying drone designs is the quadcopter, which is a type of drone that is lifted and propelled by four rotors. The concept of quadcopter vehicles is not new; manned quadcopters were first experimented with in the 1920s, but their effectiveness was hampered by the technology available at the time.

However, with the advancement of electronic technology in sensors, batteries, cameras, and GPS systems, quadcopters have become widely employed over the past decade both recreationally and commercially.

Basic Principle - How Do Quadcopters Work?

The 4 propellers of a quadcopter are fixed and vertically orientated. Each propeller has a variable and independent speed which allows a full range of movements. Shown below is the different propeller combinations that facilitate different drone movements.

This is unlike conventional helicopters which are controlled by propellers with blades that dynamically pitch around the rotor hub. The components required for blade pitch are expensive which is one of the reasons quadcopters are becoming so common with recreational UAV enthusiasts.

The core components of a quadcopter are as follows:

- Chassis – the skeleton of the drone which all componentry is fixed to. The chassis design is a trade-off between strength (especially when additional weight such as cameras are attached) and additional weight, which will require longer propellers and stronger motors to lift.
- Propellers – principally effect the load that the quadcopter can carry, the speed it can fly, and the speed it can manoeuvre. The length can be modified; longer propellers can achieve greater lift at a lower rpm but take longer to speed up/slow down. Shorter propellers can change speed quicker and thus are more maneuverable, however they require a higher rotational speed to achieve the same power as longer blades. This causes excess motor strain and thus reduces motor life span. A more aggressive pitch will allow quicker movement but reduced hovering efficiency.

- Motors – 1 per propeller, drone motors are rated in “Kv” units which equates to the number of revolutions per minute it can achieve when a voltage of 1 volt is supplied to the motor with no load. A faster motor spin will give more flight power, but requires more power from the battery resulting in a decreased flight time.
- Electronic Speed Controller (ESC) – provides a controlled current to each motor to produce the correct spin speed and direction.
- Flight Controller – the onboard computer which interprets incoming signals sent from the pilot and sends corresponding inputs to the ESC to control the quadcopter.
- Radio Receiver – receives the control signals from the pilot.
- Battery – generally lithium polymer batteries are used due to high power density and ability to recharge.

Further to this, sensors can be used such as accelerometers, gyroscopes, GPS and barometers for positional measurements. Cameras are also frequently mounted for navigation and aerial photography.

How Do You Fly a Quadcopter Drone?

A quadcopter is controlled manually with a hand-held radio control transmitter which manually controls the propellers. Sticks on the controller allow movements in different directions and trim buttons allow the trim to be adjusted to balance the drone. Screens can also be used to receive live video footage from the on-board camera and to display sensor data.

Further to this, on-board sensors can provide helpful settings such as;

- Auto altitude where the quadcopter will move at a fixed altitude, and;
- GPS hold, where the quadcopter will remain at a fixed GPS position.

Quadcopters can also be flown autonomously, where modern flight controllers can use software to mark GPS waypoints that the vehicle will fly to and land or move to a set altitude. This kind of autonomy is becoming increasingly common and contributes to much of the increased interest in civilian drone technologies that has been observed in recent years.