

# A Platform for Fashion Shopping with Individualized Avatars and Personalized Customer Consulting

Henning Hinderer<sup>1</sup>, Thorsten Gurzki<sup>2</sup>, Uwe Rotter<sup>1</sup>

<sup>1</sup>Universitaet Stuttgart, Institut fuer Arbeitswissenschaft und Technologiemanagement IAT  
Nobelstr. 12, 70569 Stuttgart, Germany, {henning.hinderer, uwe.rotter}@iat.uni-stuttgart.de

<sup>2</sup>Fraunhofer-Institut fuer Arbeitswirtschaft und Organisation IAO  
Nobelstr. 12, 70569 Stuttgart, Germany, thorsten.gurzki@iao.fhg.de

## Abstract

Electronic Commerce is growing world-wide. The fashion industry, however, has only experienced minor benefits from this growth. Major problems are the lack of customer consulting and the missing possibilities to try on fashion products in online shops with high three-dimensional display quality. This paper gives an overview of the requirements of Business-to-Consumer online fashion retailing and the available technologies. It develops an approach for an online fashion shopping platform with individualized avatars for animated fashion presentation and integrated natural-language text-based customer consulting features. The approach is based on the results of two research and development projects, consisting of international consortia and funded by the European Union.

Keywords: Fashion, Personalization, E-Commerce

## 1 INTRODUCTION

Mass customization based on online technologies requires a high level of integration into the textile process chain. This paper mainly focuses on the interface between suppliers and consumers (Figure 1). It describes the creation of a customer-oriented enhancement of existing E-Commerce solutions especially for the fashion industry. Two heterogeneous system architectures, one focusing three-dimensional garment and customer representation, the other focusing customer consulting services, are combined. The content of this paper is based on the research and development projects FashionMe [1] and ADVICE [2], both funded by the European Union. The platform described is designed in such a way that integration into existing enterprise information technology environments is enabled. The platform will lie the foundations for custom-designed online fashion retailing.

## 2 REQUIREMENTS FOR ONLINE FASHION RETAILING

Online fashion retailing has special requirements compared to other online retailing sectors. Display quality and consulting offers need to be realized at a high level in order to achieve broad customer acceptance. The main requirements for online fashion retailing are [3]:

- improved visualization, 3D product representation, animated presentation of garment
- user-friendly offer of additional product information by integration of links
- enhanced product presentation by means of audio tools
- personalization features: individual product offer, use of personalized avatars

- individualized online consulting services
- 24-hours availability of the shop and the consulting services

In the fashion and textile sector, online shopping has not yet achieved significant economic importance. According to a representative survey conducted in Germany [4], one of the prominent reasons for Internet users not to take advantage of online fashion shopping offers is that 60% of the shoppers want to try on the articles before they buy them. 29% mentioned the missing possibility to 'look and feel' the fashion products as a negative characteristic of online fashion shopping. Only 6%, however, say they would miss the real-life conditions of a shopping event in a store. Another main result of the study was that shoppers demand customer consulting services.

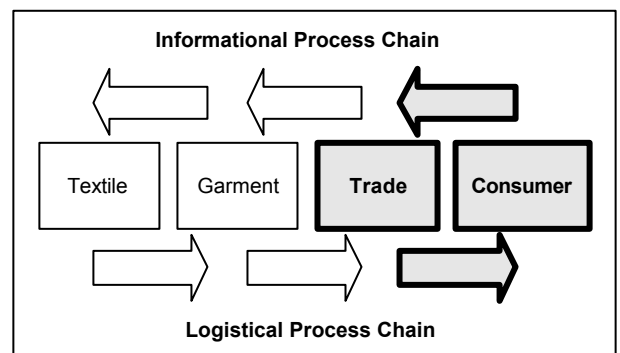


Figure 1: Part of the textile process chain [5]

Checking the fitting of clothes over the Internet is still by far not sufficiently possible today [6]. In the following sections, the concept of individualized 3D avatars is introduced, allowing to virtually try on clothing in order to better check the fitting and the garment characteristics especially when motions are made.

### 3 FASHION VISUALIZATION

In order to realize 3D garment visualization on an individualized avatar or to use a virtual catwalk displayed with regular web technologies, several components are needed. The person, the garment, the animation and the shop have to be available in transferable file sizes and formats.

#### 3.1 Avatar Technology

In this context, an avatar can be understood as a digital model of a person. An avatar must have certain prerequisites in order to meet the requirements for the representation of clothing and for walking on a virtual catwalk.

The three essential components are:

1. a three-dimensional mesh representing the shape of the body,
2. graphical information that is mapped on this mesh as textures, giving the avatar a realistic appearance,
3. a virtual skeleton that can be taken as a basis for the definition of motions; this also comprises the definition of joints with certain degrees of freedom as well as adjustable length relations; in the application described here, the HAnim (Humanoid Animation) standard is used [7].

#### 3.2 eGarments

The term eGarments denotes digital, three-dimensional models of real pieces of clothing. Most online product catalogs only consist of two-dimensional pictures. In order to show garment in three dimensions and with animated features, the effort for generating the necessary data material is higher.

The easiest way to produce eGarments is to generate data from a CAD program which is used for the design and the cutting construction of the clothing. State-of-the-art of cutting construction is, however, in most cases only two-dimensional. In order to generate a three-dimensional volume model of the garment, these faces must be sewed together virtually and then transferred into a three-dimensional grid model (Figure 2).

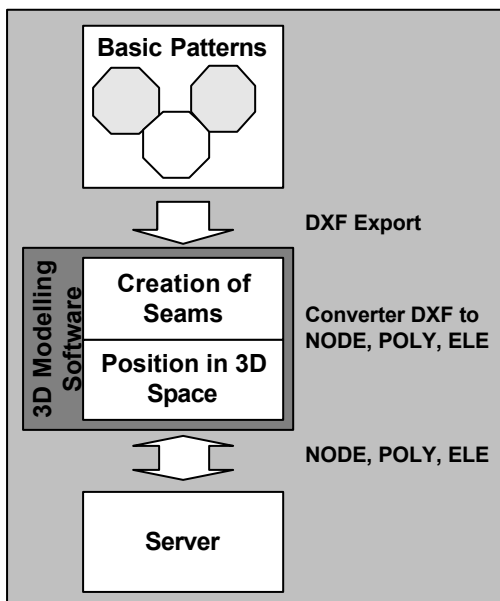


Figure 2: eGarments taken from a CAD system

However, eGarments can also be generated by digitizing the pictures of existing pieces of clothing. This method is employed in cases where, for example, the construction is not computer-based, or when CAD data cannot be transformed into the necessary data format.

eGarments are produced in a multistage process. A real dummy is equipped with the specific garment and is then scanned in 3D (Figure 3).



Figure 3: Preparation for garment scanning

The basis for this method is that the naked dummy was scanned in the first instance so that the system knows the gages of the dummy. In a second step, the dummy is scanned wearing the garment. By subtracting the known rough model from the dressed model, the necessary geometric data is computed.

The eGarment consists of

- the offset of the dummy and the garment's surface, and
- the graphical information which maps the surface and is used as a texture.

#### 3.3 Scan Technology

Currently, there is a multitude of 3D scanners on the market that take advantage of different scan technology. The selection of a certain scanner depends on the specific field of application. Besides the exactness of the measuring results, also aspects such as speed, usability, expenses for mass utilization and interfaces to further data processing systems are decisive criteria [8].

The solution to be described here is a technology developed by a member of the FashionMe project consortium, AvatarMe. The focus of AvatarMe's technology basically lies on the simple and fast generation of Internet-enabled, personalized avatars that have a realistic appearance, and not so much on an exact rendering of the actual gages of a person. The scanner is accommodated in a booth that can also be set up in public places (Figure 4).



Figure 4: 'Type 6' Avatar Booth of AvatarMe

The scanning process comprises digital photographing of the model from four different perspectives. Based on these digital views, the avatar is computed by means of existing rough models. In order to perform motions with the model, the avatar is assigned a skeleton (see 3.1 Avatar Technology). The assignment of all necessary points in the avatar for the individual joints is realized with a simple method: predefined avatars are being used (Figure 5). After size, weight, age and sex of the scanned person have been recorded, the most appropriate avatar is automatically selected from a number of about 60 different predefined body models. Then, the avatar is being personalized by integration of the digital pictures.

This procedure provides a first skeleton which can be further refined manually in order to equip fingers with knuckles, for example.

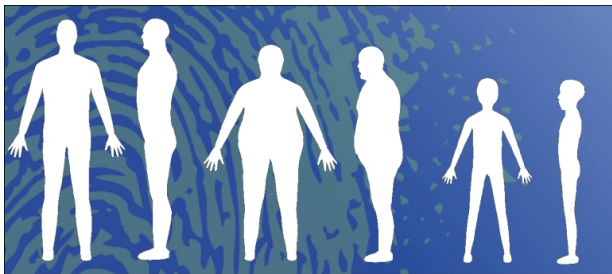


Figure 5: Predefined avatars

By doing so, the avatar does not really comply with the exact body measures of the respective person. The quality, however, is sufficient to walk on the virtual catwalk and get a realistic impression of how the garment would actually look like on one's body.

The mesh of such an avatar consists of about 3.800 nodes. This figure can be considered a compromise between the desired accuracy and the minimal amount of data. The procedure is optimized for real-time web animation.

### 3.4 The Virtual Catwalk

The virtual catwalk itself is a software that determines the motions of the virtual skeleton. The software animates the avatar according to defined, sex-specific motion sequences, i.e. it can be used with any avatar. The motion sequences contain detailed, time-dependent descriptions of motions for every joint.

To generate these motions, two possibilities are used: Either they are generated artificially by means of a 3D editor, or they are digitized by motion capturing of real motions. Motion capturing (e.g., the technology of Vicon [9]) records and digitizes the motions of a human model with all their irregularities. These irregularities provide the realistic impression of the model. By doing so, complex motions can be transformed and edited easily.

### 3.5 User Interface

The user interface design is of crucial importance to the acceptance on the part of the user. The design of the following websites was made in an iterative process under consideration of the results of usability tests according to DIN ISO 9241-10.

The interface is divided into a two-dimensional part (Figure 6) and a three-dimensional environment (Figure 7). For representation of the products, samples from the Avatar Booth are used.

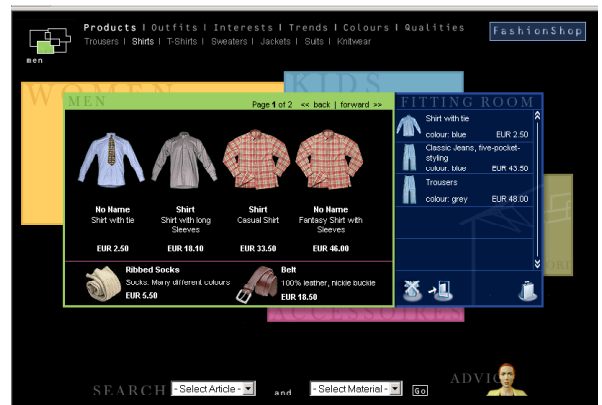


Figure 6: Screenshot of the FashionMe 2D Shop Pilot

The desired garments can be put in a shopping cart by drag and drop. With these products selected, the virtual catwalk can be entered.



Figure 7: Screenshot of the 3D catwalk

### 3.6 Client/Server Architecture

The integration of the various technological components described above requires networking various heterogeneous data sources. The IT architecture used in the system for setting up an online shop is visualized in Figure 8.

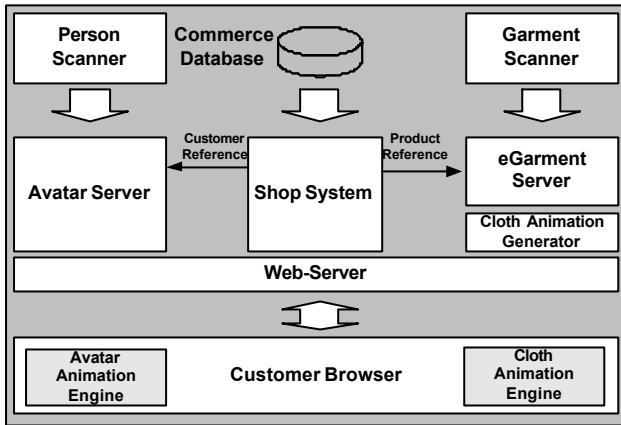


Figure 8: Client/Server Architecture

On the client side, for the 2D section of the shop a standard Web browser is used. In the 3D section comprising the virtual catwalk, a plug-in (Avatar Animation Engine) is used for visualization which is automatically installed when the user enters the shop for the first time. The avatar is loaded by the Avatar Server, and the files for the selected pieces of clothing are loaded by the eGarment Server. If pieces of garment are selected where the representation is based on a CAD construction, in addition the Cloth Animation Engine must be installed. In this connection, the shop system serves for the representation of conventional product information.

#### 4 CUSTOMER CONSULTING

In order to sell information-intensive products on the Internet, automated online consulting features are necessary. Existing natural-language text-based virtual sales systems lack intelligent customer consulting and adequate product presentation. The R&D tasks conducted within the ADVICE project aim on improving existing approaches concerning these two aspects.

##### 4.1 Virtual Sales-Assistant Systems

Virtual sales-assistant systems can be classified roughly into three groups (Figure 9). Catalog guides act as a guide through the online offer, reacting on input patterns with a comment and the presentation of a suitable web page or catalog content.

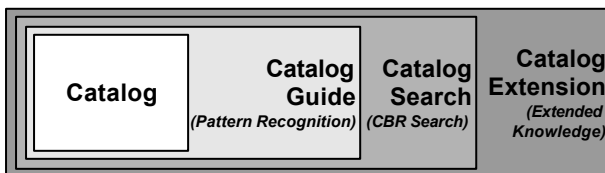


Figure 9: A classification for virtual sales assistant systems

Catalog-search systems help the customer to retrieve appropriate products – depending on the customer's input – by a case-based reasoning supported (CBR) search in a catalog. The CBR approach allows to identify patterns and to offer similar or related products. Catalog-extension systems provide additional information on the products and decision support for the buying process. Most systems offer an animated character as user interface for the customer.

#### 4.2 The ADVICE Approach

ADVICE acts as a catalog-extension system and is able to provide customer-decision support. This feature allows the use of ADVICE in the fashion sector. The ADVICE approach separates the product knowledge from the presentation knowledge, thereby achieving enhanced suitability of the presentation. A special feature of ADVICE is the operation of the system by speech acts [10]. Incoming natural-language customer utterances are analyzed and translated to speech acts, representing the semantics of the utterance, and then transferred to the Dialog Processing Component [11] which is generating the answer. This answer is also represented semantically with XML-based speech acts. The natural-language text-answer synthesis of the system is based on these speech acts. Natural-language analysis and generation is described in [12]. The generated speech acts are also used for gesture generation of the virtual assistant in the user interface of ADVICE and for the product presentation in the Presentation Manager of the system [13]. The Presentation Manager is located in the Interface Agent (Figure 10), which represents a user session. The Presentation Manager is client-specific. It is available for a broad variety of client devices such as personal computers running the native ADVICE virtual assistant and mobile phones using the Wireless Application Protocol (WAP). Since speech acts include the semantics of the answer, the gestures are generated very accurately according to the natural-language text answer. The core ADVICE system is a multi-agent system. This agent architecture has been adapted to a four tier business system architecture, which fulfils the requirements of business users.

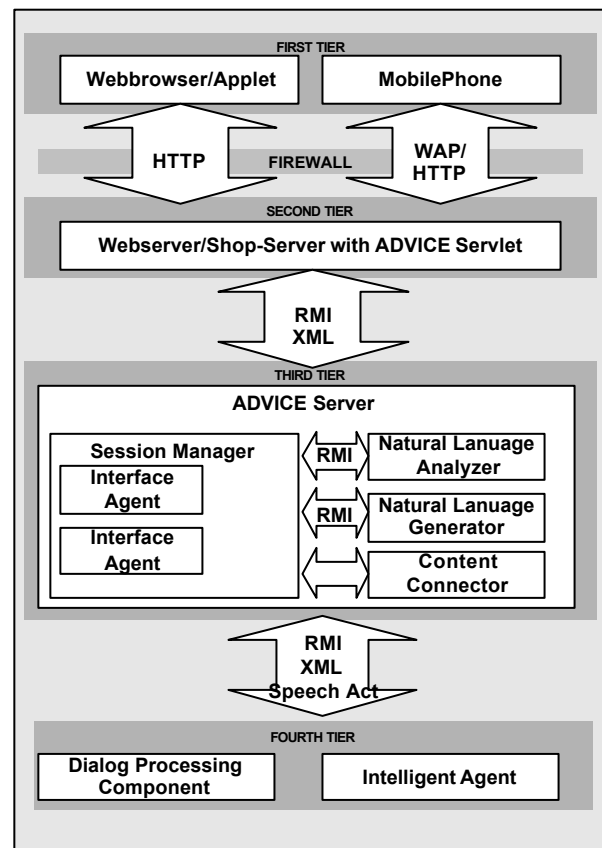


Figure 10 : ADVICE System architecture

### 4.3 Virtual Character

Two primary goals are achieved in the project's client development: First, the client is plug-in free to allow any user to use the assistant without having to download client software. And second, the client is able to make advanced human-like visual expressions. These goals have been achieved by creating a JAVA applet viewing a 3D VRML-based model of the assistant character (Figure 11). For the animation, two techniques are used: The motions of the head with its fine facial musculature are modelled directly, whereas the motions of the body are generated with the H-Anim standard. By this, the mimic can be adapted very specifically to any virtual character, that might be cartoon or animal characters as well. The H-Anim standard, too, allows to adapt the body motions (arms, legs) to a multitude of characters. When required, the body motions are loaded dynamically, therefore allowing a high number of possible motions. The character for an application needs to be carefully designed with respect to the specific requirements (e.g. credibility of the character) of the application and the use in the targeted customer group (refer to [14], [15]). The client is capable of loading websites for which it gets the URLs from the ADVICE Server. By this, the server can present content from external data sources (shop system, Web content management system) in the browser of the user. For the client, predefined questions can be generated in the server application, which are presented to the customer as a sample of possible questions directed to the assistant. By this, also unpracticed users can operate with the system since special data input over the keyboard is reduced.



Figure 11: ADVICE client software

## 5 INTEGRATION OF FASHION VISUALIZATION AND CONSULTING

The results of the projects FashionMe and ADVICE can be combined to an innovative fashion shopping platform. The platform is extended in such a way that shopping processes both on the supplier side and the customer side are supported.

### 5.1 Customer Side

There are two interfaces between the customer and the supplier. First the customer must draw up a personalized avatar using an avatar scanner, then he must enter the shop, where he can go shopping with his avatar. The scanning process can be done in a shopping mall or, in the future, in avatar booths in place of today's photo booths. Alternatively, a personal avatar can be created online without scanning by means of a conventional photo, a selection of standard avatars and manual entry of the person's measures. Since the creation of an avatar is already a personal act of the customer, it is possible to inquire preferences of the customer which later can be used for the online shopping process. In this connection, data protection must be guaranteed, which might require considerable efforts due to the high degree of variation of international data protection regulations. The representation of the avatar is done (as described in Section 3.6) by means of a plug-in.

The JAVA client developed within the ADVICE project is employed for the consulting services. The functionality of the client will be enhanced, so that the client is not only capable of presenting shop-system pages to the customer but also of dressing the avatar according to the natural-language utterances of the customer. A further enhancement of the concept will be done for non-broadband connections (e.g., for modems or mobile devices) for which the presentation of the personal, dressed avatar must be realized as a plug-in free picture or sequence of pictures. In such cases, the consulting dialog will be conducted by means of text input and output.

### 5.2 Enterprise Side

The connection of avatar technology and eGarment technology with shop systems developed in the FashionMe project constitute the core of an integrated fashion platform (Figure 12) that consists of the following components: Avatar Server, which provides the customer avatars, eGarment Server, which administers the eGarments, Shop System, which is responsible for product description and order processes, and Consulting System, which supports the customer in the process of product selection by means of recommendations. A crucial aspect is the data administration in the back-end systems, so that the E-Commerce components of the platform and other enterprise systems operate on the same up-to-date data inventories. Important interfaces are between the ERP system, CRM system, and Shop System, Avatar Database and Avatar Server, in the eGarment section, and between Fashion Knowledge and Consulting System.

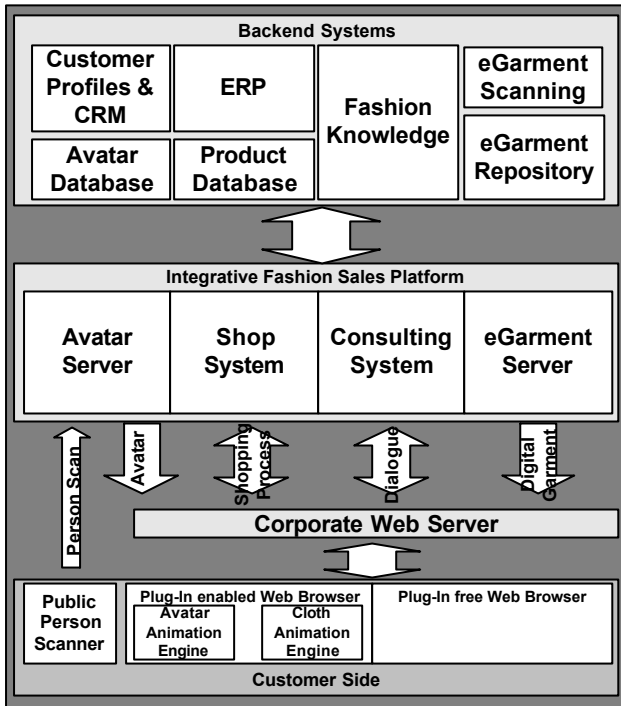


Figure 12 : Integrated platform for personalized fashion shopping

The Shop System accesses customer data in the CRM System and checks the availability of products in the ERP System. Orders are reported directly from the Shop System to the ERP System. Manual editing of an order is not necessary any more. The consulting component taken from the ADVICE project can be easily integrated into the fashion retailing platform. If a customer addresses the assistant as to, for example, suitable beachwear, the system generates an output from the knowledge base of the fashion knowledge component comprising data about beachwear and the personal profile of the customer (size, skin type etc.), presenting the customer one or several products. System-internal communication is conducted (as described before) on XML-based speech acts. Besides generating the natural-language answers, the Presentation Manager (Figure 13) analyzes the speech acts and determines which products are to be presented.

Over the Content Connector, the system accesses the Avatar Server, the eGarment Server and the Shop System, and gets an URL with a reference to a personal avatar dressed with the desired article and a reference to the respective shop page. The Content Connector serves to abstract the details of the underlying content systems, such as the Avatar Server or the Shop System, in order to be able to use the software for a multitude of purposes together with various other systems. The references are embedded into an XML document that is stored in the Virtual Sales Assistant Client. The client transforms the references into a link and makes the browser load the customer's avatar dressed with the respective garment. The Avatar Database is placed in the back-end section in order to enable an enterprise to offer different shops under different brands, if need be, that all operate on a single data inventory.

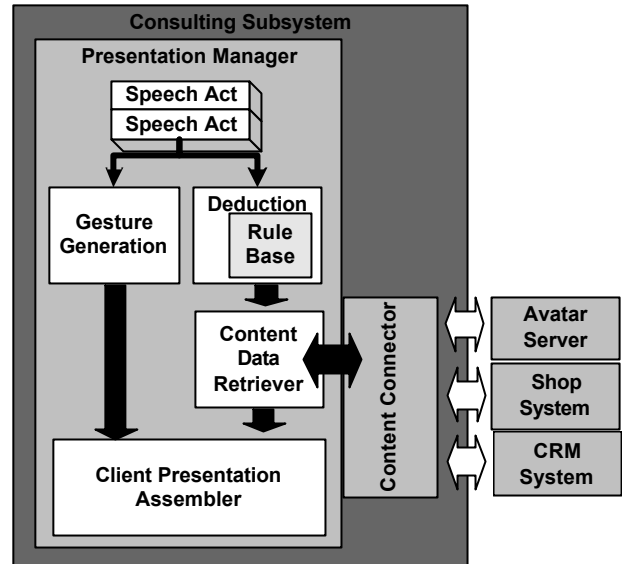


Figure 13: Presentation Manager and interface to the Avatar Server and Shop System

The customer must put their avatar into the system only once since then they can use one avatar in each of the shops. This possibility also enables the use of the personal avatar in enterprise networks, where enterprises mutually permit the use of external avatars on their websites.

## 6 BUSINESS USE

The research aspects and software architecture described in this paper are being implemented within the project context at various demo business sites. These use cases are also subject of user tests to show proof of usability and customer acceptance. The platforms created are supposed to enrich the existing online presentations in order to improve customer relationship, customer care and service.

The provision of interfaces for the integration of the discussed architectures into various systems used on-site, e.g. ERP, CBR, assure operability and success of the platform. The FashionMe tool set will be installed in the Macmoda Online Shops. Macmoda is the Portuguese and Spanish retail chain of Maconde, one of the five leading European garment producers. The FashionMe architecture can be extended to the presented integrative platform at a later stage of the development.

The system also offers the possibility to use single components in other business cases. At the moment Fraunhofer IAO is working in two initiatives of other business sectors that will take advantage of the modular architecture. A personalizable, multimedia enhanced Bto-C portal for a global manufacturer of cellular phone technologies and a tool portal for craftsmen are to be realized. These projects themselves are part of the eBusiness strategy of the companies involved. Therefore, compatibility and cooperation with various heterogeneous software architectures are crucial aspects of the success and acceptance of the projects. The emphasis lies on personalization and individualized customer support in the respective businesses.

## 7 CONCLUSIONS

Potentials for further development currently are located in the improvement of the realistic representation of the eGarments, such as truthful representation of the colors, the `behavior` of the cloth, and the fitting of the garment on the avatars. The techniques for creating avatars must be further refined in order to accomplish an even more detailed graphical representation while at the same time operating with smaller file size of the avatar.

The combination of fashion visualization and automated natural-language consulting with text dialogs aims on solving two main problems of online fashion shopping: the missing visualization of the products and the customers and the missing consulting services. The architecture presented in this paper is based on the projects FashionMe and ADVICE, which both involve enterprises into R&D activities. This close cooperation guarantees that the individual systems and the entire integrated architecture will meet business requirements.

At the moment, the overall system is being developed. A special focus is to increasingly support sales processes and data administration / content management processes on the side of the suppliers. The platform already enables easy-to-perform online fashion shopping.

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