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Research and Development of PSC Intelligent Training Platform Based on 3D Virtual Technology*

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Abstract—**Port state control (PSC) inspection has played an important role in the navigation safety and Maritime environmental protection. In order to better train PSCO and improve its post skills, this paper proposes the application of virtual reality technology (VR) and artificial intelligence technology to realize fully the visible of ship equipment, then research on the ship's main key area and main equipment inspection points to develop the visual operation of related equipment, at last develop a PSC intelligent training platform based on virtual reality technology (VR) for becoming a standard PSCO training course, so as to achieve the goal of upgrading PSCO post skills.**

Keywords—PSC; intellectualization; function

I. INTRODUCTION

Port state control (PSC) inspection has played an important role in navigation safety and Maritime environmental protection. It can be seen from "Fig. 1" that inspection numbers of ship and inspection rate of Tokyo MOU increased every year from 2006 to 2016, the demand for PSCO and technology demand is higher and higher. In addition, PSCO inspection level directly determines the quality of port state supervision and inspection, so improving the ability of PSCO is an important means to improve the quality and level of PSC inspection in China. At present, there are still some problems to be solved, such as the great difference in the level of PSCO inspection team, the great difference in seniority and the gap between training courses and requirements. [1] [2] [3] [4] [5]
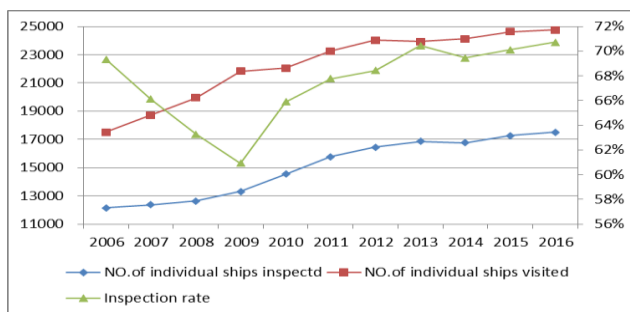

Fig. 1. Inspection rate of Tokyo MOU.

II. RESEARCH VALUE OF PSC INTELLIGENT TRAINING PLATFORM

As a highly skilled work, PSC is in ship's large-scale development trend and PSCO on board training subject to shipping schedule and other factors. It is more and more difficult for them to play their role. At present, current training mode is still relying more on original stage of static materials such as text, photographs, slides, which is in great contrast to the rapid development of ship technology. Using virtual reality technology to build a 3D virtual ship and build PSC inspection training platform on this basis, it can meet the practical needs of PSC inspection training. Specifically embodied in:

A. Inspection Training Is Not Restricted by Region

In a small amount ship of port, PSCO under the precondition of limited on board training can use the virtual ship PSC training platform, without being limited by ship number and size and type of further enhance professional skills.

B. Making Up for the Lack of Real Ship Experience

The virtual ship PSC inspection training platform can provide plenty of simulation training, by scene roaming, it can increase the understanding of ship, enhance the operation experience, help to improve their comprehensive ability, and deepen the understanding of the related conventions and regulations.

C. The PSCO Training Platform Is Easy to Operate

The training platform is easy to operate, convenient for environment, and not limited by regional restrictions, so PSCO can better understand the knowledge involved in intensive training. Meanwhile, this PSCO training platform can continue to research and develop different types and gross tonnage of ship, and provide a good field for PSC inspection training and teaching platform.

III. COMPOSITION AND FUNCTION OF PSC INTELLIGENT TRAINING PLATFORM

The PSCO intelligent training platform can be divided into two parts: server and training terminal. Main function of

server is set training subjects, trainer sets inspection scene and training course based on PSC inspection procedures and regulatory requirements; Training terminal has the training and automatic evaluation function, that is to say, according to the training course and time in 3D virtual, the inspection records steps and related data of trainees if necessary, then make a comprehensive evaluation and give evaluation results. In order to realize these functions, the intelligent training platform consists of three systems, including 3D virtual ship simulation, intelligent item editing, inspection training and evaluation etc. The following "Fig. 2" shows:
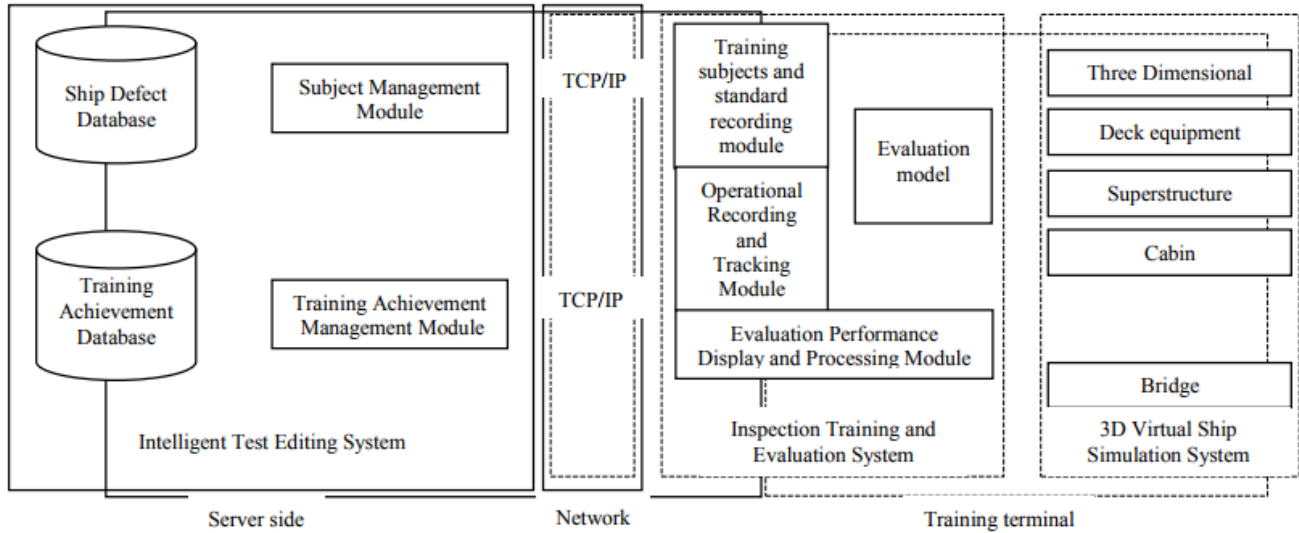

Fig. 2. System structure diagram of PSC intelligent training platform.

A. 3D Virtual Ship Simulation System

The 3D virtual ship simulation system is located in the training terminal and is the foundation of the whole training platform. The system can show the three-dimensional environment of the ship's three-dimensional hull, deck equipment, forecastle and bridge, dynamic and realistic in the scene (as can be seen in "Fig. 3"). Meanwhile it can realize the operation process and effect of main equipment, the operation process and effect are basically the same as the actual ship. Also, it can realize the coordinated inspection work of many PSCOs (as can be seen in "Fig. 4").

Fig. 3. A virtual scene in the bridge.

Fig. 4. Virtual proxy.

B. Intelligence Test Editing System

The intelligent test editing system is located on the server side, which is the background of whole training platform. The system controls the PSC inspection procedures and all kinds of convention, at the same time it is responsible for not only the maintenance and management of ship deficiencies database, but also training course and training evaluation database.

C. Inspection Training and Evaluation System

The training and evaluation system is located at the training terminal and is the core of the whole platform. In this system, PSCO carries out the corresponding PSC inspection according to the requirements of the training course; when necessary, the system will record the inspection operation steps and relevant data of PSCO. Based on the intelligent evaluation model in the background, the evaluation results will be given.

IV. KEY TECHNOLOGIES OF PSC INTELLIGENT TRAINING PLATFORM

The key technologies include the following items:

A. 3D Virtual Ship Simulation Technology

According to the actual ship design and trial data, an integrated 3D simulation are able to operate the virtual ship according to the facts as the ship's equipment, and the virtual characters can simulate ship deficiencies scene and PSC inspection. Rest of 3D virtual ship also can render large amount of calculation and need real-time rendering technology of virtual scene, the acceleration of technology based on complex scene was analyzed, it mainly including block out, GPU computing and parallel rendering etc.

B. Establishment and Mining of Deficiencies Database of Ships

Since the implementation of the PSC inspection, the PSC inspection authorities and shipping companies have made statistics on the PSC inspection data in past years, including the deficiencies statistics. Because PSC inspection data volume is very large, therefore, it can establish ship deficiencies database. In addition, a corresponding data mining model based on ship deficiencies database is also needed to be able to carry out statistics and analysis on deficiencies of ships in a short time.

C. Establishment of Intelligent Evaluation Model

According to the professional knowledge and convention standards, a reasonable evaluation index system can be established based on the expert judgment method and fuzzy comprehensive evaluation, and then intelligent evaluation model can be built with subjective and objective evaluation method. At the same time, the intelligent evaluation model has a friendly inspection rules and professional knowledge system, and convenient maintenance staff to achieve the PSC inspection according to different functions, also it can make the system have continuously updated ability, extend the period shall apply.

V. CONCLUSION

Interactive virtual reality and simulation technology can be applied to Port State Control inspection (PSC); the study results of this paper will play a major role in promoting China's voice in the International Maritime Organization and the world shipping industry. PSCO training platform may make a proposal for IMO to amend 2011 PSC procedures in 2011 relating to PSCO knowledge updating, and the proposal is recommended to use our training platform and adopt the Chinese PSCO standard training course.

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