

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

## **IoT Technology Application**

### **Test Projects**

**Workstation No.:** \_\_\_\_\_

## **Part I Competition Notice**

### **I. Competition requirements**

1. Use tools correctly and operate safely according to the specification.
2. Any objection during the Competition may be reported to judges, and competitors must not disturb the order of the venue.
3. Observe the discipline of the workshop, respect the judges and obey the arrangements.

### **II. Professionalism and safety awareness**

1. Complete the Test Project (“TP”) in accordance with the safety operation specifications, and use electricity in a safe manner.
2. The surface of the operating table and workbench shall be tidy, and the placement of tools and handling of wire connectors shall meet the requirements of the occupational position.
3. Abide by the discipline of the workshop and respect the staff; and take care of the equipment and facilities.

### **III. Deductions**

1. During the Competition, if destructive damage to the equipment or an accident is caused due to improper operations, 10 to 20 points will be deducted depending on the circumstances, and qualification for the Competition will be canceled if the circumstance is serious.
2. In case of behaviors not in line with professional norms such as untidy clothing, polluting the workshop environment, disrupting the workshop and interference with judges, 5 to 10 points will be deducted depending on the circumstances, and qualification for the Competition will be canceled if the circumstance is serious.

### **IV. Notice for competitors**

1. If there are any missing pages or illegible handwriting in the TP, please promptly indicate it to the judge and have it replaced; after the Competition, all paper materials and USB flash disks provided for the Competition should not be taken away from the workshop.
2. The installation and configuration of the equipment should be carried out in strict accordance with the TP requirements and the process specifications.
3. Teams should complete the content required in the TP within the specified time, and files formed during the implementation of the task must be stored in the designated position on the USB flash disk, and a copy of the “Submitted Information” must be made to the root directory of the “D drive” on the server. No points will be awarded for files not stored in the designated location.
4. During the Competition, a competitor who determines that the equipment or device is faulty may propose to the judge for replacement; if the device or equipment is determined to be intact upon measurement, the time for which the device or equipment is determined will be included in the Competition duration; if the device or equipment is determined to be faulty, it will be replaced on the spot, and the time lost

during this process (from the start of the equipment testing to the end of the replacement) will be compensated to the team after the end of Competition duration.

5. If the device is damaged due to human error during the Competition, the device will not be replaced.

6. Competitors should stop any operation of the Competition equipment and computers immediately after the jury has announced the end of the Competition.

## **Part II Competition Equipment and Points for Attention**

The workshop provides platform equipment and computers for the IoT engineering Competition, and the competitors should follow the module content of the Competition to complete the relevant operations and tasks required by the TP.

### **I. Points for Attention**

1. Check whether the hardware equipment and computer equipment are normal. Check all equipment, software and Competition materials required for the Competition.
2. All software tools and software installation files used in the Competition have been copied to the USB flash disk (if a zip package is provided, competitors should copy it to the D drive and unzip it), so please use them according to the TP requirements.
3. During the Competition, please strictly follow the descriptions in the TP to install, configure and operate each IoT device. For the equipment that have been connected to the IoT training stations before the Competition, they may be related to the subsequent Competition tasks, and please do not change them.
4. After the completion of TP, please save the device configuration, and do not turn off any equipment, dismantle the hardware connection cables or encrypt the device without permission.

### **II. Hardware environment**

<b>No.</b>	<b>Equipment name</b>	<b>Unit</b>	<b>Quantity</b>
1	IoT technology application competition platform	Set	1
2	IoT toolkit and consumables kit	Set	1
3	Server (marked on the computer)	Set	1
4	Development machine (marked on the computer)	Set	1

## **Part III Competition Tasks**

### **I. TP requirements**

The rapid development of a new generation of information technology, represented by the Internet of Things (IoT), is promoting the upgrade and transformation of various industries towards digitalization. The application of IoT-related technologies to industrial production is of great significance, not only optimizing production processes and management methods and improving production efficiency, but also promoting the integration of industrialization and informatization to realize the intelligence of industrial production, which is of positive significance to the construction of a modern intelligent industrial system.

A chemical plant needs to implement an IoT upgrade program, requiring each part to be controlled independently. All sensor monitoring information can be aggregated to the IoT Cloud Platform. All actuators can be monitored on the IoT Cloud Platform for their operation status and controlled via the IoT Cloud Platform. The upgrade project is planned to be designed and implemented in several parts as follows:

#### **1. Construction of the network area**

Build the IoT network link environment and install appropriate equipment: RS485 device (digital), RS485 device (analog), router, IoT central gateway, serial server, switch, ZigBee coordinator, etc.

#### **2. Construction of the office area**

For the office area of the chemical plant, by monitoring information such as temperature, humidity and light levels in the current environment, the system can automatically control the operation of the air conditioning system (replaced with fans) according to the temperature and control the operation of the lighting system according to the light monitoring. An LED screen is installed in the office area, and various text notifications can be manually released on the LED screen via the cloud platform.

#### **3. Construction of the workshop area**

The production of various chemical products in the workshop requires reliable monitoring of air quality, noise, wind speed and other information to ensure the safety of production personnel. Noise, wind speed and concentrations of carbon dioxide in the workshop are monitored. When the monitoring value of wind speed exceeds the monitoring range, the red light of the three-color light in the area lights up to make a warning and goes out when the value returns to normal.

#### **4. Construction of the storehouse area**

Various finished products and raw materials are stored in the storehouse of the plant, and to ensure the security of the area, intrusion, smoke and other situations need to be monitored in real time. Photoelectric monitoring equipment needs to be installed at the edge of the storehouse. When there is an intrusion, the photoelectric equipment signal will be triggered, and at the same time, the yellow light of the three-color light will light up for ten seconds and then go out automatically. The alarm light will light up when there is smoke and will go out when the smoke is lifted.

### **II. TP environment**

Hardware resources: computers, IoT engineering competition platform kit, IoT toolkit, consumables, etc.

Software resources: Please see the “Competition materials” folder on the USB flash disk.

### **III. TP implementation**

Complete each required function according to the TP requirements described in the following modules and submit and save the results of the Competition as required.

## **Module A: Design of an implementation plan for the IoT engineering project (15 points)**

### **1. Equipment selection and topology design**

Please analyze the project requirements and complete the selection of equipment for each area based on the equipment provided, and draw a topology diagram of the equipment installation using Visio. Each area should be specified in the topology diagram, the names of equipment used in each area and the connection methods of equipment should be clearly marked. Use solid lines to indicate wired connections and dashed lines to indicate wireless connections. Upon finishing the design, name the file “A-1-1.vsdX” and save it to the “Submitted Information” on the USB flash disk.

### **2. Design of operation flow chart**

Please carefully analyze the construction requirements of the “workshop”, and use Visio to design an operation flow chart of the wind speed monitoring and alarm function in this area. Upon finishing the design, name the file “A-1-2.vsdX” and save it to the “Submitted Information” on the USB flash disk.

### **3. Prototyping of supporting applications**

Please use Axure to prototype applications for the construction of the office area in Module B as required. Upon finishing the design, name the file “A-1-3.rp” and save it to the “Submitted Information” on the USB flash disk.

## Module B: Installation and debugging of IoT equipment (50 points)

Please use black electrical tape to mark out the areas on the **left and middle stations** of the competition platform according to the requirements of the project, install corresponding equipment in each area, complete the configuration and connection of the equipment and ensure proper equipment communications. Use a ticket printer to print out the name of each area (Chinese or English) based on the “Print Name Comparison” and use black electrical tape to attach the ticket to each area. Equipment for each area should be firmly installed and beautifully arranged.

Table 1 Print Name Comparison

No.	Area name	Printed text (Chinese)	Printed text (English)
1	Network area	网络区	Network
2	Office area	办公区	Office
3	Workshop area	车间	Workshop
4	Storehouse area	仓库	Storehouse

### 1. Construction requirements of the network link management area

- Complete equipment selection, installation, connection and configuration according to the construction requirements of the area.
- Complete the configuration of the router according to Table 2.

Table 2 Router Parameters Configuration

Network configuration items	Configuration content
<b>Network settings</b>	
WAN port connection type	Fixed IP address
IP address	192.168.0.[Workstation No.]
Subnet mask	255.255.255.0
Gateway	192.168.0.254
<b>Wireless settings</b>	
Wireless network name (SSID)	"2022SZS" + [Workstation No.]
Wireless password	Random
<b>LAN settings</b>	
IP setting of the LAN port	Manual
IP address	172.16.[Workstation No.].1
Subnet mask	255.255.255.0



Upon finishing the configuration, take a screenshot of the router's Internet settings, name it “B-1-1.jpg”, and save it to the “Submitted Information” on the USB flash disk. Take a screenshot of the router's LAN port settings, name it “B-1-2.jpg”, and save it to the “Submitted Information” on the USB flash disk. Take a screenshot of the router's wireless settings, name it “B-1-3.jpg”, and save it to the “Submitted Information” on the USB flash disk. Open the browser and take a screenshot of the home page of the IoT Cloud Platform, name it “B-1-4.jpg” and save it to the “Submitted Information” on the USB flash disk.

■ Configure the IP address of each equipment according to Table 3, and connect the local area network to ensure normal communication between the equipment.

Table 3 Router Parameters Configuration

Equipment name	Configuration content	Notes
Server	IP address: 172.16.[Workstation No.].11	
Workstation	IP address: 172.16.[Workstation No.].12	
Serial server	IP address: 172.16.[Workstation No.].13	
Central gateway	IP address: 172.16.[Workstation No.].14	User name: newland Password: newland

Upon finishing the configuration, use the IP scanning tool provided in the Competition materials to scan and check the IP address of each piece of equipment in the LAN, requiring at least three or more IP addresses in Table 3 to be detected, take a screenshot of the router's Internet settings, name it “B-1-2.jpg”, and save it to the “Submitted Information” on the USB flash disk.

Note: Please refer to the relevant information on the USB flash disk for information on the configuration of the serial server, gateway device and access to the IoT Cloud Platform.

## 2. Construction requirements of the office area

■ Complete equipment selection, installation, connection and configuration according to the construction requirements of the area.

■ The construction of equipment in this area is all wirelessly connected. In consideration of the construction cost, it is required to install simple equipment as far as possible.

■ Based on the construction requirements of this area, create an application called “Office Monitor” featuring simplicity and aesthetics on the IoT Cloud Platform.

■ It is required that the real-time monitoring status of light, temperature and humidity, as well as the real-time operation of the air conditioning system and the lighting system, are available in this application.

■ Complete the operation of the temperature and air conditioning system (simulated with a fan) according to the construction requirements of this area and ensure that this

operation can be verified in the created application. When the temperature exceeds a set threshold (the threshold is self-set), the application can control and activate the air conditioning system. When the temperature returns to normal, the application can stop the operation of the air conditioning.

- Complete the operation of the light level and lighting system (simulated with an LED light) according to the construction requirements of this area and ensure that this operation can be verified in the created application. When the light level falls below a set threshold (the threshold is self-set), the application can control and activate the lighting system. When the light level reaches the normal threshold, the application can turn off the lighting system.

Upon finishing the construction, take a screenshot of the running interface of the “Office Monitor”, name it “B-2-1.jpg”, which should show the lighting, temperature and humidity data and the operation of the air conditioning and lighting systems, and save the screenshot to the “Submitted Information” on the USB flash disk.

### **3. Construction requirements of the workshop area**

- Complete equipment selection, installation, connection and configuration according to the construction requirements of the area.

- Type-485 equipment is required to monitor environmental information, and sensors of noise, wind speed and carbon dioxide are required to collect relevant environmental data.

- Based on the construction requirements of this area, create an application called “Workshop Monitor” featuring simplicity and aesthetics on the IoT Cloud Platform.

- It is required that the real-time monitoring results of noise, wind speed and concentration of carbon dioxide are available in this application. The operation status of the red light of the three-color light should be also available.

- It is required that the strobe warning function for the wind speed reaching the monitoring threshold (the threshold is self-designed) can be verified in the application. When the wind speed monitoring value returns to normal, the application can turn off the warning function of the red light.

Upon finishing the construction, take a screenshot of the running interface of the “Workshop Monitor”, name it “B-3-1.jpg”, which should show the noise, wind speed and carbon dioxide data and the operation of the red light of the three-color light, and save the screenshot to the “Submitted Information” on the USB flash disk.

### **4. Construction requirements of the storehouse area**

- Complete equipment selection, installation, connection and configuration according to the construction requirements of the area.

- Based on the construction requirements of this area, create an application called “Storehouse Monitor” featuring simplicity and aesthetics on the IoT Cloud Platform.

- It is required that the real-time monitoring information of the infrared radiation and smoke, as well as the real-time operation status of the strobe yellow light and the alarm light, are available in this application.

- By triggering the smoke signal, the application shows that the alarm light in the

application is active and the alarm light at the workstation is also on. When the smoke is lifted, the alarm light stops working.

- The intrusion monitoring should be seen in this application. When someone intrudes, the yellow light of the three-color light lights up and goes out after ten seconds.

Upon finishing the construction, take a screenshot of the running interface of the “Storehouse Monitor”, name it “B-4-1.jpg”, which should show the infrared radiation and smoke data, and the operation of the alarm light and the yellow light of the three-color light, and save the screenshot to the “Submitted Information” on the USB flash disk.

## **5. Equipment debugging**

- Connect the green light of the three-color light to the system.

- Use the “Serial Assistant” tool provided on the USB flash disk on the computer to debug the equipment. Send commands to the system to turn the green light of the three-color light on and off respectively.

Upon finishing the debugging, take a screenshot of the interface where the Serial Assistant sends the command to turn on the green light of the three-color light, name it “B-5-1.jpg” and save it to the “Submitted Information” on the USB flash disk. Take a screenshot of the interface where the Serial Assistant sends the command to turn off the green light of the three-color light, name it “B-5-2.jpg” and save it to the “Submitted Information” on the USB flash disk. The above screenshots should clearly show the command sent and the connection status of the serial ports.

## **6. On-site photography**

After the construction of all areas is complete, start the camera and take a picture of the equipment installation at the left and middle workstations, name the photo of the left workstation “B-6-1.jpg” and the photo of the middle workstation “B-6-2.jpg”, and save the screenshots to the “Submitted Information” on the USB flash disk.

## **Module C: Innovation in IoT technology application (20 points)**

### **1. Innovation in application**

With the deepening urban construction, more and more high-rise buildings are emerging. Each building is equipped with an elevator to facilitate people's travel. As digital technology continuously develops, elevators are becoming more and more intelligent. For example, during peak travel periods, when there is a large flow of people and the quality of the environment inside the elevators is not guaranteed, intelligent elevators can monitor environmental information such as temperature and humidity inside the car. Additionally, because of the pandemic, non-contact elevator control is now advocated to reduce the possibility of contact infection.

There is also an elevator in the chemical plant. Please use the various IoT technologies mastered to innovate in applications, design an intelligent elevator system based on practical application scenarios, and make full use of the existing software and hardware equipment to install and debug the equipment and develop software systems at the right workstation of the competition platform to simulate the implementation of the functions of the intelligent elevator system.

#### **Special notes:**

- (1) The system designed and implemented should be practical, stable and reliable, with the hardware equipment used to vividly simulate the work of the elevator and the equipment and technical means used are not limited.
- (2) Competitors are allowed to use equipment (e.g., serial server and gateway) at the left and middle workstations to complete the operation of this module. When using, please directly connect the equipment on the left and middle workstations with cables, and do not remove the equipment on the left and middle workstations to install them on the right workstation.

## **Module D: Presentation and defense of IoT project results (15 points)**

### **1. Display resource design**

Please prepare resources to present the system to Party A based on the needs of the digital upgrade of the chemical plant and the TP requirements in Module B and Module C. The resource can be a PowerPoint (PPT) or in other form, which shall include specific description of the system functions, technical route, design ideas, implementation methods and working results.

### **2. Site presentation of the project**

Explain to the jury the overall upgrade requirements and implementation plans of the project using resources such as PPT, and give a demonstration of the operation. This task can be presented in Chinese or English, with a Chinese interpreter when presented in English.