Research on Apply of Digital Tutor for Helicopter Equipment Teaching

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Abstract. This paper discusses the post requirements and system architecture of the dual-tutor teaching mode constructed by using virtual human system in helicopter equipment teaching under the environment of artificial intelligence. Taking theoretical course teaching as an example, the collaborative process of dual-tutor mode is expounded.

1 Introduction

With the continuous deepening of the application of artificial intelligence, big data, Internet of Things, and other related technologies in the field of education, especially the blowout development of online education spawned by the epidemic, the application of Digital Tutors in the teaching mode has received unprecedented attention, and it has further accelerated the application research and exploration practice of Digital Tutors by educators.

Virtual teacher refers to the teaching mode of using virtual human technology as teaching assistant. Virtual human refers to a virtual character with a digital shape[1], is a 'digital person' endowed with occupation, personality, and story. It refers to the anthropomorphic image created by computer graphics technology, which is endowed with distinct character setting and runs on the computing device in the form of code and data. Virtual teacher is a virtual person endowed with the professional characteristics of teachers. Specifically, it refers to the technical entity that can simulate the appearance image and action expression of real teachers and simulate the teaching function of real teachers in the three-dimensional virtual learning environment generated by computer.

At present, a variety of virtual teacher systems have been developed at home and abroad, mainly classifies virtual teachers into three categories[2]: Intelligent Virtual Teacher System. For example, Steve[3], a teaching agent developed by the Computer Department of the University of Southern California School of Information Sciences, Whizlow[4], one of the three animation teaching agents developed by North Carolina State University; Virtual Teacher System with Three-Dimensional Realistic Image. The wide application of these virtual teachers with different types and functions largely supports and serves the education and teaching work.

Nowadays, the helicopter equipment teaching mode, especially the theoretical studying period, is still based on the mode of Human Tutors' classroom teaching. This paper aims to explore the application of virtual human technology as a Digital Tutor's teaching assistant system in helicopter equipment teaching through job demand analysis, main system architecture and collaborative mode process.

2 Identifying Digital Tutor Post Requirements

Present helicopter equipment teaching positions can be divided into three categories: theoretical teachers, experimental teachers, and practical teachers. The teachers of theoretical courses mainly teach indoors, teaching the basic principles, working process of systems. The teachers of experimental course mainly conduct laboratory teaching, conducting demonstration and operation. The teachers of the practical course mainly teach in the practice field, teaching the operation of systems, fault analysis and maintenance.

Based on three different types of teaching positions, the job requirements of Digital Tutors need to be set differently. Digital Tutors of theoretical courses focus on cultivating students' memory, understanding, analysis and creation of knowledge, and can provide course preview and review, knowledge point test, knowledge point slicing, auxiliary teacher preparation, auxiliary classroom teaching and various analysis reports; the Digital Tutors of experiment course focus on cultivating students' perception, imitation, externalization and proficiency of skills, and can provide course preparation and review, knowledge point test, auxiliary experiment process, prompt and early warning and various analysis reports. Practice course Digital Tutors focus on cultivating students' perception, proficiency, judgment, and correction of operation, and can provide course preparation and review, knowledge point test, auxiliary

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practice process, guidance group training and various analysis reports.

The common demand part is extracted from different positions, and the system is divided into pre-class preview system, in-class auxiliary system and after-class review system. The Digital Tutor is embedded in different job scenarios as a separate system, and appears in the form of one-to-one, one-to-many, or multi-modal interaction at different stages of the classroom/laboratory/training field. The network relies on the private network or private cloud for resource allocation, retrieval, and interconnection.

3 System Construction

In view of the current teaching mode of helicopter equipment teaching based on Human Tutors, when establishing the system, Digital Tutors are set to appear as 'assistants' as a supplement and expansion of Human Tutors' teaching. Digital Tutors should have an independent and optional digital person image, realize the multi-modal interactive function of client-side 'face-to-face' teaching, and be able to generate interactive content according to the resource library in the computing and storage environment.

The main architecture of the system includes four layers, hardware support layer, public resource layer, software function layer and application interaction layer. Hardware support layer includes audio and video equipment, servers, interactive terminals, MR/VR glasses, etc., to provide hardware support for the interaction between teachers and students, decision-making planning, action, and emotional control in the teaching process. The public resource layer includes a resource library and an AI platform, which is used to build a virtual teaching environment, provide resources for curriculum design, and for AI deep learning, intelligent mapping, AI training, etc. The software function layer includes intelligent basic software and Digital Tutor system, realizes the basic functions of intelligent classroom, analyses, and evaluates the teaching activities, classroom quality and resource management. The application interaction layer includes pre-class preview system, in-class teaching assistant system and after-class review tutoring system, which are used differently according to different teaching application scenarios. The system architecture is shown in Figure 1.

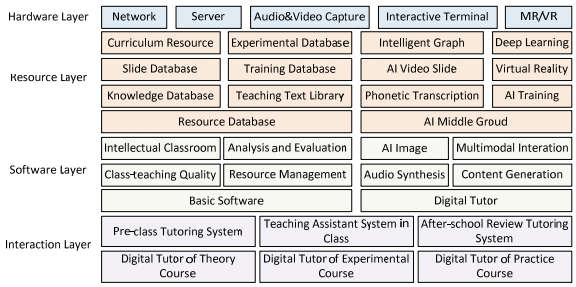

Fig. 1. System Construction.

The three application scenarios of the Digital Tutor system realize the deployment and application of the system through six deployment points. The cloud server is deployed in the computer room. By deploying private cloud servers, data storage servers, and AI computing servers, resource storage, AI model design, training, distribution, etc., provide resource storage services and AI model support services.

The theoretical Digital Tutor system is deployed in the smart classroom, including modules such as student learning monitoring, auxiliary teaching, interactive control, resource push, and learning effect evaluation, to complete the theoretical classroom teaching with human tutors.

The Digital Tutor system of experimental course is deployed in the laboratory, including experimental operation demonstration, experimental process monitoring, resource push, interactive control and learning effect evaluation module, and completes the classroom teaching of experimental course with human tutors.

Deployed in the equipment practice/training field, the Digital Tutor of the practice class includes modules such as actual operation demonstration, student operation monitoring, synchronous classroom, interactive control, resource push, and learning effect evaluation, completing field practice classes with human tutors.

4 Key Technical Analysis

Based on the basic hardware platform, the virtual teacher system constructs system functions at the ability layer and application layer and realizes human-machine interface and interaction through multi-type terminals. The key technologies of system implementation mainly include virtual reality technology, virtual human technology, intelligent voice key technology, knowledge graph technology and so on.

4.1 Virtual Reality Technology

Virtual reality technology refers to the combination of virtual and reality technology, it is defined as having three typical characteristics, namely immersion, interaction, and imagination [5]. Due to the combination of computer technology, image technology, simulation technology and other information technology, it can generate a variety of sensory stimulation of the virtual environment, so that users can interact with the environment in a natural way, resulting in a sense of experience and immersion in the corresponding real environment. Its key technologies include binocular stereo vision technology, virtual environment construction, holographic waveguide display technology, etc.

4.2 Virtual Human Technology

Virtual human image mainly includes virtual image motion capture, virtual portrait generation, based on modelling, driving, and rendering three core technologies to achieve. The specific steps are to build a basic 3D model with real person as model or design

person as virtual person; determining the basic action of the virtual human through the form of live action capture, namely the driving link; according to the external factors such as the final rendering effect and application scene of the virtual human determined in the design process, the model and its motion are rendered to present the best effect. Its key technologies include multi-mode sensing technology, cognitive intelligence technology, multi-dimensional expression technology, etc.

1) The problem to be solved by Auto Speech Recognize (ASR) is to make the virtual human 'understand' the human language and 'extract' the text information contained in the language. The recognition process can usually be divided into two modules: 'front-end' and 'back-end'. The main function of the 'front-end' module is to perform endpoint detection, noise reduction, feature extraction, etc; the function of the 'back-end' module is to use the trained 'acoustic model' and 'language model' to perform statistical pattern recognition on the feature vectors of the user's speech to obtain the text information it contains.

2)Natural Language Processing (NLP) aims to enable machines to understand the information contained in texts based on human natural language like human beings and complete some specific tasks in the field of language. Natural Language Processing (NLP) has many sub-domains and technologies. According to the data, as the key technology of artificial intelligence, China has become one of the countries with the largest number of patent applications for natural language processing[7]. The goal of NLP, it can be divided into Natural Language Understanding (NLU) and Natural Language Generation (NLG).

3)Speech synthesis is to transform the text information of text state into audible sound information, which gives the virtual human the same speech ability as human. It is a process of Text to Speech (TTS). The current mainstream technical routes of speech synthesis are divided into three types: speech synthesis method based on unit selection waveform splicing, speech synthesis method based on statistical modelling (HMM) parameters, and speech synthesis method based on deep learning technology.

4.3 Intelligent Voice Key Technology

In the process of realizing the interaction between virtual teachers and real teachers and students, it is necessary to realize the processes of voice acquisition, voice wake-up, voice detection, cloud recognition, local knowledge base retrieval, robot interaction, voice synthesis, output device playback, judgment end, etc., to form a logical and complete voice interaction system to meet the functional needs. The key technologies include speech recognition technology, speech synthesis technology, natural language understanding technology and so on.

4.4 Knowledge Graph Technology

Knowledge graph is a semantic network that reveals the relationship between entities, which can formally describe things in the real world and their relationships. Its essence is a large-scale heterogeneous semantic network composed of massive knowledge contained in pictures, texts, audio, and databases. It uses entities and relationships for knowledge representation and is stored in the form of triples or graph data structures [6]. Knowledge graphs have now been used to refer to various large-scale knowledge bases. This system mainly includes:

1)Knowledge graph construction technology for pre-job training: Accumulation of business knowledge based on rapid reuse, knowledge base construction and closed-loop optimization program.

2)Construction technology of diversified comprehensive competency evaluation system: Realize adaptive, personalized, quantifiable, full-cycle, interactive dynamic evaluation model, and build an evaluation framework covering multiple dimensions, serving all kinds of people, and satisfying comprehensive competence.

3)User portrait generation and iteration based on multimodal data: Realize the user portrait construction process based on the multi-dimensional label system, mine the attribute characteristics of multiple dimensions such as user context, project context, time context, space context, and calculation context, and construct an adaptive iterative model of user portrait for user growth process.

4)Key technologies of adaptive education for pre-service training: Achieve personalized, efficient speech recognition, speech synthesis and gesture recognition capabilities to build a real data-driven personalized learning engine.

5 Collaboration Mode Process

According to the general requirements of teaching content, the main links of teaching design can be divided into three stages: pre-class preview stage, teaching implementation stage and after-class guidance stage. This paper takes the 'Dual-Tutor' mode of theoretical course as an example.

5.1 Pre-Class Preparation Phase

Through the pre-class preview guidance system, the Digital Tutor releases the preview task to the students, pushes the preview resources, guides the students to study the preview resources in the self-study room, and conducts the preview test, evaluates the preview results, summarizes, and forms the preview report, and pushes the learning materials of weak knowledge points to the students according to the report. Assist Human Tutors to complete the analysis of learning situation before teaching, push teaching resources based on big data and resource library, assist Human Tutors to design teaching key and difficult points, and prepare for teaching.

5.2 In-Class Tutoring Phase

In the teaching implementation link, modules such as synchronous classroom, AI recording and broadcasting, AI micro-course, and Digital Tutor-assisted teaching are set up to support cross-regional and cross-temporal teaching. Digital Tutors are embedded in the teaching process to cope with the real-time awakening of Human Tutors and the interaction of speech semantic recognition. For example, according to the progress of the launch of the Digital Tutor' s knowledge Q&A, to achieve important knowledge points graphic combination of solutions and broadcast; according to the Human Tutor's instructions, search the resource database and large database for case analysis, and split parts and view details according to the coarse-grained model; according to the requirements of Human Tutors, push and summarize knowledge points, and present and interact; according to the pre-class students' preview, test scores, classroom performance and other data for comprehensive analysis, support Human Tutors to open real-time classroom analysis screen, select students for targeted interaction; support voice transcription of teaching content, generate electronic lesson plans, to achieve after-school review of video clip retrieval.

5.3 After-Class Tutoring Phase

Place figures and through the after-school tutoring system, Digital Tutors carry out after-school tests and automatic marking, present students' after-school test results and learning weakness analysis, support the functions of Digital Tutors' wake-up intelligent question and answer, online interaction, student group discussion setting, review task reminder, etc., and push the background data to real teachers for problem solving and teaching design improvement. The main content of the collaborative process is shown in Figure 2.

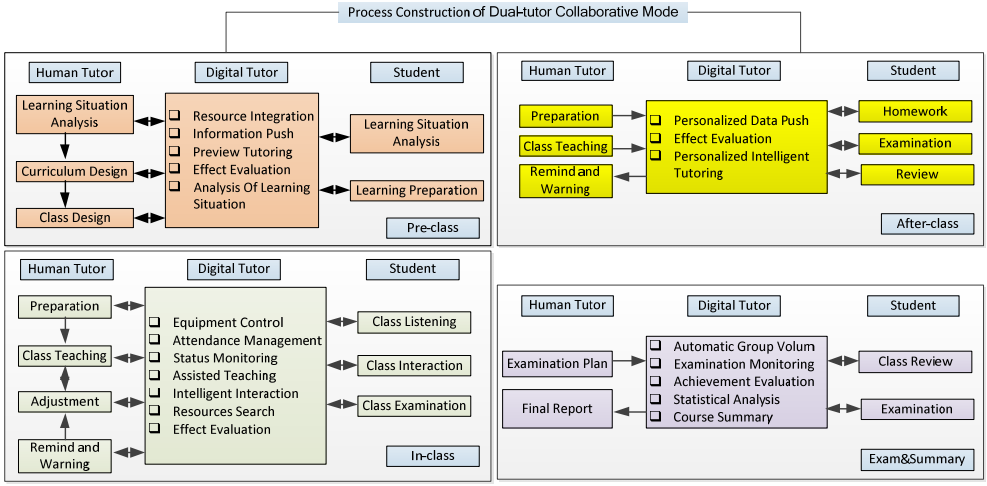

Fig. 2. Process Construction of Dual-Tutor Collaborative Mode.

6 Conclusions

Helicopter equipment teaching is a professional course for helicopter pilots and maintenance personnel, which occupies an important proportion in the training cycle. In view of the current urgent need for innovative development and training of equipment teaching, it is the only way to meet the future intelligent education to construct a typical 'Dual-Tutor' collaborative teaching mode with system construction as the leading factor and intelligent technology application post as the main line, and to study the typical 'Dual-Tutor' collaborative teaching mode adapted to development according to the general idea of human intelligence integration and gradual iteration.

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