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Adaptive bra designs for the individuals with special needs

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Abstract. Nowadays the numbers of disabled and elderly people is increasing, and the development of adaptive clothing for these people is in demand. The purpose of this study is to add features in bra design, to make it “Easy on, Easy off”, to encourage the hemiplegic females to begin to dress themselves and to make dressing easier and more protective for them. This adaptive bra design will offer benefits to the wearer that include independence, conformity to culture, concealment of the disability, comfort, psychological contentment, safety, and durability. Our adaptive bra will promote harmony between functionality and aesthetics. Our e-bra enables continuous, real-time monitoring to identify any pathophysiological changes by monitoring blood pressure, body temperature, respiratory rate, oxygen consumption, some neural activity.

1. Introduction

Brain damage is one of the most common and serious injuries, and the elimination of its effects is a long, complex and expensive process. According to research data, 20% of patients die from stroke, more than 50% of stroke survivors remain temporarily or permanently disabled, only 20% of working-age people return to work, and about 10% of patients are in need of nursing. Approximately 43 to 69% of patients who have suffered a stroke, have problems with their hand movements, and four years after the disease, impaired hand function and its restriction remains a major problem for patients [11].

The most common consequence of stroke is paralysis, which disrupts movements. There are two broad types of paralysis: hemiparesis and hemiplegia. Statistics show that after stroke hemiplegia occurs in 11.2%, severe hemiparesis in 11.1%, and mild hemiparesis in 58.9% of patients [10]. Hemiplegia (sometimes called hemiparesis) is a condition that affects one side of the body (Greek ‘hemi’ = half). The brain is made-up of two sides or hemispheres. Each hemisphere is responsible for different body functions and skills. For the majority of people, the left side of the brain controls the person’s analytic functions; it also controls the right hand activity. The right hemisphere contributes, listed in Figure 1 and the left hand activity.

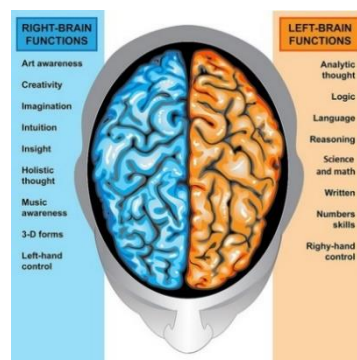


Figure 1. The functions of brain



Damage to the right hemisphere of the brain may lead to disruption of these cognitive processes, resulting in unique cognitive and communication problems. In many cases, the person with right brain damage is not aware of the problems that he or she is experiencing [1].

The left-brain controls activities such as speaking, reading, memory, analysis and controlling the right side of the body. As such, damage to the left-brain affects these processes, and may result in cognitive issues, difficulty in speaking or writing, and difficulty with the right side of the body activity.

Hands function is one of the most important components of the quality of life. Hands can help us manipulating objects in different environments, so the arm function recovery is of great importance. Many scientific articles explore the upper extremity disorders and its restoration after stroke. Most physiotherapy methodologies used on patients after stroke tend to compensate the impaired function and ensure the recovery of independence in daily life [5]. Patients have taught to use the undamaged hand and various compensatory measures, while the purpose of constraint-induced movement therapy is maximum return of hand functions or improvement of existing functions in damaged hands [4].

Activities of daily living (ADL) often pose significant difficulty for physically challenged people. Inability to perform certain ADLs independently can affect an individual's privacy, dignity and self-esteem. Clothing is one of the basic needs of human life. It plays an important role in the development of an individual, which is equally true in case of physically challenged [2]. Adaptive clothing can offer arthritis women an easy, time saving and pain free way to dress. A woman whose one hand is dysfunctional, viz. amputees, stroke-induced hemiplegia or congenital disorder, would find it difficult to dress up herself independently. Therefore, a design intervention is imperative to save the dignity of such members with special needs in our society [11].

Donning and doffing of undergarments is the main area of our research where patients suffering from hemiplegia experienced great dissatisfaction with their clothing. Frustration about not being able to dress or undress independently was apparent in their comments. Figure 2 illustrates this statement by showing the typical problems of donning and doffing of bra in the patients suffering from hemiplegia [3].

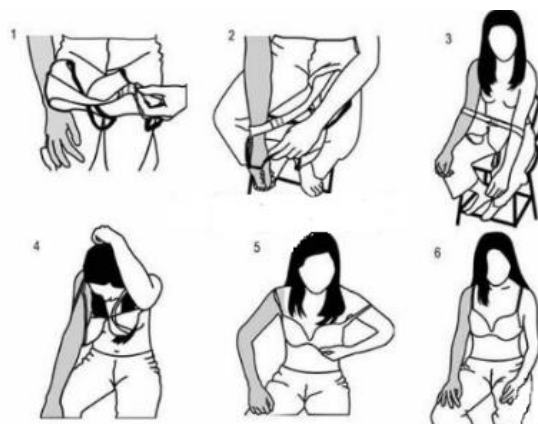


Figure 2. Donning and doffing of bra

Fasteners are often a critical element that determines if a garment functions properly and should be one of the primary concerns of designers. People with disabilities may find fasteners to be the most difficult clothing problem to deal with. Small buttons, hooks and eyes and zippers can be a challenge to use when hand dexterity is impaired. There are simple solutions suggested by the research that can reduce the difficulty of opening and closing a garment [9].

2. Functional Design Process

Functional clothing falls into two different categories. The first category is functional design for occupations that require specialized clothing. The second category is for those who need functional clothing for daily living. Functional design keeps the consumer and the desired effect of the clothing designed at the center of the design process and allows designers to do much more than fashion design. The specific functions of clothing have considered in the process of assessing the wearer's needs and product properties throughout the development of the design.

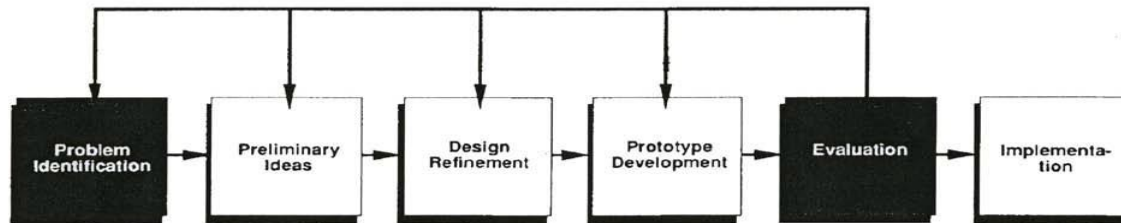


Figure 3. Functional Design Process

An advantage of this approach when designing for people with disabilities is that the focus is on improving the garment rather than the disability. The goal of functional apparel designs in this sense is to contribute to the independence of a person with a disability, which may also contribute to an increase in confidence and sense of self. In regards to people with disabilities, functional clothing is any clothing which has specially designed, altered or adapted to eliminate, or lessen clothing problems, and which at the same time is pleasing to the wearer [2].

The type and location of apparel fasteners (e.g. buttons) are important to facilitate dressing for persons with hemiplegia. This study evaluated a series of garments with different fastener types and locations using hemiplegic subjects. For persons with stroke-induced hemiplegia, dressing and undressing can be a daily challenge. The small buttons, hooks and eyes, snaps and buckle fasteners that has used on many items of apparel can be difficult for the hemiplegic to manipulate because of muscular weakness, loss of finger dexterity and/or eye/hand coordination, and limited ranges of motion [8]. In addition, the openings on garments must be in an accessible location for the fastener to be functional; persons with a nonfunctional or limited-function hand need fasteners located within the range of the functional hand. Little research has done to specifically investigate, apparel fastener systems for hemiplegics [11]. While previous research dealing with apparel fasteners has included many types of physical impairment, it has not focused specifically on the problems of hemiplegics or has studied a specific disability other than hemiplegia, e.g. arthritis [4]. The purpose of this study was to evaluate the functional qualities (i.e. time to open and close, number opened and closed, subjective preferences) of different fasteners in various garment locations for persons with hemiplegia due to stroke.

In addition, an advisory group attached to the project specified safety and maintenance demands, which are stated below.

2.1. Functional demands:

The clothing fastener should;

- be located in the patient's optimum grip area,
- be easy to understand and identify, visually as well as tactually,
- be possible to handle with one hand,
- be easy to grip and hold,
- not demand more grip strength or precision handling than the patient is able to produce,
- stand body movements without opening,
- be of suitable dimensions for handling as well as clothing construction.

2.2. Comfort and safety demands:

The closure should;

- not scratch or rub the skin,
- not cause such a pressure against the skin that might lead to pressure-sores.

2.3. Sewing and maintenance demands

The closure should;

- be easy to fasten,
- be lasting and easy to replace,
- stand washing (chemicals, high temperature),
- be 'cheap'.

3. Development of prototypes

The prototype work started with a brainstorming session, in which a great number of realizable and, for the actual purpose, unrealizable ideas on clothing fasteners had been presented. After a discussion with the advisory group, it had been decided to work along three lines. On the one hand, adapted magnetic fasteners were to be developed, making it possible also for persons with reduced strength, mobility and sensitivity in their hands to manage fastening. On the other hand, extended bra strap with front opening, making it possible to handle the closure with one hand and without genuine grip function, and lastly the use of sensors for monitoring. After an initial evaluation of the available models, there will be further modifications.

A brassiere designed particularly for easily put on by partly incapacitated persons is shown in Figure 4.

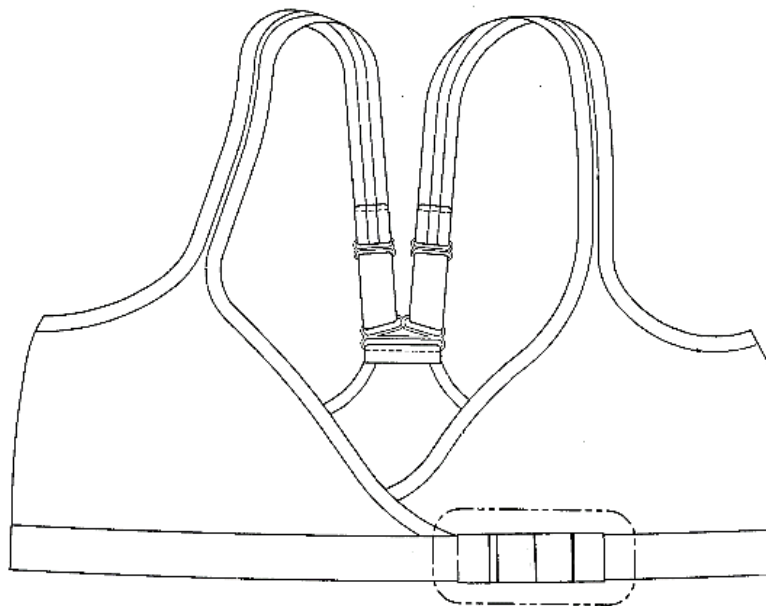


Figure 4. Prototype Bra design

Fastening is achieved by a strap fastener comprising a pair of engage-able magnetic fasteners of opposite polarity to each. A strap engagement portion is connected to each magnetic fastener and extending transverse to said common axis of engagement of said magnetic fasteners; and at least one protrusion to reside against a perimeter of an opposed magnetic fastener to resist movement of one magnetic fastener with respect to the other transverse to said common axis on which they engage [5].

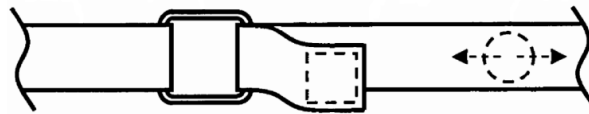


Figure 5. Use of Magnetic fasteners

A number of smart wearable electronic garments have incorporated existing, adapted or developed sensors for the measurement of biometric factors such as body temperature, heart rate, respiration rate, skin conductivity, etc. [6, 7].

Our e-bra enables continuous, real-time monitoring to identify any pathophysiological changes. The system monitors blood pressure, body temperature, respiratory rate, oxygen consumption, some neural activity and all the readings provided by a conventional electrocardiograph (ECG), including the ability to display inverted T waves, which indicate the onset of cardiac arrest. The platform shown in Figure 6 have various sensors for cardiac-health monitoring which are integrated into the fabric. The bra collects and transmits vital health signals to any desired location in the world. The sensors, which are smaller than a dime, include gold nanowires, as well as flexible, conducting textile Nano-sensors. The sensors are made of arrays of gold Nano-electrodes fabricated on a flexible substrate. The textile sensors are woven into the bra material. These sensors do not require conventional sticky electrodes or the use of gel.

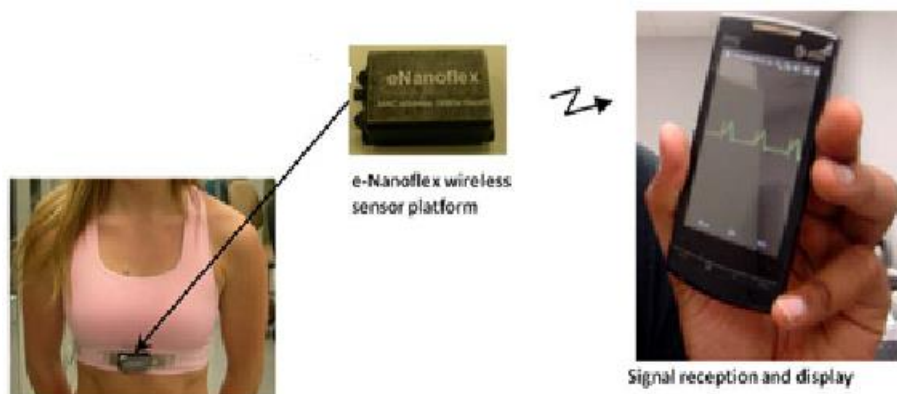


Figure 6. E- Bra

4. Conclusion

All the efforts made to meet the needs of physically handicapped in the area of special appliances to enable them to be independent and self-sufficient. Our e-bra enables continuous, real-time monitoring to identify any pathophysiological changes. The system monitors blood pressure, body temperature, respiratory rate, oxygen consumption, some neural activity and all the readings provided by a conventional electrocardiograph. However, the importance of comfortable, convenient and self-help clothing, to give a feeling of self-confidence to the handicapped females were a neglected area. Specific features in bra will help the handicapped females to get more fun and comfort from her clothes, will

help her to dress and undress herself more easily and quickly, and life easier and protected as by monitoring we can get information about the about any pathophysiological changes.

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