Exploring the Integration of Gaze Control for Robotic Surgical Microscope Operation: A Feasibility Study

Author: Jonas Kreiner, j.kreiner@mci4me.at

INTRODUCTION

This work aimed to generate novice user data on interactions with a state-of-the-art robotic surgical microscope and to explore the potential integration of eye-gaze input as a control method through two user studies conducted in a virtual environment with 30 participants.

USER INTERACTION ASSESSMENT OF BHS ROBOTICSCOPE® SURGICAL MICROSCOPE

Within 7.61 hours of recorded surgical videos from 14 procedures, a segmentation process was used to analyze the distribution and average interaction time for each control function of the RoboticScope® (BHS Technologies, Innsbruck, Austria).

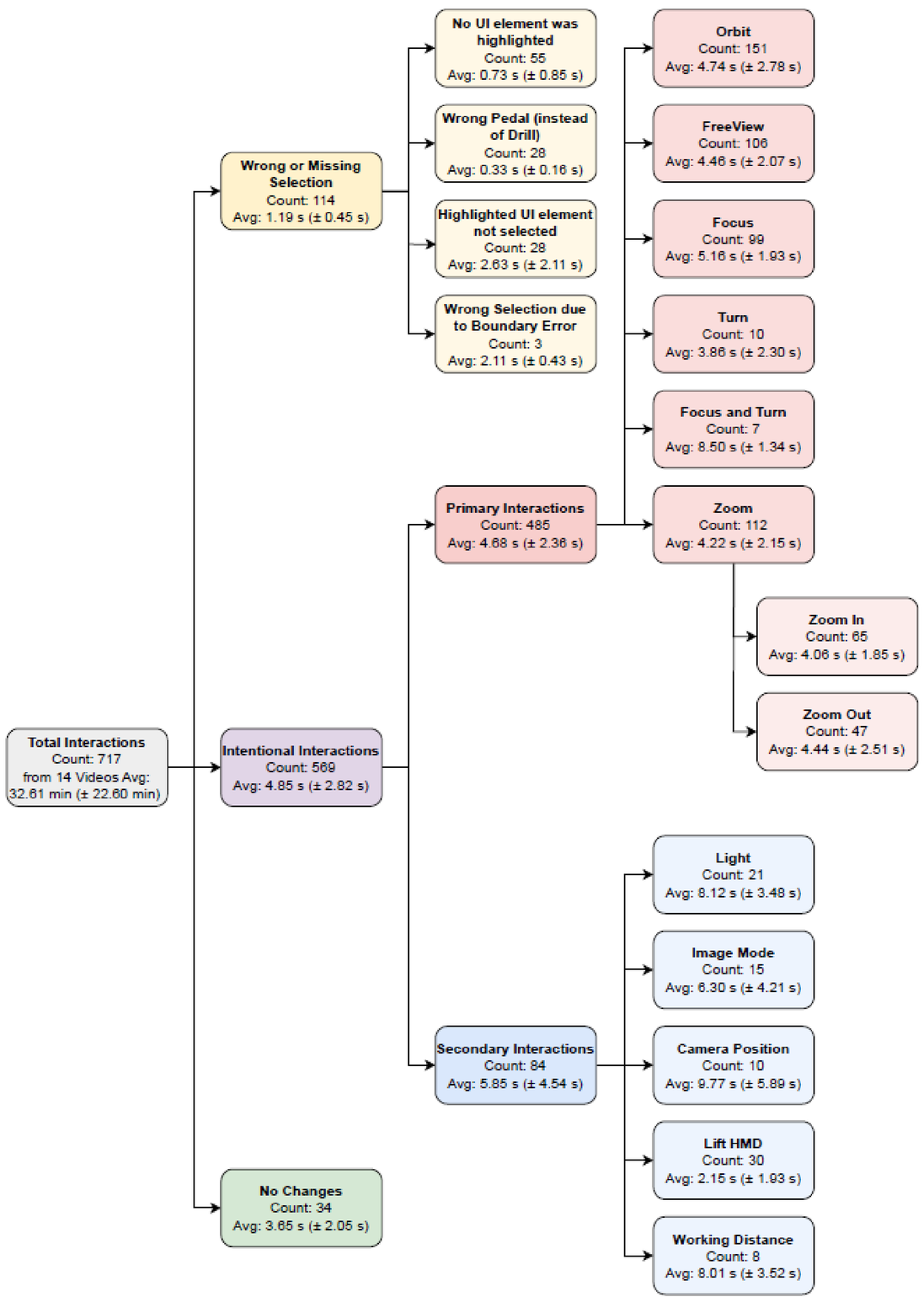

Fig. 1: Distribution, quantity, and average duration of RoboticScope® interactions with standard deviations in brackets

BUTTON SELECTION STUDY

Conducted in a virtual environment, this user study aimed to evaluate five different eye-gaze interaction methods in comparison to the current RoboticScope® head control method (HButton). While user preferences varied, two eye-gaze methods stood out in terms of both user experience and interaction time.

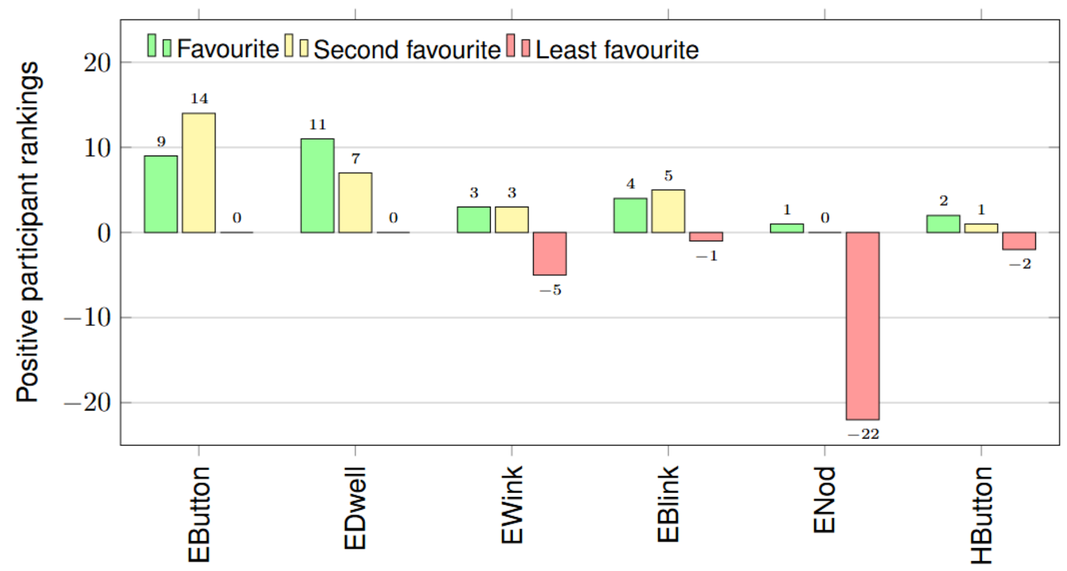

Fig. 2: User preference rankings for button selection study

FOCUS STUDY

This study compared camera focus control using the state-of-the-art head pitch method with a novel gaze-contingent autofocus approach. Across all analyzed metrics, the gaze-contingent method demonstrated highly significant improvements ($p < .01$) over the conventional approach in terms of user experience, required time, and focus accuracy.

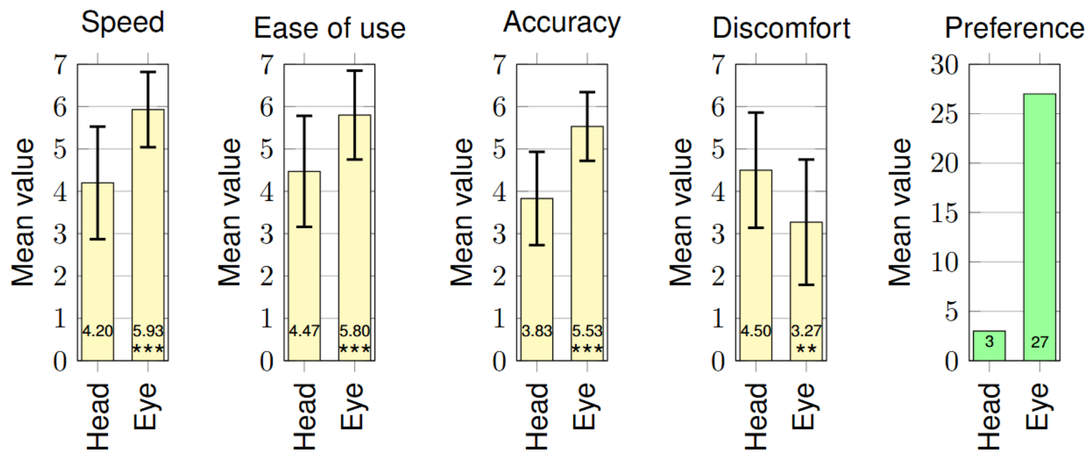

Fig. 3: User experiences responses in questionnaire. (Discomfort: lower is better)

CONCLUSION

While eye-gaze methods show promising trends, more realistic user scenarios must be tested and remaining usability challenges addressed to verify their suitability for use in the operating room.