Research on 3D Visualization Design of Industrial Production Management Software

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Abstract. Affected by the wave of Industry 4.0, the Internet and IoT technologies are becoming more mature. However, when selecting industrial production management software, many companies still use traditional software management methods. This article describes a 3D visualization upgrade of enterprise implementation management software that describes and demonstrates the important role of 3D visualization throughout the production management process. In addition, this article studies the role of 3D visualization in the management software interface from the perspective of academic research, so as to achieve the purpose of improving the efficiency and operational efficiency of workshop management. And as a reference for industrial production enterprises in 3D visual design.

1. Introduction
In the era of Industry 4.0 and China Manufacturing 2025, many companies are committed to promoting industrial intelligent upgrading and upgrading, aiming to improve the level of intelligence in the manufacturing industry and adapt to the new changes in the new era. The intelligent manufacturing pursued by Industry 4.0 is a highly automated, highly information-based, highly networked production model. In this production mode, the people, equipment and information in the workshop cooperate independently, and the value chain is shared and coordinated through end-to-end integration and horizontal integration, so that efficiency, cost, quality and personalization can be qualitatively leap. In order to achieve this series of goals, information visualization is an essential part of it.

The visualization of information is mainly realized through a visual interface. The collected information is displayed by the data acquisition system through the interface, and human-computer interaction is performed based on the interface. The interface display layer is designed in a modular fashion and presented to the manager through business system diagrams and 3D simulation graphics.

Therefore, the existing traditional software needs to be upgraded, and the three-dimensional visualized virtual device is added to the management software, so that the manager can improve the information running quality more accurately and higher in the actual information decision and discovery process. This shows that the advantage of using visual technology to manage the factory can make the company more competitive.
2. Reasons for 3D visualization of the management software

2.1. Software interface upgrade for production management
In a variety of factory management methods, visual management is a newly emerging management method. This method is based on the actual production and operation of the factory, which is an innovation in management mode and an important means of building a smart factory. There are two types of smart factories. The first one is transformed from a traditional factory, and the second is directly built with a smart factory. The project described in this article is the former.

Almost all traditional factories use automated control software to manage the production process. The use of management software has become an indispensable means of equipment management, but at present many of the factory's software is still using the old operating system many years ago, and still uses the traditional management.

Traditional drawing management methods and maintenance methods are not intuitive and difficult to use, and cannot meet safe and efficient management requirements. As visualization technology and VR technology continue to mature, a solution based on 3D visualization "what you see is what you get" has been created, and this management method also provides a new way for enterprises to achieve long-term sustainable development.

2.2. Spatial cognitive properties of the human eye
From mechanized industrial 1.0 to standardized industrial 2.0, to automated industrial 3.0, to now information and intelligent industry 4.0. In fact, every industrial upgrade revolves around the technological revolution of cost and efficiency. Industrial production technology is more and more developed, and more attention is paid to the "human-machine" friendly management method, which enables people to exert greater value in the manufacturing process. Spatial information for 3D visualization is a way to handle manager-friendly visual information.

This friendliness due to the three-dimensional visualization of spatial information is more intuitive and closer to the objects in the real world. It is easier for people to perceive this expression and increase it into a rational understanding. At the same time, 3D visualization conforms to the parallel nature of the human visual system and increases the spatial dimension. It expresses more spatial relationships on the same view, making the activities of the central nervous system more easily perceived and caused, thus enhancing the cognitive effect, which enables managers to quickly understand the information and improve work efficiency.

3. 3D Visualization Design of Industrial Management Software

3.1. 3D modeling of each device
First, the modeling of the device in the modeling software (Figure 1) completes the three-dimensional transformation. The biggest advantage of using the 3D form is that it can clearly display the various devices, and the utilization of the device is also clearer, which facilitates the management of each individual device for the next step. Ultimately, visualization of equipment management in the production process can be achieved.

Figure 1. Modeling and rendering of real devices
3.2. Design of Integrated Operational Management Interface
The 3D visualization of the workshop equipment is displayed on the system terminal operation page. The post-design interface (Figure 2) is mainly divided into the viewing interface of the workshop virtual device and the property editor for control. This page presents the manufacturing process clearly and completely in real time to the user, the designed system interface consists of a menu bar, a property editor, and a display interface for all devices in the workshop, and the entire system provides users with a 3D visual, interactive factory that allows users to manage data and objects, and perform equipment operations and inspections.

Figure 2. Comparison of the effects of workshop production visualization design

Compared with the previous operation management interface, the device in the operation interface now has a one-to-one correspondence between data and virtual devices, realizing real-time display and further operation management of on-site related data such as various production and manufacturing information and resource device status information. It needs to achieve a more realistic display effect, you can use 3D virtual technology to display the workshop, equipment and human body models in a 3D form, and realize various operations such as walking of the human body, rotation of the workshop, and enlargement and reduction of the equipment, which give users a more intuitive and visual display.

3.3. Design of Single Equipment Operating Interface
Each virtual device in the operation interface of the overall management of the workshop is connected with the real device. When you need to manage a single device or view an error device, clicking on the corresponding virtual device will jump to the device's details page (Figure 3), which will show the operation of the specific device and the corresponding management operations.
4. Advantages of realizing 3D visualization of software Interface

Based on 3D visualization technology, management is integrated with real-time production processes, it can effectively solve the management problems of the factory and improve the production management level, and it is also the only way to upgrade software management, which is a necessary condition for the realization of smart factory and industry 4.0 in the future.

Therefore, three-dimensional modeling of workshops, production lines and production equipment can bring real value to the naked eye of the production management of the enterprise:

- 3D visualization can visually display the entire workshop, intuitively grasp the layout of the pipeline, the specific location of the equipment, strengthen management, and ensure the safe production of the workshop.
- The bidirectional real-time feedback of "Device – Data – 3D model" is realized by the bidirectional association of virtual and real information. Display various types of sensory measurement and control data in 3D scenes to intuitively grasp the current operating status.
- Realize alarm analysis based on real-time data, locate fault points in 3D scenes, thus shortening troubleshooting preparation time.

Through OPC UA (OLE for Process Control Unified Architecture) realize the visualization of devices, and associate the model and attribute data. OPC UA provides the transfer of raw data and pre-processed information from the manufacturing level to the production planning or ERP level. With OPC UA, all required information is available to each authorized application and to each authorized person at any time and any place. OPC UA provides some important features including platform...
independence, scalability, high reliability and the ability to connect to the Internet. As shown in Figure 4, it implements a loop from the physical world to the information world in the information physics system and finally back to the physical world. It is real-time and efficient, enabling managers to quickly find the right device and view real-world conditions such as the site location, environment, associated devices and device parameters.

5. Conclusion
This article describes the solution at the design level for workshop equipment visualization management. The visual interface operation environment is intuitive. Based on the virtual workshop equipment, the job flow status can be directly displayed in the plant view, thus realizing the visualization of production management. Provide a smooth operating experience for management, enabling managers to have a specific concept of the devices they manage. At the same time, all the parameters generated in the operation of the device are clear at a glance, which is more in line with the natural attributes of the human eye to obtain information, and thereby greatly reducing the labor intensity of managers, improving management efficiency and management level, making enterprises more competitive in development.

The daily work of future control standardization can rely on information physics systems, but complex decision-making work is still done by people. The relationship between machines and people will be closer in the production process, the cooperation mode will be more flexible, and the flexibility of people and the flexibility of machinery and equipment will be Match and form a team to work together.

Smart Factory adopts advanced automation and information technology to realize the production process and data visualization, and provide users with a full process experience, which is also the theme of future manufacturing development. After the Internet of Things was used in the production operation system of the factory, the traditional operation mode of the factory has undergone a tremendous transformation. Driven by emerging technologies, data visualization operations management will become an important way for companies to build smart factories. Production management in the future will be more intelligent.

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