The Empirical Study of Augmented Reality and Virtual Reality for Computer Accessory Maintenance

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Abstract—This paper discusses how effectively Augmented Reality (AR) and Virtual Reality (VR) displays aid an operator perform computer accessory maintenance. The research concentrated on comparing two technologies for generating AR and VR displays for maintenance. The maintenance time and errors were measured. A questionnaire was administered to each subject to determine the usability of both technologies. The results indicated that AR condition was more effective instructional aid for the maintenance task than the VR, where AR resulted in faster maintenance times and had fewer errors. However, there were still some important usability issues associated with the AR and VR technologies. Many of the subjects indicated that AR was uncomfortable and over half of the subjects expressed concerns about poor image resolution and tracking features. Finally, this paper discusses the results of this study and implications for the design and use of AR and VR for maintenance tasks.

Keywords: Augmented Reality, Virtual Reality, effectiveness, usability.

1 Introduction

Augmented Reality (AR) techniques offer a potential solution to the problems of training users to perform maintenance tasks. With AR, the computer provides additional information in the user’s field of view, typically in a Head-Mounted Display (HMD) worn by the user that enhances or augments the view of the real world [1]. This contrasts with the Virtual Reality (VR) approach, which effectively replaces the real world maintenance environment by a virtual one [5]. AR can potentially provide the training guidance and experience that could be provided in the virtual world or desktop environment, while allows the user to see and touch the real objects. The help provided by the AR system, for example, may include annotated support for naming system components or functionality of the system, or the presentation of documentation such as maintenance or manufacturing records. In addition, it would be possible for a remote expert to provide assistance by controlling the information displayed by the system.

2 The Advantages of Using AR for Maintenance

Maintenance is one of the most ignored aspects of equipment ownership. Most people seem to think that equipment does not need maintenance, and they should just use it until it breaks, and then repair or replace it. Those people generally find themselves repairing or replacing much sooner than those that take definite steps to avoid difficulties in the first place.

In general terms, four main important objectives can be identified in maintenance. Firstly, to introduce the user to the concept of optimal maintenance in the sense of optimal use of resources (labour and material). Secondly, to teach the user the steps required for setting up a maintenance program. Thirdly, to introduce the user to the diagnostic techniques relating the levels of system parameters to its condition. Finally, to lead to improved equipment reliability, safety and quality.

The advantages of use of AR to help address these issues are:

i. Simplicity: Easy for any user to obtain faster, more accurate defect or failure diagnosis, as well as quality control on repairs. Minimal training is required.

ii. Sensitivity: Enables user to detect any of the individual components.

iii. Selectivity: Enables user to differentiate between various sources of equipment emissions, even when components are within close proximity.

iv. Accessibility: Slim and lightweight tool with selectable-length probe-attachments for easy access to difficult-to-reach locations.

v. Ease of use: No calibration. No special maintenance. Simple controls to adjust sensitivity.