Integration of CAD Technology for Fast and Customized Production of Apparels

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ABSTRACT

The innovation in the field of Custom fit apparel and the demand of the day to beat the challenge of the competition in fashion world, the 3D Scanners and the CAD/CAM have made the show. The design and sizing attributes to a fast and custom design of costumes to the customers and the models is the latest trend and demand of the day. The availability of various3D capture software and scanning techniques have simplified the procedure and led to the development and fast procurement of custom fit apparel design The approaches to designing virtual garments may be categorized as "2D to 3D" and "3D to 2D". The former refers to draping flat digital pattern pieces on a virtual mannequin, and the later indicates the development of clothing design on a realistic body and subsequent flattening into 2D pattern pieces. Several CAD systems for garment visualization in space from flat patterns have already been introduced into the clothing industry. Any industrial application of the pattern flattening technique is yet to be made, due to the non-availability of an appropriate CAD system on the market. This work reveals the importance of CAD and the virtual platform for the final customized apparel designing

Keywords

Customized Pattern, 3D Modeling, Garment simulation, software,CAD

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I. Introduction

The garment industry today increasingly tends to use computer-aided design (CAD) techniques for both apparel design and pattern formation, since it provides more effective and time-saving solutions to many challenging tasks and also enables Internet-based collaboration between designers, manufacturers and retailers. Often used throughout the globe are two-dimensional (2D) graphics programme packages such as Illustrator (Adobe Inc.) and CorelDRAW (Corel Corp.) or personalised fashion industry packages such as Kaledo Style (Lectra), Vision fashion studio (Gerber), Tex-Design (Koppermann) etc. Specialized 2D CAD software packages, including packages such as cad.assyst (Assyst-Bullmer), Modaris (Lectra), Accumark (Gerber), Master Pattern Design (PAD System), TUKAcad (Tukatech), GRAFIS (Dr. K. Friedrich Software), Audaces Apparel (Audaces), Wear (COAT-EDV-System) and Fashion CAD (Cad Cam Solutions), support the first concepts of geometric pattern drawing utilising just anthropometric calculation. It is necessary to enter established block patterns into nearly all of the different programme packages commonly accessible with the aid of a "digitiser," so that an extensive library of patterns of several sizes can be easily saved for potential usage on the device.

Now commercially accessible is a collection of three-dimensional (3D) CAD app kits for apparel interactive prototyping. Two distinct approaches to clothing design considered during the development of 3D CAD systems have been described in a study of published literature. These two approaches may be classified as the "2D to 3D" approach, which relates to the draping of digital 2D template parts on a 3D mannequin, and the "3D to 2D" approach, which demonstrates the creation of a 3D body garment concept and then flattening the form into 2D pattern pieces. In certain CAD schemes, a mixture of these methods is often suggested. This paper explores the historical history of the textile industry's 3D CAD systems and discusses the 3D CAD systems available and considers their facilities and how they may be successfully used.

Commercially available 3D CAD systems for 3D garment visualisation and virtual try-on software can be categorised into two groups, based on the underlying working procedure, to create 3D designs. One group, which includes software such as Virtualfashion® (Reyes Infografica) and TPC

Parametric Pattern Generator (TPC), allows designers to develop garment silhouettes and styles in a 3D environment according to their preference. Other types of 3D CAD system allow the importation of 2D pattern pieces from the appropriate 2D CAD software to wrap them onto a virtual model in order to visualise the virtual product and also to simulate fabric drape and fit. This group includes Vstitcher™ (Browzwear), Accumark Vstistcher™ (Gerber), Haute Couture 3D (PAD system), Modaris 3D FIT (Lectra), efit Simulator (Tukatech), 3D Runway (OptiTex), Vidya (Assyst-Bullmer).

Thecommonly used software and platforms have been tabulated with their brief description in the Table 1.

S.No.	**Name of the Software**	**Description**	**Application Area**
	Modaris 3D Fit (Lectra)	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	provides the opportunity to check garment fit in various fabrics and sizes
	Vstitcher™ (Browzwear) and AccumarkVstitcher™ (Gerber)	the app enables modification of the incorporated virtual human models. Based on physical characteristics, it can transform the 2D pattern parts into 3D garment designs that reflect the fabric's practical draping behaviour	allows the facility accessible to hold real-time fit approval sessions online around the globe.
	Haute Couture 3D (PAD system)	can create simulated 3D garments from 2D pattern parts.	It facilitates the application of paint, textures and prints through its texture mapping software, in addition to fabric simulation
	eFit Simulator™ (Tukatech)	a software solution that creates simulated 3D prototypes of garments on virtual models from 2D designs and fabric assets	enables interactive product prototypes to be submitted via e-mail
	Vidya a Vidya (Assyst-Bullmer)	uses for product creation and in computer games, animation films and Internet shops in the apparel industry	allows personalised virtual mannequins focused on the market of the consumer and

			unique size tables and body-scanned data to be produced.

2. LITERATURE REVIEW

Hinds and McCartney, (1990); Hinds et al., (1992) showed one of the early 3D CAD structures for garment design in the early 1990s (Hinds and J. McCartney, 1990; Hinds et al., 1992). Their method used a virtual mannequin created by scanning a tailor's dummy with the usage of a modelling platform, and it used a digitiser as an input device to present clothing panels on the virtual mannequin (Hinds et al., 1992).. Ito et al. (1992), Fozzard and Rawling (1991, 1992), Matsuura (1993) and Rasdomakinakin were produced and introduced by several prominent early frameworks targeting the "2D to 3D" clothing modelling method (1995). In order to imagine the differential silhouettes, the CAD method of Ito et al. (1992) might simulate simulated clothing from differently constructed 2D pattern sets on a 3D body shape, which they imagined as a helpful method for designers to study and change the designs. Use of 2D and 3D CAD programs in the classroomMatsuura, S., (1993) suggested placing the 3D CAD device at the core of a garment knowledge network to synchronously and concurrently process textile design and clothing design. Matsuura (1993) and Rasdomakin (1995) provided 3D CAD structures with pre-developed 3D blocks that permit user interactions to change style-line and other interface parameters. In Japan, the Matsuura CAD system is branded as the Asahi 3D system (Hardaker and Fozzard, 1998). Matsuura, S., (1993) presented a description of a CAD framework for clothing containing both "2D to 3D" and "3D to 2D" methods. Second, as part of their CAD framework, the programming language "FORTRAN" was used along with application programming interfaces in "CORE" for 3D viewing and "PLOT10" for 2D display. Christerson and Appelbaum, (1995); Firoz and Ammaturo, (2002); Gereffi and Memedovic, (2003) presented that Clothing retailers in Europe and America have implemented overseas manufacturing and development techniques in order to take advantage of labour cost differentials (Christerson and Appelbaum, 1995; Firoz and Ammaturo, 2002; Gereffi and Memedovic, 2003). As a consequence, much of the world's textile production is concentrated in countries with lower labour rates, typically far from European and American retailers of clothing. Later in 2000, McCartney et al, a CAD framework was proposed for a revised textile design method covering both "3D to 2D" and "2D to 3D" methods (McCartney et al., 2000). This framework contained three main elements: a modelling interface to promote the designer's development of 3D apparel requirements, a pattern flattening module, and a drape motor focused on a computational algorithm to precisely model materials on a 3D body. Fang, J., 2003 research has explored how 3D CAD simulation affects student learning and the process of design (Salman, 2011), with results showing that comprehensive representation of 3D CAD simulations, particularly for students of architecture, may significantly change the design process. Fuhrmann, A.; Gross, C.; Luckas, V. and Weber, A., (2003) suggested a CAD tool that could mimic the "haute couture" garment-making system. The technology perceived cloth as a virtual rectangular sheet that a human could drape on a virtual mannequin. During the draping process, it enabled the designer to eliminate the unwanted pieces of virtual fabric using the scissoring method. The unit did not have a flattening module, but it might have 2D flat pattern bits by simulating the virtual scissoring process at the same time in 2D. Fang, J., 2003, studied that with regard to the 3D garment simulation curriculum, it can be used as an essential tool to evaluate the fit, design principles, and aesthetics of a garment in design classes, enabling students to digitally test and demonstrate the importance of their ideas without the need to create physical prototypes, representing a valuable design tool, especially in design studios where students learn design by project-based practice. Luo and Yuen (2005) implemented a CAD system based on the Visual C++6.0 and OpenGL library, which followed the "2D to 3D" architecture process, but enabled the designer to modify the 2D pattern interactively. The most remarkable feature of their CAD system is that, with any interactive modification in the 2D pattern sections, the underlying 3D design may be adjusted automatically. The method was defined as 'clothing pattern reactive 2D/3D architecture'. The CAD system suggested by Fontana et al. includes a 3D modeller, a 2D CAD computer and a 3D simulator (2005). Petrak and Rogale (2006) presented that an interactive CAD system to draw on a 3D mannequin and construct 3D patterns from the drawing and eventual flattening into 2D pattern pieces was described by Petrak and Rogale (2006) and Petrak et al (2006). They used Rhinoceros 2.0 programme under the Windows 2000 operating system to create the wireframe prototype of a garment and to construct the fabric surface utilising cloth modelling techniques. Kim & Johnson (2007) projected that rapid advances in technology will cause educators to doubt the essence of prospective clothing designers' fashion design education. Thus, Grant (2013) supports the usage of several software packages to guide fashion student education, including 2D pattern making and 3D garment modelling systems, since this will improve student meta-skills of "flexibility" and "adaptability" through the use of different resources and instruments.

Korakadis, Pavlatou, Palyvo, & Spyrellis, (2009); Perdomo, Shiratuddin, Thabet, & Ananth, (2005); Silen, Wirell, Kvist, Nylander & Smedeby, (2008), 3D modelling systems have also been used as methods to enhance student learning success in medicine, engineering, product design, science, accessories design, automobile, and several other areas, along with the creation of 2D CAD programmes for use in the garment industry. Ernst, (2009); Lectra Customer Success Story; Tukatech (2009) proposed that there is demand from the retail industry to shorten product production as far as possible and also to decrease the expenditure in physical prototyping in order to deal with rapid fashion developments and also to cut costs..Easters, (2012), proposed that the fashion industry is one of the most globalised markets (Easters, 2012), so industry and related businesses are actively finding the quickest and most profitable ways to promote improvements designed to speed up the design phase, including better collaboration and rapid prototyping technologies. Santos, (2014) proposed that the pressure to launch more collections with shorter lead times has contributed to the growth in the fashion industry of 3D technology software (Santos, 2014). In the 1980s, the principle of 3D garment simulation or computer prototyping technology was first introduced, and in the early 1990s, one of the early 3D garment simulation techniques was developed for textile design. Lectra (2014), showed that the 3D clothing modelling, involving designers, merchandisers, distributors, retailers and consumers, may theoretically serve as a valuable tool to enhance collaboration across the supply chain (Santos, 2014). Therefore, 3D technologies are utilised by more fashion firms, including Under Armor, Principle, Scoot sports, and not restricted to designer labels such as Roberto Cavali. Sierema, (2015), researched that although the digitization of the fashion industry's production phase has progressed much slowly than in many other sectors, today's fashion designers have merged both analogue and automated design methods, transforming the fashion industry drastically (Easters, 2012; Siersema, 2015). Production advancement has made design so easy over the past few years that it can be achieved with a device, and apparel industries are becoming increasingly reliant on the usage of machines and the overall function of technology in that area. (Kim & Johnson). Peterson, Skinkvist, Wang, and Smedby, (2015) demonstrated that 3D mapping has improved classroom learning as a learning platform and transfers a greater comprehension of learning with regard to the subject matter (Peterson, Skinkvist, Wang, and Smedby, 2015). Perdomo et al.7 address the consequence of utilising 3D technologies and its benefits over teaching techniques using just 2D representation for architecture students. According to Papachristou, E.; Bilalis, N. 3D (2017), In other sectors (i.e., mechanical engineering) companies commonly organise tailored courses and training sessions in collaboration with leading global vendors in order to achieve a deeper knowledge on specific CAD-based software for specific fields of application according to the professional profile and the level of expertise of their users. According to Y. hong pb, x. zeng1, k. liu, m.dong (2018), actually there are some research results using the previous Computer aided design technology (CAD) to create garment products directly. Using 3D scanning, a digitalized human body model can be obtained, based on which the visual prototyping can be realized. In this context of Hong Y, Curteza A, Zeng X, Bruniaux P and

Chen Y(2019), a personalized garment block design method is proposed in this paper, using the virtual In the context of Y.-J. Liu, D.-L. Zhang and M. Ming-Fai Yuen (2019), the importance of fashion in human history cannot be ignored. The garment industry has influenced countless lives and cultures with its notions of which styles and concepts become popular. Furthermore, fashion today is certainly a matter of taste -- a mechanism for expressing an individual's sense of self with a certain flair. In general, according to J. Power, P. Apeagyei and A. Jefferson (2019), clothing CAD systems usually involve one or more of five key processes which are: 2D pattern design, pattern prepositioning, e virtual sewing process (also called virtual try-on), drape simulation and design modification in 2D or 3D. Luo ZG and Yuen MMF (2020), proposed that the previous study reveals that both students and faculty prefer to concentrate on research and teaching aesthetics, and teaching a 3D virtual model can enable students focus further on building problems, allowing them to appreciate construction technologies more deepl

3. Methodology

Algorithm for the Work

To convert the given 2D designs into 3D designs using Software's.

3D contains more information than a 2D file. and there are no ways to retrieve that information back from a single 2D image. 2D however can be converted to 3D back via 2 methods.

1. Cross sections at various Z levels of the 3D structure, (collectively called as Image stack) integrated into back 3D structure. (Examples are voxel art, 3D cat scan files and TEM images).
2. Cross sections from different planes of the same 3D structure (from xy, yz and xz planes) merging to 3D structure. This method is more accurate but needs more sophisticated machine and software.

However, yet several methods yet, not understood by me, claim to recover all information for 3D construction via a single 2D image. The method is still under research for final release.

To customize the obtained 3D designs and customize the clothes and designs using CLO 3D.

The main objective of this study was the evaluation of 3D CAD system capacity and customization of clothes and designs using CLO 3D. For this, in the first moment of the research, the bibliographic survey was adopted as a technical procedure of data collection and analysis. Its objective was to contextualize and provide bases for the evaluation of problems such as those related to the development of functional work wear, the limits of the traditional methods of verification of clothing functionality and the technological availability of Cad 3D systems intended for the textile and of clothing. In the second moment, experimental procedures were performed with the objective of producing situations that promoted the analysis of examples that stimulated the understanding of the research problem. The results obtained were directly documented, mainly through images taken from the interface of the software and compared with the experience of evaluation of the traditional method of validation of clothing modelling.

As a methodology for the preparation of the experiment were developed design proposals for functional work clothing. These had the purpose of acting as pre-existing variables of the experiment, that is, previously established bases of comparison of results for different scenarios CLO 3D system version 4.0 was used in order to identify the ergonomic analysis capability promoted through virtual prototypes. The software served as a constructive platform in 3D models and provided model behavior data based on the shape of the flat patterns, applied fabric physics, and the test body. Various 2D figures, which have tested, are first made by hand and then translated to the software.Fig.1 and 2 show the designs, which have designed for a ramp, walk dress and has been beautifully translated to the 3D model.

Fig. 1 2D image of the drawing of dress designer

Fig. 2Design approach for a new model dress Drawing of a dress designer

4. RESULTS AND DISCUSSION

It has been observed that the application of CAD tools and software for the apparel industry shall be a boon to the industry. The challenge of acquiring the virtual data I the current era of pandemic may also be a fruitful direction to the cloth industry. People may get the trial and designing on the virtual platform and will not have to physically try the same in shops and malls. The designers and the fashion industry may have good collaboration and the effort can be synchronized. Various 2D designs made on hand can be well modeled on 3D platform for final visualization of the attire and apparel before final furnishing and cutting.

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