



## Evaluation of customer impressions using virtual prototypes in the internet environment

Chulwoo Kim<sup>a</sup>, Cheol Lee<sup>b,\*</sup>, Mark R. Lehto<sup>a</sup>, Myung Hwan Yun<sup>b</sup>

<sup>a</sup>School of Industrial Engineering, Purdue University, 315 N. Grant Street, West Lafayette, IN 47907-2023, USA

<sup>b</sup>Department of Industrial Engineering, Seoul National University, 599 Gwanak-ro, Kwanak-gu, Seoul 151-744, Republic of Korea

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### ABSTRACT

This study aims to investigate a cost effective and efficient way of analyzing customer impressions on design alternatives by incorporating the benefits of virtual prototyping into the Internet-based experimental environment. It is hypothesized that the results of the Internet-based experiment using the images of virtual prototypes are comparable to those of the virtual reality-based environment using virtual prototypes. Two experiments were conducted. In the virtual reality environment, participants were employed to evaluate virtual prototypes while in the Internet environment participants evaluated images of the same virtual prototypes from their own places. For each experiment, 16 male participants were employed to evaluate 32 different virtual prototypes generated from the combination of 17 design elements of automobile interior. The results of the experiments indicated that there were no significant differences between the two experimental methods while the Internet environment-based method could save considerable time and efforts for experimentation. This study concludes that the Internet-based evaluation method using the images of virtual prototypes could be a cost effective and efficient way of analyzing customer impressions on design alternatives.

*Relevance to Industry:* This study showed that the results of the Internet-based evaluation method using the images of virtual prototypes are comparable to those of the virtual reality-based method using real virtual prototypes. The Internet-based evaluation method could be used as a cost effective and efficient way of collecting and analyzing various customers' impressions on design alternatives at the early stage of product development process.

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### 1. Introduction

The importance of satisfying a variety of customer needs for both basic functional requirements and affective aspects of a product becomes more critical in the era of global competitions and global markets (Dahan and Hauser, 2002; Kwahk and Han, 2002; Keeney, 2004; Chang et al., 2006; Bahn et al., 2009). To incorporate the wide range of customer needs and requirements into the product design, rapid conceptualization and evaluation of potential design alternatives becomes more important than ever. Recent development of new information and communication technologies has drastically transformed product development process. For instance, virtual prototyping technology has been utilized to make rapid visualization and implementation of design alternatives in the early phase of product development (Zhang et al., 2005; Kuo and Wang, 2007; Santos et al., 2009). The use of human simulation systems and three-dimensional

computer aided design also has been utilized as an effective tool to visualize and evaluate the human–workstation interaction (Godwin et al., 2008; Jung et al., 2009). In addition, the Internet environment and web technologies have shown a possibility for capturing the voice of diverse customers with minimal time and efforts (Kuo and Chu, 2005).

Over the decades, substantial research has been conducted to capture the customers' feelings and affective demands on a product and incorporate them into the design of the product. A number of previous studies analyzed the impact of design features on customer perceptions utilizing on-site experiments with the assumption, where affective reactions of customers can be explained by the functional relationship with design features (Nagamachi, 1995, 1999; Ishihara et al., 1997; Matsubara and Nagamachi, 1997; Kim and Moon, 1998; Han et al., 2000; Han et al., 2001; Yun et al., 2001; Kwahk and Han, 2002; Yun et al., 2003; Han et al., 2004; Schütte and Eklund, 2005; Chang et al., 2006; Bahn et al., 2009). In this regard, virtual reality technology has been utilized to visualize design alternatives that best fit customers' feelings and investigate their impact on customers' feelings (Matsubara and Nagamachi, 1997; Nagamachi,

\* Corresponding author. Tel.: +82 2 885 1403; fax: +82 2 889 8560.  
E-mail address: [iehis@snu.ac.kr](mailto:iehis@snu.ac.kr) (C. Lee).