The Construction and Research of Virtual Simulation Teaching System for UAV Application Technology Major

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Abstract. The core courses of UAV application technology major include UAV aerial photography and photography, UAV mapping and data post-processing, UAV group maintenance, UAV formation flight technology, UAV flight control technology and so on. In the actual teaching, it is restricted by various conditions. In order to improve the teaching quality, it is urgent to impose the construction of UAV virtual simulation training room and virtual imitation real training resource database. From the perspective of professional teaching, this paper puts forward the guiding ideology and basic requirements of the virtual simulation teaching system of the whole UAV industry chain, and analyzes the rationality of the virtual simulation teaching system architecture with the UAV power inspection as an example.

Keywords: Virtual simulation; UAV; Teaching system

1 Introduction

UAV is widely used in the fields of efficient, low operation cost and flexible law enforcement, agricultural plant protection, emergency rescue, power inspection, logistics transportation and other fields. The graduates of this major are mainly for film and television media group, geographic information department, power grid department, agriculture, forestry and plant protection companies, UAV research and development, design and manufacturing related enterprises and institutions, and can engage in UAV aerial survey, UAV aerial photography, UAV low altitude inspection, UAV maintenance, UAV data processing and other positions. The core courses of UAV application technology major include UAV aerial photography and photography, UAV mapping and aerial survey post-processing, UAV assembly and debugging, UAV maintenance and maintenance, UAV formation flight technology, UAV mission payload and industrial application, UAV flight control technology and so on. These highly professional courses in the actual teaching are restricted by various conditions, mainly including the insufficient of drones training equipment and equipment, UAV training site limit, limitations in students' personal operational skill level, such as not skilled, easy to cause the drone to fall and crash , for which it is hard to organize the teaching with some valuable mission payloads in the practical training tasks.

In order to improve the per capita ownership rate of practical training resources and ensure the teaching quality, it is urgent to impose the construction of UAV virtual simulation training room

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and virtual imitation real training resource database. The construction of virtual simulation teaching system without limits of time and site will fully ensure the implementation of the course training tasks, improve the teaching quality of UAV training tasks, reduce the frequency of UAV damage in the training process, greatly reduce the teaching cost, , and be deeply loved by teachers and students. Virtual simulation technology can utilise the graphic features of the computer, output the simulated realistic three dimensional audio-visual feelings. Students can experience refinement modeling of the virtual world through the screen, interact with the virtual world by remote control and conduct drones virtual simulation training task anytime anywhere, breaking through the limits of time and space[1][2]. This paper puts forward the basic requirements and research methods of the construction of virtual imitation real training resources for UAV application technology, focuses on the construction of virtual simulation teaching system of the whole industry chain of UAV, and finally summarizes the development trend of UAV virtual simulation teaching.

2 Guiding ideology and basic requirements of the virtual simulation teaching system of UAV application technology major

(1) The virtual simulation equipment or software has good reliability, and the virtual simulation tasks have good repeatability of which can be saved redundantly. The practical training tasks can be repeated in practice. Always adhere to the teaching concept of contrasting between virtual and real, preferring the virtual and implementing the real. The combination of virtual and real is inseparable, so that virtual simulation should not be pursued blindly. Always adhere to the teaching thought of combining the virtual and the real which can complement each other" [3]. Always adhere to serving students wholeheartedly. The virtual simulation teaching task will fully ensure the implementation of the course practical training task, improve the teaching quality of the UAV practical training course, reduce the teaching cost, and improve the students' satisfaction and sense of experience. Always adhere to the talent training concept of "student-centered, cultivating students' practical ability", and build multi-platform integrated, multi-disciplinary UAV virtual simulation teaching resources which are open and shared. Must adhere to the teaching idea of the combination of the virtual and the real which contrasts the virtual and the real and combines the virtual and the real. UAV virtual simulation cannot be without UAV physical training. Both of them are essential that virtual imitation real training tasks should be given priority while physical training links pay more attention to the explanation of technical methods.

(2) The virtual simulation platform should be set reasonably, guiding, realistic and effective, and can fully reflect the steps, phenomena and results of the practical training. The practical training tasks can simulate various application scenarios and environments of the UAV, including weather, sound, temperature, wind speed, rainfall and the flight parameters of the UAV itself, which can prompt various matters that need attention. Virtual simulation training task requires realistic effect, reliable performance, and also meets the UAV operation inspection application and other industry standards such as T / CEC 193-2018 "Specification for Training and Assessment of UAV Inspection Operators in the Electric Power Industry", "Technical Specification for UAV Digital Aerial Photogrammetry and Remote Sensing Field", "Technical Specification for Plant Protection UAV Disinfection Operation". The training task is strictly in accordance with the UAV power inspection, plant protection technology and other industrial

operation standards. Virtual simulation tasks can simulate the situation of UAV failure and various extreme weather, cultivate students' emergency response ability, and improve students' practical ability. For example, in the virtual simulation software, such as the number of trainers, current condition, the number of power batteries, storage location, purchases and losses, use date, maintenance, flight physical strength and other important parameters.

(3) The setting of virtual simulation tasks and various rules must meet the relevant national standards and the requirements of the Civil Aviation Administration examination. For example, the Civil Aviation Administration multi-rotor inner distance pilot test, there are 360-degree spin and eight flight, there are up to 20 test standards, mainly including speed threshold (m / s), height deviation threshold, heading deviation threshold, trajectory parallelism threshold, horizontal deviation threshold. In addition, virtual simulation tasks such as UAV power inspection, agriculture, forestry and plant protection, assembly and debugging must meet industry standards, and always adhere to the "vocational activity-oriented, vocational skills as the core" as the guiding ideology.

3 The construction of the virtual simulation teaching system of the whole industry chain of UAV

With the development of the times and technology, the UAV virtual simulation platform is developing in the direction of functional integration of the whole industrial chain. Try to put multiple practical training courses on a virtual simulation platform, so that costs can be saved and user experience is better. The teaching system of UAV whole industry chain virtual simulation generally includes drone assembly debugging maintenance, intelligent drone design production, drone training module, drone flight test (civil aviation test CAAC rotor airline pilot test), aerial surveying and mapping, emergency rescue, several intelligence cluster (drone formation flight technology), logistics, power distribution, inspection, agriculture, forestry and plant protection module, etc.

The following introduces the development status of the virtual simulation teaching system in the whole industry chain of UAV. Wuhan Aer Technology Co., Ltd. was established in 2016 and developed SESP-U1 UAV application simulation training system. SP-U1 system, relying on fine modeling and flight control simulation technology, provides basic flight, power, security, mapping, plant protection, formation flight and other industrial application training projects, and provides users with a full set of UAV simulation training solutions. Ocean Aviation Technology Co., Ltd. led the development of the virtual simulation teaching system for the whole industry chain of UAV, which integrates the functions of assembly and debugging, flight examination, emergency rescue, formation flight, plant protection inspection and other functions. Both simulation software use refined 3 D simulation models, bringing users an immersive experience.

The integration of various simulation technologies, Unity3D and VR technology, gives full play to the traditional computer virtual simulation technology and cutting-edge technology VR technology. In particular, with VR technology, trainers can be placed in realistic simulation scenarios (including aerial photography, agriculture, forestry and plant protection, power inspection and other UAV industry application scenarios), and quickly improve their flying skills in immersive exercises by simulating various flight modes, flight perspectives and

physical characteristics of drones. VR technology has the advantages of strong sense of reality, simple operation and easy self-study, providing a new environment for the training of UAV application talents, so that students can master the standardized process and operational skills for pending industry applications. After studying the current situation of the UAV virtual simulation, this paper puts forward the framework of the virtual simulation teaching system of the whole UAV industry chain as shown in figure 1. That is virtual simulation teaching system architecture of the whole industrial chain of UAV which is students centered and cultivates students' practical ability as the purpose, always adhere to the central idea of "virtual-real combination, virtual first, practical implementation" , and has complete functions, conforms to the industry standard with reliable performance, good user experience, complete evaluation system [4].

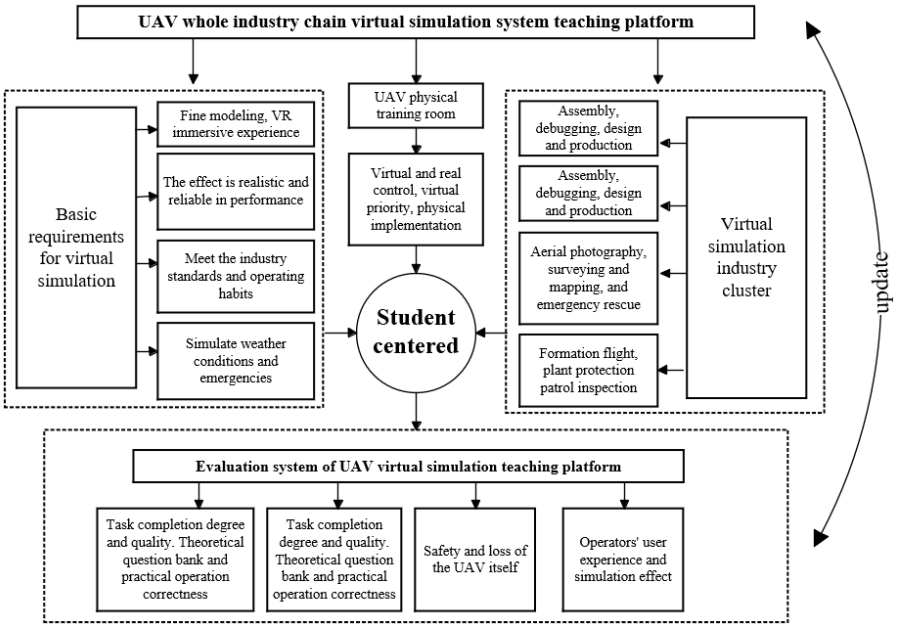

Figure 1 Framework of the virtual simulation teaching system of the whole industry chain of UAV

4 Example analysis of the virtual simulation teaching system of UAV electric power inspection

The application of UAV in transmission line inspection to replace manual inspection is gradually becoming a reality. The use of UAV for power inspection has the advantages that other inspection methods can not surpass: (1) can avoid personnel safety accidents; (2) not restricted by landform; (3) high inspection efficiency; (4) low flight cost; (5) stable patrol effect. However, in the practical teaching of UAV electric inspection course, there are some problems such as boring theoretical knowledge and difficult to carry out practical training tasks. Due to the security risk and the limitation of the physical condition of the training room, the virtual simulation of UAV will be one of the best teaching methods. After the study of UAV power inspection, this paper puts forward the framework of drone power inspection virtual simulation

teaching system that The virtual practical training task should reasonably set up human faults and practical defects, and cultivate students' emergency handling ability and operation level and UAV power inspection virtual simulation module contains simulation teaching platform evaluation system, tower type, elements, line voltage, mode, operation requirements and so on [5], as shown in figure 2. The training task can simulate various application scenarios and environments of UAV, including weather lighting, sound, temperature and humidity, wind speed, rainfall, model, GPS signal, flight parameters of UAVs themselves, and so on. The tower type of power inspection should include tensile tower, straight tower, linear tower, corner tower, linear corner tower, transposition tower (a phase position tower for replacing wires), divergent tower (single back parallel to the same tower), terminal tower, cross tower and drilling tower, etc. The voltage range should range from 110KV to 1000KV. The inspection scope includes line body inspection, auxiliary facilities inspection, channel and power protection area inspection, dynamic defect inspection and special operation mode.The UAV electric inspection system mainly uses four ways to carry out inspection tasks: visible light camera, photoelectric pod, infrared thermal imager and LiDAR. The replacement of the mission payload should be fully reflected in the UAV virtual simulation system.

The virtual simulation teaching system of UAV power inspection should meet the industry operation standards. The industry standards of UAV power inspection include DL / T 1482-2015 Technical Guidelines for UAV Inspection Operation of Overhead Transmission Line and T / CEC 193-2018 Specification for Training and Assessment of UAV Inspection Operators in the Power Industry.

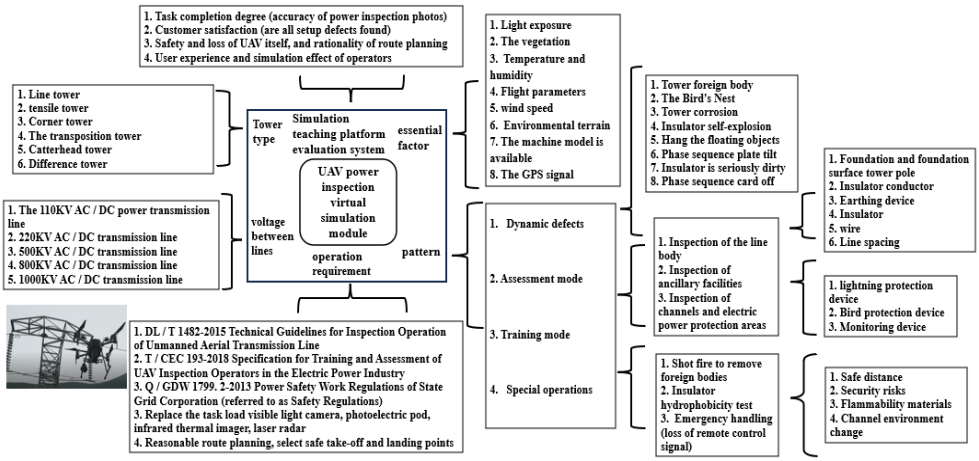

Figure 2. Framework of virtual simulation teaching system of UAV power inspection

5 Evaluation system of UAV virtual simulation teaching platform

In order to consolidate the learning effect and facilitate teachers to better understand the learning situation of students, the evaluation system of the virtual simulation teaching platform of UAV must be established. Timely feedback on the rationality and effectiveness of virtual simulation practical training tasks makes the whole teaching system constantly improve.

The evaluation system of UAV virtual simulation teaching platform mainly includes five aspects:

(1) Theoretical knowledge evaluation. Theoretical knowledge must be combined with practical operation, theory combined with practice to improve the practical level. Especially for the key points of operation, after completing the virtual simulation task, the theoretical knowledge points can be answered immediately to achieve the purpose of consolidating the knowledge points.

(2) The degree of practical task completion (such as the accuracy of power inspection photos), mainly examining the flight skills of UAV.

(3) Customer satisfaction (Whether all setting defects are found, the safety and loss of the UAV itself, and the rationality of route planning). Whether all operations are in line with industry standards.

(4) User experience and simulation effect of operators (including user interface aesthetics, simulated environment authenticity, etc.). Customer satisfaction is preferred, focusing on the user experience of operators. Make special tasks scenario-based and realistic. Virtual simulation can really improve the command and emergency response capabilities of the drone, rather than the ability to operate a drone.

(5) The novelty, effectiveness and classic nature of the virtual simulation task, and whether it can represent the operational requirements of the industry.

Through the evaluation of the entire virtual simulation teaching platform, teachers can truly understand the theoretical knowledge and practical level of each student, achieve real-time and refined teaching quality control, and promote the continuous improvement of the UAV virtual simulation teaching platform, bringing a new immersive experience to students.

6 The development trend of UAV virtual simulation teaching

(1) Virtual simulation of UAV models towards toward the development of market-oriented models. The main models of the SESP-U1 UAV application simulation training system developed by Wuhan Ao Rui Er Technology Co., Ltd. are all DJI UAV main models, of which the appearance and performance are very close, and the practical ability continues to improve, truly achieving the purpose of virtual simulation for practical training tasks. What kind of main models are there in the market, and what kind of drone models are developed by virtual simulation.

(2) The transition from the operation of a UAV to the UAV virtual simulation integrated command and flight data processing. Cultivate students' comprehensive operation and command ability of UAV in multi-airports, and cultivate UAV commanders and UAV data processing masters with good psychological quality. The practical training tasks include simulating the operation ability of a person to handle the whole drones of a city, even of a whole province, including the ability of UAV operation, maintenance and battery maintenance, so that operators can develop good UAV operation habits. For example, the virtual simulation module of "All-area air-ground integrated UAV Intelligent Application System" provides an integrated solution consisting of "system platform + UAV + fully automatic unmanned airport (vehicle-mounted airport)+ ground monitoring +AI intelligent processing". Specific virtual simulation tasks

include UAV control, automatic (or semi-automatic) inspection, airborne equipment management, and intelligent analysis of flight data (the video and pictures taken by the UAV can be stored in the system for convenient call and analysis from time to time).

7 Conclusion

From the perspective of professional teaching, this paper puts forward the basic requirements and research methods for the construction of virtual simulation practical training resources for UAV application technology specialty. It focuses on the construction of the virtual simulation teaching system of the whole industrial chain of UAV, and analyzes the rationality of the virtual simulation teaching system architecture by taking the UAV power inspection as an example, puts forward the evaluation system of the UAV virtual simulation teaching platform to improve the whole teaching system continuously, and finally summarizes the development trend of the UAV virtual simulation teaching. Through the virtual simulation system, students can increase their UAV practical experience. The teaching system always adheres to the talent training concept of "student-centered, cultivating students' practical ability", and provides a teaching platform for UAV talent training [6][7].

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