

A Design Research Methodology for Light and Stretchable Electrical Thermal Warm-Up Sportswear to Enhance the Performance of Athletes against Harsh Environment

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Abstract : In this decade, the sportswear market rapidly expanded while numerous sports brands are conducting fierce competitions to hold their market shares and trying to act as a leader in professional competition sports areas to set the trends. Thus, various advancing sports equipment is being deeply explored to improving athletes' performance in fierce competitions. Although there is plenty protective equipment such as cuff, running legging, etc., on the market, there is still blank in the field of sportswear during prerace warm-up this important time gap, especially for those competitions host in cold environment. Because there is always time gaps between warm-up and race due to event logistics or unexpected weather factors. Athletes will be exposed to chilly condition for an unpredictable long period of time. As a consequence, the effects of warm-up will be negated, and the competition performance will be degraded. However, reviewing the current market, there is none effective sports equipment provided to help athletes against this harsh environment or the rare existing products are so blocky or heavy to restrict the actions. An ideal thermal-protective sportswear should be light, flexible, comfort and aesthetic at the same time. Therefore, this design research adopted the textile circular knitting methodology to integrate soft silver-coated conductive yarns (ab. SCCYs), elastic nylon yarn and polyester yarn to develop the proposed electrical, thermal sportswear, with the strengths aforementioned. Meanwhile, the relationship between heating performance, stretch load, and energy consumption were investigated. Further, a simulation model was established to ensure providing sufficient warm and flexibility at lower energy cost and with an optimized production, parameter determined. The proposed circular knitting technology and simulation model can be directly applied to instruct prototype developments to cater different target consumers' needs and ensure prototypes' safety. On the other hand, high R&D investment and time consumption can be saved. Further, two prototypes: a kneecap and an elbow guard, were developed to facilitate the transformation of research technology into an industrial application and to give a hint on the blur future blueprint.

Keywords : cold environment, silver-coated conductive yarn, electrical thermal textile, stretchable

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