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Research Article

Hand and Gesture Module for Enabling Contactless Surgery

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Abstract

Nowadays, there are many new approaches and techniques in telemedicine and surgery with different kinds of innovations and a growing need for contactless control of surgery parameters. Our proposal is aiming to resolve the problem of standard surgical parameters with gesture-controlled surgical interventions. We designed a contactless interface as a plug-in application for the DICOM viewer platform using a hardware sensor device controller that supports hand/finger motions as input, with no hand contact, touching, or voice navigation. Our proposed approach enables surgeons to get complete and aware orientation in the operative field (which currently isn't the case and where the problem lies), where 'overlapping' of the real and virtual anatomic models is inevitable. Human mind and understanding of this new surgery work by creating entirely new models of human behavior and understanding spatial relationships, along with devising assessment that will provide an insight into our human nature. That's why the essential part of our solution is to build the adequate hand and gesture module for motion which we will describe in this paper.

Keywords: Contactless surgery; Hand and gesture module; Motion tracking; Spatial relationships

Introduction

Motion tracking enables more precise virtual movement, rotation, cutting, spatial locking, and measuring as well as slicing through datasets. To provide the most immersive experience, we use a camera for depth and motion tracking that has active stereo depth resolution with precise shutter sensors for depth streaming with a range up to 2-3 meters which is essential in the OR and which gives a sense of freedom to the surgeon during the surgery. That's why we approached the design of this part of the solution with special care to build an accurate, but still an intuitive and straightforward way of activating positioning control which is based on waiting for the users' hands to enter the central trigger area to activate the interaction with the interface, with touch-free surgeon's commands. We intend to offer an alternative to closed SW systems for visual tracking and develop the SW framework that will interface with depth cameras and provide a set of standardized methods for medical applications such as hand gestures and tracking, face recognition, navigation, etc. We found it possible to significantly simplify movement gestures in the virtual space of virtual endoscopy. Our clinical and technology research is already at the high maturity level of accomplishing the proof-of-concept phase. Our clinical tests and technological achievements where we already tested our previous solution with Leap Motion in OR are demonstrated in the results of several research papers [1-3]. After updating the needs in clinical workflow based on the inputs from several different medical specialists, we now identified two primary tasks for the hand and gesture module for motion tracking. For the part of hand tracking, it is important to provide hand coordinates in two dimensions and surrounding in 3D. For the gesture recognition and tracking part of the module, we designed gesture states based on the hand tracking.