MODULE 4: TECHNICAL LABORATORY AND FLIGHT WORKSHOP

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Outline

- Unit 1 – Drone Technology
- Unit 2 – Drone Controller
- Unit 3 – Flying a Drone

Unit 1

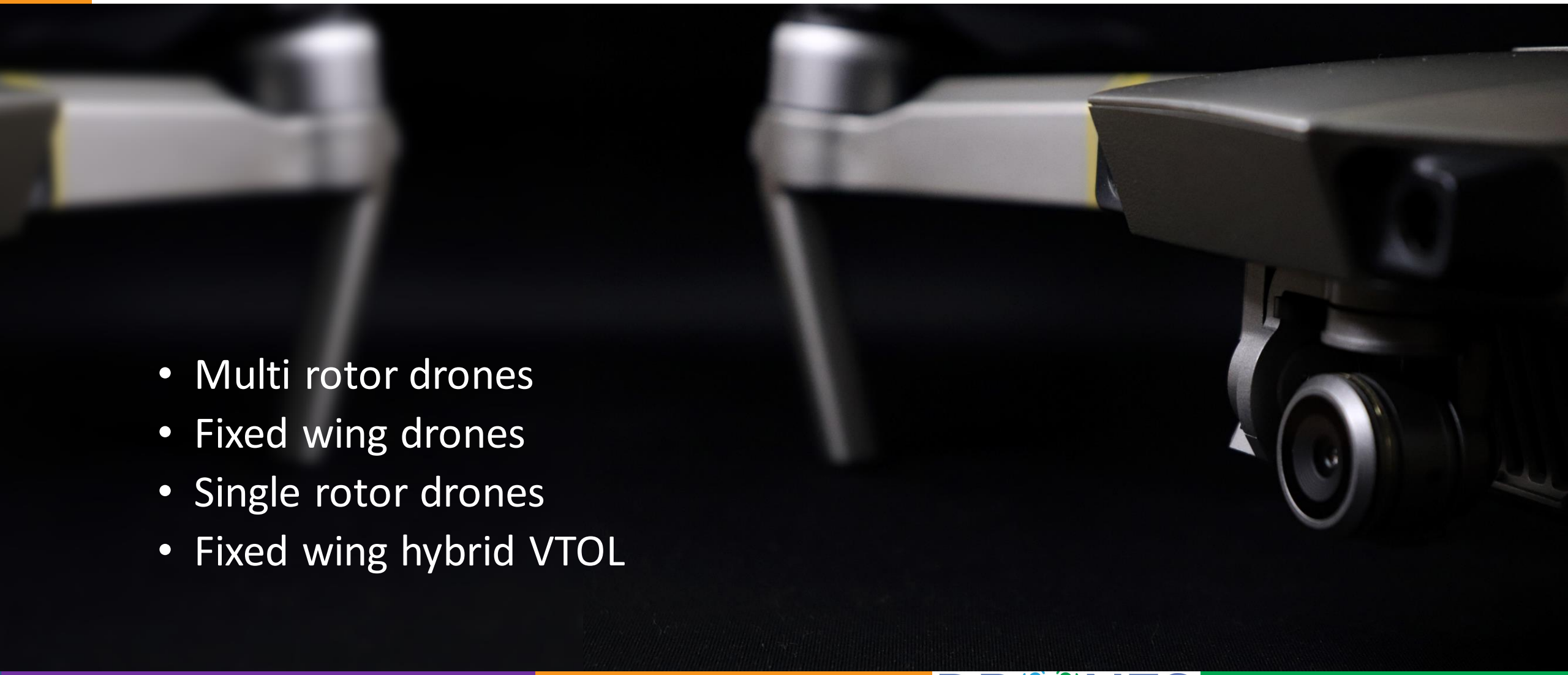
Drone Technology

Drone Technology

- Which are the main components of a drone?
- Which type of drone is most common?
- What makes drones so stable?

Drone Technology

Types of Drones



- Multi rotor drones
- Fixed wing drones
- Single rotor drones
- Fixed wing hybrid VTOL

Multi Rotor Drones

Fixed wing Drones

Single Rotor Drones

Fixed Wing Hybrid VTOL

Main components of a Drone

Drone Motor (explain the different types)

Drone propellers (materials used and why)

Drone flight controller

GPS Module

Electronic Speed Controller (ESC)

Power port module

3 Axis Gimbal (for drones with cameras)

Drone camera

Drone battery

Drone antennas

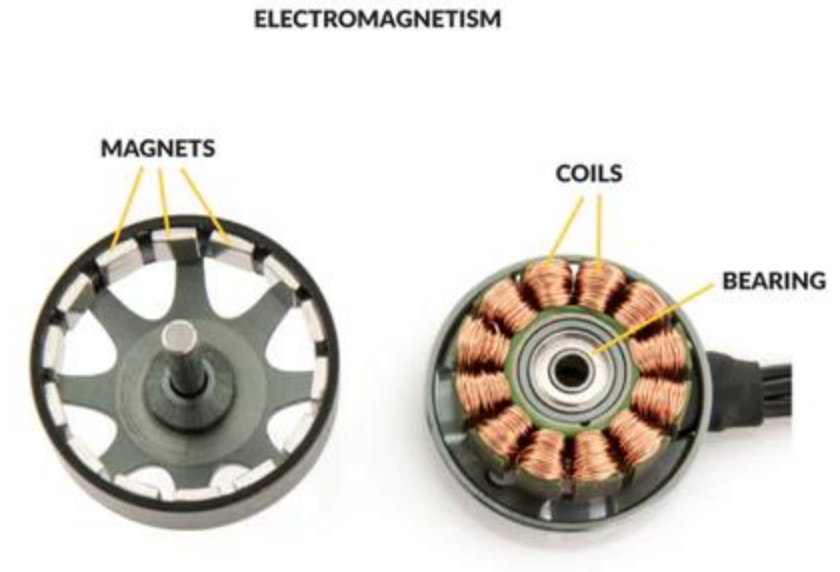
Downward ultrasonic obstacle avoidance sensor

Flight LED

Drone frame (which materials are used, pros and cons of using polymers and composites)

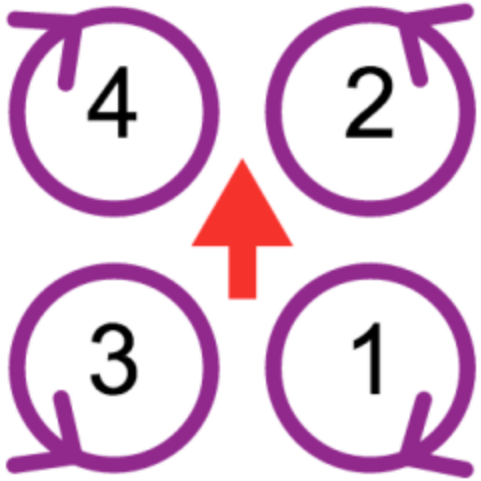
Drone Motor

- Drone motors can be either brushed or brushless
- Brushed motors are used in smaller toy drones
- Brushless motors are used in cinematography and racing drones
- The thrust to weight ratio is an important factor when selecting a drone motor
- The size of the propellors and intended use of the drone also need to be taken into consideration when choosing a drone motor



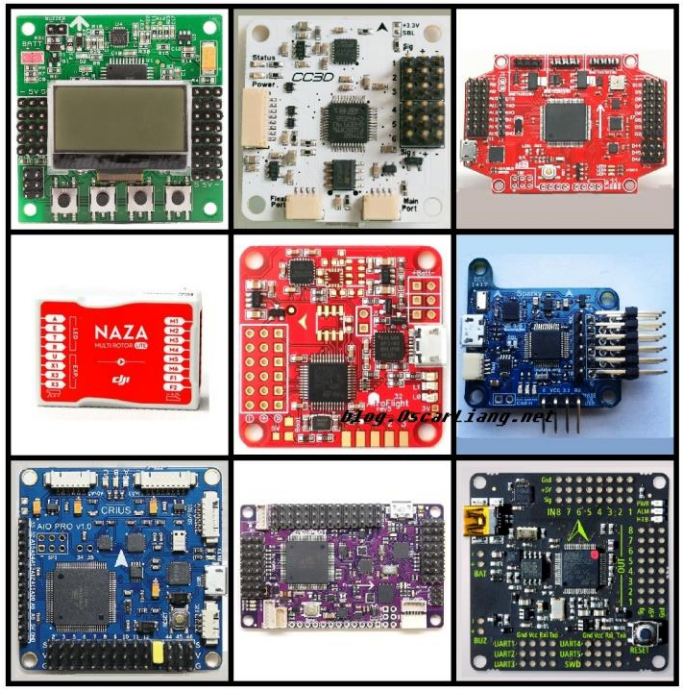
Drone propellor

- Generate thrust
- Move the drone in different directions
- The prop has to be matched to the motor (clockwise or counter clockwise)
- Most commonly used are 2 or 3 blade props
- 2 blade props are more efficient for longer use due to less drag



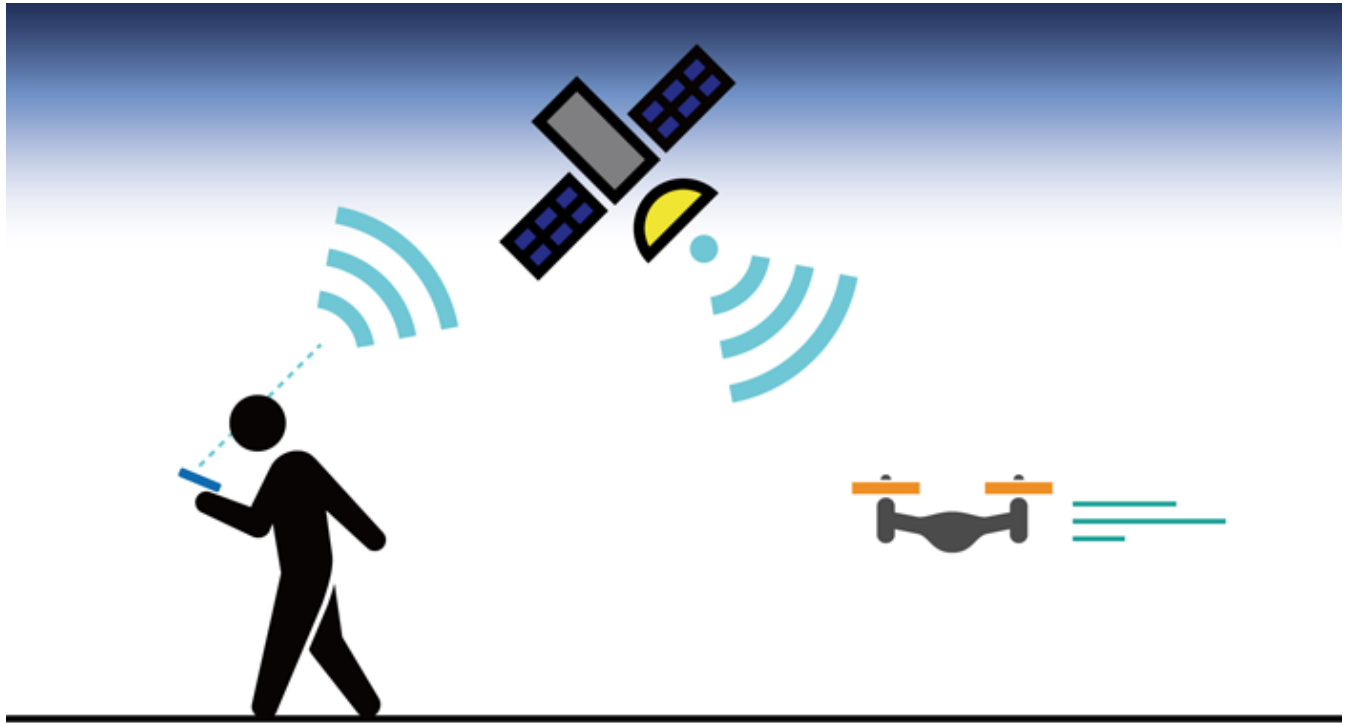
Drone flight controller

- One of the most important components
- Responsible for the drone's stability
- The pilot also receives feedback from the controller during flight
- The FC controls the speed of each motor to change the direction of flight and perform manoeuvres.
- The FC can be modified to change the way a drone behaves during flight



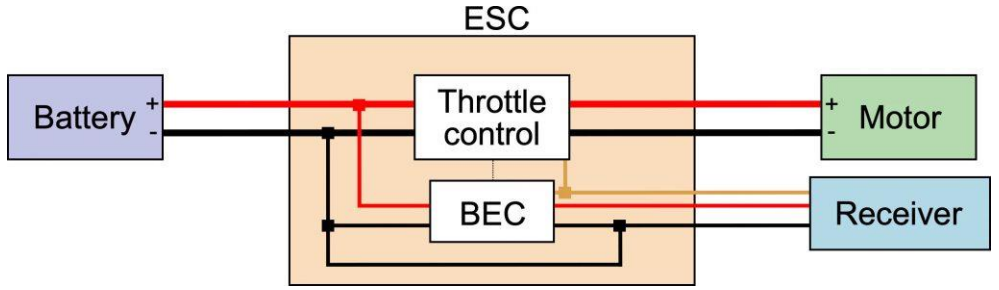
GPS Module

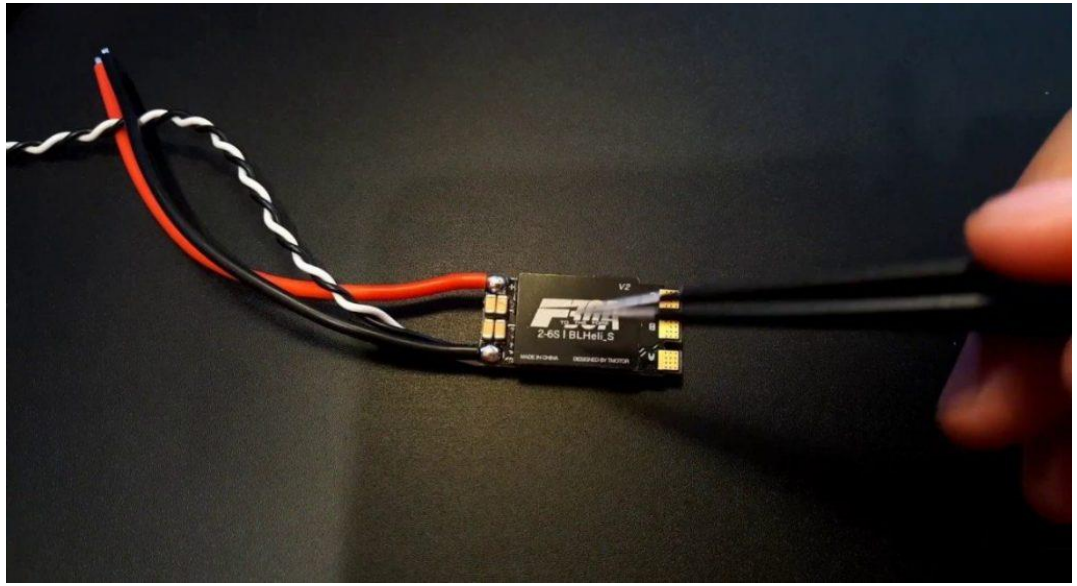
- Allows drones to know their location relative to a satellite network
- Thanks to the GPS module drones can perform the following functions:
  - Position hold
  - Return to home
  - Autonomous flight
  - Waypoint navigation



Electronic speed controller

- The ESC is a circuit that connects the battery, motor and the flight controller to control the spped of the drone
- The type of ESC used depends on the motor in the drone (brushed/brushless)
- The ESC has a receiver which receives the signal from the pilot and forwards it to the EC inside the ESC, depending on the signal the speed is adjusted.



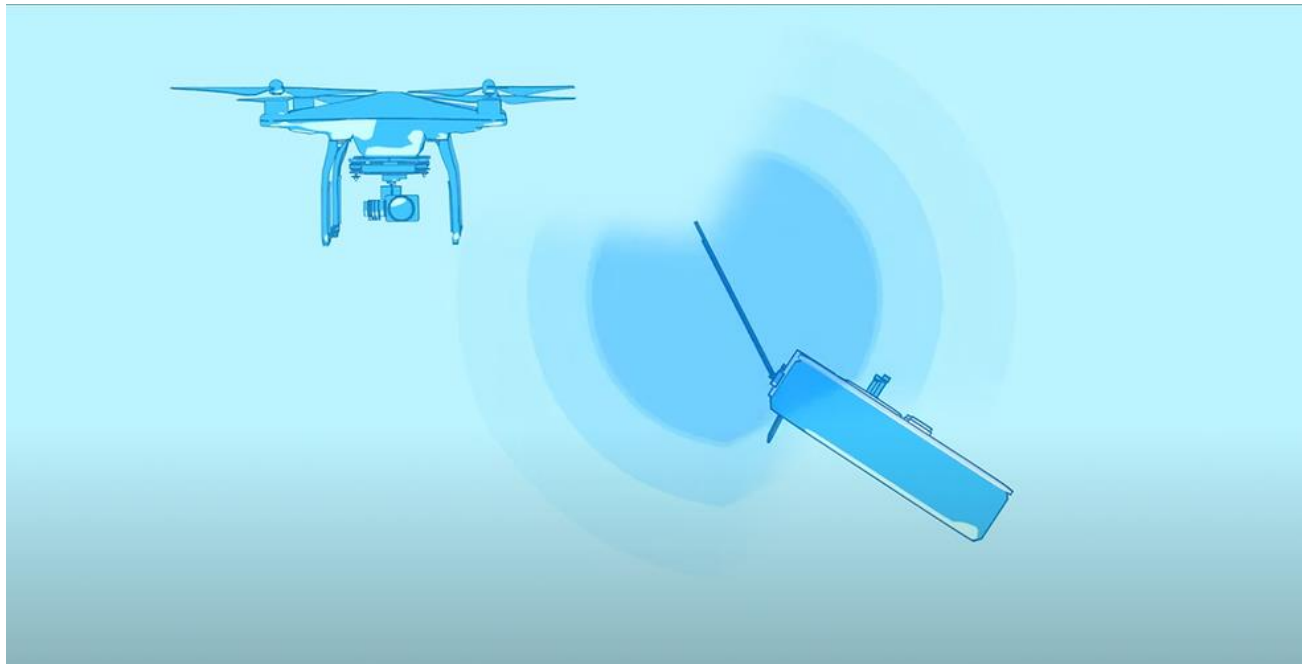


3-Axis Gimball

- Used for video stability during filming
- Eliminates all vibration from the movement of the drone
- Using the three axis of the gimball the camera can also be rotated in virtually any direction to capture the desired shot

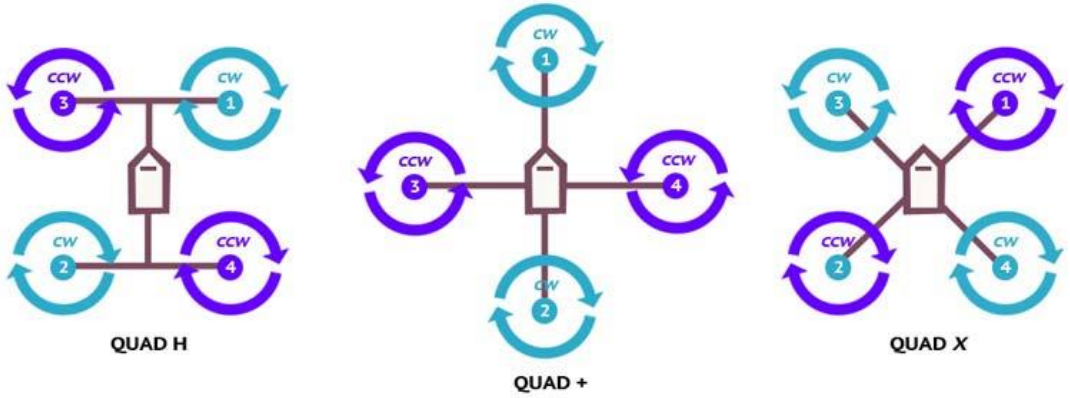
Drone antenna

- The drone antenna is an integral part of the drone's components as thanks to it the drone receives information from other systems as well as from the pilot
- Without an antenna the drone cannot be operated



Drone Frame

- The drone frame depends on the intended use of the drone
- Designed to accommodate monocopter to octacopter
- Each drone design has its intended use
- Most common drone used for photography/videography is the quadcopter
- Quadcopter comes in three different configurations:
  - Plus shape
  - H Shape
  - X shape



Unit 2

Drone Controller

Drone Controller

- Which flight terminologies are you familiar with?
- Can you name some standard buttons on the controller?

Drone Controller

The drones work by sending signals from the controller to the receiver inside the drone and this allows for wireless communication. The three main components responsible for this are:

- Drone transmitters
- Drone receivers
- Flight controllers which are made up of:
  - Accelerometers
  - Magnetometers
  - Gyroscopes
- Electronic speed controller (ESC)

Drone Communication

Technology used for drone communication:

- Radio frequencies
- Wifi
- GPS
- Satellite link

Drone Communication

Radio frequency:

- Most drones operate on a frequency of 2.4GHz, 5.8GHz, 433MHz and 915MHz
- Together with radio frequency some drones also use a GPS signal which enables a bigger range.

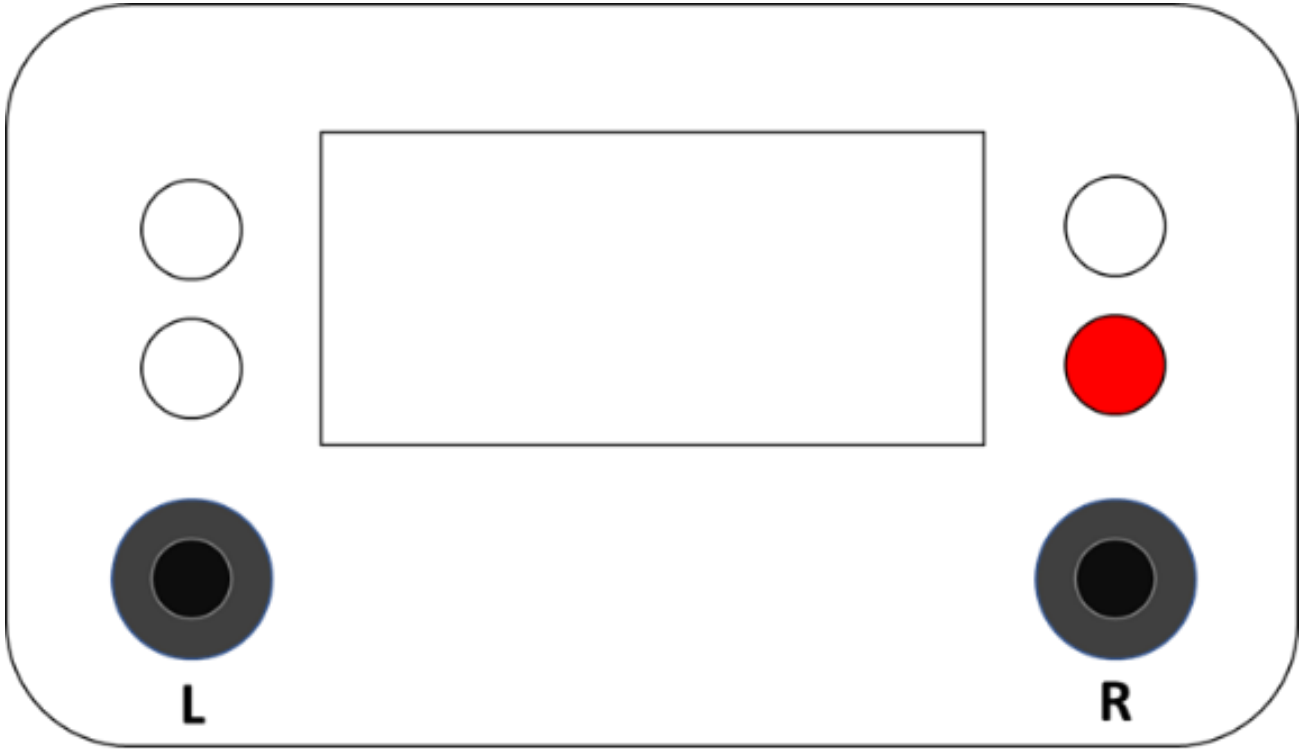
Drone Communication

Wifi:

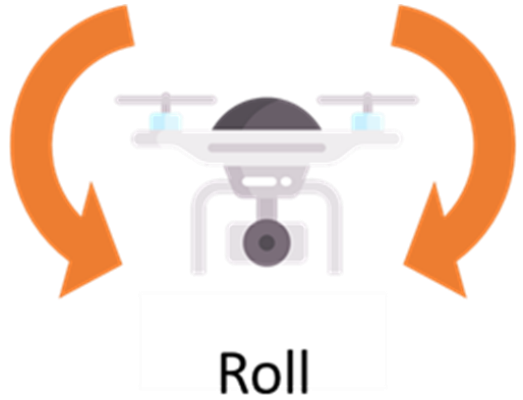
- Most drones do not require wifi for operation as long as there is a clear line of sight.
- However wifi is required for drones with features such as live video streaming, downloading maps.
- Some drones require an internet connection for operation as they are connected through an app.

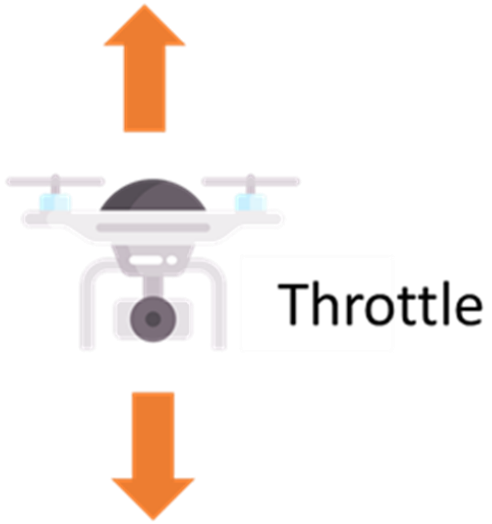
Buttons in a drone controller

- Left is used for yaw/throttle
- Right is used for roll/pitch



Basic drone manoeuvres





Unit 3

Flying a drone

Flying a drone

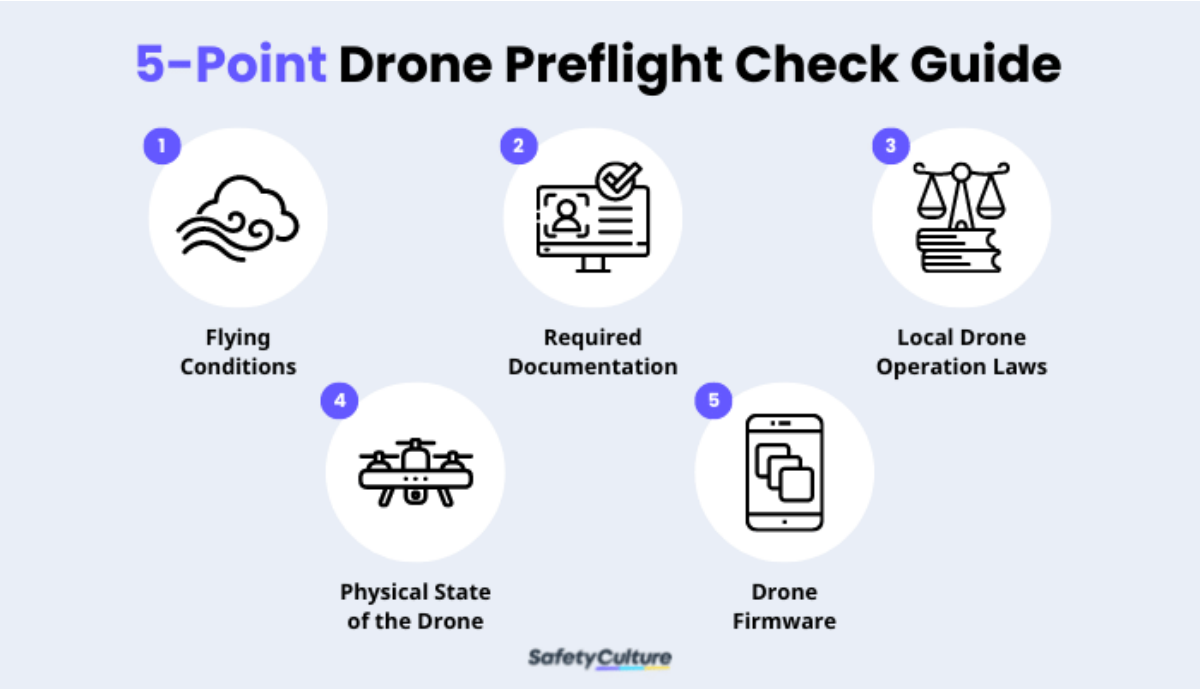
- Why are pre-flight checks important?
- Can you think of any pre-flight checks?

UNIT 3 – Flying a drone

Pre-flight checks

Before each flight there are a number of checks that one has to do on the drone, to ensure that the flight is as safe as possible. These checks include:

- Physical check of the drone to make sure that the major components are secured and not damaged
- Battery: fully charged and secured
- Propellors: clean, turn smoothly and no sign of damage or vibration
- Frame: clean, no visible damage
- Motors: good working order and no debris. Check for any abnormal sound on startup

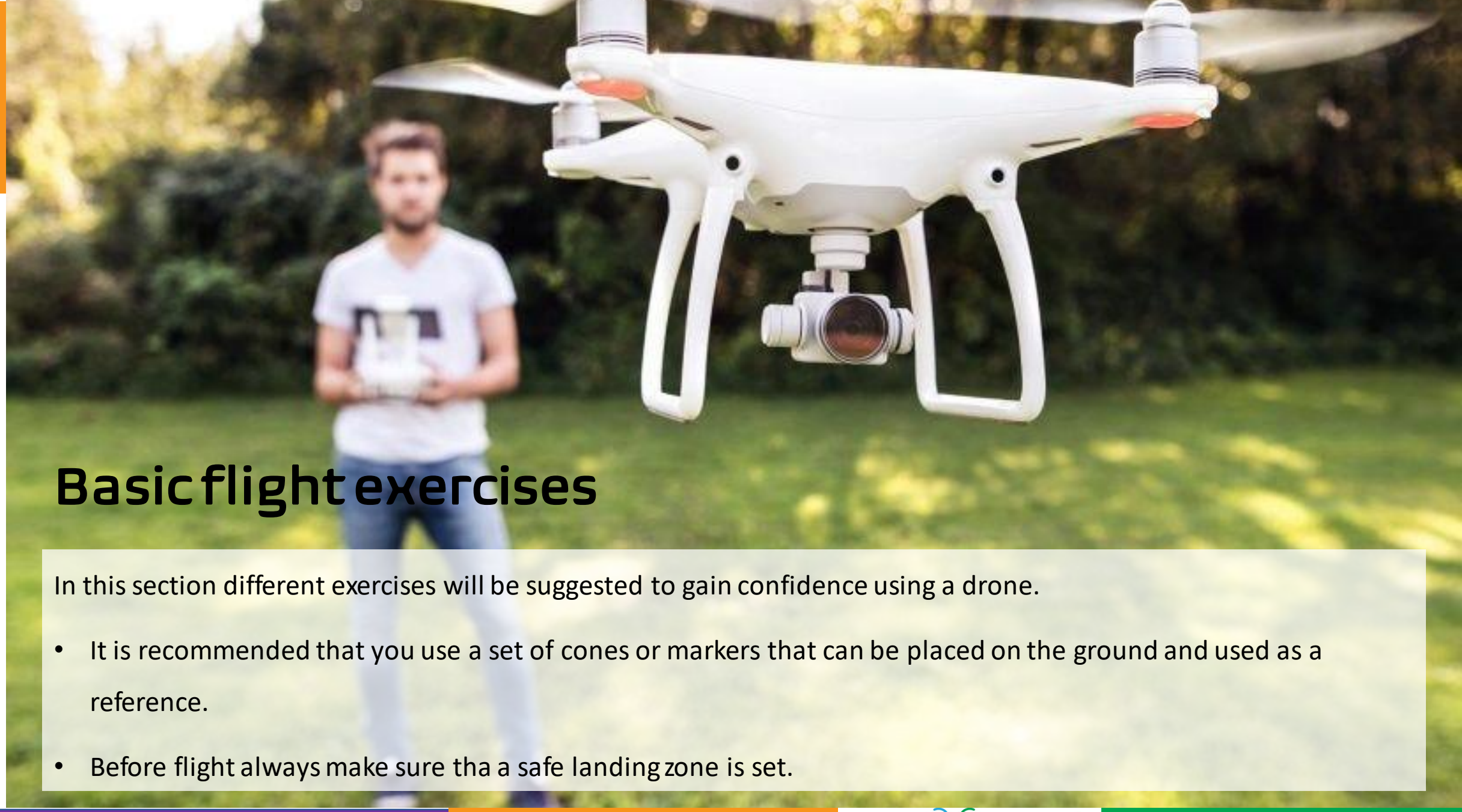


Pre-flight checks

- Make sure that all the controls on the drone controller are working
- These have to be tested before flight and before gaining altitude
- Check that the GPS and RF connection is good

Pre-flight checks

- Check that the camera and gimbal are secured and in good working order
- Camera fixed, lenses clean and clear
- Correct settings

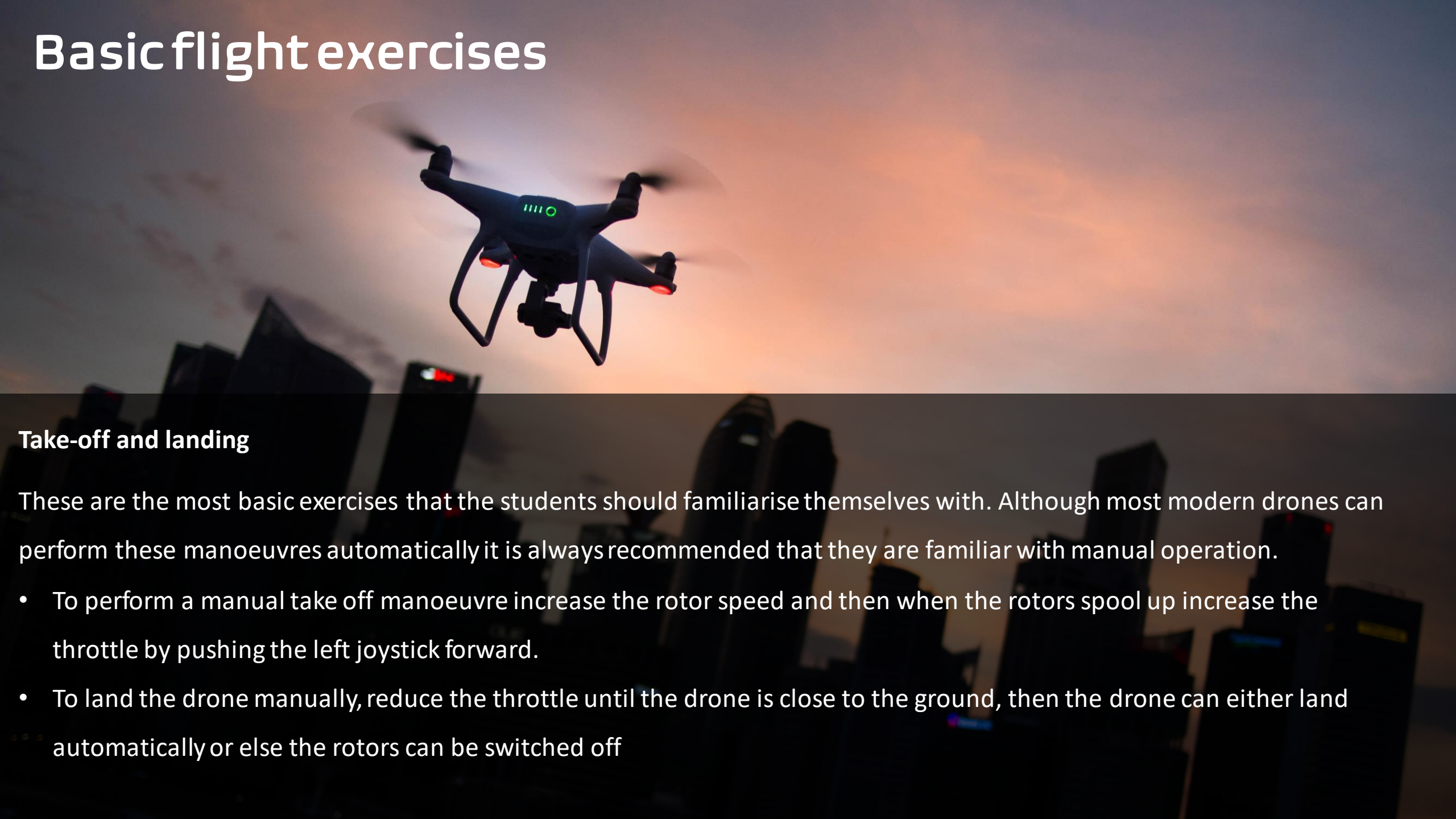


Basic flight exercises

In this section different exercises will be suggested to gain confidence using a drone.

- It is recommended that you use a set of cones or markers that can be placed on the ground and used as a reference.
- Before flight always make sure tha a safe landing zone is set.

Basic flight exercises



Take-off and landing

These are the most basic exercises that the students should familiarise themselves with. Although most modern drones can perform these manoeuvres automatically it is always recommended that they are familiar with manual operation.

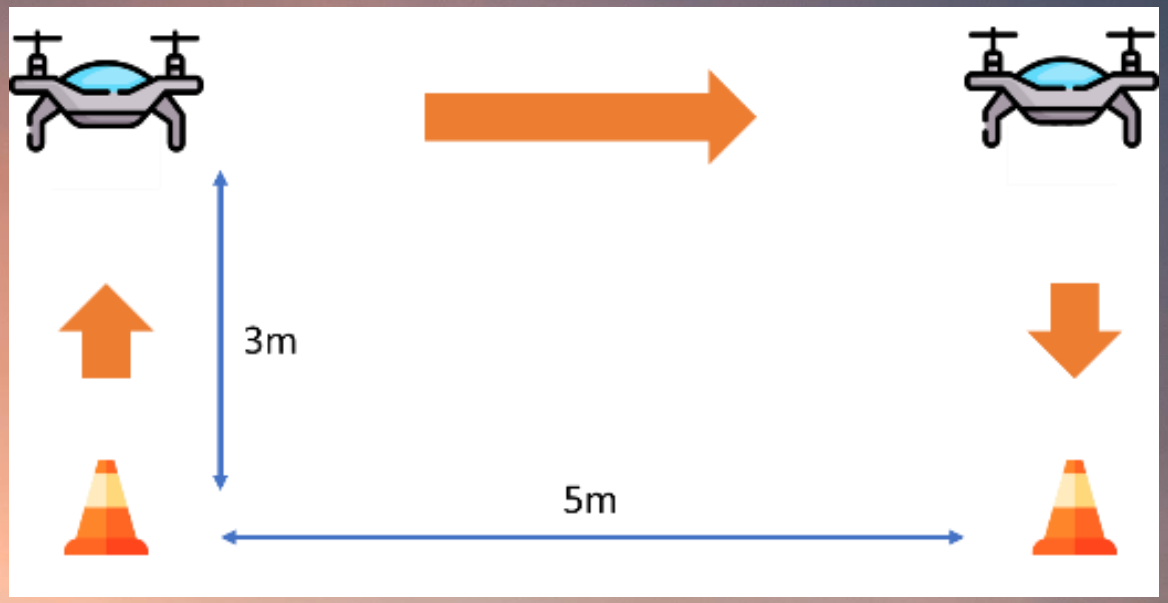
- To perform a manual take off manoeuvre increase the rotor speed and then when the rotors spool up increase the throttle by pushing the left joystick forward.
- To land the drone manually, reduce the throttle until the drone is close to the ground, then the drone can either land automatically or else the rotors can be switched off

Basic flight exercises

Hovering

- Place four markers approximately 3 metres apart in a square pattern
- Place the drone in the middle shown in the image below.
- After take-off try and keep the drone within this perimeter hovering at an altitude of 3 to five metres for about ten minutes. This task can be more challenging if there is a slight breeze.

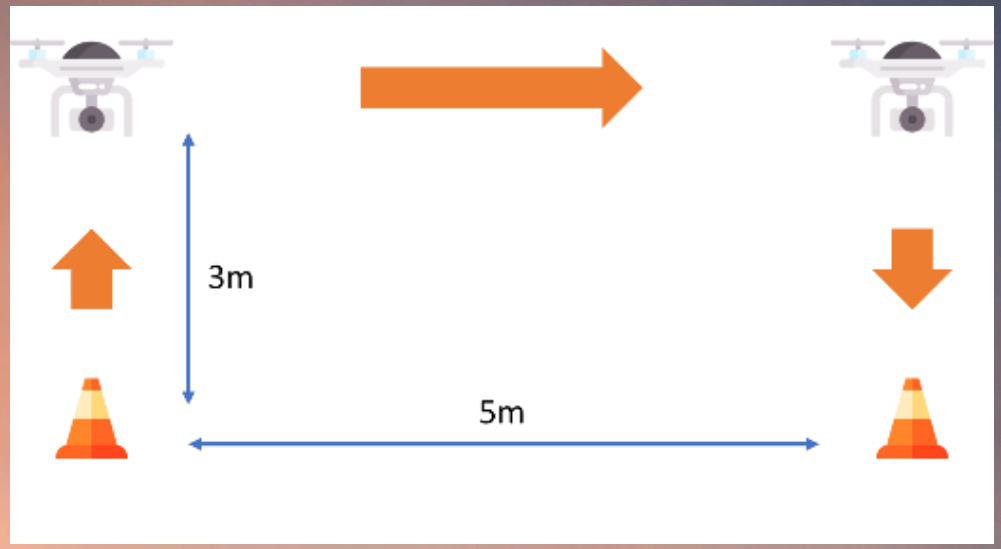
Basic flight exercises



Up, across, down

- Place two markers 5 metres apart and put the drone next to one of them.
- Perform the take off manoeuvre and go up to an altitude of approximately 3 metres.
- Move sideways 5 metres over the next cone and then land the drone.
- During the flight the tail of the drone should be facing you as shown in the image.

Basic flight exercises



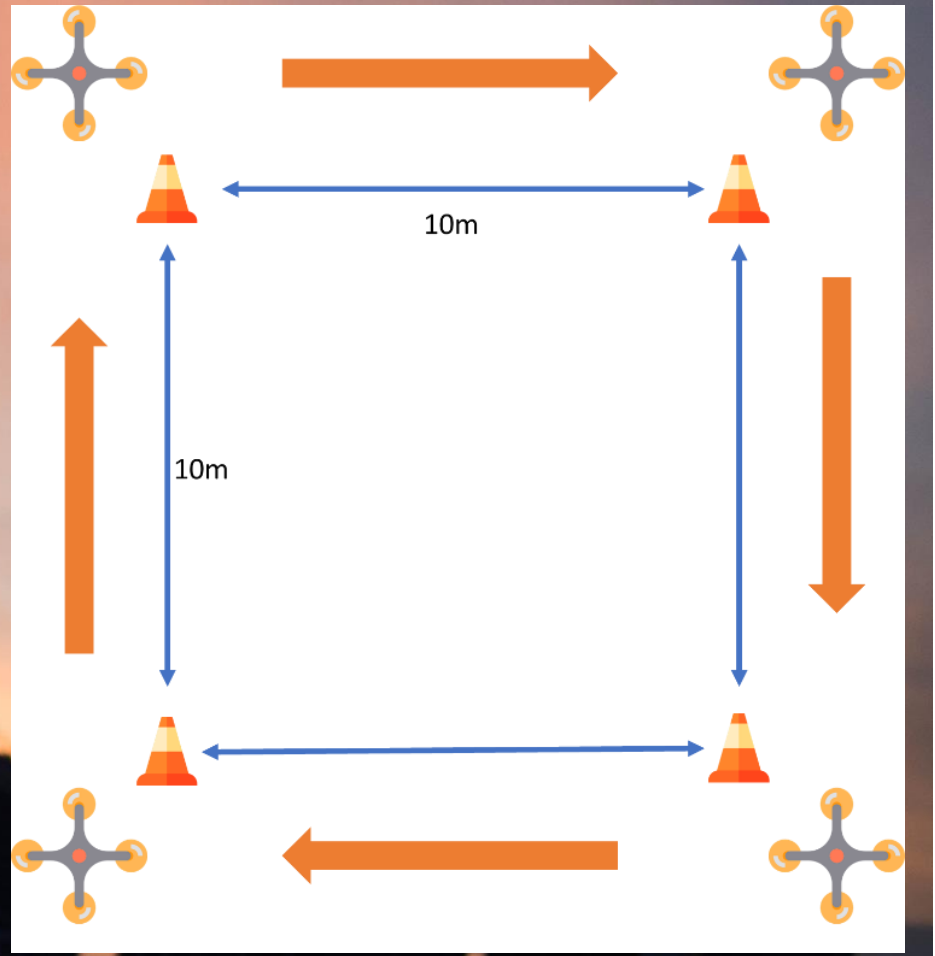
Up, across, down - Sideways

- Perform the previous exercise but this time the drone must be facing sideways.
- This is an off-axis movement as the perspective is different from the previous exercise.
- It is essential that you learn to master this technique as you will be using the controls in a different way.

Basic flight exercises

Flying in a square pattern

- Position four cones 10 metres apart in a square pattern and place the drone next to one of them tail facing towards you.
- Take off at an altitude of around 5 metres and move off to the next cone.
- While hovering, turn the drone 90 degrees to face the next cone and fly towards it.
- Continue this until the drone is over the starting cone.
- This exercise will train your ability to fly the drone in different perspectives.



Conclusions

- Types of drones
- Different components making up a drone
- Drone controller and functions
- Basic flight movements
- Pre-flight checks
- Basic flight exercises

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