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VICON

Virtual User Concept for Inclusive Design of Consumer Products and User Interfaces

Deliverable Report

D5.1: Survey regarding limitation of virtual user approach

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Deliverable abstract	This document contains a report with the results of the investigation of the limits of the concept of the virtual user model. To achieve optimized designs for the selected user group, this deliverable will depict issues and limitations of the virtual user model approach according to our experience in VICON. Which properties of users are relevant at which design? And which limitations exist at that stage? This deliverable contains the results of a further elaboration on the relation between the design requirements, the available technologies and the specific user needs and the standardization aspects discussed in the VUMS cluster.

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Table of content

1 Introduction

One of the continuous tasks in the VICON project was the elaboration and the documentation of issues and limitations of the Virtual user approach at the various phases identified in the project, which are the Sketch phase, the Design phase and the Evaluation phase (see VICON deliverable D03.1 [9.]). The VICON developers and designers were interviewed frequently to provide their opinions and experience about the virtual user model approach to identify issues and limitations. Furthermore the results were influenced by the discussions and the output of the VUMS cluster as described in the White Paper on Virtual user models. These investigations are necessary, because of the novelty of the virtual user concept in the design for all area especially with impaired users as the beneficiary user group. The focus on the determination of rules on to what extent and detail level the virtual user should emulate real world users in order to achieve optimized designs for the selected user group. Further aspects like the relation between the design requirements, the available technologies and the specific user needs were investigated. The results of this elaboration will lead to a refinement of the set of rules identified in the previous tasks of the projects and reported in deliverable D1.2 [2.], deliverable D2.1 . Correspondingly these results were influenced by tasks in WP3 and WP4 to select the appropriate virtual user properties and device characteristics, and to improve the quality of the implemented virtual user model in the mentioned work packages. As stated above the internal VICON results were fed into the VUMS cluster, VUMS stands for "Virtual User Modelling and Simulation Standardisation".

The cluster member projects are:

- GUIDE (Gentle User Interfaces for Disabled and Elderly Citizens, http://www.guide-project.eu/),
- MyUI (Mainstreaming Accessibility through Synergistic User Modelling and Adaptability, http://www.myui.eu/),
- VICON (Virtual User Concept for Inclusive Design of Consumer Products and User Interfaces, http://www.vicon-project.eu/) and
- VERITAS (Virtual and Augmented Environments and Realistic User Interactions To Achieve Embedded Accessibility Designs, http://veritas-project.eu/).

The cluster aims to lay the foundation for an improved interoperability of the projects' solutions and software as all four projects use user profiles and user models. In order to exchange these user profiles and user models among the projects the VUMS cluster is working on a unified way to describe and communicate such models and profiles, VICON tries beyond that to identify the limitations of this approach. Future research projects and industrial implementations of the research result would benefit from these results. The purpose of this white paper is to present results and positions of the VUMS cluster in order to facilitate a wider discussion and in particular to get in

contact with working groups related to relevant standardization activities. The resulting output are being disseminated in WP6 and are being fed into existing Inclusive Design Communities and standardization bodies, this is being organized through the VUMS cluster group.

2 Methodology

It was always essential for a usable and accessible design of consumer products to consider a user model during the design process. Some of these user models can be very simple ones others more complex with human body models with dimensions and human motion e.g. JACK, RAMSIS, Delmia Virtual Human 5 and SANTOS [3.]. The background of JACK is primarily computer graphics and animation and this model is frequently used within computer-based training in Virtual Environment. Delmia Virtual Human 5 has a background in industrial sciences and workplace design. The main application area for RAMSIS is the automotive industry. SANTOS, finally, has been developed for special military applications and sponsored by the US-Army.

Because most of these models come from vehicle or workplace design, it is important to investigate applicability and validity of the results before they are used for the design of consumer products.

The implementation of this task was supported by a threefold methodology involving a continuous documentation of issues, interviews with developers and designers and round table discussions of the consortium

2.1 Continuous documentation of issues

- Availability of appropriate tools and platforms
- Extensibility of existing platforms
- Efforts and obstacles on the way to implement the VICON scenarios
- Technical limitations
- Workarounds

2.2 Interviews of developers and designers

We are in the process of interviewing developers and designers in a wide range of companies including those surveyed previously for Task 1.2 and reported in D1.2 [2.]. In addition we are incorporating the developers and designers of the VICON consortium. The aim of these interviews is to gather information that will enable us to say whether developers and designers in general would use virtual user models and how they might influence the design process. This will allow us to extrapolate our data to that general audience from a large enough sample.

These interviews will be coordinated with the work of Task 5.3 which will also carry out interviews and/or questionnaires with a similar range of developers, to collect different types of information.

We will consider as well the opinions of the VICON associated partners in coordination with the work of Task 5.3 which will gather information from some of the associated partners. The data will be gathered using interviews carried out at the upcoming London Workshop.

The questions will focus on:

- How the design lifecycle getting influenced by adding the virtual user model approach to it?
- Which components are perceived as must have and other as nice to have components?

2.3 Roundtable discussions of the consortium

- Overall experience of the partners with the developed tools
- Involvement of associated partners and polling their opinion

3 Issues and limitations at the VICON Life Cycle

The design lifecycle of a product as described in deliverable D3.1 [9.] can be segregated in a sketch phase and a design phase. The VICON framework intends to support the designer in all phases of the design lifecycle (See Figure 1).

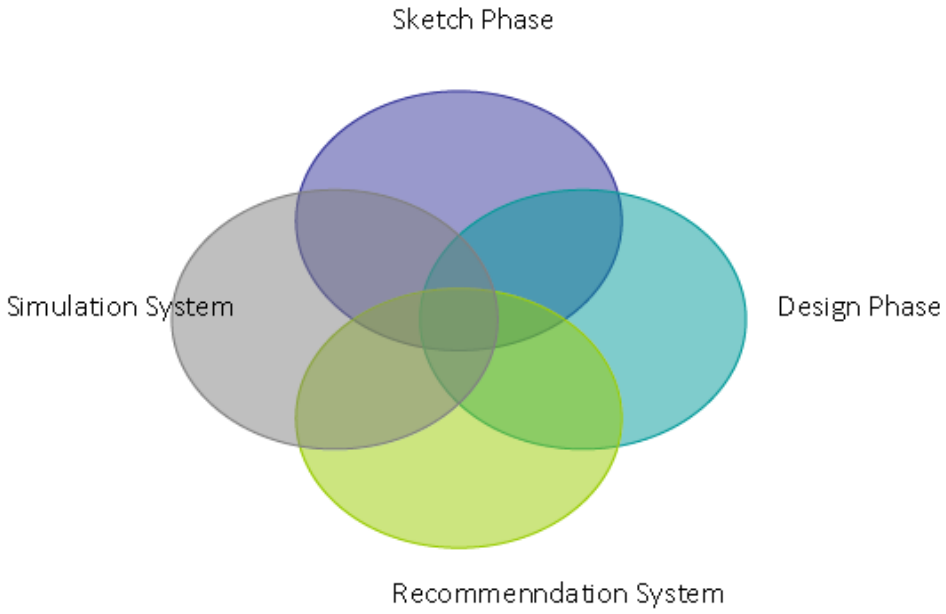

Figure 1: VICON Life Cycle

VICON will provide in the sketch phase a recommendation system as a web application to support the designer to design a product for a selected virtual user. VICON will provide in the design phase a

simulation system to support the design for a selected virtual user. During the development and tests the developers and testers have faced various issues, which were documented and discussed within the consortium.

3.1 Issues and limitations at sketch phase

- Additional burden for the designer
- Integration of the tools in the life cycle of the sketch phase
- Coverage of a wide variety of design aspects
- Lack of of valid recommendations for design for all
- Learning curve
- Which user properties to consider

3.2 Issues and limitations at design phase

- Different CAD systems
- Relation to other models like the device model, environment model are challenging
- Visualization of recommendations
- Eliciting of meta information about the design at hand
- Who enriches the design with metadata
- Exchange format among different tools

3.3 Issues and limitations at Simulation phase

- Accuracy of the digital human models is moderate
- Movement simulation and power simulation is at its beginning
- Visualization of results is sufficient
- Substantial change of the design process
- Learning curve for designers is high
- Variety of propriety platforms

- Lack of standards

3.4 Issue and limitations by reporting of results

- Textual reports are difficult to understand
- Visual reports require additional tool support
- Different purposes
- Customization of the reports to different target user groups

4 Standardization aspects

There is lack of agreed definition and terminology in the area of virtual user models, which makes the interoperability of user models difficult. On the other hand, there was a plethora of standards about human factors, user interface design, interface description language, workplace ergonomics and so on that can be used to develop user models. In this context the VUMS cluster has started the development of:

- A standard user model considering people with different range of abilities
- Common data storage format for user profiles
- Common calibration / validation technique
- Collaboration on ethical issues
- Ensuring sustainability by making them available within a standard

The cluster initiates its work by defining a common glossary of terms which enable user model developers to exchange concepts (See Appendix I: Glossary of Terms). Later it proceeds to define a set of variables to describe a user and a common format to store this detail. Finally it prepares a few use cases to demonstrate the utility of a common user model and profile across different projects and applications. A white paper about virtual user models has been published on the VUMS cluster website and the individual project websites and distributed to standardization bodies. We have identified at least two usage scenarios for virtual user models, which have enormous influence on the required content. The two usage scenarios are the adaptation scenario, where interfaces are being adapted to the virtual user profile at run time and the simulation phase, where the interface is just being used for a simulation of an user interface. There might be other usage scenario which should be considered in this on-going task.

4.1 Use cases

The VUMS model aims to achieve two main purposes derived and motivated from two major application areas for user models:

- Simulating users to help designers in designing and evaluating their work
- Adapting interfaces to cater users with a wide range of abilities

The following use case describes the simulation usage scenario as it is the one relevant for VICON and which are the benefits of having a common standard and the requirements of the common user modelling standard for simulation case.

4.2 Simulation Use Case

Traditionally, the needs of people with physical impairments such as visual, hearing, and dexterity impairments are often just not sufficiently considered by industry when designing user interfaces for automotive, consumer products and so on. This is exacerbated by the fact that it is not unusual for an individual to have multiple impairments, for example when elderly people may experience hearing and sight loss as well as loss of dexterity. Now the terms 'inclusive design', and 'universal design' are becoming more common within the designers vernacular. There is a greater awareness of the value of inclusive design methodologies for both designer and end user, such as the user testing of product prototypes [11.].

In practical terms, Universal Design methodologies must ideally complement the existing product design workflows of designer. Or at the very least be as disruptive as possible. Ideally, they should enhance how designers currently do things, and put the least cognitive load as possible on the designer. So ideally tools that support the tenants of Universal Design, which are not difficult to use and that can plug into common existing tools are desirable. For that purpose simulation environments should be integrated within the design cycle.

The main aim of simulation environments incorporated within a design cycle is to support the designer to produce inclusive designs. The simulation environments simulate the interaction of pre-configured virtual user with the virtual environment. For example a disabled virtual user is the main "actor" of a simulation that aims to assess if the virtual user is able to accomplish all necessary actions described in the Simulation Model, taking into account the constraints posed by the disabilities (as defined in the Virtual User Model). Simulation planning is performed using inverse kinematics, while dynamic properties of the human limbs (e.g. torques and forces) related to the corresponding actions (e.g. grasping) are obtained using inverse dynamics.

Simulation environments vary in their targets, powerfulness and granularity, therefore their requirements on user models varies as well. The exchange of user profiles between models will be influenced in both ways by the parameters mentioned above. The main issues, which should be considered, are:

- Representation format of user profiles e.g. RDF, XML (UsiXML), etc., here some converters should be made available to convert the profiles from one format into another
- Granularity of the user profiles, so one model can be more or less detailed than the other. In this case filters and extenders should be developed to allow automatic or semi-automatic adoption of user profiles
- There will be some variables that are non-applicable for another simulation environment and vice versa. In this case filters should be made available to filter any not required variables out of the user profile
- Variables may exist but differ in crucial properties e.g. will not have the same range, measurement method etc.. Special interface plopped procedures should be developed to cope with this challenge

5 Conclusions

In this deliverable we are aiming at eliciting the limitations of the virtual user approach. We are using the boundaries of such a system lied in the VICON project and documenting the issues and problems faced in the development and integration of such an approach. We are involving different groups of stakeholders in order to get all opinions on the chances and limitations of it. The standardization efforts and their implications are explained.

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7 Appendix I: Glossary of Terms

As a first step towards standardisation of user models, the VUMS cluster has defined a Glossary of Terms for supporting a common language. Its scope and contexts of usage is the adaptation of human-machine interfaces to the needs of the real user or the simulation of the interaction between a human and a product in order to design the product.

The definitions given in the glossary are based on literature. Neither are their derivations explained nor are the references given in order not to impair readability.

7.1 User Model

An (abstract) user model is a set of user characteristics required to describe the user of a product. The characteristics are represented by variables. The user model is established by the declaration of these variables. It is formally described in a machine-readable and human-readable format. An instantiation of the user model is a user profile.

7.2 User Profile

A user profile is an instantiation of a user model representing either a specific real user or a representative of a group of real users. It is an instantiation of an (abstract) user model it is formally described in a machine-readable and human-readable format, compatible with.

7.3 Virtual user

A virtual user is a representation of a user based on a User Profile. The virtual user exists in a computer memory during the run time of an application. It includes components, which are able to interact with other virtual entities e.g. virtual products or software applications.

VU's intended for simulation purposes represent the human body as e.g. a kinematic system, a series of links connected by rotational degrees of freedom (DOF) that collectively represent musculoskeletal joints such as the wrist, elbow, vertebra, or shoulder. The basic skeleton of the model is described usually in terms of kinematics. In this sense, a human body is

essentially a series of links connected by kinematic revolute joints. Each DOF corresponds to one kinematic revolute joint, and these revolute joints can be combined to model various musculoskeletal joints.

7.4 Environmental Model

An environmental model is formal machine-readable set of characteristics used to describe the use environment. It includes all required contextual characteristics besides the user model, the interaction model, the device model, the product and related user tasks.

7.5 Device Model

It is a formal machine-readable representation of the features and capabilities of one or several physical components involved in user interaction. It is important to carefully discriminate between user and device model as they are two kinds of models. Too often they are conflated together, with device properties sprinkled into user profiles and vice versa. The device model expresses capabilities of the device. A given device can be used by many different users and a given user could use different devices. By carefully separating the different functionalities of device modelling and user modelling in design scenarios it will be easier to enumerate the attributes for each model and from them develop the matching function and attributes of the adaptation process.

7.6 User Agent

A User Agent is any end user software (like browser, or other user interface component) that can retrieve and render application content and invoke requests to the User Agent Capabilities Model to modify the application content

7.7 User Agent Capabilities Model

A User Agent Capabilities Model is a formal machine-readable representation of the capabilities of the user agent related to user interaction.

7.8 Application Model

An Application Model is a formal machine-readable representation of the states, transitions and functions of the application.

7.9 User Interaction Model

The interaction model is a machine readable representation of the interaction behaviour of an application. The interaction model is maintained UI-agnostic, which means it is independent of the concrete format of user interface output- and input data. Interaction model is often also referred to as abstract user interface model, like for example UIML, UI Socket, XForms, etc. It should be noted that the Interaction model can be used for adaptation of Human Machine Interfaces (HMI) and for simulating the use of an application /product with a virtual user.

7.10 Context Model

It is a machine-readable representation of information that can be used to characterize the situation of an entity. An entity is a person, a place, a device, or a product that is considered relevant to the interaction between a user and an application, including the user and applications themselves.

7.11 Simulation

Simulation is the process that enables the interaction of the virtual user with the application model within an artificial environment. The simulation can be real-time or off-line. Real-time simulation can be performed autonomously or manually, where the operator can interact with the environment from a 1st or 3rd person perspective. Accessibility assessment and evaluation can be performed automatically or subjectively by the operator.

7.12 User Model/Profile Validation

User Models are always simplified descriptions of the user. Validation is the process to determine whether the model is an appropriate representation of the user for a specific application. Mathematical then it needs a statistical validation process. If the model is non-

mathematical then it should be validated through qualitative processes. We can standardize the type, process and metrics of validation,

7.13 Adaptive User Interfaces

User interfaces that adapt their appearance and/or interaction behaviour to an individual user according to a user profile. In contrast to adaptable user interfaces, which are modified by a deliberate and conscious choice of a user, adaptive user interfaces automatically initiate and perform changes according to an updated user profile.

7.14 User Interface Design Pattern

This is an approved user interface solution to a recurring design problem. User Interface Design has a formalized description. For the use in adaptive user interfaces, design patterns have a representation in form of reusable software components which can be put together to complete user interfaces during run-time.