"Using artificial intelligence to develop the product design process through digital modeling and simulation"

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Abstract:

The field of product design is considered one of the thriving domains subject to numerous development and updating processes, especially in the face of intense competition in global markets. The goal is to achieve more efficient design processes that keep pace with rapid advancements in production using advanced technologies.

This research paper aims to outline a vision for improving product development stages by utilizing artificial intelligence (AI) technologies, particularly enhancing digital modeling and simulation processes as tools for overall design improvement. The paper conceptualizes the impact of AI technologies, including decision management, vital measurements, machine learning, robotic process automation, and deep learning, on various stages of product design processes. It explores their influence on the inputs and outputs of these processes, as well as their specific impact on modeling and simulation stages, which are crucial in the design process. The paper emphasizes the significance of AI in shaping digital simulations of manufacturing processes through applications that integrate AI, virtual reality, digital twins, virtual manufacturing, and smart manufacturing. Predictive data from AI, resulting from simulations, means fewer tool failure cases, reduced processing time through machine learning (ML), and lower costs for labor and time, ultimately improving product quality.

Integrated assembly operations with machine learning contribute to creating what is known as smart manufacturing, reshaping the entire product lifecycle, including design, manufacturing, and services. Additionally, virtual manufacturing and digital twins provide a highly powerful modeling and simulation environment, enabling the simulation of manufacturing and assembly for any product before actual production. Virtual reality also allows users to immerse themselves and interact with the virtual prototype, resulting in enhanced and integrated systems, elevating the quality and performance of the final products through the integration of these applications.

Keywords:

Artificial Intelligence - Modeling and Simulation - Machine Learning - Digital Twins - Smart Manufacturing.