

# **The First World Vocational College Skills Competition**

## **Reparation and Application of UAV**

### **Skill Competition**

### **Test Projects**

## I. Name of the Skill

Reparation and Application of UAV

## II. Completion Time of the Competition

The duration of the Reparation and Application of UAV Skill Competition in the First World Vocational College Skills Competition (the “Competition”) is 300 minutes, with the composition and time allocation of specific tasks as shown in the following table.

Table 1 Time Allocation of the Competition

No.	Task name	Competition duration
Competition Task I	UAV assembly and debugging	150 min
Competition Task II	UAV flight control	30 min
Competition Task III	UAV application and development	120 min
Additional tests	Flight control on the Competition tracks with considerable difficulties	Optional

## III. Marking Allocation for Tasks

The Competition adopts a full mark of 200 points, ten of which are for additional tests, with marking allocation for the Competition as shown in the following table.

Table 2 Marking Allocation of the Competition

Assessment part	Assessment contents	Scores
Part I	UAV assembly and debugging	80
Part II	UAV flight control	40
Part III	UAV application and development	60
Part IV	Professional quality	20
Additional tests	Flight control on the Competition tracks with considerable difficulties	10
Total		210

#### **IV. Formation Method**

Each workstation has three competitors.

#### **V. Competition Equipment**

The equipment will be multi-rotor UAV assembly and debugging kits.

#### **VI. Precautions**

1. Competitors should compete at the workstation that has been drawn, and complete the entry card and workstation numbers on the cover of Test Project (“TP”) as required.

2. Competitors must conscientiously read the crucial tips of Competition tasks before the start of Competition.

3. Before the Competition starts, competitors should check the workstation equipment in line with the tool list earnestly and begin to compete after equipment confirmation; when competitors accomplish their tasks, all gauges, meters and materials that have been utilized should be collected by judges at the workshop in a unified manner.

4. Materials and software for the Competition have been saved in an electronic version in the designated D:\ folder of computers at the workstation.

For spare files and files that need to be saved in the computer required in the TP, a competitor needs to name corresponding folders in the designated D:\ folder (for instance, the “1” of “1DS01” means the first session and “DS01” refers to the number 01 workstation; competitors should create a new folder under this one for each specific task; in terms of “1RW01”, “1” represents Task I and “01” is the workstation number). Please back up the files, as required in the TP, under the corresponding folder. Even if they have zero backup file, competitors should create a new folder.

Competitors should not leverage a USB flash disk during the Competition.

5. There are two areas for the Competition workshops. To be specific, Competition Task I and II will be conducted in the development area of equipment tuning, and Competition Task III and additional tests will be launched in the integrated field validation area.

6. Time nodes for judges to mark are explicitly prompted in the TP. For tasks that need to be validated and collected by judges, competitors should give a sign to the judges for judging after completing the corresponding tasks. As for each Competition task, the judge will validate and collect it once. Please ask judges for validation and collection after the confirmation of completing the task in line with the description of TP.

For parts that need to be confirmed by judges during the Competition, competitors should first raise their hands for indication and then wait for the judges to confirm them.

7. During the Competition, competitors should conform to relevant rules and policies and safety rules. If there is any violation, corresponding points will be deducted from the overall results of the exam in accordance with relevant rules.

It is strictly forbidden for competitors to bring any communication, storage equipment and technical materials into the workshop. If identified, they will be disqualified from the Competition. A competitor should not leave the team's workstation or exchange with other competitors not in his/her workstation or speak loudly in the workshop, which will seriously impact on the order. If any, the competitor will be disqualified from the Competition.

8. During the Competition, if there is any accident that endangers equipment or personal safety, the judge has the right to suspend the Competition immediately. For severe circumstances, the judge will cancel the competitor's qualification.

9. Competitors must fill in all types of documents in an earnest manner and submit them in line with the page sequence after completing the Competition. Any items provided at the workshop should not be taken away.

# Competition Task I UAV Assembly and Debugging

**Time: 150 min**

## I. Task Background


Quad-rotor UAVs, as the typical model of multi-rotor UAVs, are the most common ones applied in a most extensive manner. Competitors need to complete the production and manufacturing of a quad-rotor logistics UAV. The materials of UAV body are carbon fiber and aviation aluminum, and the load device is a set of mechanical claws made of alloy.

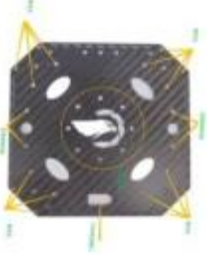
As a technician, please select a power combination for the UAV with the highest flight efficiency and then assemble the UAV body and loading device, in accordance with the material list, guidelines for UAV assembly offered on-site and relevant files.

## II. Equipment List

### 1. UAV frame




Table 3 Material List of Quad-rotor UAV Frame

Name of Part	Specifications	Sample
Upper center plate	Material: Carbon fiber Dimension: 124mm*124mm*1.5mm Quantity: 1 pc	

<p>Lower center plate</p>	<p>Material: Carbon fiber Dimension: 124mm*124mm*1.5mm Quantity: 1 pc</p>	
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Name of Part	Specifications	Sample
Hanging support plate	Material: Carbon fiber Dimension: 80mm*120mm*1.0mm Quantity: 1 pc	
Sideboard	Material: Carbon fiber Dimension: 77mm*26mm*1mm Quantity: 4pcs	
UAV arm	Material: Carbon fiber Dimension: 122mm*16mm Quantity: 4pcs	
Deviated stand of undercarriage	Material: Carbon fiber Dimension: 140mm*16mm Quantity: 2pcs	
Deviated stand of undercarriage	Material: Carbon fiber Dimension: 250mm*16mm Quantity: 2pcs	
Motor base	Dimension: 16mm Quantity: 4pcs	
Fixed base of undercarriage	Dimension: 16mm Quantity: 2pcs	



Name of Part	Specifications	Sample
TEE	Dimension: 16Mm** 16mm Quantity: 2pcs	
Multi-axle and shock-resistant protective foam sleeve	Dimension: Inner diameter: 16mm Quantity: 2pcs	
Pipe clamp	Dimension: 16mm Quantity: 8 pcs	

## 2. Flight control system

### (1) Flight controller

Table 4 Performance Parameters of Open-source Flight Controller

Performance indicators	Parameters
Model	PIXHAWK 2.4.8
Communication format	The format supports S.BUS/FHSS/DSSS
Sensor	<ol style="list-style-type: none"> <li>1. ST Micro L3GD20 three-axle and 16-bit gyroscope</li> <li>2. ST Micro LSM303D three-axle and 14-bit accelerometer/magnetometer</li> <li>3. MPU 6000 three-axle accelerometer/gyroscope of InvenSense Inc.</li> <li>4. MEAS MS5611 barometer</li> </ol>
Serial port	Five UART



**Figure 1 PIXHAWK 2.4.8 Interface Description**

Spektrum DSM 接收机	Spektrum DSM receiver
遥测 (电台遥控)	Telemetry (radio remote control)
遥测 (屏幕上显示)	Telemetry (screen display)
USB	USB
LED 指示灯	LED indicator light
SPI (串行外设接口)	SPI (serial peripheral interface)
电源模块	Power module
蜂鸣器	Buzzer
安全开关按钮	Safety switch button
串行	Serial
GPS模块	GPS module
CAN(controller a network)总线	CAN(controller area network) bus
模拟至数字转换器	Simulate to digital converter
12C分流器或罗盘	12C splitter or compass
模拟至数字转换器	Simulate to digital converter

## (2) Wireless data transfer radio

Table 5 Performance Parameters of Data Transfer Radio

<b>Performance indicators</b>	<b>Parameters</b>	<b>Sample</b>
Communication frequency	915MHz	
Transmitting power	1000mW	
Communication distance	4000m (without block)	
Dimension	49Mm*25mm*13mm (without antenna)	
Operating voltage	3.7V-6V DC	
Weight	22.5g (with antenna)	

### 3. Power system

#### (1) Motor


Table 6 Motor Performance Parameters

<b>Main parameters and indicators</b>	<b>Type A</b>	<b>Type B</b>	<b>Type C</b>
Dimension specifications	22mm*12mm	22mm*12mm	22mm*12mm
<i>KV</i> value	980KV	1250KV	1400KV
No-load current	0.3A	0.6A	0.9A
Motor resistor	133mQ	79mQ	65mQ
Maximum continuous current	15A/30S	25A/10S	28A/10S
Maximum continuous power	300W	390W	365W
Weight (with long wires)	58.5g	58g	59g




(2) Electronic controller

Table 7 Performance Parameters of Electronic Controller

<p><b>Performance indicators</b></p>	<p><b>Parameters</b></p>
<p>Drive type</p>	<p>Three-phase brushless drive</p>
<p>Continuous drive current</p>	<p>20A</p>
<p>Short-time current</p>	<p>35A</p>
<p><b>Sample</b></p>	

(3) Propeller

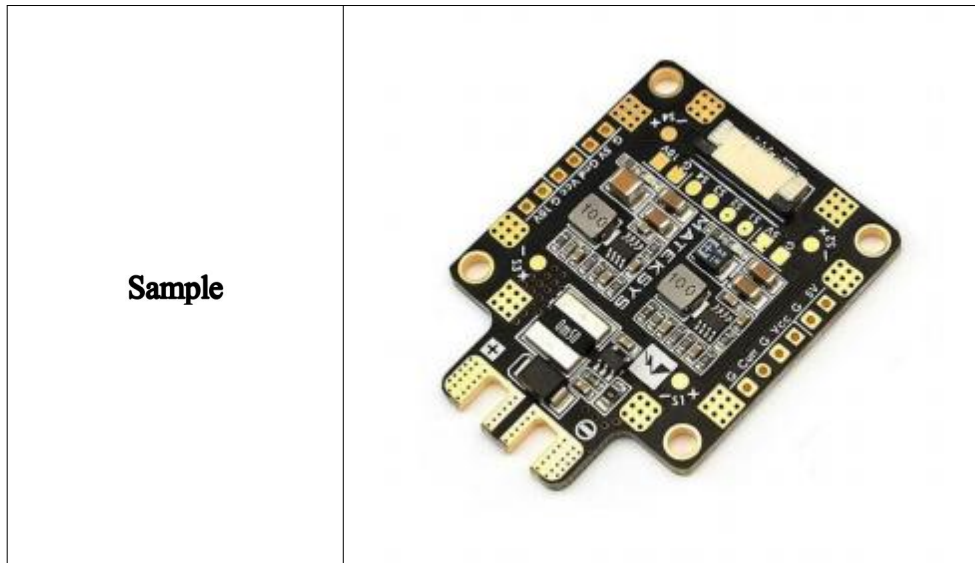
Table 8 Propeller Performance Parameters

<b>Performance indicators</b>	<b>Type A</b>	<b>Type B</b>	<b>Type C</b>
Specifications & model	8045	9047	1045
Material	ABS	Carbon fiber nylon	Carbon fiber
Weight	15.3g/pair	19.4g/pair	27.6g/pair
<b>Sample</b>			

(4 Distribution board

Table 9 Performance Parameters of Distribution Board

<b>Performance indicators</b>	<b>Parameters</b>
Dimension	36mm*36mm
Material	2Oz copper foil, 4 laminates and PCB
BEC output	Double BEC output, 5V/12V
Support battery	3S-6S lithium battery
Hole spacing of installation	30.5mm



#### (5) Chargeable lithium battery

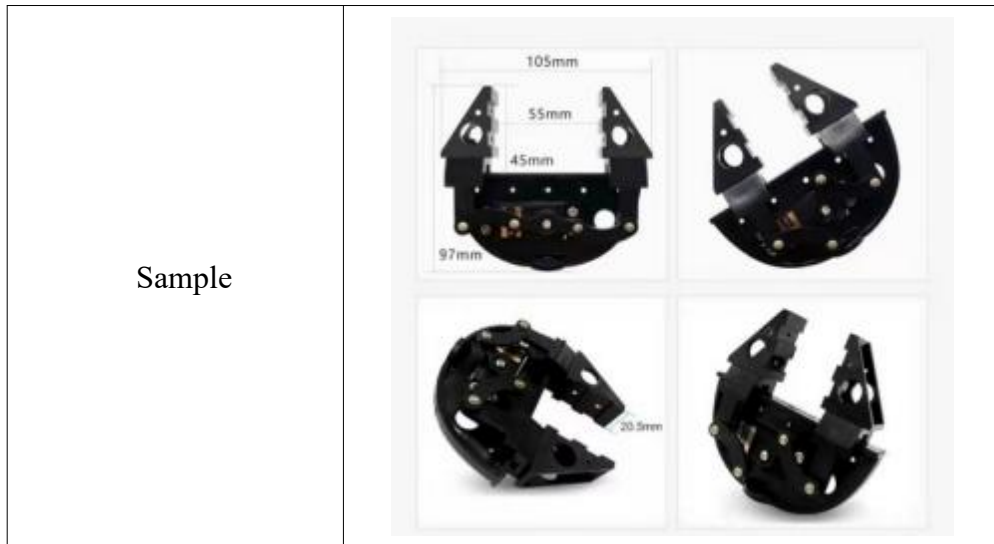
Table 10 Performance Parameters of Chargeable Lithium Battery

<b>Performance indicators</b>	<b>Validation battery</b>	<b>flight</b>	<b>Flight control battery</b>
Voltage	4S		4S
Capacity	2200mAh		5300mAh
Discharging ratio	30C		30C
Dimension	35mm*33mm*118mm		43mm*42mm*138mm
Weight	281g		505g

#### 4. Task load - robotic arm

Table 11 Performance Parameters of Robotic Arm

<b>Performance indicators</b>	<b>Parameters</b>
Material	Plastic
Input voltage	5V
Overall dimension	105mm*97mm*20.5mm
Clamp dimension	55mm*45mm (width*height)
Maximum tension and resultant force	3KG



## 5. UAV remote controller

Table 12 Performance Parameters of UAV Remote Controller

<b>Performance indicators</b>	<b>Parameters</b>
Number of channels	12
Communication format	The format supports S.BUS
Screen	It is a 3.5-inch and 16-bit true-color screen, with the resolution as 320*480 pixels
Transmitting power	100mW
Spread spectrum type	DSSS&FHSS
Transmission frequency	2.4GHz



**Figure 2 Schematic Diagram of Remote Controller Switch**

天线	Antenna
SwA二段开关	SwA two-section switch
VrA旋钮开关	VrA knob switch
电源指示灯	Power indicator
方向舵/油门操作杆	Steering wheel/throttle operating arm
升降舵微调	Elevating rudder fine-tuning
方向舵微调	Steering wheel fine-tuning
挂带环	Lanyard ring
副翼相位开关	Aileron phase switch
升降舵相位开关	Elevating rudder phase switch
把手	Handle
SwB三段开关	SwB three-section switch
VrB旋钮开关	VrB knob switch
发射指示灯	Transmitting indicator
副翼/升降舵操作杆	Aileron/Elevating rudder operating arm
电源开关	Power switch
油门微调	Throttle fine-tuning
副翼微调	Aileron fine-tuning
方向舵相位开关	Steering wheel phase switch
油门相位开关	Throttle phase switch

### III. Task



## 1. UAV assembly

Select the power combination which you believe has the maximum flight efficiency, in line with the requirements for assembly. By leveraging equipment, fixtures and tools, competitors should assemble a multi-rotor UAV which meets the flight criteria and can grab and transport objects and drop the object in the designated area. Competitors should complete all the assembly.

No.	Procedure description
1	Utilize tools to complete the assembly of body structures such as UAV tripods, body and arms in accordance with the assembly documents. It is required that components should be assembled in the correct position with the standard use of tools.
2	Complete the welding of UAV distribution boards, electronic controllers and power cords.
3	Select the specifications for adapting motors and propellers, and supplement the assembly list.
4	Install the flight controller, and connect electronic components including receivers, power modules, GPS and distribution boards. The direction is required to be correct and the distribution positions of electronic components to be rational.
5	Connect the UAV and mechanical claws properly to build a loading system. The loading system is required to be installed in a firm and reliable manner, which can run flexibly. In addition, there should be zero component collision.
6	Leverage power, electric soldering iron and chargers in a secure manner.

It is required that components should be assembled in the correct position with the standard use of tools. Moreover, the assembly and connection of sub-systems should be reliant and the assembly layout of whole machine flat and rational. The loading system should operate in a flexible manner and the assembly of whole machine meet the requirements of process documents. The welding should be standard and tight with the solder joints being aesthetic, complying with relevant technical criteria and specifications.

## 2.Parameter setting and debugging of UAV and remote controllers

For UAV power, control, communication, take-off and landing and loading systems, competitors should utilize corresponding software to complete the debugging of sub-systems in line with the requirements for debugging under TP; and complete the debugging report simultaneously. Leverage the MP software, enter the firmware program for quad-axle multi-rotor UAV, and complete the calibration and debugging of relevant parameters.

<b>No.</b>	<b>Procedure description</b>
1	Select the model for remote controller in a proper manner in the light of UAV type.
2	Complete the frequency matching of receiver.
3	Correctly connect the flight controller and ground station in line with the type of flight controller and its ground station software.
4	Complete the initial setting of flight controller including the selection of frame type.
5	Complete the accelerometer and horizontal calibration of flight controller.
6	Complete the calibration of the flight controller's compass.
7	Complete the calibration of remote controller properly.
8	Set the phase of steering engine in a correct manner.
9	Utilize the remote controller to control the opening and clamping of mechanical claws, thus achieving object grabbing by the loading system.
10	Set the flight modes to autostable, constant altitude and fixed point, respectively.
11	Correctly accomplish the parameter setting of battery monitoring in line with the actual status.
12	Complete the calibration of electronic controller and the parameter setting of its throttle range.
13	Complete the expansive parameter debugging of PID and emergency “stop” switch of motors.

After completing the Competition, competitors should raise their hands for indication and then the judge will mark according to the circumstances related to UAV assembly and debugging and record the completion time.

### 3. UAV validation flight

Employ special detecting tools and software in accordance with the requirements under TP. Furthermore, conduct performance and load function tests for UAV systems and the whole machine in line with the product performance of UAV and other relevant requirements.

For the task, the flight battery applies the validation one, with the model being 4S2200mAh. Before the flight, competitors should charge the batteries to be at full power.

In case of a bombing accident during performing the task, zero point will be given for the whole task.

<b>No.</b>	<b>Procedure description</b>
1	Complete the control over remote controller and PID test: Leverage a remote controller to operate and control a UAV for completing a steady take-off and aerial hover without shaking at the validation site.
2	Complete the UAV voyage test: Operate and control a UAV to complete the task-off at the experiment site. It is required that the hover height should stay at 1.5m. As long as the undercarriage leaves the ground, timing will begin, until the UAV lands because it is underpowered.

3	After replacing a new battery, complete the test of loading system of task: At the validation site, utilize a remote controller to operate and control a UAV. After grabbing objects at the original site, complete the fixed-point hovering for more than ten seconds, with the height required to be 1.5 m , height deviation less than 0.2m, and horizontal offset less than the width of one UAV body. In addition, the UAV should be landed safely within the landing area, and then release items. During the flight, objects should not fall; otherwise, <b>the competitor can only restart the flight once.</b>
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#### IV. Precautions

**During the debugging of UAV, it is prohibited to install propellers outside the flight area. Once identified, the competitor will be disqualified from the Competition!**

When finishing the assembly and debugging, a competitor should give a sign to the judge, and then the latter will mark the Competition for him. During the start of marking by the judge, the competitor should not re-adjust the UAV. After the marking, the judge should confirm the total mark of the Competition with the competitor's team members and sign with them.

**After the turning of UAV propellers, competitors should not enter the flight site; after the flight is completed, competitors can enter the site and power off the UAV immediately, and take their UAV out of the flight site only when the propellers stop turning. During the power-on, the remote controller of UAV should not be turned off. Upon identifying the above circumstances, zero point will be given for the Competition, and corresponding points will be deducted depending on the actual status.**

During Competition Task I, the judges will record the flight status at any time and mark the task. After the marking, the judge should confirm the Completion time and total mark of the first two Competitions with the competitor's team members and sign with them in the corresponding position of marking table.

## Competition Task II UAV Flight Control

Time: 30 min

### I. Task Background

UAV flight control is an essential skill in the sector. In the processes of equipment tests, task implementation and emergency response, there are always the circumstances where a UAV needs to be manually controlled for flight. To better safeguard the safety of flight, flight skills need to be examined.

### II. Task

Competitors **need to** charge the flight control batteries **in advance** as the batteries provided by the Competition are brand new. The battery model for the task is 4S5300mAh.

Within the specified time of task, each team is allowed to employ the quad-rotor UAVs that have been assembled and debugged for flight. During the flight, if a sandbag falls or is dropped outside the designated area, the team should be stopped from the task. In addition, the competitor should operate the UAV to fly back to the take-off and landing site, with zero point given for result of the team. Then the next team should start the flight. Two flight batteries will be offered to each team. During the flight, UAV batteries are not allowed to be replaced, and competitors should develop a plan for the use of batteries by themselves.

The flight sequence is as follows:

(1) At the validation site, competitors should first grab sandbags on the ground with mechanical claws and then place the UAV at the take-off and landing site.

(2) After exiting from the safety cage, competitors should control their UAV for take-off and to pass the number 1 and 2 obstacles successively.

(3) Operate the UAV to fly above the dropping area, and then drop the sandbag. The dropping height of UAV should not be lower than 2m (the height of obstacles in the dropping area is 2m).

(4) After the drop of sandbag, operate the UAV to pass the number 3 and 4 obstacles successively until the UAV can be landed at the take-off and landing site.

(5) During the flight, competitors operating UAV can only move around within the yellow area as shown in the following figure.





3	Square	1.2m	0.75m*0.75m
4	Circular	1.8m	Diameter: 0.8m

### **III. Precautions**

#### **During the flight, competitors are not allowed to enter the site.**

In case of a UAV bombing during the flight and the UAV fails to fly again, the competitor can apply to the judge for a backup UAV. There is only one opportunity for applying for a spare UAV, and corresponding points will be deducted in line with the marking rules. If the points deducted are larger than the full mark for the task, zero point will be awarded for this item.

During Competition Task II the judges will record the flight status at any time and mark the task. After the marking, the judge should confirm the total mark of the Competition with the competitor's team members and sign with them.

## Competition Task III UAV Application and Development

Time: 120 min

### I. Task Background

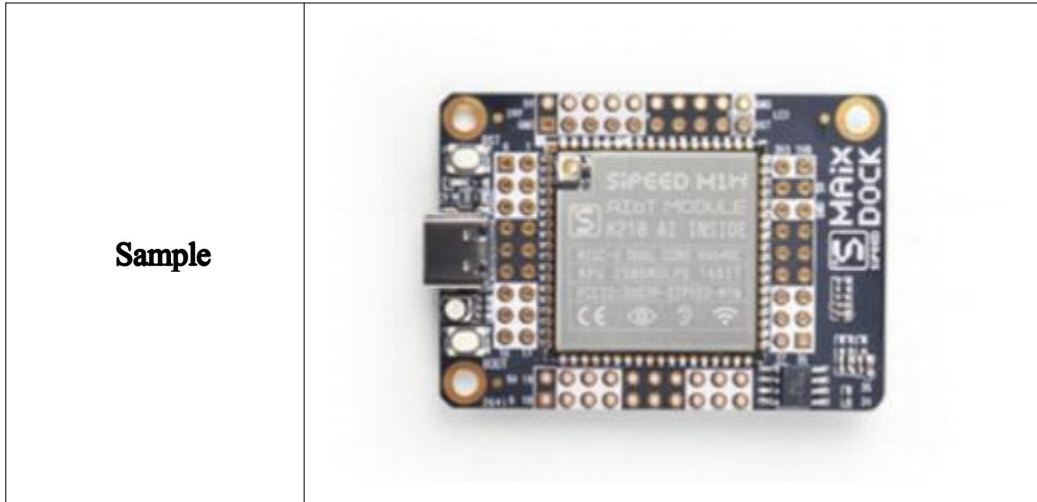
When the aerial logistics transportation is completed, there will be important large equipment on the ground that needs to be transported by land. UAVs are needed to track and monitor the transportation of significant equipment at high altitudes in an utterly automatic manner. Competitors should fulfill the flight functions of automatic whole-process tracking and monitoring of UAV through the UAV platform, and parameter debugging and functional calls of visual sensors.

### II. Equipment List

#### 1. Visual sensor

Table 14 Performance Parameters of Visual Sensor

<b>Performance indicators</b>	<b>Parameters</b>
CPU	Dual-core 64bit RISC-V/400MHz (double-precision, FPU and integrated)
Memory	8MB 64bit
Storage	Flash: 16MB; it supports the expansive storage of micro SDXC
Camera	Pixel:30W; camera: GC0328
Card slot	It supports theTF card



## 2. Visual controller

Table 15 Performance Parameters of Visual Controller


Performance indicators	Parameters
CPU	1.4GHz 64bit four-core ARM Cortex-A53
USB interface	USB2.0*2
Memory	1G LPDDR2
Activation type	PXE network and large-capacity USB storage activation
<b>Sample</b>	

40个GPIO引脚	40 GPIO pins
双频8002 11ac 无线局域网蓝牙4.2	Dual-frequency 8002 11ac Wireless Local Area Networks (LANs) Bluetooth 4.2
DSI显示连接器	DSI Display connector
全新电源管理方案	Power supply management plan
LED系统指示灯	LED system indicator light
USB电源接口	USB power interface
HDMI接口	HDMI interface
摄像头接口	Camera interface
RCAav端口音频输出	RCAav port audio output
以太网端口	Ethernet port
千兆以太网卡	Gigabit Ethernet cards
4个USB端口	Four USB ports
POE供电	POE power supply
RAM 1GB LPDDR2 BROADCOM BCM2837 1.45GHz 64位四核处理器	RAM 1GB LPDDR2 BROADCOM BCM2837 1.45GHz 64-bit quad-core processor

### 3. Tracking sensor in the visual range

Table 16 Performance Parameters of Tracking Sensor in the Visual Range

<b>Performance indicators</b>	<b>Parameters</b>
Main kernel	Intel Movidius Myriad 2.0 VPU
FOV	Composition: Two OV9282 fish-eye lenses; angle: $163 \pm 5$ ; shape: Hemispheric
IMU	High-precision inertial measuring unit BMI055

<b>Performance indicators</b>	<b>Parameters</b>
Algorithm	V-SLAM high-precision, visual, inertial, distance-detecting, simultaneous and inertial navigation algorithm
<b>Sample</b>	

### III. Task

Within the specified time, competitors should complete the development and implementation of designated functions of visual application according to the provided standard equipment, reference code, development environment and development tools.

#### 1. UAV debugging

Run the *Q Ground Control* software, connect the UAV, import the quad-axle and multi-rotor model, and write the program into the flight controller. Complete the calibration of all sensors and remote controllers, revise relevant data in line with the provided PID, and complete the basic debugging of UAV.

No.	Procedure description
1	Complete the input of flight controller model
2	Complete the accelerometer and horizontal calibration
3	Complete the calibration of magnetic compass
4	Complete the horizontal calibration
5	Complete the calibration of remote controller
6	Complete the revision for PID

#### 2. UAV development

Create an *SD* card needed for the visual controller, and run the disk sprite software for the partition that meets the system format of visual controller.

Moreover, mirror the *SDK210\_ext.pmf* and *SDK210\_fat.pmf* files to corresponding disk partitions.

Connect the display and mouse to Raspberry and power on it, and open the major folder, */catkinws offboard\_test\_01/src/offboard/armed\_test\_node*, of the *Home/lj* file. Identify the commands related to *PID*, and revise the *PID* value to ensure the stable flight of UAV. Then identify the commands related to staying position of UAV, and revise the deviated value to ensure that the UAV stops over the color block.

Install the parameter adjusting software of visual sensor, namely *maixpy-ide-windows-0.2.5*, connect the modules of visual sensor, and import the *color.py* program which can identify images. Complete the color identification of blocks by adjusting the threshold. When the visual sensor identifies a target, it will give out the long sound of singing with LED lights lighting up. When the sensor loses the target, the singing will stop with the LED lights going out.

Install the visual sensor, visual controller and tracking sensor in the visual range in the UAV.

<b>No.</b>	<b>Procedure description</b>
1	Complete the production of an SD card needed for the visual controller, and install the visual controller system
2	Adjust the parameters related to programs in the visual controller, and write them into the visual controller again
3	Complete the installation of parameter adjusting program for visual sensor
4	Complete the adjustment of initial codes, and realize the color identification of color cards based on the visual sensor

5	Complete the installation of the visual sensor, visual controller and tracking sensor in the visual range in the UAV.
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### 3. Functional implementation of UAV application

Match the frequency between a vehicle and vehicle controller, and test the vehicle to ensure normal control.

After completing the parameter debugging of machine loading equipment, give a sign to judges if you have zero question about the flight, and then start to fulfill the application function of UAV automatically tracking the vehicle.

Teams should choose three competitors to complete relevant tasks in line with the roles. One controls the vehicle, one monitors the vehicle's position, and another competitor operates the UAV to fly above the vehicle and complete image identification.

When the UAV hovers steadily above the vehicle, the UAV pilot should switch the UAV to the automatically following mode and protect the UAV in the whole process when an emergency occurs.

After the switching, the UAV pilot should report it to the judge, and then the judge will start the timing. The team member in charge of the control over vehicle should begin to control it to move in the light of set routes, with the width of routes being 0.5 m. The vehicle should not drive backward or outside the edge.

The UAV should follow the movement of vehicle completing the entire route. When the vehicle arrives at the destination, the UAV pilot should control the UAV to fly back to and land on the take-off site. At the time when

propellers stop rotating, the judge should stop the timing, and record the completion time of Competition.

No.	Procedure description
1	Complete the frequency matching and tests for vehicle
2	Place the vehicle at the starting position, fly the UAV over the vehicle, and complete image identification
3	Complete the switching of flight mode of UAV, and control the vehicle to move along the routes
4	Complete the following function of UAV
5	After the vehicle arrives at the designated position, manually operate the UAV to land on the ground in a safe and accurate manner

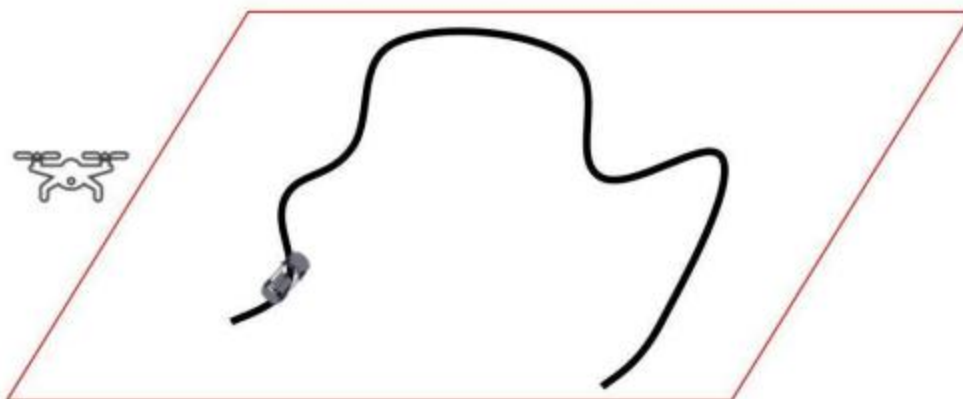


Figure 4 Implementing Sites of UAV Automatic Tracking

#### IV. Precautions

**After the turning of UAV propellers, competitors should not enter the flight site; after the flight is completed, competitors can enter the site and power off the UAV immediately, and take their UAV out of the flight**



**site only when the propellers stop turning. During the power-on, the remote controller of UAV should not be turned off. Upon identifying the above circumstances, zero point will be given for the Competition, and corresponding points will be deducted depending on the actual status.**

During UAV automatic tracking, if the target is lost, the UAV pilot should switch the mode to manual operation. When the UAV flies above the vehicle and identifies the latter again, the UAV pilot should switch back the flight mode. Judges should record the lost times of target, and deduct marks in accordance with the rules. Timing will not be stopped when competitors re-identify their targets.

During Competition Task III, the judges will record the flight status at any time and mark the task. After the marking, the judge should confirm the total mark of the Competition with the competitor's team members and sign with them.

## **Competition Task IV Additional Tests**

### **I. Task Background**

UAV passing and flight control are essential skills that professional UAV pilots should master. During the implementation of special tasks and operation of special scenarios, there are always the circumstances where a UAV needs to be manually controlled for passing and flight. To offer a presentation platform for teams or individuals, additional flight tests on the Competition tracks with considerable difficulties have been set.

### **II. Task**

Competitors **need to** charge the flight control batteries **in advance** as the batteries provided by the Competition are brand new. The battery model for the task is 4S5300mAh.

Unless all the Competition tasks have been completed, the additional tests cannot be applied. Within the specified time of task, each team is allowed to employ the quad-rotor UAVs that have been assembled and debugged for flight.

The flight routes mainly feature the passing of obstacles, including tunnel and corner passing and passing of obstacles at high and low altitudes, subject to the on-site arrangements at the sites.

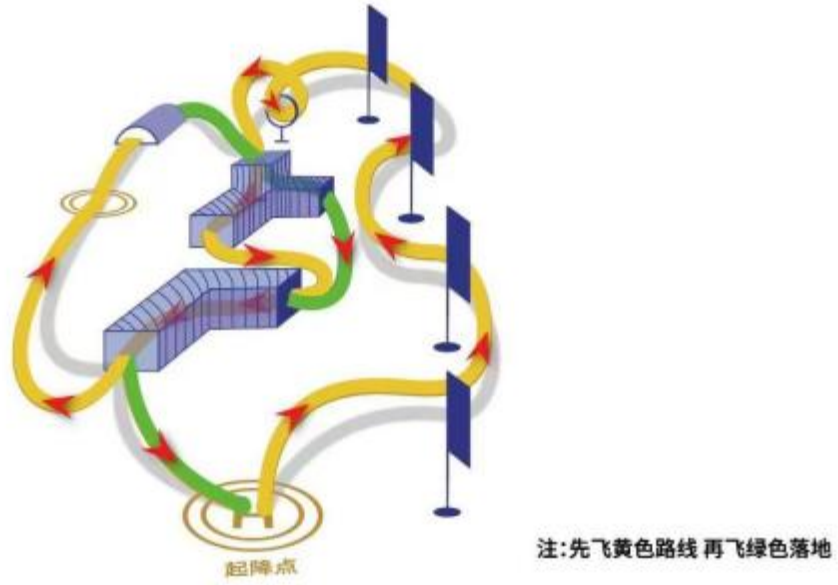


Figure 5 Flight Routes of Additional Tests

### **III. Precautions**

#### **During the flight, competitors are not allowed to enter the site.**

In case of a UAV bombing during the flight and the UAV fails to fly again, the competitor can apply to the judge for a backup UAV. There is only one opportunity for applying for a spare UAV, and corresponding points will be deducted in line with the marking rules. If the points deducted are larger than the full mark for the task, zero point will be awarded.

During the Competition tasks, judges will record the flight status at any time and mark the task. After the marking, the judge should confirm the total mark of the Competition with the competitor's team members and sign with them.