AGREEMENT
BETWEEN THE CENTER FOR EMERGENCY SITUATIONS AND DISASTER RISK REDUCTION
AND THE UNITED NATIONS CHILDREN'S FUND (UNICEF)

PROJECT
"DEVELOPMENT OF UNMANNED AERIAL VEHICLES FOR THE PREVENTION AND MITIGATION OF EMERGENCY SITUATIONS, WITH A FOCUS ON VULNERABLE POPULATION GROUPS"

Instructional Guide for the Use of Unmanned Aerial Vehicles

Almaty, 2020

CONTENT

Abbreviations and Definitions

UAV – Unmanned Aerial Vehicle
DJI – Dajiang Innovation Technology, manufacturer of UAVs

CrystalSky – Touchscreen monitor for remote controller operation
Matrice 210 V2 – UAV model
RTK – Satellite receiver (Real-Time Kinematic)
Zenmuse XT2 – Thermal imaging camera
Zenmuse Z30 – Camera with 180× zoom

Software (SW) – Software applications

DJI Pilot – Software for manual and automated UAV flight operations
Pix4Dcapture – Software for automated flight missions
CTRL+DJI – Software for UAV configuration prior to flight
DJI GO 4 – Software for manual flight control
AirMap – Software for viewing restricted flight zones
UAV Forecast – Software for checking weather conditions before flight
Pix4Dmapper – Software for post-flight data processing

Orthophoto Map – Highly detailed map of an object or area

TB55 – UAV battery model
Cendence S – Remote controller

IR – Infrared sensors
AirSense – Sensor for detecting aircraft within a 30 km radius
TimeSync – Sensor/system for synchronizing the flight controller
Payload SDK – Expansion ports for additional payload integration
Onboard SDK – Expansion ports for onboard system integration

Introduction

Due to its geographical location, the Central Asian region is highly prone to a wide range of natural disasters. Significant geological, technological, and climatic hazards, combined with the impacts of global climate change, continuously affect the population—particularly vulnerable groups such as children, persons with disabilities, and the elderly—as well as the region's economy and environment.

The territory of the Republic of Kazakhstan is exposed to nearly all types of natural and man-made hazards, including earthquakes, floods, landslides, mudflows, debris flows, avalanches, droughts, extreme temperatures, epidemics, dam failures, and hazardous material releases.

In addition to immediate consequences, such as direct economic losses, emergencies also negatively affect the long-term development and security of society. Therefore, disaster risk reduction and sustainable development should be considered complementary and mutually reinforcing objectives.

Disaster risk reduction efforts must be comprehensive, taking into account potential future threats and hazards, the development of methods for forecasting and prevention, the creation of conditions for effective response, and their integration as an essential component of sustainable development planning.

According to the Law of the Republic of Kazakhstan No. 188-V dated April 11, 2014, "On Civil Protection," the primary objective of civil protection is the rescue and evacuation of people during emergency situations through the implementation of emergency rescue and urgent operations in both peacetime and wartime.

In the modern world, the use of new technologies and innovations is indispensable. They enable more effective implementation of tasks related to public safety. Experience in operating population protection systems against natural disasters and emergencies demonstrates that response effectiveness can be significantly enhanced through the adoption of advanced technologies, the use of aerial rescue assets, and the provision of high-performance technical equipment to response units. The transition to high technologies and corresponding equipment represents a critical component of the current stage of scientific and technological development.

The use of modern technologies in preventive measures, monitoring potentially hazardous areas, and search and rescue operations enables more effective management of emergency response activities, thereby minimizing socioeconomic impacts.

This training manual on unmanned aerial vehicle (UAV) operation uses the **Matrice 210 V2** as a reference model. It is a powerful aerial imaging platform designed for search and rescue operations, mapping, and aerial photography. The system features high maneuverability and speed, redundant components to ensure maximum reliability, and intelligent functions that simplify complex tasks.

Visual obstacle avoidance sensors provide enhanced hovering accuracy, even when operating indoors or in environments where GNSS signals are unavailable. Interchangeable gimbal-mounted cameras allow flexible adaptation to mission requirements. The dual-frequency transmission system ensures a stable and efficient HD video downlink.

The UAV is equipped with a built-in flight recorder that stores critical data from each flight. Its dual IMU and barometric systems ensure stable flight performance even under strong electromagnetic interference. The platform is capable of low-altitude and indoor flight, and also provides multi-directional obstacle detection and visual positioning capabilities.

The built-in **AirSense** system alerts the operator to nearby aircraft in the surrounding airspace, enhancing operational safety. Safety beacons located on the top and bottom of the aircraft allow for identification at night or in low-light conditions. The airframe provides an IP43 protection rating in accordance with the international IEC 60529 standard.

The **TimeSync** system continuously synchronizes the flight controller, camera, GPS module, DJI payloads (such as the X4S, X5S, or X7), and onboard accessories connected via the Payload SDK or Onboard SDK with microsecond-level accuracy, ensuring compliance with the stringent time-synchronization requirements of SDK developers.

1. Assembling the UAV and remote control

1. Open the case and remove the UAV
2. Install the landing gear on the UAV and secure it

3. Extend the UAV’s arms

Extend the frame arm, slide the arm lock toward the end of the frame arm, then rotate it approximately 90°, until the silver line is inside

4. Install the propellers
4.1 Propellers without silver rings are intended for motors without any markings.
4.2 Propellers with silver rings are intended for motors with the same color markings.

4.3 Press the propeller firmly against the mounting plate and rotate it in the locking direction until it clicks into place.

Before each flight, ensure that the propellers are securely fastened.

5. Mount the Camera on the Stabilizer

5.1 Align the white and red dots, then insert the stabilizer.

5.2 Turn the suspension lock into the locked position.

Note which cardan joints (camera mounts) are compatible with the cameras listed below

Gimbal Connector II	Zenmuse X4S/X5S/X7/XT/XT2
Gimbal Connector I	Zenmuse X4S/X5S/X7/XT2/Z30

Important

Be sure to press the suspension release button when turning the suspension lock to remove the suspension and camera. The gimbal lock must be fully rotated when removing the gimbal for the next installation.

6. Installing the Smart Flight Batteries
6.1 Insert the batteries into their designated slots until they click securely into place.

6.2 Press the button once to check the battery level.
6.3 Press and hold the button to turn the batteries on or off.

Important

- Use battery compartment “B” only when powering the drone with a single battery. In this case, the drone can be turned on, but it will not be able to take off.
- If, for any reason, only one battery is available during flight, land the drone immediately and replace both batteries as soon as possible. Note: With a single battery, the gimbal connectors and rear ports will not supply power to connected devices.
- Always use the included TB55 batteries. Do not use any other types of batteries.

6.4. Removing the Batteries

Be sure to press the battery release button when removing the battery.

7. Connecting the remote control

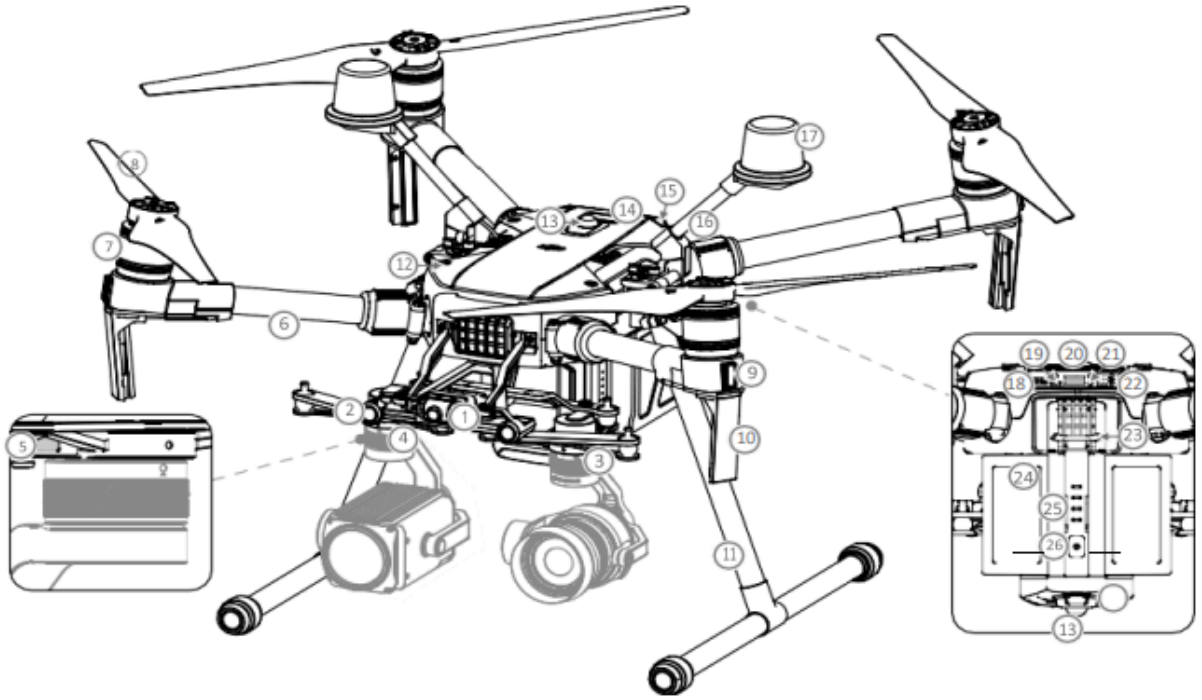
7.1 Insert the battery into the battery compartment, then slide it all the way in until you hear a click.

7.2 Press once, then press and hold until the remote control turns on or off.

Important

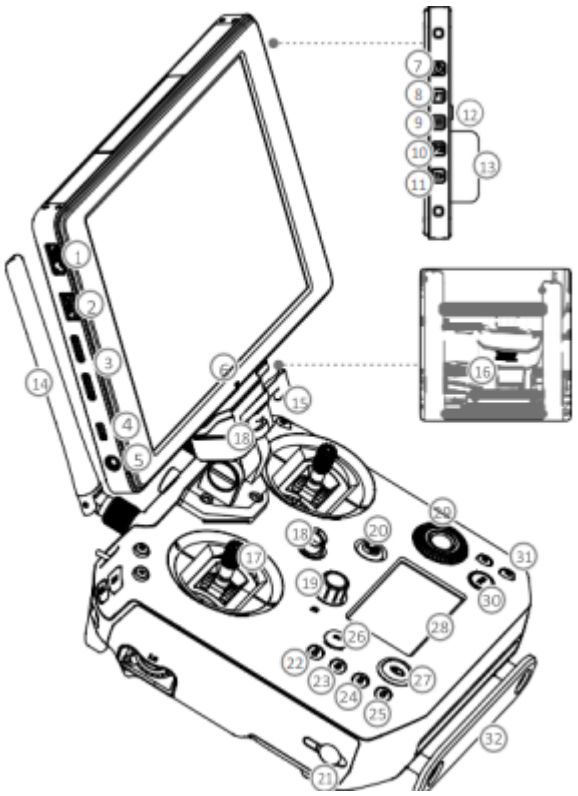
- Before removing the battery, press the battery release button.
- Press the battery level button once to checkthe battery level.

1.1 UAV Diagram

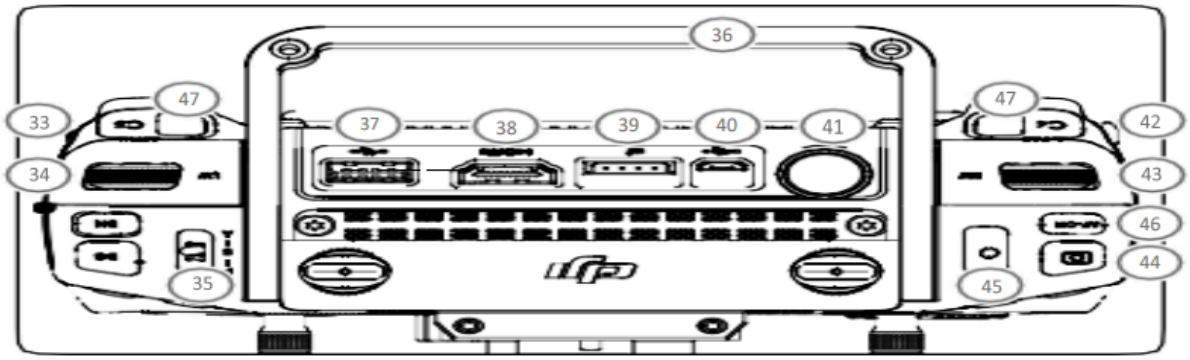


1. FPV camera
2. Forward-view system
3. DJI v2.0 gimbal mount connector (DGC2.0) I
4. DJI v2.0 gimbal mount connector (DGC2.0) II
5. Gimbal release button.
6. Arm frames
7. Motors
8. Propellers.
9. ESC LEDs.
10. Transmitter antennas
11. Landing gear
12. Gimbal mounting position (up)
13. Beacons *
14. Top infrared sensor
15. Aircraft status indicators.
16. D-RTK mounting bracket **
17. D-RTK antennas **
18. Extended power port (XT30)
19. USB mode switch.
20. USB port
21. Pairing button and indicator
22. Expansion ports
23. Battery release button.
24. Intelligent flight batteries
25. Battery level indicators.
26. Power button
27. Down-looking camera system.
28. microSD card slot.

1.2 Remote Control Diagram



1. HDMI port
Outputs an HDMI video signal.
2. USB port
3. microSD card slot. Provides additional storage space for the display device; the maximum card size is 128 GB.
4. Micro USB port.Use a Micro USB cable to connect to the remote controller when in use,or to a PC to configure settings using DJI Assistant 2.
5. Headphone jack.
6. Light sensor port
7. Power button
8. Custom button (F1)
9. Settings button
10. Custom button (F2)
11. Back button
12. Battery release button.
13. WB37 Smart Battery
14. Antennas
15. Monitor Mounting Bracket Used to mount the DJI CrystalSky monitor.
16. USB port (reserved port) and movement
17. Control sticks Control the orientation and movement of the aircraft.
18. Strap hook.
19. Focus adjustment knob Turn to set the focal ength.
20. Return-to-Home (RTH) button
Press and hold to start
the return-to-home process.
21. Power Port Connect to the charger to charge the remote control's battery.
22–25. Reserved Buttons
26. Pause Button Press once, and the drone will slow down and hover.
27. Power Button Used to turn the remote
control on and off.
28. Remote control display. Shows information about the aircraft and
the camera.
29. Camera settings dial.
When using the X4S, X5S, X7, or Z30, turn the dial to adjust the EV. When using the XT2 or XT, turn
the dial to select a color palette.
30. Customizable Button Settings Menu
Tap to configure the functions
of the customizable buttons in the DJI Pilot app.
31. Customizable Buttons (BA-BH)
Configured via the DJI Pilot app



32. Auxiliary unit
33. Left stick
Configurable via the
DJI Pilot app.
34. Left dial (gimbal pitch)
Controls the gimbal pitch.
35. Flight mode switch.
Switches between P mode,
S mode, and A mode.
36. Handle
37. USB port (for connecting
a mobile device)
Connects to a mobile
device for the DJI
Pilot app when using a third-party
mobile device.
38. HDMI A port (for
video output).
Outputs an HDMI signal to an
HDMI monitor.
39. CAN bus port (expansion
port)
Reserved port,
used to connect
external devices.
40. Micro USB port.
Connect to DJI Assistant 2 for
Matrice to update the firmware.
41. SDI port (for video output) *
Outputs the SDI video signal.
42. Right joystick
Configurable via the
DJI Pilot app.
43. Right dial
Used to control
the gimbal.
44. Autofocus button
Press to automatically
focus.
45. Record button
Press to start recording
video. Press again to
stop recording.
46. Shutter button.
Press to take a photo.
You can also take photos while
recording video.
47. Customizable buttons (C1-C4)
Configure via the
DJI Pilot app.

1.3 Flight Modes

The UAV has the following flight modes:

1. P-Mode (Positioning):
P-Mode works best with a strong GPS signal. The drone uses the GPS module, as well as the forward and downward vision systems, to determine its position, automatically stabilize itself, and navigate around obstacles.
When the forward-view system is enabled and lighting conditions are sufficient, the maximum flight angle is 25°. When forward obstacle detection is disabled, the maximum flight angle is 30°.
When the GPS signal is weak and lighting conditions are too dark for the forward and downward vision systems, the drone will use its barometer only for positioning and altitude control.
In positioning mode, the UAV accelerates to 51 km/h.

2. S-Mode (Sport):
The drone uses GPS to determine its location. Since the forward and downward vision systems are disabled, the drone will not be able to detect or avoid obstacles in Sport mode. The UAV will become much more responsive in terms of maneuverability and speed.
In Sport mode, the drone accelerates up to 81 km/h.
important

- The forward-view system is disabled in S (Sport) mode, which means the drone will not be able to automatically avoid obstacles in its flight path. Stay alert and keep the drone away from nearby obstacles.
- The drone's maximum speed and braking distance are significantly increased in S mode (Sport). The maximum braking distance is 50 meters in calm weather.
- The drone's sensitivity is significantly increased in S mode (Sport), which means that a small movement of the stick on the remote control will result in a large flight distance for the drone. Stay alert and maintain sufficient space for maneuvering during flight.

3. A-Mode (Ratio):
When neither GPS nor the vision system is available, the drone will use its barometer solely to determine its position and maintain altitude.
The drone will switch to A-Mode in the following two cases:

- Active: when you manually switch the flight mode to "A".
- Passive: when the GPS signal is weak or the compass is interfered with, and the vision system is unavailable.

In Mode A, the vision system and certain additional features are disabled. As a result, the drone cannot hover or brake automatically in this mode and is easily affected by surrounding conditions, which may cause it to drift horizontally. Use the remote control to position the drone manually.

Flying the aircraft in Mode A can be challenging. Do not fly the drone too far away, as you may lose control and create a potential hazard.

Avoid flying in areas with weak GPS signals or in confined spaces. If the drone is forced to switch to Mode A under these conditions, it could lead to dangerous flight situations. Land the drone as soon as possible in a safe location.

Use the flight mode switch on the remote control to select the UAV's flight modes.

1.4 Flight Status and UAV Status Indicators

The drone is equipped with front LEDs and rear LEDs located beneath the motors. The front LEDs indicate the orientation of the drone and glow red when the drone is powered on, pointing toward the front (or nose) of the drone. The front and rear LEDs can be turned off in the DJI Pilot app.

The drone is also equipped with “copter status” indicators that are located above the batteries.

The copter status indicators report the status of the flight controller system. Refer to the table below for more information about the drone status indicators. The front LEDs, rear LEDs, and drone status indicators can be turned off in the DJI Pilot app for a more unobtrusive drone experience.

Drone status indicators in optimal mode.

Indicator lights	**UAV Status**
Red, green, and yellow lights	Powering on and self-diagnostic testing of the drone
Flashing slowly in green	P-mode with GPS *
Two green flashes	P-mode with forward and downward view systems *
Flashing rapidly in green	Automatic braking after detecting an obstacle

Drone status indicators - warnings.

Indicator lights	**UAV Status**
Flashing rapidly in yellow	Loss of remote control signal
Slow red flashing	Low battery warning
Flashing rapidly in red	Warning: Critically low battery charge
The red light flashes for 5 seconds	IMU error
Solid red	The compass needs to be calibrated

2. DJI Pilot User Manual

DJI Pilot is an application for controlling flights in both manual and automatic modes. The program is compatible with DJI industrial drones and payloads, giving pilots the ability to manage flights more efficiently.

The app allows users to set and control flight parameters, as well as manage photo and video functions. It works with various payloads, such as the **Zenmuse XT2** thermal camera and the **Zenmuse Z30** zoom camera, accessories for the **Matrice 200** series, and third-party payloads based on the DJI SDK (via additional expansion ports).

DJI Pilot can be used alongside other DJI software. Using **DJI FlightHub**, video and flight data can be transmitted from the drone in real time. DJI Pilot also supports offline flight mode (Local Data Mode) without an internet connection, while still saving all data. The app displays DJI AirSense system alerts when detecting nearby airplanes or helicopters.

Before starting, attach the **CrystalSky monitor** to the remote controller.

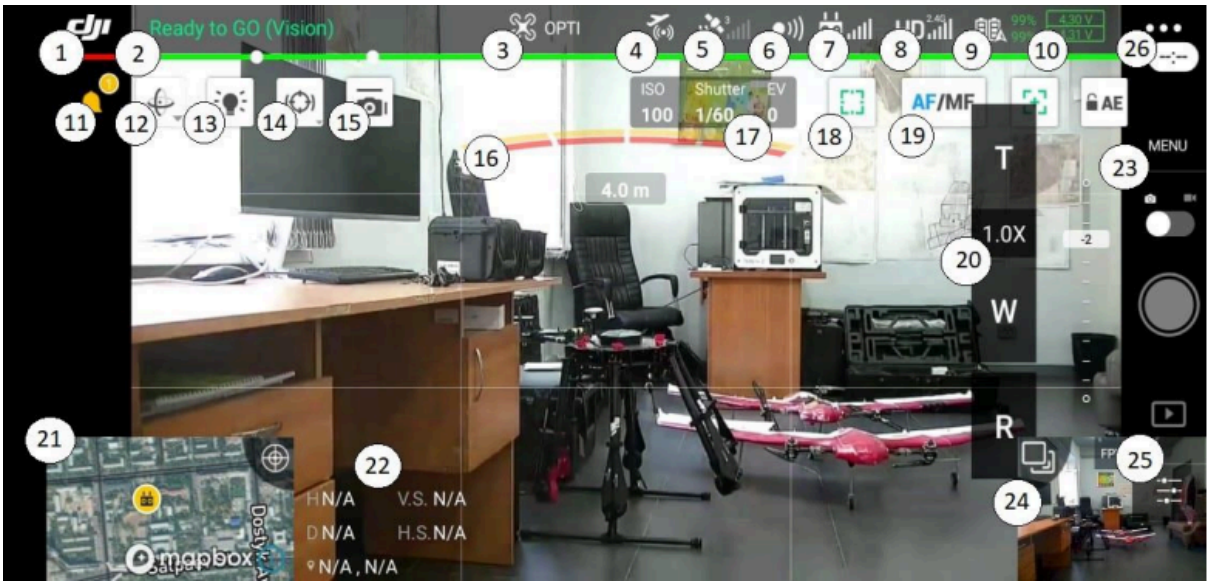
CrystalSky is a tablet with an ultra-bright screen, reaching a maximum brightness of 1000 cd/m², which is four times brighter than typical mobile device screens. Images become clearer and more detailed thanks to a special mode that activates in extremely bright lighting conditions. CrystalSky also features a state-of-the-art video decoder that minimizes video signal latency during transmission. While mobile devices may experience delays or image transmission issues due to technical limitations, CrystalSky effectively eliminates these problems.Connect the remote controller and the drone, then launch **DJI Pilot** via CrystalSky.

The app automatically identifies the drone model and payload in the lower-left corner of the screen.

The app allows operation in both manual and automatic modes:

- Manual flight – flying in manual (free) mode.
- Mission flight – flying in automatic mode.

Tap Manual flight to open the software interface.



Legend:

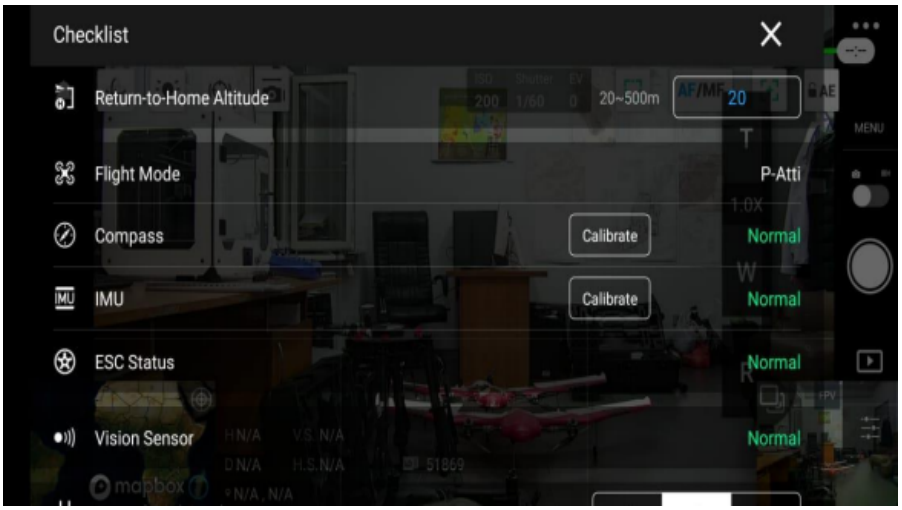
1 – Return to the home screen

2 – Ready to GO

The **“Ready to GO”** indicator displays one of three signals: red, yellow, or green:

- **Green** – GPS connection is strong, and it is safe to fly.
- **Yellow** – You can fly, but there is a risk of losing control of the drone.
- **Red** – The drone cannot fly.

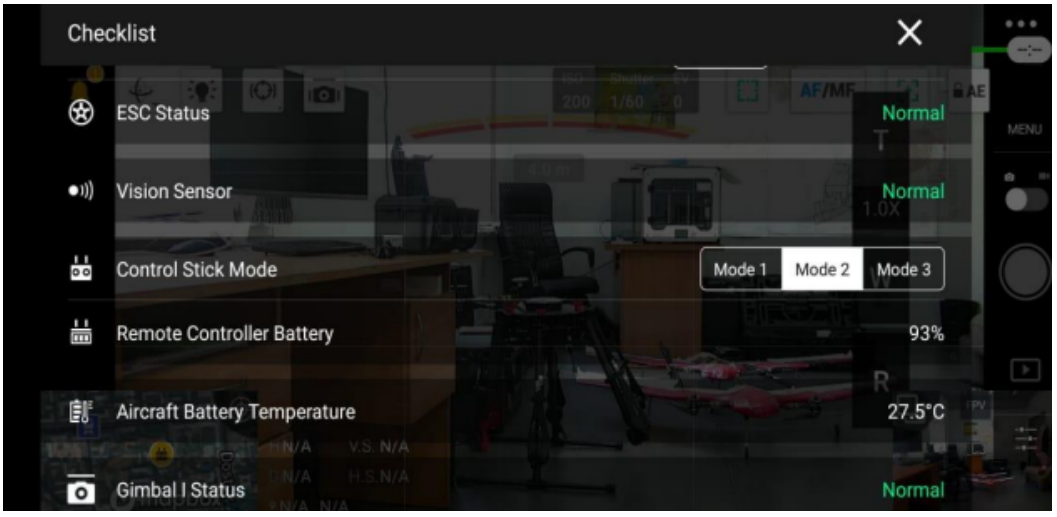
  Tapping **“Ready to GO”** opens the pre-flight settings, which should be carefully reviewed before takeoff.



Return to Home Altitude – the altitude at which the drone will return to its takeoff point and land

Flight Mode – flight mode

Compass – the compass helps your drone navigate its surroundings. When you take off from a new location, you need to calibrate the compass. Please note that electromagnetic fields can affect the compass.
IMU (Inertial Measurement Unit) – this consists of an accelerometer and a gyroscope, which allow you to see the drone's altitude and flight angle. If a message appears in the app stating that the IMU needs to be calibrated, be sure to do so by following the on-screen instructions.
ESC (Electronic Speed Control) Status controls your motors. If there is a problem with the motors, you will receive a notification on the screen indicating that they need to be adjusted. If the notification does not disappear after adjustment, you must take the drone to a service center for diagnostics.
Vision Sensors is a mode for configuring sensors that detect obstacles during flight. I recommend keeping this mode turned on at all times.



Control stick mode – UAV control mode.
Remote controller battery – battery charge indicator for the remote controller.
Aircraft battery temperature – temperature of the batteries installed on the unmanned aerial vehicle.
Gimbal status – status of the three-axis stabilizer.
Obstacle Detection Status – is a visual warning that pops up on the screen when an obstacle is detected nearby.
3. Flight Mode
Here you can select the mode required to complete your task.
P-mode: In positioning mode, all of the drone's sensors are activated. This is the safest flight mode. Even if you release the control sticks, the drone will automatically stop.
A-mode: If the drone loses the GPS signal or the signal is weak, or if it is too dark for the vision system, this mode will automatically activate. The drone will not maintain altitude but will move slowly.
S-mode: In sport mode, your drone can fly at maximum speed using the GPS signal for positionin

4. DJI AirSense

Thanks to its built-in ADS-B receiver, **DJI AirSense** enhances airspace safety by automatically providing the pilot with real-time information about nearby airplanes and helicopters.

5. GPS Signal Strength

Shows how many GPS satellites are currently connected. A **white indicator** means the GPS signal is strong.

6. 3D Sensing System Status

Here you can enable or disable the 3D sensing system functions.

7. UAV-Controller Connection

Displays the signal strength between the remote controller and the drone.

8. Flight Frequency

Shows the frequency at which the flight is taking place. The default frequency is **2.4 GHz**.

9–10. Battery Level

Displays detailed information about the battery charge. You can set a low-battery warning threshold.

11. Pop-up Notifications

12. Camera Return and Gimbal Control

Camera Centering – sets the camera horizontally in the center or pointing straight down.

Adjust Gimbal Roll – allows adjustment of the gimbal's roll angle if misaligned, even during flight.

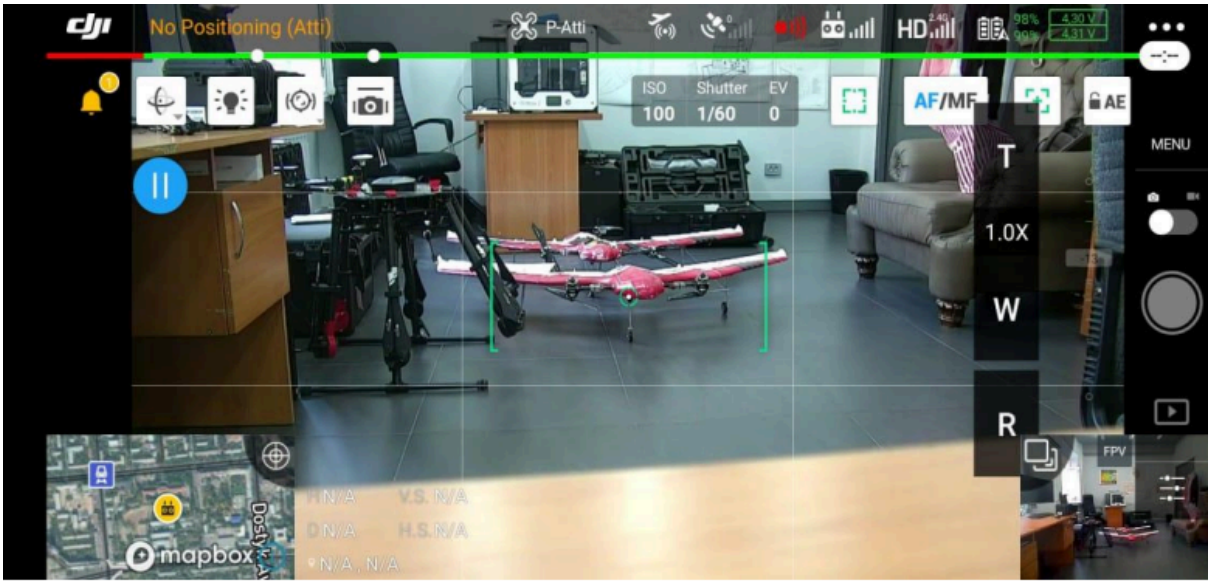
Gimbal Auto Calibration – the drone can automatically calibrate the gimbal, but only on a flat surface.

13. Collision Avoidance Beacon

Equipped with new top and bottom collision-avoidance beacons, **V2 drones** are visible at night or in low-light conditions, making operations in less-than-ideal environments safer.

14. Camera Tracking of a Selected Object

Thanks to the intelligent camera control mode, you can select an object at any time, and the camera will automatically begin tracking it.



15. Gimbal Mode Settings

- Follow – the camera remains stable and keeps the horizon level.
- FPV – the camera follows the drone's movements. If the drone changes direction, the camera moves in the same direction.
- Centring Camera – sets the camera horizontally in the center or pointing straight down.

16. 3D Sensing System Status

Displays obstacles in front of the UAV and the distance to them.

17. Advanced camera settings, quick access to ISO, Shutter, and EV settings.

Exposure triangle:

- aperture,
- shutter speed,
- ISO sensitivity.

18. Cmera Exposure

19. Autofocus AF Lock/Unlock
Function to enable/disable autofocus

20. Camera zoom settings.
- T – zoom in
- 1.0x – zoom magnification
- W – zoom out
- R – return to default

21. Map view.
By clicking on the map, you can see the location of the remote control unit and the direction of the unmanned aerial vehicle. This map also shows the UAV's flight path.

22. Key flight parameters
- H – altitude from the takeoff point;
- D – distance from the takeoff point (along the shortest path);
- V.s – acceleration (speed) during climb;
- H.s – acceleration (speed) during flight.

23. Camera Settings
Tap to open the camera settings menu

- Auto Mode: automatic camera settings.

- Aperture (A): here you can adjust the amount of light entering the camera. This is measured in f-stops. The lower the f-stop, the wider the aperture, and, consequently, the more light enters. The higher the f-number, the less light enters the camera. In A mode, you can adjust the aperture. But all other settings will be set automatically.

- Shutter (S): The shutter controls the amount of time light is allowed to hit the lens. The slower the shutter speed, the more light enters the camera. This allows you to take good photos in low light. A fast shutter speed allows you to take sharp photos of moving objects and people. In S mode, you can set the shutter speed, but the other settings will be set automatically.

- Manual mode (M): You can adjust the aperture and shutter speed in manual mode.

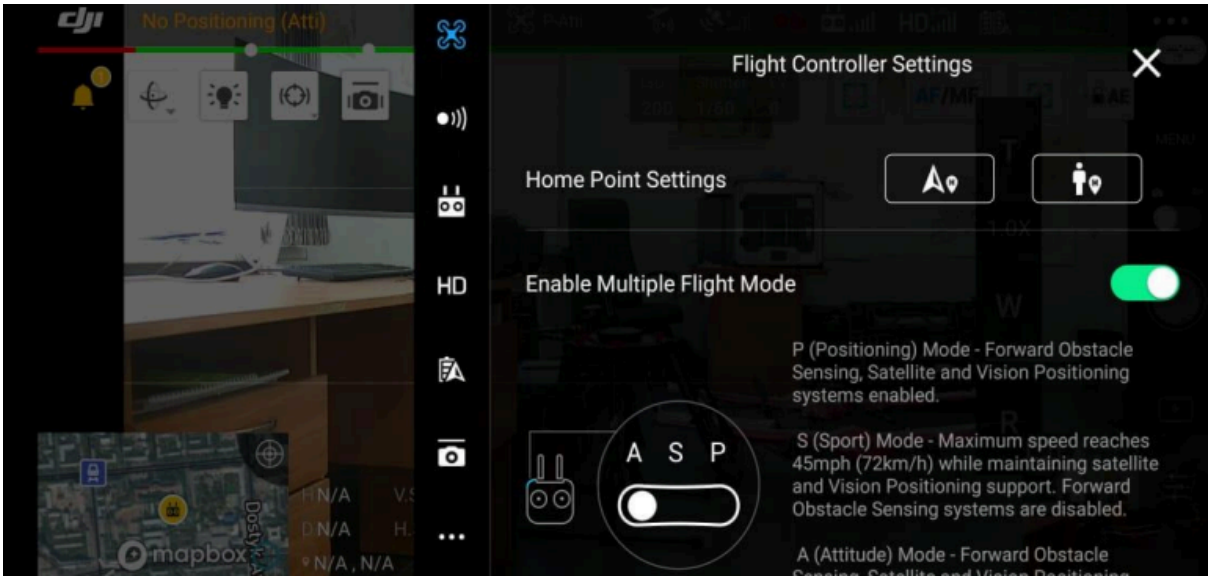
- Exposure Compensation (EV) Value: This indicates how far you have deviated from the recommended settings when configuring modes manually. For example, if the EV value should be 0 but is instead +2, this means you will get overly bright white tones. If this value is -2, your tones will be too dark. There are situations where you need higher or lower EV values. For example, if you need to take a photo in the dark at a slow shutter speed, then you need to set a higher EV value.

24. Front Camera
By tapping FPV, you can view the scene in front of the UAV at any time.

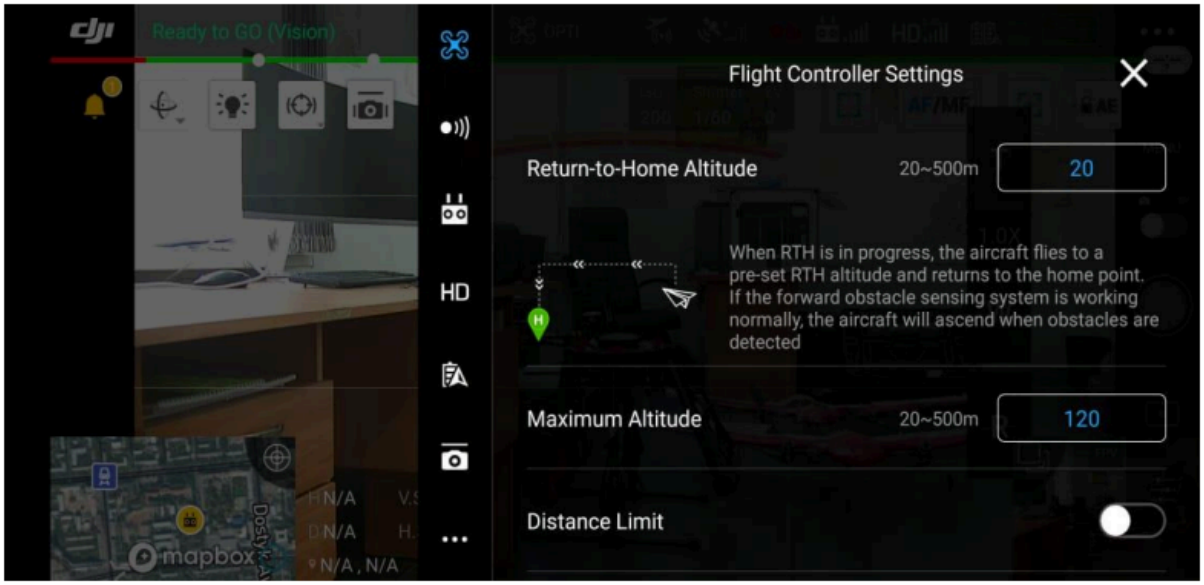
25. Exposure Settings
Tap this option, then tap the desired subject, and the camera will automatically adjust the ISO, shutter speed, and EV.

26. General Settings

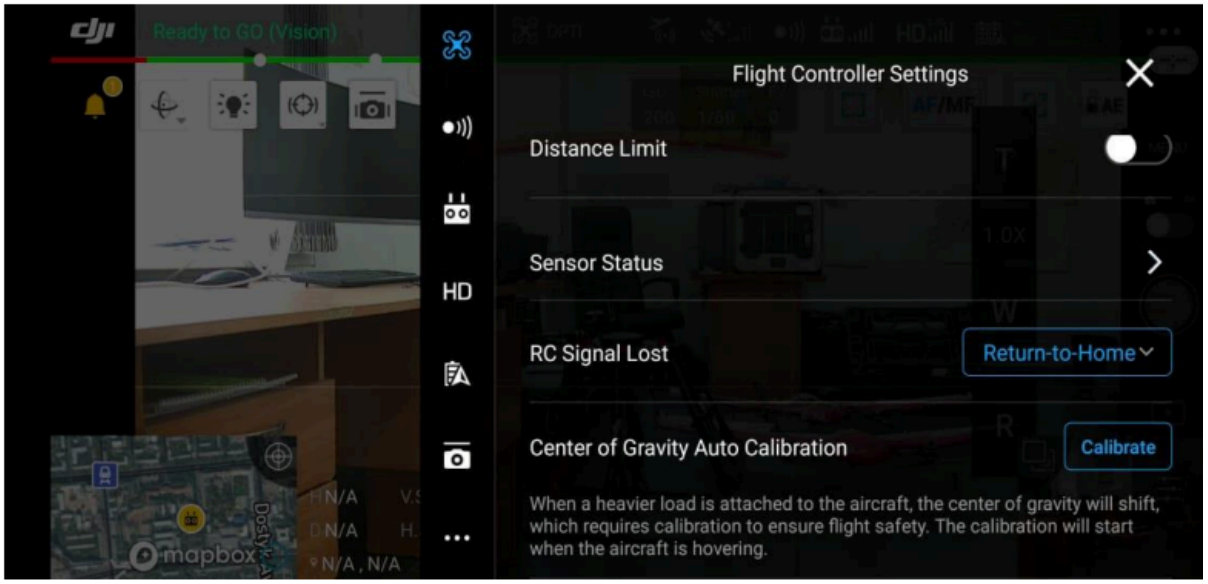
2.1 Flight controller settings



Home Point Settings – here you can
set the drone's return-to-home point. This can be either the location from which the drone took off or the location from which the pilot launched the drone



Return to Home Altitude – this setting determines the altitude at which the drone will return home.
Maximum Altitude – the maximum flight altitude.
Distance Limit – the maximum flight range.



Sensor status – here we can view the status of the IMU and compass, as well as calibrate them if necessary.
RS signal lost – what the drone will do if it loses the signal from the remote control. The app offers several options:

- Return to home – return to the takeoff point

- Hover – the drone will hover in place where the signal is lost;
- Land – the drone will land at the location where the signal is lost.

Advanced Controller Settings – advanced control mode This feature allows you to adjust the sensitivity of the control sticks. The higher the sensitivity, the faster the drone responds to changes in the position of the sticks.

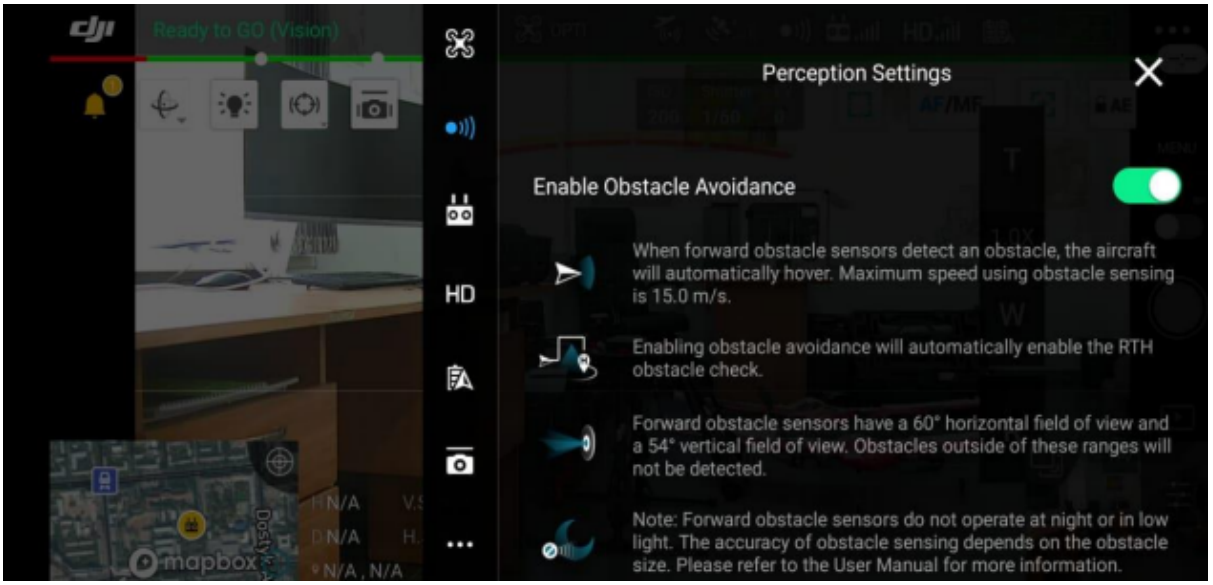
Exponential Curve (EXP) – The exponential curve (EXP) reflects the interaction between the control sticks and the drone. The X-axis shows the level of stick pressure, and the Y-axis shows the drone's response to that pressure, based on the configured EXP curve.

- Drone Response (Attitude): Here you can adjust how quickly the drone will respond to your actions.
- Brake: This controls the braking system. You can adjust how quickly the drone will brake when connected to GPS. The higher the value, the more abrupt the braking will be.
- Gain: These settings determine how quickly the drone can respond to external weather changes, such as wind. It is recommended not to change these settings unless you are a professional pilot. These settings affect the drone's behavior in the air. If you configure them incorrectly, the drone will behave unpredictably during flight.

2.2 Obstacle Detection System (Visual Navigation Settings)

Here you can manage the sensors. It is recommended that
all sensors be kept enabled at all times.

Enabling the "Obstacle Detection" feature: Enable Obstacle

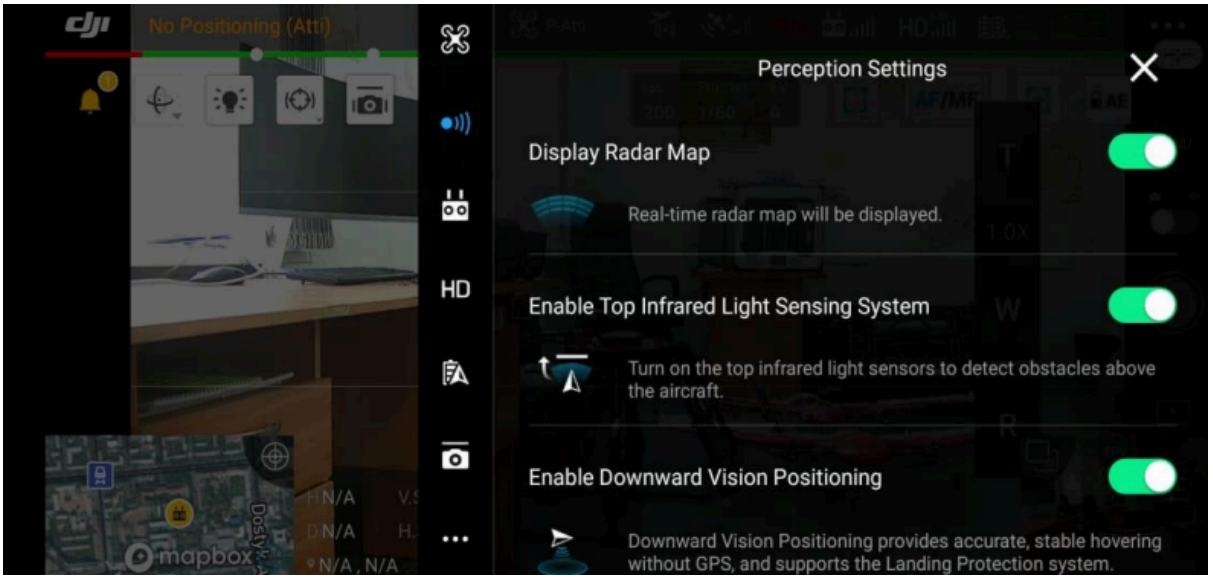


Avoidance: With this setting, your drone will detect obstacles in front of it.

Upon detecting an obstacle, the drone will automatically reduce its speed to 10 m/s and begin to slow down. This feature may not work well in very bright lighting, and thin wires may be difficult to detect.

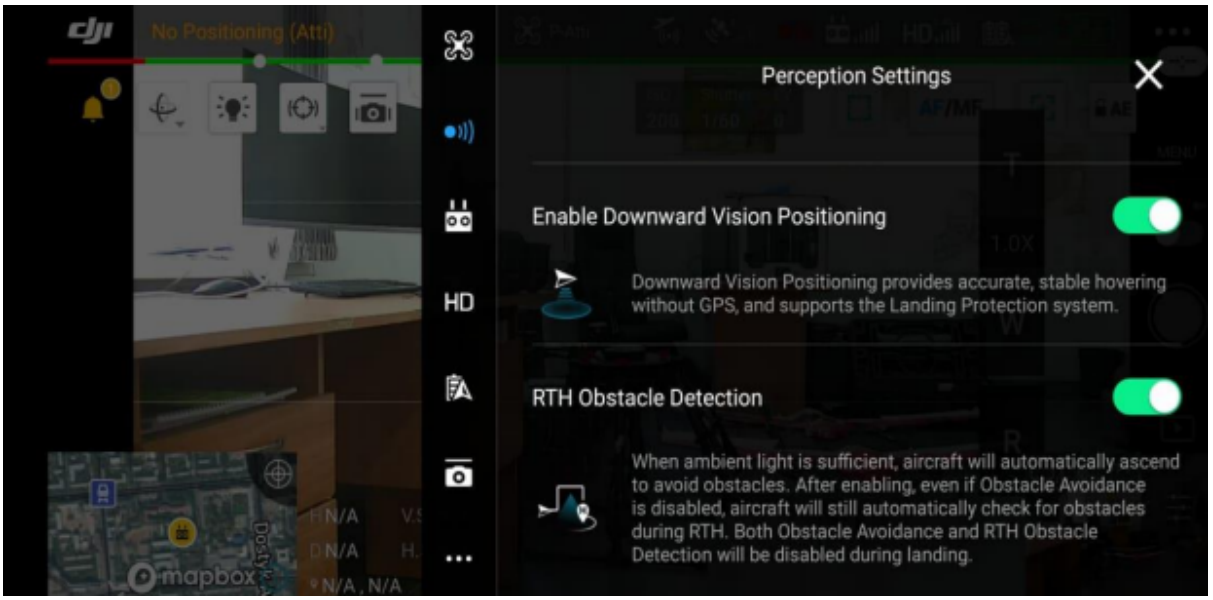
Advanced Sensor Settings Display
Radar Chart – When this feature is enabled, a small chart appears in the bottom-left corner of the flight screen, showing the drone's position during flight.

Enable Vision Positioning – This feature activates the bottom sensors, allowing the drone to maintain a fixed position while hovering. If this feature is disabled, the drone may hover and move slowly if the GPS signal is weak. Landing Protection – This feature allows the drone to scan the area for a suitable landing spot.

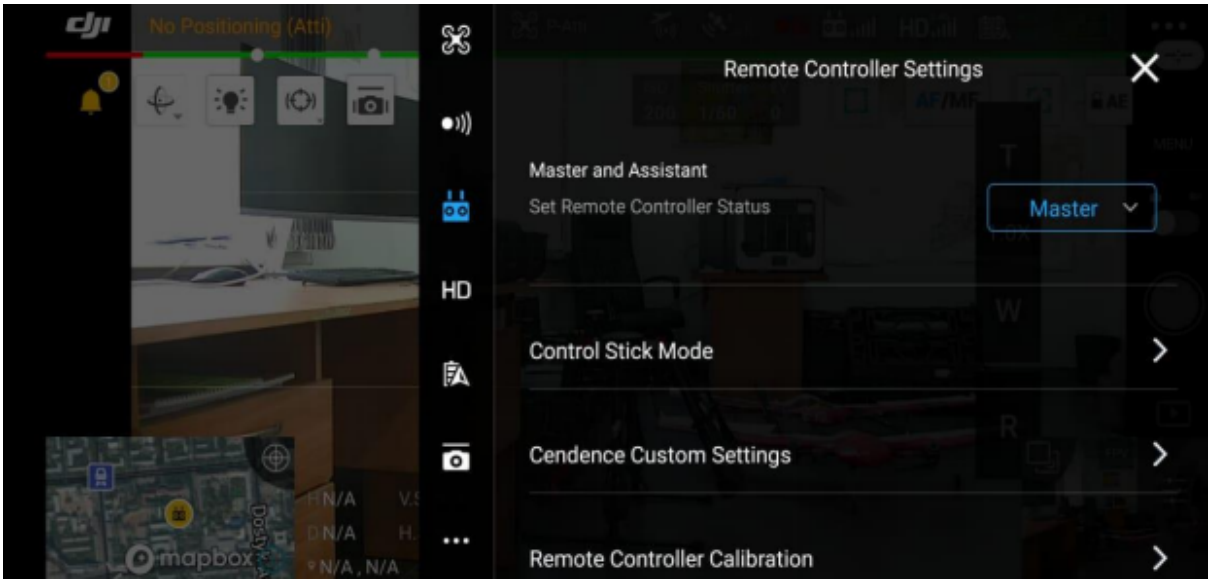


Precision Landing
This feature allows the drone to land in the exact same spot from which it took off, provided that the RTH (Return to Home) function is enabled.

Obstacle Check during RTH (Return to Home): The drone will automatically begin its descent if it detects any obstacles during the “Return to Home” process. As for the DJI Spark model, if the return-to-home range is 100 m, the drone will not be able to avoid the obstacle, as the flight speed will be too high.



2.3 Remote Controller Settings



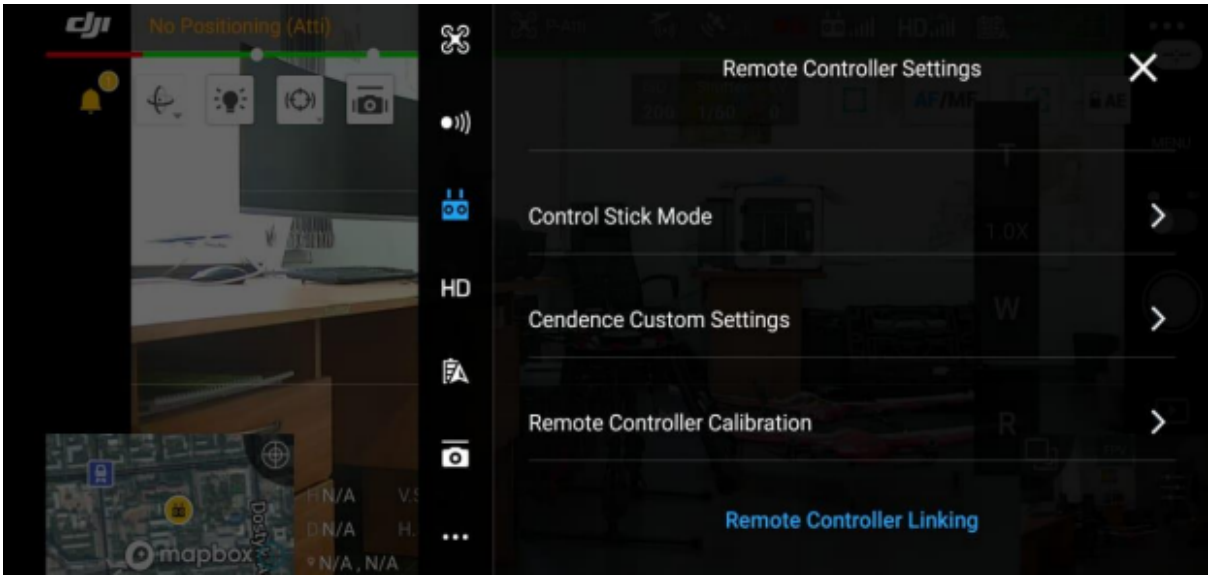
Here you can configure the remote control.

- Select the main remote control or connect a secondary one, which will allow us to control only the payload(camera)
- Remote Controller Calibration - here you can configure the joystick and switch controls. You can only make adjustments when the drone is turned off. To configure, follow the on-screen instructions.

- Stick Modes - Here you can configure the stick control modes: Mode 2 - a built-in mode that controls both the physical controller and the virtual joysticks.

With Cendence custom settings, you can configure the following functions on the remote control:

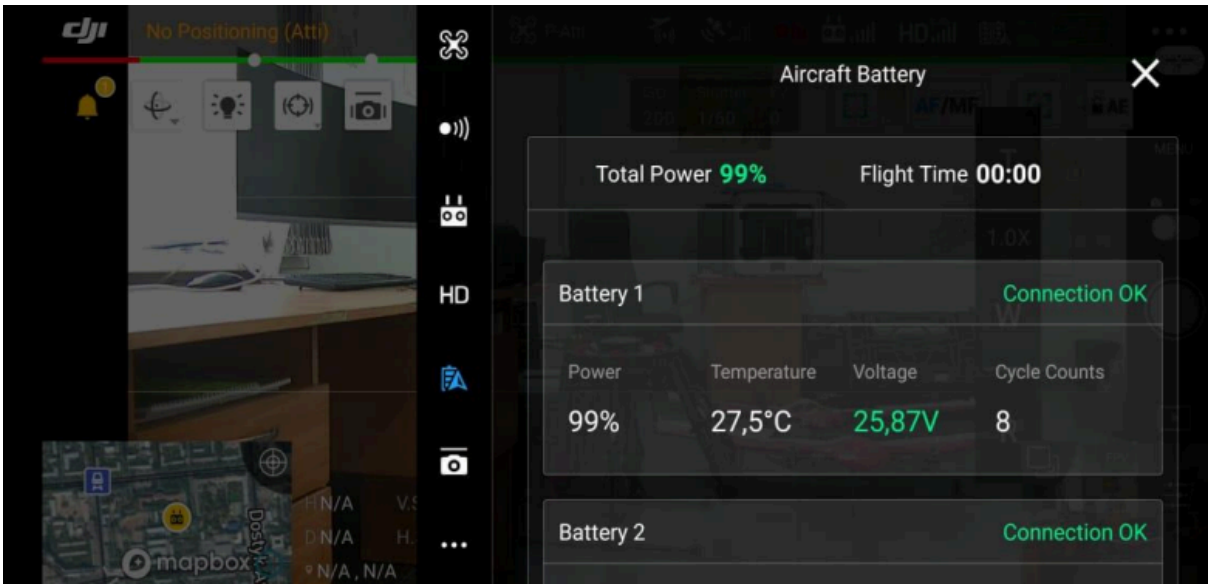
- Zoom in and out
- Autofocus AF Lock/Unlock: a function to enable/disable autofocus
- Advanced camera settings: quick access to ISO, Shutter, and EV settings.
- Camera angle adjustment: You can switch the camera position from forward to a 90° angle.
- Map display button: When you press this button, a map expands to fill the entire screen.
- Clear flight route function: You can delete the route the drone has already flown from the flight map.
- Battery info: Shows the voltage and charge level remaining in the battery.
- Playback: You can view photos and videos that have already been captured.
- Centre Auto Focus: You can set the focus to the center of the frame.
- Right Dial ISO/Shutter
- Control: Here you can configure the function of the right dial
- (ISO setting or shutter control)



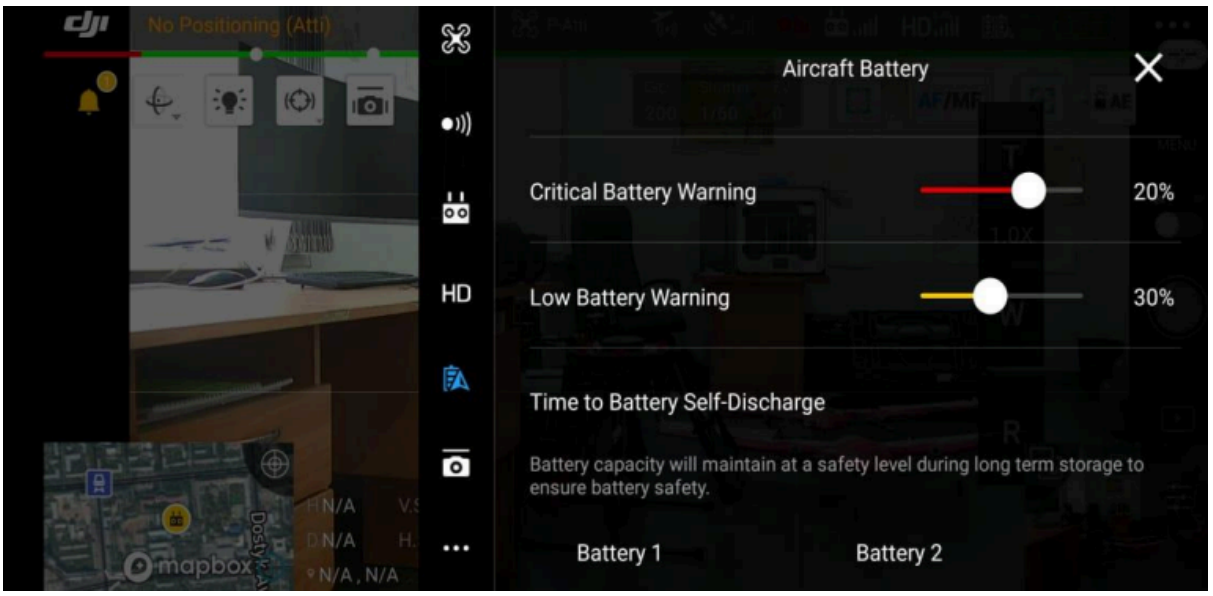
Connecting the Linking Remote Controller: This button connects the remote controller to the quadcopter.

2.4 Battery Level

Displays the status of your battery. You can customize this feature.



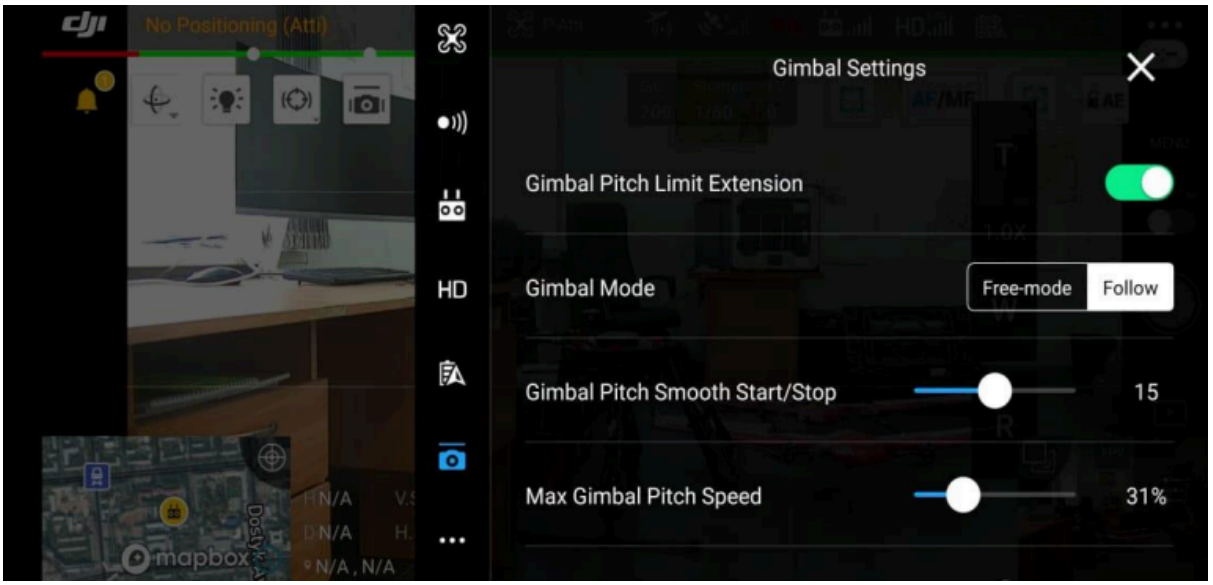
Warning about critically low battery charge (in percent).
The app will send you notifications as soon as the battery charge level falls below the set threshold



2.5 Camera Mount Settings: Gimbal Mode

The camera can operate in two modes:

- Follow mode: In this mode, the camera will remain stable and keep the horizon level.
- Free mode: In this mode, the camera will follow the drone's movements.Thus, if you change the drone's direction of travel, the camera will also move in that direction.



Gimbal Pitch Speed

Here you can adjust the camera's rotation speed. The higher the setting, the faster the camera rotates; the lower the setting, the slower the rotation.

Enable Upwards Gimbal Tilt Limit to 30 Degrees

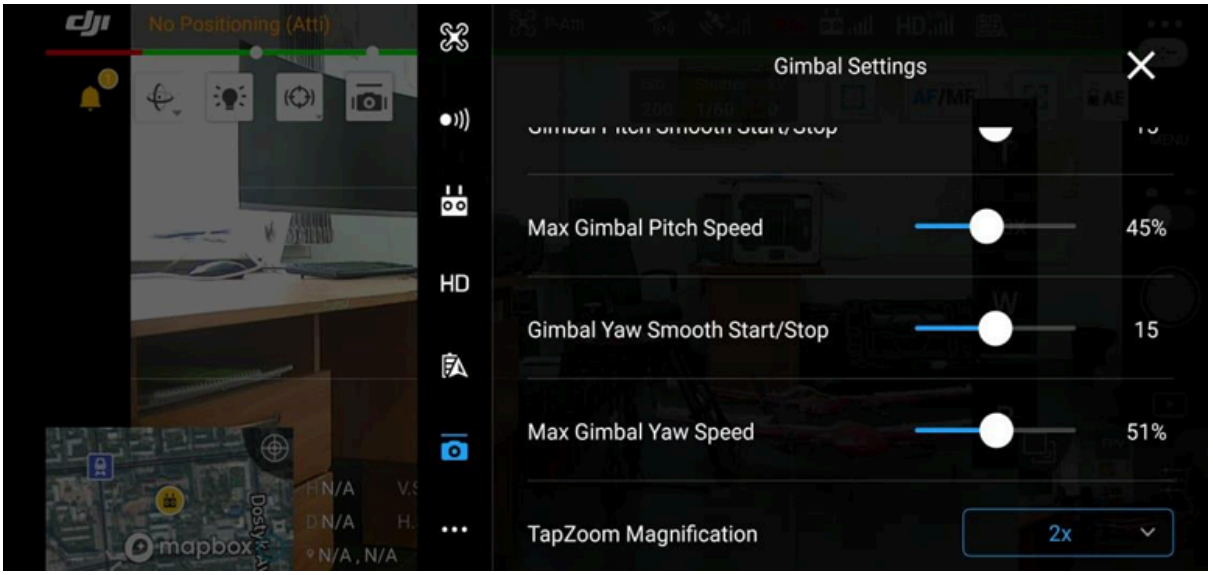
If this feature is disabled, the camera can tilt upward more than 30 degrees, but the propellers may be visible in the frame.

Gimbal Pitch Smoothness

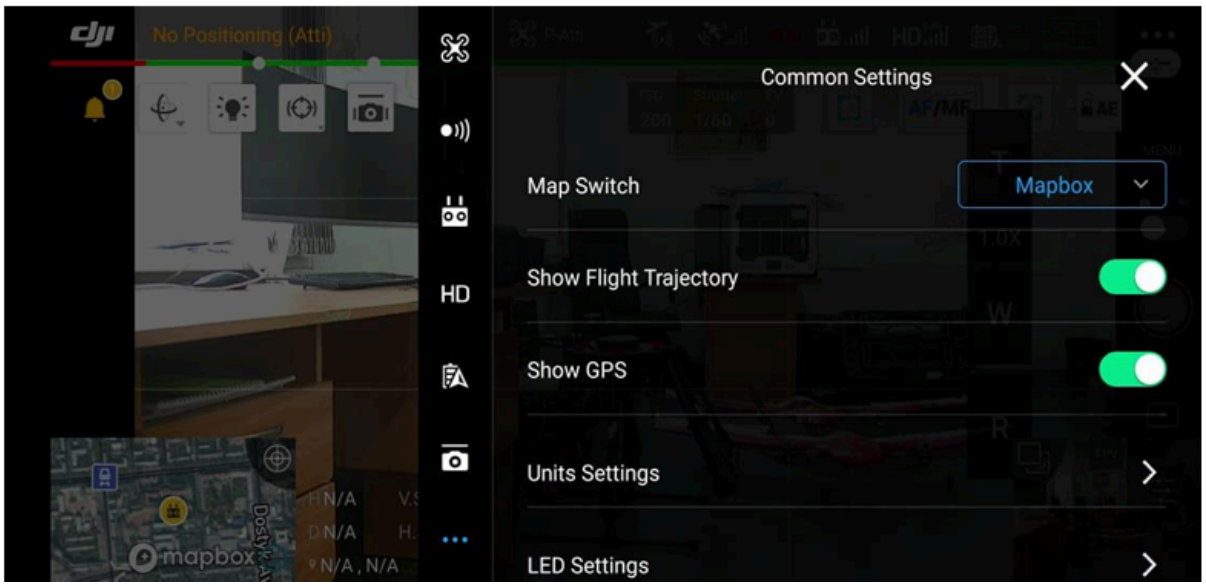
This feature allows you to control how quickly the gimbal stops moving. The lower the level, the faster it stops; the higher the level, the slower the stop.

Synchronizing the camera gimbal's movement with joystick controls.

Enable Synchronized Gimbal Pan Follow: This feature allows you to synchronize the camera's movement with the joystick's movement, making video recording smoother.



2.6 Common settings



In the map settings, you can toggle the switch on and off for the following features:
Also Save the Flight Path (Show Flight Trajectory): This option allows you to display and save the drone’s flight trajectory.

Measurement Units: Here, you can change the parameters displayed in the DJI GO 4 app, such as speed in km/h, m/s, or mph.

Long press on the screen: You can configure this feature for the following settings:

- **Gimbal Control:** Tap and hold the screen, then move your finger up or down to adjust the gimbal's position.

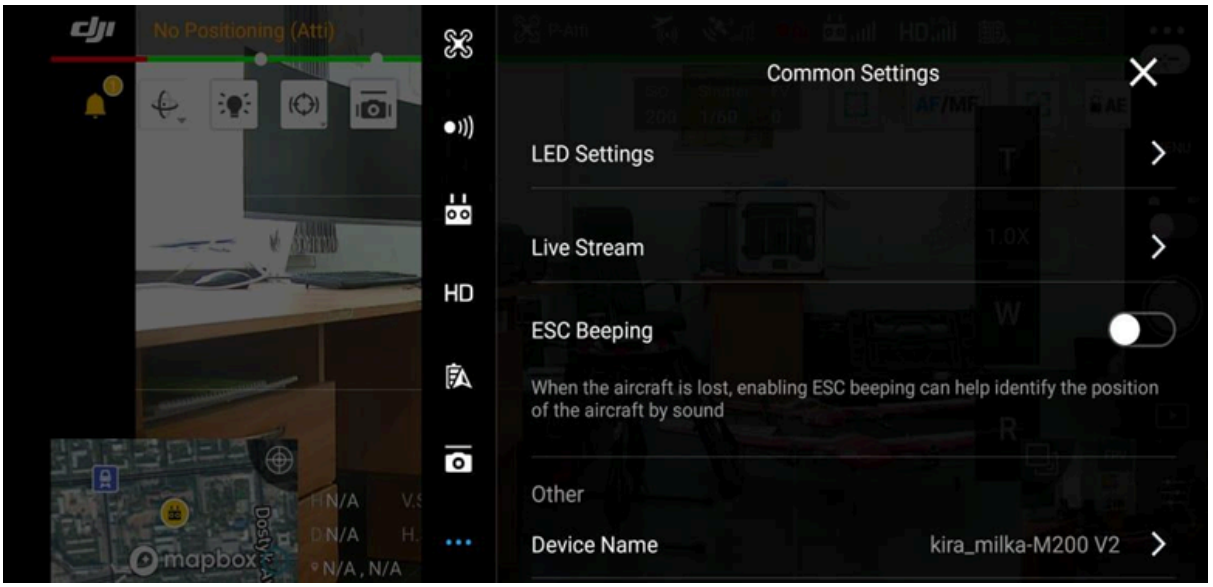
- **Focus:** When you press and hold the screen, a green square appears. Here, you can adjust the focus of the composition.

- **Live Streaming:** With this feature, you can stream live to Facebook and other social media platforms. To enable it, log in to your social media account and follow the on-screen instructions.

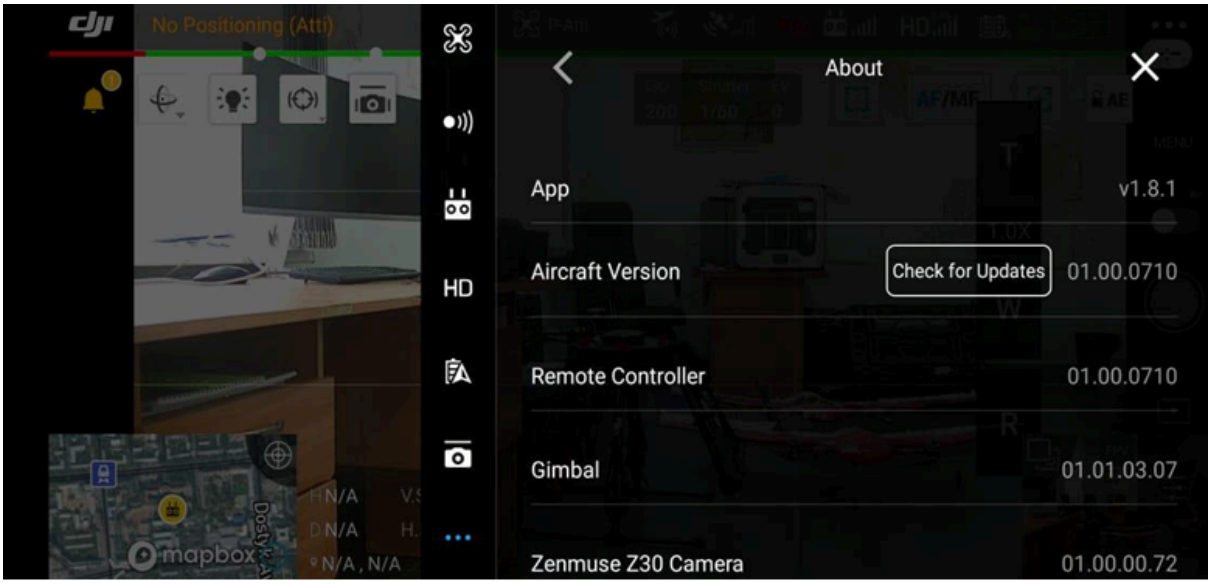
LED Settings: Here, you can activate the LED beacon or enable the status lights.

Using Live Stream, you can broadcast video through social media platforms such as Facebook and YouTube.

When ESC Beeping is activated, all status lights turn red, and the drone begins to emit audible signals. It is recommended to use this feature if the UAV is lost.



Next, in the About section, you can check for firmware updates.



2.7 Photo Settings

Here, you can configure the photo shooting mode.

- Single Shot: The standard mode. With one press of the button, you capture one photo.
- HDR Shot (High Dynamic Range): In this mode, the camera takes three photos at once. One will be underexposed, the second overexposed, and the third with normal exposure. After merging them, you get a dynamic image in JPEG format.
- Multiple Shot: When you press the button in this mode, the camera takes multiple photos. This mode can be useful when capturing a moving object.
- AEB (Automatic Exposure Bracketing): Here, you can set from 3 to 5 shots. The principle is the same as in HDR mode — the images are underexposed, overexposed, and normally exposed. However, in AEB mode, the images are in RAW format and are not merged. Therefore, you need to combine them yourself using special editing software.
- Timed Shot: Here, you can set a timer before taking a photo. This function is convenient for selfies.
- Pano (Panorama): You can quickly take a panoramic shot. There is also a separate mode for panorama shooting (Sphere mode). In this mode, the drone takes a large number of photos, and after merging them, you get a spherical image.
- Shallow Focus: This mode allows you to create a depth-of-field effect in your photo.

Image Size
You can configure the following image sizes:

- 4:3 – This is an older 35 mm standard that was widely used during the SD television era.
- 16:9 – This size is suitable for HD-format devices.
- 3:2 – This is the standard size for printed photos (3:2 P4P).

Image Format
You can choose the following formats for photos:

- RAW format
- JPEG format
  Combined RAW+JPEG format

White Balance
Here, you can adjust unrealistic color tones. For example, white objects in real life will also appear white in photos. This parameter is measured in Kelvin. If the Auto mode is enabled, the camera automatically sets the optimal colors for the photo. You can also choose preset color profiles or adjust them manually.

Color Temperature	Light Source
1000 – 2000 K	Artificial lighting
2500 – 3500 K	Tungsten lamp
3000 – 4000 K	Sunrise/Sunset (clear sky)
4000 – 5000 K	Fluorescent lamp
5000 – 5500 K	Electronic flash
5000 – 6500 K	Daylight (clear sky)
6500 – 8000 K	Moderately overcast sky
9000 – 10000 K	Shadow or Heavily overcast sky

Image Style
Here, you can adjust the sharpness, contrast, and color saturation of the image.

- **Sharpness (triangle icon):** This setting increases the digital sharpness of your image, making it appear clearer and more defined.
- **Contrast (circle icon):** This controls the contrast level between black and white.
- **Saturation (triangle icon):** With a low saturation level, the photo appears dull. With a high saturation level, the photo becomes more vibrant. The color saturation level can be adjusted from -3 to +3.

Image Color

Here, you can adjust the camera's color profile: **D-Cinelike** or **D-Log**. These profiles are specifically designed for photos that will undergo further post-processing.

Other Camera Options

A variety of additional settings are available, which you can control. The availability of these options depends on the drone model.

- **Histogram:** When this function is enabled, a histogram square appears on the screen. It displays the exposure of the photo you are about to take. The left side of the diagram shows the proportion of black and gray tones, the right side shows highlights and bright areas, and the middle represents midtones.

- **Front LED Disable During Shooting:** Here, you can turn this function on or off.

- **Gimbal Lock During Shooting:** If this function is enabled, the gimbal will remain directed toward the position where you need to take the photo. If this function is disabled, the gimbal will move following the drone's movements.

Enabled AFC Mode (Continuous Auto Focus): When this function is enabled, the camera will activate auto focus as soon as you start recording video or taking photos.

MF Focus (Manual Focus Assistant, P4P): In manual shooting mode, this function helps you control the focus.

Mechanical Shutter (P4P + Inspire 2): This function helps prevent the "jello" effect when shooting fast-moving objects.

Auto Sync HD Photos: When enabled, high-resolution photos taken during flight will be transmitted from your drone to your mobile device in real time.

Long Exposure Preview: This function allows you to preview the exposure before taking a long-exposure photo.

Video Caption: When enabled, the app creates an SRT file during recording that includes information such as altitude, GPS, ISO, shutter speed, barometer data, GPS coordinates for Return-to-Home, and more.

Centre Points: Here, you can choose the visual style of the central point displayed on the screen.

Anti-Flicker: This function helps prevent flickering in your footage. You can select a frequency of 50 Hz or 60 Hz. The option depends on your region: in Europe – 50 Hz, in the USA – 60 Hz.

File Index Mode: Here, you can set the numbering of photo and video files from lowest to highest. With each subsequent capture, numbering continues from the last file. This function can be reset, in which case numbering will start over at 001 for each new shoot.

Peak Focus Threshold: When this function is enabled, additional red lines will appear around the object during focusing. This function has several levels: Off / Low / Normal / High.

Format SD Card: Here, you can format your SD card.

Reset Camera Settings: Here, you can reset all existing camera settings.

2.8 Video Settings

Video Format: Here, you can select the video format you need. The available formats may depend on the drone model or camera you are using.

Video Standards NTSC / PAL: The NTSC format is used in the USA, while the PAL format is used in the rest of the world.

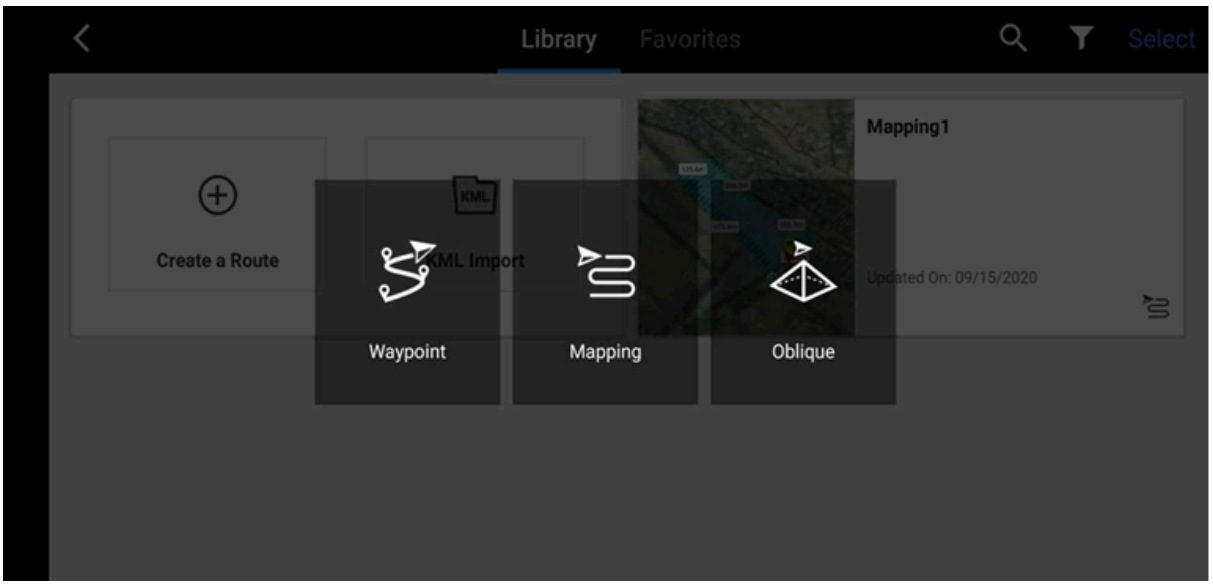
DJI Pilot User Guide (Waypoint Flight)

Connect the remote controller and the UAV, and then launch **DJI Pilot** using **CrystalSky**.

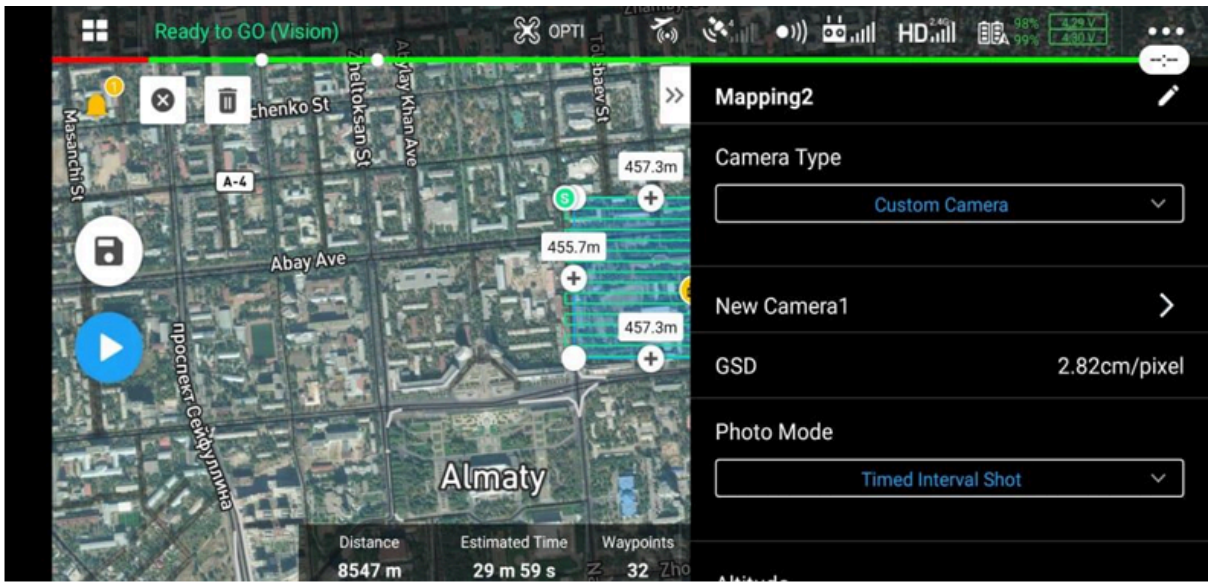
The app will automatically identify the drone model and payload, displayed in the lower-left corner of the screen.

Enter **Mission Flight**, and the app offers several flight plan options:

- **Waypoint:** Flight along specified points.
- **Mapping:** Mission flight planning (recommended).
- **Oblique:** 3D object imaging.



Select Mapping, and the following interface will open.

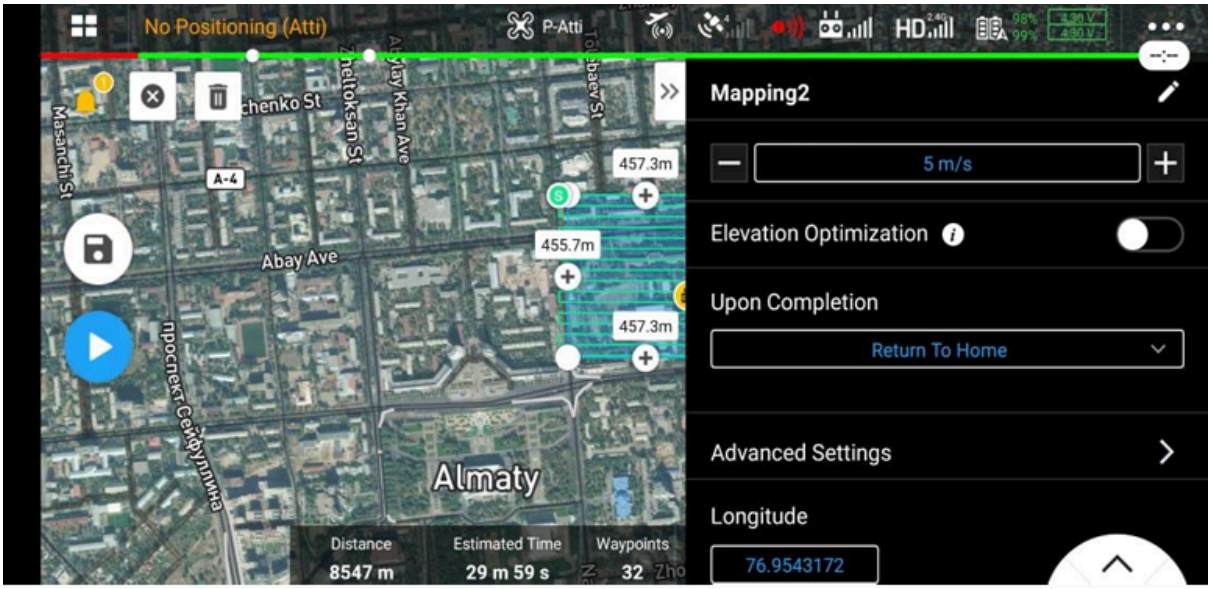


Here, you have the option to configure the mission flight plan. Once the flight plan is set for the desired area, you can proceed to the settings.

First, select the required camera. Based on the chosen camera, the app will approximately indicate the resolution (GSD) in centimeters per pixel.

In the **Photo Mode** settings, you can choose interval shooting:

- **By Time:** Photos are taken every 5 seconds (recommended).
- **By Distance:** Photos are taken every 30 meters.



Next, configure the following:

- **Altitude:** Flight altitude
- **Takeoff Speed:** Speed of ascent

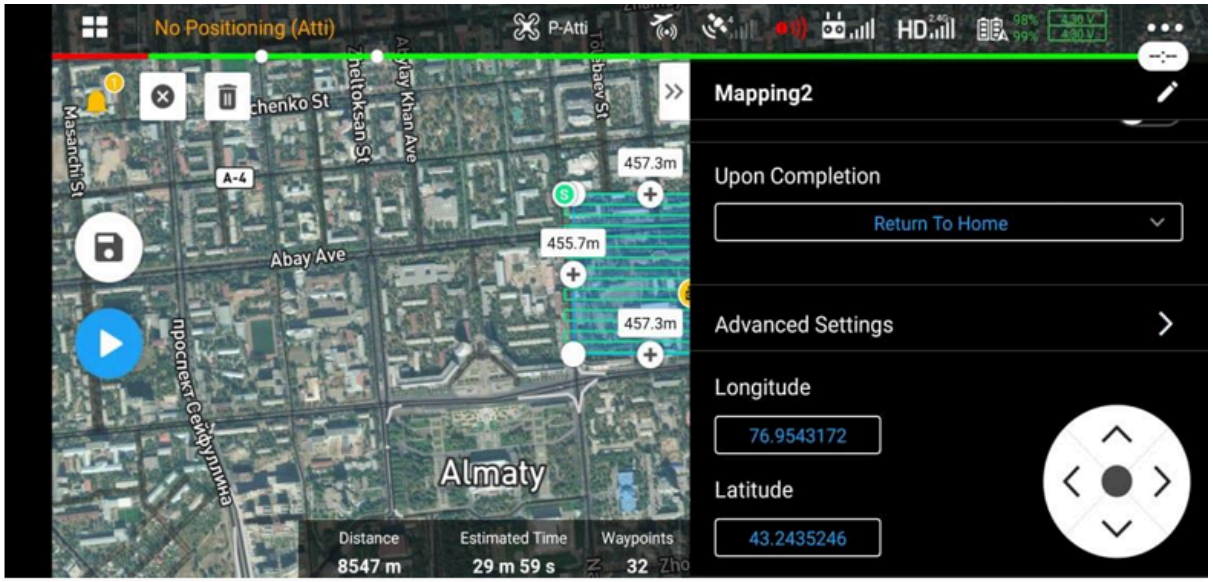
- **Speed:** Flight speed

When **Elevation Optimization** is enabled, the drone will fly to the center of the mission upon completion.

The app offers several options for the drone's behavior at the end of the flight:

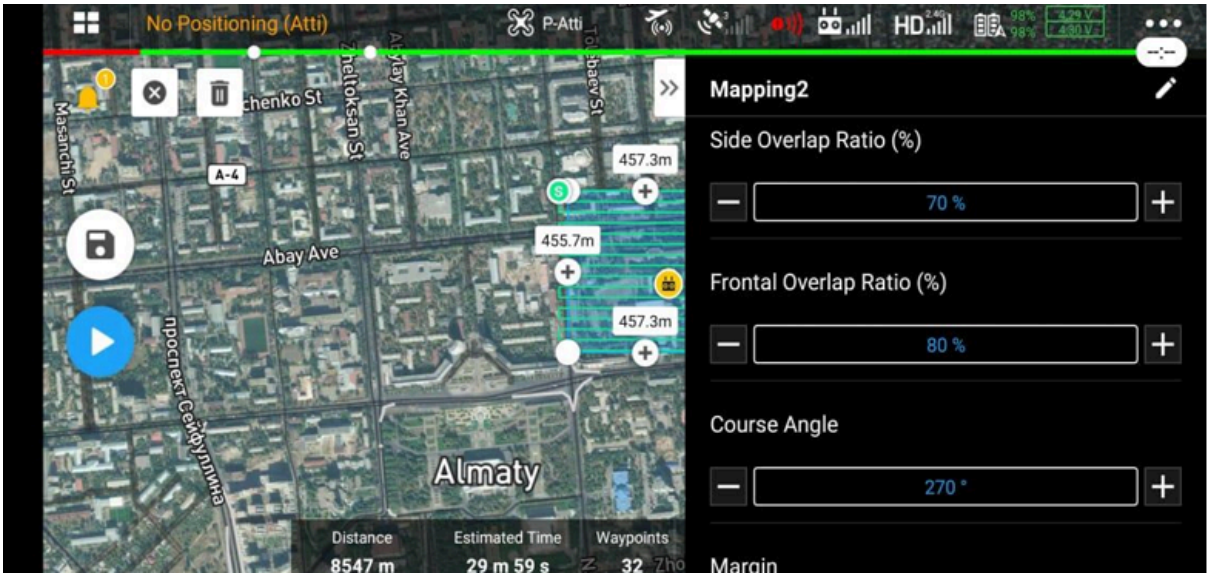
- **Return to Home:** Fly to the takeoff point
- **Hover:** Hover in place
- **Landing:** Land

Additionally, below this, you can view the exact coordinates.



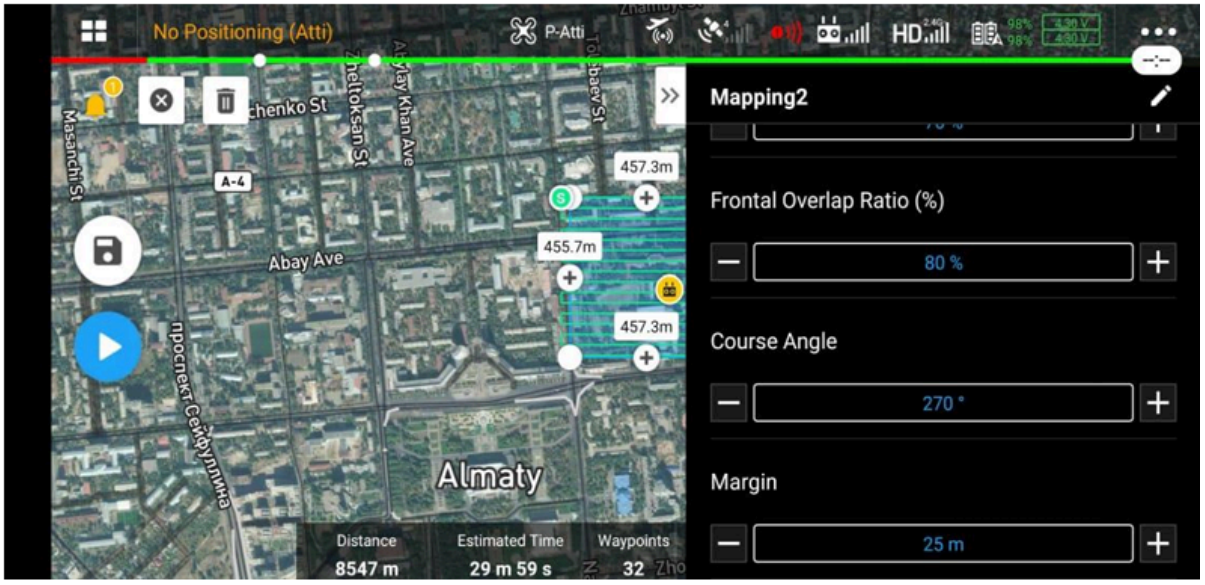
Next, tap Advanced Settings and configure the image overlap.

> Side Overlap and Frontal Overlap are recommended to be set at no less than 70%, preferably even higher.

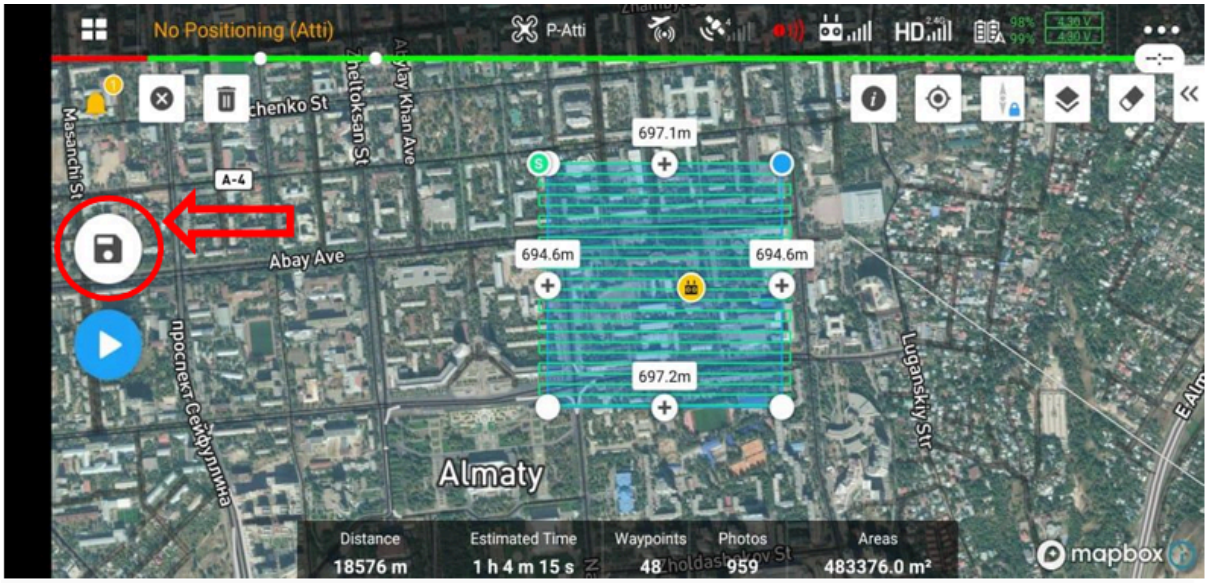


Using **Course Angle**, you can adjust the flight path in the direction that is most convenient for you.

With **Margin**, you can set an additional buffer for your mission, meaning the area (in meters) that the UAV will capture beyond the selected flight zone. It is recommended to set this to at least 25 meters, as the edges of the map may not stitch correctly if there are not enough photos after processing.



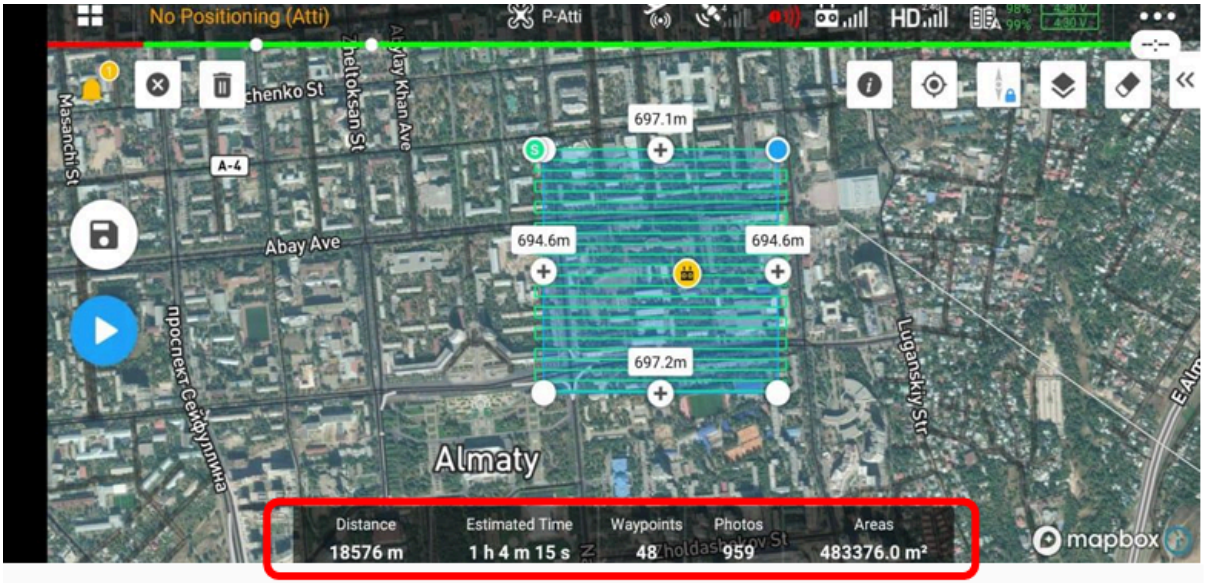
Once all settings are configured, you can either save the mission.



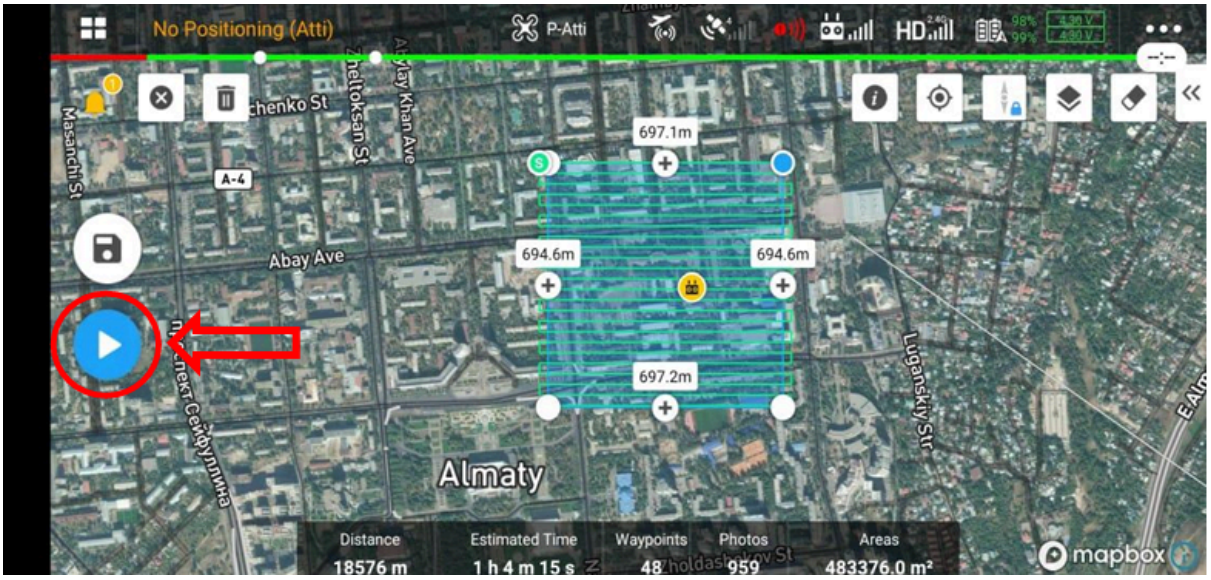
Or check the selected settings at the bottom center:

- **Distance:** Total flight distance
- **Estimated Time:** Total flight time

- **Waypoints:** Number of waypoints
- **Photos:** Number of photos that will be taken during the flight
- **Areas:** Total area covered

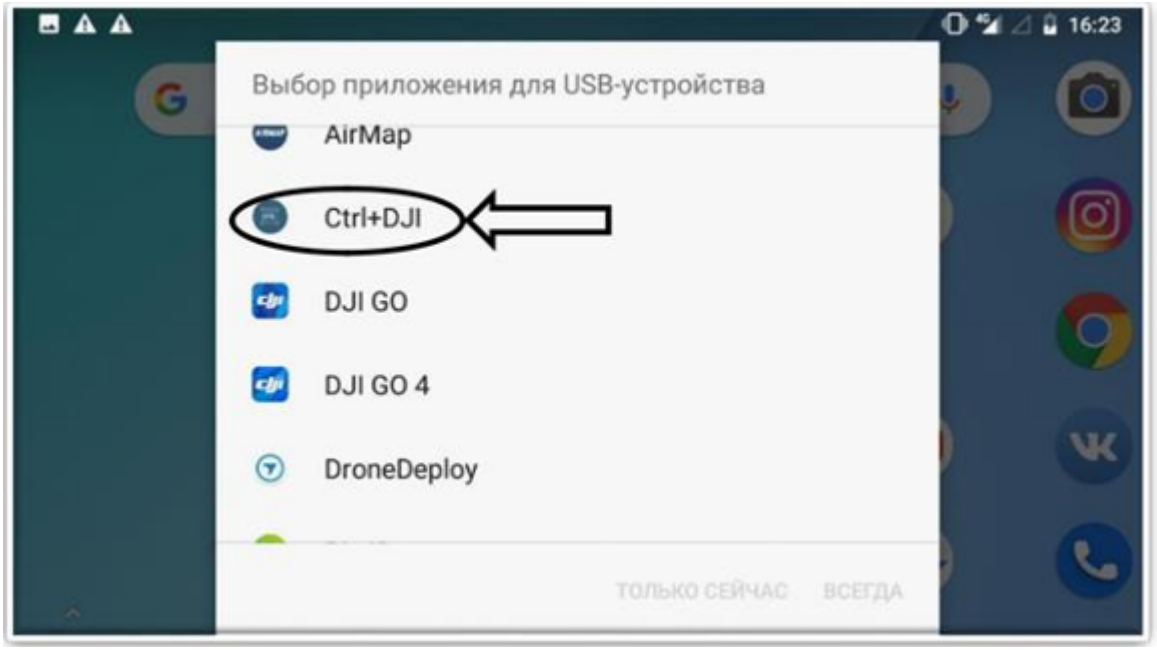


Next, **upload the mission to the UAV** and **perform takeoff**.



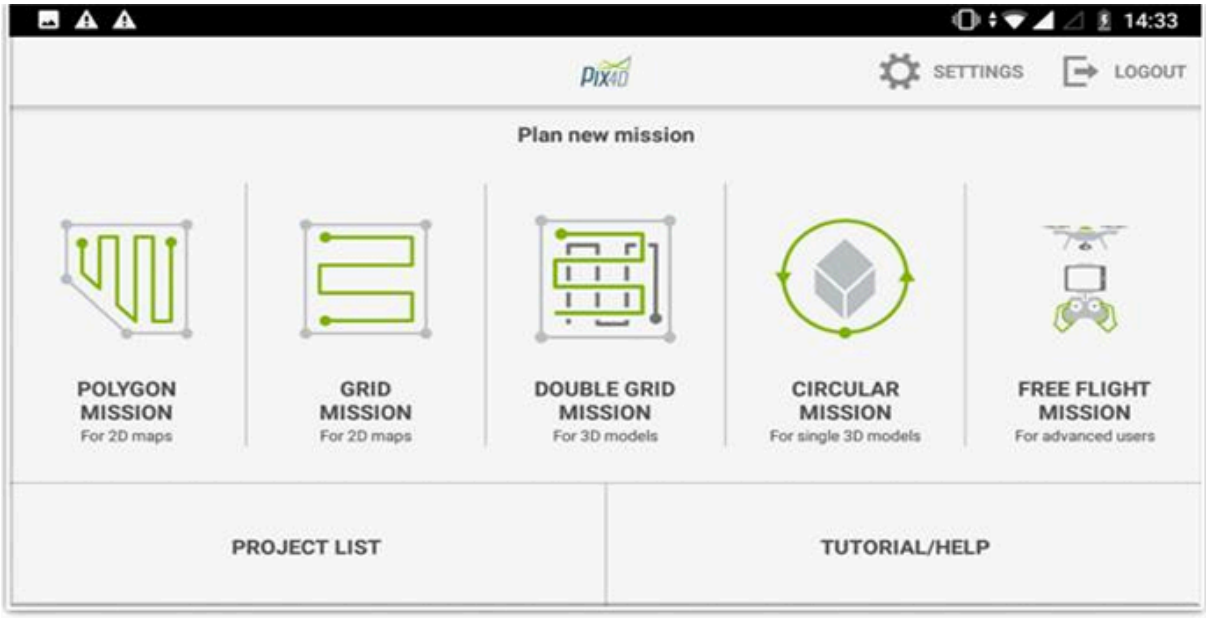
3. Training on Using Ctrl+DJI and Pix4Dcapture

Pix4Dcapture is an app for flight planning and image acquisition, available on Android and iOS platforms.
First, attach your phone or tablet to the remote controller mount, and then connect it using the appropriate USB cable.
Once the remote controller is connected, the phone interface will present a list of apps for you to start working with.



First, select the **Ctrl+DJI** app and tap **“Just Once.”**
Next, the software interface will open. Here, you can check the UAV’s connection status, its coordinates, and battery level. After that, tap **“Open Pix4Dcapture.”**

The **Pix4Dcapture** software interface will now open.



4.1 Functionality of Pix4Dcapture

1. **Polygon Mission** – Planning a mission to create a detailed orthophoto map (2D map). This mode is suitable for projects requiring flexible flight boundaries or complex map shapes. It ensures image overlap necessary for optimal processing.

Recommended in the following cases:

- Main focus on 2D map outputs (DSM, orthophoto map, etc.)
- Relatively flat surfaces (e.g., fields, earthworks)
- Large areas
- Complex shapes or flight boundary restrictions
-
2. **Grid Mission** – Planning a mission to create a detailed orthophoto map (2D map). This mode ensures image overlap necessary for optimal processing.

Recommended in the following cases:

- Main focus on 2D map outputs (DSM, orthophoto map, etc.)
- Relatively flat surfaces (e.g., fields, earthworks)
- Large areas

3) Double grid mission – a mission planning method for creating a 3D model of terrain. It ensures that images are captured from multiple angles with the overlap required for optimal processing. Compared to a simple grid, this mission is recommended for flying closer to objects to capture more vertical detail.

Recommended in the following cases:

- The main interest is in 3D model outputs (point cloud, mesh, etc.).
- The surface has elevation variations or includes objects (e.g., buildings, forest).
- Small to medium areas, as flight time is doubled.

4) Circular mission – a mission planning method for creating a 3D model of a specific object. It ensures images are captured from all angles around the target point with the overlap required for optimal processing. For tall objects, it is recommended to perform several circular flights at different altitudes.

Recommended in the following cases:

- The main interest is in 3D model outputs (point cloud, mesh, etc.).
- An isolated object (e.g., tower, pylon, building).
- A small area.

5) Free flight mission – free-form mission planning. Suitable for mapping more complex objects that require greater flexibility. The camera shutter is triggered automatically based on horizontal and vertical distance intervals. This requires manual drone piloting.

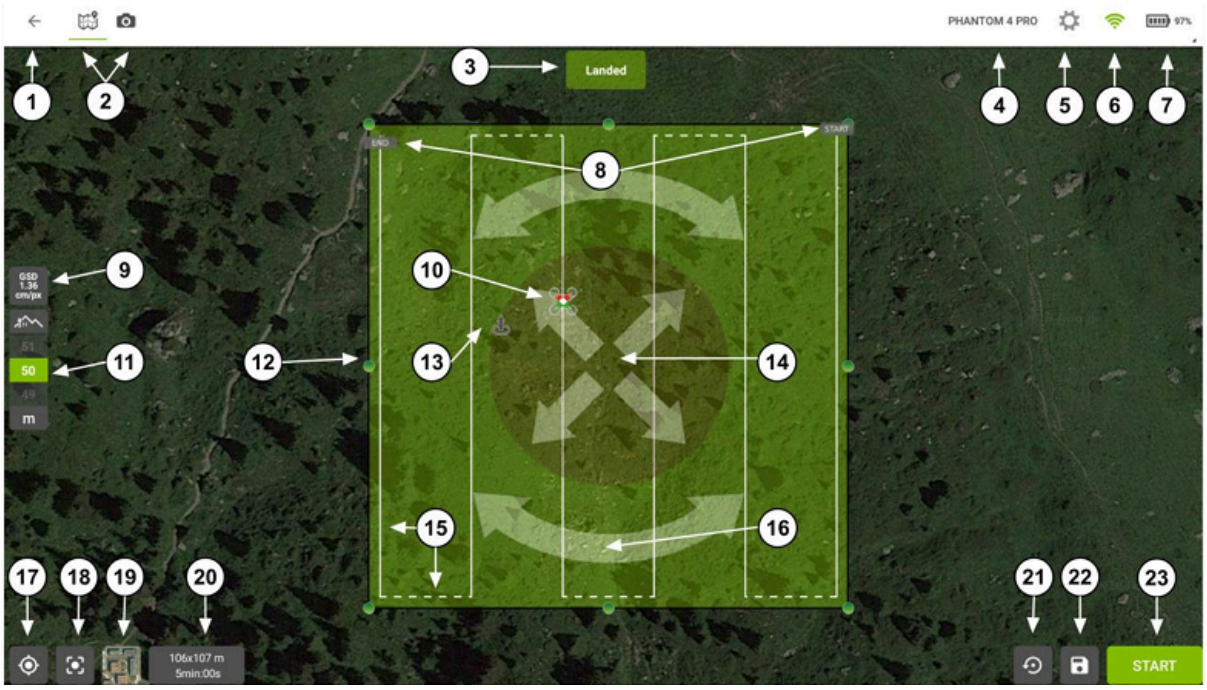
Recommended in the following cases:

- The main interest is in 3D model outputs (point cloud, mesh, etc.).
- A small area.
- Complex or vertical structures (e.g., building façade, cliff, bridge, etc.).

In the Project list, you can find saved flight missions.

4.2 Creating a mission plan

Select “Polygon mission”, and an interface will open where you can create a flight mission plan.

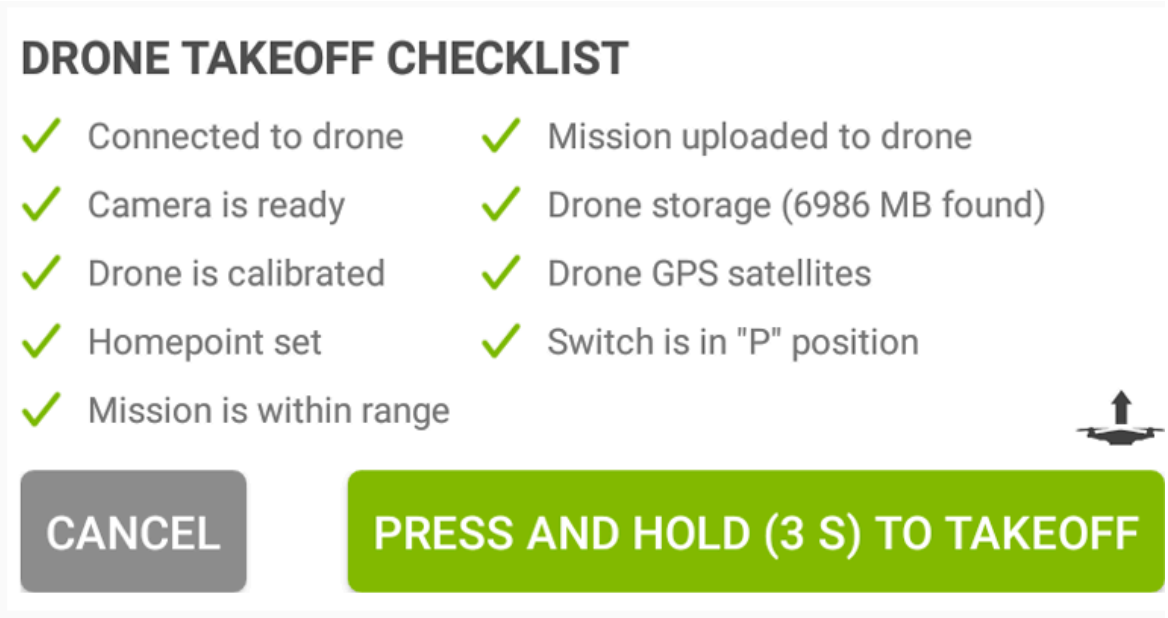


Legend:

1. Return to the main interface
2. Project view via map or camera
3. UAV status indicator at the current moment
4. Indicator of which drone the software is connected to
5. Pre-flight settings
6. Drone connection to the controller
7. Drone battery level and UAV status indicators during flight
8. Mission rotation
9. Resolution (centimeters per pixel)
10. Current UAV location
11. Flight altitude
12. Drag the markers to adjust the size and shape of the flight plan grid
13. Takeoff point
14. Tap the cross-shaped arrow to move the flight plan grid to the desired location
15. Flight boundaries
16. Tap the curved arrows to rotate the flight plan grid
17. Center the map view on the mobile device’s GPS position
18. Center the map view on the grid
19. Switch between map and satellite view (default is map view)

20. Indicator of the selected flight area, as well as the time required to cover this area
21. Reset the grid to its default size of 100 × 100 m at the current location
22. Save the mission
23. Start the mission

As soon as you press Start, the following window will appear.



Legend:

Conneted to drone	БПЛА подключен к ПО
Camera is ready	Камера исправна
Drone is calibrated	БПЛА откалиброван
Homepoint set	Определена точка взлета и посадки
Mission is within range	Миссия в пределах досягаемости
Mission uploated to drone	Миссия прогружена на БПЛА
Drone storage(6986 MB found)	Свободная память на флэш карте
Rone GPS satellites	Достигнуто нужное количество спутников GPS
Switch is in «P» position	Установлен режим полета «P»

Once you make sure that all indicators show green checkmarks, press and hold **“Press and Hold”** for 3 seconds. The drone will then begin ascending to the set altitude and fly to the mission start point. During the flight, the drone automatically takes photos every five seconds.
After the mission is completed, the UAV returns to the takeoff point at the set altitude, then descends and lands.

Next, remove the SD card, insert it into your computer or laptop, and transfer the collected data. This data will need to be processed using specialized post-flight processing software, Pix4Dmapper.

5. Instructions for using DJI GO 4

The DJI GO 4 app is used to control and capture footage with DJI quadcopters. Within the app, you can adjust camera settings, select shooting modes, monitor your flight statistics, and more. There is currently no official Russian version of the DJI GO 4 app. Below is the main screen of the software.

During flight, this screen will be used most frequently. The main area of the screen displays the video feed from the quadcopter's camera. Around the edges, there are icons that you can tap to change settings. At the top of the screen is the battery level indicator, and at the bottom, key telemetry data is displayed: distance from the Home point, altitude, horizontal and vertical speeds.

Legend:

1. **System Status** – General system information
   In the top left corner, information about flight status, compass and IMU errors is displayed, as well as various warnings, such as strong wind or magnetic interference.

2. **Obstacle Detection Status** – Obstacle detection system
   Red LEDs indicate an obstacle is close to the drone. An orange signal indicates that an obstacle is within the detection range.

3. **Battery Level Indicator** – Battery charge level
   Colored segments on the indicator show the current battery level of the drone.

4. Flight mode
Here you can select the mode required to complete your task.

5. GPS Signal Strength
Shows the number of GPS satellites currently connected. If the indicator is white, the GPS signal is good.

6. 3D Sensing System Status
Here you can enable or disable the functions of the sensing system.

7. Wi-Fi settings
Icon for changing Wi-Fi settings.

8. Battery Level
Displays detailed information about the battery charge. You can set low battery warning thresholds.

9. General settings
In this section, you can change general settings: shooting parameters, flight route, etc.

10. Gimbal Tilt (Gimbal Slide)
Tap this icon to adjust the camera tilt angle.

11. Photo/Video Toggle
Tap to switch between Photo and Video modes.

12. Shoot/Record Button
Tap to start taking photos or recording video.

13. Camera Settings
Tap to open the camera settings menu.

14. Playback
View previews of captured photos and videos.

15. Flight telemetry
Displays flight information such as speed.

16. Virtual Joystick
Tap to bring up virtual joysticks for controlling the drone.

17. Intelligent Flight Mode
Access smart flight control modes.

By tapping the icon, you can select an **Intelligent Flight Mode**.

18. Smart RTH (Return to Home)
Function for automatically returning the drone to its takeoff point.

19. Auto Take Off / Landing
Here you can set up automatic takeoff or landing.

20. Back to Main Menu (DJI icon)
Tap the DJI icon in the top left corner to return to the main menu.

5.1 Intelligent Flight Modes

Usually, creating professional-quality footage requires experience, skill, and expertise. **Intelligent Flight Modes** help capture professional shots with minimal effort.

TapFly Mode: You set a point on the app screen (by tapping it), and the drone automatically flies there without manual control. The drone will also automatically avoid obstacles, slow down, and hover as needed for proper lighting.
To activate this function, ensure the drone is at least 2 meters above the ground. Then select **TapFly Mode** and tap once on the desired point. A **GO** button will appear—tap the point again to confirm. The drone will fly in that direction.

ActiveTrack Mode: In this mode, you can select and follow a moving object on your mobile device's screen. The drone will automatically avoid obstacles in its path.
To activate this function, ensure the drone is at least 2 meters above the ground. Open the DJI GO app and select **ActiveTrack Mode**. Then select the object on the screen by tapping it once, and confirm with the **Confirm** button.
If the drone does not automatically recognize the object, drag the frame to it with your fingers. When tracking is active, the frame will turn green. If the frame is red, the object is not recognized, and you need to repeat the process.

Cinematic Mode: In this mode, the drone's braking distance is increased. It will slow down gradually while maintaining altitude, creating smooth cinematic shots.

QuickShot Mode: This automatic mode allows you to record a short 10-second video, which can be immediately edited and shared on social media from the playback menu. Before enabling this mode, ensure the drone is at least 1.5 meters above the ground.

Then select **QuickShot** and follow the on-screen instructions. Choose the subject, select the mode, and tap **GO** to start recording. Once the recording is complete, the drone will return to its takeoff point.

Dronie (Selfie with Drone):
You can take selfies using the drone. In this mode, it doesn't matter which direction the drone is flying—the camera will always face the subject.

Helix Mode:
You can set the drone to fly forward while moving in a spiral around the subject.

Rocket Mode:
In this mode, the drone will ascend vertically while the camera points downward.

Circle Mode:
The drone will fly around the subject in a circular path.

Gesture Mode:
This feature allows you to control the drone using hand gestures. For detailed instructions, refer to your drone model's manual.

Tripod Mode:
In this mode, the maximum flight speed is limited to 3.6 km/h. The stick sensitivity is reduced so that controls respond slowly and smoothly. This mode can only be used in good lighting and with a strong GPS signal.

Waypoints:
You can set a flight path for the drone to automatically follow selected points while you control the camera. The flight path can be saved and reused later (except for DJI Spark).

Follow Me Mode:
In this mode, the drone is virtually linked to your mobile device and will follow its movements. The accuracy of this mode depends on the GPS signal of your device (except for DJI Spark).

Home Lock Mode:
Regardless of the drone's front orientation, it will move toward the takeoff point when you push **forward** on the controller (except for DJI Spark).

Course Lock Mode:
The drone will move only in the set direction, regardless of its front orientation (except for DJI Spark).

Draw Mode:
In this mode, the drone will follow a route drawn on the screen with your finger. If obstacles are detected, the drone will automatically slow down and hover. This mode requires sufficient lighting (between 300 and 10,000 lux). Ensure the drone is at least 2 meters above the ground before activating. Select **Draw Mode**, draw the route on the screen, then press **GO**. The drone will follow the designated path. (For DJI Phantom 4 Pro/A and DJI Inspire 2)

Spotlight Pro Mode:
This mode is designed to capture complex, expressive shots. The camera gimbal automatically adjusts to keep the camera focused on the subject.

Quick Mode:
In this mode, you can select a subject, draw a square around it on the screen, and start following it.

In Free Mode:
Here you can control the drone's flight direction independently from the camera.

In Follow Mode:
In this mode, the drone's flight direction will align with the camera's direction (DJI Inspire 2).

5. State Regulation

A UAV (Unmanned Aerial Vehicle) is an aircraft operated in flight by a pilot located outside of the vehicle.

The rules for UAV flights are governed by the **Law of the Republic of Kazakhstan No. 339 dated July 15, 2010, "On the Use of Airspace of the Republic of Kazakhstan and Aviation Activities."**

Clause 66-1 of Article 1:
An unmanned aerial vehicle (hereinafter – UAV) is an aircraft that flies without a pilot (crew) on board and is controlled in flight automatically, by an operator from a control station, or using a combination of these methods.

Article 31. Flights over populated areas

1. Aircraft flights over densely populated areas of cities or towns must be at an altitude that ensures, in case of emergencies, a safe landing without posing excessive danger to people or property on the ground, except when necessary for takeoff or landing or if a permit is issued by the air traffic control authority.

2. The procedure for approving flights over populated areas, including the establishment of permanent flight patterns (routes) over them, is determined by the rules for the use of airspace of the Republic of Kazakhstan.

3. During security operations, flights of aircraft and UAVs over populated areas must be coordinated with the national security authorities and the State Security Service of the Republic of Kazakhstan.

Article 33. UAV Flights

1. The operation of UAVs must minimize threats to human life or health, property damage, and hazards to other aircraft, in compliance with the rules for the use of airspace of the Republic of Kazakhstan and the operational documentation of the

UAV.

2. UAV operators must provide air traffic service authorities and/or air traffic control authorities with detailed information about planned UAV flights in accordance with the Rules for the Use of Airspace of the Republic of Kazakhstan (see Clause 82, Chapter 5 of the Rules for the Use of Airspace of the Republic of Kazakhstan).

3. UAV flights over protected facilities must be coordinated with the State Security Service of the Republic of Kazakhstan.

Article 87. Mandatory Insurance Related to Civil Aviation Activities

Owners and operators of aircraft, as well as other civil aviation facilities and equipment, are required to insure their civil liability, including liability to passengers and aviation personnel, as well as to cargo owners or shippers, in accordance with the insurance laws of the Republic of Kazakhstan.

Government Resolution of the Republic of Kazakhstan No. 506 dated May 12, 2011, “On Approval of the Rules for the Use of Airspace of the Republic of Kazakhstan”

32. Flights over populated areas outside established routes
Flights of aircraft over populated areas outside established routes for the purpose of life-saving operations, public health protection, crime prevention and investigation, as well as for aviation works, parachute jumps, UAV flights, and tethered balloon ascents, must be conducted at altitudes that ensure the safe execution of these activities, with flight safety ensured by the organizer of such flights.

Approval of flights over populated areas outside established routes, except for flights related to life-saving, public health protection, crime prevention and investigation, and flights conducted during security operations of the State Security Service of the Republic of Kazakhstan, must be coordinated with the national security authorities and the authorized civil aviation authority.

During security operations, flights over populated areas must be coordinated with the national security authorities and the State Security Service of the Republic of Kazakhstan at least two working days before the start of flights.

33. Aviation works, parachute jumps, UAV flights, and tethered balloon ascents over populated areas
These activities can only be conducted if the users of airspace have obtained permission from the **Main Air Traffic Management Center (MATMC)** for flights over populated areas and have notified the local executive authorities of cities of republican significance, the capital, and cities of regional significance within whose territory the flights are planned.

Chapter 5. Operating Conditions for Unmanned Aerial Vehicles (UAVs)

82. UAV flights with submitted flight plans

UAV flights for which flight plans have been submitted must be conducted in accordance with those plans. Flight plans can be submitted via the following link: **websppi.ans.kz**.

82-1. A UAV flight plan does not need to be submitted to air traffic service authorities and/or air traffic control if the planned flight altitude does not exceed 50 meters above ground level, and the flight route (planned trajectory) is at least 5.5 km away from the aerodrome perimeter (or, if there is no perimeter, at least 5.5 km from marked signs indicating the aerodrome boundary).

82-2. UAV flights and aircraft operations must be conducted as follows:

1. Within **Class G airspace** provided meteorological minimums are met (horizontal visibility at least 1500 meters and cloud base at least 300 meters vertically).

2. In controlled airspace (except as provided in subparagraphs 3) and 4) below), provided temporary restrictions are imposed by air traffic control centers in accordance with Clause 144 of the Rules. Temporary restrictions are not required for UAV flights in airspace extending from the surface up to 50 meters.

3. In a **control zone** – airspace extending from the surface up to 50 meters and at least 5.5 km from the aerodrome perimeter (or, if no perimeter, at least 5.5 km from marked aerodrome boundary signs), except for aviation works and mass demonstration flights (airshows) with UAVs. These may only be conducted at all altitudes after coordination with the air traffic service authority responsible for the aerodrome and with temporary restrictions imposed by air traffic control centers in accordance with Clause 144 of the Rules.

4. In the **aerodrome zone** of an uncontrolled aerodrome:

    - In Class G airspace – with agreement from the aerodrome operator and coordination with the aerodrome flight information service (if available).

    - In controlled airspace – with agreement from the aerodrome operator and air traffic service authority responsible for the aerodrome, provided temporary restrictions are imposed by air traffic control centers in accordance with Clause 144 of the Rules.

82-3. The UAV operator must not drop any cargo or animals (without a special parachute) from the UAV to avoid endangering people or property.

82-4. When temporary restrictions are not imposed by air traffic control centers, the UAV operator must maintain direct visual contact without external assistance (including optical devices) sufficient to monitor the UAV's trajectory and position relative to other aircraft, people, vehicles, vessels, and structures to avoid collisions.

82-5. UAVs must not be operated:

1. During takeoff and landing – closer than 50 meters horizontally from any person (except the UAV operator), another vehicle, building, or structure.
2. During flight – closer than 100 meters horizontally from any person (except the UAV operator), another vehicle, building, or structure.
   In all cases – closer than 150 meters horizontally from large gatherings of people and/or vehicles.
3. In prohibited and hazardous flight zones, as well as restricted airspace (except for flights conducted in the interests of the authorities establishing such zones). Current restrictions can be found at: websppi.ans.kz.

82-6. When temporary restrictions are introduced in controlled airspace to allow UAV operations, the conditions of its operation must be specified.

Order of the Minister of Investment and Development of the Republic of Kazakhstan No. 409 dated June 30, 2017

"On Approval of the Rules for State Registration of Civil Aircraft of the Republic of Kazakhstan, Rights to Them, and the Forms of Documents Certifying Such Rights" (hereinafter – the Rules)

Chapter 4. Procedure for Registering Unmanned Aerial Vehicles (UAVs)

61. UAVs with a maximum takeoff weight exceeding 1.5 kg are subject to registration.

62. When registering a UAV, the authorized body issues a certificate of UAV registration in the form specified in Appendix 12 of the Rules.

63. UAV registration is maintained by the authorized body in a special logbook. Registration numbers assigned to UAVs must correspond to their sequential numbers in the UAV logbook. The UAV registry is maintained in the form specified in Appendix 13 of the Rules in paper form. If a secure software system is available, the UAV registry may also be maintained electronically with the ability to duplicate records. In case of discrepancies between paper and electronic records, paper records take precedence.

64. The term for registration, as well as deregistration of a UAV, is 30 working days.

65. Individuals acquiring UAVs for operation must submit a registration application to the authorized body with the following documents attached:

1. An application in the form specified in Appendix 14 of the Rules;

2. A copy of the **founding document** (for legal entities) or **identity document** (for foreign individuals); if the individual or legal entity is a non-resident of the Republic of Kazakhstan, the documents must be **notarized**.
3. A notarized copy of the **sales agreement** or another document confirming ownership (notarized), or a **court decision**.
4. A notarized copy of a **lease, rental, or other agreement** confirming the right to use the UAV.
5. A copy of the **manufacturer's document** describing the UAV system characteristics (maximum takeoff weight, maximum speed, maximum flight altitude, maximum flight time, control channel, flight range, control range).
6. **Type and serial number** of the aircraft (passport), engine, and remote pilot station (passport).
   A copy of the **type certificate** or equivalent document (if available).
7. **Certificate of deregistration** (if the UAV was previously registered in a foreign country).
8. A written statement from the applicant confirming the **absence of military or surveillance equipment** on the UAV being registered.

68. Grounds for refusal of UAV registration

1. Detection of **false documents** submitted by the applicant or false information contained in them.
2. Non-compliance of the applicant and/or submitted materials, data, and information required for issuing the registration certificate with the conditions established in Clause 65 of the Registration Rules.
3. The applicant has a **final court decision** (sentence) prohibiting aviation activities or certain types of aviation activities.
4. The applicant has a **final court decision** depriving them of special rights related to obtaining the UAV registration certificate.

Refusal to issue a registration certificate must be issued **in writing** within **15 working days** from the date of receipt of the application.

69. After correcting the deficiencies, the applicant may reapply to the authorized body for UAV registration.

Currently, there is no content classified under this term.

Law of the Republic of Kazakhstan No. 580 dated July 7, 2004 “On Mandatory Civil Liability Insurance for Owners of Facilities Whose Activities Involve the Risk of Causing Harm to Third Parties”

Article 3. Object of Mandatory Civil Liability Insurance for Owners of Facilities Whose Activities Involve the Risk of Causing Harm to Third Parties The object of mandatory civil liability insurance for owners of facilities whose activities involve the risk of causing harm to third parties (hereinafter – mandatory liability insurance for facility owners) is the property interest of the owner of the facility, whose activity involves the risk of causing harm to third parties. This interest is related to the owner’s obligation under civil law of the Republic of Kazakhstan to compensate for damage caused to the life, health, and/or property of third parties by a hazardous production factor.

Code of the Republic of Kazakhstan No. 235-V ZRK dated July 5, 2014 “On Administrative Offenses”

For violations of the rules for the use of the airspace of the Republic of Kazakhstan and safety rules for operating unmanned aerial vehicles, owners bear responsibility as provided in the Code of the Republic of Kazakhstan No. 235-V ZRK “On Administrative Offenses.”

A separate document attached to the Rules for State Registration of Civil Aircraft of the Republic of Kazakhstan and Rights to Them will include the application form for UAV registration and the application form for UAV deregistration (Appendix No. 14).

Conclusion

In addition to this educational and methodological material, 16 appendices have been prepared on the operation of DJI multirotor unmanned aerial vehicles (UAVs) for employees of the Emergency Situations and Disaster Risk Reduction Center, UNICEF Kazakhstan, and the Emergency Committee of the Republic of Kazakhstan. This educational material is designed to help users quickly master the operation of UAVs with onboard cameras and post-flight data processing using specialized software.

The materials include essential information for operating the Matrice 210 V2 UAV, the Zenmuse Z30 camera with 180x zoom, and the Zenmuse XT2 thermal camera. Detailed instructions are provided for operation in adverse weather conditions, safety precautions, and working with various software, including post-flight data processing in Pix4D Mapper.

The educational and methodological materials include:

- **Appendix No. 1**: Introductory presentation on the use of drones in various sectors of the economy
- **Appendix No. 2**: Main presentation
- **Appendix No. 3**: Common flight errors and safety precautions
- **Appendix No. 4**: Conducting flights in adverse weather conditions
- **Appendix No. 5**: State regulation in the Republic of Kazakhstan
- **Appendix No. 6**: Major system errors and warnings during UAV flight
- **Appendix No. 7**: Technical specifications of the Matrice 210 V2 UAV; Guide for using the Zenmuse XT2 thermal camera
- **Appendix No. 8**: UAV operation manual
- **Appendix No. 9**: Information on the Matrice 210 V2 UAV delivery kit
- **Appendix No. 10**: Guide for using the Zenmuse Z30 camera with 180x zoom
- **Appendix No. 11**: Guide for using the Zenmuse XT2 thermal camera
- **Appendix No. 12**: Guide for using Pix4D Mapper
- **Appendix No. 13**: Instructions for using CrystalSky (monitor for the remote controller)
- **Appendix No. 14**: Instructions for operating TB55 batteries
- **Appendix No. 15**: State regulation

Expected Results

Upon completion of this educational and methodological material, rescue units will be able to:

- Configure the Matrice 210 V2 UAV for flights using specialized software (DJI Go 4, Pix4D Capture, DJI Pilot, CTRL+DJI)
- Process data in the specialized software Pix4D Mapper
- Conduct flights using the Zenmuse Z30 camera with 180x optical zoom
- Conduct flights using the specialized Zenmuse XT2 thermal camera
- Create detailed orthophoto maps with maximum object detail
- Create 3D digital terrain maps
- Perform various calculations and assess the current situation based on digital maps (orthophotos and 3D terrain models)

Thanks to the knowledge acquired, rescue services using the Matrice 210 V2 UAV, along with the Zenmuse Z30 and Zenmuse XT2 cameras, will be able to:

- Search for objects in a designated area
- Monitor emergency zones
- Monitor forested areas to detect forest fires
- Provide informational support and guidance for mobile search teams
- Forecast emergencies
- Conduct aerial photo and video surveys
- Monitor ice jams, flood, and mudflow situations
- Conduct ecological monitoring of water surfaces
- Search for victims of avalanches
- Effectively and promptly manage rescue operations based on changes in the current situation

Thanks to the specialized post-flight data processing software Pix4D Mapper, rescue services will be able to:

- Determine accurate coordinates of search objects and boundaries of emergency zones
- Perform calculations in the designated emergency area
- Assess damage caused by emergencies
- Monitor the condition and perform calculations for linear objects (pipelines, riverbeds, roads, railway tracks, etc.)

Considering the use of UAVs for the benefit of rescue units, the following generalizations can be made:

- The economic feasibility of using UAVs is due to their ease of use and the ability to take off and land on any selected terrain

- The operations headquarters receives reliable photo and video information, which allows effective management of forces and resources for emergency localization and response
- The ability to transmit photo and video information in real time to control points enables rapid influence on the situation and informed decision-making
- UAVs can be used both in manual and automatic modes

Conclusion:

As global experience shows, the effectiveness of emergency response can be significantly enhanced through the implementation of advanced innovative technologies, including the use of Unmanned Aerial Vehicles (UAVs).

The use of UAVs and innovative technical tools for forecasting and responding to emergencies allows for rapid managerial decision-making in conducting search and rescue operations, thereby minimizing the socio-economic consequences of natural disasters and emergencies.

The use of a thermal camera enables search and rescue operations even during nighttime or in subzero temperatures, while the 180x zoom camera allows for searching and identifying objects in the finest detail.

References / Literature Used

1. https://www.dji.com/downloads/products/matrice-200-series-v2 2. https://support.pix4d.com/hc/en-us/categories/200300675-Pix4Dcapture