Design of Helicopter Avionics Maintenance Training System Based on Intelligent Teaching System

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Abstract. In view of the shortcomings of the traditional avionics maintenance training method for helicopters, the importance of designing a intelligence teaching system (ITS) for helicopter avionics maintenance training is proposed. The functional requirements of the ITS are analyzed, and the ITS for helicopter avionics maintenance training is designed and developed based on artificial intelligence technologies such as virtual human, intelligent voice, knowledge mapping, virtual reality and helicopter learning. The ITS solves the real problem of restricted helicopter avionics maintenance training equipment and sites, improves training efficiency and reduces training costs, and provides reference for the design of teaching system and construction of teaching environment in the context of current intelligent education.

Keywords: Intelligent Teaching System · Avionics Maintenance Training · AI Virtual Instructor · Helicopter

1 Introduction

With the rapid development of the helicopter industry and the increasing integration, modularity and intelligence of avionics equipment, higher requirements are put forward for the business skills and comprehensive quality of the flight crew. The traditional training mode of mechanic staff generally adopts the method of simple theoretical lectures combined with hands-on practice, which has become increasingly unsuited to the needs of modern equipment operation training. First of all, the teaching method of purely theoretical lectures is mechanical and boring, and the students' enthusiasm and initiative to learn is not high. Secondly, the avionics equipment is updated at a fast pace, and a lot of hardware facilities cannot be provided for training in a short time for the relevant contents of new models. Once again, the actual installation training is more restricted by time and space, and the training cost is high, the hardware loss is large, and the training cycle is long. Therefore, how to improve training efficiency and reduce training costs has become a pressing issue for training aircrew.

With the rapid development of mobile Internet, cloud computing, Internet of Things and other information technologies, it has become a trend to provide trainees with a safe,

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efficient and interesting intelligent teaching system (ITS) based on artificial intelligence technologies such as virtual human, intelligent voice, knowledge mapping, image recognition, virtual reality and helicopter learning [1, 2]. ITS can effectively reduce training costs, break through environmental conditions, shorten the training cycle, improve the safety of training and stimulate the interest of trainees in learning.

2 System Requirements Analysis

The core requirement of the ITS is to build a smart training field for helicopter avionics training and AI virtual instructors. It can also realize teaching resource management, intelligent learning analysis, intelligent teaching assessment, personalized recommendation, AI interactive teaching and other functions.

2.1 Intelligent Training Field Construction

In order to crack the current situation of site and equipment shortage, the intelligent training field can realize real-time synchronization classroom, virtual reality training and simulation training and other functions.

Real-time synchronization classroom for In-class explanation stage, can make the teaching class out of space, time constraints and improve teaching efficiency. Virtual reality device cameras and fixed cameras synchronize images in real time to the large indoor screen and online; virtual reality training and simulation training are used in the combination of practice stage, but they are used in slightly different situations. Virtual reality training in a real training ground, which can accelerate the practice efficiency of students and give more trainees the opportunity to have practical training on the helicopter. Simulation training is used for extra-curricular training or virtual-reality training waiting period, so that students can feel the real operation method in the virtual scene and effectively solve the problem of insufficient operation in practical classes.

2.2 AI Virtual Instructor

AI virtual instructors can teach and interact with digital avatars, providing students with interactive services like real people, accompanying them throughout their studies, answering their questions at any time, and guiding them to learn accurately [3, 4].

In the pre-course preparation phase, AI virtual instructors can help students with interactive answers to frequently asked questions and resource-assisted searches. In the teaching implementation stage, AI virtual instructor as an instructor's assistant, can present in the MR glasses' view, inform the current trainee's practice task with sound, text and graphic broadcast, help the instructor to explain professional problems and guide the trainee to complete the avionics maintenance training practice. After-session tutoring stage, it can help students retrieve questions, intelligent Q & A, to solve most of their consulting problems, while having the ability of deep learning, synchronized records of unsolved problems, and further learning optimization.

2.3 Teaching Resources Access

Access to teaching resources is a major obstacle limiting the reform of traditional teaching models. In order to break the status quo of relatively closed teaching resources of traditional teaching mode, the ITS of helicopter avionics maintenance training should process and integrate diversified teaching resource information, so that the resources between multiple system platforms can be shared and common. Under the condition of ensuring the overall idea of the course remains unchanged, the resources of other resource platforms can be directly introduced into the training teaching, expanding the content of teaching resources, realizing the diversification of classroom teaching forms and improving the quality of classroom lectures.

2.4 Intelligent Learning Analysis

The ITS can provide accurate learning analysis reports. In the pre-course preparation stage, the ITS push review materials, collect and analyse the pre-course effect and problem feedback according to the content of the lecture and the student's pre-course learning situation. During the teaching implementation stage, the intelligent teaching assistant can collect real-time information on students' expressions and movements, identify students' listening status and inappropriate movements, assist the lead instructor in issuing classroom quizzes, and provide real-time statistical analysis of students' learning content mastery. In the after-school tutoring stage, the intelligent teaching assistant generates personalized after-school homework and review contents based on the important and difficult contents of the course and feedback from the lectures [6].

2.5 Smart Teaching Evaluation

ITS cannot only realize the daily training of avionics maintenance, but also need to quantify and assess the quality of maintenance training and test the effect of maintenance training. During maintenance training, ITS should be able to implement assessment process actions and be able to remind, warn and correct errors according to the regulations, while also providing warnings of dangerous behaviour and safety disposal plans. During the assessment process, it can automatically carry out personnel inventory, registration, examination room situation monitoring, cheating confirmation, and processing. It can intelligently quantify the assessment scores according to the operation process of the students as well as the proficiency and effect of the operation; it can complete the summary, registration and statistical analysis of the results; it can automatically generate assessment summary reports and course summary reports according to the formative and summative assessments.

3 System Functional Design

The functional design of the ITS should include pre-study content release, intelligent Q&A, learning analysis, resource search, electronic roll call, voice broadcast, synchronous classroom, AI recording, voice transcription subtitles, real-time interaction, behaviour analysis, practice process analysis, guidance error correction, intelligent

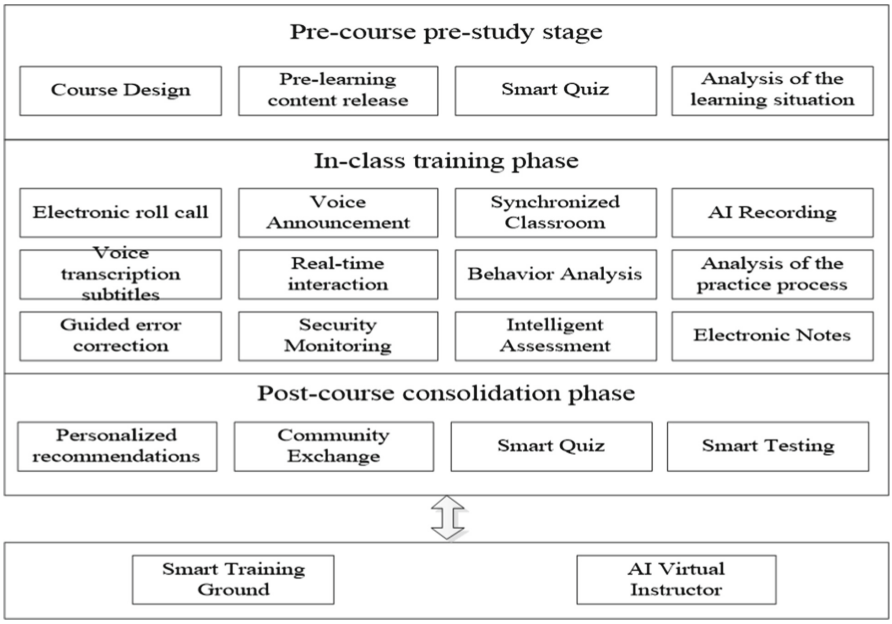

Fig. 1. System functional framework

assessment, electronic notes, personalized recommendation, community communication, task reminder and other functional modules [6]. The above functional modules are mainly reflected in the three stages of pre-course pre-study, in-class training and post-course consolidation, whose functional framework is shown in Fig. 1.

In the pre-course pre-study stage, ITS can gather and integrate high-quality teaching resources from multiple platforms, and assist instructors to complete perfect course design and preparation tasks based on the course syllabus, talent training program, course teaching plan and learning situation analysis; it can assist the instructor to complete the analysis of the learning situation by intelligently extracting the analysis report of the learning situation of this course in the previous teaching period class and the students' leading course in this teaching period class. According to the teaching progress of the course, it can lay out the learning tasks at this stage, clarify the pre-study contents, and prompt the students to carry out pre-study work; AI virtual instructor can help students to carry out interactive answers to frequently asked questions and resource-assisted search, and after understanding the intention of the students' inquiries, broadcast the answer in the form of a simulator by calling the content of the preset knowledge base in real time, or retrieve the relevant resource base contents for foreground presentation according to business settings.

During the training phase of the class, AI intelligent instructors can complete opening environment control and teaching equipment, detecting and adjusting equipment operation status, collecting students' identity information with the help of face recognition, matching all teaching objects, counting the number of people and classroom reporting.

After the instructor completes his work in the preparation room, he wears MR glasses to enter the outdoor practice field and conducts live interactive teaching. Through the virtual reality equipment camera and fixed camera, the teaching screen of the internship field is synchronized to the large screen in the preparation room. Synchronized classroom includes time, live screen (combined with outdoor video camera, supports multiple screens including instructor's view (MR glasses camera), left, right, front, back and top 5 directions fixed camera position), preparation room screen (indoor camera), audio input device (MR glasses integration), transcription caption, and classroom permission setting. The instructor can view the picture and sound of the students' classroom in real time in addition to the live view inside the glasses, and choose to interact with the students' classroom with audio and video for one-to-one and one-to-many interactive teaching.

After the instructor has finished concentrating on teaching, in order to speed up the practice efficiency and learning effect of the trainees, the ITS adopts virtual reality technology to help trainees quickly carry out the maintenance training work of avionics equipment. When trainees wear MR glasses to practice on the helicopter, virtual people, graphics, audio, location markers and other information guidelines are displayed simultaneously in addition to the actual visual image inside the glasses. Trainees need to operate according to the prompts inside the glasses, which can show the overall operation steps, the buttons and operation methods that should be operated in the current step, the judging criteria of the current operation, and the buttons that warn that the current operation cannot be operated.

To effectively solve the problem of inadequate operation of equipment practice classes, trainees can use the simulation training function. The ITS uses virtual reality technology to build a virtual practice field, trainees can feel the real operation method in the virtual scene, and carry out different difficulties of avionics maintenance training virtual operation.

In the post-class consolidation stage, the ITS provides personalized personal assessment reports, makes learning suggestions and recommends personalized learning materials based on the assessment reports; AI virtual instructors help students retrieve questions, intelligent Q&A, and also have deep learning capabilities; the community forum of the ITS provides multi-directional communication between tutors and tutors, tutors and students, students and students, and students and virtual tutors.

4 System Technology Architecture

The technical architecture of the avionics maintenance training ITS adopts a hierarchical design mode, and the system architecture is divided into four layers, which are hardware support layer, resource & capability layer, software function layer and application interaction layer, as shown in Fig. 2.

Hardware support layer provides hardware support for the operation of ITS, mainly including IOT sensing and acquisition equipment, audio acquisition and output equipment, data storage, analysis, calculation and image generation equipment, display equipment, and MR glasses, etc. Display equipment, mainly including display screens and three-dimensional display equipment, is mainly used to display the demonstration video

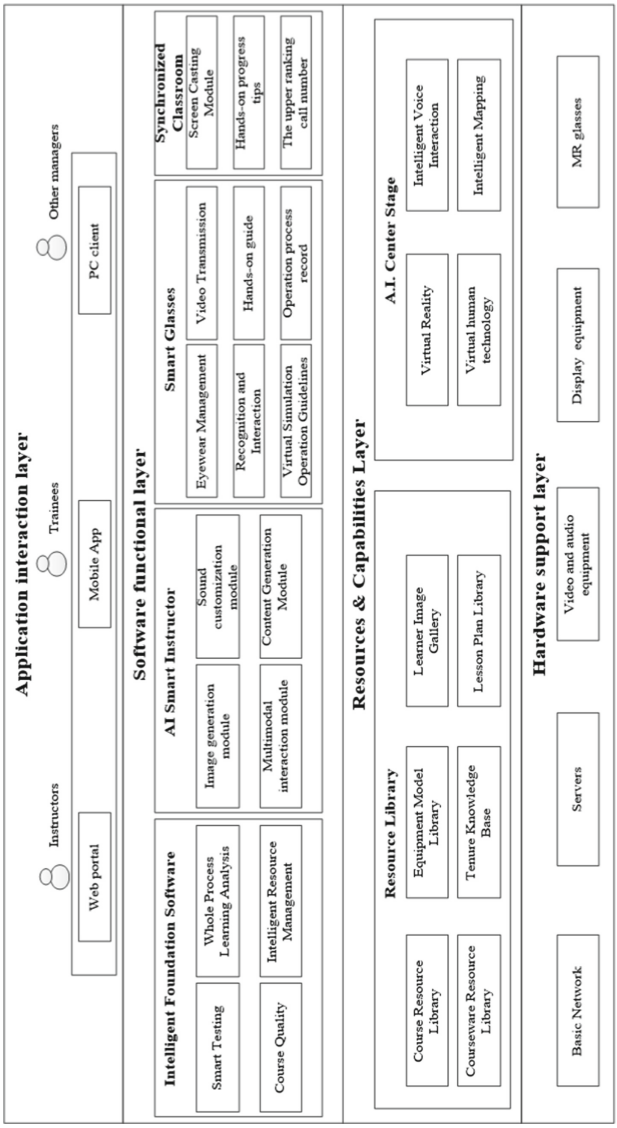

Fig. 2. Functional architecture of ITS for avionics maintenance training

of virtual instructors in a flat and three-dimensional way, display the simulation practice video of trainees, trainees' help information, practice real-time operation screen, queuing and calling for admission, etc. MR glasses are mainly used to assist in the actual operation process, including instructor demonstration assistance, student demonstration assistance, student practical process knowledge retrieval, consulting help and other functions.

The resource & capability layer provides the basic common resources for the operation of the system, including the resource library and the A.I. middle platform. The resource library includes course resource library, equipment model library, courseware resource library, trainee image library, tenure knowledge library and lesson plan library. The teaching resource library such as course resource library, courseware resource library and lesson plan library mainly provides sufficient resources for classroom and course design. The equipment model library is mainly used to build a virtual teaching environment to assist course teaching; the cadet image library is used to store the learning characteristics of cadets, which can make appropriate process evaluation of cadet learning; the tenure knowledge library is mainly used to assess the mastery of cadets' knowledge points, conduct comprehensive analysis and generate the whole process learning situation [7].

The A.I. middle platform includes virtual reality, intelligent voice interaction, virtual human technology and intelligent mapping.

Virtual reality, intelligent voice interaction, and virtual human technology mainly provide technical support for virtual intelligent instructor image generation, voice customization, multimodal interaction, and content generation. Intelligent mapping is mainly used for knowledge extraction, knowledge expression and embedding, knowledge reasoning, knowledge fusion and knowledge application. ITS can provide multichannel and targeted learning methods, providing help to achieve personalized precision learning.

The software function layer provides software support for the operation of the system, mainly including intelligent basic software and AI smart instructor, smart glasses and synchronous classroom. The intelligent basic software is used to realize the functions of intelligent testing, whole process learning analysis, course quality and resource intelligent management; AI intelligent instructor includes image generation module, voice customization module, multimodal interaction module and content generation module, which are mainly used for the management and control of avatar image, voice and multimodal interaction.

The smart glasses are used for backend management of the glasses, for front and backend interaction, and for receiving video streams from the glasses camera. Frame parsing of the video stream enables item recognition of the items in the glasses based on a pre-set model. The frames are dynamically marked, enabling the processed video stream to be pushed back into the glasses, and the video stream to be pushed to the display showcase device.

The video stream is also pushed to the display showcase device at the same time.

The synchronous classroom includes screen projection module, hands-on progress prompts, onboard scheduling call and interactive help. The synchronized classroom for practical classes is mainly synchronized to the large indoor screen and online in real

time through smart cameras. Trainees can directly watch the live screen projected onto the big screen.

The application interaction layer includes web portal, mobile APP and PC client, which are mainly used for instructors, students and other managers to log in the system for operation and use.

5 Conclusion

With the rapid development of helicopter avionics technology, the traditional avionics maintenance training method can no longer meet the needs of aircrew training. The demand of avionics maintenance training is analyzed, and ITS for helicopter avionics maintenance training is developed to solve the shortcomings and weaknesses of avionics maintenance mechanic training. The ITS uses virtual reality as well as augmented reality technology to build a wisdom training field and virtual wisdom assistant, which solves the problem of equipment and training site shortage. The ITS stimulates the initiative and enthusiasm of trainees to learn, improves the quality of avionics personnel training, reduces training costs, and provides an effective way for avionics personnel training.

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