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Functional clothing: A review

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Abstract

Clothing also known as attire or apparel, used for covering the body and protection purpose. The aim of designing is create more than creativity, which possesses both aesthetic and functionality. It is entails conceptualization of the needs of the wearer and accommodating the solution. According to functionality, apparel works in two directions namely – Physical aspects and performance aspects, Aesthetic performance refers to attractiveness. Performance aspects provides standard and benefits through aesthetic and functional performance. Functional clothing includes multiple performance aspects other than appearance and basic protection. Presented review paper discussed on concept of functional clothing, need, development and future aspect in textile and apparel industry.

Keywords: Functional clothing, design engineering, smart textile, special need

1. Introduction

Clothing also known as attire or apparel, used for covering the body and protection purpose. According to Sproles and burns (1994) that, all clothing (including garments) worn by people fulfill intrinsic and social psychological needs. The intrinsic function includes protection, modesty, immodesty, adornment etc. Social psychological functions of cloths understood as the functionality of cloths attend to need, society, symbolic norms, social affiliation and desire. The aim of designing is create more than creativity, which possesses both aesthetic and functionality. It is entails conceptualization of the needs of the wearer and accommodating the solution. Dehhia documented in their article in functional attributes (2015) that, according to functionality apparel works in two directions namely – Physical aspects (what the garments is) and performance aspects (what the garments does). In other term, Physical aspects provides a tangible form and composition to a garment which includes the garment's design, materials, construction and finish, Example - loose or fitted, cotton or blended fabric. Performance aspects provides standard and benefits through aesthetic and functional performance. Aesthetic performance refers to attractiveness. It is subject of perception and visual sensation, Influenced by color, style, garment fitting, fashion compatibility, fabric construction and finish. In the broad sense, aesthetic is the reaction of pleasure and satisfaction derived from human sensations through experiences of sight, smell, touch, hearing, and taste. Aesthetics involves understanding value. Functional clothing includes multiple performance aspects other than appearance and basic protection, can be defined as those garments, which prepared by combination of technical textile and pattern engineering/designing and fulfill the needs of users, according to their requirements such as Physiological needs, biomechanical reasons, ergonomics and psychological needs. In other words, we can say that, functional clothing would normally be made from mix of innovative material and functionality, which increase value, performance and functionality of expected garments. Physiological requirements are related to the human physiological and anatomy such as shape, size, mass, strength and metabolic activities of the body, which gives comfort, feel to the human body. It is extremely complex subject to predict the comfort aspects of a garment accurately. It can be possible through - shape, size, feel, design, and properties of selected textile material (heat evaporation, moisture absorbency, clothing thermal properties etc.) of the garment. Physiological needs, also related to the kinematic, dynamic and behavioral analysis or biomechanical characteristics of human activity. Generally considered specialized garment category such as sports-cloth. Functional garments are also prepared due to reasons of ergonomics requirement such as degree of freedom, moments of human joints, force, posture, health etc. of human body.

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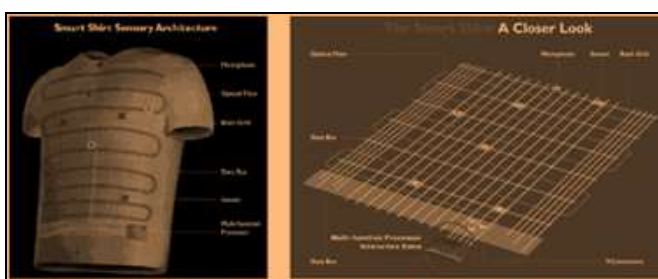
The impact of psychological needs on functional clothing creates according to human thinking, feeling, act, social behavior and interest. Circumstances, culture, social behavior preferences, expectations, work profile, activity all may be considered as factors of psychological requirement. Therefore, we can say that, aesthetic aspects are not very important in designing of functional clothing. According to needs it may considered in functional clothing.

2. Category of Functional Clothing

As per requirements and parameters functional clothing can be categorized in following sections: Protective Functional Clothing, Medical Functional Clothing, Sports Functional Clothing, Vanity Functional Clothing, Cross Functional Clothing and Clothing for special needs



2.1 Protective functional clothing



Protective functional clothing, is one of the most largest and diverse segments of the functional clothing. The designing of the protective functional clothing is related to environment hazards (such as extremely heat, cold, fire, wind, snow etc.) biological, chemical and radiation hazard and injury protection subject. The designing of the protective clothing is a challenging subject, which offers maximum protection without affecting the metabolic heat transmission, body's thermal balance, weight and volume of material, better moisture management, chemical and radiation protection etc. For example - in the case of extreme environment conditions - natural and man-made in both conditions required desired protection. Clothing for doctors and health workers constitutes a major portion of biological protective clothing; while industrial and military clothing has designed for provide protection from chemicals and radiation hazards. Sometime Protective clothing is also required for protection from cut,

rashes, rubbing, and ballistics during working.

2.2 Medical Functional clothing

Medical functional Clothing such as medical gown, gloves, aprons, and mask has been used for medical treatments from long time back ago. It was basically used for many purposes such as surgery, wound protection, burn injury, venous and lymphatic disorders etc. The major functions of these clothing are to protect from the bacteria, viruses and body fluid infection. Such products are covered under the protective functionality. Medical functionality now encompasses much wider and sophisticated applications to cover therapeutic, bio sensing, emergency care and rehabilitation activities. Pressure therapy imparted through compression garments is a well established line of treatment for hypertrophic scars, burn injuries, venous and lymphatic disorders. Pressure is imparted by use of stretch fabrics containing elastic yarns. Pressure garment provide support to paraplegics, neonates, elderly, pregnant and nursing women and patients. Bio-sensing clothing is one of the most recent and exciting category of medical clothing which has worn next to the skin used to map critical physiological parameters like hear rate, pulse rate, body temperature etc. New researches are working towards these types of innovations and development. Such items are not covered under medical clothing but are classed under devices. Intelligent Medical Clothes is a key topic for the future. Developments in telecommunication, information technology and computers are provides many possibilities in the field of medical textiles. Recent developments on smart garments, designed for medical usage owing to their electronic functions are introduced. Intelligent or smart Clothing" is made from fabrics that are wireless and washable that integrate computing fibers and materials into the structure of the fabrics. This technology represents a quantum leap in healthcare monitoring, producing accurate, real-time result. Georgia Institute of Technology is a university, developed a "Wearable Motherboard" (GTWM), which was use under the name "Smart Shirt". The Smart Shirt allows the comfortable measuring and/or monitoring of individual biometric data, such as heart rate, respiration rate, body temperature, caloric burn, and provides readouts via a wristwatch, PDA, or voice. Biometric information is wirelessly transmitted to a personal computer and ultimately, the Internet. Scientists at the University of Wollongong in Australia are developing a 'smart bra' that will change its properties in response to breast movement, giving better support to active women when they need it most. Intelligent medical clothing and textiles have the potential to substantially change the provision of health and health care services for large population groups, e.g. those suffering from chronic diseases (such as cardiovascular, diabetes, respiratory and neurological disorders) and the elderly with specific needs. In future e-Textiles, sensing, processing and communication capabilities are integrated in a woven structure to monitor biomechanical variables and physiological signals. This requires research on new fiber electro-conductive materials. This kind of products could even make virtual medical exams possible. A patient would wear one of the shirts and a physician could monitor the vital signs from a remote location via the Internet.

Kadim N. & Lioya K. (2018) wrote in their review paper entitled "Sustainable Personal protective Clothing for healthcare Applications: A Review" that, there are several different types of medical clothing products, usually made of synthetic fibers due to better liquid barrier properties, could

be manufactured using nonwoven, weaving or knitting technologies. Non woven fabrics are typically made from polypropylene and polyester; usually have a spun bond-melt blown-spun bond (SMS) construction. In contrast woven fabrics typically made from cotton or polyester/cotton/Viscose/blends. Medical textiles are typically soft goods used for healthcare and hygiene applications. Such textiles are broadly categorized into implantable (vascular grafts, artificial ligaments etc.) non-implantable (wound dressing, bandages and pressure garments), extracorporeal devices (artificial kidneys, artificial lungs, liver etc.) and protective, hygienic and healthcare products (surgeons and operating theater wear and medical staff wear). The properties of protective clothing are defined by the physical and chemical properties. Less absorbency or Hygroscopic nature, surface tension, viscosity, density, pore characteristics and twisting of yarn and manufacturing techniques are generally consider as properties of medical clothing.

2.3 Sports functional clothing

Sportswear is the most versatile and fastest growing segment of the performance clothing market. The popularity of sport wear industry has increased day by day. The main characteristics of sports functional clothing are moisture management, quick moisture transport, temperature management, odor control, lightweight and fit. The designing of sports functional clothing govern by two main principles – application of compression on specific muscles to increase blood flow and application of principle of aerodynamics to reduce wind or air drag in high speed sports. Both principles can be used in combination or individuality, depending on the requirements. Aesthetic aspects also an important criterion of designing of sport wears. Guru R. & Kumar A. (2021) ^[3] wrote in their study on Functional Textile for Active Wear Clothing is that, Moisture management property is an important aspect of any active wear fabric, which decides the comfort level of that fabric. Author says that, The moisture management finish (MMF) and Antimicrobial finish (AMF) can be increased moisture absorbency and improve wetting action. Author studied on influence of MMF and AMF finishes on moisture management property of different knitted active wear fabrics. For the study they took two different knit fabric 100% polyester and 100% Nylon. They found in result that, at certain concentration level as the fabric GSM increases the value of accumulative one way transport index (OWTI) %, water vapour permeability but same time drying rate increases. HDS finish provides a surface finish on the fiber surface to increase its moisture management property. The HDS softness creates and increases core hydrophilicity and softness to the fabrics. Bajpai J & Kapoor G. (2021) ^[2] focused on their article: “Interpreting The Functional Properties of Sportswear” that, physiological, biomechanical and ergonomics properties form an integral part of sportswear, that enhance the overall performance and efficiency of the wearer by imparting physical comfort, reducing physical exertion, enhancing speed and mobility and reduction of risk due to injury. Psychological properties in sports wear like color, design elements; prints have profound effect on the mind of the sportsman that can impart physical as well as mental boost.

2.4 Vanity Clothing

Vanity Clothing is a unique category of functional clothing, which used to enhance body aesthetic. The principle of vanity clothing is to create artificially sculpted and perfect shaped

body. For the achieving of the better results and desired properties, there may used many techniques like padding, molding, wiring, special seams and construction etc. Various types of garments and undergarments, are available in the market, that can creates slimming and flattering effect on different parts of body like stomach, waist, hip, thigh etc. Nilufer Z. & Krishn A. (2012) ^[7] reported in their study topic on *Imagining Thin: Why Vanity Sizing Works* that, vanity sizing enhances positive mental imagery, irrespective of self esteem level, supported by the theory of compensatory self enhancement.

2.5 Cross- functional clothing

This class of functional clothing represents multitasking parameters of clothing. These clothing are worked to perform across several complex functionalities at the same time for example space suit both and military clothing. For achieving of desired parameters, varied materials ranging from metals, ceramics, composites, high performance polymers electronic textile can be used. New researches are continuing working in this direction. Ibharim M. & Tajuddin R. (2021) ^[5] worked on multifunctional clothing. The objective of the research were to design a range of multifunctional clothing, they added a creative values, which can be transformed into multiple usages, styles and looks. They found in their research on “Zero Waste Concept of Multifunctional Clothing Design” that, the application of the zero waste concepts would improve the functional features, which could sustain the garment worn for a long period. Annad N. (2012) worked on “Smart Maternity Wear” and they explored the possibility of using features to make the maternity wear fit well and hence remain serviceable pre-pregnancy, during-pregnancy and post pregnancy periods. Designs of the garments were achieved through- pattern styling and construction Pattern Engineering and fabrics selections. She found the garments were well appreciated by the target group as they provided good styling, fit and comfort with longevity. Mansour O. (2019) studied on transformation concept on multifunctional designs for women. The aim of study was to explore the feasibility of extending multifunctional product and how to enable newly developed product to be both safari clothing and various utilitarian items. For the achieving of objectives they worked on aesthetic properties and transformed on designs. They find out that the multifunctional transformation design is an effective way to solve material wastage of product manufacturing, improve utilization frequency of products and meet the basic needs of consumers.

2.6 Clothing for special needs

This segment of functional clothing is designed for those peoples, who face critical situations due to reasons of disabled life, paraplegics, pregnancy and so on. Studies are shows that, these peoples are very sensitive about their clothing. They want special design and pattern engineering in their clothing, which provide feel good and comfortable factors. This type of requirement can be create through pattern engineering, special trims and accessory fabric material and design techniques. Imran A. & Dreean E. (2012) studied on topic disabled and elderly people on the topic of Adaptive bra designs for the individuals with special needs. The purpose of study was to add feature in Bra design will offer benefits to the wearer that include independence, conformity to culture, concealment of the disability, comfort, psychological contentment, safety and durability, which promote harmony between functionality and aesthetics. Researcher also worked on E- Bra, which enables

for monitoring and pathological changes of the body. Purwar S. & Jaiswal A. (2018) studied on Adaptive clothing: A Smart solution for Arthritis Impairment, after collection of data, they prepared prototype of functional jacket for arthritis patient. Designs of the garments were achieved through- pattern styling, Pattern Engineering and fabrics selections. They found the garments were well appreciated by the target group as they provided good styling, fit and comfort.

article/395/intelligent-medical-garments
<https://www.hospitalmanagement.net/features/feature104447/>

3. Material selection and required efforts

So we can say that, functional clothing provides comfort and protection from external conditions. In some cases it performs extremely, such as fire, radiation, microbes, viruses, medical and many more. Material selection for functional clothing is a difficult task. It is all depends on requirement and objective of the functional clothing. Innovative fibers with special properties, technologies, chemical and mechanical finishes all are important elements, which make high performance functional clothing. Now a variety of materials are developed and available, such as stretch fabrics – which support to mobility, muscle alignment and compression. Smart textiles, such as chromatic materials which change color, phase change materials for thermal regulation, E- textile, which can be exhibit sensing behavior and reaction. Nano-fibers also used for functional clothing. For the construction of special functional clothing, may be required special pattern engineering, style, fit, trims and accessories. Design and engineering of functional clothing is a complex and challenging process. User requirements and conditions of use play a critical role in the entire process of design, manufacture and testing. Availability of innovative material and technology has made the opportunities for the development of new and innovative clothing. Joint efforts of engineers and designers can be create a new direction and development.

4. Conclusion

Functional clothing is a new and wide area of technical textile. Each area has its own specification, parameters, requirement and technology. This field requires intense research and development inputs, research data, guidelines, global and regional focus and procedure. Active support and participation by researcher, industrialist, scientist and designers can provide big efforts to this sector.

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