VP Database Support for a More Efficient Cyber Shopping Mall

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효과적인 사이버 쇼핑몰을 위한 VP 데이타베이스 지원

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Abstract

More and more cyber shopping malls, one of the new promising Internet businesses of today, are opening business everyday. And instead of the ordinary image and text type of product display, buyers can now view products from any viewpoint through 3D images and also get more detail information on the product more easily thanks to the new VP technology, visual tools, and statecharts. However the currently used virtual prototyping supporting method does not consist of any database support for sharing the data from different virtual prototype developments and reusing the data in developing other prototypes. And in cases of custom order products, there is no linkage with the virtual product database that enables buyers in cyberspace such as cybermalls to try out the products before purchasing. This paper is purported for being applied as the basis for planning the construction of a complete CRM method applied cyber shopping mall that can accommodate all the demands and requests from customers. And the database supporting VP framework that supports data sharing and collaboration between virtual prototype developers and manufacturing custom order products is suggested for this purpose.

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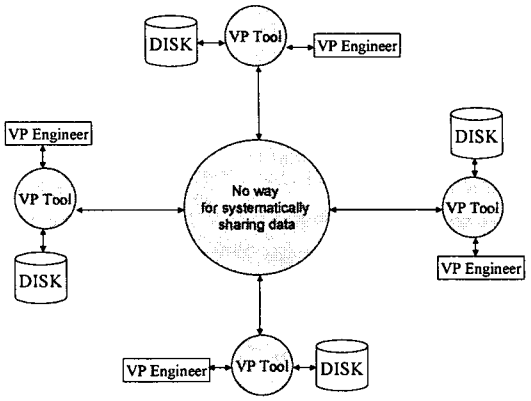
1. Introduction

Along with the rapidly advancing multimedia technology and the diversified tastes of online consumers, businesses in advanced countries have long before started developing cyber shopping malls that can satisfy the consumer's demands and are on the verge of providing the new services to customers. And a new evolution has taken place in the cyber shopping mall market with the emergence of the VP technology, which enabled virtual production of products in time to match today's short life cycle of new models and display the products so that buyers can view them as if the actual products were right before their eyes.

Unlike the former prototyping process where real life prototypes are actually made, VP refers to prototype production on the computer using simulation software. This new prototyping process saves the time and money wasted in manufacturing real life prototypes. This process can also be applied in manufacturing products that are custom ordered by each individual buyer.

Other than saving time and money VP has many advantages compared to the old way of prototyping. But as shown in (Figure 1), the current VP tool-working environment has some problems itself. These problematic matters can be largely divided into two.

First of all, there is no database for sharing and reusing the data from development of different virtual prototypes. Because of this, there is no way for VP developers to share the necessary data and reuse the existing data to save time in producing new prototypes.



(Figure 1) The working environment of the currently used VP tools

Second, one of the main purposes of VP is to let buyers try out the products so they can purchase the most appropriate product. If the buyer cannot find the product he or she wants, the buyer should be able to custom order a product according his or her individual taste. For this purpose, the buyer must be provided a database that holds prototypes of various products so he or she can try out all of the product models available. However, the current VP environment does not provide such a database to buyers.

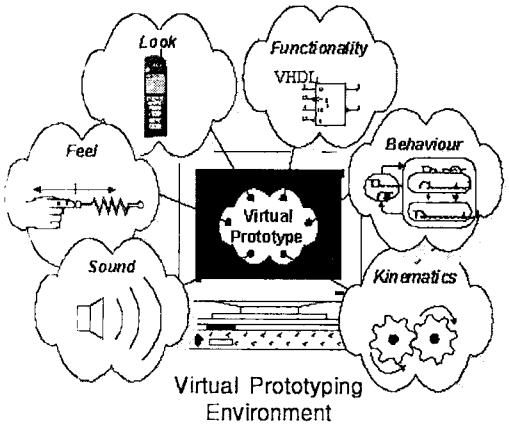
As a solution for such problems with the current VP environment, this paper suggests the database supported VP framework where data sharing and collaborative work between VP developers is possible and where buyers can test virtual prototypes in cyberspace such as cyber malls. And the technologies for supporting this framework will be also looked over.

This paper is organized in the following order. Chapter 3 suggests the database supported VP framework for a better VP environment, Chapter 4 deals with the database technologies that supports the framework, and Chapter 5 closes the

study with the conclusions and suggests how the research shall advance in the future.

2. Virtual Prototyping

In this chapter we will briefly go over on what VP is. As mentioned in the Foreword, producing a virtual prototype using the computer is referred as VP (virtual prototyping.) Since this virtual prototype is not tangible, the developer who designs and engineers the virtual prototype should be most concerned with how close to real life the prototype looks so that the buyer can try out the prototype as if it were the actual product. For such purposes VP must provide the environment as shown in (Figure 2) below.



(Figure 2) Virtual Prototyping Environment [3]

The VP technologies used for providing the environment shown in (figure 2) can be largely classified into three groups.

- Visualization
- Simulation
- Automatic Code Production

Visualization is the technique used for making the virtual prototype look exactly like the real product. It includes modeling for designing the product, rendering for presenting the surface and the material of the product, and animation for showing how the product actually works. Also, virtual reality can be used in order to provide the target environment where the functions of the virtual prototype can be tested.

Simulation is used in testing the function of the product that is to be produced. The formal specification method is applied here. The formal specification must clearly and accurately specify the functions. As a formal specification method, the statechart, which has been mentioned in [2] can be applied [1].

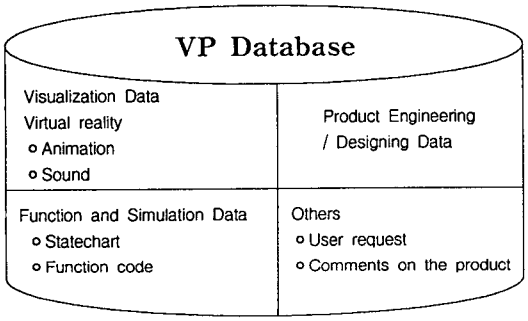
Automatic code production produces codes because the product functions specified should be mapped into physical objects of the target system. The hardware engineering language VHDL code and the software code to be executed in the hardware are automatically produced by this technique [1].

3. Database support for VP

The problems with the current VP environment have already been mentioned in the Foreword. This chapter suggests the database support VP framework as the solution for such matters. Chapter 3.1 describes what is stored in the VP database, which is the key for constructing the suggested framework. And Chapter 3.2 deals with the VP working structure, the VP user, VP workflow, and the database used in the framework.

3.1 What is stored in the VP database

VP is not just simply designing the outer design of the virtual prototype. VP must also show the prototype's functions and how it actually works to the virtual prototype user. And the requests of custom order buyers must also be applied in designing and manufacturing the customized product. Due to this, a large number of various data are produced in the VP environment. And these various VP data should be stored in the VP database as shown in (Figure 3).



(Figure 3) Types of Data Stored in the Database

Data that are produced during VP include the visualization data, which is a key requirement for organizing a virtual prototype, the product designing data, the function and simulation data, and the customers' requests for custom order products and comments on the products.

The visualization data is used for producing the target environment where the virtual prototype's actual operating motions and functions can be tested. Animation, sound, and virtual reality are used to support this. The product designing data is used for designing the outer design of the virtual prototype.

The function and simulation data are used in assigning functions to the virtual prototype and simulating the assigned functions. The statechart is used for indicating the process of the movements, and the function codes are used to produce the results of the movements.

The data including the buyer's comments on the purchased product and the buyer's requests for the custom ordered product are used for developing custom order products that satisfy every individual buyer'tastes.

3.2 Database support VP framework

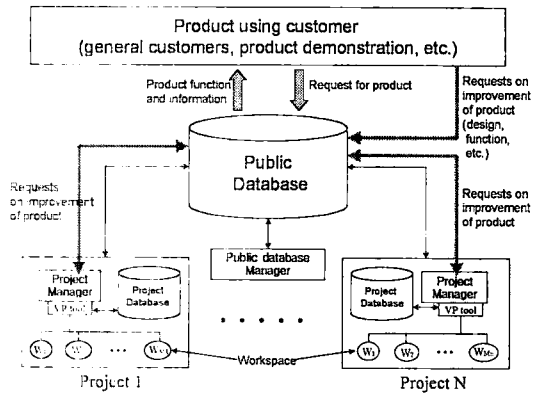
The VP framework should provide a convenient working environment so that the VP developer can work efficiently on developing virtual prototypes. It must also provide buyers easy access to the product they want to purchase. This chapter suggests the database supported VP framework based on the VP database for supporting the VP developer and the product buyers.

3.2.1 VP Working Structure

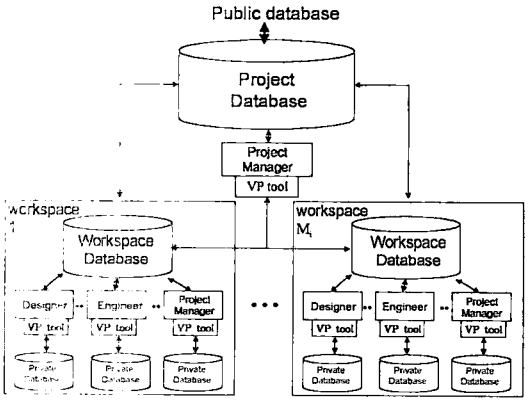
(Figure 4) shows the framework this study suggests. The concept of the suggested database supported VP framework can be described from two perspectives.

First, the VP environment is made up of several different projects for developing virtual prototypes of various products in cyberspace such as cybermalls. The word project refers to each of the separate developments of different virtual prototypes. And as shown in (Figure 5), each project is composed of several workspaces.

Each workspace develops each separate component of a prototype. Since each workspace produces the different prototype components simultaneously, time can be saved in developing a prototype.



(Figure 4) Database Supported VP Framework



(Figure 5) Project Structure

In each workspace, there is a designer for designing the outer design of the prototype and an engineer for providing the functions. There is also a workspace manager for managing the work done in the workspace[4]. The public database, project database, and the workspace database are used so that each project or workspace can collaborate and share data with other projects or workspaces[5]. The second perspective of the framework can be described as a structure that enables buyers purchase the exact product they want by letting the buyers try out the products in cyber space and see how well the product works. For this purpose, the public database that stores a large number of various product prototypes is operated in linkage so that buyers can test all sorts of products before making their choice.

3.2.2 Types of database applied in the framework

In order to support the suggested framework, several different databases are used as shown in (Figures 4) and (Figures 5). The application of such various databases is for supporting collaborative work and data sharing between VP developers, and also for supporting operation in linkage with database so that the buyers can try out the various products before purchasing.

The databases to be used in the suggested framework are classified into the following four.

- Public database
- Project database
- Workspace database
- Private database

All the VP data described in Chapter 3.1 can be stored in the four databases listed above. Certain databases store certain VP data according to its purpose as indicated below.

The public database is used for supporting both the product buyer and the VP developer.

First, the virtual prototypes of various products are stored in order to support the product buyers and let them try out the products. And for producing custom order products, the virtual prototype of the product being produced and the customers' request and comments on after using the product are stored also. And secondly, to support VP developers, all the VP data that can be used in developing other virtual prototypes are stored in units of components. With such a database, the already existing VP data can be reused and virtual prototype development can be less time consuming.

On the other hand, the project database is purported for sharing the data required in developing a virtual prototype within a project and integrating all the separate components that are developed by different workspaces. For this purpose, all the VP data that can be used in the project are checked out from the public database and stored in the project database. After all the components that are separately developed by each workspace are put together to form a virtual prototype, the integrated data is stored in the project database also.

The workspace database is similar to the project database. The only difference is that the workspace database supports data sharing and integration of the separate components developed within a workspace, which is a smaller unit of a project.

The fourth database called the private database is the personal database owned by each of the designers and engineers who participate in developing a virtual prototype. For this reason, the private database of each designer or engineer stores the VP data that is most frequently used by the individual developer. In the private database owned by designers, the product designing data and the visualization data are stored so that designers can design the outer design of the virtual prototype and view how it works. And the function and simulation data relevant to the product functions are usually stored in the database owned by engineers.

3.2.3 VP Users

The suggested database supported VP framework is capable of supporting various VP users as shown in (Figure 4) and (Figure 5). This chapter deals with each of the VP users.

The users of the database supported VP framework are divided into 3 groups as listed below.

- Product buyer
- Application program
- VP developer

The product buyer first tries out the virtual prototype of the products displayed in cyberspace such as cyber malls before making the purchase. The product buyers are again divided into two groups. Those who buy the displayed product and those who custom order by making requests on what kind of functions or style they want to the manufacturing company. Both groups use the public database in order to view the product and its functions through virtual prototypes.

Application programs are used by product sellers or at product demonstrations for advertising the products. These programs also use the public database in order to show buyers how the

products look like and what functions they have.

The VP developers develop the virtual prototypes of products and displays them in cyberspace such as cyber malls so that buyers can try out the products before making the purchase. VP developers are specifically classified into public database managers who manage the virtual prototypes and customer requests that are stored in the public database, the workspace managers who manage the workspace database and integrate the separate components designed in the workspace, the designers who design the outer design of the virtual prototypes, and the engineers who assign the functions to the prototypes. All of these VP developers are allowed to use all of the databases within the suggested framework for developing, integrating, and displaying the virtual prototypes.

3.2.4 VP Workflow

This chapter is a description of how the prototypes are developed within the suggested framework.

As shown in (Figure 4), the public database is shared by the several different projects within the suggested framework. This is to enable different projects to easily apply the data that is commonly used in developing each of the virtual prototypes. For such purposes each of the VP developers must check out the necessary data for their work from the public database and store the data in their personal database before starting VP designing.

As shown in (Figure 5), a project is composed of several workspaces, and each of the workspaces design separate components with different functions simultaneously in order to save time in developing a virtual prototype. The function of each component is tested within each workspace. Meanwhile, collaborative work between individual VP developers is essential, since for example, the prototype design and function are developed separately by the designer and engineer respectively before the data are integrated. VP developers are to collaborate by sharing data through the public database.

When the assigned component is finished, the authorized workplace manager checks in the completed data into the project database so it can be applied in the virtual prototype integration.

While developing each component within each workplace, it is necessary to test with the other relevant components to check that it operates properly. For this purpose, the project database is used for sharing data with other workspaces. The project database is also used in integrating the different components checked in by each separate workspace. The project manager integrates the components to form a complete virtual prototype.

After the virtual prototype integration is complete the data must be stored in the public database so that the customers can view it. The project manager who is authorized to check in data into the public database does this. The project manager can also refer to the public database for customer requests that are required for producing custom order products.

The virtual prototypes stored in the public database are used for advertisement events held by sellers, or viewed by buyers through cyberspace such as cyber malls.

4. Database technology for supporting VP

This chapter deals with the technologies required for supporting the VP framework, which has been suggested in the preceding chapter.

The technologies necessary for database support in a VP environment are as listed below.

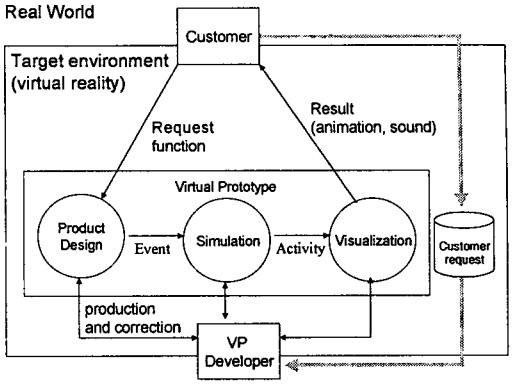
- VP data modeling
- Version management
- VP data clustering
- VP transaction management for supporting collaborative work

These technologies are dealt with in the following subchapters.

4.1 VP data modeling

Advanced modeling is necessary for storing the VP data in the database. As a basic method for VP data modeling, the object-oriented modeling [6] can be applied since the inheritance and encapsulation effects of this modeling method supports reuse, expansion, and modulation of the virtual prototype. However, there are several aspects that VP differs from the generally applied object oriented.

First, the virtual prototype is simulated in a virtual target environment in order to test the functions. Though the test is carried out in virtual reality, the VP user can actually try out the virtual prototype interactively. (Figure 6) below shows the environment where the virtual prototype is operated.



(Figure 6) Environment of the Virtual Prototype Movement

Second, different types of data are used together in developing a virtual prototype. For example, different data such as product design data, function and simulation data, and visualization data are combined organically to present the product's design and functions.

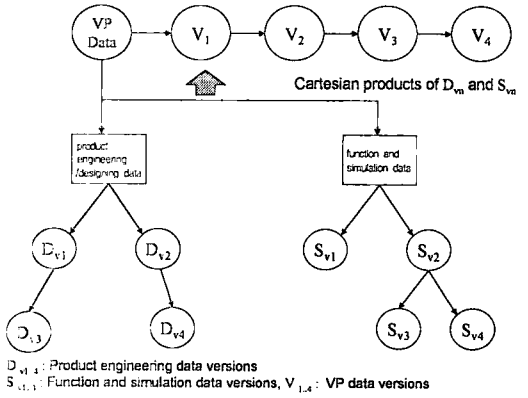
Third, the customer'requests and comments can be referred to and applied in product development. Through a target environment, the product buyer can try out a product that is currently being developed and send their comments and requests concerning the product to the developers online. Buyers are able to request production of custom order products to the developers.

As seen above, VP data modeling is difficult to carry out with the ordinary object oriented modeling method in several aspects. Because of this, a new VP data modeling method that can efficiently store the data that occur during virtual prototyping is necessary.

4.2 Version Management

During the process of producing a virtual prototype the designers and engineers continuously

test and correct the data until they come up with the desired design or function. As a result of these continuous tests and corrections, there tends to be several versions of the same data and the VP system must be capable of managing these different versions.



(Figure 7) Production of VP data versions

[7] and [8] suggest how the versions of a data should be managed. However the data management suggested in [7] and [8] have some inadequate aspects for managing VP data. This is due to the fact that VP data is composed of several versions of product engineering/designing data and function and simulation data. Also, the Cartesian products of the data listed above produce the various versions of the VP data. Because of such reasons mentioned above, the suggested framework requires a new method for managing the many versions of the data.

4.3 VP Data Clustering

In developing or using the virtual prototype, VP users require different data according to the purpose. The VP users have already been classified into the product buyers, application programs, and the VP developers in Chapter 3.2.

The product buyer and application program use the product designing data for viewing the design of the completed virtual prototype. And for testing the functions of the product and viewing the results these users also use the function and simulation data and the visualization data.

Meanwhile VP developers use different data according to the work they are assigned to. The designer mainly uses the visualization data and the product engineering/designing data for designing the outer design of the virtual prototype and its movements. The engineer usually uses the function and simulation data for assigning the functions of the product. And the managers participating in the development of the virtual prototype use all the VP data that are being developed for integrating them into one complete virtual prototype.

For such reasons, VP data clustering should be supported to have relevant data clustered together so that product buyers can quickly view the virtual prototype of the product through quick visualization and VP developers can quickly apply the required data in developing the virtual prototype[9].

4.4 VP transaction management for supporting collaborative work

A virtual prototype is developed by not just one but several other VP developers. In the beginning of the process, these VP developers work separately on the work they are each assigned to. And as the development progresses, the separate components developed by each indivi-

dual developer are integrated to form one complete virtual prototype [10-12]. For efficient integration it is important for the VP developers to share data and collaborate with each other. For this purpose, the VP transaction management should be carried out so that long-term data transaction between VP developers is possible.

5. Conclusion

VP is the emerging technology for fast development of consumer satisfying products. And for fast development of the virtual prototype, database support is required in the VP working environment so that VP developers can share data and collaborate. Also, product buyers should be able to try out the products in cyberspace such as a cyber mall so more satisfying products can be developed and produced by taking in customer requests and comments.

However, the current VP work tools do not provide such functions. This paper has suggested the database supporting VP framework for supporting such functions mentioned above and dealt with the technical database factors required for the suggested framework.

The suggested framework supports collaborative work between the several work divisions separated in order to save the time consumed in development. The framework also saves time and money wasted on producing the same data by providing database for sharing the data. And buyers can get the exact product they want quickly by trying out the products in cyberspace such as cyber malls and making requests or comments.

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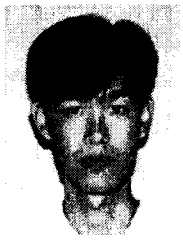
■ 저자소개



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서울 대학교를 졸업하고, 미네소타 대학에서 박사학위를 취득하였다. 미국 IBM 연구소, Visiting Scholar, U. C. Berkeley에서 근무하였다. 현재는 중앙대 컴퓨터 공학과 교수로 재직중이다. 주요관심분야는 전자 상거래, 인터넷응용, 자바 기술이다