Study on Collaborative Design System Based on PDM

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Abstract: There are many problems to be solved in the research field of CSCD, for example, how to manage product information conveniently in the collaborative design system, how to support Human-Human interaction in the network, etc. Based on the platform PDM of B/C/S mode, this paper constructs the framework of CSCD system, and through developing CAD Tools and PDM API respectively and integrating CAD system with PDM system ensures the coherence of product information in CSCD system. Finally this paper implements this CSCD system, realizes the function of collaborative design in the network and solves the Human-Human interaction key technology of CSCD in the real-time WEB environment.

Key-Words: collaborative design, product data management, integration, computer-aided design, architecture

1 Introduction

As an important technique of contemporary integrated manufacturing system (CIMS), computer supported collaborative design (CSCD) has become a hot research area since 1990s. Because have not real-time interaction character and unable to realize collaborative design with concurrent engineering (CE), the past product design modes haven't been able to meet the need of modern product market, for example, shorting product development period, reducing product cost, improving product quality, responding to market demand change timely, etc[1,2]. The design process of the complicated product not only needs working in coordination with of each department inside the enterprise, but also needs many enterprises in different regions to cooperate. For effectively assigning various kinds of resources and supporting designers' cooperation and interaction, the enterprise must contact the data of aspects and manage product information effectively. With the development of information and network technology, as support technology of CSCD, product data management (PDM) has already become the focus of studying product collaborative design of the distributed network based on WEB. Therefore the technology of collaborative design based on PDM received much recognition in CSCD domain [3]. Through the preliminary research to the integration of CAD system with PDM system, this paper put forward a kind of collaborative design system based on PDM in WEB environment and can satisfy the requirement of the product collaborative design in the network.

2 CSCD-supported PDM system

Due to CAD model information in CSCD system includes two-dimensional (2D) and three-dimensional (3D) complex model data, which may distribute on LAN, Intranet or any area of corporation, these need PDM system to effectively manage the CAD model information. According to the recently international and domestic research on CSCD system, PDM system has become the essential supporting platform in the facet of accurately managing CAD model information. The construction of collaborative design prototype system includes generally concentrated and distributed types, among them the concentrated type is applicable to apply on local-area network (LAN) with client/server (C/S) mode; and distributed type is applicable to apply on Internet and Intranet with browser/server (B/S) mode [4]. Now for combining the common advantage of C/S mode and B/S mode, we present a PDM system of browser/client/server (B/C/S) mixed mode, which can be applied to LAN, Intranet and even Internet.
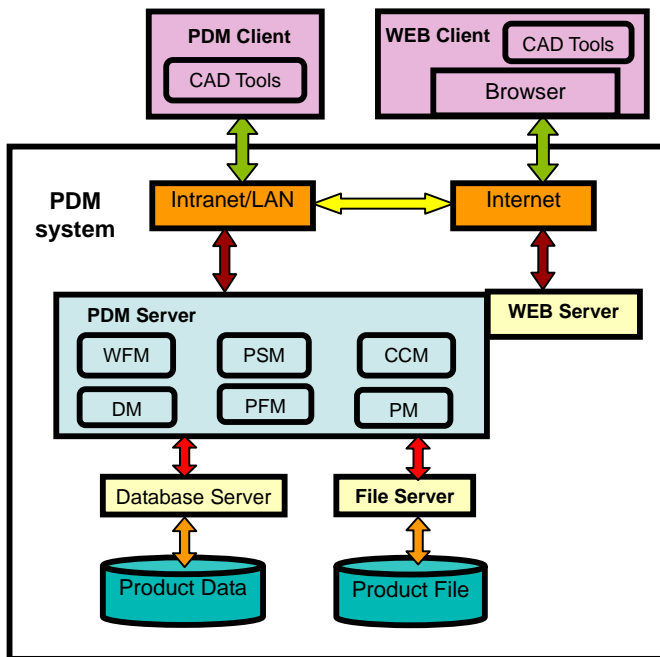
Fig. 1. The framework of CSCD-supported PDM system of B/C/S mode

Figure 1 illustrates the framework of PDM system of B/C/S mode. This system is WEB-oriented and can better support the integration with CAD tools, which afford a basic platform for CSCD system. The PDM system under consideration is an important component of CSCD prototype system. Which is developed based on PDM application software and can be divided into three levels: support for data processing, PDM server and client application.

The level of support for data processing consists of database server and files server. Database server is employed to manage data forms, which are stored in relationship database (e.g. Oracle database). Files server is used to manage data files authored with application tools (e.g. UGNX, Pro/E, AutoCAD, Microsoft Word, etc.), which are stored in folder.

The level of PDM server consists of many basic functional models: work flow management (WFM), document management (DM), product structure management (PSM), product configuration management (PCM), change control management (CCM), project management (PM), etc, which provide all management services for PDM clients in Intranet or LAN. PDM server also contains WEB server. The WEB server provides a communication service for PDM server and WEB clients.

The level of client application contains PDM clients and WEB clients. Every client can utilize CAD tools

(e.g. UGNX, Pro/E, AutoCAD, Inventor, etc.) to complete product design tasks.

3 CSCD-supported CAD system

In order to implement collaborative design base on WEB, a strong CAD system of multiple functional perfection is need to be structured [5]. We adopted CAD software Inventor as the CAD support system. Inventor is a popular CAD application software that Autodesk Company developed, it has powerful parametric modeling ability of three-dimensional entity and self-adaptive assembly function. The self-adaptive technique of Inventor can change the parameter automatically, by according with the modification of designed intention to relevant parts, and Inventor possesses the ability to support CSCD system with advanced collaboration technology.

Inventor can conveniently translate CAD model files with such software as AutoCAD, Pro/E, MDT, etc. The superior place is that Inventor has integrated NetMeeting system, which can utilize the multimedia functions (e.g. sharing white board, pronunciation chatting, video conference, etc.) at any moment through electronic meeting to support the discussion among designers, realize the Human-Human interaction function, and meet the need of real-time transmitting of multimedia in the network.

So in order to support CSCD system, the CAD system, as shown in Figure 2, should include the following tools: (1) multimedia interaction tool (e.g. NetMeeting); (2) CAD application tools (e.g. Inventor, AutoCAD, Pro/E, MDT); (3) PDM client; (4) WEB client.
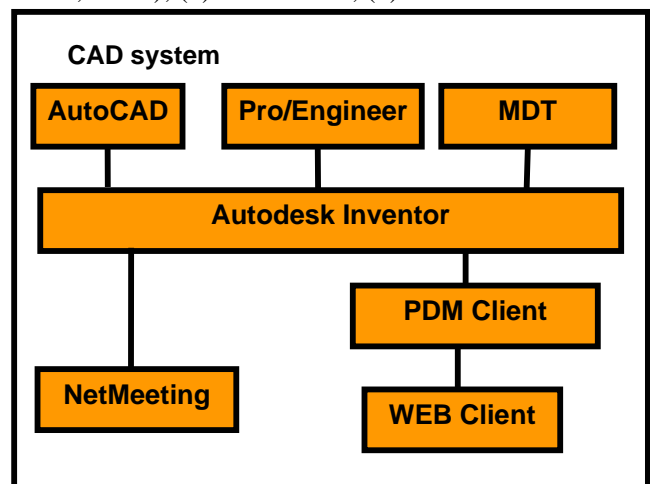

Fig. 2. The framework of CSCD-supported CAD system

4 Information integration of CAD system and PDM system

Inventor has strong modeling capability, but in many cases, it cannot support the especial PDM system of B/C/S mode. In order to ensure the coherence of product data information and CAD model attribute information, implement the integration of CAD system and PDM system, we choose the scheme of secondary development to CAD system and PDM system separately, to make PDM system of B/C/S mode really support collaborative design. Through the scheme of secondary development, CAD model attribute information can be picked-out, transmitted to PDM system and saved in the distributed database automatically.

4.1 Development of CAD System

The development to CAD system is the basic work of implementing CSCD system. A lot of large-scale CAD application software (e.g. Inventor, AutoCAD, Pro/E, MTD, etc.) offers the application-programming interface (API) for customization. According to the demands of different customers in the CSCD system, we can customize the interface, parts list and title bar of CAD drawing file with API, which is able to obtain the requisite attribute information of CAD model drawing. For example, we has utilized the visual basic application (VBA) procedure to carry on the secondary development to the API of Inventor, through which the product structure information, 2D drawing information and 3D physical information of CAD model file can be gained.

4.2 Customization of PDM System

There is a lot of PDM software in the market of CAD product, but some of them cannot support B/C/S mode. For support PDM system of B/C/S mode, we select Teamcenter Enterprise (TC) PDM software of EDS Corporation as platform of CSCD system, which support different operation system, WEB and network based, utilize open standard web-native technology and adopt J2EE, Microsoft .NET frame, SOAP, JSP and WEB serve technology. Teamcenter offered the attached language——Metaphase Object Definition Language (MODeL), we can utilize MODeL customize interface, the inside object class and its structured

relation, make 3D part models and 2D part drawings of CAD system get corresponding objects in the PDM.

4.3 Integration approach of CAD System and PDM System

After the development of CAD system and the customization of PDM system have been completed, we need programming the communication interface to realize the integration of both systems. The bi-directional integration of CAD system and PDM system means that the model attribute information picked-out from CAD system can be conveyed automatically to PDM system, then product object and its structure relation can be established in PDM system correspondingly; on the other hand, according to newer object information of PDM system, CAD system can change the attribute information of CAD model file automatically. There are two kinds of ways of realizing the integration of systems: (1) Through developing independently the third party client software to realize the communication service between both systems; (2) Through transacting API function of PDM in the CAD application process, and transferring API function of CAD software in the PDM system, to realize the bi-directional integrating of two systems.

Now we have completed the bi-directional integration of CAD system and PDM system through the secondary development to application software of Inventor, AutoCAD and TC. CAD model attribute information can be picked-out and collected through API of Inventor and AutoCAD, at the same time, the object information can be created or renewed in PDM system correspondingly.

5 Collaborative design system implementation

According to structuring WEB-oriented PDM system of B/C/S mode, and the integration approach of CAD system and PDM system discussed above, we presented one PDM-based prototype system of collaborative design in WEB environment. In order to verify the feasibility of this collaborative design system, the development and application has been implemented further. Firstly, we adopt TC as PDM server to set up the CAD system, which regards Inventor as the core and owns AutoCAD, MDT, Pro/E, etc. application tools and includes PDM clients and WEB clients. Secondly, we develop the integration of two systems.

Finally, we implement the collaborative design system, which is based on PDM system with B/C/S mode. Now we can utilize PDM client on LAN or WEB client on Internet to realize collaborative design.
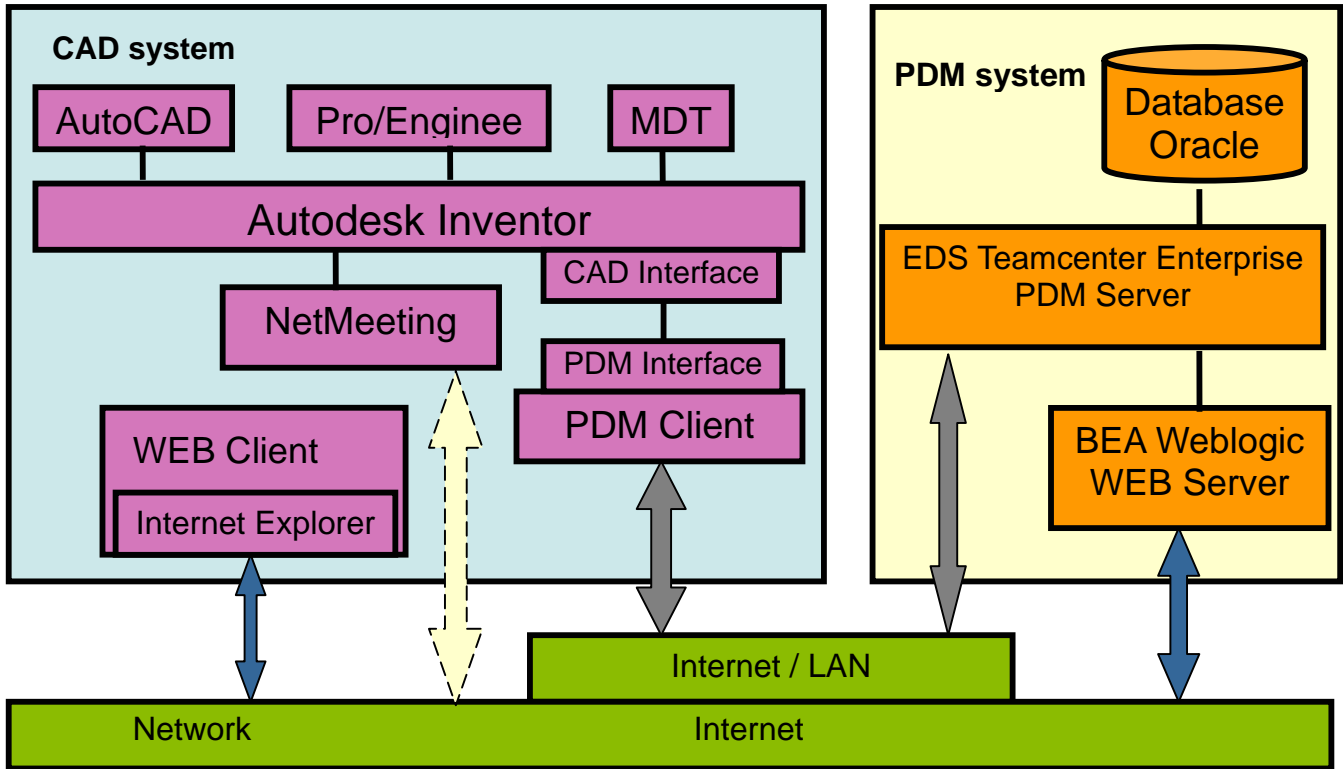

Fig. 3. The architecture of collaborative design system based on PDM

As shown in Figure 3, there are two kinds of integration and two ways of communication. The first kind of integrated structure is that the integration of coordinative tool (e.g. NetMeeting) and the core software of CAD system (e.g. Inventor). The second kind of integrated structure is that integration of CAD system and PDM system; through developing the PDM interface and CAD interface, designers can establish, obtain, upgrade, and change the data information of the product conveniently. The one way of communication is that PDM client of CAD system can communicate with PDM server (e.g. Teamcenter) of PDM system; in the same way, the product designers or project managers can manage the product information on LAN or Intranet with this way of communication. The other way of communication is that WEB client of CAD system can communicate with WEB server (e.g. WebLogic) of PDM system, similarly, product data information on Internet can be managed through Internet Explorer browser with this way.

This collaborative design system integrates Teamcenter and NetMeeting through Inventor, on one hand realizes the collaborative design function in WEB environment, on the other hand keeps the coherence of CAD model information and data information of PDM system, which can support the management of the product data effectively in the enterprise and offer the reliable environment for the collaborative work in the network. This system, in Intranet or LAN, can support communication mutually in real time among the designers, share the application tools, translate and transmit CAD model data files; on Internet, can support the meeting of the network and work group members to manage product data through the IE browser log-in WEB server.

6 Conclusion

The research on CSCD system, especially based PDM, is not only one of key techniques for CSCW, but also a basis for realizing collaborative design on WEB. This paper discusses the methodology and technology of

developing Inventor, AutoCAD and Teamcenter, proposes the integration approach of CAD system and PDM system with B/C/S mode, realizes collaborative design system based on PDM. This research aims to implement a CSCD system architecture based PDM to support collaborative design, development and management to product data in the network. The implementation of CSCD system results has demonstrated the high-efficiency in WEB environment.

Acknowledgements

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