Research on Key Techniques for Enginery Teaching Platform Based on Computer Dynamic Simulation Technique

Huiping Guo*, Lin Zhu, Fengxin Yan
Northwest A&F University, Yangling, Shaanxi, China

Abstract—The web teaching platform based on virtual reality technique is a challenge to the traditional teaching mode and a necessity with the development and maturity of information technologies. Based on the easily made and operated VR techniques with its immersion and interactivity, this paper combined resources about the enginery knowledge and information to build the overall platform. It significantly improves users' feeling about and understanding of the part models. It can be visually perceived and is flexible and convenient, providing users with operating experience which makes virtual reality and the real world consistent with each other. Eventually, both people and models can dynamically interact and perceptively communicate with each other.

Index Terms—enginery teaching platform; computer dynamic simulation technique; electronic file.

I. INTRODUCTION

Virtual reality is a digital information technique developed over a long period of time by labs of various disciplines. The rapid development of various techniques, including screen, computer system, graphics, optical fiber and 3-D tracing also boosted the development of virtual reality. When various techniques reached their corresponding highest standards, the virtual reality technique based on these techniques appeared naturally. It can create the virtual world, or help to experience the virtual world. It is called "Ling Jing" or "Huan Zhen" in Chinese [4]. The so-called virtual reality is a lifelike virtual world created by computer graphics and possessing visual, auditory and tactile senses. The virtual reality technique covers knowledge of various branches of information, such as AI, image processing, intelligent interface, sensor technique, multi-thread processing and network. It can be utilized in other disciplines, such as mathematics, physics and geography.

The virtual reality technique provides users with some advanced interfacing methods. The advanced sensor devices can be employed to observe and operate in 360 degrees the object models in a virtual setting in order to naturally interact with virtual setting and to provide users with a direct and natural visiting experience. Generally, a typical virtual reality system comprises a computer, input device, output device, virtual reality software, as well as a virtual world [1]. Meanwhile, it boasts three important characteristics; namely, immersion, interactivity and imagination.

II. METHODS FOR VIRTUAL REALITY TECHNIQUE

The virtual reality technique is based on advanced devices, such as a data helmet and a glove. However, with the developing of information technologies over many years, the virtual reality technique has evolved into including all and any related techniques and methods possessing virtual reality and lifelike experience. Depending on varying degree of interactivity and immersion, a virtual reality system can be categorized into four types:

(1) Desktop VR

The desktop VR system is the VR environment system based on a computer and a workstation. The computer screen is used by users as the transmission medium between the virtual world and the real world to experience the object models in the virtual environment. Meanwhile, the input devices are equipped to work this virtual environment and to operate models in the virtual setting so that the object models can be rotated, zoomed out and browsed in 360 degrees in the virtual environment. Due to its relatively low costs, the desktop virtual reality system is more likely to be popular. A personal computer and some related input and output devices are what is needed to create a three-dimensional space to build up the feelings of immersion.

(2) Immersive VR System

The immersive VR system is capable of creating a new virtual space for any experiencers. With advanced virtual reality devices, the user's visual, auditory and tactile senses are all included in the experience, so that the user can be put into the virtual reality world, being part of it and having a sense that one is personally on the scene. In this way, users can avoid outside interference and concentrate on studying in the virtual reality environment. Immersion manifests itself in the degree of existing in the virtual space. However, it also has weaknesses [2]. For example, for developers, the immersive virtual reality system is difficult to build and more complicated. For users, a data glove, position sensors and other advanced devices must be used to interact with objects in the virtual reality environment. However, these advanced devices are generally expensive, and therefore will probably not, gain widespread popularity.

(3) Superposed Virtual Reality System

The superposed virtual reality system, also called enhanced virtual reality, is capable of providing a virtual reality system which is connected with the real environment and stored in computer. Through a wearable headset screen, based on the real environment, the superposed

computer virtual images significantly improve users' experience and feelings towards virtual environment. Compared with other types of virtual reality techniques, the superposed virtual reality system can be used to enhance users' perception about the realness of the virtual environment. Additionally, it may even enhance feelings that are impossible in the real world. Users can operate the model objects in virtual reality world at will according to their jobs. Meanwhile, they can obtain synchronized activity information from the produced environment [3].

(4) Distributed Virtual Reality System

The distributed virtual reality system is a resource-abundant network virtual world built by the network communication technologies and virtual reality techniques. It provides a virtual space which can be shared through a network and breaks the limitation of spatial positions. Wherever the users are, the virtual environment can be accessed to do work through the network so that the virtual reality resources can be shared through the network and mutual study and communication can be achieved. It can also provide efficient computing capability for the virtual reality system. For example, the long-distance virtual lab can be accessible to users at various geographic locations at the same time through the network so that researchers can communicate and co-operate to finish the experiments [5]. In this way, long-distance co-operative work can be achieved. It can also be widely used in various fields, such as engineering, training and entertainment.

III. BUILDING OF WEB SERVER

A web server is computer software on the internet, which is also called HTTP server. After users request files, at first, the server will be connected. When the server receives requests for connection and processed them, the information is communicated to the user's browser through the network. The communicated information can also control the methods of how the browser checks the information documents through codes [6].

A web server also has a storage function, which can run scripts and software while users are browsing information. If information should be provided on the web, a request list is needed that asks users to input relevant information. After the list is filled in and submitted, it is sent to software with particular function in the server [7]. This software processes the request and sends a file of information inquiry to the reader. Software with these functions is called gateway scripts and software. In the web, most lists and search engines employ this kind of technology.

To establish a workable web server, a well-performing CPU is needed as well as sufficient memory configured according to particular needs (e.g. 16GB or 32GB) and a high-capability SATA hard disk (e.g. 5TB or 8TB). A server of this level can be easier to maintain and manage. It has good performance and can serve small and medium-size enterprises well. It can also be used in construction of multi-media classrooms or campus networks [10].

A. Development and Operation Environment

Before using Tomcat, JDK (Java Development Kit) should be downloaded and installed, and the Java environmental variables can be configured. JDK is a developing environment used to publish application, applet and components. It includes Java compiler, JVM, many Java tools and a class library based on Java and Java language standards. Meanwhile, any modifications of Java language should be included and will be published as a subsequent version. For a programmer, JDK is the most fundamental tool.

B. Necessity of Configuring Java Environment

Environmental variables are parameters used to designate the operating environment in the operating system.

The PATH environmental variable is used to designate paths for command searching. While exercising commands in Shell script, the environmental variables will search the corresponding command programs in the paths designated by the PATH variable. Thus, the Bin directory under the installation directory of JDK should be added to the existing PATH variable. Bin directory includes the commonly used executable files such as Java and *Javadoc*. By setting PATH variable, tools such as *Javac* and Java can be executed in any directory.

The purpose of setting CLASSPATH is to enable the Java operating environment to search classes and bags required by Java programs which are to be executed.

JAVA_HOME Environmental Variables. The installation locations of JDK, Eclipse, Net Beans, Tomcat and other software must search JAVA_HOME to determine the location of JDK and use it. Its functions are: (1) Convenient reference. For example, if JDK is installed in directory "C:\Program Files\Java\jdk1.7.0", then JAVA_HOME should be set as this directory path. To use this path, only "%JAVA_HOME" should be entered, without having to input long path names for each reference. (2) Normalization principle. To modify the JDK path, only the variable value of JAVA_HOME needs to be altered. Otherwise, all absolute paths must be altered to reference documents in the JDK directory. If anyone is missed, some software will fail to search JDK, and as a result the software may crash.

The third-party software shall reference the configured JAVA_HOME variables so that this software can be properly operated. Thus, if any software fails to run smoothly, JAVA_HOME may be incorrectly set.

C. Methods for Configuring Java Environmental Variables

(1) In order to configure java environmental variables, first choose the Advanced Settings option in the computer's Properties tab. Then go to the setting for environmental variables.

(2) Newly establishing variable name(N): JAVA_HOME variable value (V): C:\Program Files\Java\jdk1.8.0_65, as shown in Figure 1.
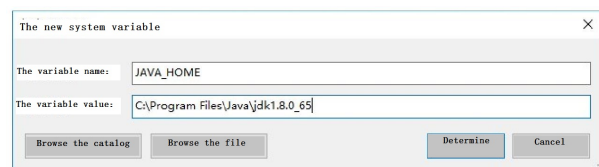

Figure 1.   Configuration of JAVA_HOME environment variable

Variable Name(N): CLASSPATH

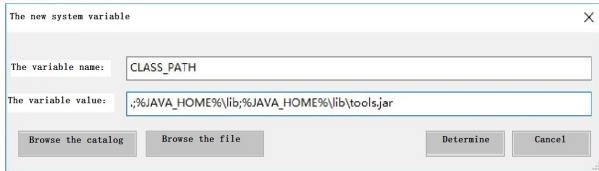Variable Value(V): %JAVA_HOME%\lib\dt.jar;%JAVA_ HOME %\ lib\ tools.jar;, as shown in Figure 2.

Figure 2.   Configuration of CLASSPATH environment variable

Select the environmental variable with its variable name as Path in System Variables. The absolute path of the Bin directory in the JDK installation directory should be added to value of Path variable. Variable Name (N): Value of Variable Path (V): %JAVA_HOME%\bin; %JAVA_ HOME%\jre \ bin;, as shown in Figure 3.
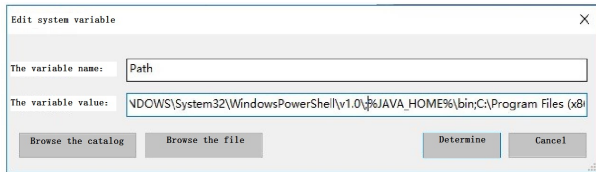

Figure 3.   Configuration of path environment variable

Test whether the Java environment has been successfully configured. Use the keyboard shortcut Win+R to start the Control Window of the Command Prompt and input "java-version". If the version number of the Java software can be displayed, it suggests that the configuring process has been successful. Then the testing procedure is finished. As shown in Figure 4, the version number is "1.8.0_65".

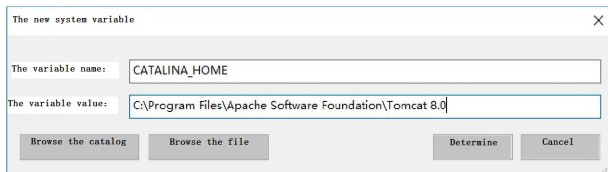Figure 4.   Configuration of CATALINA_HOME environment variable

D. Configuring Web Server

Download and install Tomcat 8.0. Then the environmental variables should be configured. Variable Name: CATALINA_HOME.   Variable   Value: C:\Program Files\Apache Software Foundation\Tomcat 8.0, as shown in Figure 5.

After the configuring of environmental variables has been done, it should be tested to determine whether the configuring process was successful. Enter the Tomcat 8.0 software and click "Start" to start the server. Then open IE browser and input the local address of server; namely http://localhost:8080. Then an interface shown as Figure 6 will appear, suggesting that Tomcat Web Server has been successfully configured.

IV.   DEVELOPMENT OF TEACHING PLATFORM WEBSITE

A. Introduction of Dreamweaver

Adobe Dreamweaver (usually abbreviated to DW) is a visual web page editor developed by an American company called MACROMEDIA. The software can make web pages and manage websites. It is the first visual webpage developing tool especially for professional designers of webpages. With this software, the designer can easily
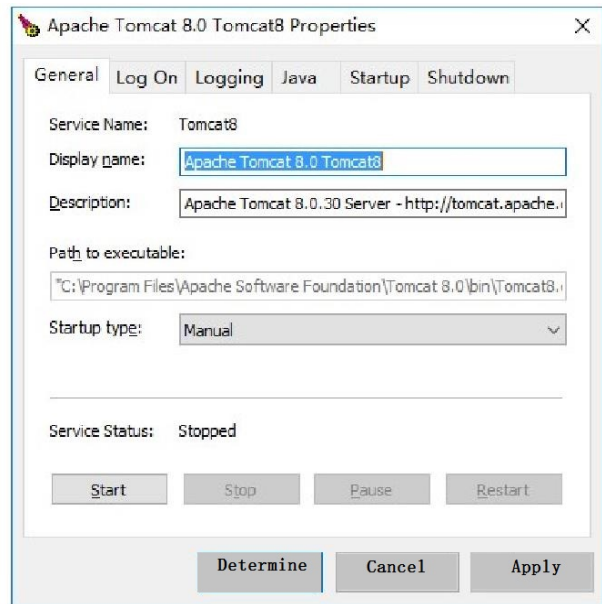

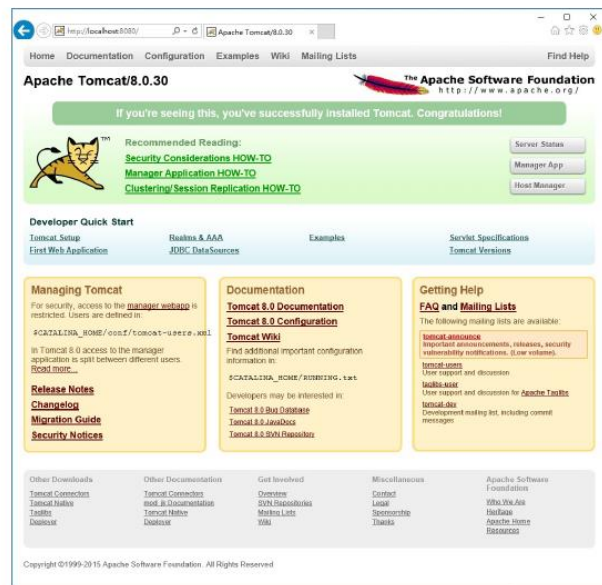Figure 5.   Configuration of the web server

Figure 6.   Configuration of the web server

make dynamic webpages that go beyond the limitations caused by various platforms and browsers.

Adobe Dreamweaver CC 2015 is its newest version. It can be used to design webpages in a visual environment and quickly, conveniently and efficiently finish the process of webpage designing. Adobe Dreamweaver CC supports CSS editor and Auto-Complete function of jQuery library code. The company Macromedia was established in 1992 and was purchased by the company Adobe in 2005. In December 1997, the first version of Dreamweaver 1.0 was launched by Macromedia. In September 2005, the lanch of Dreamweaver 8 marked the end of the Macromedia period. Dreamweaver 8 further advanced the main functions of the previous versions and simplified the previous working processes, making it easier and more convenient to operate. After Macromedia was purchased by Adobe in April 2007, Adobe Dreamweaver was published. Adobe Dreamweaver CS 5 was

launched in April 2010. Currently, Adobe Dreamweaver CC 2015 is its latest version.

The newly added functions of Dreamweaver CC include:

(1) Quickly checking elements on the website

The newly added "quickly checking elements" can check marks in the files and can produce an interactive HTML tree structure for both dynamic and static contents. Meanwhile, the structures of static contents can be directly altered.

(2) New functions for editing in real-time

The visual editing tools in Dreamweaver CC CSS helps to originate simple web standard program codes. It also allows quick use of CSS properties, such as Gradients and Square Shadows.

(3) Enhanced functions for CSS designing tools

The designing tools include enhancement of border controls interface□styles for copy and paste, quickly editing s text block, enhancing the working process for custom property, shortcut keys for the keyboard, specific and non-specific selector as well as rolling into class, etc.

(4) Real-time insertion

In the latest version, the panel can be inserted without having to switch modes. The HTML elements can be directly inserted into "real time checking" and the corresponding changes can be overviewed immediately.

(1) Supporting identification files and SFTP

When the server is connected, the connection of the SFTP server can be verified according to identification keys.

(2) Restoration and redo

In the previous versions, when the execution step in CSS Design Tool Panel are to be redone, the CSS files must be clicked to restore or redo this step. In the process of redoing and restoration, Real-Time Check automatically re-arranges the files. When the edit files of original codes are used and the changes are restored from Real-Time Check, the display changes and the related original codes from Segmentation Check becomes the focus. All actions are recorded in HTML files. Any manual changes done by CSS files can be restored from any related files.

(1) Changes in Dreamweaver's extended function

Users can use Adobe Creative Cloud to check and install Dreamweaver's extended function; namely Additional Component. To find additional component through Adobe Creative Cloud, click on the Window tab and select "Overview Additional Components" to display the page of additional components.

(2) Changes in Synchronization Setting

The function of the synchronization setting in the latest version can synchronize the settings of Dreamweaver with Creative Cloud. Dreamweaver CC automatically checks whether the sync settings have been started in the previous version of Dreamweaver. Then settings in Creative Cloud can be introduced.

(3) Improvement in Help Menu

The Help menu has been re-arranged and re-designed so that users can quickly store the new functions introduction, save video, studying resources, as well as sending errors and lists for function requirements.
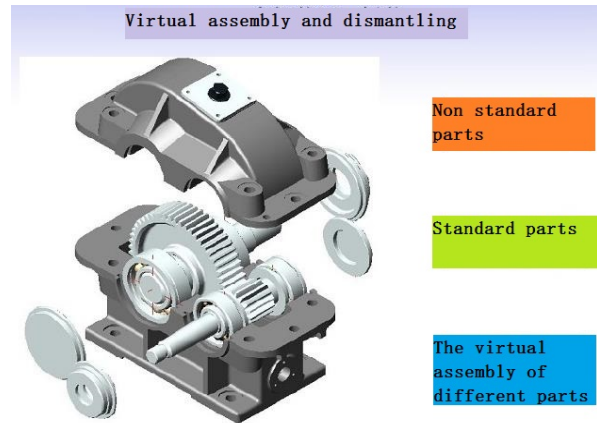

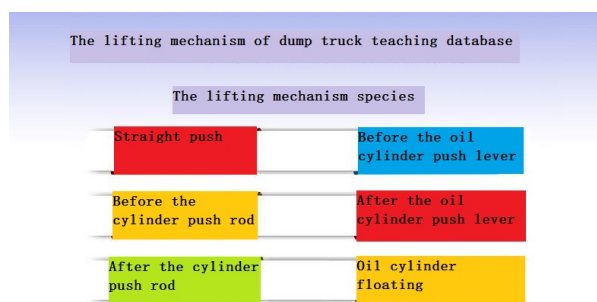Figure 7. Interactive interface of gearbox virtual disassembly

Figure 8. Interactive interface of dump track lifting

Using Adobe Dreamweaver CC, webpages can be quickly and efficiently done in a visual environment. Adobe Dreamweaver CC supports CSS editor and Auto-Complete function of jQuery library code. The proficient use of shortcut keys can get twice the result with half the time and effort.

B. Designing Interactive Interface

The building of an interactive interface is to provide an operative platform for users. That is to obtain resources measuring and drawing from various means and to integrate these resources. Then these resources will be organized in a logic order to efficiently and effectively share these resources, to provide users with systematic resource services and to make standards for the subsequent managing and using of resources.

Dreamweaver CC 2015 is used to build a enginery-type web teaching platform based on virtual reality techniques. The interfaces and final designing effects are shown in Figures 7 and 8.

V. CONCLUSION

The web teaching platform based on virtual reality technique is a challenge to the traditional teaching mode and a necessity with the development and maturity of information technologies. Based on the easily made and operated VR techniques with its immersion and interactivity, this paper combined resources about the enginery knowledge and information to build the overall platform. It significantly improves users' feeling abour and understanding of the part models. It can be visually perceived, and is flexible and convenient, providing users with operating experience which make virtual reality and the real

world consistent with each other. Eventually, both people and models can dynamically interact and perceptively communicate with each other. This paper focuses on the following aspects:

(1) The methods of establishing web virtual platform, operating principles of X3D virtual reality techniques, development environment and key development nodes are compared and analyzed to determine the key technologies of X3D virtual reality and an overall plan for the web teaching platform established by this paper.

(2) According to requirements based on X3D virtual process, parametric modelling and stimulated configuring were conducted upon the parts. UG draft module was used to determine the detailed tracks of movement of parts. CATIA was employed to set and optimize the object models and generate the VRML files which can be recognized by X3D language. Thus, the moving parts straying away from their correct tracks can be prevented. The starting and ending time, the detailed tracks of movement and rotation angles of each object in the movement mechanism can be reasonably configured.

(3) X3D node design and its operating principles were analyzed. Specific cases such as the virtual disassembling and assembling of a decelerator in the enginery course module and the lifting mechanism of a dump truck in the innovation and practice module were used to design X3D source programs for virtual disassembling and assembling and movement simulation.

(4) By simulating the mechanical structural movement and analyzing principles of animated smart sensor nodes of X3D virtual reality programming language, the transformation formulas for X3D programming time of parts movement were deducted. Based on the movement properties of parts of an existing mechanism, this formula can directly generate the key values of parts in the time sensor of X3D source program. It can provide theoretical evidences for X3D programming language to configure the assembling and disassembling of mechanical structures and the movement simulation through animated smart sensor nodes.

(5) The functional module of web virtual teaching was researched and analyzed. The teaching resources about enginery were combined to establish the workable web server and to establish the overall framework for the functional module in the VR web teaching platform. Through Dreamweaver, the integrated enginery course resources were uploaded into the web server. The relevant testing and running were conducted. Therefore, the VR environment, dynamic interaction and smart perception were achieved.

REFERENCES

[1] L.M. Mary, "Designing the virtual campus as a virtual world," *Computer Support for Collaborative Learning*, vol.2, pp. 376-382, May 2008.

[2] L. Ieronutti, L.Chittaro, "Employing virtual humans for education and training in X3D/VRML worlds," *International workshop on Web3D technologies for learning education and training*, vol.49, pp. 93-109, August 2007. http://dx.doi.org/10.1016/j.compedu.2005.06.007

[3] H. Salah, M. Hassan, "Adaptive e-learning system based on agents and object petri nets (AELS-A/OPN)," *Computer applications in engineering education*, vol. 23, pp. 170-190, June 2015. http://dx.doi.org/10.1002/cae.21587

[4] T. Tuikka, M. Salmela, "Facilitating designer-customer communication in the worldwide web," *Journal of Internet Research*, vol. 5, pp. 56-58, July 2008.

[5] J.A. Barceló, "Virtual reality and scientific visualization. Working with Models and Hypothese," *International Journal of Modern Physics C*, vol. 1, pp. 569-580, February 2001. http://dx.doi.org/10.1142/S0129183101002243

[6] J.A. "Georgiou virtual reality laboratory for distance education in chemistry," *International Journal of Social Sciences*, vol. 2, pp. 69-75, June 2008.

[7] M. Simon, M. John, "e-Learning initiatives to support prescribing," *British Journal of Clinical Pharmacology*, vol. 74, pp. 621-631, May 2012. http://dx.doi.org/10.1111/j.1365-2125.2012.04300.x

[8] M. Paul, H. Margaret, "3D UML state machine diagrams," *Model Driven Engineering Languages and Systems 11th International Conference*, vol. 32, pp. 264-279, May 2008.

[9] M.A. Fisehle, J.M. Tenenbnam, "Detection of Roads and Linear Structures in Low-Resolution Aerial Imagery Using a Multisource Knowledge in ration technique," *Computer Graphics and Image Proeessing*, vol. 15, pp. 201-209, August 1981. http://dx.doi.org/10.1016/0146-664X(81)90056-3

[10] B.T. Buseh. "A Common Framework of the Extraction of Lines and Edges," *Archives of Photogrammetry and Remote Sensing*, vol. 388, pp. 112-123, August 2006.

[11] A. Soini, "Machine vision technology take-up in industrial applications international Symposium an image and Signal Processing and Analysis, *ISPA2001Proeeedings of the 2td 2001*: 332-338.

[12] J. Zhipeng, Z. Sanguo, "Reliability evaluation of wireless sensor networks using logistic regression," *2010 WRI International Conference on Communications and Mobile Computing*, CMC 2010, Vol. 3, pp. 334-338, April 2010.

[13] B. Steffen, L. Cyril, "Rollout Algorithms for Wireless Sensor Network-Assisted Target Search," *IEEE Sensors Journal*, Vol. 15, pp. 3835-3845, July 2015. http://dx.doi.org/10.1109/JSEN.2015.2393893

[14] P. Koivisto, H. Huttunen, "Design of weight order statistic filters by Training-based optimization," Signal Processing and its Applications, *Sixth international, symposium*, vol. 1, pp. 40-43, July 2001.

[15] A. Hammoude. "An empirical parameter selection method for border identification," *algorithms Computers in Cardiology*, vol. 23, pp. 445-448, 2008.

[16] S.H. Chang, "A causal model method for fault diagnosis in wireless sensor networks," *Proceedings-10th IEEE International Conference on Computer and Information Technology*, CIT-2010, pp. 155-162. http://dx.doi.org/10.1109/cit.2010.65

[17] C.L. He, "Technology research on the fault diagnosis of wireless sensor network system," *Advanced Materials Research*, vol. 84, pp. 442-445, April 2014.

[18] R.J. Qina, T.S. Hunag. "A two-dimensional edge detections scheme of general visual Processing International Conference on Pattern Recognition," Conference A: Computer Vision & hage-poreessing, *Proceedings of the 12th IAPR 1994*:595-598.

[19] R.J. Qina, T. S. Hunag, "Optimal edge detection in two-dimensional images," *EIEE Transaction in image Processing*, vol. 5, pp.1215-1220, June 1996.

[20] J. Prinene, H.K. Yuen, J. Illinwgohrt, "A comparison of Hough transform methods. image Pressing and its applications," *Third International Conference*. Vol. 23, pp. 73-77, May 2009.

[21] V. K. Sadekara, S. Ganesana. "Complete descriptions of multiple line segments using the Hough transform," *image and Vision Computing*, vol. 16, pp. 597-607, June 2012.

AUTHORS

Huiping Guo is with College of Mechanical and Electronic Engineering, Northwest A&F University, Yangling, 712100, China (e-mail: imghp@163.com).

Lin Zhu is with College of Mechanical and Electronic Engineering, Northwest A&F University, Yangling, 712100, China (e-mail: zhulin@nwsuaf.edu.cn).

Fengxin Yan is with College of Mechanical and Electronic Engineering, Northwest A&F University, Yangling, 712100, China (e-mail: yfx2016@126.com).