AN EXPLORATORY STUDY ON MODERN 3D COMPUTERISED BODY SCANNING SYSTEM AND VARIOUS TYPES OF PATTERN MAKING SOFTWARE'S WITH THEIR CONSTRUCTIVE IMPLEMENTATION IN APPAREL INDUSTRY

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Abstract

Nowadays Computer-aided design (CAD) techniques such as Lectra Modaris are becoming exceedingly popular in the apparel industries worldwide for pattern construction because of its accuracy, efficiency and time-saving solutions to much arduous operation. The principle objective of this article is to draft a set of pattern pieces by applying Lectra Modaris design environment after selecting a convenient style of trouser by different retail websites or fashion manuals. This paper contains all the essential draft patterns for the selected trouser such as front, back, waistband, pocket bag, pocket facing and fly piece which are constructed in Lectra Modaris V6R1 design software. These patterns are prepared after incorporating measurements into the design extracted from the body-scan point cloud data and from manual tape measurement. This paper also discussed briefly about the pattern construction procedure, different types of body scanning system and various types of pattern making software.

Keywords: 3D body scanning, Pattern construction, Pattern making software, Lectra Modaris V6R1, CAD

1. Introduction

In recent years, due to the industry's increased consciousness about fashion and design the clothing industry has transformed its policy from mass production to mass customization. For this reason, it is essential to expand modern production techniques that furnish to distinctive precedence's, especially apparel fitting that must be integrated into pattern-making methods. As a result, the modification of techniques for superior fitting clothing for individual body shapes is continuing day by day (Cho et al., 2005).

Currently clothing industry significantly favours to apply computer-aided design (CAD) techniques for both fashion design and pattern formation as it provides greater efficiency and time-saving solutions to many complicated functions as well as assisting Internet-based communication amongst designers, manufactures and retailers. Two-dimensional (2D) graphics software packages such as Illustrator (Adobe Inc.) and Corel-DRAW (Corel Corp.) or packages that have been customised for the fashion industry such as Kaledo Style (Lectra), Vision fashion studio (Gerber), Tex-Design (Koppermann), etc. are also are used around the world. Specialised 2D CAD software, including packages such as cad.assyst (Assyst-Bullmer), Modaris Lectra), Accumark (Gerber), Master Pattern Design (PAD System), TUKAcad (Tukatech), GRAFIS (Software Dr K. Friedrich), Audaces Apparel (Audaces), COAT (COAT- EDV-Systeme) and Fashion CAD (Cad Cam Solutions) support geometrical pattern drafting from first principles utilizing only anthropometric measurements of the target size and shape (Sayem et al., 2010).

2. Computerised body measuring techniques

The features of computerised technique are as follows:

- In the majority of cases, three-dimensional body scanners capture the outside surface of the human body by using optical techniques, in amalgamation with light sensitive devices, without physical contact with the body (Simmons, 2001).
- The scan subject usually wears form-fitting briefs or bicycle/running shorts during the process. Body scanning systems consist of one or more light sources, one or more vision or capturing devices, software, computer systems and monitor screens in order to visualise the data capture process. The primary types of body scanning systems are laser and light (Istook and Hwang, 2001).

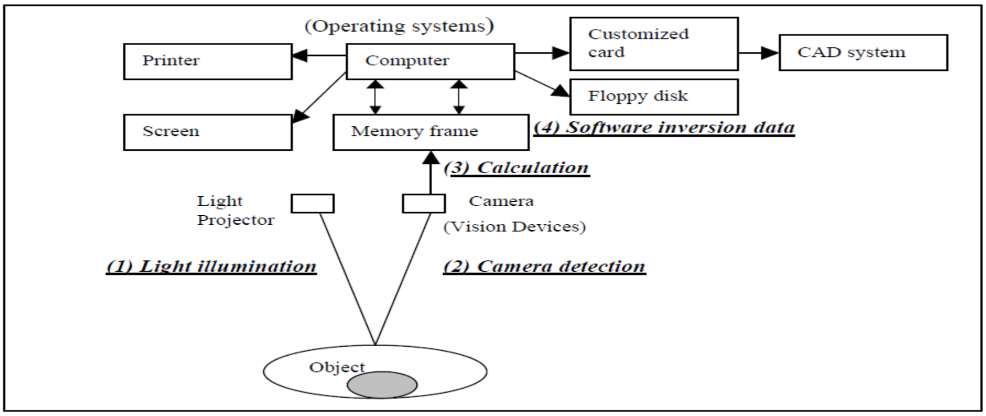

Figure 1. A flow process of 3D body scanning systems (Hwang, 2001).

Table 1. Current Major Scanning Systems (Simmons, 2001)

Scanning System	System Type
Hamamatsu	Light
Loughborough	Light
ImageTwin	Light
Wicks and Wilson	Light
TELMAT	Light
Turing	Light
PulsScanning	Light
Cognitens	Light
Cyberware	Laser
TECMATH	Laser
Victronic	Laser
Hamano	Laser
Polhemus	Laser
3DScanner	Laser

3. Modern Body Scanning Systems

3.1 Shadow Scanning System

One of the earliest 3D body scanning systems was a shadow scanning method developed by Loughborough University in the UK. The camera faces the scene, illuminated by a halogen desk lamp. The camera captures images as an operator moves the light so that the shadow scans the entire scene. This constitutes the input data to the 3D reconstruction system (Istook and Hwang, 2001).

3.2 Telmat

SYMCAD Turbo Flash/3D is Telmat's 3D body scanning system, developed in the framework of a partnership with the French Navy (Soir, 1999). The resulting measurement data can be integrated into apparel CAD systems such as Gerber Technology's Accumark system or Lectra System's Modaris software. Telmat acquires pieces of information in 1/25 of a second. It takes 30 seconds for the cameras to move along the beams and acquire data from the whole body. After computational calculations are made on the formed scanned image, the system is able to generate 70 precise body measurements (Istook and Hwang, 2001).

3.3 White light scanning systems

The Textile Clothing Technology Corporation (TC2) uses a Phase Measuring Profilometry (PMP) technique that they developed for commercialisation. This method is thought to improve overall image resolution (Paquette, 1996). The PMP technique uses a white light source to project a contour pattern on the surface of an object. A coupled charged device (CCD) camera linked to a computer detects the resulting deformed light strip. The PMP method involves shifting the grating preset distances in the direction of the varying phase and capturing images at each position (Istook and Hwang, 2001).

A total of four images are taken for each sensor, each with the same amount of phase shift of the projected sinusoidal patterns. Using the four captured images, the phase of each pixel can be determined. The phase is then used to calculate the three-dimensional data points. The intermediate output of the PMP process is a data cloud of points for each of the six views (right front, left front, and rear in both the upper and lower part of the body) (TC2, 2000).

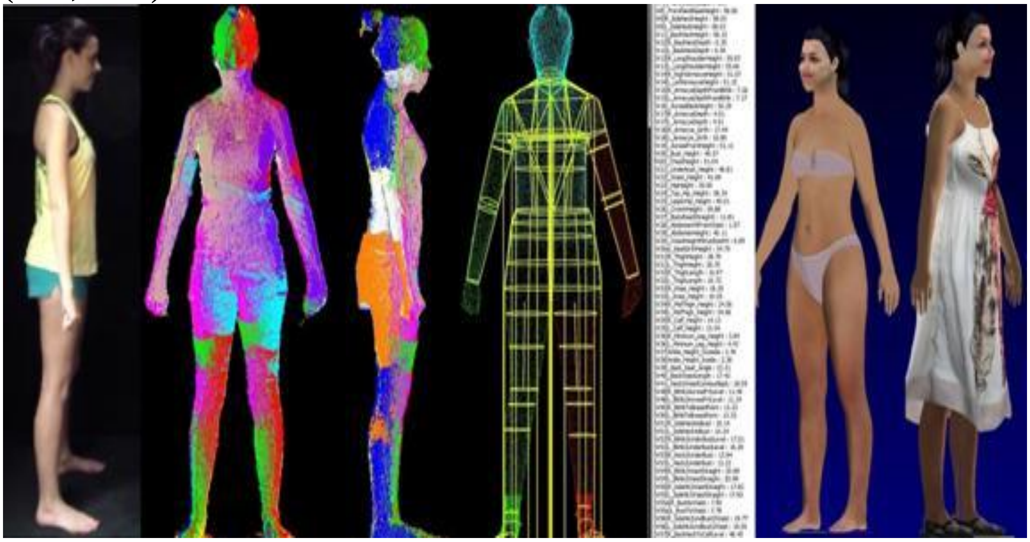

Figure 3. Scan Subject-Raw Data-Body Model and Measurements – Avatar and Virtual Fashion (*Image adapted from web page available at* http://www.tc2.com/newsletter/2012/022912.html *accessed: 22 December 2014).*

3.4 Vitus 3-D 1600 whole body scanning system

In Vitus 3-D 1600 whole body scanning system the surface of human body can be captured by four sets of laser beams and CCD cameras within 20 seconds (Lu and Wang, 2008). In order to obtain optimal scanning image, the subject is asked to adopt a specified posture with standard measurement attire and cap. Arms are kept apart from the torso to facilitate body segmentation(Kennedy, 2008). In addition, to minimize the effect of movements, subjects are requested to hold their breaths while scanning (Hwang, 2001).

Figure 4. Vitus 3-D 1600 whole body scanning system (Lu and Wang, 2008).

3.5 Advantages of 3D body scanning system

- Compared to traditional measurement methods using measuring tapes and callipers, laser scanning systems have the advantage of speed. For example, the ARN Scan takes 17 seconds in the initial scanning phase and results in a digitised cloud of 300,000 data points to map the body surface (Istook and Hwang, 2001).

3.6 Drawbacks of 3D body scanning system

The disadvantages of 3D scanning technology in contrast with traditional anthropometry or tape measurement methods are as follows:

- The costs of the technology.
- The problem with missing data because of shading. The armpits and crotch areas are often shaded (Istook and Hwang, 2001).
- Problem with defining the person’s actual height because of amount of hair that rises above the scalp as the scanners cannot differentiate between the hair and the head (Beazley and Bond, 2009).

- It can be difficult to calculate form the scanned image some body measurements required for constructing or altering garments patterns (Beazley and Bond, 2009).
- The scanner is unable to locate landmark positions on the skeleton accurately that are used when measuring manually (Beazley and Bond, 2009).

4. Different types of pattern making software

4.1 Modaris 3D Fit from Lectra

Modaris 3D Fit from Lectra is a 3D virtual prototyping solution, which associates 2D patterns, fabric information and 3D virtual models. It enables simulation of 3D design from 2D pattern pieces developed by a wide range of 2D CAD software and helps the designer to validate fabrics, motifs and colours (Sayem et al., 2010).

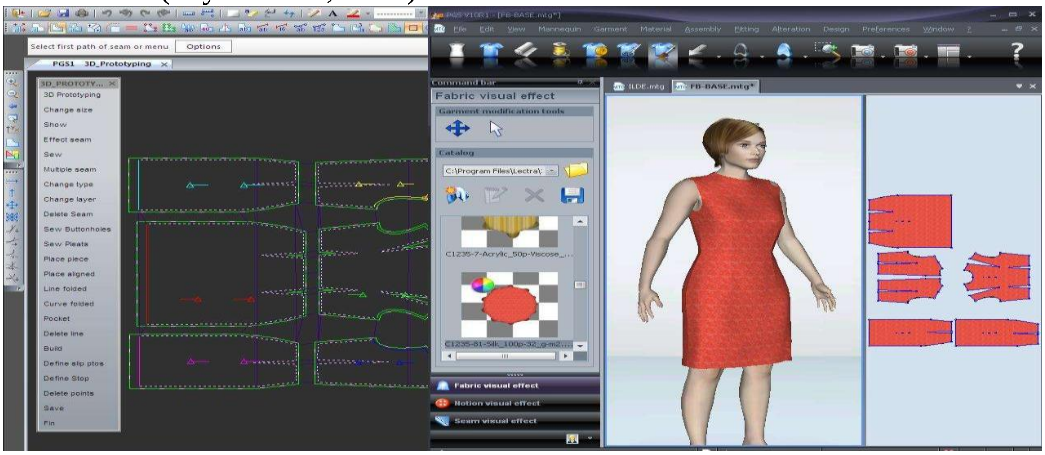

Figure 7. Lectra Modaris® PGS V10, for faster decision making (*Image adapted from web page available at* http://www.technofashionworld.com/tag/pattern/ *accessed: 20 December 2014).*

It provides an onsite or distant analysis of the virtual prototypes in three dimensions and enhances the opportunity to inspect garment fit in various fabrics and sizes. It has an extensive library of more than 120 materials along with their mechanical characteristics. It also admits the designer to insert new fabric properties in order to view distinctive drape (Sayem et al., 2010).

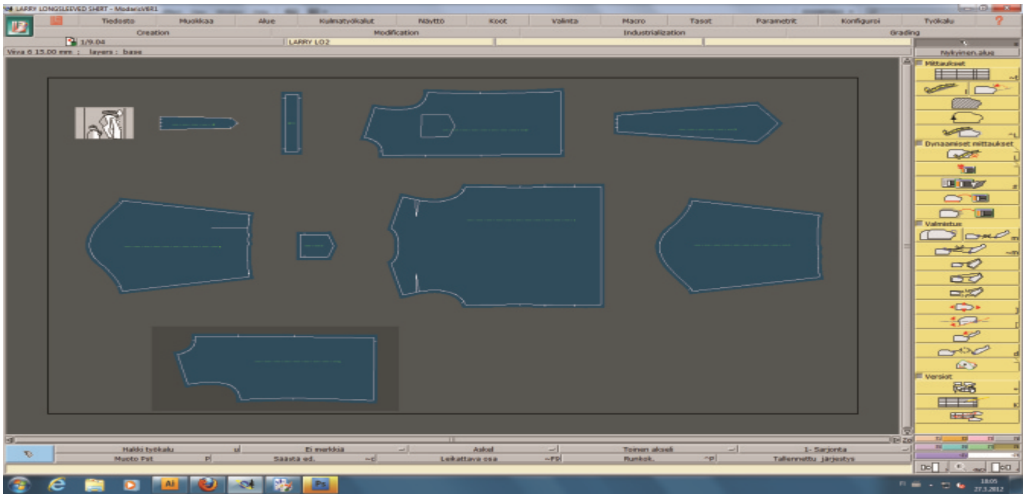

Figure 8. 2D Pattern design(Men's shirt with a tie) by Lectra*Image adapted from web page available at* (http://iidtz.wordpress.com/collections/*accessed : 20 December 2014).*

4.2Design Concept (Lectra)

Design Concept from Lectra is a '2D and 3D' software solution based on TOPSOLID, a software package from another French company, MISSLER, used for 3D mechanical design. The software is currently being offered for the automobile and technical textiles industries with the name Design Concept Auto and Design Concept TechTex. The distinct feature of this software is that it is capable of producing 2D templates from 3D designs using the flattening mechanism (Sayem et al., 2010).

4.3 Gerber Vstitcher

Gerber Vstitcher software Software is a 3D design and visualization system, it transforms two dimensional patterns into three dimensional garments. It interfaces seamlessly with Gerber's Accu Mark pattern design, grading and marker making software, enabling a transformation of 2D patterns into 3D garments. Virtual samples can be used for internal design reviews before the factory creates actual samples (Viļumsone and Dāboliņa).

4.4 The Human Solutions GmbH

At present the cooperation between Assyst and Human Solutions has grown into a successful virtual fitting and prototyping system allowing more than just integrating individually scanned mannequins and fitting the chosen apparel model on it. It is also capable of a realistic analysis and reproduction of the characteristics of a model, seam allowance placement – constructively technological individualities (Viļumsone and Dāboliņa).

4.5 Assol

Assol is an apparel designing system have created a garment designing module on the basis of AutoCAD which contributes the parametric designing of garment templates, as well as a parametric gradation of templates, application of different mannequins (parametric and digitized) for 3D designing and the designing of 3D garments for restricted varieties. The application of AutoCAD as a base admits for a more elastic relation of software and hardware (Viļumsone and Dāboliņa).

4.6 TPC parametric pattern generator and 3D interactive software

Parametric Pattern Generator (PPG) from TPC (HK) Limited is software which has been developed to allow the design of garments directly on a virtual mannequin in a 3D environment. It comes with a set of virtual mannequins as design platforms and it can also create a virtual mannequin using body scanned data. Its 2D module can generate 2D patterns simultaneously, based on the designer's adjustment and modifications to the 3D design (Sayem et al., 2010).

5. Specification of Selected Trouser

Jeans are trousers made from denim or dungaree fabric. Generally the term "jeans" refers to a specific style of trousers, called "blue jeans" and invented by Jacob Davis and Levi Strauss in 1873. Jeans are now a very popular article of casual dress around the world. They come in many styles and colours. However, blue jeans are particularly identified with American culture, especially the American Old West.

The jeans brand "Levis" is named after the inventor, Levi Strauss (http://en.wikipedia.org/wiki/Jeans). For this specific course work, a 505™ Levi's Regular Fit Jeans tourser is selected (http://us.levi.com/product/index.jsp?productId=3716857&*)*. Regular fit jeans trouser is selected for this experiment because of its comfortability.

6. Image of the selected trouser design

9 (a)

9 (b)

9 (c)

9 (d)

Figure 9. Images of different views of selected trouser (on model) 9 (a). Front View 9 (b) Back View 9 (c) Front Top (Right side) 9 (d) back top (Right side). (this image is a*dapted from web page available at* http://us.levi.com/product/index.jsp?productId=3716857 &*accessed : 10 December 2014).*

7. Measurements at the 3D Body Scanning system

Measurements of the entire body is captured at an advanced body scanning system from[TC2] (Textile/Clothing Technology Corporation), USA having operational parameters of: point accuracy <1 mm, circumferential accuracy <3 mm and data density between 600,000 and 1,000,000 points per subject (Sayem et al., 2012). Measurements are applied for drafting men's regular fit jeans trousers paper pattern. Measurements taken at the 3D body scanner is represented in the following figure.

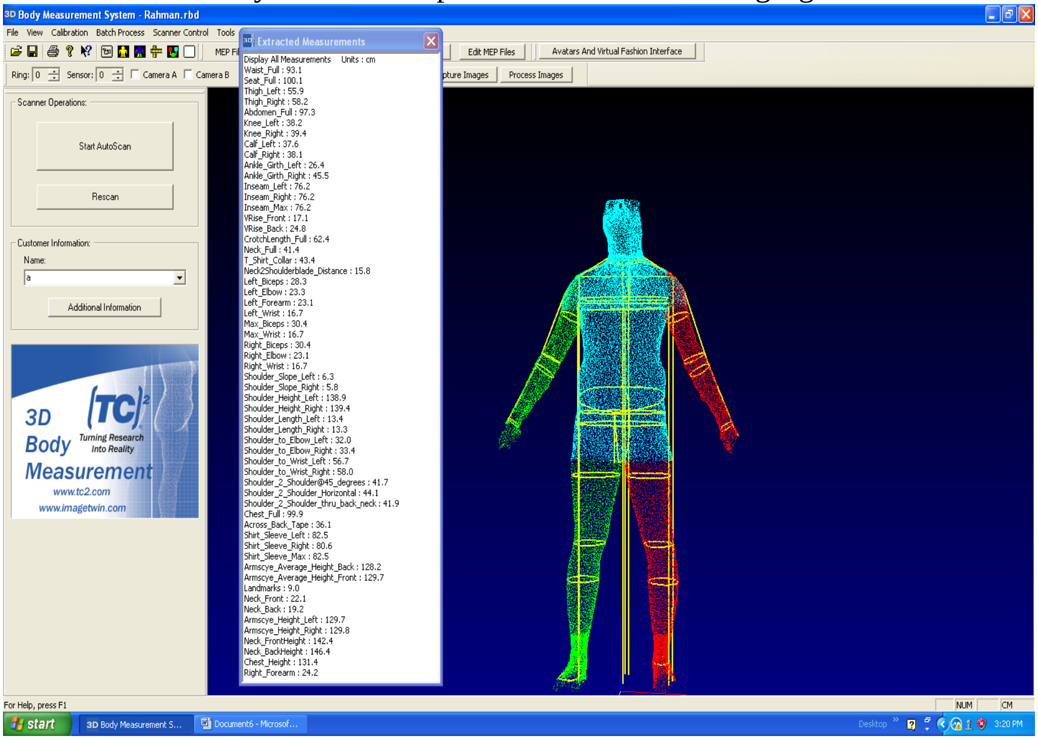

Figure 13. 3D Body Scanner Measurements.

Table 2. 3D Body Scanner Measurements

Measuring Position	Measurements at body scaner (cm)
Waist Full	93.1
Seat Full	100.1
Thigh Left	55.9
Thigh Right	58.2
Abdomen Full	97.3
Knee Left	38.2
Knee Right	38.4
Calf Left	37.6
Calf Right	38.1
Ankle Girth Left	26.4
Ankle Girth Right	45.5
Inseam Left	76.9
Inseam Right	76.9
Inseam Max	76.9
Rise Front	17.1
Rise Back	24.8
Crotch Length Full	62.4

Table 3. Principle measurements taken to draft pattern paper

Measuring Position	Measurements(cm)
Seat	101.6
Waist	86.4
Body rise	28.4
Inside leg	82
Trouser bottom width	29.5
Waistband depth	4

8. Construction procedure of pattern draft

- Due to preference of length in manufacturing trousers measurement from the body scanning report cannot be implement directly.
- During construction of block patterns the direction of the body movement has to be considered because this contributes the amount of essential ease allowance which has to be added. The greatest movement happens with the limbs. In order to acquire this, extra width has to be added to specific positions on the patterns (Beazley and Bond, 2009).
- The expansion of body increases the girth measurements. For example, when the wearer sits down the hip and seat girth measurements increase. Similarly elbows and knees also expand with bent (Beazley and Bond, 2009).
- For this particular design, a standard pattern drafting process is followed based on the constructional sequences created by **Winifred Aldrich** from the book **Metric Pattern Cutting for Menswear, Second Edition.**

9. Images of different drafted pattern piece prepared by Lectra Modairs V6R1 design software

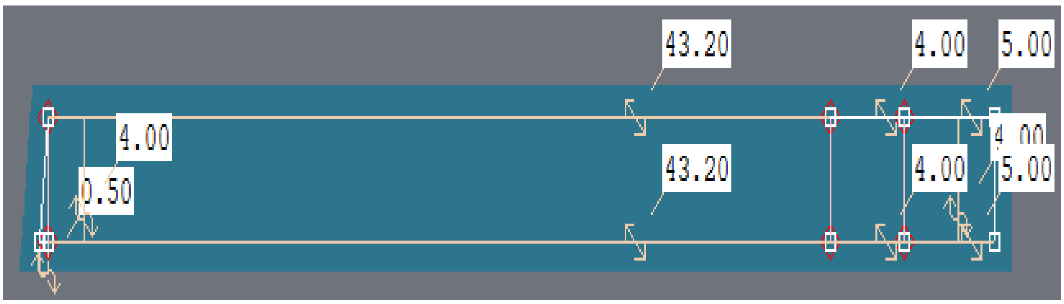

Figure 14. Drafted shape waistband pattern piece with measurements.

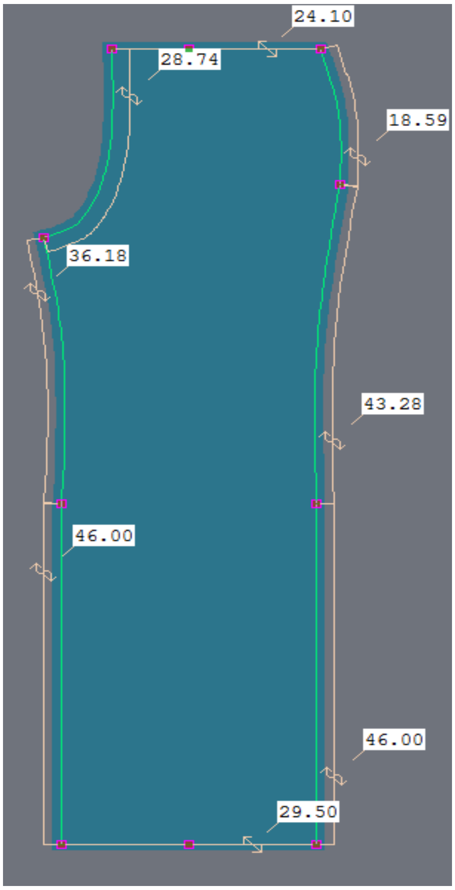

Figure 15. Drafted shape topside flat pattern piece with measurements.

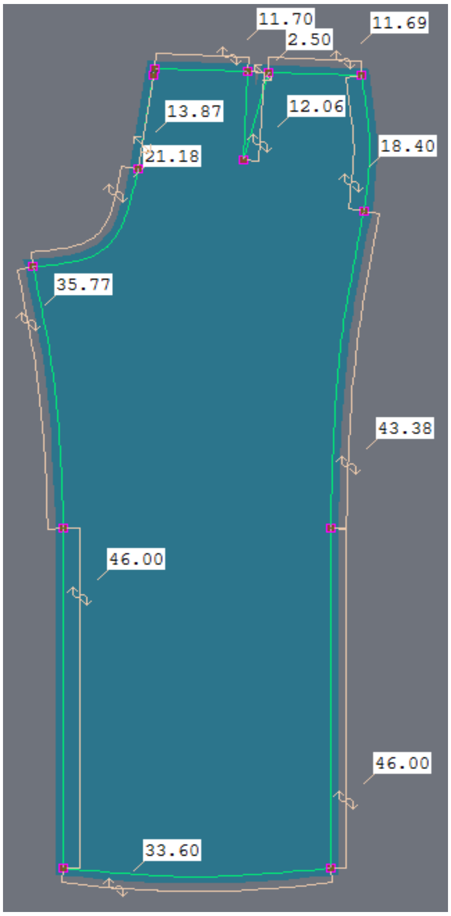

Figure 16. Drafted shape underside pattern piece with measurements.

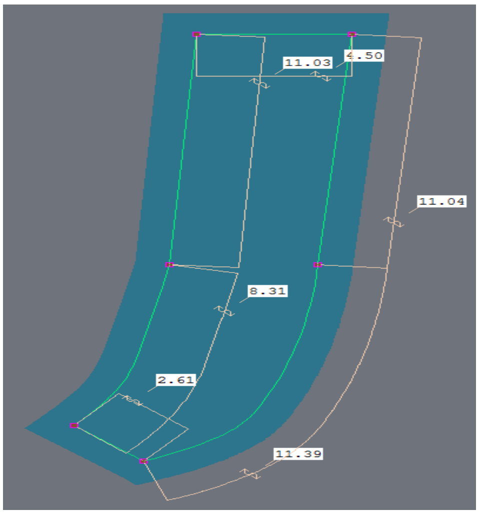

Figure 17. Drafted shape fly piece pattern piece with measurements.

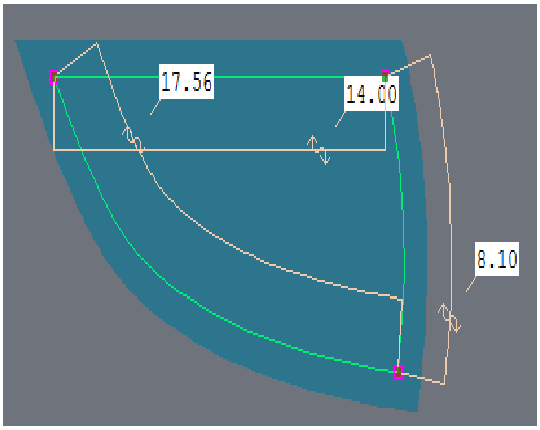

Figure 18. Drafted shape pocket bag pattern piece with measurements.

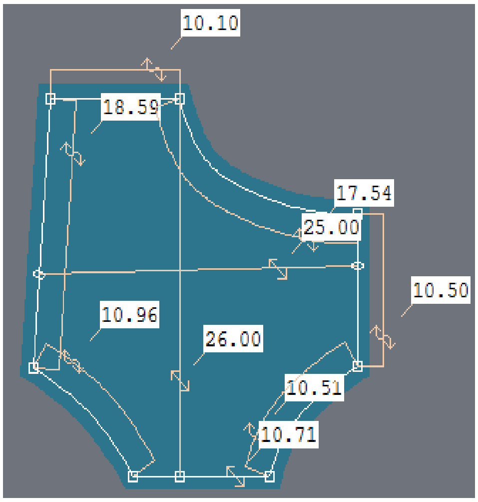

Figure 19. Drafted shape pocket facing pattern piece with measurements.

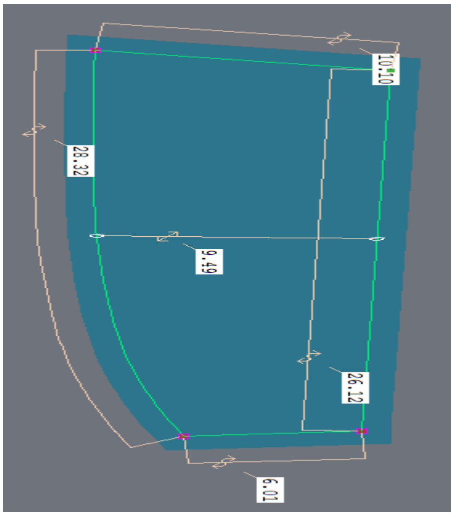

Figure 20. Drafted shape pocket facing pattern piece with measurements.

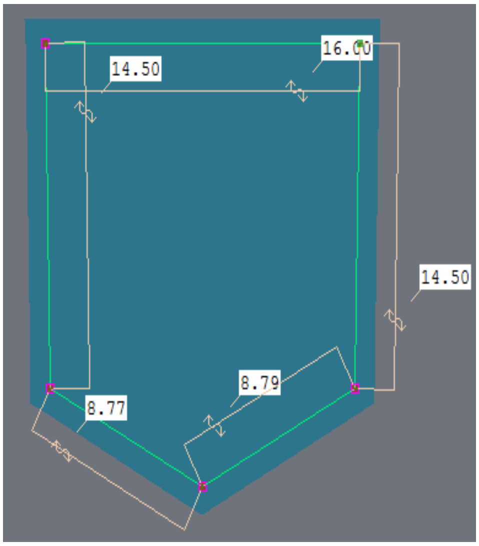

Figure 21. Drafted shape back pocket pattern piece with measurements.

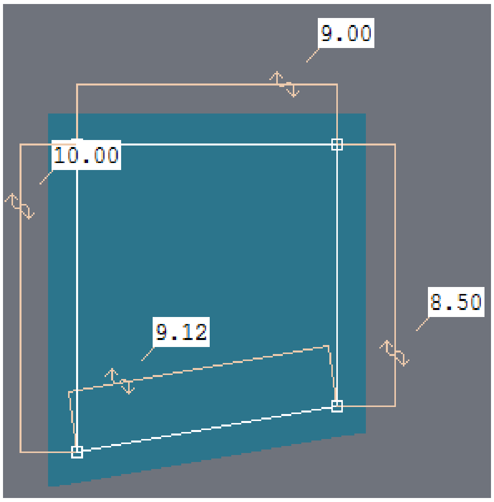

Figure 22. Drafted shape coin pocket pattern piece with measurements.

10. Conclusion

Three dimensional body measuring scanners has a remarkable potential for the apparel industry worldwide in order to provide a precise, speedy and consistent data as well as capability of extracting infinite number of data at any time. On the other hand, the application of 3D CAD system such as Lectra Modaris in the clothing industry can bring a huge influence on garments-development time and production cost. Moreover, it is also capable to detect any errors quickly and advance correction of design elements. It significantly reduces the garment-development time and manpower involvement which is actually a huge commercial benefit. As a whole, it integrates the fashion design and pattern drafting into a single step. For this reason, nowadays industries are gradually implementing 3D body scanning system and various types of pattern drafting software like Lectra Modaris in order to develop product quality in an economical and more productive way. Researchers are also working for the operational improvement of these software for making them more users friendly and enhance accuracy.

11. References:

ASHDOWN, S. P. & DUNNE, L. 2006. A study of automated custom fit: Readiness of the technology for the apparel industry. *Clothing and Textiles Research Journal*, 24, 121-136.

BEAZLEY, A. & BOND, T. 2009. *Computer-aided pattern design and product development*, Wiley. com.

CHO, Y., OKADA, N., PARK, H., TAKATERA, M., INUI, S. & SHIMIZU, Y. 2005. An interactive body model for individual pattern making. *International Journal of Clothing Science and Technology*, 17, 91-99.

FONTANA, M., RIZZI, C. & CUGINI, U. 2005. 3D virtual apparel design for industrial applications. *Computer-Aided Design*, 37, 609-622.

FONTANA, M., RIZZI, C. & CUGINI, U. 2006. A CAD-oriented cloth simulation system with stable and efficient ODE solution. *Computers & Graphics*, 30, 391-406.

HWANG, S.-J. 2001. *Three dimensional body scanning systems with potential for use in the apparel industry.* Citeseer.

ISTOOK, C. L. & HWANG, S.-J. 2001. 3D body scanning systems with application to the apparel industry. *Journal of Fashion Marketing and Management*, 5, 120-132.

KENNEDY, K. 2008. 3 Dimensional Body Scanning Techniques and Applications for the Australian Apparel Industry.

LU, J.-M. & WANG, M.-J. J. 2008. Automated anthropometric data collection using 3D whole body scanners. *Expert Systems with Applications*, 35, 407-414.

POWER, J., APEAGYEI, P. R. & JEFFERSON, A. 2011. Integrating 3D Scanning Data & Textile Parameters into Virtual Clothing.
SAYEM, A. S. M., KENNON, R. & CLARKE, N. 2010. 3D CAD systems for the clothing industry. *International Journal of Fashion Design, Technology and Education,* 3, 45-53.
SIMMONS, K. P. 2001. *Body measurement techniques: a comparison of three-dimensional body scanning and physical anthropometric methods.* North Carolina State University.
VIĻUMSONE, A. & DĀBOLIŅA, I. Virtual Garment Creation.
YUNCHU, Y. & WEIYUAN, Z. 2007. Prototype garment pattern flattening based on individual 3D virtual dummy. *International Journal of Clothing Science and Technology,* 19, 334-348.