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Review Article

Enhancing Elderly Well-Being: Smart Chromic and Illuminative Textiles for Health Monitoring, Sensory Engagement, and Movement Promotion

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Abstract

Background: The rapid expansion of the global aging population, combined with caregiver shortages and rising care demands, highlights the urgent need for innovative, non-intrusive, and user-centered solutions in elderly healthcare. While current smart textiles primarily focus on physiological monitoring, few have explored the integration of visual, chromic, and interactive functionalities tailored for older adults.

Objective: This review examines the potential of smart chromic and illuminative textiles—including thermochromic yarns and Polymeric Optical Fibers (POFs)—to support elderly care through intuitive visual feedback, sensory interaction, and gesture-responsive systems.

Methods: This review synthesizes outcomes from co-designed prototypes implemented and evaluated in institutional and community-based elderly care settings, incorporating observational data and subject trials to assess effectiveness, usability, and engagement.

Results: Thermochromic heating textiles offer real-time visual indicators of temperature changes, mitigating burn risks and supporting safe thermal regulation in garments and cushions. Illuminative sensory fabrics provide portable and scalable alternatives to fixed multisensory environments, promoting cognitive stimulation in dementia care. Additionally, AI-enhanced illuminative fabric panels encourage stretching and mobility by responding to posture and gesture through embedded recognition systems—empowering elderly users to engage more actively in physical routines.

Conclusion: Smart chromic and illuminative textiles represent a promising frontier in elderly healthcare. By combining familiarity, intelligent responsiveness, and user-friendly feedback, these technologies provide greater autonomy, safety, and well-being among aging populations. Their integration into diverse care settings offers an impactful, human-centered approach to improving the quality of life in later life.

Keywords: Dementia support; Elderly care; Illuminative textiles; Interactive health monitoring; Smart textiles; Thermochromic fabrics

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Introduction

The global population is aging at an unprecedented rate, bringing about critical challenges for healthcare systems worldwide. According to the World Health Organization, by 2030, one in six individuals globally will be aged 60 or older, and by 2050, this number is expected to double, reaching over 2 billion [1,2]. This demographic shift is particularly pronounced in densely populated and economically advanced regions such as Hong Kong, Japan, and South Korea, where elderly populations are projected to comprise over 37% of the total population by mid-century [3]. As older adults frequently present with complex health issues—including cardiovascular diseases, diabetes, and neurodegenerative conditions—they consume significantly more healthcare resources compared to younger cohorts, further amplifying the strain on already overextended healthcare systems [4-7]. Among these age-related illnesses, dementia stands out as one of the most pressing challenges. Characterized by progressive cognitive decline and loss of independence, dementia currently affects more than 55 million people globally, with approximately 10 million new cases diagnosed each year. By 2050, this number is expected to rise dramatically [8,9]. In regions like Hong Kong, the number of individuals living with dementia is projected to triple by 2039, highlighting the urgency of developing comprehensive and sustainable care strategies [10]. While pharmacological treatments remain limited in effectiveness, non-pharmacological interventions—particularly those involving sensory enrichment and cognitive engagement—have shown promise in improving patients' quality of life [11].

To address the escalating need for elderly care, some governments have implemented initiatives such as community-based care centers. For example, Hong Kong introduced District Health Centres (DHCs) in 2019 to enhance access to primary healthcare services and rehabilitative programs. As of 2023, these centers serve over 200,000 elderly residents [12]. Nonetheless, technology integration in these settings remains limited, with basic digital resources but minimal uptake of advanced solutions such as artificial intelligence (AI) or wearable health-monitoring tools. In addition, older adults often face challenges in adopting new technologies due to reduced digital literacy, technophobia, or self-perceived incompetence—factors that reinforce the existing "grey digital divide" [13].

Amid these challenges, smart textile technologies emerge as promising solutions to support health monitoring, physical activity promotion, and cognitive stimulation in aging populations. Smart textiles are a class of materials that combine traditional fabrics with embedded sensors, actuators, or light-reactive elements, enabling them to interact dynamically with the user and environment [14-19]. These textiles can be designed to monitor physiological data, regulate body temperature, provide visual or tactile feedback, or respond to user gestures. Their familiar, flexible, and non-intrusive properties make them particularly well-suited for applications in elderly care, where comfort, usability, and dignity are paramount.

This review explores the role of smart chromic and illuminative textiles in enhancing elderly care [20-23]. It provides an overview of their application in real-time temperature monitoring, dementia-friendly sensory feedback, and gesture-responsive systems that promote movement and well-being. Additionally, it discusses key design considerations, such as material selection and AI integration, while highlighting real-world examples of co-designed textile systems implemented in community care settings. Through this, the paper underscores the potential of smart textiles to bridge the gap between advanced health technologies and the unique needs of the aging population.

Challenges in Elderly Healthcare

Rising prevalence of dementia

Dementia is a primary public health concern in aging populations, characterized by progressive cognitive impairment that severely impacts memory, communication, reasoning, and the ability to perform daily activities. Globally, more than 55 million individuals currently live with dementia, and this figure is projected to reach 78 million by 2030 and 139 million by 2050 [8]. The burden is particularly acute in rapidly aging societies such as Hong Kong, where the prevalence of dementia is expected to triple from approximately 103,000 cases in 2009 to over 300,000 by 2039 [10].

Despite ongoing research, the effectiveness of pharmacological treatments for dementia remains limited. Most available drugs can only help manage symptoms temporarily, without halting or reversing disease progression [24,25]. This has led to a growing emphasis on non-pharmacological interventions targeting cognitive support, emotional engagement, and quality of life. Sensory stimulation has emerged as a particularly valuable approach, offering multi-dimensional therapeutic benefits. Techniques involving tactile materials, light, sound, and visual stimuli have demonstrated potential in reducing agitation, enhancing orientation, and improving overall mood and engagement for individuals with dementia [26-33]. However, traditional sensory environments—such as specialized multi-sensory rooms—often require significant space and financial investment, limiting their accessibility in densely populated, resource-limited care settings. Consequently, there is an immediate need for portable, scalable, and user-friendly sensory tools that can be implemented flexibly across various care contexts, including community centers and long-term care facilities.

Technology adoption barriers in elderly populations

While digital health solutions, including remote monitoring and AI-enhanced interventions, have shown substantial promise in improving elderly care, the adoption of such technologies remains slow and uneven among older adults. A key barrier lies in the digital divide—the disparity between individuals who have ready access to and understanding of digital tools and those who do not. This "grey digital divide" is exacerbated by technophobia, physical limitations, or self-perceived inability among older users, often resulting from internalized ageism or lack of prior exposure to digital platforms [13,34-36].

In response to the growing healthcare needs of aging populations, the Hong Kong government introduced DHCs in 2019 as a key public health initiative [12]. These centers aim to strengthen community-based primary care through risk assessment, chronic disease management, and rehabilitation services. By the end of 2023, more than 200,000 elderly individuals had accessed services through this initiative. However, the technological infrastructure of the DHCs remains relatively basic. Health services are primarily supported by digital recordkeeping systems and standard diagnostic tools, with minimal integration of AI, sensor-based monitoring, or smart wearable technologies. As such, their capacity to deliver personalized, real-time, and preventive care remains limited.

Overcoming the digital gap requires not only improvements in technology accessibility and interface design but also the development of familiar, intuitive platforms tailored to seniors' sensory and cognitive needs. This is where smart textiles—particularly those integrating visual cues, touch-responsive feedback, and ambient intelligence—emerge as a uniquely suitable solution. Unlike traditional devices which may feel foreign or intimidating, smart textiles blend seamlessly into daily routines, offering non-intrusive ways to interact with healthcare technologies and encouraging broader acceptance among elderly users.

Smart Textile Technologies in Elderly Care

Overview of smart textiles

Smart textiles, also known as intelligent or e-textiles, are materials that incorporate advanced technologies into traditional fabric structures to perform sensing, actuating, or data processing functions [37]. These textiles are characterized by their ability to communicate with their environment or users, enabling dynamic responses to external or internal stimuli. Smart textiles are typically classified into three generations based on their level of functionality:

- First-generation smart textiles are passive systems that include sensors to detect stimuli such as pressure, temperature, or moisture but do not respond to them [38,39]
- Second-generation smart textiles are active systems that not only sense but also include actuators capable of responding to stimuli (e.g., heating, light emission, or fabric color change) [38]
- Third-generation or "very smart" textiles are embedded with microprocessors or AI algorithms that allow integrated sensing, monitoring, decision-making, and adaptive responses, forming a closed-loop interaction system [38]

These functional textiles often combine sensors, conductive yarns, shape-memory alloys, or optoelectronic fibers to achieve specific capabilities [15]. Integrated elements may measure physiological parameters, transmit data wirelessly, deliver therapeutic modalities, or respond to user gestures and environmental inputs [21,22]. In elderly care, the applicability of smart textiles holds substantial potential across preventive care, rehabilitation, safety monitoring, and sensory stimulation [20,21,23]. Their lightweight, flexible, and familiar form factors make them especially suitable for older adults, who may face challenges with more rigid or technical devices. By embedding digital functionality into everyday items such as garments, cushions, or interior furniture, smart textiles can facilitate unobtrusive health surveillance and engagement tools—promoting aging in place, reducing caregiver burden, and enhancing quality of life for older individuals.

Sensor-based smart textiles

Sensor-based smart textiles represent one of the most mature and widely explored categories within the field. These systems commonly integrate biosensors or conductive fibers within textiles to monitor a range of health-related physiological parameters such as Heart Rate (HR), respiratory rate, Blood Pressure (BP), temperature, and skin conductivity [40]. Data is typically collected through embedded electrodes or conductive yarns, and then transmitted via Bluetooth or Wi-Fi to a monitoring device or application for real-time analysis [41]. In the context of elderly care, these sensor-based textiles support personalized and continuous monitoring, which can facilitate early detection of medical anomalies such as arrhythmias, febrile conditions, or blood pressure fluctuations. Products such as smart shirts, socks, and bedding have been developed to support passive ongoing health assessment without requiring active patient participation, offering particular value for individuals with limited mobility or cognitive difficulties. In addition to health monitoring, sensor-integrated smart textiles have also been applied in systems for fall detection and physical activity tracking, both critical areas in geriatric care [42]. Falls remain a leading cause of injury and hospitalization in older adults. Sensors such as accelerometers and gyroscopes embedded in garments or footwear are capable of detecting abnormal movements and sending alerts to caregivers or healthcare personnel in real time [43]. These systems often use threshold-based algorithms or AI-powered classifiers to distinguish between accidental falls and safe movements, offering a potential reduction in injury-related hospitalizations through fast intervention.

Despite these advantages, current sensor-based textile systems exhibit several limitations. First, many designs prioritize engineering performance but neglect user comfort, aesthetic acceptability, or manufacturability—factors crucial for real-world use among elderly adults. Second, while data collection is robust, sensory feedback integration —such as visual, tactile, or thermal signals to inform the user of system activity or health states—is still underdeveloped [44]. This lack of feedback can make the technology feel passive or disconnected from the user experience. Furthermore, interoperability issues, miniaturization of components, battery life, and data privacy concerns continue to be significant technical and ethical challenges [45]. To enhance adoption and long-term usability, future developments must focus on fully integrated, feedback-enabled systems that are user-centered, adaptive, and personalized for the diverse needs of aging individuals.

Smart Chromic and Illuminative Textiles for Aging Populations

Smart chromic and illuminative textiles represent a new frontier in elderly care, offering real-time feedback, visual communication, and interactive engagement without relying on digital interfaces that may be difficult for older adults to navigate. These textiles not only improve the safety and comfort of wearable devices but also promote sensory stimulation, cognitive engagement, and physical activity—key elements in successful aging. Emerging innovations in thermochromic and illuminative fabric systems have shown promise in addressing the limitations of traditional tools in both institutional and community-based elderly care settings.

Thermochromic heating textiles

Heating electronic textiles (e-textiles) are commonly used in personal thermal comfort systems to help elderly individuals maintain body temperature and prevent cold-related stress. However, conventional solutions rely heavily on manual heat adjustment—typically via mobile applications or preset control systems [46]. These systems pose two major risks in the context of aging users: low-temperature burns caused by prolonged exposure to seemingly mild heating levels (typically 44-50^{o}C), and an inability to detect and react to temperature fluctuations due to reduced thermosensitivity in older adults.

Thermochromic yarns and Polymeric Optical Fibre (POF) offer a novel solution to these challenges by visually indicating heating levels through dynamic color changes when the textile surface reaches specific temperatures [20,21]. This visual feedback allows caregivers and users to monitor temperature levels in real time without relying on small display screens or digital interfaces. For older users with deteriorating vision or cognitive limitations, this intuitive color-based system can greatly reduce the risk of overheating. Material structure plays a critical role in the performance of thermochromic heating textiles. Woven fabrics, with their tightly interlaced yarns, tend to offer better thermal conductivity and heat distribution, while knitted fabrics provide greater softness and flexibility, making them ideal for garments or direct contact applications. Experimental prototypes have been fabricated using thermochromic yarns, silver-coated conductive yarns for heating, and natural insulating fibers such as cotton, soybean, or wool. Double-layer woven structures demonstrated superior heating efficiency and more distinct color changes than single-layer or knitted variations. These fabrics have been adapted into heating cushions and jackets designed for elderly individuals, combining thermal comfort with safe, visually trackable self-regulation.

To further improve safety and personalization, AI has been integrated into thermochromic heat-regulating systems [21]. These systems utilize Artificial Neural Networks (ANNs) trained on user-specific and environmental data to optimize heating parameters in real time. Key adaptive strategies include:

- Adjusting heat levels based on the user's age, gender, weight and height
- Sensing external environmental factors such as room temperature, humidity and airflow
- Responding to real-time physiological data captured through embedded textile-based sensors

Using a trained ANN model, the system can maintain an optimal thermal range within 40-50^{o}C, tailored to individual comfort needs while minimizing the risk of overheating. Early trials demonstrated high accuracy in temperature prediction and control, with significant improvement in skin comfort and reduced caregiver intervention. A subject test involving fifty healthy participants was conducted. Participants wore a cotton T-shirt under the thermochromic heating jacket and remained seated in a climate-controlled chamber under two conditions: Case 1 (21^{o}C, 60% RH, 3 m/s airflow) and Case 2 (17^{o}C, 70% RH, 0 m/s). After a 15-minute acclimation, heating was gradually increased from 40°C to 50°C over 10 minutes (1°C/min). Skin temperature at the upper back was recorded using a thermocouple, and comfort sensation was rated every minute using a Semantic Differential Scale (-3 to +3). Data including ambient temperature, RH, air velocity, and heating temperature were logged for ANN model training. ANN model was developed to predict the optimal heating temperature for maximum thermal comfort based on inputs including age, gender, height, weight, ambient temperature, humidity, and air velocity. A total of 100 datasets were collected from subject tests; 80 were used for training and 20 for testing. The final ANN architecture included four hidden layers, optimized using ReLU activation functions and the Stochastic Gradient Descent (SGD) solver. The model was trained with a regularization parameter (alpha = 1e-08) and adaptive learning rate to minimize Mean Squared Error (MSE), achieving its lowest MSE at 5.083. The validated model was integrated into the intelligent thermochromic heating jacket and tested on a new subject under controlled conditions. The ANN-predicted temperature (47 ± 0.5°C) closely matched the subject's reported peak comfort level, demonstrating strong predictive accuracy and thermal comfort alignment. This integration of thermochromic feedback with AI-driven regulation offers a safe, responsive, and elderly-friendly solution to personal heating care, providing caregivers and users alike with clear, real-time indicators and enhanced autonomy.

Illuminative sensory textiles for dementia care

Sensory stimulation has been proven to play a significant role in dementia care by promoting cognitive function, reducing agitation, and enhancing emotional well-being. However, in densely populated urban centers such as Hong Kong, creating fixed multisensory environments—such as "Snoezelen" rooms—can be cost-prohibitive and spatially unfeasible due to limited facility size and high occupancy rates [47]. As a more accessible alternative, portable and multifunctional textile-based sensory tools have been developed [23]. These tools combine the softness, familiarity, and wearable nature of textiles with illuminative and tactile features that can respond to touch or body movement. Their seamless integration into daily life environments makes them particularly suitable for elderly individuals with advanced cognitive decline.

Previous design efforts include projects like "Tactile Dialogues" and "Sensor e-textiles," which offered tactile or auditory stimulation but were limited by single-sensory input and lack of scalability. Furthermore, a large-scale sensory wall designed using POF illuminated textiles offered rich engagement but proved impractical due to installation requirements and space limitations. To address these shortcomings, a co-design approach was adopted to create flexible and scalable textile sensory tools in a form of cushion [23]. In collaboration with textile designers, engineers, caregivers, and occupational therapists, a user-centered prototype was developed and tested in a hospital-affiliated dementia care setting. A total of 20 residents (mean age 87.35) with late-stage dementia were recruited from a Care and Attention home between November 2023 and March 2024. Each participant completed two treatment sessions using novel illuminative cushions and two control sessions with conventional vibrating cushions. Sessions were standardized in structure and delivered by the same occupational therapist. Engagement level was assessed using the Observational Measurement of Engagement. Results showed significantly higher engagement during the treatment sessions (mean score = 4.73) compared to control (mean = 2.64, $p < 0.001$). Notably, 90% of participants were engaged for more than half of the time with the novel cushions, compared to only 50% with the control. Participants responded positively, often touching, exploring textures, and verbally interacting with the cushions. The resulting illuminative textile cushions, embedded with POF and touch-responsive circuits, allowed dynamic light stimulation based on user interaction. Feedback indicated enhanced engagement, emotional responsiveness, and ease of integration within routine care activities, particularly in settings lacking dedicated sensory rooms.

Illuminative textiles for stretching and mobility promotion

Physical inactivity and progressive frailty are common challenges among older adults and can significantly affect independence and quality of life [48]. To address this, interactive illuminative textile wall panels have been developed to promote stretching, posture awareness, and body movement through gesture-responsive visual cues [22]. These panels were designed using an AI-driven co-design framework and installed at the Wong Tai Sin District Health Centre (WTSDHC) in Hong Kong. The system incorporated knitted POF and an embedded microcomputer equipped with a real-time deep learning-based landmark detection model. This model detects hand, shoulder, and head positions through a live camera feed—processed discretely without image storage—and responds with corresponding visual feedback (e.g., illuminating color patterns) on the fabric's surface. Gesture recognition is enabled through a lightweight neural network capable of tracking up to 33 body landmarks, making it possible to distinguish between different physical postures and movements. Based on the gesture classification, specific LEDs embedded in the textile were activated via optically linked fibers to encourage stretching or joint articulation. Feedback collected through user interviews and OT evaluations revealed high levels of acceptance, with elderly participants reporting improved motivation to engage in movement-based exercises. The softness and familiarity of fabric-based systems helped reduce technological intimidation, while the responsive visual cues offered real-time encouragement for movement and engagement. This novel application highlights the potential of smart illuminative textiles as motivating, interactive tools for improving physical activity, mobility, and emotional well-being among older adults in both clinical and community care environments.

Design Considerations for Elderly-Oriented Smart Textiles

The effective integration of smart textiles into elderly care requires thoughtful attention to user experience, technical function, and the specific needs of aging individuals. For this population, comfort, familiarity, ease of use, and perceived safety are crucial determinants of technology acceptance. Therefore, designing smart textile solutions for older adults must go beyond technological capabilities to encompass sensory appeal, ergonomics, co-creation, and sustainability.

Material selection

Material choice plays a pivotal role in shaping the comfort, safety, and usability of smart textile applications in elderly care. Older adults often experience changes in skin integrity, thermoregulation, and tactile perception, making them more sensitive to surface textures, temperature fluctuations, and pressure [49]. As such, fabrics intended for prolonged contact with the skin must prioritize sensory comfort and user preferences [46]. Woven and knitted fabrics are the two most commonly used textile structures in smart textile development, each offering distinct benefits [50,51]. Woven textiles, created by interlacing warp and weft yarns, offer excellent dimensional stability, durability, and consistent heat distribution—qualities that are advantageous in thermochromic heating textiles where precise temperature control is necessary. However, woven fabrics may feel stiffer and less pliable, which can be a disadvantage for applications requiring close contact with the body. In contrast, knitted textiles—formed through interlooping yarns—naturally provide increased softness, stretchability, and flexibility, which contribute to wearer comfort. These properties are particularly important for older users with mobility or sensory limitations, as they offer a more adaptive and easy-to-wear solution. Knitted fabrics are often favored in garments, underlayers, or cushions designed for direct skin interaction due to their gentle hand feel and breathable structure.

Beyond texture, other key factors include breathability, to prevent skin irritation and overheating; elasticity, to ensure proper fit and movement; and hypoallergenic properties, which are critical for sensitive or fragile skin. Importantly, smart textile components—such as conductive yarns, thermochromic fibers, or POFs—must be integrated without compromising the overall tactile experience or causing structural rigidity. Material selection, therefore, must balance technical performance with sensory compatibility. Choosing appropriate combinations of functional and comfort-enhancing fibers is essential for ensuring that the final product meets both technological and human-centered performance requirements.

Co-Design with end users

Incorporating the perspectives of end users is a fundamental principle of designing effective assistive technologies, particularly in geriatric and dementia care. A co-design approach ensures that smart textile solutions are not only technologically sound but also contextually relevant, emotionally resonant, and practically implementable within real-life care settings. Key stakeholders in the co-design process typically include older adults, caregivers, occupational therapists, nurses, rehabilitation specialists and textile designers. Each group offers valuable insights: older adults can share preferences and usability concerns; caregivers and therapists provide practical feedback on workflow integration, therapeutic needs, and risk management; and design professionals translate these insights into tangible, functional design solutions.

In the development of several smart textile systems featured in this review, the Double Diamond design model was used to guide the creative process [52]. This model includes four iterative phases:

- Discover, where user needs are explored through interviews, observation, or literature review
- Define, where insights are synthesized into design goals
- Develop, where prototypes are created collaboratively
- Deliver, where the final product is tested, iterated, and implemented in real-care environments

Applying this structured approach promotes innovation while staying grounded in user realities. For example, co-design workshops conducted in a WTSDHC led to the successful development of soft, gesture-responsive textile panels tailored for elderly users [22]. The involvement of participants at every stage—from early ideation through testing—helped ensure that the solution not only met therapeutic goals (e.g., movement promotion or sensory stimulation) but also aligned with practical care workflows and user comfort requirements. Additionally, the co-design model facilitates sustainable and scalable implementation. When stakeholders feel ownership over a design, its acceptance increases, making real-world application and institutional adoption more likely. As smart textiles continue to mature, embedding co-design methodologies in the development cycle will be critical to producing solutions that are safe, appealing, and impactful in everyday elder care.

Future Directions and Opportunities

As smart textiles continue to transform the landscape of elderly healthcare, there are several strategic pathways that can accelerate their integration into clinical and community settings. Beyond technical advancements, the future success of these systems will rely on personalization, scalability, interdisciplinary cooperation, and responsible deployment.

Integration of AI for personalization and autonomy

AI offers exceptional potential to enhance smart textiles through real-time adaptation to user-specific needs and environmental conditions. Future smart fabric systems could integrate AI not only for temperature control or motion detection but also for proactive health management—such as recognizing early signs of cognitive decline, detecting sleep disruptions, or predicting fall risk patterns. With continual learning from behavioral and physiological data, AI-integrated textiles may transform into intelligent caregiving companions that support autonomy and aging-in-place for older adults.

Scaling up smart fabric prototypes for mass production

While numerous prototypes have demonstrated feasibility in small-scale trials, broader impact depends on the ability to transition these innovations into scalable, affordable and manufacturable products. Future research and development should focus on simplifying integration processes for functional elements like sensors, conductive yarns, and optical fibers to maintain durability and washability. Partnerships with industry stakeholders—including textile manufacturers, healthcare providers, and distributors—will be essential to bridge the gap from lab-based innovation to widespread commercial adoption.

Cross-disciplinary collaboration opportunities

The successful development of elderly-oriented smart textiles necessitates continued collaboration across diverse fields, including textile engineering, human-computer interaction, AI and data science, geriatrics, occupational therapy, and healthcare policy. Design teams must remain inclusive of primary stakeholders—particularly caregivers and older adults—to ensure outcomes that are both technically robust and human-centered. Interdisciplinary cooperation will be the cornerstone of developing adaptable, ethical, and culturally responsive textile systems for aging societies around the world.

Addressing ethical considerations and data privacy

As smart textiles increasingly incorporate data collection and AI decision-making, ethical concerns must be addressed. Transparent data practices, informed consent protocols, and respect for user autonomy are paramount. Sensitive health data collected through biometric sensors or gesture recognition systems must be protected through robust encryption, limited access, and compliance with data protection regulations such as General Data Protection Regulation (GDPR) or local equivalents. Future innovations must balance assistive functionality with ethical responsibility and digital dignity for elderly users.

Conclusion

Smart chromic and illuminative textiles represent a compelling advancement in the future of elderly care. By combining real-time feedback, interactive visual and sensory experiences, and AI-enabled personalization in a familiar, non-intrusive format, these technologies offer unique advantages for safety, comfort, and engagement. Whether enhancing thermal awareness through thermochromic yarns, promoting cognitive stimulation in dementia care with illuminative cushions, or encouraging movement through gesture-responsive fabric panels, these innovations exemplify how design and technology can converge to meet the complex needs of aging populations.

With thoughtful material selection, inclusive co-design, and meaningful collaboration across disciplines, smart textiles can offer older adults greater autonomy, improved well-being, and a higher quality of life. As these systems develop and scale, they promise not only to support caregivers and healthcare providers but also to empower elderly individuals to age with dignity, independence and connection. Through continued research, design innovation, and ethical foresight, smart chromic and illuminative textiles can redefine the fabric of elderly healthcare for generations to come.

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