

SERVICE ORIENTED PRODUCT DATA CUSTOMIZATION THROUGH VISUAL MARKERS ON MOBILE DEVICES

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Abstract: *The main goal of this work is to show author's ideas and experience in providing direct customers' participation within the product design and development process in form of "a pre-sale service" using visual markers on mobile devices. Possibilities for product individualization through Augmented Reality technology are discussed. Further an experimental prototype of a visual product configurator working on Android based mobile devices is presented*

Key words: *product customization and individualization, augmented reality, service oriented architecture, mobile devices*

1. INTRODUCTION

The approach for the direct customers' participation in the product design and development process by expressing their preferences allows customers to be actively involved already in the early stages of the product development, e.g. product definition, rather than passively receive the end product designed by the producer. Product customization by the customer or so called Customer Co-Design describes a process that allows individual customers to express their specific requirements during configuration of a product by mapping the requirements into the physical domain of the product (Franke & Piller, 2003). As a result the customer can choose an individualized combination of product properties and features (functional, structural, aesthetic etc.) from a very large set of options. The customers' knowledge and direct participation in the design process leverages product and product related information, facilitates marketing research and brings different customers' attitudes towards buying decision making. If implemented as a pre-sales service, such an approach for development of individualized products bring a lot of benefits for both the customer (potential user of the product) and designer (producer) summarized in (Piller et al., 2005) as follows: (i) providing a better starting configuration through direct use of customer needs; (ii) supporting the product design through fostering joint creativity problem solving capability of the stakeholders; (iii) reduction of costs, efforts and time; (iv) changing the customer attitude toward new developed product through building trust relation and reducing the perception risk.

2. VR PRODUCT CUSTOMIZATION

In recent years, developments in the field of IT have made it possible to build interactive 3D models of objects and complex 3D Virtual Environments (VE) that can be experienced through the Web, using common, low-cost personal computer work stations or through specialized Virtual Reality projection facilities, enabling high level of immersion. VR has proven to be an effective tool for helping engineers to evaluate product designs (Seth & Smith, 2004). The stereo image facilitates perception of the spatial relationships position in 3D product models, which enhances users' understanding of a design. 1:1 representation of the complex 3D structures ensures

that viewers can perceive distance and spatial relationships between the different components more realistically and accurately than with conventional visualization tools.

In a previous work (Bachvarov et al., 2009) we have adopted a structured work flow based on systematic decomposition and generation of the product structure with direct involvement of the customer additionally enhanced through integration of Virtual Reality technologies (Figure 1).

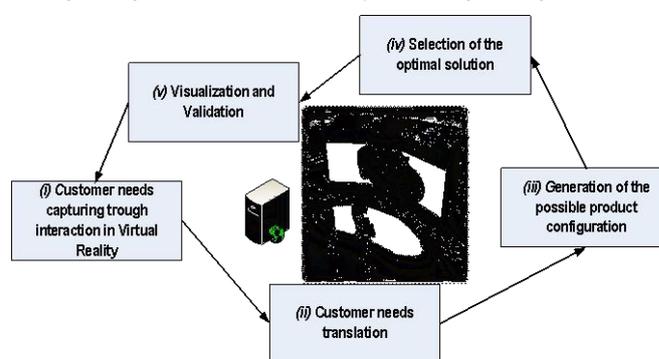


Fig 1. Structured work flow for product development by customer involvement through Virtual Reality

The core component for realization of this work flow is the VR configuration module which has to cover all the above mentioned stages. It is responsible for the real-time realistic 3D graphical representation of the designed product and its native working environment within the configuration and development process. Customers are presented a wizard or working environment, in which a set of predefined product attributes (which could be freely set up) and their possible values are presented for selection and modification. In this manner the customer is directly involved within configuration process not only through the common operations, but is provided with additional extended functionality typical for Virtual Reality applications (e.g. functional interaction, manipulating and exploration of the virtual product model using turning, aligning, flying, driving, scaling, zooming, cutting, altering transparency, etc.) and additional augmented information.

Nowadays, the research interest of the scientists is mainly focused on the deployment of certain technologies used in video games and mobile devices to bring VR on mainstream scale. The video game industry and mobile devices bring the spatial 3D interaction into people's living rooms through rather simple, yet effective technologies such as computer vision and motion sensing (e.g. Nintendo Wii Remote Control, Microsoft Kinect Sensor, Android software stack).

3. IMPLEMENTATION AND RESULTS

We have extended the proposed approach for direct involvement of the customer at product design process by adding at the top an application enabling the use of mobile devices for configuration of structural properties and space

arrangement of the newly developed product model in a virtual or augmented reality environment.

This service oriented architecture (SOA) has been applied which represents a structure for design and implementation of business processes by using a set of loosely coupled black-box components arranged to communicate together in order to deliver a well-defined business service. The SOA principle to use and reuse tested components makes it easier to create new applications as well as change existing applications. This method already widely-used in the general software development process is adopted with some limitations for development of mobile applications also (Natchetoi, 2008). Such architecture has proven its potentials and benefits by orchestrating user and third-party components to deliver specific services for mobile devices (Paganelli, 2009). Following SOA components have been used: (i) PHP server for storing object meta data as XML files; (ii) Package explorer which communicates with the server via HTTP, downloads and shows the object files and their meta data to the mobile device. Package Explorer consists of two parts: The server side is written in PHP – server.php. This file reads the configuration file packages.xml and pushes to the client information about the available 3D Objects in the server. The configuration is done in packages.xml. It is XML based and contains information about the 3D Objects like filenames, description and etc. The client side is written in Java for Android. The application connects to the server and shows the user all available 3D Objects. The user can see additional information about an object or can download all the files associated with this 3D Object. (iii) AndAr Library and Viewer loads object files and visualizes them on the screen. AndAR Model Viewer uses a modified version of ARToolKit Library for mobile devices running Android. ARToolKit is a computer vision tracking library that allows for the creation of augmented reality applications that overlay virtual imagery on the real world. To do this, it uses video tracking capabilities in order to calculate the real camera position and orientation relative to square visual markers in real time. Once the real camera position is known a virtual camera can be placed at the same point in the scene and the 3D computer graphics models are drawn tooverly exactly the visual marker. So ARToolKit solves two of the key problems in Augmented Reality: viewpoint tracking and virtual object interaction. (iv) IO File Manager which provides basic explorer functionality.

The work-flow of the application is shown on Figure 2 and can be briefly explained as follows: **1.** User starts Package Explorer; **2.** Package Explorer communicates with the server to show the available object files to the user; **3.** The user selects an object file. The file is downloaded and stored to the SD Card on the device; **4.** User starts AndAr Library and Viewer to view the object in augmented reality; **5.** AndAr Library and Viewer start IO File Manager; **6.** IO File Manager loads parts of the object from the SD Card; **7.** IO File Manager returns the loaded data to AndAr Library and Viewer; **8.** AndAr Library and Viewer loads the whole object in the memory and shows the object on the device's screen.

Two experiments were carried out for testing and verification the functionality of the developed implementation. As test object a model of display rack has been used. In this test case the mobile device has been applied as interface tool for spatial arrangement of racks of different functional properties and sizes within their real operating environment registered by the camera of the mobile device. The position of the overlaid rack is given by corresponding visual marker which is recognized by the application and so the associated 3D file and meta data are loaded and visualized on the screen to build a hybrid image. Two mobile devices have been applied in this test case: Android Dev Phone (G1) and HTC Desire HD (see Fig.3).

4. CONCLUSIONS AND FUTURE WORK

Our study has shown that user customization can be successfully applied on mobile devices using SOA. This solution empowers the customer to participate in the product specification phase via VR product configurator. The proposed approach can be extended to a broader class of related tasks and will facilitate the access to individualized mobile services.

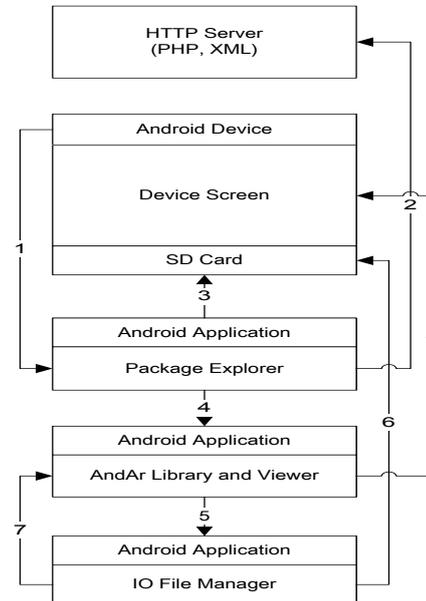


Fig 2. Work flow of the application for AR-visualization

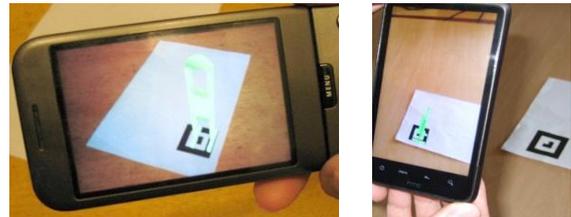


Fig 3. Experimental spatial rack arrangement in AR-environment through visual markers

5. ACKNOWLEDGEMENT

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