D-90AI
User Manual

Using this Manual – Legend

⚠ Important   🔍 Tips   ❓ Explanation

Revision History

Date	Document Version
2023.06.19	V1.0

Date	Document Version
2023.10.16	V1.1

1. Installation: Add requirement of gimbal cooling.[P3]
2. Configuring & Updating Firmware:
   2.1 Modify default IP address of GCU
   (192.168.1.121 → 192.168.144.121)
   and default IP address of camera
   (192.168.1.108 → 192.168.144.108).[P4]
3. Configuring & Updating Firmware - Camera Configuring & Firmware Updating:
   3.1 Modify address of camera configuring webpage (http://192.168.1.108/cgi-bin/config → http://192.168.144.108/cgi-bin/config).[P4]
   3.2 Modify supported stream mode (RTSP & UDP → RTSP).[P5]
   3.3 Add explanation of camera firmware updating.[P6]
4. Add explanation of real-time video playing.[P6]
5. Appendix 1 Specifications:
   5.1 Add parameters of target positioning accuracy.[P7]
   5.2 Add parameters of laser range finder (Beam Diameter).[P8]
   5.3 Modify supported stream network protocol (Delete UDP).[P9]
   5.4 Modify supported maximum SD card capacity (128GB → 256GB).[P9]
6. Add Appendix 2: SEI Data Structure.[P10]

Date	Document Version
2024.03.12	V1.2

1. Appendix 1 Specifications:
   1.1 Modify parameters of object detection/ identification/ verification distance of zoom camera.[P7]
   1.2 Modify parameters of object detection/ identification/ verification distance of thermal camera.[P8]
2. Modify Appendix 2: SEI Data Structure.[P10]

Caution

1. When not in use, store the D-90 in the package box. The recommended storage environment is a relative humidity less than 40% at a temperature of 20±5° C. If the lenses fog up. The water vapor will usually dissipate after turning on the device for a while.
2. Do not expose the thermal camera lens to a strong energy source such as sun, lava or laser beam. The temperature of the observation target should not exceed 800°C , otherwise it will cause permanent damage.
3. Do not place the product under direct sunlight, in areas with poor ventilation, or near a heat source such as a heater.
4. Do not frequently power on/off the product. After it is turned off, wait at least 30 seconds before turning back on, otherwise the product life will be affected.
5. Make sure the gimbal port and gimbal surface are free from any liquid before installation.
6. Make sure the gimbal is securely installed onto the aircraft, the microSD card slot cover is clean and firmly in place.
7. Make sure the gimbal surface is dry before opening the microSD card slot cover.
8. Do not plug or unplug the microSD card during use.
9. Do not touch the surface of the camera lenses and keep it away from hard objects. As doing so may lead to blurred images and affect the imaging quality.
10. Clean the surface of the camera lenses with a soft, dry, clean cloth. Do not use alkaline detergents.
11. When not receiving valid carrier INS data, the yaw shaft of the gimbal will drift about 15 degrees per hour because of the earth rotation. To make sure the gimbal attitude corrects, it is necessary to transmit valid carrier INS data, usually the GNSS should be positioning.

Catalog

Introduction

Synopsis

The D-90ᴀɪ equips with a high accuracy 3-axis nonorthogonal gombal, a 30x zoom camera and a long-wave thermal camera, which can provide visual and infrared images simultaneously. Thanks to the laser range finder, the D-90ᴀɪ can provide the location of a target and the distance to it that improves working efficiency.

The D-90ᴀɪ have AI multi-object detection and tracking function. The gimble camera can intelligently identify the persons and vehicles in the image, and constantly track one of them.

The D-90ᴀɪ can be mounted tool-lessly onto multiple carriers, whether downward or upward. With the GCU and the Dragonfly software, user can watch the image from the camera and control the gimbal real-timely on a computer.

Characteristics

- Features AI multi-object detection and tracking, which can constantly track one of the persons and vehicles intelligently identified in the image.
- Carries a 30x zoom camera, a thermal camera and a laser range finder.
- Low-profile spherical shape and 3-axis nonorthogonal mechanical stabilized structure, minimize the gyration radius and the wind resistance of the gimbal. The D-90ᴀɪ is able to spin continually around its yaw axis.
- With the GCU, the D-90ᴀɪ supports network, UART and S.BUS control. The GCU supports both private protocol and MAVlink protocol.
- Thanks to the Dual-IMU complementary algorithms with IMU temperature control and carrier AHRS fusion, the D-90ᴀɪ provides a stabilization accuracy at $\pm0.01°$.
- Can be mounted onto multiple carriers, whether downward or upward.
- With the GCU and the Dragonfly software, user can watch the image and control the gimbal without protocol ducking.
- Screen supports overlaying OSD information such as latitude, longitude and altitude. Image supports shooting point coordinate EXIF save. Video stream supports SEI stacking.
- 14~53 VDC wide voltage input.

Overview
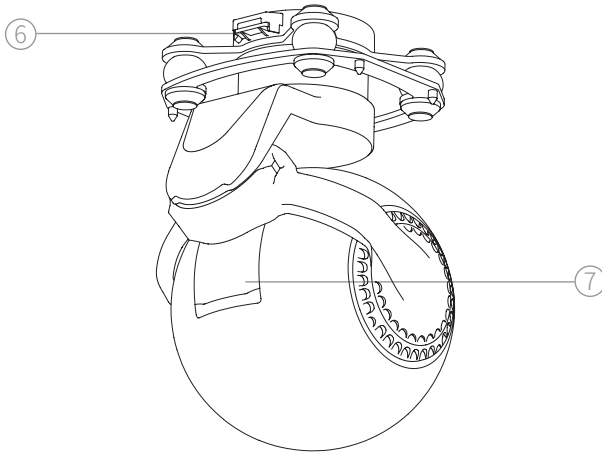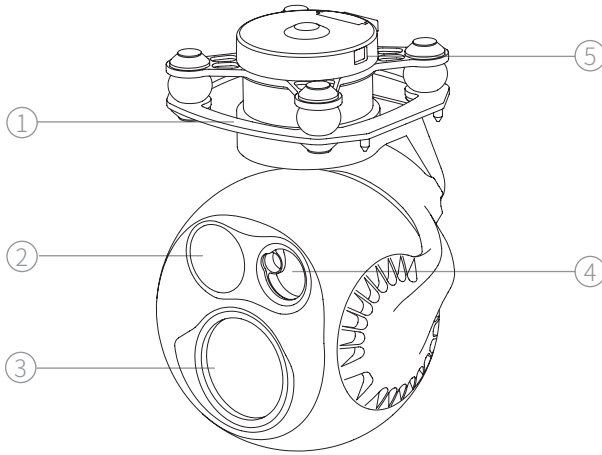
1. Damping Platform   2. Thermal Camera
3. Zoom Camera   4. Laser Range Finder
5. Update Port   6. Control Port
7. MicroSD Card Slot

Installation

1. Remove the control port protector.
2. Align and insert the 4 pins into the locating holes of the mount platform. Press down the lock catch to fix the gimbal. The gimbal can be also fixed with screws through the holes on the damping platform.
3. Plug the gimbal control cable into the control port and install the port protector back.
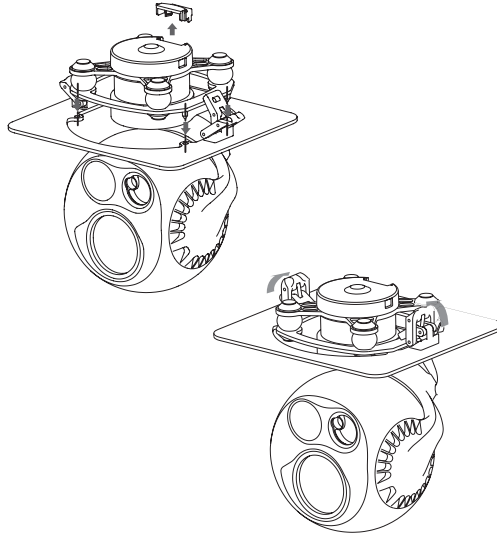
⚠ While upward mounted or mounted at carriers with large vibration or impact, the gimbal should be fixed with screws nor the quick-release locks.

⚠

⚠ Avoid squash the cable while installing the port protector.

⚠ Ensure the microSD card slot cover is firmly in place to prevent dust or moisture entering during usage or storage.

⚠ The gimbal heats while operating. Please ensure the device good cooling.

🔍 The MicroSD card should be configured as HDD-FAT32 mode.

Configuring & Updating Firmware

⚠ Ensure the gimbal and the GCU have both been updated to the latest firmware before use. Otherwise, usage may be affected.

⚠ Ensure the diver of the config module is installed on the computer before configuring or updating the firmware.

⚠ Before configuring, the computer should be set to a static IP address, which is in the same network segment with the GCU and the camera (without IP address conflicts). The default IP address of the GCU and the camera are 192.168.144.121 and 192.168.144.108.

⚠ Do not power off the device while updating the firmware. Restart the device once firmware update is complete.

Camera Configuring & Firmware Updating

Camera Configuring

1. Connect the gimbal and the GCU with the gimbal control cable. Connect the computer and ETH port of the GCU with the network conversion module. Power on the devices.
2. Visit http://192.168.144.108/cgi-bin/config on the computer (if the IP address of the camera has been changed, the IP address in the URL should be replaced with the current camera IP address).
3. Configure the camera in the web page, and click"save"to save the configuration.
4. Restart the gimbal to enable the configurations to take effect.

⚠ It is not able to read current configurations of the camera in this page.

IP Address: [ ]
Gateway: [ ]
Udp target: [ ]
Udp port: [ ]
Stream Bitrate: [ ]
Output Resolution: [1080P ▾] Output FPS: [25FPS ▾]
Stream Mode: [stream media ▾]
Encode Format: [h264 ▾]
Save Format: [mp4 ▾]
Save Stream Bitrate: [ ]
[save]
Update File: [选择文件] 未选择文件   (Select Your Local Update File)
[update]

- IP Address / Gateway
  Camera IP Address / Camera Gateway.
- Udp target / Udp port
  Should be configured while the stream is in UDP mode.
- Stream Bitrate
  Image transfer rate, which is in the unit of bps. The higher the stream bitrate, the clearer the transferred image, yet the higher request to the bandwidth of the image transmission system.The recommended range is [2048~8192].
- Output Resolution / Output FPS
  Default as 1080P / 25FPS
- Stream Mode
  Stream Media / UDP / GB/T28181. Default as Stream Media. The Stream Media is RTSP mode. UDP mode and GB/T28181 mode is unavailable temporarily.
- Encode Format
  H.264 / H.265. Default as H.264.
- Save Format
  Default as MP4.
- Save Stream Bitrate
  Image storage rate, which is in the unit of bps. The higher the storage bitrate, the clearer the storage image, yet the higher request to the storage rate of the MicroSD card.The recommended range is [2048~9216].

Camera Firmware Updating

Select the firmware, click "update" and wait for updating completing. If the updating failed, please retry on another computer.

Gimbal Updating Firmware

1. Connect the gimbal and the GCU with the gimbal control cable. Connect the computer and the gimbal update port with the config module. Power on the devices.
2. Run GimbalConfig software. Choose the COM port corresponding to the config module. Click "Open Firmware" , choose the firmware file, click "Start Upgrade" and wait for the updating complete.
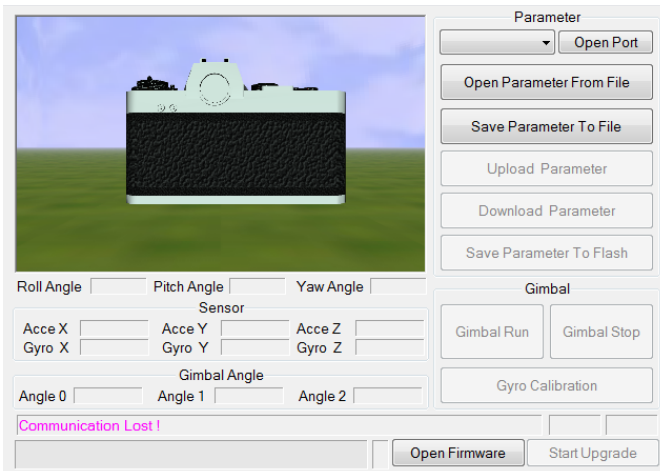
Real-time Vedio Playing

Example as camera IP address 192.168.144.108:
Stream address: rtsp://192.168.144.108/554

Appendix 1 Specifications

General	
Product Name	D-90AI
Dimensions	Gimbal: 96.4 x 96 x 147mm GCU: 45.4 x 40 x 13.5mm
Weight	Gimbal: 608g GCU: 18.6g
Operating Voltage	14 ~ 53 VDC
Power	Gimbal: 10.5W (AVG, ranging off) / 55W (Stall, ranging on) GCU: 1.8W
Mounting	Downward / Upward
Target Positioning Accuracy[1]	Horizonal Error：1.8m @ Horizonal Distance：105m Vertical Error：0.7m Relative Height：75m Horizonal Error：17.4m @ Horizonal Distance：513m Vertical Error：6.7m Relative Height：119m Horizonal Error：33.8m @ Horizonal Distance：1003m Vertical Error：13.7m Relative Height：246m
Gimbal	
Gimbal Type	3-axis Nonorthogonal Mechanical Stabilization
Angular Accuracy	±0.01°
Controllable Range	Pitch: -150°～ +50° , Yaw: ±360° constantly
Max Controllable Speed	Pitch: ±200° /s, Yaw:±200° /s
Zoom Camera	
Image Sensor	1/2.8" CMOS; Effective Pixels: 2.07M
Lens	Focal Length: 4.7~47mm HFOV: 61.3°～ 6.8° VFOV: 36.9°～ 3.9° DFOV: 68.4°～ 7.8°
Resolution	1920 x 1080
Pixel Pitch	2.9μm
Optical Zoom Rate	10x
Equivalent Digital Zoom Rate	3x
Min Illumination	Night Vision off: 0.01Lux / F1.6 Night Vision on: 0.0015Lux / F1.6
Object Detection Distance	EN62676-4:2015 — Person[2]: 709m / Light vehicle[3]: 932m / Large vehicle[4]: 1986m Johnson Criteria — Person: 8103m / Light vehicle: 24851m / Large vehicle: 52943m

Object Identification Distance	EN62676-4:2015	Person: 142m Light vehicle: 187m Large vehicle: 397m
	Johnson Criteria	Person: 2026m Light vehicle: 6213m Large vehicle: 13236m
Object Verification Distance	EN62676-4:2015	Person: 71m Light vehicle: 93m Large vehicle: 199m
	Johnson Criteria	Person: 1013m Light vehicle: 3106m Large vehicle: 6618m

Thermal Camera		
Thermal Sensor	Uncooled VOx Microbolometer	
Lens	Focal Length: 18mm HFOV: 24° VFOV: 18° DFOV: 30.4°	
Resolution	640 x 512	
Pixel Pitch	12μm	
Spectral Band	8~12μm	
Sensitivity (NETD)	<50mk@25° C	
Object Detection Distance	Johnson Criteria	Person: 750m Light vehicle: 2300m Large vehicle: 4900m
Object Identification Distance		Person: 188m Light vehicle: 575m Large vehicle: 1225m
Object Verification Distance		Person: 94m Light vehicle: 288m Large vehicle: 613m

Laser Range Finder	
Wavelength	905nm
Max Laser Power	1mW
Beam Angle	3.5mrad
Beam Diameter	0.35m@100m
Laser Safety	Class 1M（IEC 60825-1:2014)
Measurement Accuracy	±1.0m
Measurement Range	5-1200m（φ12m vertical surface with 20% reflectivity)

AI Multi-object Detection & Tracking	
Object Size	16x16 ~ 128x128 px
Object Identification Delay	＜ 40ms
Tracking Speed	±32 px / field
Tracking Deviation Refresh Rate	30Hz
Tracking Deviation Output Delay	≤ 5ms
Image & Video	
Image Format	JPEG
Maximum Image Resolution	1920 x 1080
EXIF	Shooting point coordinate
Video Format	MP4
Maximum Video Resolution	1080P@25fps
Stream Encode Format	H.264, H.265
Stream Network Protocol	RTSP
Storage	
Supported SD Cards	Supports a Speed Class 10 MicroSD card with a capacity of up to 256GB
Support File System	HDD-FAT32
Environment	
Operating Temperature	-20°C～ 50°C
Storage Temperature	-40°C～ 60°C
Operating Humidity	≤ 85%RH （Non-condensing）

[1] Measured by gimbal mounted on a dual antenna RTK positioned multicopter drone to a known coordinate point. The target positioning accuracy is influenced by carrier's positioning and orientation accuracy, angle between the direction of gimbal mounted and the heading of carrier, slant range, gradient of measurement line and air quality. The data is for reference only.
[2] Reference dimension of person: 1.8x0.5m. Critical dimension under Johnson criteria is 0.75m.
[3] Reference dimension of light vehicle: 4.2x1.8m. Critical dimension under Johnson criteria is 2.3m.
[4] Reference dimension of large vehicle: 6.0x4.0m. Critical dimension under Johnson criteria is 4.9m.

Appendix 2 SEI Data Structure

```
typedef struct // 64 bytes. Little-endian byte order. Byte alignment
{
    uint8_t head[2]; // Header [0xEE, 0x16]
    struct
    {
        uint8_t rng_trig:1; // Ranging trigger flag
        uint8_t_pip_state:3; // Pic-in-Pic Statue
                            0-Zoom camera (main)+Thermal camera (sub);
                                1-Thermal camera;
                            2-Thermal camera (main)+ Zoom camera (sub);
                                3-Zoom camera
        uint8_t data_valid:1; //Validity flag of carrier's coordinate, carrier's attitude
                            and gimbal's attitude
        uint8_t tgt_valid:1; //Validity flag of target's coordinate
        uint8_t reserved:2; // Reserved flag
    } flag;
    int32_t uav_lon; // Longitude of carrier. [-180°, 180°). Resolution 1e-7deg
    int32_t uav_lat; // Latitude of carrier. [-90°, 90°]. Resolution1e-7deg
    int32_t uav_alt; // Altitude of carrier. Resolution 1mm
    int32_t uav_hgt; // Relative height of carrier. Resolution 1mm
    int16_t uav_phi; // Roll angle of carrier. [-180°, 180°). Resolution 0.01deg
    int16_t uav_the; // Pitch angle of carrier. [-90°, 90°]. Resolution 0.01deg
    uint16_t uav_psi; // Yaw angle of carrier. [0°, 360°). Resolution 0.01deg
    int16_t cam_phi; // Roll angle of gimbal. [-90°, 90°]. Resolution 0.01deg
    int16_t cam_the; // Pitch angle of gimbal. [-180°, 180°). Resolution 0.01deg
    uint16_t cam_psi; // Yaw angle of gimbal. [0°, 360°). Resolution 0.01deg
    uint16_t cam1_zoom; // Zoom rate of zoom camera. Resolution 0.01x
    uint16_t cam2_zoom; // Zoom rate of thermal camera. Resolution 0.01x
    uint16_t rng_dist; // Distance from target. Resolution 0.1m (Invalid, 0)
    uint16_t gnss_week; //GNSS week
    uint32_t gnss_itow; //GNSS microsecond. Resolution 1ms
    int32_t tgt_lon; // Longitude of target. [-180°, 180°). Resolution 1e-7deg  (Invalid, 0)
    int32_t tgt_lat; // Latitude of target. [-90°, 90°]. Resolution 1e-7deg (Invalid, 0)
    int32_t tgt_alt; // Altitude of target. Resolution 1mm (Invalid, 0)
    uint16_t cam1_fl1x; // Focal length of zoom camera at 1x. Resolution 0.01mm
    uint16_t cam2_f1x; // Focal length of thermal camera at 1x. Resolution 0.01mm
    uint8_t reserved[4]; // Reserved
    uint8_t check_sum; // Checksum
} SdSei_t;
```