A DEVELOPMENT OF WEB APPLICATION FOR VIEWING SPEEDS FORMAT USING X3D

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SUMMARY
Currently, in Japan, as an information sharing platform to effectively use ship 3D data in the maritime industry, a format called SPEEDS (Smart Platform of Enhanced Engineering Data for Shipping and Shipbuilding) is being developed. This is a format that aims to facilitate the sharing of ship 3D data between shipyards and other organizations[1][2]. However, SPEEDS is still a developing, and there is no free software that can handle. Therefore, we aimed for free system development for SPEEDS, and developed an open source system that can browse SPEEDS data. This system uses X3D and operates on a web browser. Therefore, even small devices can use data, so various usage scenes can be expected. This paper describes the functions and specifications of this system and the expected use cases. We will also examine the problems and possibilities of SPEEDS discovered through the development of this system.

1. INTRODUCTION

3D CAD has long been used in shipbuilding design. However, when 3D information is shared with third parties such as shipowners, class associations, and research institutes such as universities, it is difficult because each shipyard uses its own CAD and security policy. In order to resolve this, the Japan Shipbuilding and Oceanographic Society has recently established the Project Research Committee P-40 "Common Format Review Committee for Ship 3D Information to Realize Information Sharing and Advanced Use of Ship 3D Information".his committee will conduct a survey to develop a standard of information exchange within the marine industry to resolve the aforementioned information sharing issues. Accordingly, the common format of ship 3D information currently under development is "Smart Platform of Enhanced Engineering Data for Shipping and Shipbuilding" (SPEEDS)[1][2]. This SPEEDS is still a developing format, and each shipyard is promoting development of applications using it. For example, when a research institution such as a university develops an application using outfitting information, the format of 3D data provided by each shipyard is unique, so that they were converted into another format that can be easily processed. However, with the advent of SPEEDS, there is no need to convert each company's data individually, and it has become possible to handle data efficiently. SPEEDS is currently under development, and no free application has yet been developed that anyone can use freely. So we developed the system with the aim of making SPEEDS free and easy for anyone to use. This system is a viewer that visualizes SPEEDS data provided by the shipyard and can easily make reference to each component information. This viewer uses X3D, a general-purpose 3D format, and operates on a web browser. Therefore, anyone can easily handle SPEEDS data. This paper describes the outline and features of the system, the expected use cases, and the problems and possibilities of SPEEDS through the development of this viewer.

2. OVERVIEW OF EACH FORMAT

2.1 OVERVIEW OF SPEEDS

SPEEDS is a ship product information sharing basis having simplified ship 3D shape information and various attribute information. It is output from the CAD of each company according to the use case (class approval, information provision to affiliated companies, for supervisors, 3D models for ship mounting, etc.). Also, it is described in XML format, and has an open architecture that exposes its basic structure. Mainly divided into hulls, outfittings and welding lines, each of which has shape information and attribute information. Depending on the use case, even assembly information is expressed. The schematic structure of XML in SPEEDS is shown in Fig. 2 below. Thus, SPEEDS establishes Japan's first industry standard in the maritime industry and aims to accelerate the computerization of the Japanese maritime industry by enabling free development and competition of analysis software etc. based on SPEEDS of each company related to the maritime industry[2].

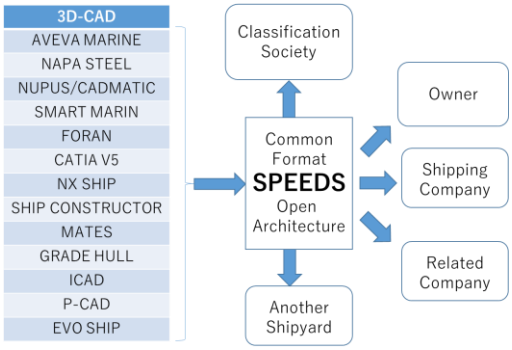

Figure 1: Basic Concept of SPEEDS[1]

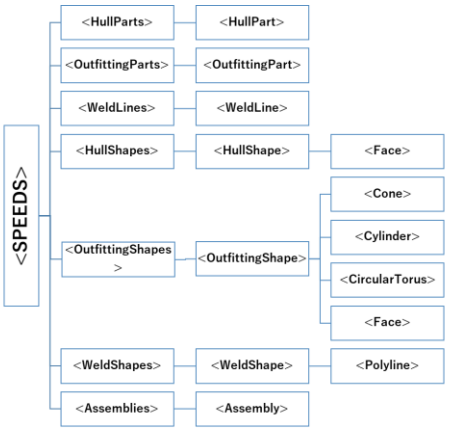

Figure 2: A schematic diagram of the structure of XML in SPEEDS

2.3 OVERVIEW OF X3D

X3D is a standard for handling 3D computer graphics developed as a successor to VRML. This is written in proprietary XML format as well as SPEEDS. In addition to building simple 3D models, it is possible to combine with other programming languages such as JavaScript and Java, which enables construction of dynamic 3D models such as adding animations and mouse events. Furthermore, the constructed 3D model can be linked with a web page, and by embedding it in HTML, the contents of X3D can be displayed as CG on the web browser. In addition, X3D has already been developed as a viewer with many free software (Flux Player, Octaga Player, etc.). By using these, anyone can easily browse the contents if you have an X3D file at hand[3].

3. PROPOSED SYSTEM

3.1 OVERVIEW OF THE PROPOSED SYSTEM

SPEEDS is still in development and there are no free applications and systems that anyone can use. Therefore, we developed a viewer that anyone could easily use. This does not assume that only data sharing with affiliates other than shipyards is expected, and it is expected that 3D data will be used in on-site work etc. in shipyards. Also, by developing a system that anyone can use for free, it is possible to promote cross-industry system development using SPEEDS

The system proposed in this paper is a viewer for visualizing SPEEDS data, and is a client server system that operates on a browser using X3D. The 3D object can be intuitively manipulated by mouse operation, and it is possible to refer to the attribute information contained therein by clicking on a specific part. In addition, visualization of assembly information by hierarchical tree, writing of additional information to each part, retrieval of parts from attribute information, etc. are possible. Because these functions are available through a server and on a browser, users can access data without installing special applications. Furthermore, because it works with small devices such as tablets and smartphones, it can be expected to be useful in field work. However, due to the nature of this system, construction of a server is essential. Therefore, in order to save time and effort for server construction on the user side, it is considered in the future to construct a server on the Internet and to open source its function. The schematic and UI of this system are shown in Fig. 3 and Fig. 4 below, respectively.

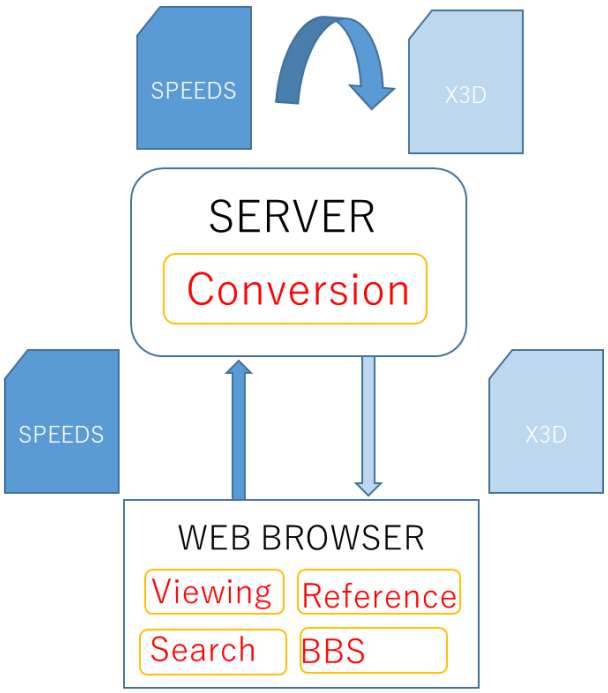

Figure 3: A schematic diagram of this application's process flow

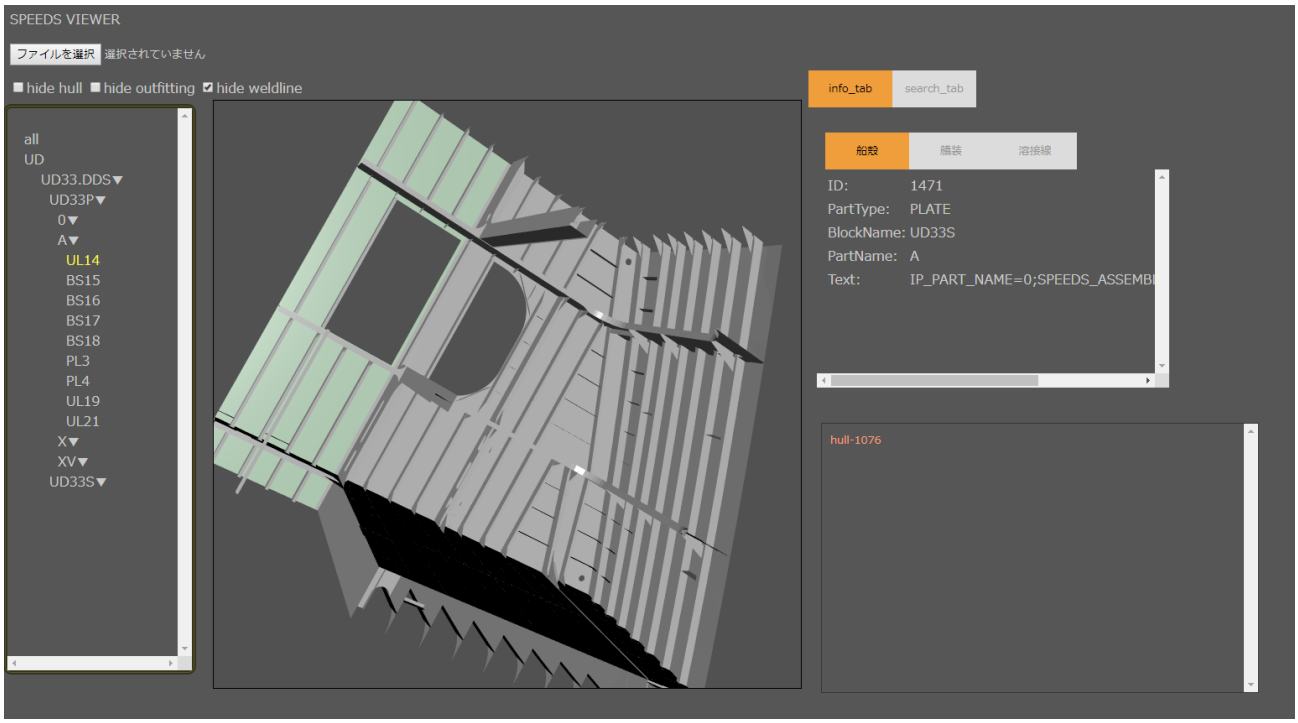

Figure 4: The UI of this application on a web browser

3.2 FUNCTIONS

The system mainly consists of five functions: conversion, viewing, reference, search, and BBS. Here, we describe the detailed specifications of each function.

3.2 (a) Conversion Function

This function is performed on the server-side uploaded SPEEDS file, and converts the SPEEDS file into an X3D file. Since both SPEEDS and X3D are described in XML in their structure, schema-compliant conversion can be easily performed using a dedicated library. In addition, although SPEEDS deals with some primitive figures, it was decided to represent all with triangular polygons at the time of conversion, due to the difference in expression from X3D

3.2 (b) Viewing Function

The viewing function displays 3D data on the browser by embedding the converted X3D data into the HTML. 3D data embedded in HTML can be moved by mouse operation on the browser, and can be intuitively grasped from various viewpoints. When embedding, use an open source JavaScript library called X3DOM[4]. This eliminates the need for installing a new plug-in on the user's browser, and allows display independent of the user's environment. Furthermore, since X3DOM also has a function as Document Object Model (DOM), X3D objects can be handled dynamically by linking with JavaScript. In other words, operations such as changing the color of the part clicked with the mouse or hiding a specific part are also possible. Figures 5 and 6 below show how 3D data is actually displayed on the system.

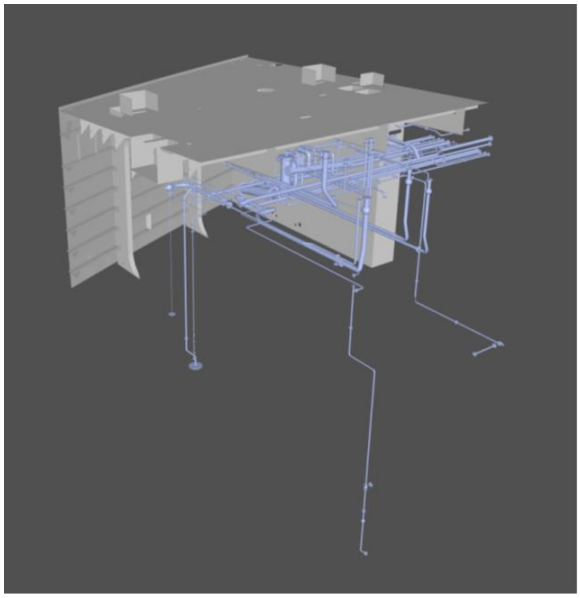

Figure 5: Display of hull and outfitting 3D data on this system

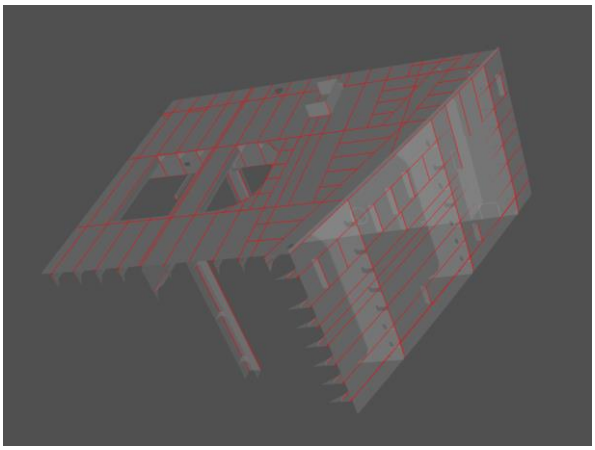

Figure 6: Display of hull and weld lines 3D data on this system

3.3 (c) Reference Function

This function refers to the information of each part and assembly from the 3D object or the hierarchical tree located on the left of the UI, and the referenced data is placed in each of the tabs located on the right side of the UI. It is displayed divided into outfitting and weldline.

3.3 (d) Search Function

This function is an inverse function of the reference function described above, and highlights matching parts in 3D data based on the information input to the form.

3.3 (e) BBS Function

This function adds additional information to the clicked part, and can add user name and text information. The written information is stored on the server via Python CGI. Currently, only text information is supported, but it is planned to support external files such as image data in the future. The BBS UI is shown in Fig.7.

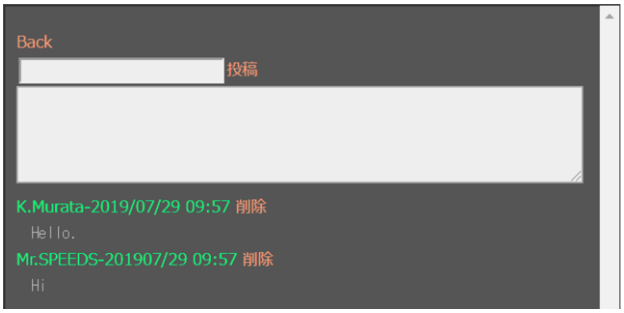

Figure 7: The UI of BBS function

4. DISCUSSION

SPEEDS is still in the development stage. Although interviews have been conducted at each shipyard and various use cases have been assumed, the advantages and disadvantages of actual system development have not been examined. Therefore, this chapter assumes some use cases as a study on this system, and also examines the problems and possibilities of SPEEDS obtained through system development.

4.1 USE CASES

We consider some possible use cases in this system. This system is a client server system, and it has the feature that data can be accessed only with a browser if the server is constructed. This enables access to 3D data using small devices such as smartphones and tablets, further expanding the scene of use of SPEEDS. In addition to the advantage of SPEEDS in sharing 3D data of each company by using this system, it may be useful for data sharing in various situations in the company. Therefore, we will consider not only the data sharing with other companies as a use case, but also the in-house use.

4.1 (a) Inside Shipyard

In a shipyard, a CAD system is used at a design site, but since it conforms to a specific format, there are limited places and terminals from which the data can be referenced. When field workers refer to data, it is necessary to look at the printed two-dimensional drawing and refer to the arrangement of parts. In this application, in order to enable access to design information from a smartphone or a tablet terminal, it is considered that the site worker does not need to carry around these design drawings by constructing an environment on an in-house server. Furthermore, by using the BBS function, information sharing can be made smarter, which will lead to facilitation of design and communication in the field. Specific possible use cases and corresponding functions are listed below.

·Clearing of parts in assembly work (Viewing Function)

・ Progress management of assembly work (BBS Function)

・ Share defect information (BBS Function)

・Calculation of block's center of gravity (Reference Function)

・ Examination of the position of the suspended piece by crane (Viewing and Reference Function)

In fact, although it is still only possible to view the shape and includes some practical problems, it can be expected to promote IT implementation of field work.

4.1 (b) Outside Shipyard

When research institutes like universities do system development, there are many differences in data formats. The shipyard may provide data and use it for testing, but the problem was that the data format of each company

was different. This problem not only significantly reduces the efficiency of system development, but also can reduce the versatility of the completed system. Since SPEEDS can solve these problems, it is thought that this system will help other system development if data is provided by SPEEDS in the future. Furthermore, 3D data can be used for maintenance etc. also in the case where a classification association or a shipowner is assumed as a user. In particular, the X3D system represents the structure of the ship, so it has a high degree of freedom in color information and viewpoint operations, and can be used as a three-dimensional map on a browser. In the future, it can also contribute to raising the added value of the ship itself by linking with cameras and measuring devices. At present, only the browsing function is mainly, but by expanding the information that can be extracted further, the possibility of various system development can be considered.

4.2 PROBLEMS OF SPEEDS

Here, we will point out some problems of SPEEDS that we noticed through the development of this system. First of all, the complexity of the representation of primitive figures in SPEEDS files is raised as a problem. In SPEEDS, parameters such as normals are required even for cylinders and the like. The cases of utilizing these parameters are limited and not considered necessary. Other primitive figures such as cubes and spheres can only be represented by polygons. If the primitive figure is expressed as a polygon, the calculation cost increases when performing calculations such as interference determination of an object in another system, and it becomes necessary to pre-process data. Therefore, SPEEDS is required to simplify the geometrical representation. However, since SPEEDS is output from CAD of each company, there is a possibility that it is unavoidable for ensuring compatibility with CAD data of each company.

Next, there is a problem that only HullPart can represent hierarchically in Assembly. There are cases where the same hierarchical representation is required for Outfitting. Therefore, I think that the expression of Outfitting needs to be improved.

4.2 POSSIBILITY OF SPEEDS

In this research, we actually developed a system for SPEEDS. Although the problems as described above are still included, it has been confirmed that the range of system development is broadened. At this time, information on attribute values is hardly used, but there is a possibility that the system can be further expanded by making good use of such information in the future. The use of the XML format makes it easy to interpret 3D information, and has the advantage of being easy to process in writing a program. Currently, libraries for processing XML are also developed in various programming languages, and using these makes it possible to develop systems more efficiently. In addition, SPEEDS will be able to process data from various shipyards with the same program, and research at universities may be more efficient because it saves time and effort to write programs individually for each company's samples. Furthermore, SPEEDS has been adopted by i-Shipping, a project aimed at achieving a maritime productivity revolution, which was raised in Japan in 2017, and further development can be expected.

5. CONCLUSION

In this research, we developed a Web application for browsing SPEEDS files using X3D. By using X3D, it was possible to visualize 3D data using a web browser. This made it possible for anyone to easily read SPEEDS files, and to improve other system development efficiency and in shipyards. It can be expected to improve the efficiency of on-site work. In addition, we examined the problems and possibilities that SPEEDS faced through the development of the system. It can be expected that the range of utilization of this system will further expand with the development of SPEEDS in the future. At present, it has only a viewer function, but we think that various other functions can be implemented by effectively using the information contained in SPEEDS. There are also security problems as practical problems. Furthermore, while anyone can easily view it, there are also problems related to confidentiality. We will face these problems in the future and plan to expand the system more.

6. REFERENCES

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4. Fraunhofer-Gesellschaft, ‘x3dom Instant 3D the HTML way!’, https://www.x3dom.org/,2019/07/29(access).

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