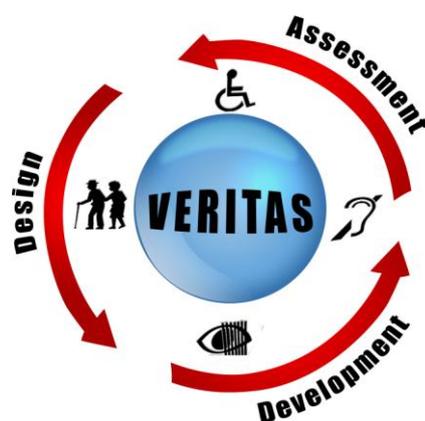


Accessible and Assistive ICT



VERITAS

Virtual and Augmented Environments and Realistic User Interactions To achieve Embedded Accessibility DesignS

247765

Implementation of VERITAS virtual user model platform

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Abbreviations list

Abbreviation	Explanation
A	Activity
API	Application Programming Interface
D	Deliverable
DOF	Degree of freedom
ID	Internal Deliverable
DoW	Description of Work
SP	Subproject
UCD	User Centred design
WP	Work package

Executive Summary

The main software output of SP1 (User Modelling), is a model platform for the generation of virtual user model files, ready to be used in the simulation platform implemented in SP2 (Innovative VR models, tools and simulation environments).

The model platform is implemented in activity A1.6.1 and provides several utilities to customize and parameterize virtual user models, including a 3D avatar model representation and a virtual user generator, which are provided by external software tools.

The present report describes the requirements and the corresponding model platform specifications. In addition to the report, a software prototype is being developed, which will include all features documented in the report. This software is currently being debugged and it will be fully operational in M14 (February 2011). This software will be constantly be updated during the project and it will be integrate to its final outcomes.

The functional requirements for the model platform are given from the user modelling (SP1) and the simulation (SP2) points of view. The corresponding specifications of the model platform are divided in general aspects as architecture and workflows, as well as, detailed aspects regarding the model and posture customization procedures and software tools. The necessary interfaces to the external software prototypes (3D avatar representation and virtual user generator) are specified according to the current development status.

1 Introduction

1.1 Objectives

One of the main VERITAS project objectives is the specification and generation of virtual user models in SP1 (User Modelling). In particular a model platform should be developed, which supports the generation of virtual user model files for the simulation platform in SP2 (Innovative VR models, tools and simulation environments). The virtual user models address physical, cognitive and behavioural impairment parameters and a physical avatar including physical dimensions and postural information.

The model platform is implemented in activity A1.6.1 and provides several utilities to customize and parameterize virtual user models. These utilities include a 3D avatar model representation and a virtual user generator to create specific user model instantiations according to physical, cognitive and behavioural impairment parameters. Both features are provided by external software prototypes interfacing with the model platform. Since the related developments (A1.6.3 & A1.6.5) are currently ongoing and will be completed by M24 (D1.6.3 “Intelligent Avatar and User model generator components”), the interface implementations are not finished yet. Hence this report gives the current status of the interface specification.

The present report describes the requirements and the corresponding model platform specification. The work is based on the internal deliverables “ID1.6.1: Specification of the model platform, the Intelligent Avatar and the User model generator” and “ID1.6.2: 3D Methodology”.

In addition to the report a software prototype will be delivered to the consortium by M14. This prototype will include all features, which are documented in this report.

1.2 Overview

This document is organised in two main sections.

The functional requirements for the model platform are given from different views in the project in Section 2. The first aspect addresses requirements from the user modelling procedure implemented in SP1. The second aspect includes requirements from the simulation procedure implemented in SP2.

Taking these requirements into account, the specifications of the model platform are documented in Section 3. First, the overall architecture and supported workflows are given. Secondly, the main procedures model and posture customization are documented in more detail, addressing the related workflows and the corresponding software modules. The necessary interfaces to the external software prototypes (3D avatar representation and virtual user generator) are specified according to the current development status.

2 Functional Requirements

In this section the functional requirements of the model platform are documented. They are separated into requirements from virtual user modelling in SP1 and from the simulation platform in SP2.

2.1 Virtual user modelling (SP1)

2.1.1 Overview

The model platform is the central software tool for designers and developers to define virtual user models according to their needs and applications. These models are the main input for the simulation platform of the second subproject (SP2) to simulate humans in virtual environments.

Hence the model platform has to support the following basic tasks:

- Customization and parameterization of virtual user models
- Generation of virtual user models ready for simulation in the open simulation platform (SP2)

These basic tasks can be divided into model and posture customization tasks. In addition some tasks are supported by different software tools. The task and interface requirements are given in the subsequent sections.

2.1.2 Model customization

The objective of this task is the parameterization of a virtual user model, based upon the following parameters:

- Sociodemographical information.
In this context the parameter *gender* and *age* should be available.
- Anthropometrics.
The physical *body dimensions* should be provided as conventional one-dimensional body measurements (e.g. stature, sitting height, waist circumference).
- Impairments caused by disabilities or aging.
 - Physical parameters defined in WP1.3.
 - Cognitive parameters defined in WP1.4.
 - Behavioural and psychological parameters defined in WP1.5.

In addition, the virtual user model should contain a physical 3D avatar linked to the anthropometrical parameters. The avatar is provided by an external software tool and the requirements on the interface to the model platform are given in Section 2.1.4.

The user definition of the impairment parameters should be supported by a specific user model generator. This is provided by an external software tool and the requirements on the interface to the model platform are given in Section 2.1.5.

2.1.3 Posture customization

The objective of this task is the definition of physical postures of a virtual user model based on the following parameters:

- **Subtask**
The sub task should be selected from the task model file and assigned to the customized posture. The task model file holds task information from the task analysis in WP1.7 in hierarchical order (sector, task, subtask and primitive task). Hence the selected subtask is related to a sector & task and to a set of specific primitive tasks.
- **Posture parameter**
The posture definition should be based on the following parameters
 - Body element orientations (e.g. vision, head, hands, feet, torso)
 - Distances of manikin body parts to referential planes (e.g. distance of hand to ground)

The posture information should be transferred from the model platform to the physical 3D avatar. The related requirements on the interface to the model platform are given in Section 2.1.4.

2.1.4 Interface avatar

Since the model platform is mainly based on authoring functionalities of the available human model system RAMSIS, all virtual user parameter like dimensions and postures are specified using the anthropometrical and kinematical RAMSIS human model definitions.

Nevertheless, the RAMSIS avatar will not be used in the VERITAS open simulation platform. For this purpose, a new VERITAS avatar model is developed in the project. In order to apply the model platform authoring functions to the VERITAS avatar, the following RAMSIS human model parameter have to be transferred on the VERITAS avatar:

1. Anthropometrics: A RAMSIS manikin is scaled by up to 22 specific body dimensions. The VERITAS avatar scaling model should take these body dimensions into account.
2. Kinematics: A RAMSIS manikin is based on a kinematical structure containing joints and limbs. In general limbs are connections between adjacent joints. The joints are spherical and represent anatomical joints. In order to model joint specific mobility the joints provide between one and three degree of freedoms (DOF). The VERITAS avatar kinematical model should take the RAMSIS kinematical model into account.
3. Postures: A RAMSIS manikin posture consists of the pelvis center position and a set of joint angle values according to the RAMSIS kinematical definitions. The VERITAS avatar kinematical model should be driven by RAMSIS postural information.

2.1.5 Interface user model generator

The specifications for the interface of the user model generator is currently in progress and will be completed in D1.6.3 “Intelligent Avatar and User model generator components” (M24).

2.2 Simulation platform (SP2)

The simulation platform in SP2 is divided into the *VERITAS open simulation platform*, which is developed during the project, and the already available *RAMSIS simulation platform*, which is adapted to the VERITAS needs especially for automotive applications.

The VERITAS open simulation platform should import and interpret VERITAS virtual user model files generated by the model platform. In particular the 3D avatar model and the user impairment parameters should be read by the core simulation engine to drive the simulations.

The RAMSIS program should also import and interpret VERITAS virtual user model files generated by the model platform. In particular the physical impairment parameters should be applied to the RAMSIS human model and related simulation methods and a RAMSIS avatar should be created from the VERITAS avatar instance taking into account the aspects anthropometrics, kinematics and postures in Section 2.1. In principle the conversion process in Section 2.1 should be performed in the opposite direction without losing human model information.

3 Specifications

The following subsections provide the model platform specifications according to the requirements in Section 2.

First, the main model platform workflows and the corresponding overall architecture are given in Section 3.1. The main elements of the workflows are the model customization procedure and the posture customization procedure. Both procedures, related software components and interfaces are documented in more detail in Section 3.2 and 3.3 respectively. Finally the main output of the model platform, the VERITAS virtual user model file, is described in Section 3.4.

3.1 Workflows and architecture

According to the functional requirements in Section 2, the main task of the model platform is the generation of virtual user models with respect to the designer's and developer's needs, which will be used in the simulation platform to simulate humans in virtual environments. The virtual user models should address sociodemographical and anthropometrical parameters as well as impairment parameters (physical, cognitive and behavioural & psychological). In addition the virtual user models should contain user defined physical postures for the subtasks identified in the task analysis of WP1.7.

This generation process is divided into different workflows supported by specific software components as displayed in Figure 1.

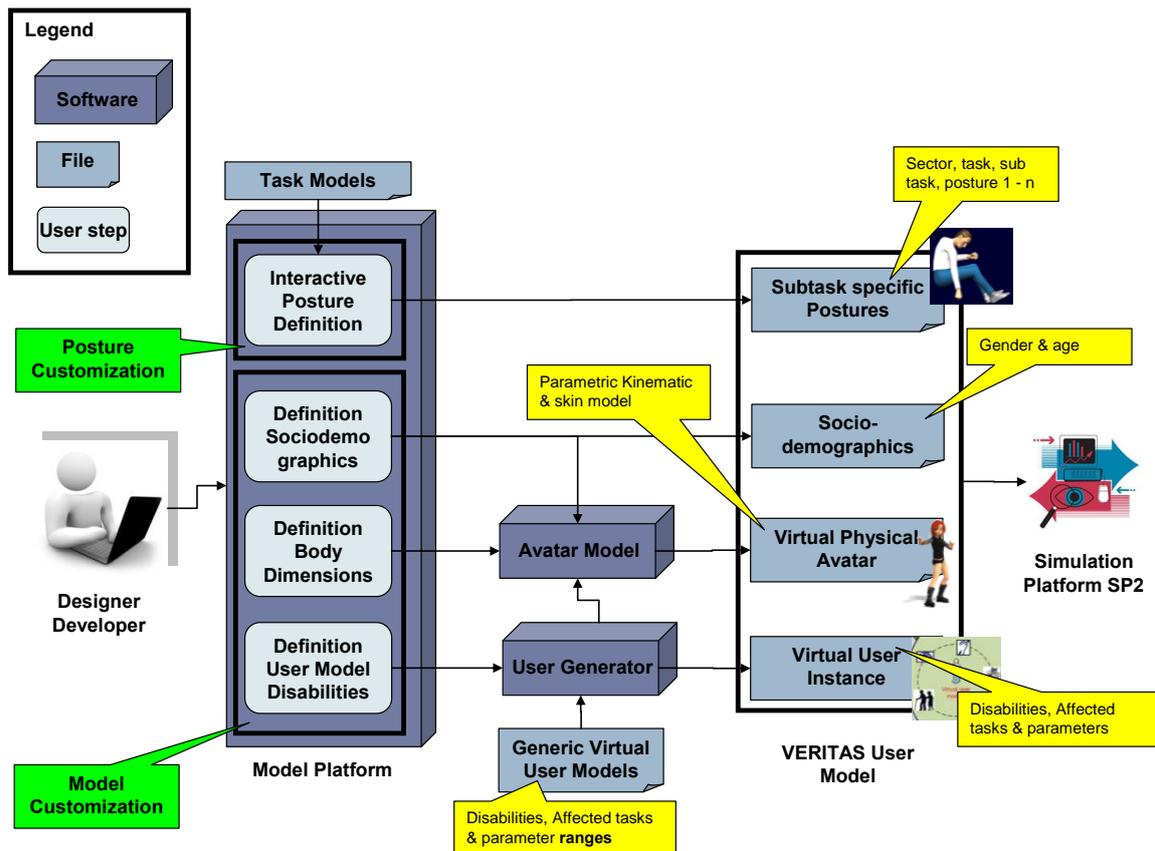


Figure 1 Workflow and software components of model platform.

In fact, there are the two separate workflows of model and posture customization. Both workflows are based on input from the designers and developers through the model platform GUI and generate data, which is collected in the virtual user model file. The workflow process steps are described in the following:

- **Model customization**

In the model platform GUI, the designer / developer defines the sociodemographical data (gender, age), the body dimensions and the disabilities of the virtual user model instantiation. The gender and body dimensions are transferred to the external avatar model software to create a physical avatar model file, which is included in the final VERITAS user model file. In addition, the selected disabilities are provided to the external user generator software to specify specific impairment parameters based on imported generic virtual user model. These parameters are also included in the final VERITAS user model file.
- **Posture customization**

In the model platform GUI, the designer / developer interactively defines a set of postures and assigns them to subtasks extracted from the task model file (results of task analysis in WP1.7). This postural information is also included in the final VERITAS user model file.

These workflows and the related software components are specified in more detail in the following sections. The final output VERITAS user model file is documented in the last section.

3.2 Model customization

3.2.1 Definition of virtual user parameter

The definition of the sociodemographical and anthropometrical parameters is supported through the GUI in the model platform.

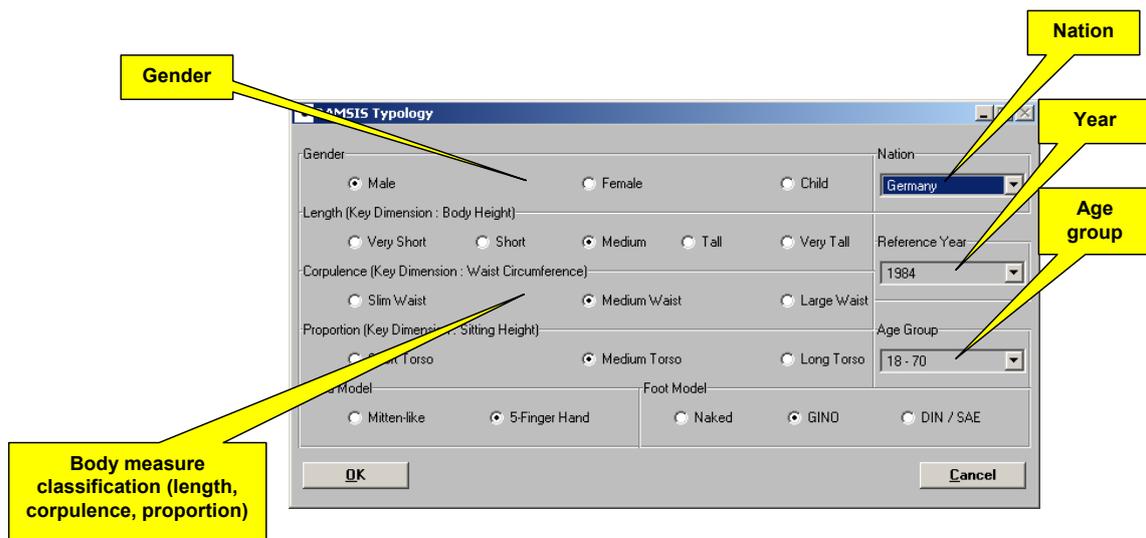


Figure 2 Definition of sociodemographical and anthropometrical parameters (GUI)

The corresponding control mask provides the following elements (Figure 2):

- Selection menu for gender (male, female)
- Selection menu for body dimension classifications with respect to:
 - Body height (very short, short, medium, tall, very tall)

The height classification is based on percentiles of the measurement distribution according to the selected data source (see nation selection below):

 - Very short = 5. percentile body height
 - Short = 15. percentile body height
 - Medium = 50. percentile body height
 - Tall = 85. percentile body height
 - Very tall = 95. percentile body height
 - Waist circumference (slim, medium, large)

The waist classification is based on percentiles of the measurement distribution according to the selected data source (see nation selection below):

 - Slim = 20. percentile waist circumference

- Medium = 50. percentile waist circumference
- Large = 80. percentile waist circumference
- Sitting height (short, medium, long)
The sitting height classification is based on percentiles of the measurement distribution according to the selected data source (see nation selection below):
 - Short = 20. percentile sitting height
 - Medium = 50. percentile sitting height
 - Long = 80. percentile sitting height
- Selection menu for age groups (18-29, 30-49, 50-70, 18-70)
- Selection menu for nations
The nation defines the data source for the body dimension classification above. Currently the German nation is provided for demonstration purposes.
- Selection menu for reference year
The reference year controls the prediction of body dimensions according to the secular growth. Body measurement surveys are conducted in a specific year in general. Hence all measurement information is only valid for that specific survey year. Additionally a secular growth model predicts body measurement values for (reference) years following the survey year.

As illustrated in Figure 1 the sociodemographical and anthropometrical parameters are transferred to the external 3D avatar model software. The interface specification is given in Section 3.2.2. The remaining impairment parameters are defined by the user through the external user model generator. The interface specification is given in Section 3.2.3.

3.2.2 Generation of physical avatar

The body dimension and gender parameter are transferred to an external avatar software tool. The following sections provide the interface specifications on an architectural and layout level. The final details will be completed in D1.6.3 “Intelligent Avatar and User model generator components” (M24).

The interface between the model platform and the 3D avatar model software is documented in Section 3.2.2.1. Since the model platform is based on the digital human model RAMSIS and the VERITAS simulation platform refers to the new developed VERITAS avatar model, the required human model converter interface is given in Section 3.2.2.2.

3.2.2.1 Model platform – VERITAS avatar

The model platform has to interface to the 3D avatar model software to provide a physical instantiation of user model. In particular the following interface features have to be implemented:

1. Generation (avatar definition)
This interface requires the following input data and provides the following output data:
 - a. Input

- i. Anthropometrics: Set of low level skin dimensions to scale the avatar. Bone influence over skin vertices is also necessary for the exact reproduction of the RAMSIS avatar by using the VERITAS avatar.
 - ii. Sociodemographics: Gender and age to control the appearance of the avatar.
 - iii. Kinematics: Skeleton dimensions and joint parameters to defined the avatar skeleton model.
 - b. Output
 - i. Avatar model file: Data file including all necessary information to use the avatar in the simulation platform.
2. Visualization (avatar animation, forward kinematics)

This interface requires the following input data and provides the following output data:

- a. Input
 - i. Avatar model file: Output of the avatar generation interface (see above) containing all model data for simulation.
 - ii. Posture data: Pelvis position and set of joint angles representing a certain posture.
- b. Output
 - i. Graphical avatar in posture: Set of graphical objects representing the appearance of the avatar in the given posture.

3.2.2.2 RAMSIS – VERITAS avatar

Since the model platform customization functions mainly work on the RAMSIS human model, a human model data converter from RAMSIS to the VERITAS avatar model is required (bi-directional transformation). This converter should provide equal physical human representations in both avatar models. The transformed parameters are the following:

- Anthropometrics (skeleton dimensions)
- Skin vertices for exact reproduction
- Bone influence over skin vertices
- Kinematical parameter (joint angles and joint range of motion limits)

3.2.3 Generation of virtual user instance

The generation of the virtual user instance from the specified impairment parameters is done by the external user model generator. As illustrated in Figure 1 the user generator reads generic virtual user model files, which include disabilities, affected tasks and parameter ranges (generated in A1.6.2). The user selects specific percentiles of disability parameters to generate virtual user models covering a specific population segment. Finally the disabilities, affected tasks and specific parameters are transferred to the VERITAS virtual user model file.

The user model generator and interface specification is currently in progress and will be completed in D1.6.3 “Intelligent Avatar and User model generator components” (month 24).

3.3 Posture customization

The posture customization process is described in Section 3.3.1. The main components posture library and posture adaptation are given in Section 3.3.2 and 3.3.3.

3.3.1 Process

The customization of subtask specific predefined postures is performed in the following interactive posture adaptation process:

1. Selection of primitive task
First the user selects a subtask for which the posture should be defined. The subtask is selected from the VERITAS task model matrix. In this matrix each subtask is assigned to a task, sector and related primitive tasks. In order to select the desired subtask, the related task and sector is additionally selected by the user. E.g. for the subtask “handbrake” the additional entries “automotive” (sector) and “operating a car” (task) are selected.
2. Selection of basic posture
The posture customization is performed through an adaptation of an initial posture. This initial posture is selected from a set of basic postures (e.g. driving a car, motor bike or standing).
3. Posture adaptation
The selected basic posture is adjusted by specifying body element orientations (e.g. vision, head, hands, feet and torso) and distances of manikin to referential planes (e.g. distance of hand to ground). The details are given in Section 3.3.3.
4. Storage of task specific posture data
Finally the posture data and selected task data are stored in the in intelligent avatar user model file.

The corresponding customization workflow and related software components are displayed in Figure 3.

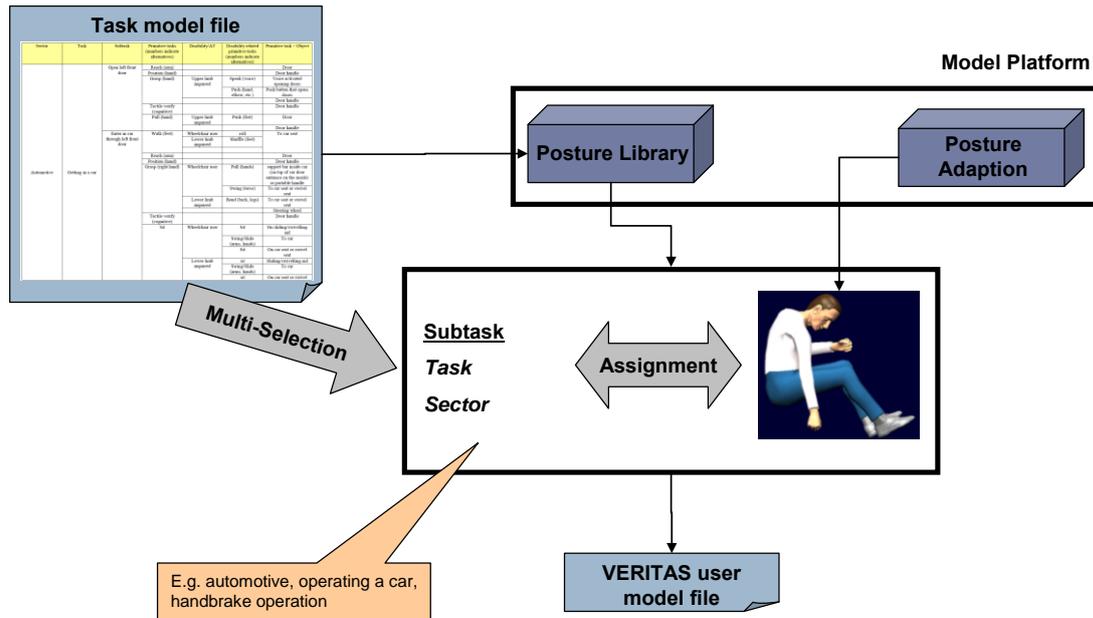


Figure 3 Posture customization workflow

The workflow is mainly supported by the posture library and adaption components in the model platform, which are specified in the following sections.

3.3.2 Posture library

The posture library manages a list of postures in combination with the corresponding task model information (sector, task and subtask).

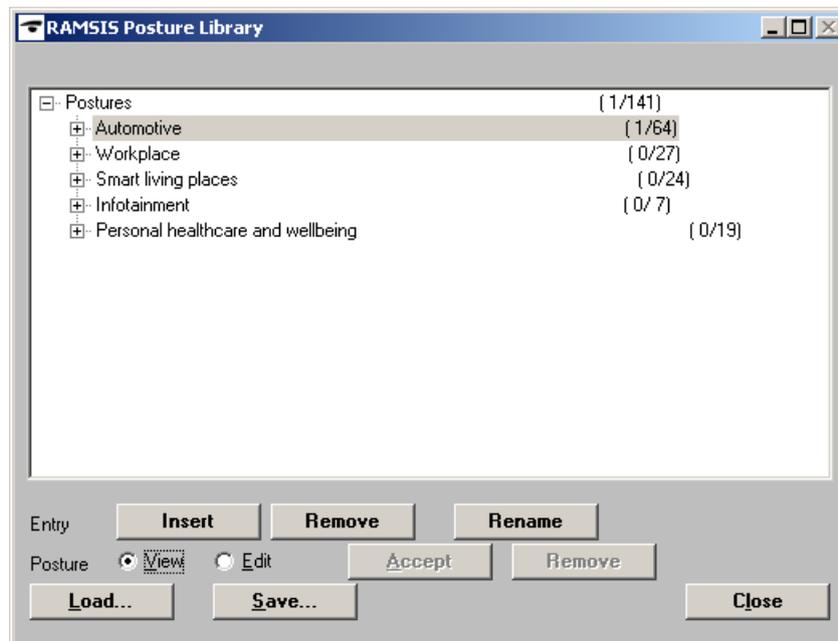


Figure 4 Control mask of posture library

In particular the GUI contains the following elements and functions (Figure 4):

- Tree view of task data (sector, task and subtask) and assigned postures in the upper block.

The upper block provides an interactive (Windows Explorer like) view on the hierarchical tree structure of the VERITAS task models. After the root (Postures) the next level holds the sector data, followed by the task and finally the subtask data. Each node contains the task element name and shows two numbers. The first number gives the number of defined postures in the sub nodes and the second number the number of all sub nodes.

- Import the VERITAS task model file.
The control mask is initialized with the VERITAS task model file including the sectors automotive, workplace, smart living places and personal healthcare and wellbeing based on the task analysis in WP1.7.

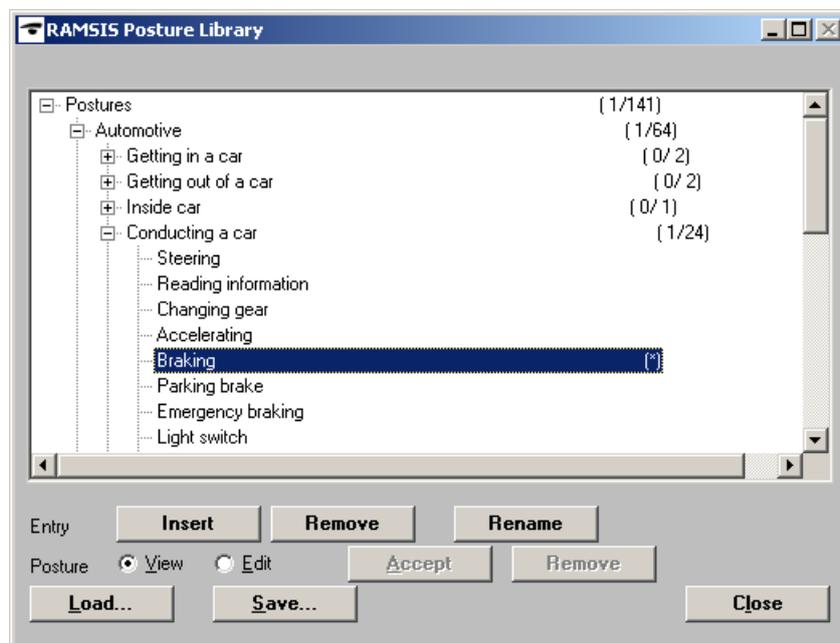


Figure 5 Selection of a subtask

- Selection of a combination of subtask, task and sector from the VERITAS task model matrix (Figure 5).
A subtask is interactively selected by using the tree navigation (see above) to select the related sector, task and subtask node. Only a subtask can hold postural information, which is indicated by a star (*) after the subtask name.
- Display of the posture assigned to the task model data.
As long as the option “Posture” is set to “View”, the manikin is adapted to the posture assigned to the selected subtask when available (Figure 6).



Figure 6 Visualization of posture of selected subtask

- Assignment of a new posture to the task model data.
As long as the option “Posture” is set to “Edit”, the buttons “Accept” and “Remove” are sensitive. While the button “Accept” assigns the current manikin posture to the selected subtask, the button “Remove” deletes the postural information of the selected subtask.
- Modification of a posture assigned to the task model data.
The modification can be done in three steps. First the posture is visualized in the workspace using the display feature of above. Second the posture adaptation function in Section 3.3.3 is used to modify the posture. Finally the posture is assigned to the subtask again by using the assignment feature of above.
- Loading and saving posture and task data from a file or to a file respectively.
The contents of the posture library (task model data and postural information) can be stored to a file (extension *.plb, posture library) using the button “Save”. These files can be loaded again using the button “Load”.

The posture library file is based on the xml format.

The posture visualization is implemented on available technologies of the human model RAMSIS.

3.3.3 Posture adaptation

The posture adaptation function manages the user defined refinements of a basic posture based on user defined body element orientations and distances (Figure 7).

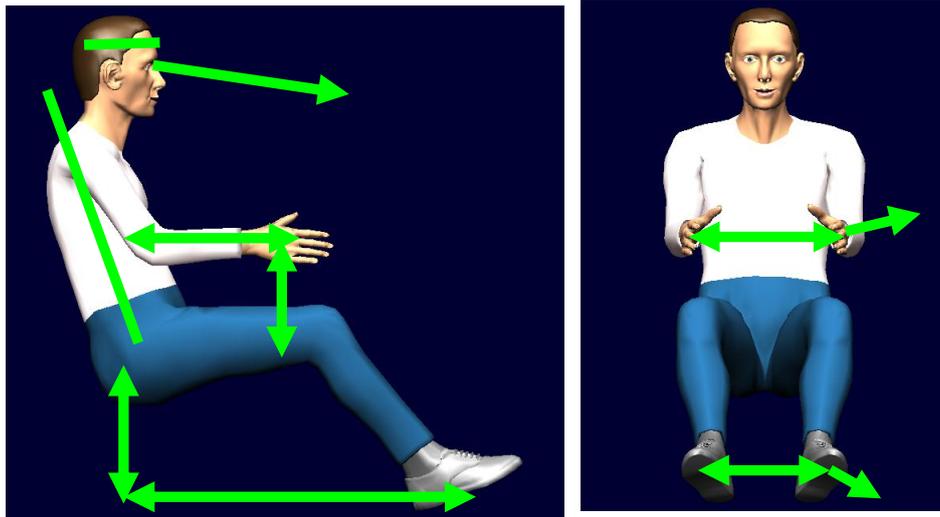


Figure 7 Posture adaptation

The basic posture is selected from the posture model list provided in section Manikin-Model of the configuration mask (Figure 8).

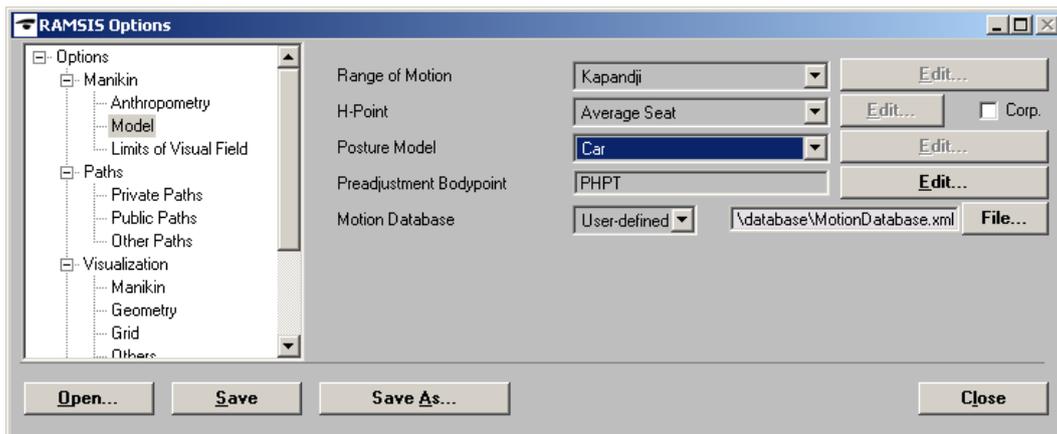


Figure 8 Basic posture selection

Currently following posture models Car, Standing and Motorbike are available. They are used in the following posture adaption function to create a final user defined posture.

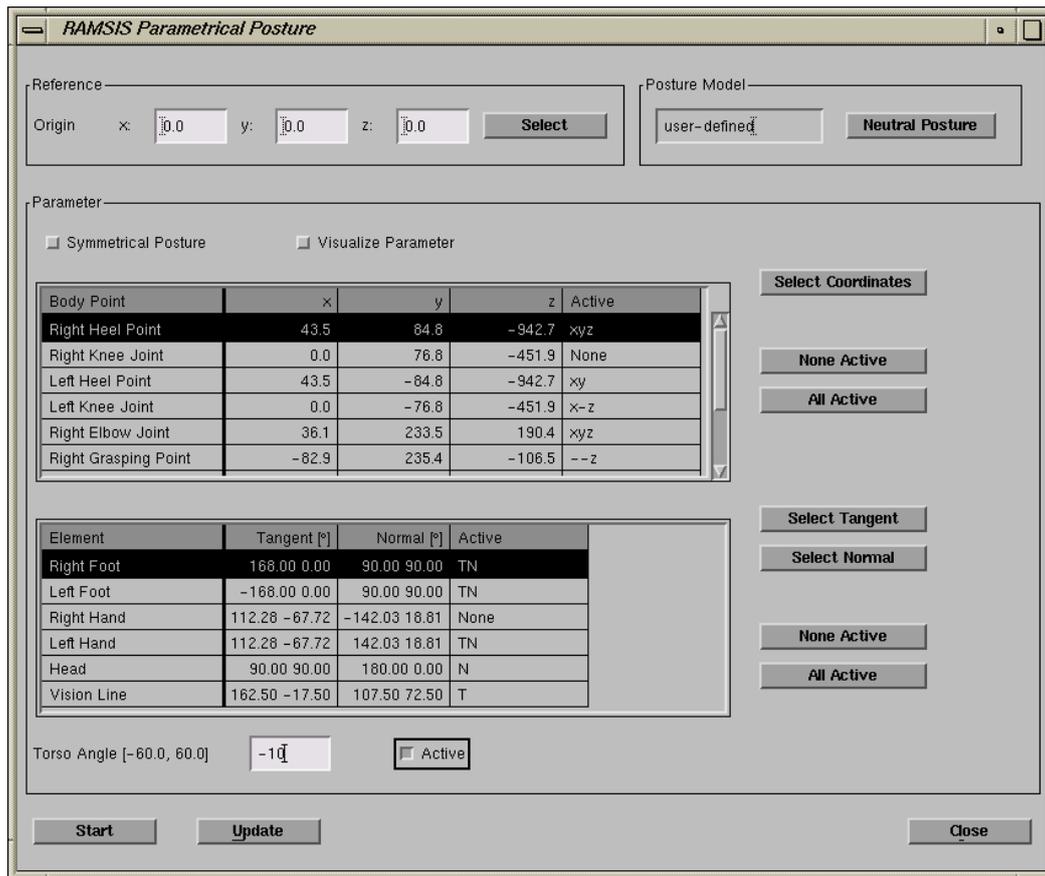


Figure 9 Parametrical posture control mask

The posture adaptation is implemented on available posture simulation technologies of the human model RAMSIS. In particular the GUI provides the following elements and functions (Figure 9):

- **Definition of a reference coordinate system**
All spatial input parameters are interpreted with respect to the referential system. The origin is defined in the block "Reference" either by keyboard or by selecting a point in the work space. The reference axes are always equal to the global coordinate axes.
- **Display of posture model**
The posture adaptation is based on the selected posture model in the configuration mask (Figure 8), which is also displayed in the block "Posture Model". In addition the current manikin can be set to the neutral posture of the posture model using the button "Neutral Posture" (Figure 10).

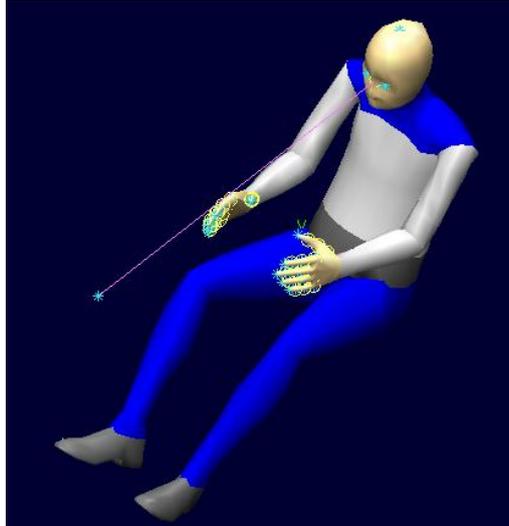


Figure 10 Neutral posture of car posture model

- Specification of body point positions

The target positions of the following body points are specified in the table “Body Point”:

- Right Heel Point
- Right Knee Joint
- Left Heel Point
- Left Knee Joint
- Preadjustment Point
- Right Grasping Point
- Right Elbow Joint
- Left Grasping Point
- Left Elbow Joint
- Eye Point
- Fixation Point

The coordinates (x,y,z) are defined by keyboard or by an interactive selection in the workspace. The selection is done using the button “Select Coordinates”. This button is sensitive, when one body point is selected in the table and starts a point selection in the workspace. The extracted point location is transferred into the table.

In addition to the target values the coordinates can be activated for the posture adaptation using the selection in the column “Active”. After clicking the table field with the left mouse, a drop down menu is displayed using the right mouse.

A modification of a coordinate automatically activates the coordinate for the posture adaptation.

The button “None Active” deactivates all coordinates and the button “All Active” activates all coordinates.

- Specification of body element orientations

The target orientations of the following body elements are specified in the table “Element”. The directions are given in spherical coordinates (degrees).

- Right Foot
- Left Foot
- Right Hand
- Left Hand
- Head
- Vision line

The element directions tangent and normal (T,N) are defined by keyboard or by an interactive selection in the workspace. The selection is done using the button “Select Tangent” or “Select Normal”. These buttons are sensitive, when one body element is selected in the table and starts a direction selection in the workspace. Two successively mouse clicks on points defines a direction. The extracted direction is transferred into the table.

In addition to the target values the directions can be activated for the posture adaptation using the selection in the column “Active”. After clicking the table field with the left mouse, a drop down menu is displayed using the right mouse.

A modification of an orientation automatically activates the coordinate for the posture adaptation.

The button “None Active” deactivates all orientations and the button “All Active” activates all orientations.

- Specification of torso angle
The torso angle is specified in the input field „Torso Angle“ and can be activated for the posture adaptation through the corresponding option.
- Visualisation of parameter
The parameters in both tables “Body Point” and “Element” are displayed in the work space, when the option “Visualize Parameter” is active. The distances of the body points to the global coordinates planes through the reference point as well as the body element orientations are displayed (Figure 11).

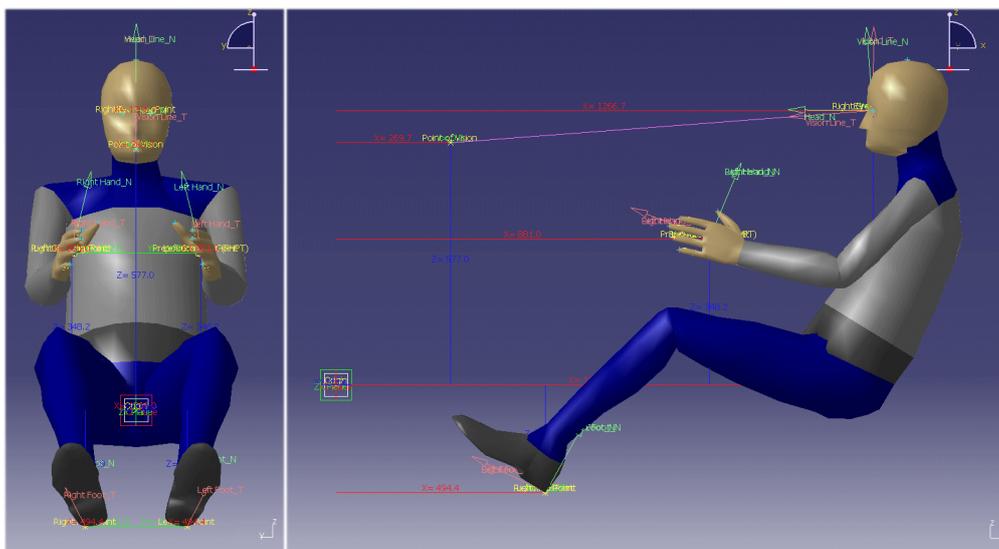


Figure 11 Visualisation of posture parameter

- **Specification of symmetrical posture**
When the option “Symmetrical Posture” is active, all body point and element inputs for one body side are automatically mirrored with respect to the xz-plane through the reference point. The mirrored parameters are written into the corresponding table fields.
- **Update of table fields to current manikin posture**
The button “Update” initializes all body point coordinates and element directions by the corresponding parameters from the current manikin posture in the work space.
- **Calculation of posture according to the given body point positions and body element orientations**
The button “Start” calculates the posture based on the posture model and the active body point coordinates and element directions. The manikin in the work space is automatically updated to the calculated posture. In addition all deactivated body point coordinates and element directions are updated from the calculated posture.

When the current posture fulfils the active target values in the table fields, the corresponding fields are coloured green. Otherwise they are coloured red, if the active target values are not fulfilled. Deactivated target values are coloured grey.

3.4 VERITAS virtual user model file

The model platform workflows of Section 3.1 result in the virtual user model file for the simulation platform in SP2. This file includes the following data:

- Sociodemographics (gender, age)
- Avatar model instantiation (kinematics & skin representation)
- Virtual user model instantiation (physical, cognitive & behavioral parameters)
- Subtask specific postures (e.g. handbrake operation)

These parameters are provided through a set of specific files, which are organized by the VERITAS virtual user model file (Figure 12).

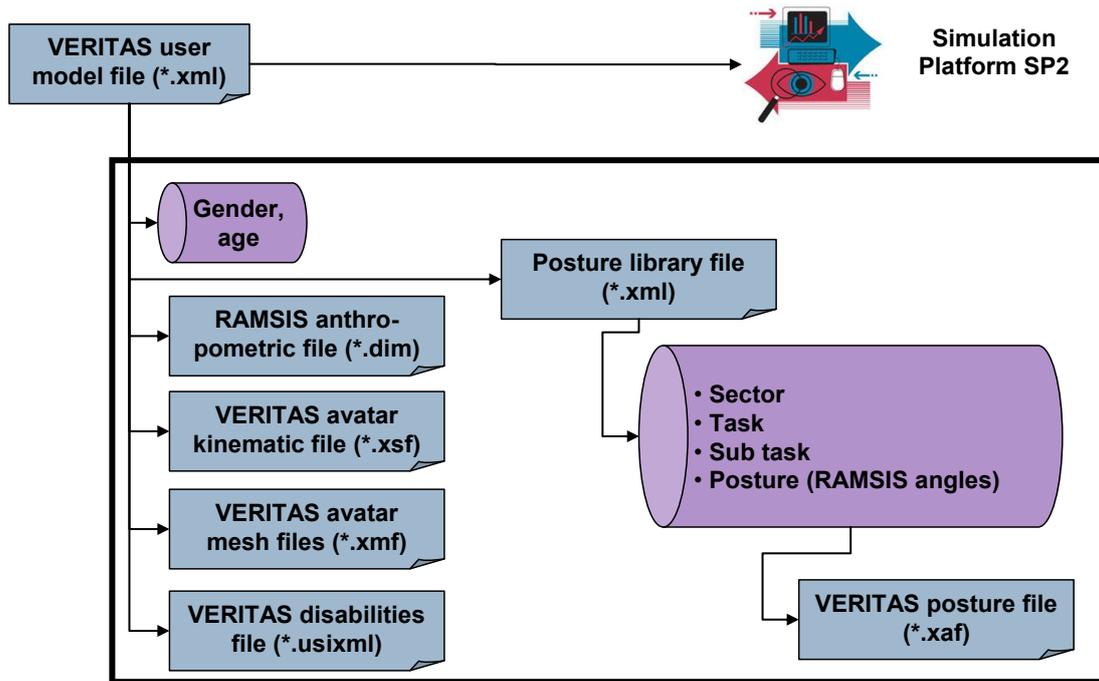


Figure 12 VERITAS virtual user model file

The VERITAS virtual user model file is a xml file, which is read and interpreted by the simulation platform and includes data and links on several files holding specific information:

- Gender and age data are included in the user file.
- Link to the posture library file
The subtask specific postural data are stored in the posture library file based on xml format (see Section 3.3.2). The posture data are stored in RAMSIS joint angle convention. In addition the posture data is converted in the VERITAS avatar convention (see Section 3.2.2.1) and provided in VERITAS posture files (file extension *.xaf), which are linked by the posture library file.
- Link to the RAMSIS anthropometric file
The results of the model customization in Section 3.2 are provided in the native RAMSIS anthropometric format (file extension *.dim). This file specifies the physical 3D avatar model definition, which is used by the external RAMSIS application of the simulation platform (WP2.2).
- Link to the VERITAS avatar kinematic file
The results of the model customization in Section 3.2 are provided in the VERITAS avatar model format for the core simulation platform in WP2.1 (see Section 3.2.2.1). One part of this is the kinematical information stored in a kinematic file (file extension *.xsf).
- Links to the VERITAS avatar mesh files
The results of the model customization in Section 3.2 are provided in the VERITAS avatar model format for the core simulation platform in WP2.1 (see Section 3.2.2.1). One part of this is the outer skin mesh information stored in body element specific mesh files (file extension *.xmf).
- Link to the VERITAS disabilities file

The disability parameters are generated by the virtual user generator (see Section 3.2.3) and stored in a UsiXML file (file extension *.usixml).

The VERITAS virtual user model file format is closely related to the currently ongoing developments of the avatar and virtual user model generator software. Hence the final format will be completed by M24 (D1.6.3 “Intelligent Avatar and User model generator components”).

4 Conclusions

In activity A1.6.1 a model platform is implemented to generate virtual user models ready for the use in the VERITAS simulation platform. According to the project needs (virtual user modelling and simulation), the platform provides several utilities to customize and parameterize virtual user models with respect to physical, cognitive and behavioural parameters.

The current implemented utilities address model and posture customizations. The model customization generates 3D avatar information with respect to user defined physical body dimensions and sociodemographics. In addition the posture customization supports the task specific posture definition and storage in a posture library. The model platform transfers the 3D avatar as well as the postural information to an external 3D avatar tool. The corresponding software interface is specified on architectural level and will be completed in activity A1.6.3 by M24.

Finally the model customization of physical, cognitive and behavioural parameters will be implemented in an external virtual user model generator. The interface between the model platform and that tool is specified on architectural level and will be completed in activity A1.6.5 by M24.

In addition to the report, a software prototype is being developed, which will include all features documented in the report. This software is currently being debugged and it will be fully operational in M14 (February 2011).