A quality model of virtual reality endoscopic simulator for oral surgery

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Abstract

This paper aims at construction of a model to evaluate the objective and subjective quality of human-machine interaction within a VR (Virtual Reality) endoscopic simulator developed for the oral surgery. Today, endoscopic surgery has increased as a minimally invasive therapy to reduce the scarring and pain of patients and to minimize cost. Beside its many advantage, endoscopic surgery requires advanced operation technique, where professional training is acquired. However surgical simulator and training method remain to be developed because of the delay of introduction in oral surgery field. The purpose of this study is to develop VR endoscopic simulator for oral surgery, and it will be able to exercise as effective as possible, culture surgical technique. First of all, we focus on the model that evaluated the simulator quantitatively. In this study, the subjective quality (for a man-machine interaction) of surgery simulator is taken by assessment. It use tissue is able to synthesize near graphics, tissue change by surgery. We consider that it use concrete and easy the evaluation approach.

Keywords: VR, endoscopic simulator, a quality model

Introduction

Today, minimally invasive medical services are required by patients in medical practice among which there is the endoscopic surgery. Endoscope surgery is operated by watching images captured from an endoscope (as shown in Fig. 1), which reaches the target organ through a short incision. This surgery has been applied in many filed, due to its advantages, including minimal invasion and reducing hospital time for recovery.

However, as a surgery performed in the narrow visual filed, endoscopic surgery requires a operator to have advanced knowledge and techniques[1]. Especially, an untrained operator may cause death accident to a patient and lead to severe social problems in the medical filed. Therefore, training methods, including VR-base simulator, have been rapidly improved and deployed in medical fields.

Compared to widespread utilization of endoscopic surgery in other medical practices open surgery remains common in the oral surgery field. Recently, Matsui et al. [2] presented its effectiveness in endoscopically assisted submandibular surgery, which open the way to use endoscopic surgery in oral surgery field. It is required effective training exercise of surgical techniques to develop a VR endoscopic simulator in the oral surgery field.

We consider an advanced machine that can handle complex movement and large amonunt of information, e.g., a VR simulator, so as to support the medical education. However, what is an “effective simulator” for a trainee? Especially, it is still not clear that what are the elemental factors to design an effective simulator. Slight unsatisfaction of user expectations might displease the users, and lead to a negative evalution of the whole system. Instead of regarding the simulator as a standalone system, we have to design a simulator which is able to include a person. However, there is not metric on how to evaluate a simulator. And subjective evaluation consists of a wide variety of component factors which make it difficult to analyze.

Fig. 1. Submandibular surgery using endoscope

In order to facilitate the analysis, in this study, we limit our analysis to studying the relation between the subjective quality of evaluation factors and the overall impression. Here, the overall impression is defined as a distance to the real endoscopic surgery, evaluated by users’ visual and haptic appreciation, and represented by psychological and physical characteristics of the system.

We proposed a model to evaluate the impression by inferring the psychological factors that affect a generic endoscope simulator for oral surgery, from those physical factors existing in the implemented VR endoscopic simulator. In order to establish the relationship between the overall impression and those psychological and physical factors, we define a metric for subjective evaluation of impressions. With this metric, we compared the appreciation of overall impression between two user groups, (that is) i.e., medical students and experienced doctors, and discussed their different characteristics.