



## Gracefall: Codesigning a Fall-Protective Winter Coat Technology for Elderly Women

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**Introduction.** As the human body ages, various physical changes occur that can greatly affect the fit and look of clothing previously worn by an individual at an earlier age. However, there is evidence to show that the fit needs of the elderly are not considered by clothing manufacturers (Ashdown & Hyunshin, 2008), which results in clothing options which are ill-fitting and uncomfortable. Additionally, diminished strength, balance, cognition, and other physical consequences of aging increase the likelihood of falls (Alwan, 2008). One-third of the elderly population falls each year (Karlsson, Vonschewelov, Karlsson, Coster, & Rosengen, 2013). Out of 37.3 million falls, 424,000 lead to death (Terroso, Rosa, Torres Marques, & Simoes, 2014). The high-rate of falls amongst the elderly is an area in which designers and researchers alike should be seeking solutions. Therefore, the purpose of this study was to design and evaluate a fall-protective winter coat for elderly women that better fits their body shape and safety needs.

**Related Literature.** The decision to undertake a research project of this scope and structure was made based on a review of literature on elderly falls, as well as on the unmet needs that exist for the elderly in the apparel industry. The changes in body size and shape that elderly women experience are often not reflected in the structure and fit of the clothing offered to the elderly female market (Ashdown & Hyunshin, 2008). Also, falls are a main healthcare problem amongst the elderly, yet many members of the elderly demographic do not use wearable fall protection products because the products are perceived as bulky and aesthetically unpleasing (Alwan, 2008). Most existing products focus on fall detection rather than the prevention of injury, which is one aim of this line of research. Although the needs of this demographic are significantly different than younger populations, elderly females have seldom been consulted directly regarding their clothing preferences and specific needs.

**Methods.** By nature, this is an experimental study. The method selected for this study consisted of three parts. Codesign, as described by Sanders and Stappers (2008), was the theoretical design approach with which the garment was developed and subsequently constructed. The codesign process involved the feedback of an elderly female participant from the beginning of the coat's development to the end. Additionally, a research and development (R & D) process was followed to develop the technology that was ultimately integrated into the garment. Finally, a focus group was conducted with four elderly participants to validate the technology and design of the garment. Each participant was female, over the age of 70, in possession of her full mental capacities and without any physical limitations that would hinder her participation in the study.

**Results.** This study resulted in a first prototype of a coat that represents the convergence of two different product development processes. The coat was designed to fit the elderly female participant and was the final outcome of four garment prototypes, each of which was a result of a

fit session with the codesign participant. The fall protective technology was developed using a 3-axis accelerometer which detects the fall and sends a signal to a microcontroller. The microcontroller connects to a solenoid, which then punctures a CO<sub>2</sub> capsule, causing air to flow through a tube to inflate three rectangular airbags attached inside the coat around the wearer's hips. Although the fall protective system would require further technology evaluation before finalizing the design, the appeal and utility of the concept was validated by a focus group. Members of the focus group stated that although it was important that the technology be as subtle as possible, they would recommend the coat and fall protective system to friends or would use it themselves. Their responses provided insight on three major themes, which were ease of use, expressive preferences, and consumer adoption of the coat. Participant responses corroborated the codesign process as a viable approach for producing wearable products that are well suited to the functional and aesthetic needs of the elderly as well as provide necessary safety systems for fall protection.

**Discussion, Future Research, and Implications.** Future studies on this topic could draw from samples consisting of larger numbers of participants from varied demographic profiles and geographic areas. Future research could also focus on expanding the implementation of the fall protective technology into other arenas, such as skiing or climbing where falls frequently occur. A novel technology was developed in this study, but it is not yet the quality to be commercialized. Further evaluation and modification of the technology are appropriate. True to the concept espoused by codesign, the fall-protective coat developed in this study is one example of interdisciplinary research endeavors among various disciplines including design, science, and engineering. Insights gained from this study urge designers and manufacturers to further explore how they could provide functional yet aesthetically appealing wearable products that protect the elderly population from falls.

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