Implementation of Product Data Management System for CAD Systems by using XML-based Web Service

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Abstract

It is certain that the future manufacturing environment will be network-centric and spatially distributed based on Internet. Today, wide variety of distributed computing and communication technologies are available for implementing a system for product data exchange and sharing. One of the technologies that have been received most attentions for product data exchange and sharing is Product Data Management (PDM). PDM tries to integrate and manage process of data and technical documents that are connected to physical product components. In accordance to previous researches about PDM, it can be regarded as an integration tool of many different areas, which ensures that the right information is available to the right person at the right time and in the right form throughout the enterprise. PDM with Web-enabled CAD system is proposed in this paper in order to acknowledge the usefulness of the system mentioned. The system will use Web service on Visual Studio C#.Net to invoke the web application system.

Keywords: Web-Enabled CAD, Product Data Management, XML, Web Service

1. Introduction

"The future winners are companies mastering information / data / document management." In order to meet the market needs and get a better assessment from customer, the use of information technology (IT) should be maximized to obtain more accurate and reliable data and information. Many enterprises have used IT as the basis of the enterprise system to achieve ultimate goals that are to increase productivity, reduce lead times, shorten design cycles, improve quality, etc.

One of the technologies that have been received most attentions recently for product data exchange and sharing is Product Data Management (PDM). One of the reasons using PDM on CAD system is maintaining the data for product life-cycle as a function for product development. Manufacturing organizations try to minimize a lead time for development of new product. This objective could be achieved by using web-based or internet system to meet customer requirement for a product.

The XML (eXtensible Markup Language) technology already published by W3C (World Wide Web Corporation) in order to overcome the problem using internet, exchanging data instead of displaying the data with HTML. XML, with simple tag and easy syntax, will be the future of HTTP technology for exchanging the data through the network system.

In order to make PDM workable in real manufacturing environment, it has to be implemented with technology that can overcome a limitation caused by spatially distributed systems throughout enterprise. And also the system should be implemented in such way that the incompatibility among product data generated by various systems could be resolved. Web Service has been recognized and widely accepted by industrial and academic research for providing services to the systems that are spatially distributed. In order to address the incompatibility, a standard for product data should be utilized. Recently, STEP standard has been considered as one possible way to solve the incompatibility problem that can be occurred during product life cycle.

In this paper, the architecture for PDM system by using XML based of the web service and STEP standard is proposed. The proposed system, Web-enabled for CAD system is implemented with Visual Studio C#.Net in order to demonstrate that the system is workable. The detail of the architecture is also discussed in this paper.

2. Product Data Management System

2.1. Concepts of PDM

PDM stands for Product Data Management. It means **managing information** of product from several simultaneous points of view. The data for PDM include text document, CAD drawing file and other data objects that has its own description.

Product Data Management can be seen as an integration tool connection many different areas, which ensures that the right information is available to the right person at the right time and in the right form throughout the enterprise [6]. It can also be said that PDM is an information infrastructure to manage all product-related information and the complete product life cycle [4].

The PDM system is an integrated system to manage the product data, process data and all the documents that related with the product in a better repository. Information Technology / Software Package is just a tool to simplify and make rapid process of accessing the repository. IT or Software Package will reduce the accessing time to search, store, maintain, sort the documents, and can be accessed from any department, any place to support the enterprise activity. So, the PDM system will include all integration system and the system should be supported by a good IT or Software Packages. It's not only about the IT or Software Package, but also related with dealing people, changing system and redesigning process to apply the IT or Software Package.

2.2. PDM and STEP (Standard for the Exchange of Product Model Data)

STEP (Standard for the Exchange of Product Model Data) is based on information models. These models make the standardization efforts on information content, rather than implementation technology. This insures that the development of the model will not be discarded upon a change in computing technology.

In mostly system, PDM is built according to STEP standard to meet the requirement among various kind of technology for distributed environment. Based on ISO 10303, STEP keeps developing the product exchange standard for global network-computing environment using XML.

2.3. PDM for Web-Enabled CAD system

The PDM term will consist of the whole integration of enterprise business process, start from marketing, product design, process design, manufacturing process until distributing the finished good to customer. For the CAD system, PDM will be limited on the product data, which is based on product management and data management, and also using the geometrical data to represent the product with STEP-based.

Product management discuss about the product structure and configurable of a product. And the data management will talk about making a well-established model of database management system. The geometrical data will be used to handle the feature modeling and feature recognition of a product.

3. Web Service System

There are several term that can be mentioned for Web Service System. SOAP, WSDL, UDDI, XML are the embedded system on Web Service. Visual C#.Net provides these tools to make a response-request service through the network for server-client tier technology. SOAP, WSDL and UDDI used the XML grammar for describing web services.

XML (eXtensible Markup Language) is a new generation of HTTP. It is a data format for structured document interchange on the Web. The XML specification describes a class of data objects called XML documents, and partially describes the behavior of computer programs that process them. A key aspect of XML is its portability. It is self describing, easy to read and because it is ASCII can be transferred using standard protocols such as HTTP.

SOAP (Simple Object Access Protocol), using XML syntax for exchanging messages to different type of application of client-side, is a distributed technology to invoke a connection to server without any barrier such as firewall. SOAP is a fundamental part of .NET, Microsoft's web programming platform. The previous technology such as DCOM (Distributed Component Object Model), CORBA (Common Object Request Broker Architecture) have some weakness in that SOAP can cover it.

The Web Service Description Language (WSDL) is an XML-based grammar for describing web services, their functions, parameters, and return values. Every web service must have a WSDL. The WSDL supplies the detailed information about the web service's functionality and how to access this functionality, to the clients. Rather than creating an actual WSDL file, ASP.NET generates the WSDL information dynamically. If a client requests the web service's WSDL file (either by appending *?WSDL* to the ASMX file's URL or by clicking the "Service Description" link in the web service help page), ASP.NET generates the WSDL description, which is then returned to the client and displayed in the web browser. Because the WSDL file is generated when it is requested, clients can be sure that the WSDL contains the most current information.

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UDDI (Universal Description, Discovery, and Integration) is a web-based distributed directory that enables business to list them on the internet and discover each other, similar to a traditional phone book's yellow and white pages.

4. Proposed System Architecture

4.1. Database Management

The database management system only include the CAD system, even PDM system can accommodate CAM and CAPP as the integrated system. The database can be separated as 3 big section, product and part, versioning document, and geometrical and topological data.

The product and part database mention about the product structure (tree structure) for BOM, assembly part and other things related with components. The versioning document connects to the product and part data as an integration data for product design. Each product or part will have their own document, which is has its own version, in order to trace the historical design of a product and/or also make a configurable product. The geometrical and topological data that can be related with STEP file have a close affiliation with feature modeling system and feature recognition module.

4.2. System Design
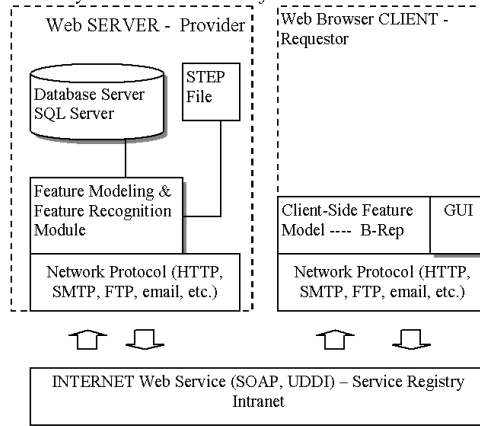
4.2.1. System Architecture definition

Figure 2. System Design Architecture

Using Microsoft Visual Studio.Net, C# developer system, we can build the server-client system using the Web Service technology such kind of SOAP, WSDL

and UDDI. This framework will describe the whole integrated system to be built.

The Web Server is located on the local host computer. The Internet Information Service, Windows Server component, provide connection through RPC (Remote Procedure Control) combined by ASP.NET language using Visual C#.NET.

Data for product can be provided through the database server, in this case we used SQL server, or using the STEP file converter to be an XML document. Thus, the data will be used for feature modeling and recognition module for the product.

The Feature Modeling and Feature Recognition module is connected to the network protocol (HTTP (Hyper Text Transfer Protocol), used WSDL based on XML grammar) and published through the internet via SOAP and UDDI – Service Registry. Once a request come from the client, the network protocol will flow the data using the Network Protocol to the server and the server will update the request and send it back to the client through the same way.

4.2.2. Module

4.2.2.1. Web-Server

The product data database included in this system is based on STEP standard. The system still need database system, which is used SQL Server, in order to easily-manipulate the graphical data in real time. The STEP file itself can be a directly converted data to the successor module.

The module for Feature Modeling System (FMS) will include several function as create, modify, delete feature as shown on the display on web browser.

Feature Recognition module is about recognizing a specific feature as a slot, hole, block etc. This module is useful for making the process design, related with CAPP (Computer-Aided Process Planning) and many things about cost. More complex a product design, using the complicated feature, means more difficult on the manufacturing process and it indicates more cost on producing the product.

4.2.2.2. Web-Client

The feature model on client side is a kind of display to show the product, included all of the components, which is connected to GUI (Graphical User Interface). B-Rep (boundary representation), one of the widely-used method for feature modeling system, can be used for the exchanging product data and display using request and response services.

The GUI, on client side, will be built as easy as possible to be understood by the user. The design will

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use some term, like tree structure data, panel interface to see the part graphics.

4.2.2.3. *Internet Web-Service Service Registry*

In order to be recognized, a web service should be registered to a Provider and Service with UDDI Services. Microsoft provides a web site, http://uddi.microsoft.com, to have a free registration of a web-service and publish it through the internet. Each user has to register using Microsoft .Net Passport to manipulate the server-client web-service design with internet.

4.2.3. *Implementation*

Visual Studio C#.Net is a new .NET programming languages which almost similar with C++ or even Java languages. One advantage of using C#.NET is the ease of use that can make the same result as other web-programming languages such as C++ and/or Java.

5. Conclusion

In this paper, the PDM for CAD by using XML based Web service is proposed for manufacturing organizations which need to implement a concurrent engineering concept in their product development. The system is implemented for local engineering consulting company in order to demonstrate that the manufacturing organizations can actually have some benefits. The system has shown that the Web-enabled CAD system is very useful for engineering consulting companies which provide design service for new product needs.

There are some benefits because of this implementation.

- The documentation has a good structural mechanism to be shared among the business function of an enterprise
- Feature modeling and feature recognition module used in this system will be necessary for planning the manufacturing process design.
- Better control of the engineering data and historical design activity is well-established.

Microsoft Visual C#.Net, a new programming language which provides XML and web services, could establish a well-PDM distributed system using simple language for a new learner in web technology.

For the next step, it would be a better research to provide the process design until the manufacturing design using the PDM system.

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