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A data-driven framework for intelligent product development of wearable health monitoring devices using deep learning

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ABSTRACT

The rapid growth of artificial intelligence (AI) has shifted the development of wearable health monitoring devices toward intelligent design. However, conventional approaches still rely heavily on experience, involve inefficient user requirement acquisition, and lack systematic support for innovation. To address these limitations, this study proposes a data-driven framework for intelligent product development that integrates deep learning, Kansei Engineering, and TRIZ theory. The framework establishes an AI-assisted workflow comprising online data acquisition, requirement identification, knowledge mapping, concept generation, and engineering optimization. First, web crawlers collect user reviews and product images. A convolutional neural network (CNN) identifies form features, while a generative adversarial network (GAN) generates diverse design concepts. Kansei Engineering then maps user requirements to design elements, and TRIZ theory resolves engineering contradictions to support systematic optimization. A case study of smart health watches, using a dataset of nearly 30,000 images and more than 12,000 reviews, demonstrates that the framework can effectively automate requirement extraction, concept generation, and design optimization. Compared with traditional experience-driven methods, the proposed framework significantly improves decision-making efficiency and supports product innovation. This study extends the application of deep learning to engineering design support and provides a transferable methodology for data-driven intelligent product development.

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