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Validity of virtual-reality-based systems applied to lighting and colour rendering research

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1.Introduction

In recent years, there has been a very important advance in graphic computing and technology related to the capture and representation of images in both 2 and 3 dimensions. One of these technologies is Virtual Reality (VR). Colour vision researchers could incorporate VR devices to research tasks in colour vision. The objective of this work is to perform the validation of these VR systems for research in colour vision and colour rendering of light sources.

2. Pseudoisochromatic plates test

We have implemented a virtual version of a previous existing colour blindness test for children. To do this, we have included a colour management system in the virtual reality software that has allowed us to obtain a faithful reproduction of the colour when working with digital images.

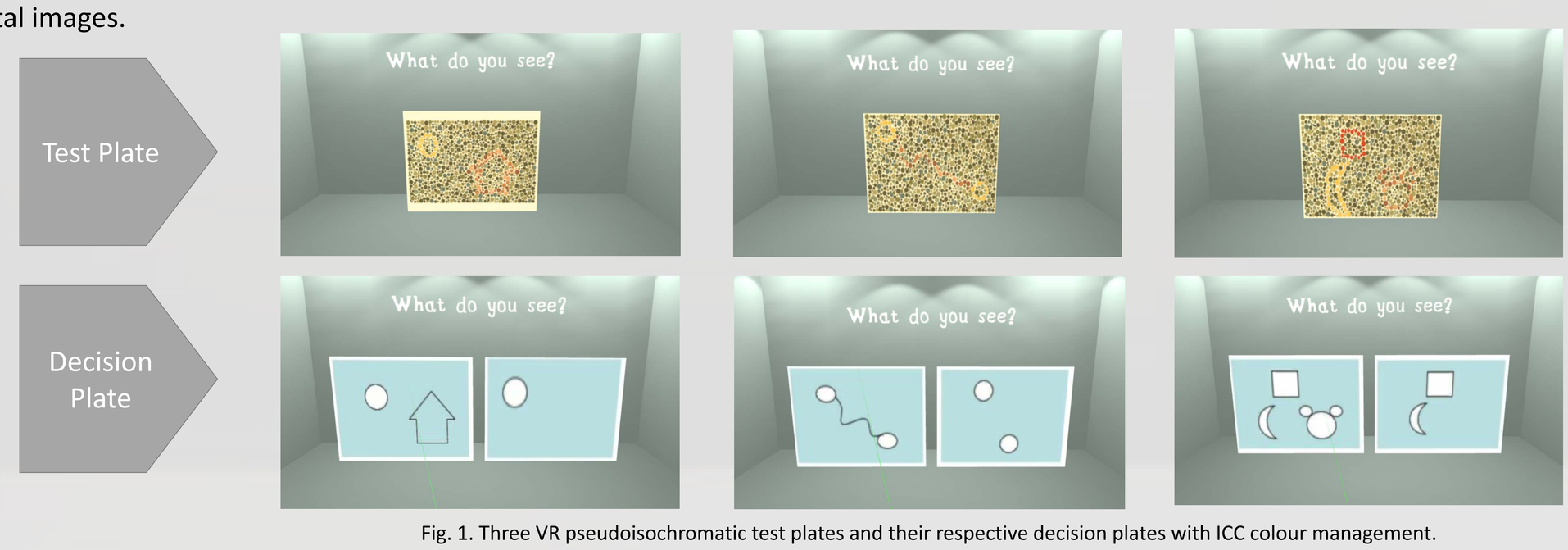

Fig. 1. Three VR pseudoisochromatic test plates and their respective decision plates with ICC colour management.

3.Hue arrangement test

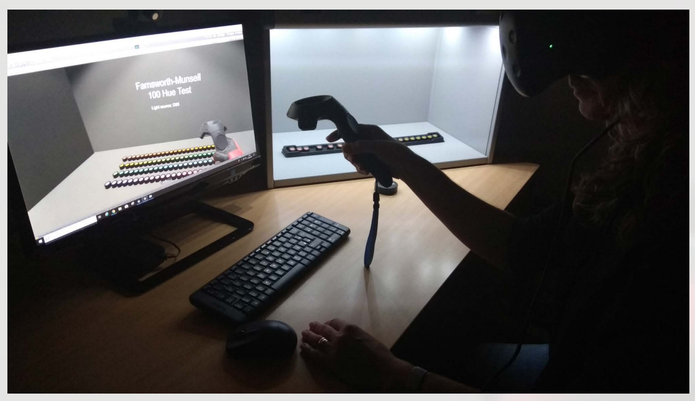

Fig. 2. Experimental set-up for VR colour arrangement test

We have also implemented spectral computing algorithms that allow us to obtain a realistic colour visualization when changing light sources.

To show the validity of this spectral computing method we have implemented a virtual version of the FM 100 Hue test.

Fig. 3. Screenshot during realization of virtual FM-100 Hue test

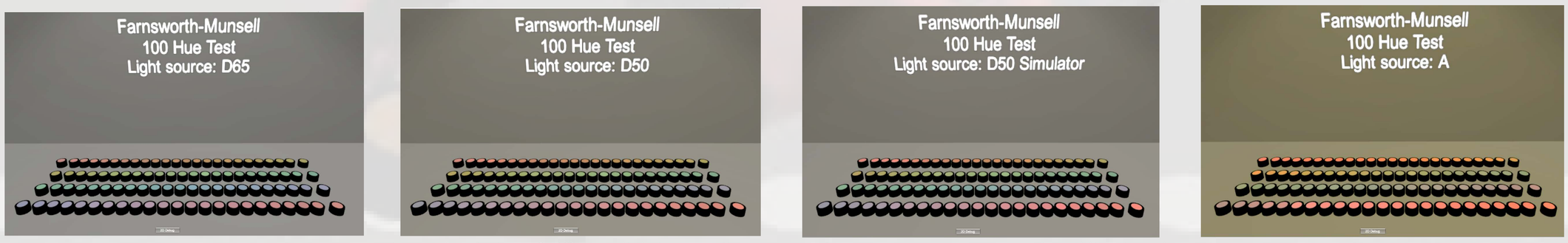

Fig. 4. Simulation of different lighting conditions over virtual FM-100 Hue test at virtual lightbooth

4.Colour Blindness simulation

All these colour management improvements applied to virtual reality devices are compatible with previous well-known simulations of colour vision deficiencies as we can see in figure 5. With this VR system we can explore the effect of light changes over different scenes and observers.

Fig. 5. Colour arrangement of a weak defective observer (protanomaly) seen by a normal observer (left) and a defective protan observer (right).

The results of these tests are diverse since they are very different in terms of complexity and standardization, but in all cases they have shown that there are not statistically significant differences between the real and virtual versions of the tests.

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