Software Requirements Specification

for

A mesh to mesh or mesh to image manual fusion tool

Version 1.0
Deliverable D7.1

INRIA

Virtual Physiological Human Project

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1. Introduction

1.1 Purpose

This document includes software requirements for a mesh to mesh or mesh to image manual fusion tool. The purpose of this document is to present a detailed description of the above mentioned fusion tool. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to user actions.

The intended audiences for this specification include:
- Developers: in order to be sure they will develop the project in a way that fulfills the requirements provided in this document.
- Users: in order to get familiar with the concept of the project and provide comments and suggestions about the tool.
- Advanced end users: in order to know exactly what they have to expect from the tool, right inputs and outputs and responses in error situations.

1.2 Scope

This mesh to mesh or mesh to image manual fusion tool is designed to provide a user interface that will allow the user to manually:

- Move one of the two data sets.
- Select corresponding landmarks/points in both data sets.
- Activate the fusion process.

The following types of transformation will be used for the registration:

- Rigid body.
- Affine.

1.3 Definitions, acronyms and abbreviations

- FTP: File Transfer Protocol
- HTTP: HyperText Transfer Protocol
- VTK: Visualization ToolKit
- DICOM: Digital Imaging and Communications in Medicine

1.4 References

Qt library website: http://www.qtsoftware.com
VTK website: http://www.vtk.org/
DICOM homepage: http://medical.nema.org/

1.5 Overview

The remainder of this document is organised as follows: section 2 gives a description of the system with information about the functions that will be provided by the system, operating systems, etc…
The third section is then dedicated to the specific requirements such as data format or communication interface.

2. Overall description

2.1 Product perspective

The mesh to mesh or mesh to image manual fusion tool will be designed as a self-contained system.
In the context of medical imaging, it will enable the user to handle heterogeneous data such as meshes and images at the organ level.

2.2 Product functions

The tool will provide the user with the following functions:

- **Database – Open, Close, Save**
  The user can open existing meshes and images by browsing through local directories. Those data can be closed at any time.
  The user can save new data generated after the fusion process.

- **Visualisation**
  The user can visualise the data in a graphical user interface.

- **Selection**
  The user can select corresponding points in the mesh and image to be processed.

- **Fusion**
  The user can activate the fusion process by clicking a button in the graphical interface.

2.3 User characteristics

The main class of user of this fusion tool is the scientist. It is assumed that the user is familiar with the type of data that is processed. The user must also be able to identify corresponding points in both the image and/or the mesh to be fused.

2.4 Operating environment

The mesh to mesh or mesh to image manual fusion tool should run on the following operating systems:
- 32-bit MS Windows XP
- 32-bit Linux
- Mac OS X

2.5 Design and implementation constraints

The fusion tool will be written in C++ and the graphical user interface will be designed with Qt library.

2.6 User documentation

The fusion tool will come with:

- An offline user manual.
- Floating tooltips integrated to the application.
- Online tutorials.

3. Specific requirements

3.1 External interfaces

- **User interface**

The user graphical interface will be created through C++ and Qt library.
All functionalities will be accessed via mouse clicks: open/close data, select points, activate the fusion process. Data will be visualised in the interface's main window. Fusion process results will be displayed in a separate window.

- **Data format**

The user is required to open data with the following formats:
- VTK for meshes.
- DICOM for images.

After the fusion process the data generated will be saved using the format of the moving data.

- **Communication interface**

The fusion tool does not use internet communication interfaces such as ftp or http.

- **Operations**

The tool will allow the user to indicate which data set will be used as the reference for the fusion process. The other one will therefore be denoted as the moving data set.

3.2 Functions

Here are described the functional requirements for the fundamental actions that must be handled by the system.

3.2.1 Open

Purpose	Allow the user to open a mesh or an image.
Inputs	Click on the "open" button or click "open" in file menu.
Processing	The system enables the user to browse through its directory to find the file. The system checks whether the file format is handled. If the format is handled, the system opens the file. If not an error message is displayed.
Outputs	The system displays the selected data file.

3.2.2 Close

Purpose	Allow the user to close an already open data file.
Inputs	Click on the “close” button or click “close” in file menu.
Processing	The system first checks that a data file is currently open. If yes the file is closed, if not an error message is displayed.
Outputs	The system closes the data that is being displayed.

3.2.3 Save

Purpose	Allow the user to save the result of the fusion process.
Inputs	Click on the “save” button or click “save” in file menu.
Processing	The system first checks that a fusion process has been run. If yes the result is saved in a data file with the appropriate format, if not error message is displayed.
Outputs	The system saves the data into a file and refreshes the display if necessary.

3.2.4 Visualisation

Purpose	Allow the user to visualise a mesh or an image.
Inputs	Select the data file to visualise.
Processing	The system retrieves information from the file to enable a correct display.
Outputs	The system display the data file and allow the user to select points in the mesh or the image.

3.2.5 Selection

Purpose	Allow the user to select corresponding points in the mesh or the image.
Inputs	Click on the mesh or image.
Processing	The system displays the selected points with colors.
Outputs	Selected points are made visible and fusion process can be activated.

3.2.6 Fusion

Purpose	Allow the user to activate the fusion process.
Inputs	Click on the “fusion” button.
Processing	The system retrieves spatial information

	from the points that were selected and launches the fusion process.
Outputs	Result of the fusion process is displayed in a separate window: axial, coronal, sagittal, as well as 3D views of the aligned data sets will be displayed. The user will be allowed to refine the fusion process by manually adjusting the position of the moving data if needed.

3.3 Performance requirements

A real-time synchronisation of the views must be achieved if one view is being modified by the user, for example during manual refinement of the fusion.

3.4 Software quality requirements

The mesh to mesh or mesh to image fusion tool must be designed as a light and self-contained project so it may be run without being installed. All it must take is unpacking from a zip or tar file.
It must be designed via the use of software patterns whenever possible, for robustness and for code clarity to facilitate future maintenance.

3.5 Other requirements

It is expected that user feedback will result in requests of increased functionality.