

# Drones and Tools

Skill-Based Course on  
*“Drone Technology: Fundamentals, Flight and  
Field Applications”*



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# VAJRA - Mapping Drone (AERO360's)



# Vajra

Aero360's VAJRA is a quadcopter and is built of carbon fiber, which makes it lightweight, tough, solid, and equipped with powerful landing gears.

- Drone Category: Small Class UAV
- Propulsion: Electric
- Battery: Lithium-Ion
- Max. Flight Distance: 2 kms
- Diagonal Dimension/Wheelbase: 690 mm
- Max Take-off Weight: 3 kg
- Flight Time Upto: 35 minutes



# STRUCTURE

70% of the drone body structure is made out of carbon fiber

Battery strap holder  
Landing gear bush  
Arm caps  
Canopy

3D Printed  
Parts



# Global Positioning System (GPS)

Operating Temperature:  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

Communication Protocol: CAN (Controller Area Network)

Processor: STM32F302

IMU sensor: ICM20948

Positioning accuracy: 3D FIX: 2.5 m

Weight: 48.8g



## Photogrammetry payload specifications

Effective Pixels: 24.2 MP

Sensor Type: CMOS

Weight: 512 g

Image Format: JPEG

Image Sensor Size: 23.5 x 15.6 mm

Shutter Speed: 1/4000 - 30 sec

Battery Type: Lithium Battery



# T12 Transmitter / Remote Controller

## Flight modes

- Loiter
- Alt Hold
- RTL
- Auto

## Features:

Frequency: 2.400-2.4833GHz

Working voltage: 3.7V(1s Li-ion)

Working Current: 130mA

Duration: 25 hours

Range: 2Km

Weight: 560g



# Geotagging vs georeferencing

georeferencing is a completely different process than geotagging.

- Georeferencing takes an aerial photograph and assigns coordinates to each pixel in the raster.
- Geotagging simply means a photo (often ground-based photographs) has a **single coordinate point** associated with it.

Georeferencing involves fitting an image to the Earth based on matching up visual features of the image with their known location.

Input: Imagery, Image control points, Matching geospatial control points

Output: Image with data attached showing how it fits onto the globe.

Geocoding involves converting some human placename or label into coordinates. Often this is done thousands of items at a time.

Input: "642 Arbitrary Lane, Cityville, MA" or "Miami" or "FIPS county #64623", large database of spatial reference info

Output: "53.645 N, 73.6453 W"

Example form: [MappingTomorrow](#)

# Flight Planning in QGIS

The screenshot displays the QGIS interface for flight planning. The main map area shows a grid overlaid on a satellite-style map of Gandhinagar, Gandhinagar, Gandhinagar. A yellow rectangular area in the top-left corner of the grid is highlighted. A flight path is indicated by a series of red dots (waypoints) connected by dashed lines. The path starts at a yellow waypoint in the top-left, moves right to a second yellow waypoint, then down to a third yellow waypoint, then right to a fourth yellow waypoint, then down to a fifth yellow waypoint, then right to a sixth yellow waypoint, then down to a seventh yellow waypoint, then right to an eighth yellow waypoint, then down to a ninth yellow waypoint, then right to a tenth yellow waypoint, then down to an eleventh yellow waypoint, then right to a twelfth yellow waypoint, then down to a thirteenth yellow waypoint, then right to a fourteenth yellow waypoint, then down to a fifteenth yellow waypoint, then right to a sixteenth yellow waypoint, then down to a seventeenth yellow waypoint, then right to an eighteenth yellow waypoint, then down to a nineteenth yellow waypoint, then right to a twentieth yellow waypoint, then down to a twenty-first yellow waypoint, then right to a twenty-second yellow waypoint, then down to a twenty-third yellow waypoint, then right to a twenty-fourth yellow waypoint, then down to a twenty-fifth yellow waypoint, then right to a twenty-sixth yellow waypoint, then down to a twenty-seventh yellow waypoint, then right to a twenty-eighth yellow waypoint, then down to a twenty-ninth yellow waypoint, then right to a thirtieth yellow waypoint, then down to a thirty-first yellow waypoint, then right to a thirty-second yellow waypoint, then down to a thirty-third yellow waypoint, then right to a thirty-fourth yellow waypoint, then down to a thirty-fifth yellow waypoint, then right to a thirty-sixth yellow waypoint, then down to a thirty-seventh yellow waypoint, then right to a thirty-eighth yellow waypoint, then down to a thirty-ninth yellow waypoint, then right to a fortieth yellow waypoint, then down to a forty-first yellow waypoint, then right to a forty-second yellow waypoint, then down to a forty-third yellow waypoint, then right to a forty-fourth yellow waypoint, then down to a forty-fifth yellow waypoint, then right to a forty-sixth yellow waypoint, then down to a forty-seventh yellow waypoint, then right to a forty-eighth yellow waypoint, then down to a forty-ninth yellow waypoint, then right to a fiftieth yellow waypoint, then down to a fifty-first yellow waypoint, then right to a fifty-second yellow waypoint, then down to a fifty-third yellow waypoint, then right to a fifty-fourth yellow waypoint, then down to a fifty-fifth yellow waypoint, then right to a fifty-sixth yellow waypoint, then down to a fifty-seventh yellow waypoint, then right to a fifty-eighth yellow waypoint, then down to a fifty-ninth yellow waypoint, then right to a sixtieth yellow waypoint, then down to a sixty-first yellow waypoint, then right to a sixty-second yellow waypoint, then down to a sixty-third yellow waypoint, then right to a sixty-fourth yellow waypoint, then down to a sixty-fifth yellow waypoint, then right to a sixty-sixth yellow waypoint, then down to a sixty-seventh yellow waypoint, then right to a sixty-eighth yellow waypoint, then down to a sixty-ninth yellow waypoint, then right to a seventieth yellow waypoint, then down to a seventy-first yellow waypoint, then right to a seventy-second yellow waypoint, then down to a seventy-third yellow waypoint, then right to a seventy-fourth yellow waypoint, then down to a seventy-fifth yellow waypoint, then right to a seventy-sixth yellow waypoint, then down to a seventy-seventh yellow waypoint, then right to a seventy-eighth yellow waypoint, then down to a seventy-ninth yellow waypoint, then right to an eightieth yellow waypoint, then down to an eighty-first yellow waypoint, then right to an eighty-second yellow waypoint, then down to an eighty-third yellow waypoint, then right to an eighty-fourth yellow waypoint, then down to an eighty-fifth yellow waypoint, then right to an eighty-sixth yellow waypoint, then down to an eighty-seventh yellow waypoint, then right to an eighty-eighth yellow waypoint, then down to an eighty-ninth yellow waypoint, then right to a ninetieth yellow waypoint, then down to a ninety-first yellow waypoint, then right to a ninety-second yellow waypoint, then down to a ninety-third yellow waypoint, then right to a ninety-fourth yellow waypoint, then down to a ninety-fifth yellow waypoint, then right to a ninety-sixth yellow waypoint, then down to a ninety-seventh yellow waypoint, then right to a ninety-eighth yellow waypoint, then down to a ninety-ninth yellow waypoint, then right to a hundredth yellow waypoint.

The interface includes a menu bar at the top with options like Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Mesh, Processing, and Help. A toolbar with various icons is located below the menu bar. On the left side, there is a Browser panel showing a file tree with folders like Favorites, Spatial Bookmarks, Home, and various data sources. Below the Browser is the Layers panel, which lists several layers: flight\_design\_1, projection centres\_1, flight\_line\_1, waypoints\_1, photos\_1 (highlighted in green), Reprojected, and OpenStreetMap. On the right side, there is a Processing Toolbox panel with a search bar containing the text 'repro'. Below the search bar, there is a list of processing tools, including 'Reproject layer' (highlighted in green), 'Reproject', 'Assign projection', 'Define Shapefile projection', 'Warp (reproject)', and others. At the bottom of the window, there is a status bar showing the current coordinate (8087996, 2650327), scale (1:5977), magnifier (100%), rotation (0.0 degrees), and the current layer (photos\_1 (0001)).

# Flight Planning in QGIS

The screenshot displays the QGIS interface for flight planning. The main map area shows a grid overlaid on a satellite-style map of Gandhinagar, Gandhinagar, Gandhinagar. A yellow rectangular area in the upper left of the grid is highlighted. A series of red dots, representing waypoints, are connected by dashed black lines with arrows, forming a flight path that starts from the yellow area, moves horizontally, then vertically down, then horizontally right, then vertically down, then horizontally right, then vertically down, then horizontally right, and finally vertically down. The map includes labels for 'Sree Rang Udyan', 'Pandit Deendayya Energy University', 'GNLU library', and 'Gujarat National Law University'. The interface includes a top menu bar, a toolbar, a left sidebar with 'Favorites' and 'Layers' panels, and a right sidebar with the 'Processing Toolbox'.

**Processing Toolbox**

- repro
- Recently used
  - Reproject layer
- Point cloud data management
  - Reproject
- Vector general
  - Assign projection
  - Define Shapefile projection
  - Reproject layer
- GDAL
  - Raster projections
    - Assign projection
    - Warp (reproject)

Coordinate: 8088001, 2650482 Scale: 1:5977 Magnifier: 100% Rotation: 0.0° Render: EPSG:3857



# Flight Planning in QGIS

The screenshot displays the QGIS interface for flight planning. The main map area shows a grid overlaid on a satellite-style map of Gandhinagar, Gandhinagar, Gandhinagar. A yellow rectangular area is highlighted on the left side of the grid. Dashed lines with arrows indicate flight paths between grid intersections, forming a grid pattern. The map includes labels for 'Sree Rang Ujvan', 'Pandit Deendayya Energy University', 'GNLU library', and 'Gujarat National Law University'. The interface includes a top menu bar, a toolbar, a left sidebar with 'Favorites' and 'Layers' panels, and a right sidebar with the 'Processing Toolbox'.

**Processing Toolbox**

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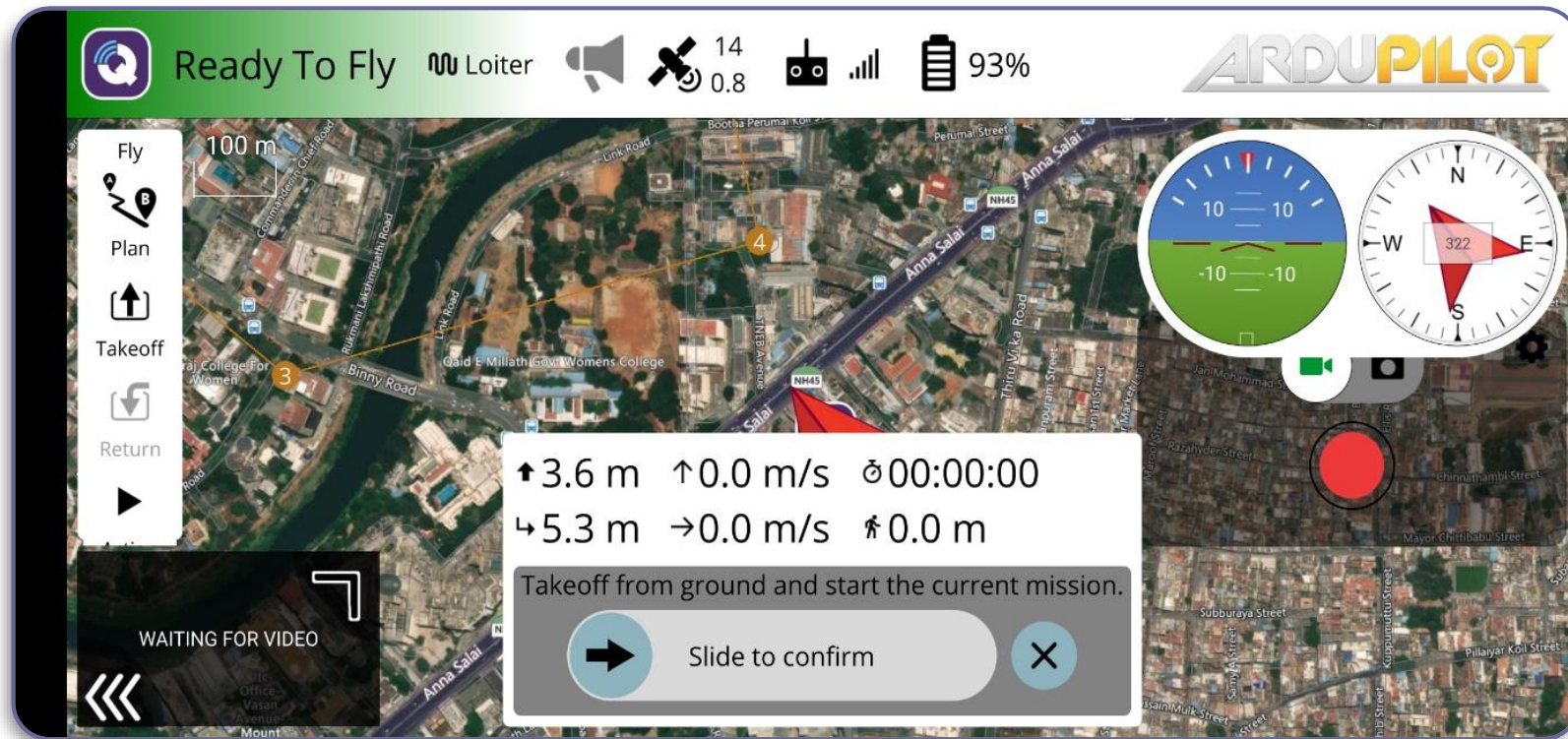
**Layers**

- flight\_design\_1
  - projection centres\_1
  - flight\_line\_1
  - waypoints\_1
  - photos\_1
- Reprojected
- OpenStreetMap

Coordinate: 8089111, 2651567 Scale: 1:5977 Magnifier: 100% Rotation: 0.0° Render: EPSG:3857

# QGroundControl

- QGroundControl (QGC) is an intuitive and powerful ground control station (GCS) for UAVs.
- Provides full flight control and mission planning for any MAVLink enabled drone.
- Its primary goal is ease of use for professional users and developers.



## Caution while using QGroundControl (QGC)

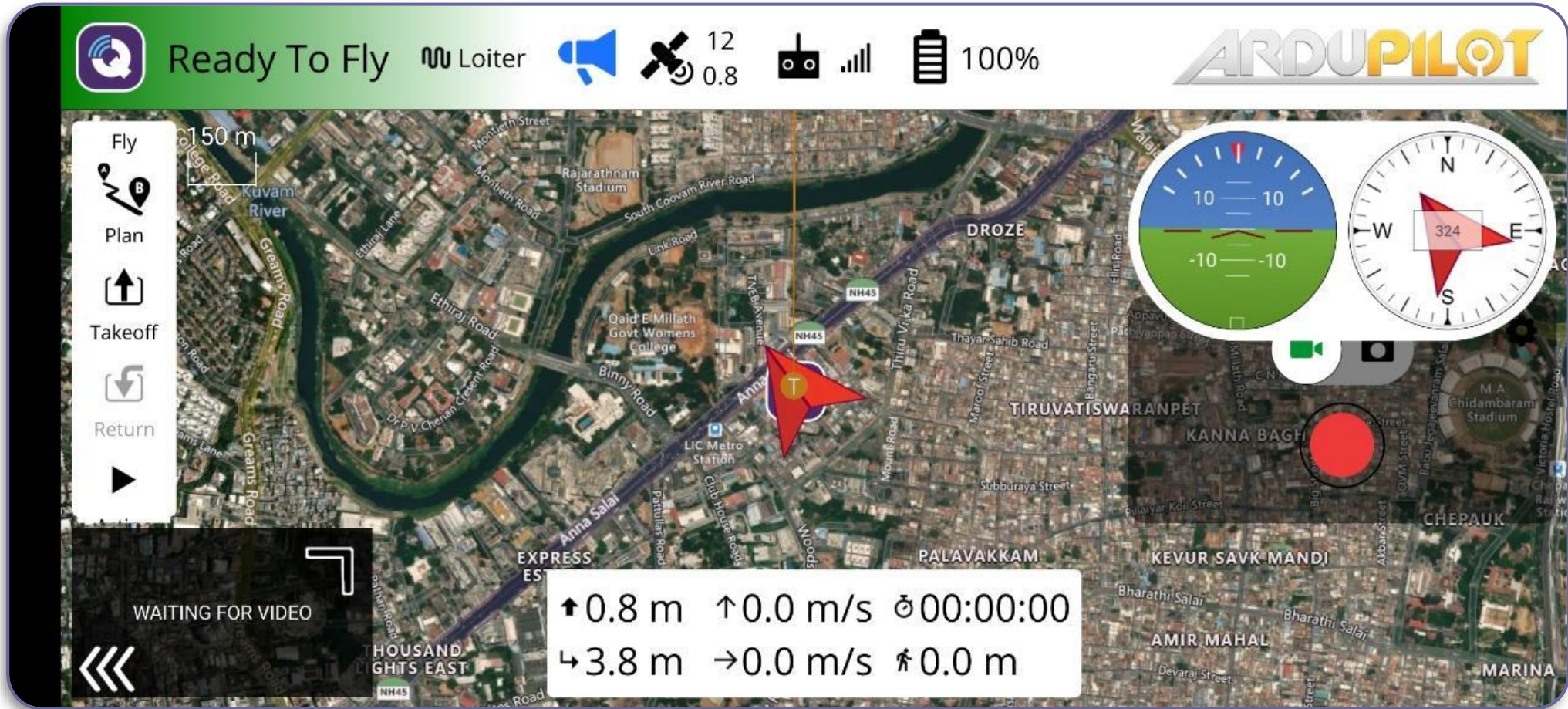
While using a QgroundControl following things should be appear on QGC.

1. Ready to Fly should be appear in top left corner
2. Satellite count should be more than 10s
3. Horizontal Dilution of Precision (HDOP) should be less than 1.



# Steps to plan a survey mission

1. Click on plan



# Steps to plan a survey mission

## 2. Select Survey

The screenshot displays a drone mission planning application interface. At the top, a status bar shows mission details: "Selected Waypoint" (Alt diff: 0.0 m, Azimuth: 0, Distance: 0.0 m, Gradient: --, Heading: nan), "Total Mission" (Distance: 0 m, Time: 00:00:00), and "Max telem dist: 0 m". An "Upload" button is located in the top right corner. On the left, a vertical toolbar contains icons for Plan, Fly, File (highlighted in orange), Takeoff, Waypoint, Pattern, and Storage. The main area is divided into a "Create Plan" menu and a map. The "Create Plan" menu has four options: "Blank", "Survey" (highlighted with a white border), "Corridor Scan", and "Structure Scan". The map shows a satellite view of a rural area with a river and a red drone icon. On the right, a "Mission" panel is open, showing "Mission Start" settings: "All Altitudes", "Relative To Launch" (dropdown), "Initial Waypoint Alt" (50.0 m), "Vehicle Info" (dropdown), and "Launch Position" (dropdown).

# Steps to plan a survey mission

3. Add take off (Altitude) value in m. and Flight Speed

The screenshot displays a drone mission planning application interface. At the top, a status bar shows mission details: Selected Waypoint (Alt diff: 0.0 m, Azimuth: 0, Distance: 0.0 m, Gradient: --, Heading: nan), Total Mission (Distance: 0 m, Time: 00:00:00), and Max telem dist: 0 m. An 'Upload' button is located on the right. A central map shows a satellite view of a rural area with a red arrow indicating the launch position. A 'Create Plan' menu is open, showing four options: Blank, Survey, Corridor Scan, and Structure Scan. On the left, a vertical toolbar includes icons for Plan, Fly, File, Takeoff, Waypoint, Pattern, and Storage. On the right, a 'Mission Start' configuration menu is open, showing 'All Altitudes' set to 'Relative To Launch' and 'Initial Waypoint Alt' set to 50.0 m. Other menu items include 'Vehicle Info' and 'Launch Position'.

Selected Waypoint  
Alt diff: 0.0 m Azimuth: 0 Distance: 0.0 m  
Gradient: -- Heading: nan

Total Mission  
Distance: 0 m Time: 00:00:00  
Max telem dist: 0 m

Upload

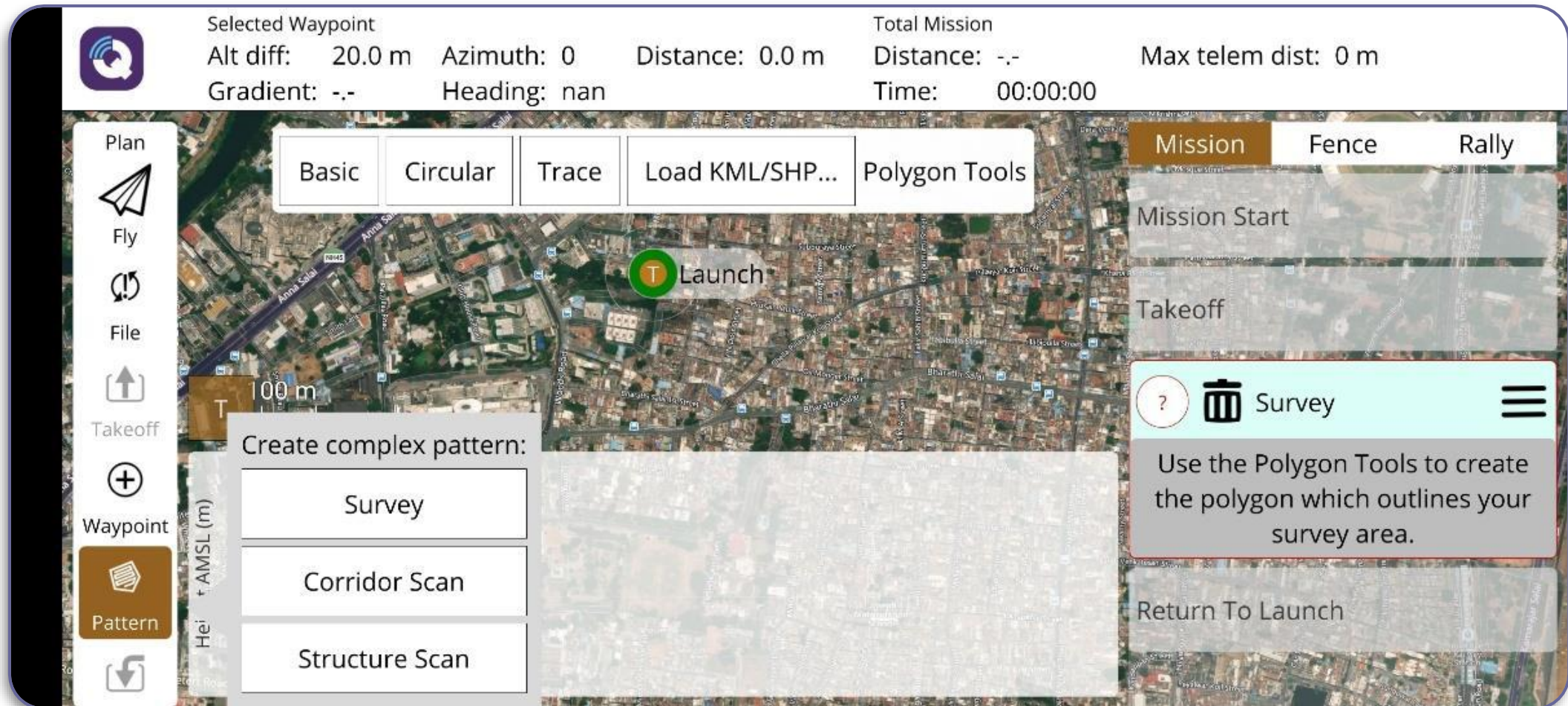
Plan  
Fly  
File  
Takeoff  
Waypoint  
Pattern  
Storage

Create Plan  
Blank  
Survey  
Corridor Scan  
Structure Scan

Mission Start  
All Altitudes  
Relative To Launch  
Initial Waypoint Alt  
50.0 m  
Vehicle Info  
Launch Position

# Steps to plan a survey mission

4. From mission tab select survey and then from *"pattern tab"* select survey, Mark the area accordingly.



# Steps to plan a survey mission

5. Add overlap more than 60% and altitude accordingly

The screenshot displays a flight planning application interface. At the top, mission statistics are shown: Selected Waypoint (Alt diff: 70.0 m, Azimuth: 114, Distance: 224.4 m, Gradient: 17 deg, Heading: nan), Total Mission (Distance: 1235 m, Time: 00:08:38), and Max telem dist: 224 m. A 'Upload' button is visible on the right.

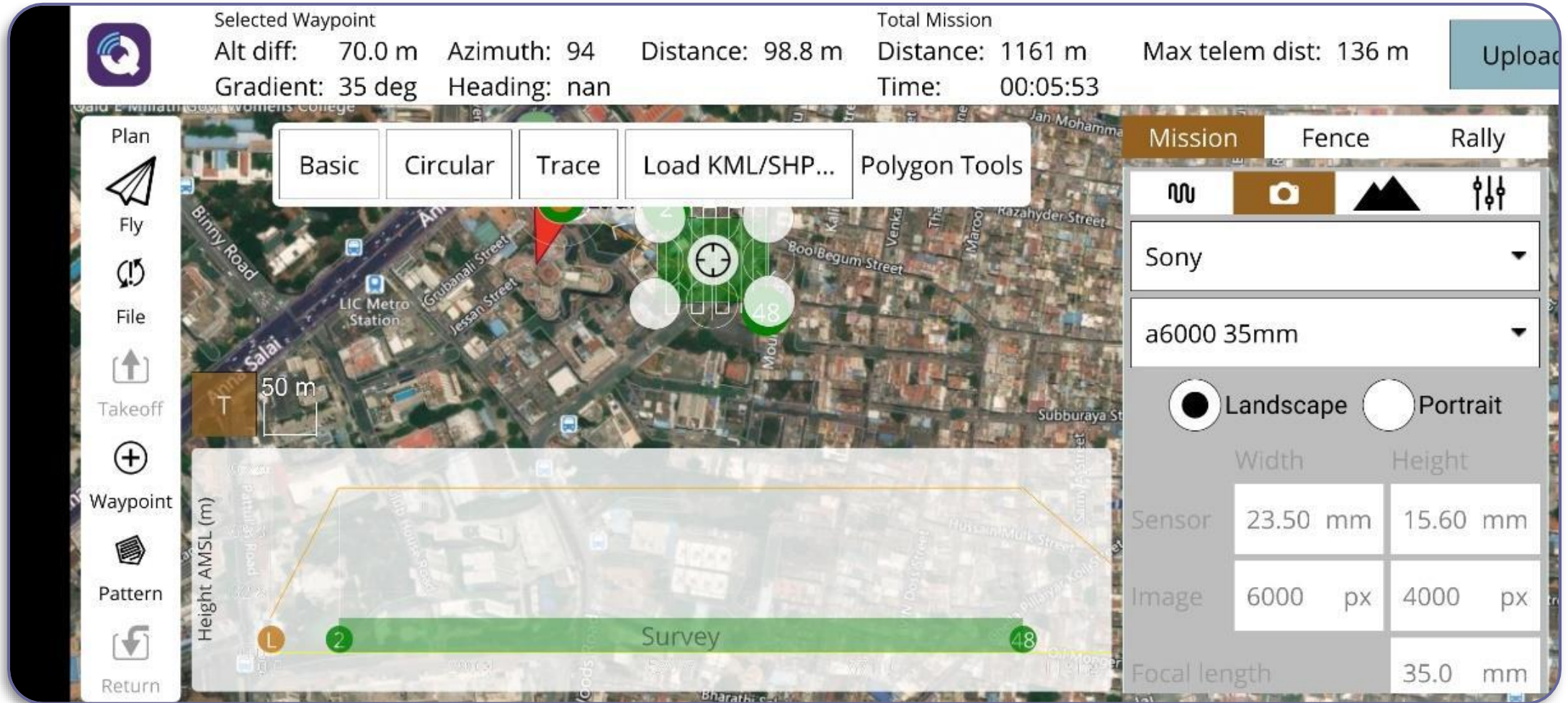
The main interface features a map with a green survey path and waypoints labeled 'Launch', '2', and '38'. A '50 m' scale bar is present. Below the map is a graph of Height AMSL (m) vs. distance, showing a green line for the survey path and a yellow line for the altitude profile.

Navigation and mission planning options are available on the left (Plan, Fly, File, Takeoff, Waypoint, Pattern, Return) and top (Basic, Circular, Trace, Load KML/SHP..., Polygon Tools). The right sidebar shows mission settings for 'Survey' under the 'Mission' tab, including 'Front Lap' and 'Side Lap' both set to 75%, and 'Altitude' set to 70.00 m.

Parameter	Value	Unit
Altitude	70.00	m
Grnd Res	0.8	cm/px

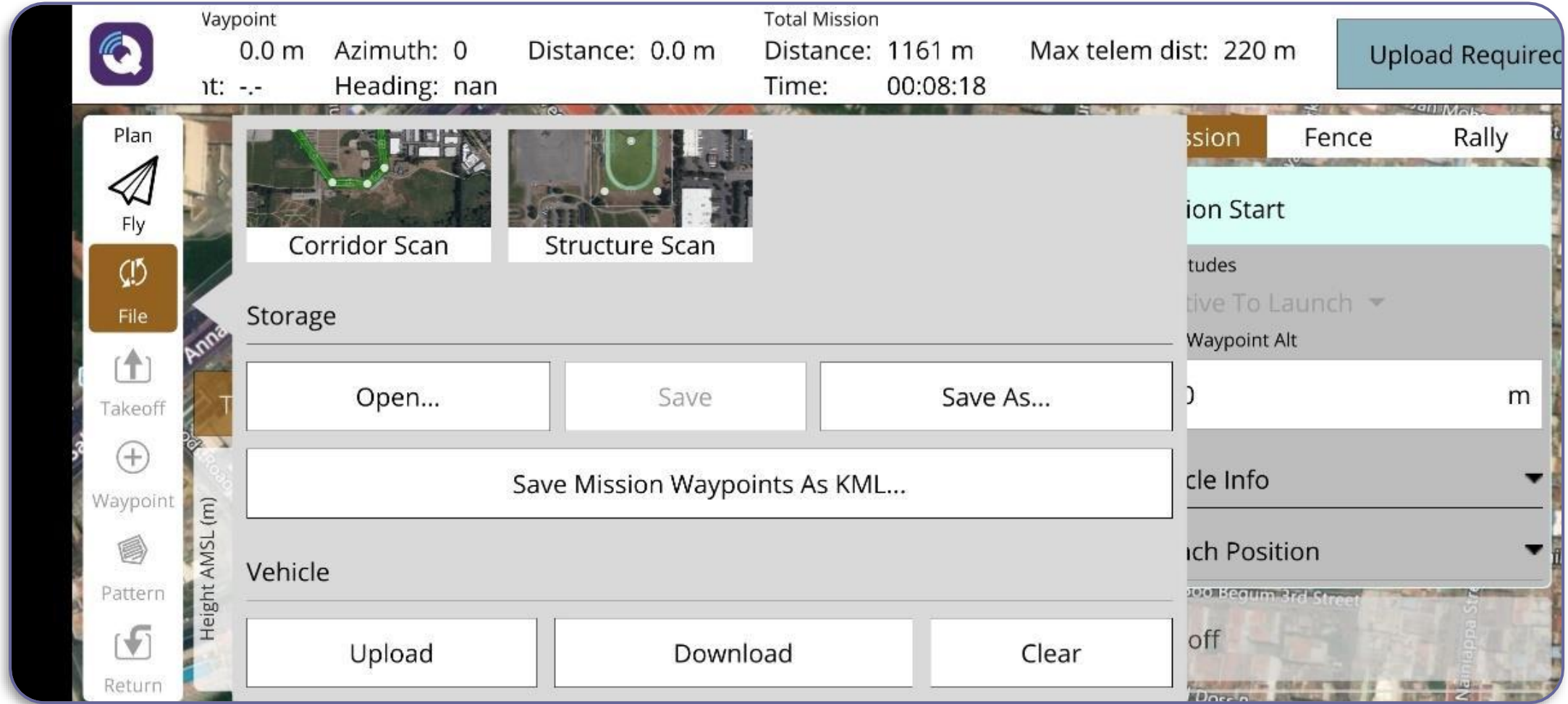
# Steps to plan a survey mission

6. Then select camera as Sony and model as a6000 35mm and upload the mission



# Steps to plan a survey mission

7. Go to file Download the mission



# Steps to plan a survey mission

8. Arm the Drone and slide the bar to execute the mission

