

Subjective and Objective Evaluation of Colour Difference Encountered through the Use of CAD Systems in the Fashion/Textile Industry

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In modern fashion and textile design it is particularly important to produce highly accurate colour reproduction using a variety of imaging equipment such as scanners, colour monitors and printers. A problem that is often encountered by fashion and textile designers when using CAD systems for design work is that the self-luminous display image(softcopy) does not exactly match the reflection print image(hardcopy). This problem is compounded by the fabric failing to match the original idea. No research has been published, however, investigating this area in relation to the fashion / textile industry using CAD. In consequence, then, this paper summerises experiments conducted to determine the objective and subjective difference threshold of colour difference evaluation using dyed fabrics and hardcopy images to identify the distortion occurring in colour perception in the process of fabric design to fabric scanning to printed image, especially when using the hardware normally used in educational institutions. To obtain softcopy images and hardcopies five colour fabrics(Red, Yellow, Blue, Purple, Steel Blue)were selected. The reflection print images were generated from the scanned image data on the CAD system ENEAS. The initial selection was made by trained designers selecting up to 5 representations of the scanned colour on a monitor as in normal industry practice. Thus, in total 25 reflection print images were obtained. The original fabric samples and the printed images were objectively analysed on a reflectance spectrophotometer, Spectraflash 600(SF600). Colour measurements from ten areas of the reflection print images were carried out randomly. As a result, in total 250 results of objective colour analysis were generated. The first step of the subjective assessment was a prescreening of the hardcopy images by researchers. Three samples from five reflection print images per colour were selected. Thus the main experimental setup involved five reference colours of dyed fabrics and fifteen hardcopy images. For the main subjective assessment a panel of 26 judges was used. These judges had varying degrees of experience in fashion/textile industries and all had normal vision. A

forced-choice paired comparison method was employed. In all cases of objective measurement, except Yellow, the printed copies lost chroma, indicating that the colour of the original fabric was more vivid than the printed images. The results obtained from the spectrophotometer demonstrated that the hue and chroma of the printed copies differed to the originals. When the results from the spectrophotometer and the preliminary subjective assessment were compared it was shown that in 27% of cases the selection made by subjective assessment of printed copies having the closest matches to the original fabrics did not agree with the results obtained from the spectrophotometer. Comparing the rank order given by the panel of judges for the printed copies being closest to the original fabrics to the results given by the spectrophotometer, only 50% were in agreement. It was found that the perception of colour by fashion/textile designers mainly depends upon overall colour differences (ΔE) rather than any individual factors such as lightness, chroma and hue. Colour management is the most problematic area when dealing with CAD in fashion/textile industries and educational institutions. Further research to identify the optimized combination of subjective assessment and objective measurement; Integrate the spectrophotometer and CIELAB colour assessment standard into CAD system.

CAD를 이용한 Fashion/Textile Design의 색차 평가에 관한 연구

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최근의 fashion/textile design에 있어서, 다양한 image 재생 장비인 scanners, colour monitors, printers등을 통한 정확한 색채의 재현은 매우 어렵고도 중요한 일이다. 이러한 가운데 fashion/textile designer들이 CAD system을 이용하여 작업을 할 때, 부딪히게 되는 문제점은 colour monitor상의 image(softcopy)와 재생된 프린터 출력 image(hardcopy)의 색차가 서로 일치하지 않는데 있다. 더욱이 이러한 문제점은 직물의 염색공정에서 원래 의도된 색채의 재현을 어렵게 한다. Graphic art분야나 조명환경 분야에서는 색차보정에 관한 연구가 종종 보고되고 있으나, 아직까지 fashion/textile design분야에서 이와 관련된 연구는 좀처럼 찾아보기 어려운 실정이다. 따라서 본 연구에서는 fashion/textile design과정 중에 일어나는 모니터 영상색과 출력물, 그리고 염색된 직물의 색차에 대한 객관적 주관적인 평가를 통해 색채재현의 문제점에 접근해 보려고 하였다. 먼저 연구에 필요한 softcopy와 hardcopy image들을 얻기 위해 5가지종류의 색채를 가진 직물(Red, Yellow, Blue, Purple, Steel Blue)을 선택 하였다. 프린터 출력 image는 CAD system인 ENEAS를 통해 모니터상의 scanned image 데이터에서 속련된 디자이너에 의해 5개의 hardcopy로 재생되었다. 따라서 총 25종류의 hardcopy가 얻어지게 되었다. 원래의 직물 sample과 프린터 출력 image들은 spectrophotometer인 Spectraflash 600(SF600)을 이용하여 객관적으로 분석되어 총 250개의 색채 분석 결과가 얻어졌다. 객관적 색채분석에 이어 주관적 평가 단계에서는 우선 연구자들에 의한 hardcopy image의 prescreening을 통해 한 직물당 3개씩의 프린터 출력 sample들이 선택되었으며, 따라서 본 실험에서는 5개의 reference colour와 15개의 hardcopy image가 포함되었다. 주관적 색채 평가 실험에 참여한 평가자는 모두 26명 이었으며, 이들은 fashion/textile을 전공한 전문가들로서 normal colour vision을 가진 자들이었다. 주관적 실험의 연구는 forced-choice paired comparison method를 이용하여 수행되었다. 객관적 색채 측정의 결과에서는 Yellow를 제외한 모든 hardcopy image들이 채도(chroma)가 낮아졌으며, 색상(hue)이 변화하는 것으로 나타났다. Spectrophotometer를 이용한 객관적 측정치와 1차의 주관적 평가치와는 73%의 일치를 보였으며, 2차의 실험 결과치와는 50%의 일치를 나타내었다. 또한 평가 자들은 색채인식에 있어, 각각의 요소인 명도(lightness), 채도(chroma), 색상(hue)보다는 전체 색차를 나타내는 ΔE 에 더욱 의존한다는 것을 보여 주었다. Fashion/textile산업에서 색채경영은 매우 중요한 분야로서, 앞으로 보다 많은 연구가 이루어져야 할 것이다.