



Drummers' Functional Apparel: A Virtual User-Centered Product Development Approach

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Introduction: Drumming has gained interests as an alternative means for physical activity due to the required high levels of physical demand and associated health benefits (Ho et al., 2011; Smith et al., 2014). Approximately 2.5 million Americans have participated in some form of drumming and in 2020, an estimated 106,000 drum kit units were sold in the United States alone (NAMM, 2021). Muscular movement, body heat, and perspiration must be properly regulated in drummers to avoid prolonged heat increases, which can negatively affect the body and performance. However, currently there is no apparel specifically designed for drummers to alleviate these experienced effects and only limited studies have focused on designing apparel for musicians to aid their performance (Birringer & Danjoux, 2013; Sokolowski & Lang, 2017). Thus, the purpose of this study was to virtually develop and propose functional drumming apparel guided by identified key drumming design factors and criteria. To fulfill the purpose of the study, a three-stage design process that includes a 1) problem definition and research, 2) creative exploration, and 3) virtual implementation stage (LaBat & Sokolowski, 1999) was used as it incorporates the critical and necessary stages for the assessment of user needs and development of effective functional apparel.

Problem Definition and Research: A preliminary study focusing on 1) the exploration of literature and market, 2) observations, and 3) in-depth interviews was conducted to identify and define the working problem of commercially available apparel worn by drummers and determine drummers' user needs (Villanueva & Min, 2022). The data collected revealed the main problems encountered in current apparel worn for drumming – body movement restriction, increased heat insulation, decreased moisture transfer, and improper fit – and areas of discomfort due to increased muscular movement, body heat, and perspiration. At the upper body, these areas included the face, front and back torso, and upper and lower arms.

Creative Exploration: A series of activities were explored and conducted to effectively design drumming apparel that met and satisfied drummers' identified needs. These included: a) design factors identification, b) design criteria selection through an interaction matrix, c) development of preliminary design ideas consisting of functional features for drumming apparel, and the d) design and development of 2D CAD technical drawings and specifications of drumming apparel using Adobe Illustrator. Five design factors of drumming – thermal balance, mobility, fit comfort, aesthetic, versatility, and ease of care – were determined based on the user research conducted in the preliminary study. These design factors were then translated into design criteria for drumming apparel, which included: 1) provide heat and moisture management, 2) increase air flow, 3) minimal coverage at arms, 4) use of knit and stretchable materials, 5) use of stretchable

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and soft seams, 6) use of dark neutral colors and patterns, 7) comfortable fit at torso and arms, 8) easy donning and doffing, 9) be aesthetically appealing, and 10) be easy to care and launder. Preliminary design and functional features to fulfill the criteria determined consisted of the use of smart and flexible material technology and ventilation methods, contrasting sleeve lengths and seam types, minimalistic styles with proper garment fit, and materials of dark neutral colors with distinct fiber contents and properties. Based on this creative exploration, three drumming tops (DT) were designed, and technical drawings and specifications were established (see Figure 1).

Virtual Implementation: Virtual design activities were performed for the development of each DT. Virtual prototyping enables the exploration of a design through 3D computerized software prior to the physical production of a garment, which allows further improvements towards solving a design problem based on immediate fit evaluations and user feedback (Jhanji, 2018). Similarly, this stage included: a) 3D virtual prototyping simulation process of each DT using Browzwear V-Stitcher, b) fit evaluation of each DT through pressure and tension maps using similar active poses in drumming, and d) working problem evaluation of the proposed DT solutions and user feedback. The simulation process consisted of developing the 2D patterns, selecting the proper materials, 60% polyester and 40% cotton single knit jersey, 145 g/m², and 100% polyester athletic mesh, 100 g/m², to ensure stretchability and breathability, and sewing each DT in a 3D virtual context to simulate the drape. A 360° fit assessment of the key areas of the prototypes – neck, shoulders, arms, and torso – was conducted using virtual pressure and tension maps in the following body poses: 1) arms down, 2) arms forward, 3) arms spread, 4) arms up, and 5) sitting. The overall fit of DT1, DT2, and DT3 was acceptable as no high pressure and tension areas were displayed or observed. An evaluation of the prototypes in relation to the working problem identified followed. First, body movement restriction was addressed using sleeveless and short sleeve options, stretchable materials and seams, and proper fit at the neck, shoulders, arms, and torso. Second, increased heat insulation and decreased moisture transfer were addressed using ventilation panels and vents and proper contact area between the prototypes and the torso. Rendered images of each DT were then used to assess wearing intentions among five drummer participants from the preliminary study. A majority of the drummers would wear the proposed DT prototypes (80%), as well as perceived them as visually appealing (100%) and appropriate for drumming (80%).

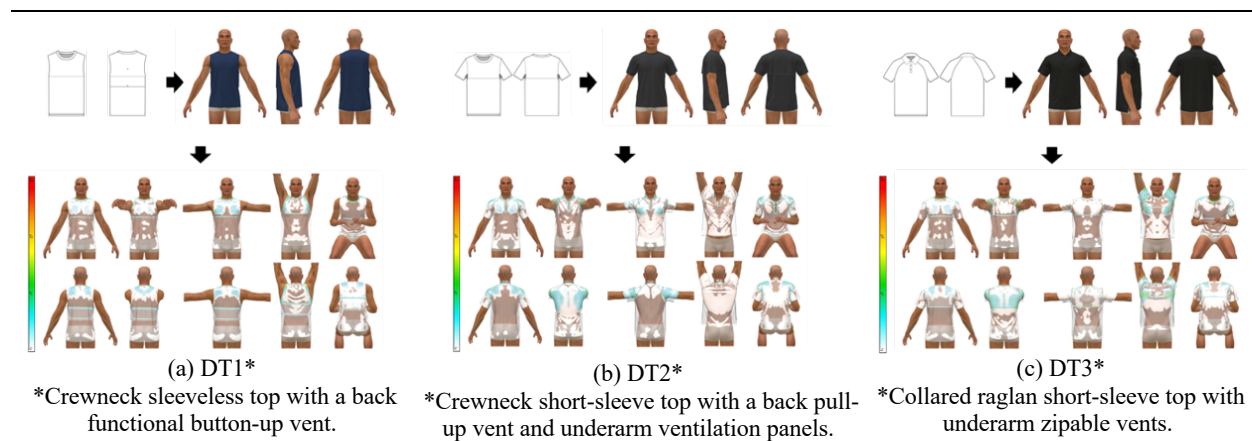


Figure 1. Virtual product development process of each DT through 2D CAD technical drawings, 3D virtual prototyping, and tension and pressure mapping.

Conclusion and Implications: The proposed DT designs and prototypes in this study provide a potential apparel solution for drummers to engage in drumming without sacrificing comfort and visual appeal, which is a frequent challenge. Drum brands and manufacturers can use the identified design criteria to effectively develop and incorporate drumming apparel into their merchandise due to their immediate access to the drummer population. Additionally, an efficient virtual product development approach guided by user data is presented to develop functional apparel solutions for understudied and vulnerable groups in industry and academic settings.

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