DIRECT USE OF DESIGN INFORMATION FOR E-CATALOG GENERATION

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ABSTRACT

With the wide spread of internet, the electronic commerce (e-commerce) market is rapidly expanding. A web-based e-catalog system is used to provide e-commerce customers relevant product information. The accurate and timely delivery of product information is the key to the e-catalog system. This paper describes a systematic approach to generate an e-catalog web page by direct use of design information such as PDM data and 3D CAD data. The e-catalog generator consists of the data converter and the e-catalog manager. Since the product data stored in PDM systems are difficult to understand for the customers, the data are converted to customer-oriented format. The data that will be provided to the customers are selected and the related technical terminologies are converted to common words. The data converted including images of products, product specifications and product features are stored in the e-catalog database. The e-catalog manager integrates the data in the e-catalog database to generate XML format e-catalog documents. In addition, the e-catalog manager receives 3D CAD design model, adds texture information, and enables virtual reality simulation of product functions. It is shown that the most up-to-date e-catalog web service can be realized with the least amount of web designer intervention using the e-catalog manager in order to reduce time and cost when new products are released.

1 INTRODUCTION

Electronic commerce has emerged as a primary part of enterprise activity according to the spread of internet (Adam and Yesha, 1996). Rapid information transfer of both business to business (B2B) and business to customer (B2C) transactions has been made possible (Baron et al.,

2000). In order to reflect characteristics of customers, enterprises continuously collect customer requirements and provide advertisement of new products to help customers purchase. Therfore, product catalogs are crucial to provide all the relevant information of current products to customers. The product catalogs can be classified into three categories: paper catalog, 2D digital catalog, and 3D e-Catalog. The paper catalogs have been most widely used. However it is expensive to update and distribute the paper catalogs. With the wide spread of internet, 2D digital catalogs became very popular. The characteristics of 2D digital catalogs are as follows (Jianxin, and Mitchell, 2002 and Gatner, 2001).

- They can provide product information rapidly.
- They can provide chances that customers try products online before purchase.
- They can provide a way that customers give feedback information for the products to companies.

Although 2D digital catalogs are convenient for on-line shopping, customers are unlikely to be satisfied with the information since the information of 2D digital catalogs is static. This is because most digital catalogs in the internet are created using 2D still images. Customers usually want to acquire realistic information by manipulating the associated products. Moreover, 2D digital catalog systems are not connected to Product Data Management (PDM) systems or 3D CAD systems. Detailed shape models in 2D digital catalogs are becoming popular, and the diversity of such product models presents challenges in manipulation, rendering and storage of the shape models.

In this paper, a web-based 3D e-Catalog is proposed that allows customers to access product information via

internet. The system efficiently integrates infomation such as 3D CAD models, 3D images, product specification and manuals. In order to utilize necessary information in e-Catalog , the information in PDM system is converted into e-Catalog database. The conversion is capable of accurate transfer of product information and reduction of time in proposed system since the product information in PDM syetm is directly utilized. All the information in the proposed system is stored in e-Catalog database and manipulated by e-Catalog manager. Moreover, e-Catalog documents are represented in eXtensible Markup Language (XML) format (World, 1996). The XML is designed to facilitate the interchange of structured documents over the internet (Yao et al., 2003). The XML is quite appropriate for certain electronic commerce (Li, 2000). Since the e-Catalog database contains all the information based on the XML technology, the objects can be efficiently changed, added and extended. The e-Catalog manager integates various infomation in order to create e-Catalogs and reduces time and cost for management of e-Catalogs. In addition, it can construct e-Catalogs for not only developed products but also products under development, since it directly uses product information in PDM system. Table 1 compares features of the proposed e-Catalog with the paper catalog and the 2D digital catalog.

Table 1: Comparion among paper catalog, 2D digital catalog and e-Catalog

	data from	image presentation	customer interaction
Paper catalog	develped products	fixed	off-line
2D digital catalog	develped products	static	on-line
e-Catalog	developed/ developing products	dynamic with VRML	real time

This paper is organized as follows: Section 2 describes the structure of e-Catalog system and the characteristics of e-Catalog document. Section 3 describes data conversion from PDM system to e-Catalog system. Section 4 proposes the e-Catalog manager and describes the function of the e-Catalog manager. Section 5 presents the implementation examples and section 6 summarizes the results.

2　E-CATALOG SYSTEM

2.1　e-Catalog web service

As explained above, e-Catalog system supports customers' purchase decision by providing product data and services, enables customers' needs to be reflected to product development, and consequently intensifies competitiveness of products and web-based business activities through the customer-enterprise interactions over the internet. The functions of e-Catalog web service are following:

- Rapid and easy service of product information
- Circulation of company newsletter
- Order and payment
- On-line simulation of product functions with 3D images
- Estimation of delivery time
- Recommendation of products considering customers' preferences
- Search for product data such as inventory, delivery and BOM
- On-line manual service

For example, a local dealer can show the e-Catalog using internet to customers who visit him/her, provide product data such as 3D image of products, product specifications and characteristics and help the customers decide orders. Order information from customers and customer interview information with dealers are supposed to be transferred to e-Catalog web server and utilized effectively when new products are planned and developed.

An e-Catalog including product data should contain the most recently updated information for the rapid and accurate information service to the customers. Therefore an integrated system which imports product data from PDM system and 3D CAD system directly, which reduces the time lag between product development and sales, is necessary.

2.2　Components of e-Catalog system

The e-Catalog system is composed of data converter, e-Catalog database, e-Catalog manager. The operation of the e-Catalog web service is based on the data exchange among the components of the e-Catalog system. The first step of implementation for the e-Catalog is to extract the necessary product information from PDM systems and integrate them into e-Catalog database. The data acquired from PDM system are : 3D CAD models of products, 2D texture images, product specifications, product characteristics and product manuals (Jang and Park, 2002). Figure 1 shows the architecture of the e-Catalog system.

As data transfer from PDM systems to the e-Catalog database is completed, the product data in the e-Catalog database should be published in XML format which is available for web service. The CAD data of products should be transformed to VRML format, which is one of the standards of web 3D, by additional work with specific tools because the CAD data are not directly available for web display. The transformed VRML data can be shown as realistic images in clients' web browsers with texture mapping.
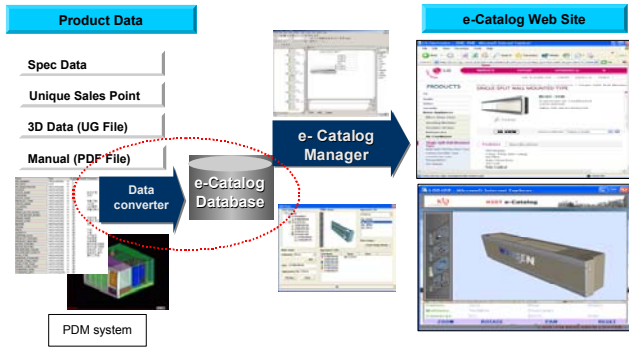
Figure 1: Architecture of e-Catalog system

e-Catalog manager specifies the necessary documents which store the local path of web server, and supports the design of web site for web service. Finally, e-Catalog documents are stored in e-Catalog database, and the e-Catalog system provides product information including 3D images according to the request of customers.

e-Catalog manager provides users with a web-based 3D-viewing window template that facilitates the process of developing animated 3D images from the CAD data. The template enables to include prospective 3D images and to control them interactively within the web documents.

The e-Catalog system efficiently manages updated product information about various product categories using data exchange among the components, and provides integrated product information through the web service.

2.3 e-Catalog database

2.3.1 Features of e-Catalog database

The e-Catalog database includes information of both enterprises and customers. The enterprise-related information consists of developed product lists, product specifications, CAD models, 3D images, performance and BOM (bill of material). The customer-related information includes the order information.

In the web service of e-Catalog, the product web pages should be made easy to search, which depends on the systematic classification of the products. The web sites of e-Catalog are organized as hierarchical structures according to the product type and include well-defined hyperlinks of lists. Therefore, e-Catalog database also has to be arranged in hierarchical structure.

In this research, the e-Catalog database is designed as hierarchical directory structure and e-catalog document in each directory manages the hierarchy. The e-Catalog documents are represented using XML format, since it is independent of server operating systems and is appropriate to represent the hierarchical structure of products. Since e-Catalog documents in XML format contain contents and structures only, Cascade Style Sheet (CSS) or eXtensible Style Language (XSL) is needed in order to show the

documents with the web browsers. e-Catalog documents written in XML format have outstanding capability of maintenance and management.

2.3.2 Contents of e-Catalog document

The e-Catalog documents of product hierarchy provide not only the basic product information but also the necessary information for simulating product functions. The contents of the e-Catalog document for product hierarchy are as follows.

- Product name or model number
- 3D images of products
- Viewpoint handle of 3D images
- Motion handle of 3D images
- Material/color handle of 3D images
- Simulation handle
- Product characteristics
- Product specifications
- Product manuals

e-Catalog documents consist of the documents of site level, product category level, product type level, and product level. The e-Catalog document classification provides customers with the capability of easy search of detailed information. Site level documents have links to various product category level documents. Product-category level documents describe the information of a set of products. Product type level documents have classification links to the product level documents. Product level documents provide detailed product information.

Figure 2 shows an example of a hierarchy of the e-Catalog document for air conditioner. Figure 3 shows an example of Data Type Definition (DTD) document of product document. The product document includes model's name, dimension, color, size, weight, watt and efficiency. Each element has the attributes of name, value, description, and unit.

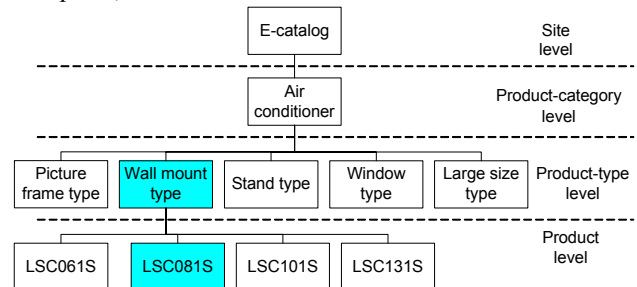Figure 2: An example for hierarchy of e-Catalog document

```
<?xml version="1.0" encoding="EUC-
KR"?><!ELEMENT airspec (spec+)>
<!ELEMENT spec
(model,dimension,color,size,weight,watt,efficiency)>
<!ELEMENT model (#PCDATA)>
<!ELEMENT dimension (#PCDATA)>
<!ELEMENT color (#PCDATA)>
<!ELEMENT size (#PCDATA)>
<!ELEMENT weight (#PCDATA)>
<!ELEMENT watt (#PCDATA)>
<!ELEMENT efficiency (#PCDATA)>
<!ATTLIST spec
name CDATA #REQUIRED
value CDATA #REQUIRED
description CDATA #REQUIRED
unit CDATA #IMPLIED>
```

Figure 3: An example for DTD document of product document

3 DATA CONVERSION FROM PDM SYSTEM TO E-CATALOG

In order to utilize product data in the e-Catalog system, it is necessary to convert product data in product development process. Since the product data stored in PDM systems are difficult to understand for the customers. The operation converts product data into e-Catalog database. The converted data consist of the product specification, unique sales point including product features, 3D model and product manual with pdf file format (Figure 4).

The product data managed in PDM system is necessary information for the product development. Various product categories are exist and product specification information is different product by product. On the other hand, product data in the e-Catalog is to provide customers with product information of customers' interests. Therefore, it is not necessary to convert all the information in PDM system into e-Catalog system. The product information in e-Catalog system is the compact information which consists of product specification, product features, 3D models. The data which is utilized in e-Catalog system is not the engineering product data in PDM system but information which is expressed with customes' language(Figure 5).

Product specification in various PDM systems has different structure. Therefore it is necessary to extract common specification database from various product specification database. Common specification table in e-Catalog is defined as model names, specification names, specification contents and units. The specification conversion module composes of database definition, table mapping, field mapping and rule assignment(Figure 6).

For the data conversion, users firstly select product specification table to be converted from PDM system to e-Catalog system. In Figure 7, the source table means the table in PDM system and the target table means the table in e-Catalog system. Secondly, users select data field to include e-Catalog from selected specification table(Figure 7). Thirldly, users select product table from target table lists. Fourthly, users select field data from field list of description table. Lastly, users add name, unit and description of target data(Figure 8).

To select necessary information in e-Catalog, a conversion rule is necessary. Figure 9 shows an example applying a conversion rule. The conversion rule defines selected data fields among data fileds in PDM system. In addition, description table defining object names, descriptions and units of the selected data fields.

In addition to the product specification, Unique Sales Point is converted to e-Catalog database. Unique Sales Point describes documentaion of development information in PDM system. Converted Unique Sales Point in e-Catalog system provides detail information including product features and reusability for sharing items in various products(Figure 10).
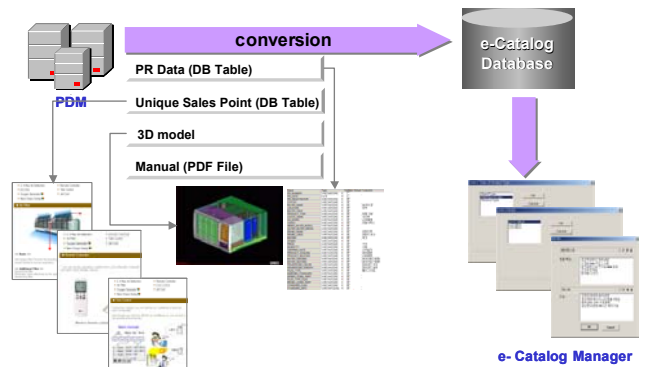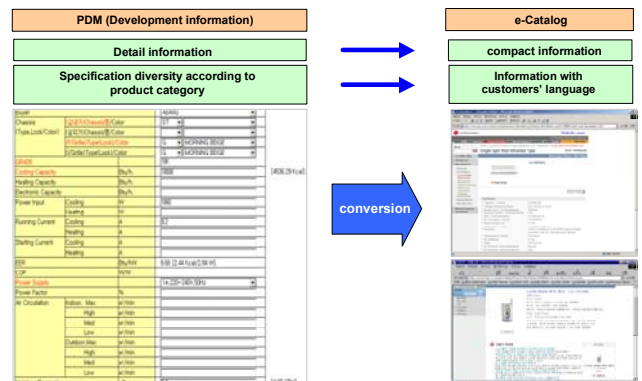

Figure 4: Conversion of product data.

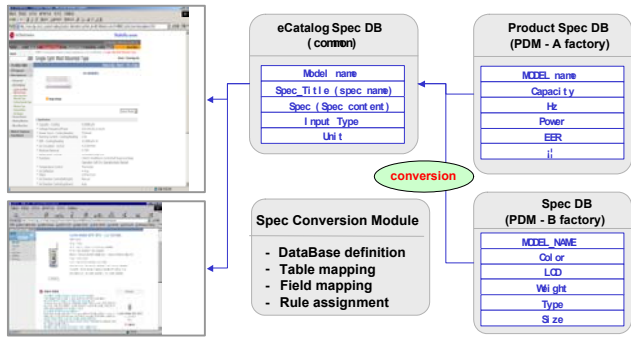Figure 5: Data characteristics beteween PDM system and e-Catalog
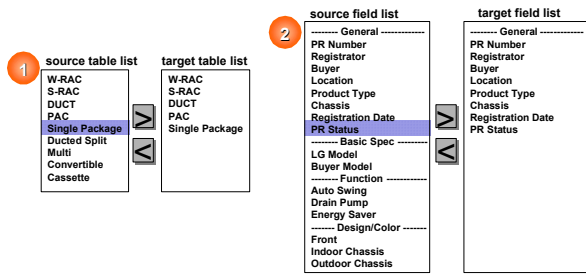
Figure 6: e-Catalog specification database.
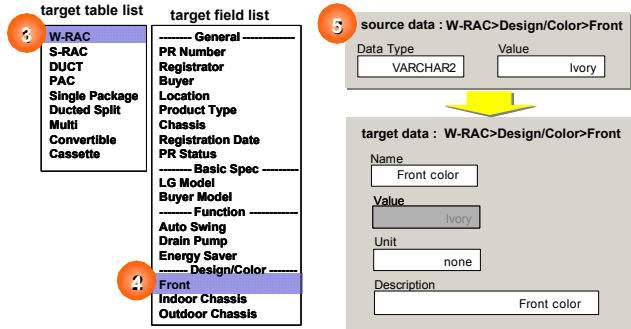

Figure 7: Source and target table

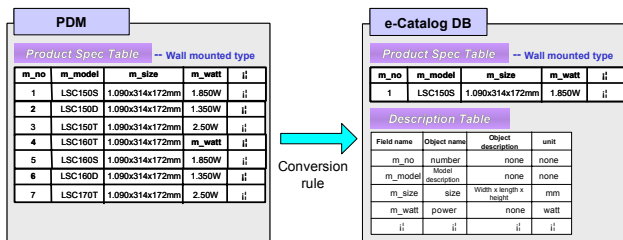Figure 8: Definition of target data.
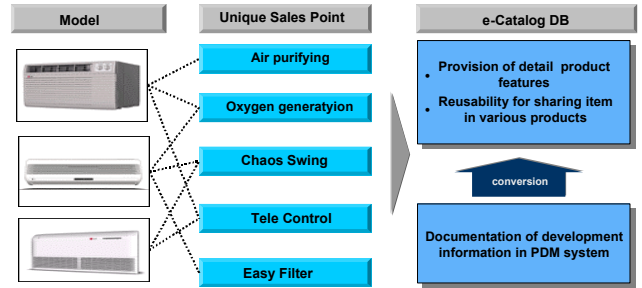

Figure 9: Conversion rule.

Figure 10: Unique Sales Point.

4   E-CATALOG MANAGER

4.1 The characteristics of e-Catalog manager

e-Catalog manager integrates necessary information for publishing e-Catalogs. Its characteristics are listed below:

● Functionality: The e-Catalog manager provides a systematic classification of the e-Catalog documents according to the product hierarchy.

● Extendibility: The e-Catalog manager can easily extend the e-Catalog documents of products to the other products of the same product type.

● Compatibility: The e-Catalog manager uses the industrial standard formats for web documents such as XML and VRML which are fully compatible for information exchange among other e-Catalog system and CAD systems.

4.2 Components of e-Catalog manager

e-Catalog manager helps to create and manage product information in e-commerce environments such as B2C and B2B businesses. The overall architecture of the e-Catalog manager is based on several modules of product specification manager, 3D image input module, and web page manager as shown in Figure 11.

4.2.1 Product specification manager

The product specification manager stores the product information transferred from PDM systems to the e-Catalog database. It selects a table where the product type is defined. When the model number of product in the product level is selected, the product specification is determined, modified and added. The selection and modification processes are made easy since the product specification is expressed in the customers' language.

4.2.2 3D image input module

In order to create 3D image models, 3D image input module imports both 3D CAD models and 2D texture

images from the e-Catalog database. It also manages the filing systems of the e-Catalog database. The 3D CAD models and 2D texture images are to be transferred to VR composer for texture mapping, VRML conversion, VRML data reduction and simulation of product functions.

4.2.3 Web page manager

The web page manager provides necessary information in order to create web pages. It is capable of automatic creation of DTD documents from the product specification which was selected in the product specification manager.

The DTD document checks whether XML documents are valid for application programs or not. If the XML document is not valid to the application program, an error message is invoked. The creation of XML documents is based on the DTD documents. The web page manager creates customizable web pages which can be displayed in different formats and styles in web browser windows with various XSL documents applied. The XML is a very effective language in describing the hierarchy of products and has useful functions for web applications. The web page manager convert product information to XML documents.

product-category structure is also performed with the similar dialog box.

Figure 13 shows the process of product specification modification that selects necessary specification. The necessary specificaitons for the e-Catalog are selected by clicking the corresponding items from the left area.

Figure 14 is an example of an XML document created for the air conditioner specificaiton. The specifications are expressed in XML foramat with the correspoding tags.

The web browser of the customers will display the e-Catalog as shown in Figure 15 where the product shape, color and specifications are included. In the figure the texture of the product is added to the 3D CAD model by the VR composer and the customers can see the realistic shape of the product. The VR composer also enables the animation of the product image. Figure 16 shows that the cover of the air conditioner is open by the customer interaction. Table 2 illustrates comparion between previous e-Catalog generator and porposed e-Catalog generator.
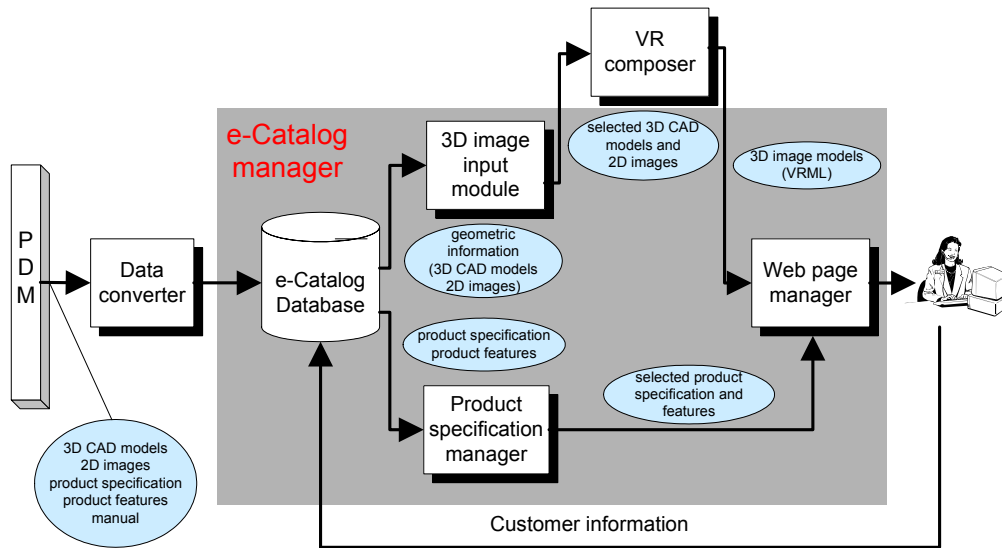

Figure 11: e-Catalog manager structure.

5 System implementation example

A prototype system is implemented to demonstrate the e-Catalog. The e-Catalog for an air conditioner has been developed. The Figure 12 shows the e-Catalog manager screen, where the left plane of the screen is the architecture view that provides the hierarchical information of e-Catalog. The dialog box indicates the selection process of product-type table from the e-Catalog database. The selection of a model name of the product among a set of
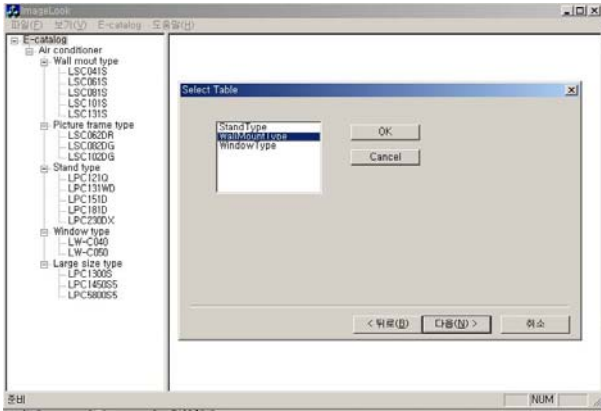
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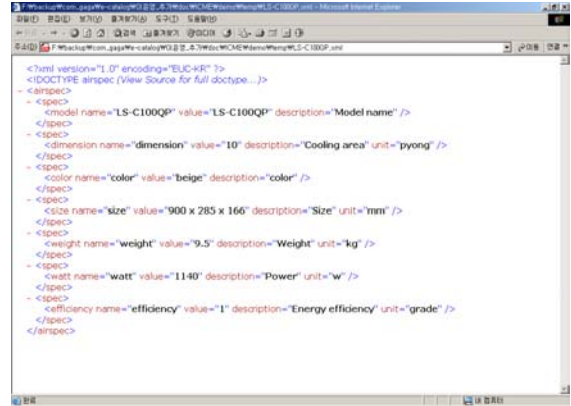Figure 12: e-Catalog manager example.
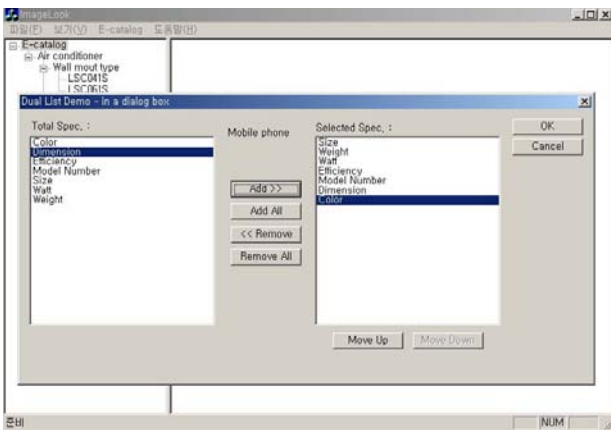

Figure 14: An example of XML document.

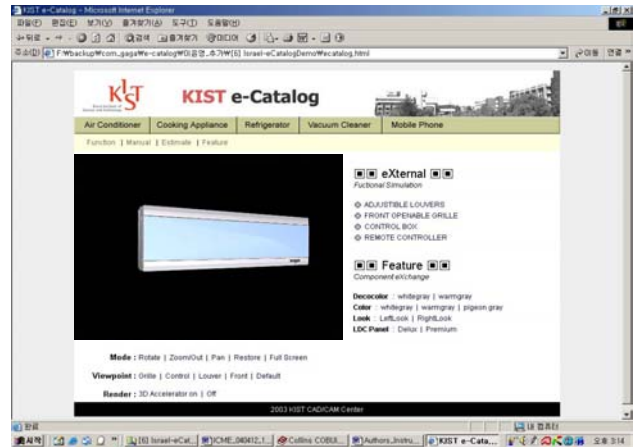Figure 13: Modification process of the product specifications.

Figure 15: e-Catalog example for air conditioner.

Table 2: Comparion between previous e-Catalog and proposed e-Catalog.

|	Previous e-Catalog generator	Proposed e-Catalog generator
Product modeling	Remodeling of product using graphics s/w such as 3DS Max is necessary	Modeling is not necessary since 3D CAD data is directly used
Operating hours	One month	Three or four day
Customer type	End Users	End Users/Buyers
Addition of new products	Creation of e-Catalog through outsourcing company	Creation of e-Catalog is possible internally
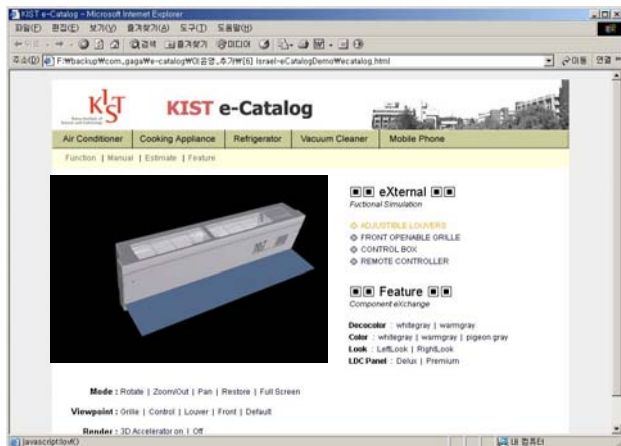
Figure 16: e-Catalog example for air conditioner with animation.

6 Conclusions

The e-Catalog allows customers to access product information via internet. The e-Catalog system manages product information such as 3D CAD models, 3D images, product specification and manuals that are imported from PDM systems. It provides customers with the most recent information as well as the realistic image of the product over the internet.

In order to support the e-Catalog system, the e-Catalog manager based upon XML technology was developed. The e-Catalog manager can reduce time and cost needed to create e-Catalog web sites, and can easily update contents when the registration of new products or the modification of developed products is necessary. Since the e-Catalog system directly utilizes product information from PDM systems, the e-Catalog manager increases the efficiency of e-Catalogs by providing customers with updated product information without time delay.

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