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Virtual Reality Typing: The Effect of Virtual Hand Representation in Muscle Activity and Task Performance

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Extended Abstract: Typing is fundamental to our daily lives, particularly at work. Virtual reality (VR) technology has seen increasing interest in incorporating it into job training and rehabilitation programs. The concept of this study involves displaying the effect of virtual hands on a user's view in VR environment to mimic their real-time hand movements. The main objective of this study was to investigate muscle activity and task performance with and without virtual hand representation during VR typing tasks. As part of the study, wireless electromyography (EMG) sensors were used to measure the left and right neck splenius capitis muscles' activity (LSC and RSC), and typing performance was measured in terms of actual and net typing speed (WPM) and accuracy percentage (%). In addition, the NASA-TLX subjective workload scale was used to compare the users' mental workload with and without the virtual hand representations. This study involved 15 participants (7 females and 8 males), all over the age between 18 and 30 years who participated voluntarily and had no symptoms of musculoskeletal disorders or back/neck pain within 7 days of participation. During the study, participants were randomly assigned to two conditions: typing in VR with and without virtual hand representation. The Oculus Quest 2 VR headset and a Logitech k830 Bluetooth keyboard were utilized. A typing test was conducted using typingtest.com with five minutes of typing per condition. The results of the study indicated that virtual hand representation had a positive effect on typing performance, resulting in significantly higher typing speed (125.86% higher net speed) and accuracy (1.63% higher) compared to the condition without virtual hand representation. Additionally, the study found that typing in VR with virtual hand representation resulted in a significantly higher normalized muscle activities (% maximum voluntary contractions) of the neck muscles (17% higher for LSC and 19.58% higher for RSC) than in VR without virtual hand representation. Participants showed significantly lower NASA-TLX values with the virtual hand representation. In other words, lower mental demand was recorded during typing tasks with virtual hand representation. The findings of this study suggested that the presence of virtual hands for typing in VR resulted in more active typing behavior and improved performance. Increasing neck muscle activities during virtual hand representation could be associated with more active typing behavior and improved performance. Furthermore, participants perceived the virtual hand representation condition to be less mentally demanding due to the increased sensory feedback provided. Virtual hand representation was able to enhance typing efficiency, although further design configuration and improvement will be required to improve typing speed. With more realistic virtual hand representations, haptic feedback, and customizing virtual hand size and position to match the user's real hand size and position, virtual hand representation can be more effective in typing.

Keywords: Virtual Reality Typing, Virtual Hand Representation, Electromyography, Typing Performance, NASA-TLX

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