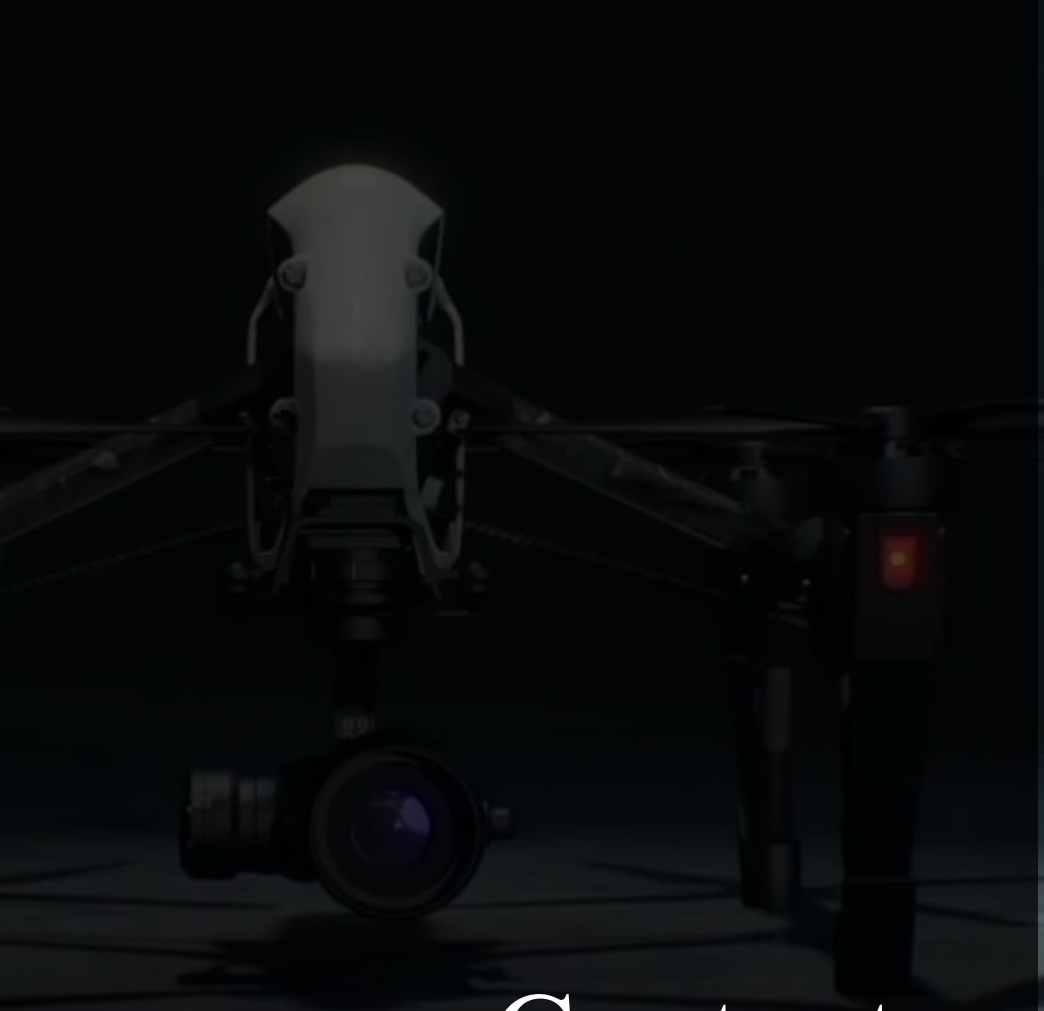
Aerial Robotics

Aerial Tracing Drone

Shandong Polytechnic College



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Name: Li Xiang

Role：Software engineer & Pilot

Responsibilities：Write code for autonomous fligt、multi-objects recognition system、autonomous tracking system and obstacle avoidance system，UAV flight & maintenance。

Name: Cao Li

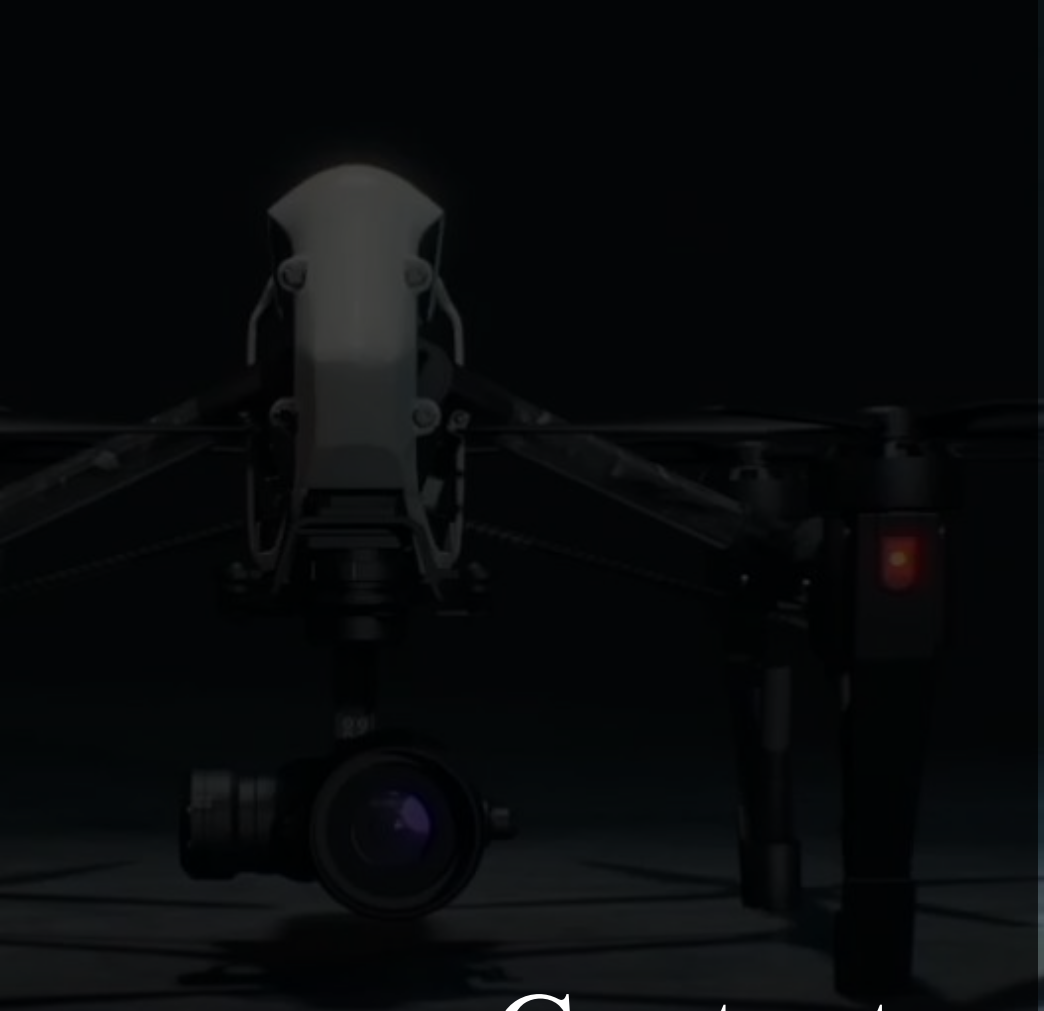
Role：Technical engineer & Translator

Responsibilities：Design propeller protection，test the function of sensors，organize the team’s work on github。

Name: Yin Zhihao

Role：Software engineer & Team caption

Responsibilities：Computer vision algorithm & Path planning algorithm，data analysis & visualization，machine learning。



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Theft

Tracing

Fire

Project background:

Drones can be useful in areas like large supermarkets 、 museums and unmanned monitoring of warehouses where there are several threats, including: things lost, fires predicted, and thieves who are difficult to capture.

	Problem	Our Solution
1	Drones may collide while in flight and pose a risk to pedestrians when they are dropped.	Develop a propeller protection for drones
2		Develop the UAV obstacle avoidance system and path planning system
3	Drones need to be able to fly stably and position themselves accurately during patrols.	Develop a drone positioning system
4	It is time-consuming and labor-intensive to manually search for lost items in large venues.	Development of computer vision recognition systems with the ability to perform multi-target recognition
5	There is not a single lost item, but many categories such as bags, cell phones, laptops, bicycles, mugs, etc.	
6	Unattended warehouses, museums, and other places are at risk of fires that are not immediately detected.	
7	It is not possible for warehouses and museums to react rapidly to unattended trespassers or the vehicles they drive.	Development of a drone tracking system
8	Some small targets are hard to spot	Using large data sets, resizing input images
9	Need to be able to view drone status and image information in real time	Prometheus-based development of human-computer interface, real-time view of the status of the drone

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Hardware

1.PX4

Open source flight controller

2.Nvidia Orin NX

Onboard computer

3.intel D435i

Realsense camera

7. LQ-3

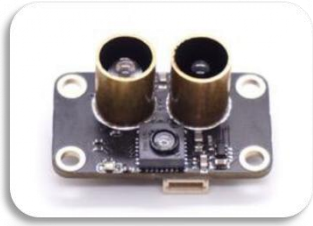
Image & data transmission module

4.intel T265

Realsense camera

5.MTF - 01

Optical flow & Laser Ranging



6.LiDAR

Detecting object location

Software

Based on:

Ubuntu 20.04
&
ROS

1.VS Code
Programming

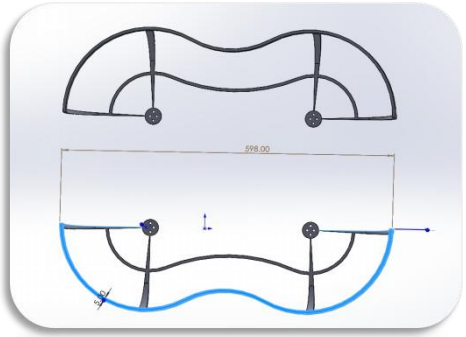
2.Gazebo
Simulation

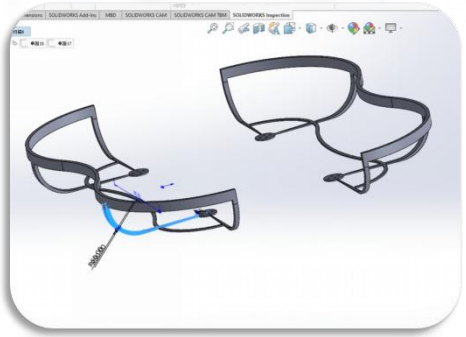
3.RViz
3D visualization

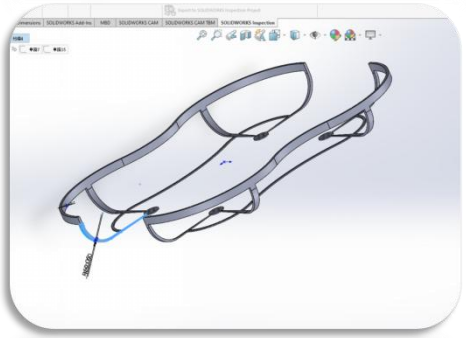
4.QGrandControl
UAV ground station

5.NoMachine
Remote Desktop Tools

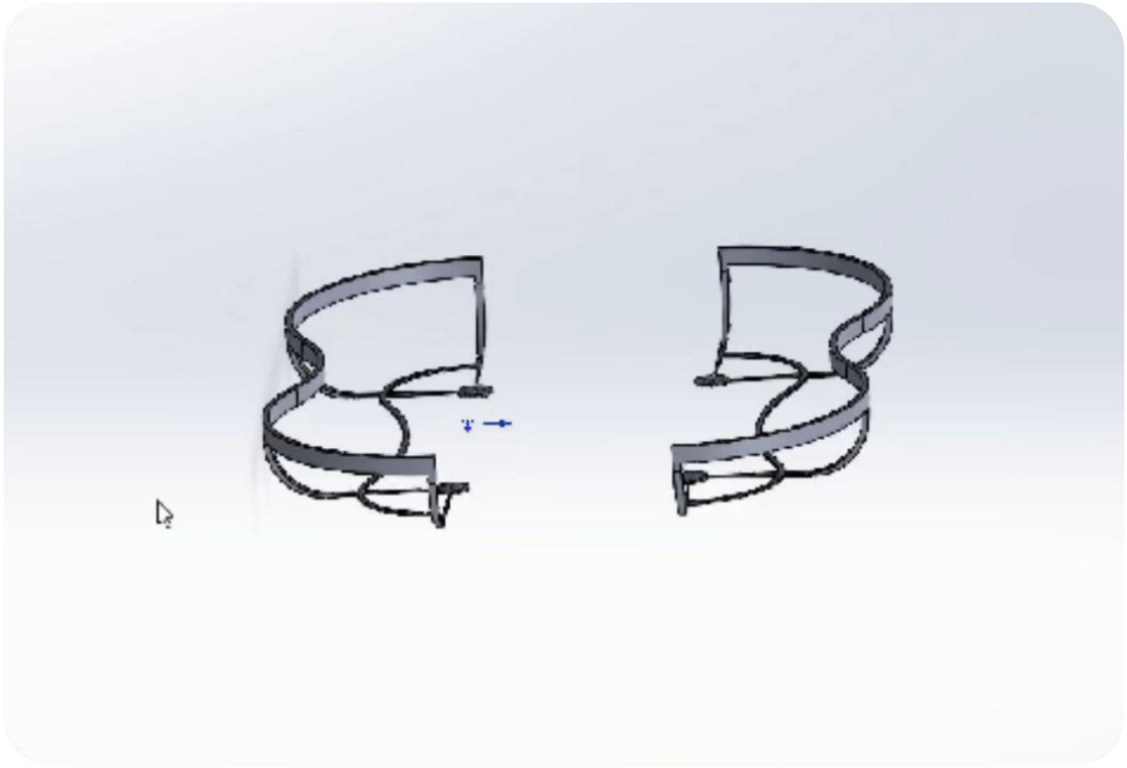
6.PrometheusGS
Real time status monitoring of UAV

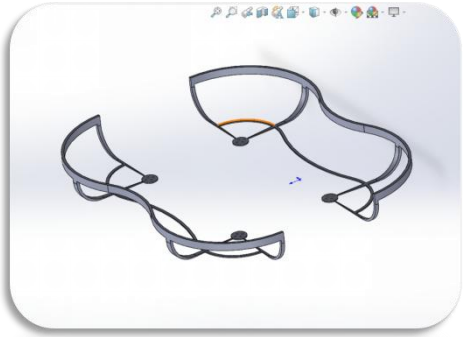


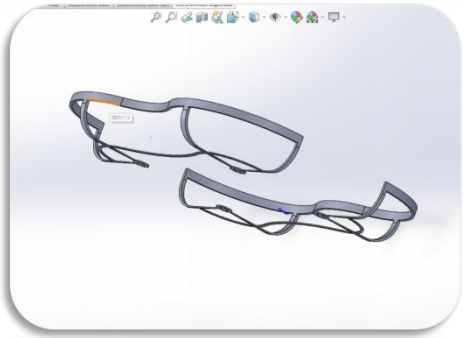


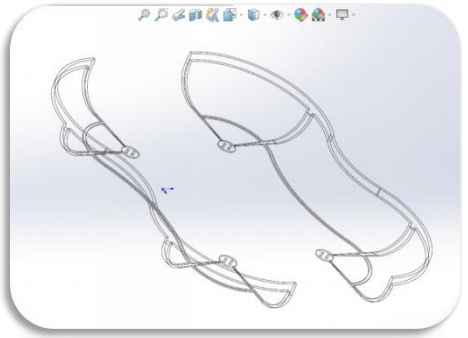


1.Propeller protection

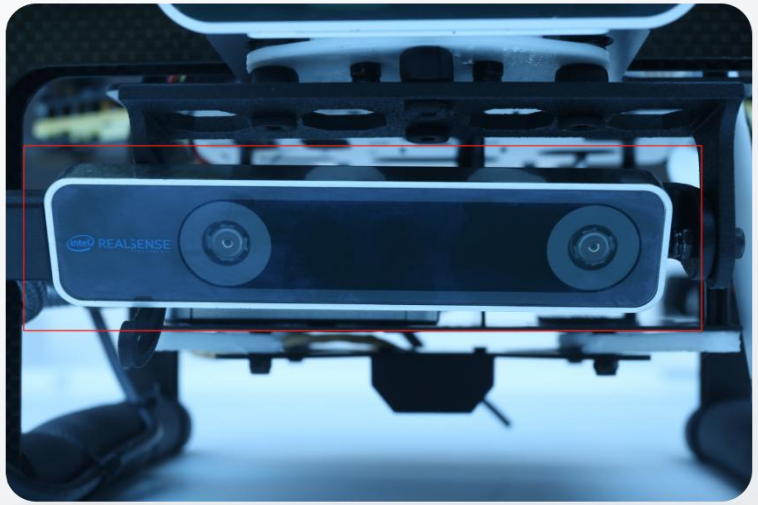








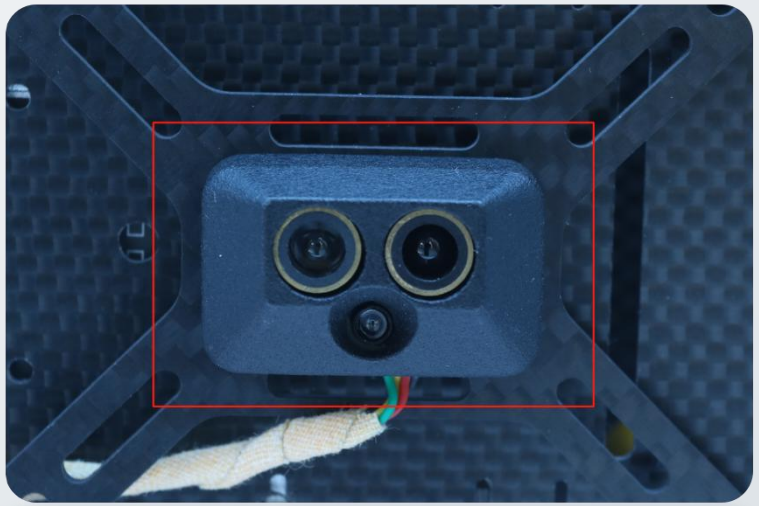
2. Technology： UAV positioning



Sensor： intel RealSense T265

Technology： Computer vision

Instruction： The target’s data is captured by the camera, and then the target is localized by the image processing algorithm.



Sensor： Optical flow & Laser Ranging Model

Technology： Computer vision & TOF

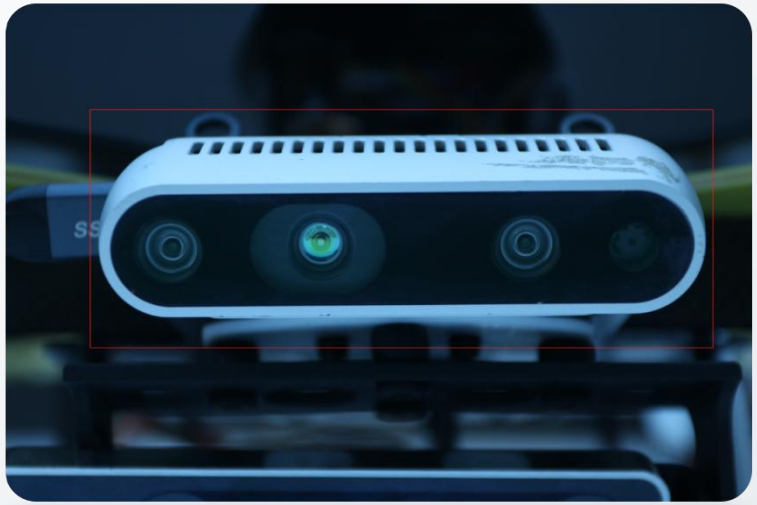
Instruction： Positional information can be inferred and the velocity in both the horizontal and vertical directions can be approximated by examining the motion of pixel points in a series of frames of an image.

2. Technology： UAV positioning

Use computer vision & optical flow system to localize the UAV.

During the manual test, release the remote control and keep the UAV flying steadily at the current point.

3. Technology： obstacle avoidance & path planning



Sensor： intel RealSense D435i

Technology： Computer vision

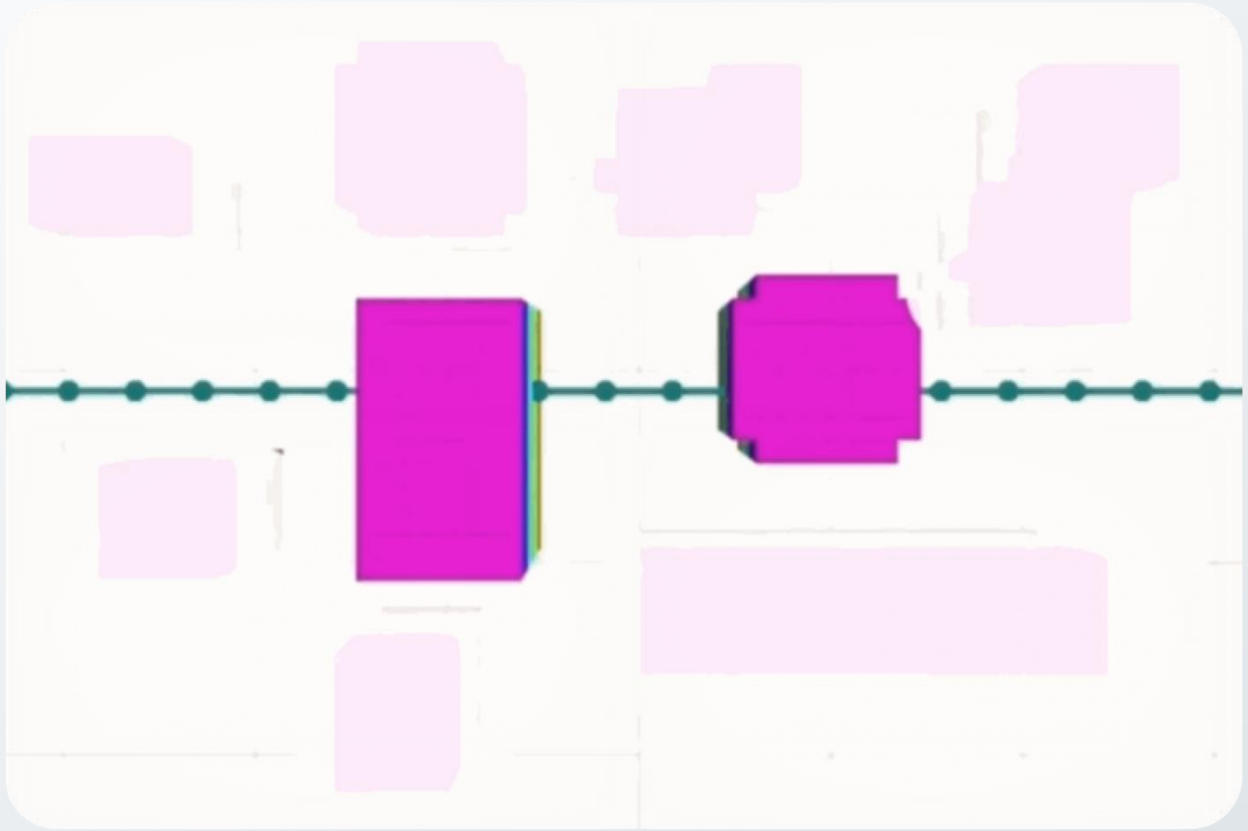
Instruction： It is able to process point cloud data to realise the visual obstacle avoidance function and determinethe distance between an item and the camera with accuracy by its built-in depth perceptiontechnology and image processing algorithms.

Sensor： LiDAR

Technology： TOF

Instruction： Transmitting microwave signals and measuring the reflected back signals allows users to determine the position, dimensions, and shape of obstacles.

3. Technology： obstacle avoidance & path planning



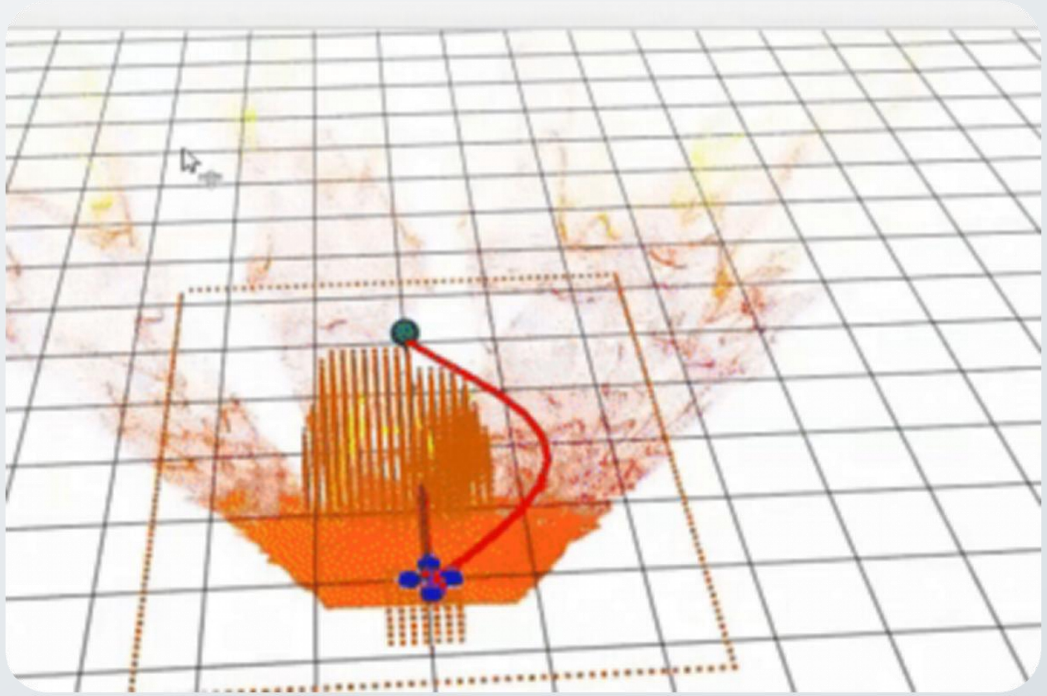
Planning algorithm for the Ego-Planner path:

When a trajectory collides with an obstacle during the optimisation process, a force is generated on the trajectory depending on the collision that pushesthe trajectory away from the obstacle.

3. Technology： obstacle avoidance & path planning

Visual obstacle avoidance

(VOA)



3D visualization tools in the ROS framework

RViz

4. Technology： Multi-objects recognition

Sensor：intel RealSense D435i

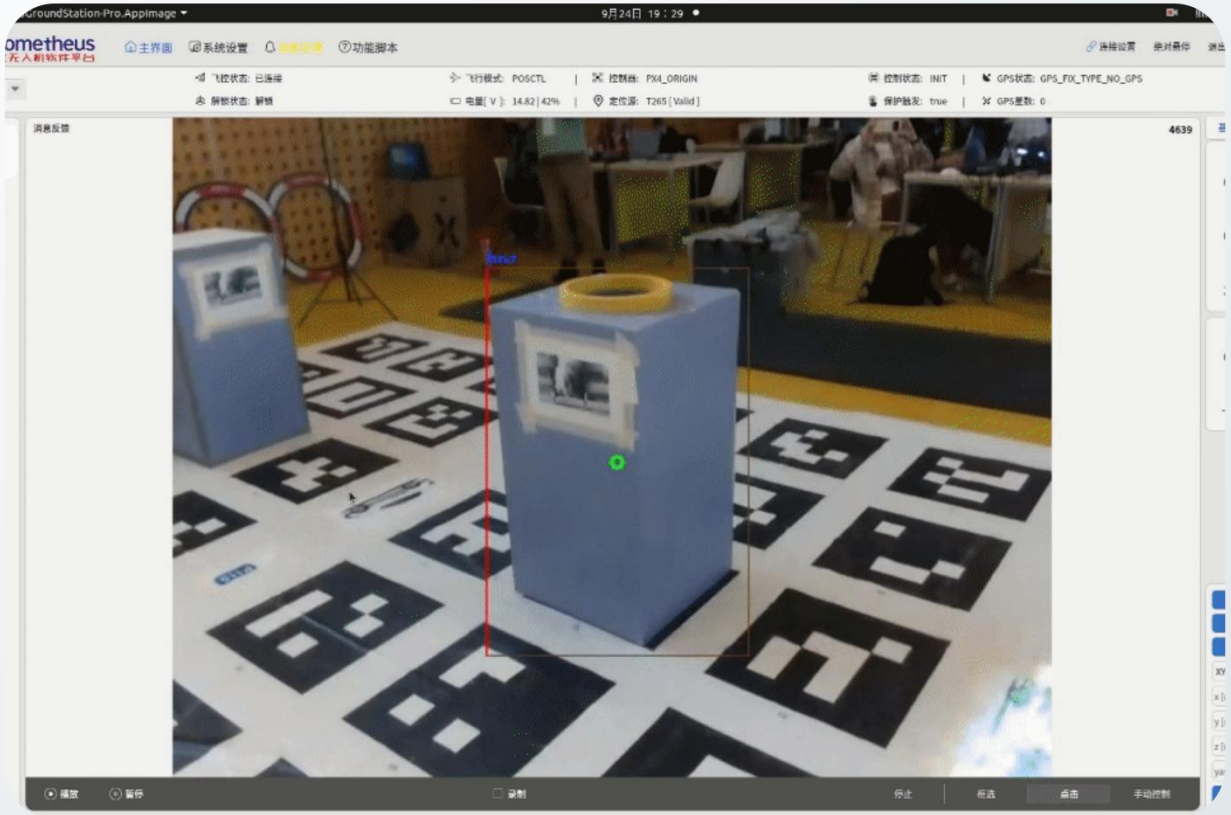
Technology：Computer vision

Algorithm：yolov5

Instruction：Convolutional Neural Networks (CNN) are used to identify the target's location and category by extracting characteristics from the image.

目标追踪介绍：

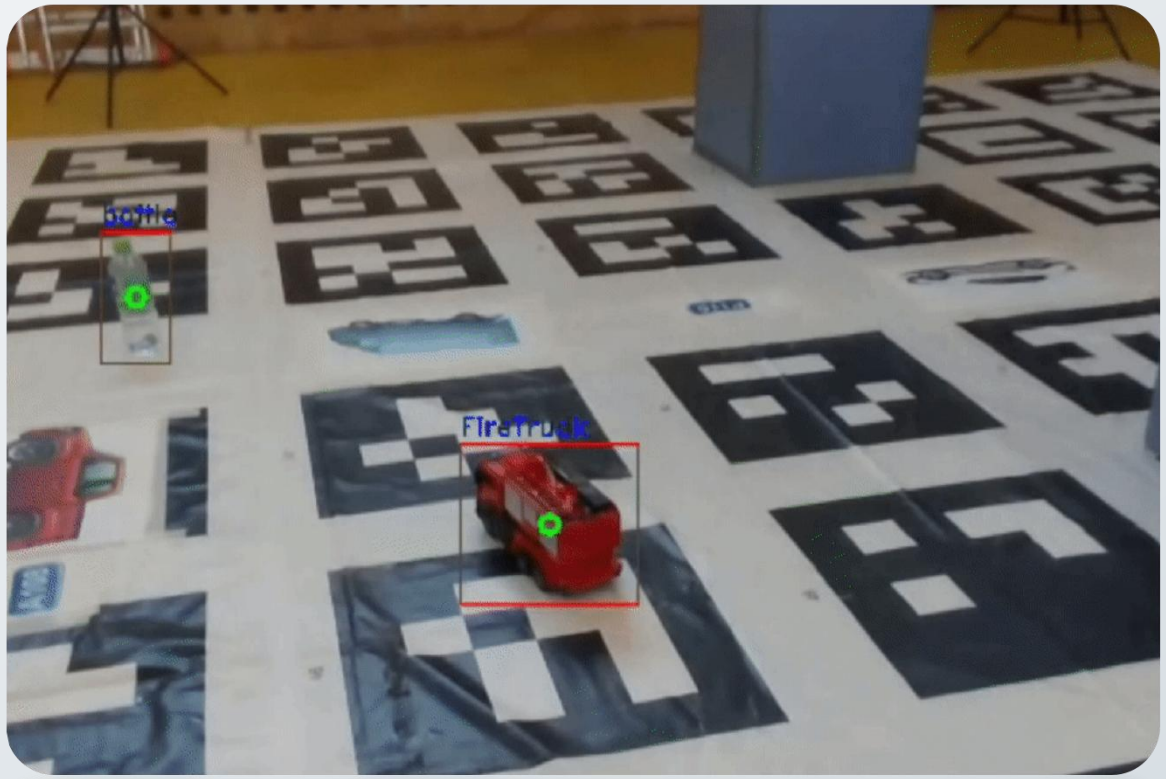
4. Technology： Multi-objects recognition



Use machine learning to improve UAV recognition of multi-target objects.

4. Technology： Drone tracing

Shooting Angle



Drone View

Target tracking in the Yolov5 model can be achieved by using the prediction frame's position data and confidence level.

Use yolov5 algorithm to detect objects in the image, assign a unique ID to each object, and then perform target object locking to track the target at a fixed distance and speed, and keep the target in the center of the screen at all times.

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Creativity

Multi-objects recognition & Autonomous tracking

Target user group

Massive unmanned monitoring of sites requiring security monitoring

Benefits

Reduction of on-duty personnel & Increase of on-duty efficiency

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