

Chapter 29

Virtual Reality for Supporting Surgical Planning

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ABSTRACT

Nowadays many surgical procedures are still carried out based on the skills and manual dexterity of each surgeon. The complexity and variability of the operations (very dependent on anatomical and functional personal characteristics), the difficulty of sharing and transferring the acquired knowledge, and the problems for surgeons to train in a realistic context make up a very complex scenario. In this sense, Virtual Reality (VR) provide supporting for surgical training and planning. VR permits modeling, simulation and visualization techniques using 3-D, anatomical predictive models, which are based on realistic models of tissues and organs. The usage of these technologies as a support for surgical planning results in a reduction of the uncertainty in the surgical process, a decrease in the risks for the patients, as well as an improvement of the results. This chapter presents a case of study of a Virtual Reality tool for supporting surgical planning, called VirSSPA, that has been already successfully applied in the University Hospital "Virgen del Rocío" (Seville-Spain).

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INTRODUCTION

In daily practice, surgeons are provided with radiological images such as Computed Tomography (CT) or Magnetic Resonances (MR) before carrying out a surgical procedure. However, the use of specific tools to allow them a planning procedure for optimizing the preoperative process is not yet commonplace in medical practice, even if the use of such planning procedures is particularly important in reconstructive surgery. Reconstructive surgery is performed on abnormal structures of the body, caused by congenital deformities, developmental abnormalities, trauma or injury, infection, tumors, or disease. It is generally performed to improve function, but may also be done to approximate a normal appearance. In this kind of surgeries, the uncertainty of the operation -mainly associated with anatomical and functional characteristics of the patients-, and its intervention times are particularly high, since each case is unique and depends on patient's individual circumstances. Due to this, we highlight the importance of a personalized treatment with more knowledge of the patient's pathology.

VR constitutes one of the most important areas for research and development. Medical devices based on Virtual Reality (VR) have experienced an increase in the last years (Székely & Satava, 1999; McCloy & Stone, 2001; Rubino, Soler, Marescaux & Maisonneuve, 2002). In the Medical context it is necessary to highlight the introduction of VR tools for the image based diagnosis by a virtual reconstruction (3D) of internal and external structures of the patients (Székely & Satava, 1999). These techniques allow the surgeons to visualize and manipulate real information from the patient in a more natural and efficient way. Besides, the surgery field is currently focused on VR developments which would allow the simulation of different scenarios within the surgical procedures. This feature serves as a training platform for non experienced surgeons, which enables to work out different 'virtual surgical procedures' in advance,

looking for the best procedure to be followed and practicing it in order to anticipate possible problems that may appear during surgery.

Therefore, VR is considered a great advantage for medical professionals, since the interactive inspection of certain organs allows them to introduce substantial improvements in the areas of training, non invasive diagnosis and surgical procedure planning.

VR applications are often developed relatively independent from the real contexts in which they are going to be used. However, it is recognised that user needs should play a central role in the development of virtual environments that are going to be used in a real-life context (Cramer Henriette S.M., Evers, Zudilova, & Slood, 2004). Therefore, an analysis of the healthcare context must be considered in order to ensure that this system fulfils all the requirements and restrictions of this context.

This chapter shows a case study based on a project named VirSSPA in which a VR tool has been developed and implemented. The VirSSPA project began in June of the 2005 and is nowadays being used as a pilot study at the University Hospital "Virgen del Rocío" (Seville. Spain) (Portal Hospital Universitario Virgen del Rocío).

The aim of this project was to develop software to provide support to professional surgeons during all the phases involved in the surgical processes, with special attention to the tasks related to intervention planning. The purpose of the tool is to optimize all processes involved, to increase the reliability of the decisions as well as to improve the surgery practice efficiency. This project and the technical solution adopted have important competitive advantages with respect to other solutions in the market, i.e.: 1) It is user-oriented (surgeons have actively participated in the design requirement gathering); 2) it is more than a 3D viewer; 3) it solves the problem of portability (is compatible on any PC platform, including laptops) thus allowing the surgeons a complete mobility in the surgical procedure planning, being able to

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