

Remote Interactive Digital Transmission Classroom Based on IP Net

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Abstract—Adapting to the demand by the Ministry of education to strengthen specialty construction in higher vocational schools, the paper elaborates on the importance and construction scheme of remote digital transmission class, discusses the key technology. The scheme can make the part-time teachers in enterprises directly teach professional lesson in his work site. The scheme plays an important role to improve the quality of teaching and bring out school-enterprise cooperation. Taking the example of productive process automation specialty construction supporting by central finance in national key college (Anhui Electrical Engineering Professional Technique College), it details the design and construction process of Remote Interactive Digital Transmission Classroom. Application cases show that, this mode is useful for reference to other high schools.

Index Terms—digital transmission classroom, remote teaching, school-enterprise cooperation, IP net, multimedia

I. INTRODUCTION

Anhui Electrical Engineering Professional Technique College is a typical electric-characteristic college, for the school was established by power industry. The major of process automation technology was approved as national specialty by the Ministry of Education and Finance in 2011. The specialty follows the purpose "taking school-enterprise cooperation system innovation as the core, forming a training mode of working combining with learning, establishing training base including enough factory-in-school and school-in factory", so as to improve the quality of personnel training.

Professional teaching team independently design, plan and construct a new type practice base – school enterprise integration automation teaching factory, combine teach, training, production, occupation skill appraisal and social service functions. Depending on the "teaching factory", promotes various specialty construction projects smoothly and orderly. In the "teaching factory", the team created remote interactive digital transmission class, to break time and space

barriers, and realize college and enterprise combination teaching.

II. CONSTRUCTION SCHEME

A. Project Importance and Necessity

At present, there are more than 10000 occupation schools, more than 1000 higher vocational colleges, about 30000000 students in reading in China. Occupation education should pay attention to cultivate student's practical skills. But because the students number in the higher vocational colleges is very large, and the students in the school has not yet signed a contract with any employment, so the students have no chance to practice in enterprise. (On this point, the situation is different from German "dual system"). [1]

In order to improve the teaching quality, strengthen students' industry and profession cognition, many occupation colleges hire part-time from industry enterprises, and also arrange students' field practice. But implementation is difficult due to following reasons.

In recent years, the professional students entering into field to practice will bring some practical problems. Because of the special environment of power plant, safety requirement is so high, while students practice exist a certain potential risk. Because the job busy teachers and enterprises, to be here to school teaching; so the construction of the teaching of the factory will solve the problem of students do not go to the site can still learn the knowledge and skills of the field. [2]

On the one hand, because of distance, time and many other uncertain factors, the enterprise engineers can't arrive at the school for teaching according to arrangement. On the other hand, to ensure students safety and avoid normal production from interfering, enterprises usually won't allow students to practice on producing site. Then it brings a reality problem, how to combine the business teaching with classroom teaching of colleges, let the students feel enterprise production atmosphere? Digital transmission class can solve this problem perfectly. [3].

B. Scheme Design

21 century is a century that information industry and technology develop rapidly.

With the unprecedented development of education information infrastructure and microcomputer technology, people will learn knowledge and improve ability through the Internet, studying can be not affected by time, place restrictions, so, it greatly improve the learning initiative, while also greatly reduces the cost of learning. [4], [5]

Visual communication, because of its large amount of information, easy to use, communication natural advantage, becomes the focus of development.

Video conference is one technology which realizes the remote real-time video and audio transmission and switching using a digital transmission network, the system is mainly component of the terminal equipment, transmission channel (communication networks), and multipoint control unit, is an effective tool for improving productivity, efficiency and interpersonal communication.

The project of digital transmission class built in Anhui Electrical Engineering Professional Technique College, used video conference technique, promotes enterprise personnel at the scene teaching and school full-time teacher teaching cooperation, interaction and complement, transmit maximum information of knowledge to students. [6].

Between 4 places (see Fig. 1)—Anhui Hefei Power Generation Company thermal control plant, Huaneng Chaohu Power Generation Company chemical water process workshop, Anhui Electrical Engineering Professional Technique College campus automation factory and thermal meter training room, remote interactive digital transmission class is constructed, reforming the traditional teaching mode. The production process, work flow and real-time information of the enterprise are transported to school classroom, school

teaching process and enterprise production combining closely.

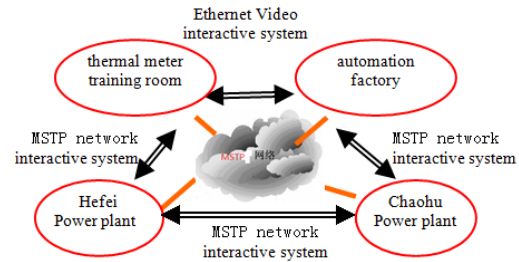


Figure 1. Network diagram

III. CORE TECHNOLOGY

A. System Configuration

This project uses the video conference system based on IP network, which has the advantages of low cost, interactive strong, more in common, and is superior to the traditional television and telephone conference. Video conference system is the ideal choice for teaching and communication via remote.

By comparison, investment of hardware video conference system is higher, but the stability, reliability, quality of video, voice condition coherence and stability is much better than software video technology, so this project is determined to use hardware video conference. [7]

Hardware video conference is of the video communication mode based on embedded system, relying on the DSP and embedded software to realize video and audio processing, network communication and various conference functions. Its biggest advantage is high performance and good reliability. The main configuration of the project system is as Table I.

TABLE I. PROJECT SYSTEM CONFIGURATION

No.	Device name	Models and performance parameters	Number	Function	Installation position
1	Video conference server (MCU)	ZXV10 M800; Multimedia exchange unit	1 set	Designed specifically for the network stream media application and design based on IPC plug-in monitoring device, decoding device belongs to the center of the network video monitoring system.	automation factory in college
2	Video conference terminal	ZXV10 T502 2M ; (Including supporting software)	4 sets	Multimedia access unit, implementation of 1M to 8M bandwidth and H.264 4CIF HD codec.	2 sets in the campus; 2 sets in the power plants
3	SD integration CCD camera	SONY D70P;	4	Video tracking dedicated camera, can be remote controlled	2 sets in the campus; 2 sets in the power plants
4	Microphone	Gooseneck microphone	4	Change the sound signal into electrical signal	2 sets in the campus; 2 sets in the power plants
5	TV	Hisense TLM32V78K	2	Used to display images	2 sets in the power plants
6	Metal moving cart	Customized metal cart, with brake wheel	4	Can be fixed or shifted; used to place video conferencing device and realize mobile teaching. In enterprise.	2 sets in the campus; 2 sets in the power plants
7	Hub	Wireless AP	2	formation of small wireless LAN	2 sets in the power plants

Using the above equipments, related software and network technology, the remote video teaching system was embedded into integration systems. It support ITU-T.H.323 and SIP, protocol, uses the H.239 video coding standard, simultaneously with the WEB video and audio monitoring, super multi screen, H.460 firewall traversal, H.235 encryption, T.140 short message banner, terminal meeting-calling and other advanced technology.

Between the 4 places – two "factories in school" and two "schools in factory", interactive conversation at the same time will be realized, teaching task can be completed together by enterprises and school, in addition through the audio signal, but also through the real-time image video terminal transmission. Especially, the system can be expanded in the future, for seeking more enterprises to cooperate with school. [8].

The core plant--MCU is specially designed for streaming media applications based on industrial PC plug-in monitoring equipment, belonging to the network video monitoring system of the decoding center equipment. This product adopts the technology of H.264 decoding and supports a maximum of 16 D1/64 road CIF video decoding and single video channels support 4 picture segmentation, can provide a fast Ethernet port can support video matrix, split screen and picture in picture function.

MCU is used as a server, cooperated with a video conference terminal T502, a net switch and a set of meeting scheduling enterprise edition software, equipment management software, all arranged in standard network server cabinet in automation factory in college. The main teaching venue may achieve image monitoring function units according to need, conference TV system can realize the dual video stream function according to remote education and training need. All distance education content can be recorded and preserved through the hard disk system for future reference.

The terminal host machine is a key equipment of the ZXV10 T502, it sends image and speech coding to the transmission network, at the same time, decodes the remote image and speech received to the end of the connected video, audio equipment.

Each teaching site equipped with high definition cameras and gooseneck microphone. Microphone is audio input device of ZXV10 T502, connected to the audio input interface of T502. The video camera

provides input video for T502, connected to the video input interface of T502. (see Fig. 2.)



Figure 2. Assembled terminal equipment in production site

B. System Communication Net

Through China United Network Communications Co. Ltd., 2 MSTP local 2M circuits are opened, respectively to Anhui Hefei Power Plant and Huaneng Chaohu power plant. "A" end is located in Anhui Electrical Engineering Professional Technique College campus. "Z" end is located respectively in two power plants. And in campus, each room in same building is connected by cable.

MSTP line, constructed on MSTP equipment platform, provides the point to point data line business through the Ethernet interface, fully guaranteeing communication quality.

Considering the image and sound quality, image stability and security, system uses H.323 network, adopts star type structure, namely the radiation from the center to each node. [9] IP address assignment and HMI Design is shown in Table II and Fig. 3 respectively.

TABLE II. IP ADDRESS ASSIGNMENT

Equipment	Interface	IP address	Gateway address	Remarks
M800	LAN	192.168.1.10	255.255.255.0	
T502-Chaohu Power Plant	WAN	192.168.1.13	255.255.255.0	
T502-Hefei Power Plant	WAN	192.168.1.14	255.255.255.0	
T502-4 Floor	WAN	192.168.1.15	255.255.255.0	automation factory ("factories in school")
T502-5 Floor	WAN	192.168.1.16	255.255.255.0	thermal meter training room("factories in school")

C. System Safety Management

Video teaching system security is an important factor that should be considered, safety measures are adopted in

this system includes the following aspects: set called password, entering the teaching system must enter the password to control the teaching process; authorized

username and password needing for the system management and equipment management.

Four teaching sites of the system take the type of zoning management. Each authority is divided by region management, management within the region unit.

Network operator is governed by different level management authority. According to the permission level, the network management system user is divided into two

groups-- ordinary user, and super user group. Ordinary users only can browse but cannot change settings, while the super users can configure the system. At the same time, the unit also supports the validation of user identity. When one user views or changes the configuration unit, he must enter the correct user name, password.

The security log of the system is capable of recording all operations relating to safety management.

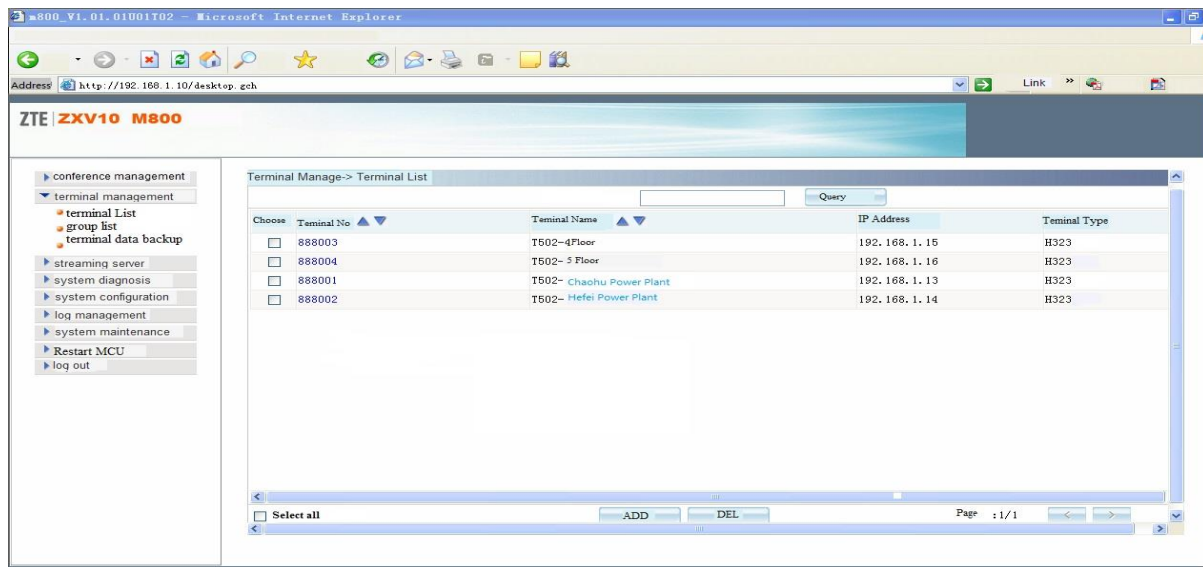


Figure 3. MCU terminal configuration management

IV. APPLICATION EFFECT

Adapting to the demand by the Ministry of education to strengthen specialty construction in higher vocational schools, we built "School in Plant and Plant in School" since 2007, now construction situation has took shape. So the author brings forth a new idea of "teaching factory" building based on interactive mode of "school in plant and plant in school", and used it in productive process automation specialty construction supporting by central finance in national key college (Anhui Electrical Engineering Professional Technique College).

This project is supported by national fund, autonomously designed by Anhui Electrical Engineering Professional Technique College teacher, developed through school-enterprise cooperation. The digital transmission class began to put into teaching operation in 2012. This project got "Provincial Teaching Effect Reward" for its outstanding effect in China.

With help of the device, 3 courses -- "process measurement instrument", "field bus control system" and "variable frequency control technology" -- teaching was completed. Senior technician teaching in power plant, meantime college professor teaching in school, students lessoning and practicing in training room, all people are linked together through the interactive distance teaching system. Students can interactively communicate and consultation question enterprise expert in real time; and students can synchronously practice skill following the business professional operation video.

With the aid of the video scene feature, enterprise production detail can be focused; with the help of the

mobile cart flexibility, every corner of all production sites can be displayed [10]. Further more, it can promote excellent teaching resources opening and sharing, and college teachers can carry out on-the-job training for enterprise workers, to realize the win-win between college and enterprise. See Fig. 4.



Figure 4. School-enterprise cooperation teaching real scenery

The system can real-time display video and voice information of every teaching point, and be able to display in various mode--full screen mode, split screen mode (four screens) and picture in picture mode, to display video signal around the schools and factories. Especially, through monitoring platform function, each teaching point image can be real-time maintaining by the main teaching point, each branch field picture clarity can be up to 4CIF resolution ratio.

V. CONCLUSIONS

Remote interactive digital transmission class, building information platform, creating digital learning space, combining the theory teaching with the real scene training, vividly manifesting the teaching content, effectively creating teaching environment of real work

process, realized school enterprise cross-border joint teaching. It can improve the students' efficiency of mastering the knowledge and skills, achieving the objective of improving the teaching quality and optimizing the teaching process. Practical proof shows that, this teaching factory mode is useful for reference to other high schools.

Furthermore, reforming the traditional teaching mode with the modern information technology, sharing the high quality teaching resources, and cracking the obstacle of time and space between school enterprise cooperation, cooperating with enterprises to develop virtual process, virtual technology, virtual production, virtual operation and other digital teaching resources; all these frontier technologies of education will greatly promote vocational education to develop.

REFERENCES

- [1] B. Zhu and B. Cheng, "Thinking of fostering highness skilled specialties talent," *Journal of Anhui Electrical Engineering Professional Technique College*, vol. 19, pp. 99-103, June 2014.
- [2] J. G. Ding, "The exploration of the mode of 'school enterprise cooperation and work study combination' in higher vocational colleges," *Research in Higher Education of Engineering*, vol. 6, pp. 114-117, December 2010.
- [3] B. Cheng, "Teaching factory building based on interactive mode of school in plant and plant in school," *Modern Occupation Education*, vol. 4, pp. 67-69, April 2013.
- [4] Z. M. Tu, "Analysis of the current situation of distance education under computer network environment," *Science & Technology Economy Market*, vol. 4, pp. 169-170, April 2006.
- [5] G. H. Yan and Y. H. Yan, "Teaching research based on information management and video teaching system," *Value Engineering*, vol. 32, pp. 99-103, June 2014.
- [6] A. M. Wang and X. M. Zhao, "Video conference system and its application in distance education," *Modern Distance Education*, vol. 16, pp. 49-51, February 2003.
- [7] C. Li, W. L. Chai, and J. S. Liu, "Technical analysis of HD video conference system," *Information Security and Technology*, vol. 1, pp. 47-49, August 2003.
- [8] Y. C. Xue and Y. F. Wen, "The exploration and practice of higher vocational colleges teaching model virtual project," *Journal of Suzhou Vocational University*, vol. 24, pp. 82-84, January 2013.
- [9] J. G. Wang, "Design and implementation of modern distance education video teaching system based on streaming media technology," M. S. thesis, Liaoning Normal University, Dalian, China, 2006.
- [10] L. F. Yan, "Higher vocational education in the video teaching resources development and application research," *Practical Electronics*, vol. 6, pp. 187-188, April 2014.



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