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Feature recognition and shape design in sneakers

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ABSTRACT

Due to the improvements associated with our modern lifestyle, both personal preferences and commercial market value should be considered when undertaking the challenge of new product development. Thus, a crucial research topic is how to design a customized product for consumers. In this study, a feature recognition and shape-design process for basketball sneakers was established that integrated Kansei engineering and artificial neural networks (ANNs), in combination with famous point guards in the National Basketball Association (NBA), as the basis for constructing a topological feature map for sneakers. We used questionnaires to get 20 fans in NBA games to assign a rating value in Kansei adjectives to evaluate 50 basketball shoes and to identify the top 10 NBA point guards. The fans' perspectives combined the psychological and physical scales for the top 10 point guards to establish a gross relationship between sneakers and the point guards. Based on competitive learning in the self-organizing map (SOM), the similarities of the inputs from the Kansei perspective concerning NBA point guards and sneakers can be reduced in their dimensions and grouped into six clusters. A back propagation network (BPN) is proposed to verify the mapping of sneakers onto point guards. The results were validated by comparing them with the target neurons based on SOM feature map. A MATLAB program was developed using SOM and BPN algorithms to verify the groups of sneakers accompanying the point guards. Then, the system can categorize the sneakers that match the players. A feature-based, shape-morphing process for the design of a new style of sneaker was implemented. A model to blend the features was constructed in SolidWorks CAD by choosing any two different shapes from the SOM map. This research was used to add the vast variety of shapes and design of sneakers from the selected SOM feature map to help designers create many different styles in a short period of time.

1. Introduction

Basketball is one of the most popular sports in the world. Many kinds of sports require different kinds of sports shoes. How to design and manufacture a pair of suitable sports shoes has become the main issue in the sports shoes industry. Both the shoes' performance and their aesthetic design should be incorporated to a high standard. The NBA is a professional basketball league, and the games are among young people's favorite sporting events. The use of popular NBA superstars to enhance the consumer's desire to purchase a new pair of sneakers is a well-known marketing strategy. We can build a combination of stars' styles and create a customized shape-curve interface in the design of a sneaker. This new, innovative pattern is different from traditional sneaker design mode. It will provide consumers with a different evaluation model in shoe selection, which will motivate consumers by providing a greater variety of sneakers (Hui & Li, 1998; Lai & Lin, 2006).

In their study of sports shoes, Azariadis et al. (2007) introduced an innovative, computer-aided engineering system, called the "virtual shoe test bed," for the development of new shoe designs. Shimoyama, Seo, Nishiwaki, Jeong, and Obayashi (2011) developed the design optimization of the sole structure of a sport shoe by evolutionary computation and finite element analysis. Shieh and Yeh (2013) proposed a design support system for the exterior form of running shoes by using Kansei questionnaires, principal component analysis (PCA), partial least squares (PLS), and a neural network (NN). The system also showed that the form of the sole in running shoes is the most significant design factor that affects consumers' emotional responses. The PLS-NN provided a better result in training and validation than the PCA-NN model. Foot measurements from 3D scans and a comparison and evaluation with other

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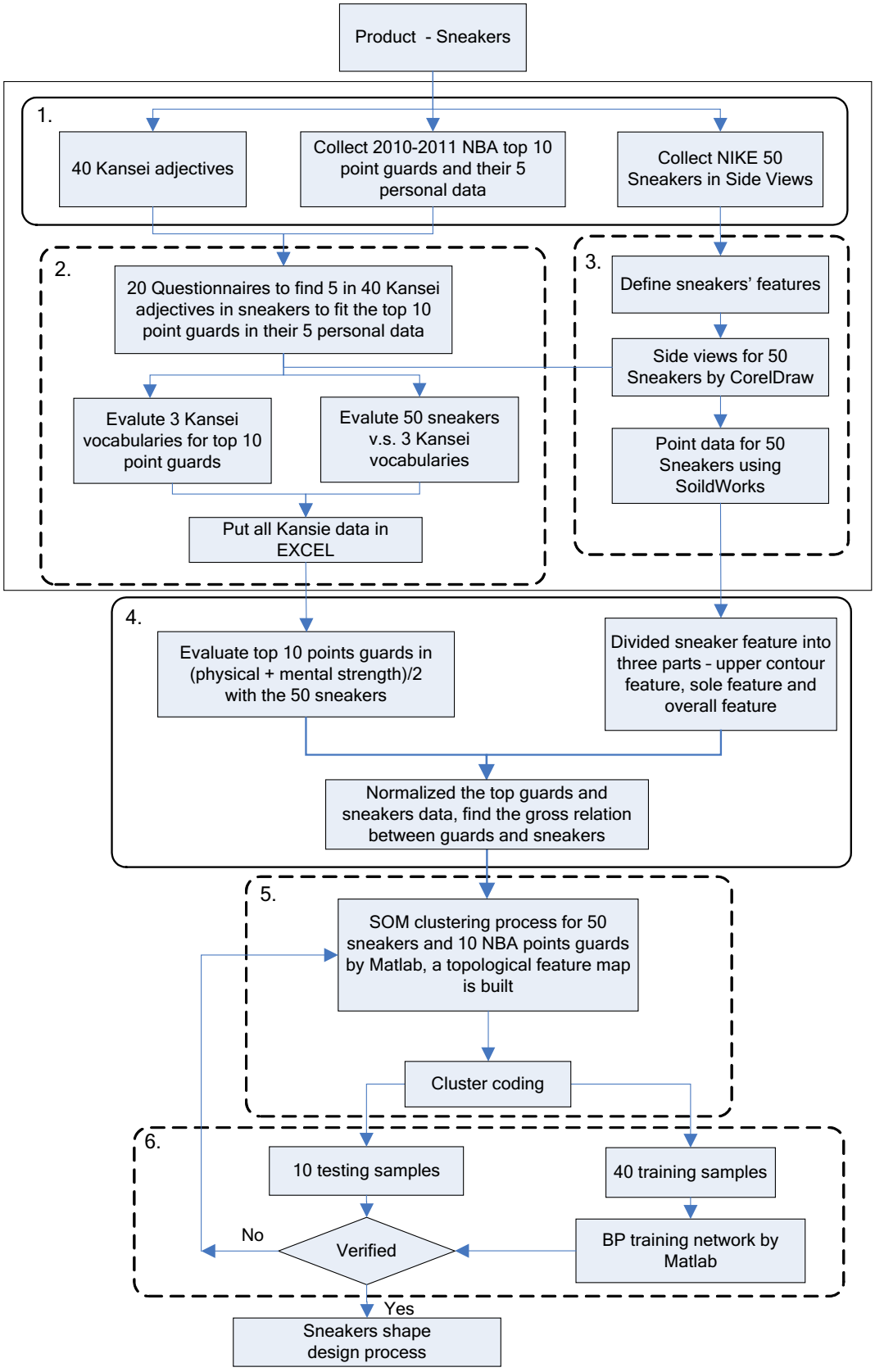

Fig. 1. Research flowchart.

measuring system were introduced by Witana, Xiong, Zhao, and Goonetilleke (2006). Using the scan of the human foot toward a shoe last selection, Wang (2010) explored a good fuzzy logic approach in determining the most suitable last for the foot. A new surface joining technique for the design of shoe last was established by Amoros-Gonzalez, Jimeno-Morenilla, and Salas-Perez (2013).