Digital Fashion Innovation (DFI) e-Symposium

28th – 30th September 2020

Online | 12:00 – 14:00 GMT

DFI

Digital Fashion Innovation

Manchester Fashion Institute

Manchester Metropolitan University

In partnership with

The Textile Institute

Book of Abstracts

Edited by

Dr. Abu Sadat Muhammad Sayem

MANCHESTER FASHION INSTITUTE

Chartered Institute for Textiles, Clothing and Footwear

The Textile Institute

Manchester Metropolitan University

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Digital Fashion Innovation (DFI) e-Symposium
is part of a research project implemented by Dr. Abu Sadat Muhammad Sayem
with support from the Manchester School of Art Research Centre (MSARC)

Programme

28 September 2020		Day 1
GMT	BST	*Session 1A: Chair - Professor Fiona Hackney, Manchester Fashion Institute, MMU, UK*
12:00	13:00	Welcome Speech - Professor Liz Barnes, Manchester Fashion Institute
12:10	13:10	Keynote - Professor Sybille Krzywinski, Technische Universität Dresden Germany, *Digital Process Chain - from the Product Idea to Production*
12:35	13:35	Invited - Dr. Pammi Sinha, University of Leeds, *The Role of Digital Fashion Design in a Circular Economy for the Fashion Industry*
12:55	13:55	Dr. Abu Sadat Muhammad Sayem, Manchester Fashion Institute, *Virtual Fashion versus Realistic Expectations: Key Issues to be addressed*
13:05	14:05	Break (5 minutes)
		Session 1B: Chair – Dr. Patsy Perry, Manchester Fashion Institute
13:10	14:10	Greta Gandossi, School of Design, London College of Fashion, UK, *Algorithm-enabled mass customisation for garment production*
13:20	14:20	Yuyuan Shi, School of Design, University of Leeds, UK, *Designing 3D Seamless Woven Sports Bra using 3D Anthropometry*
13:30	14:30	Chanitha Kithmini, De Montfort University, UK, *3D Virtual Clothing: An Operational Framework to achieve Realistic 3D Prototype*
13:40	14:40	Q&A for last three presentations
13:50	14:50	Simone Morlock, Hohenstein Laboratories GmbH, Germany, *The Transformation of Fit and Pattern – with 3D towards the Future*
14:00	15:00	Shreshta Ramkalaon, Manchester Fashion Institute, Manchester Metropolitan University, UK, *Zero-Waste Pattern Cutting (ZWPC) for Mass Production of Apparel*
14:10	15:10	Q&A for last two presentations

29 September 2020		Day 2
GMT	BST	*Session 2A: Chair – Dr. Abu Sadat Muhammad Sayem, Manchester Fashion Institute*
12:00	13:00	Keynote - Professor Deepti Gupta, Indian Institute of Technology Delhi, *Digitalisation of Clothing Design Process: Challenges and Opportunities*
12:25	13:25	Wasana Chathurangani Uduwela, Open University of Sri Lanka, *Applicability of Natural Language Based Requirement Elicitation Approach for Mass Customization in Apparel Industry*
12:35	13:35	Dr Evridiki Papachristou, International Hellenic University, Greece, *How Demand for Custom-Clothing Changes E-fashion Business Models*
12:45	13:45	Jayne Mechan, Manchester Fashion Institute, Manchester Metropolitan University, *'Phygital' Phenomenon as a Fashion Concept*
12:55	13:55	Q&A for last three presentations
13:05	14:05	Break (5 minutes)

		Session 2B: Chair – Professor Alhussein Albarbar, Department of Engineering, MMU
13:10	14:10	Barbara Shepherd, Manchester Fashion Institute, Manchester Metropolitan University, *'Fit for purpose': PPE Sustainable Design Evaluation in a Clinical Setting*
13:20	14:20	Dorota Watson, University of West London, UK, *Celebratory Communities of Practice expedited through Covid; Fashion Marketing and Promotion – a new way forward?*
13:30	14:30	Dr. Sarif Ullah Patwary, Kansas State University, USA, *Consumers' Discourse of Clothing Sustainability Aspect on Social Media*
13:40	14:40	Q&A for last three presentations
13:50	14:50	Jessica Saunders, London College of Fashion, University of the Arts, UK, *Do e-textiles for Fashion require specific Legislation and Developmental Guidelines to avoid Harmful Waste?*
14:00	15:00	Samit Chakraborty, North Carolina State University, USA, *Automatic Defect Detection of Print Fabric Using Convolutional Neural Network*
14:10	15:10	Q&A for last two presentations
30 September 2020		Day 3
GMT	BST	*Session 3A: Chair – Professor David Tyler, Manchester Fashion Institute, MMU*
12:00	13:00	Keynote - Dr Tracy Mok, The Honk Kong Polytechnique University, *Understanding Human Fashion Images: A Parse-pose based Study*
12:25	13:25	Invited - Dr. Sofia Scataglini, University of Antwerp, Belgium, *Digital Human Modelling (DHM) for Connecting Smart Apparel Design and Fashion Design: from Beauty to Practice*
12:45	13:45	Dr Rong Liu, The Hong Kong Polytechnic University, *3D Fluid-Solid Interaction Model for Pressure Transmission and Hemodynamic Analysis of Customized Elastic Compression Stockings*
12:55	13:55	Q&A for last presentation
13:00	14:00	Break (5 minutes)
		Session 3B: Chair – Dr. Phoebe Apeagyei, Manchester Fashion Institute, MMU
13:05	14:05	Dr. Nidhi Goyal, Royal University for Women, Bahrain, *Fashion Runway Gets its Speed: A Bahrain Perspective*
13:10	14:15	Rebecca Neary, Manchester Fashion Institute, Manchester Metropolitan University, *BIFT x MMU – A Digital Fashion Collaboration during a Pandemic*
13:25	14:25	Q&A for last two presentations
13:35	14:35	Shahida Afrin, Wilson College of Textile, North Carolina State University, USA, *Impact of Design details on the Simulation of Garments*
13:45	14:45	Mushfika Tasnim Mica, Oklahoma State University, USA, *Limitations of 3D body Scanner in Data Processing and Measurements*
13:55	14:55	Q&A for last two presentations

*N.B.: GMT = Greenwich Mean Time, BST = British Standard Time

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Keynote Speakers

Day 1
Session 1A

Professor Sybille Krzywinski
Institute of Textile Machinery and High Performance Material Technology (ITM),
Faculty of Mechanical Science,
Technische Universität Dresden,
Dresden, Germany

Day 2
Session 2A

Professor Deepti Gupta
Department of Textile and Fibre Engineering,
Indian Institute of Technology Delhi,
New Delhi, India

Day 3
Session 3A

Dr Tracy Mok
Associate Head,
Fashion & Textile Technology – Clothing,
Institute of Textiles and Clothing,
The Hong Kong Polytechnic University
Kowloon, Hong Kong

Invited Speakers

Day 1
Session 1A

Dr Pammi Sinha
Associate Professor - Fashion Management,
University of Leeds, UK

Day 3
Session 3A

Dr Sofia Scataglini
Department of Product Development,
Faculty of Design Sciences,
University of Antwerp, Belgium

Session 1A

Chair - Professor Fiona Hackney, Manchester Fashion Institute, MMU, UK

Welcome Speech - Professor Liz Barnes, Manchester Fashion Institute

Keynote - Professor Sybille Krzywinski, Technische Universität Dresden,
Digital Process Chain - from the Product Idea to Production

Invited - Dr. Pammi Sinha, University of Leeds,
The Role of Digital Fashion Design in a Circular Economy for the Fashion Industry

Dr. Abu Sadat Muhammad Sayem, Manchester Fashion Institute,
Virtual Fashion versus Realistic Expectations: Key Issues to be addressed

Keynote

Digital Process Chain from the Product Idea to Production

S. Krzywinski* et al.
*Institute of Textile Machinery and High Performance Material Technology (ITM), Faculty of Mechanical Science, Technische Universität Dresden, Germany (*sybille.krzywinski@tu-dresden.de)*

Key Words: Apparel, design, construction, simulation, visualisation, industry 4.0.

Abstract

For decades, apparel and technical textiles have been developed using two-dimensional construction methods, or empirically with considerable experimental support, since knowledge about the process-related deformation of textile materials with low stiffness has been very limited. Today, research in textile processing has innovative development tools at its disposal; they enable a completely new approach, reduce trial and error, and allow the representation of products at a very early development stage on a virtual level by means of simulation and visualization. Hence, it is now possible to make cross-disciplinary decisions regarding product quality. Typically, the requirements associated with the development of apparel or functional textiles are underestimated. The textile materials used require nonlinear orthotropic modelling. Often, there is still a lack of suitable testing technology to determine the required parameters for design and simulation.

Our vision is to create consistent digital process chains from the product idea to production and quality control. This contains:

- Design
- Construction
- Simulation of loads
- Visualisation of the product.

This enables us to communicate early within the company or with our customers and to respond to requests. Moreover, the generation of material-dependent production parameters and reproducible machine settings for cutting and joining technologies as well as mechanical and thermal shaping are quite important especially taking into account the future goals in the sense of Industry 4.0.

Another goal is the manufacturing of highly functional products in small batch sizes with serial production methods. These textile products must be designed in 3D, cut to form textile semi-finished products, and assembled to fulfil specific requirements. For this purpose, modelling and development strategies are explored at the Professorship for Ready-made Technology, which can be applied to various materials, and yet optimally adapted to the required property profiles of the products. A key goal is to advance product development for the garment industry; most of this development is supposed to take place in virtual space in order to minimize development costs and times.

Invited Talk

The Role of Digital Fashion Design in a Circular Economy for the Fashion Industry

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Key Words: Remanufacture, fashion design, innovation adaptation, circular economy

Abstract:

According to the UN, the fashion industry emits 10% of all industry carbon emissions. It's imperative we work towards dematerializing to achieve net zero. To do so requires systems changes across a range of actors and activities. The first principle of a circular economic approach is to design out waste and pollution. Remanufacture is one of the three principles of the circular economy: it is an approach to keep products and materials in use for as long as possible before it moves into any other system.

The less we do with the fabric, the more we conserve of the energy initially expended. Reuse and remanufacture conserve all or much of the energy expended in manufacture. The question is how to utilize innovations in digital fashion design to aid dematerialization yet retain value creation?

Examining how the term 'remanufacture' could be redefined for the fashion industry, a series of case studies will highlight what is required to aid the development of remanufacture within the fashion industry. Reviewing digital innovations in the design, manufacture and retail of clothing, we consider what adaptations might be useful towards dematerialization, achieving net zero and potentially value creation.

Through our research into remanufacture for fashion industry, it became very clear that the designer's creativity, skills and understanding of the craft of clothing design are paramount for success and we consider the gaps in our knowledge and understanding about the role of the designer and their use of technology for a remanufacture process.

Virtual Fashion versus Realistic Expectations: Key Issues to be addressed

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Key words: Avatars, drape simulation, 3D CAD, virtual prototype

1. Virtual Fashion

Virtual fashion is a function of digital avatar, drape simulation and digital apparel design. Within a three-dimensional (3D) computer-aided design (CAD) system, a virtual avatar works as a platform for producing virtual clothing. Traditional practice places digital pattern pieces on to them and applies drape simulation to produce a realistic look of clothing. Ongoing Covid-19 pandemic has sped up the adoption of virtual tools in the fashion industry. It is high time to look into the technical capabilities of the prevailing systems and to judge how fit they are to meet the expectations of the users. This review aims to throw light on a few technical issues identified through our recently completed and ongoing research works.

2. How Realistic are the Avatars?

The avatar morphing systems in the commercial 3D fashion CAD packages differ significantly from each other. They largely vary in the number of anthropometric parameters they utilise and none of them capitalises the full advantage of 3D body-scanning technology [1]. Thus, the avatars they produce are not anthropometrically and anatomically correct. Furthermore, the users are unable to import 3D scans into their 3D CAD systems without suppliers' intervention.

3. How realistic is drape simulation?

Mechanical properties of textile yarns are determined by the characteristics of textile fibres and the geometrical nature of yarns. Similarly, fabric properties are determined by the nature of yarns and their geometry (interlacing, inter-looping or intra-looping) in fabric structure. Current drape simulators consider fabric as a solid surface and utilise images to represent weave or knit designs. Either they are not transparent on how they utilise material properties or they work on unrealistic material parameters, which are not meaningful to the textile industry [2,3]. They attempt for photo-realistic drape simulation but not a true material specific simulation.

4. Which technique works better?

Early 3D CAD systems, presented in 1990s, worked on '3D to 2D surface unwrapping" design approach. Commercial software systems follow the '2D to 3D' approach where they drape 2D pattern pieces on 3D avatars., which often requires post processing of pattern pieces for any correction. Research shows 3D to 2D approach could generate right first-time pattern pieces [3], but the process demands a lot of computational skills and no off-the-self solution is available for the designers yet.

5. Conclusion

The current hype of digitalisation is resulting in increased adoption of virtual tools in the fashion industry. However, it is vital to make careful decision in technology selection and judge their technical capabilities before relying on them. There are still areas of improvement in prevailing 3D virtual fashion technology, few of which are highlighted here.

References

[1] Sayem, ASM., (2019). Virtual Fashion ID: A reality check', In Fashion ID: Proceedings of the Proceedings of the IFFTI Conference, 8 -11 April 2019, Manchester UK, pp. 230-239.
[2] Sayem, ASM., (2017). Objective analysis of the drape behaviour of virtual shirt, part 2: technical parameters and findings', International Journal of Fashion Design, Technology and Education, 10 (2), pp. 180-189.
[3] Muhammad Sayem, AS., Bednall, A. (2017). A Novel Approach to Fit Analysis of Virtual Fashion Clothing', In Breaking the Fashion Rules, Proceedings of the IFFTI Conference: Amsterdam, 29/3/2017 - 30/3/2017.
[4] Sayem, ASM. et al. (2016). The effect of link-length and vertex angle on mesh generation and pattern flattening for virtual clothing', International Journal of Clothing Science and Technology, 28 (4), pp. 503-515

Session 1B

Chair – Dr. Patsy Perry, Manchester Fashion Institute, MMU

Greta Gandossi, School of Design, London College of Fashion, UK,
Algorithm-enabled mass customisation for garment production

Yuyuan Shi, School of Design, University of Leeds, UK,
Designing 3D Seamless Woven Sports Bra using 3D Anthropometry

Chanitha Kithmini, De Montfort University, UK,
3D Virtual Clothing: An Operational Framework to achieve Realistic 3D Prototype

Simone Morlock, Hohenstein Laboratories GmbH, Germany,
The Transformation of Fit and Pattern – with 3D towards the Future

Shreshta Ramkalaon, Manchester Fashion Institute, UK,
Zero-Waste Pattern Cutting (ZWPC) for Mass Production of Apparel

Algorithm-enabled Mass Customisation for Garment Production

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Key Words: Mass customisation, digital anthropometry, bespoke, body scan, 3D garments

1. Research Gap Identified

Body shapes and volumes cannot be reduced to a set of linear measurements, as research has shown that, for example, identical waist and hip circumferences can correspond to various body configurations [1]. 3D body scanners are used to quickly acquire quantitative data for anthropometric studies [2], however the qualitative aspects are often overlooked in made-to-measure (MTM) pattern cutting applications.

2. Aim and Objectives

The size customisation system proposed aims to address the complexity of the human body shape by use of parametric modelling: the algorithm morphs the 3D garment from the base size onto detailed individual scans. The aim is to obtain a viable mass customisation system for bespoke fit pattern development that accounts for non-measurable body configurations and asymmetries, and therefore to obtain an improved fit in comparison with standard sizing or established 2D MTM practice.

3. Methodology

The exploratory nature of the study and the question addressed suggest a qualitative approach; two main phases were identified: 3D MTM script development and pilot testing on subjects with different body shapes, scanned with a Sizestream 3D body scanner. This was carried out on a form-fitting dress, in order to better assess fit. The development of the algorithm on Grasshopper required consequent cycles of scripting, testing, analysing and evaluating results.

4. Results and Key Findings

The bespoke patterns generated (Fig.1) are unpolished but show the differences in body shapes, for example in bust suppression or posture; the test garments are created from unaltered patterns (Fig. 2). From the results of the pilot application it can be inferred that 3D parametric modelling can represent an advance in fit customization, including non-measurable body configurations and asymmetries.

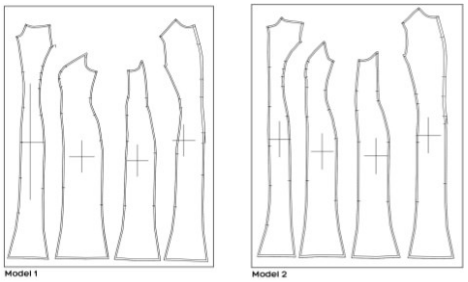

Fig. 1: Custom patterns – Model 1 & 2

Fig. 2: Custom dresses

5. Originality

The method proposed is an alternative to methods identified by previous research and current industry practice, as it is based qualitatively on the 3D body shape, without reducing its complexity to a set of linear measurements or to ruled developable surfaces.

References

[1] Song, H. and Ashdown, S. (2012). Development of Automated Custom-Made Pants Driven by Body Shape. *Clothing and Textiles Research Journal*, 30(4), pp.315-329.

[2] Gupta, D. and Zakaria, N. (2014). *Anthropometry, Apparel Sizing and Design*. Cambridge: Elsevier Science.

Designing 3D Seamless Woven Sports Bra using 3D Anthropometry

Y. Shi[1*], A.S.M. Sayem[2], V. Cheung[1], L. W. Taylor[1]
[1]*School of Design, University of Leeds, Leeds, UK;*
[2]*Manchester Fashion Institute, Manchester Metropolitan University, Manchester, UK*

Key Words: CAD/CAM, 3D weaving, 3D anthropometry, 3D-to-2D geometry

1. Research Gap Identified

Two-dimensional (2D) and three-dimensional (3D) computer-aid design and manufacture (CAD/CAM) are extensively applied in the fashion industry to save time, increase efficiency, and lower labour cost [1]. However, they are mostly used for cut-and-sew techniques only. This research bridges the 3D anthropometry with technical 3D seamless weaving to improve the dynamic comfort of sportswear and to reduce material waste.

2. Aim

This research aims to establish seamless pattern geometry from 3D anthropometry captured by contact-less scanning of female mannequin for the purpose of 3D weaving of seamless sports bra.

3. Methodology

The 3D surface geometry of female lingerie mannequin (UPD, Hongkong, Asian size: 75B) was captured by Romer Absolute Arm laser scanner (Hexagon, UK) and processed with a reverse engineering system 'Germanic Wrap' (3D Systems, Inc.) initially in STL data format. It was further processed in 'Geomagic Qualify' to reconstruct the 3D geometry of bust shape based on cross-sectional data. Using surface area mapping algorithm, this was converted into 2D graphical schematics considering real-time data and additionally drawn in Bok CAD System including marking reference points. Finally, EAT CAD/CAM textile software (EAT) was applied to draw the 2D pattern filling weaving architecture feed into Mageba multishuttle weaving machine and Staubli UNIVAL 100 jacquard harness (Multi-MS 100).

4. Results and Key Findings

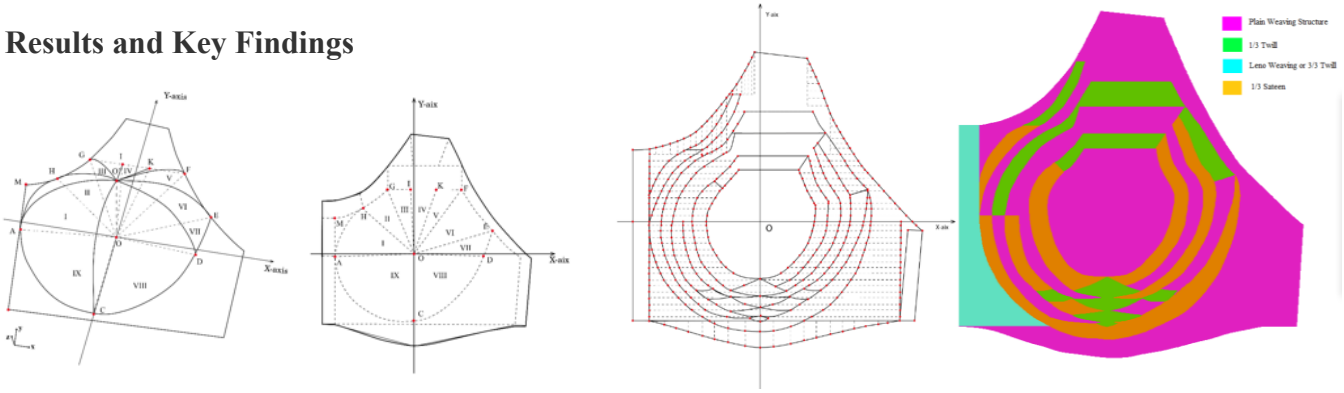

Fig. 1: The 3D geometry and 2D flatten geometry of bust area

The flatten 2D geometry pattern with segmentations and artificial boundary lines was obtained for use in weaving process (see fig. 1).

5. Originality

The cross-platform software technology – 3D reverse engineering system, 2D CAD clothing system and textile CAD/CAM – were exploited to bridge 3D anthropometry with the latest textile technology to develop seamless woven sports bra.

References

[1] Sayem, A., Kennon, R., & Clarke, N. (2010). 3D CAD systems for the clothing industry. International Journal of Fashion Design, Technology and Education, 3(2), 45–53. https://doi.org/10.1080/17543261003689888

3D Virtual Clothing: An Operational Framework to Achieve Realistic 3D Prototype

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[1]*Department of Electrical and Electronic Engineering, De Montfort University Leicester, England;* [2]*Department of Information and Communication Technology, Rajarata University of Sri Lanka;* [4]*Department of Textile and Clothing Technology, University of Moratuwa, Sri Lanka (*pkckithmini1@gmail.com)*

Key Words: 3D prototype, operational framework, rendering, simulation, training and development

1. Research gap identified

Virtual prototyping (VP) becomes a necessity in the process of modern apparel design and development. It is being practised in many manufacturing organisations, nevertheless many improvements are needed to achieve realistic rendering. It is believed that VP will enhance new product development capabilities; also, it will provide some content for online apparel marketing. With a perfect combination of digitised 3D pre-production and realistic online storefront, it will enhance the futuristic online apparel business. Importantly, virtual garments and virtual fitting rooms should be more realistic [1] to minimise the semantic gap in online apparel purchasing.

2. Aim and objectives

With the arrival of 3D clothing simulation, a prototype is often created from scratch almost instantly, allowing design teams to form decisions and significantly cut time-to-market. However, there was no published operational guidelines to achieve more realistic 3D CAD outcomes in apparel design and development. The main aim of the study is to present a practical, operational framework which should follow by the 3D CAD users to achieve more realistic garment creation.

3. Methodology

Experimental research design has been utilised in multiple stages of virtual prototyping. Casual wear and occasional wear product categories were chosen for this study as, those categories are considered as crucial product categories in virtual prototyping. 280 virtual garments have been completed during the period from June 2020 to August 2020 based on the proposed operational guide. Qualitative, visual assessment methods were utilised to review the fit on.

4. Results and Key Findings

The correct DXF 2D patterns, correct avatar with real human model measurements, and correct raw materials are the main three pillars to create a basic 3D garment. Except basic factors, light settings, 3D environment and method of rendering are subordinate factors for a true to life 3D garment. Correct fabric contains the correct physics and the correct texture image and maps. Training and developments in the field is quite essential to receive the best use in these 3D CAD tools in virtual prototyping. The main purpose of this research is to disseminate knowledge and skills of realistic 3D rendering in virtual prototyping to educate the practitioners and the academics to get the best use of this 3D fit technology.

Fig 1: Women's casual dresses in 3D prototyping

References

[1] Sayem, A.S.M., Kennon, R. & Clarke, Nick (2010). 3D CAD systems for the clothing industry, International Journal of Fashion Design, Technology and Education, 3(2), 45-53
[2] Fontana, M., Rizzib, C., and Cuginic, U. (2005). 3D virtual apparel design for industrial applications. Computer Aided, Design, 37, 609–622.
[3] Baytar, F. & Ashdown, S. (2015). An Exploratory Study of Interaction Patterns around the Use of Virtual Apparel Design and Try-on Technology, Fashion Practice, 7(1), 31-52

The transformation of Fit and Pattern with 3D towards the Future

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Key Words: 3D fit simulation, pattern, avatar, material, dynamic fit

1. Virtual Fitting – Potential and Limitation

Technologies such as 3D simulation allow not only a significant shortening of product development but also a saving of prototypes and resources. The advantages are undeniable, but users are confronted with a variety of challenges that are often underestimated, since the systems are only as good as the users themselves [1].

2. Requirements for virtual fit testing

There are a number of basic requirements that must be met in order to perform a virtual fitting. Required are the right avatar, the reliable basic pattern, the textile-physical material parameters, as well as the knowledge of 3D analysis tools and the calculation algorithms of the 3D systems [2]. In addition, in-depth user knowledge of fit and pattern cutting is required. In a study, the essentials that need to be mastered as well as the role of the user in a 3D fitting was researched.

3. Virtual 3D Fit Study

In order to identify both the potential and the limitations of 3D simulation, a study was carried out comparing three different 3D systems (CLO, V-Stitcher, Vidya). The fit of different product groups for men's and women's wear was examined physically and virtually. A proven fit evaluation protocol was used. Furthermore, different users simulated the same item of clothing using the same basic parameters. The simulation results of the different users were compared and the factors influencing the virtual fit were identified.

4. Results and Key Findings

The requirements as well as a new evaluation protocol for reliable virtual fitting were defined. The biggest challenge is the combination of technological understanding of the simulation algorithms and traditional fitting and pattern cutting know-how. Only if the two are successfully combined, the user is able to create and evaluate the simulations in a goal-oriented manner. As an example, fig. 1 shows the difference between a "beautified" and "realistic" simulation of a slim fit jacket. What is real? What is desired?

Fig. 1: Idealized and realistic 3D simulation of a slim fit jacket in comparison

5. Originality

In this study user behavior was examined as well as the software components, the pattern, the avatars and material parameters. The comparison of the virtual with the physical fitting was based on fitting models in all sizes. For testing and comparing the fit in movement the 4D scanner was used [3].

References

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Zero-Waste Pattern Cutting (ZWPC) for mass production of apparel

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Key Words: Zero-Waste Pattern Cutting (ZWPC), carbon footprint, mass production, marker making

1. Research Gap Identified

Despite several methods of ZWPC have been explored, their application remains confined within the atelier environment for designing and making one or two garments at a time. This work for the first time presented a framework for applying ZWPC into mass production of apparel.

2. Aim and Objectives

The aim of this work was to explore different methods of ZWPC and how they can be applied in fashion mass production through development a general framework. It also analysed how ZWPC can impact on the conventional fashion design and production sequence.

3. Methodology

Similar to mass production strategy in multiple sizes, two common styles of garment (joggers and a hooded T-shirt) were selected for ZWPC implementation in different sizes. At first, a strategic framework was developed to systematically implement this technique in design. Patterns were designed and graded and the layplan was created on Gerber Accumark 10, and the Gerber Easy Order tool was used to calculate fabric utilisation.

4. Results and Key Findings

It is remarkable that a 98% utilisation of fabric was achieved for both styles, while in traditional industrial practice over 85% is considered impossible [1]. Both prototypes passed an acceptable level of fit. To conclude, ZWPC in mass production is not impossible, but it would call for an alternative design process (see Fig. 1) to be managed by hybrid designers-pattern cutters. It would also call for high-street brands willing to recruit people with such skills and willing to invest in digital pattern cutting software. This also provides a potential solution to reduce an estimated amount about 60 billion square metres or more of scarp fabrics, that produce industrial carbon footprint ranging between 21.9 and 337.7 billion kg of CO2 equivalent, caused by being produced by the fashion industry.

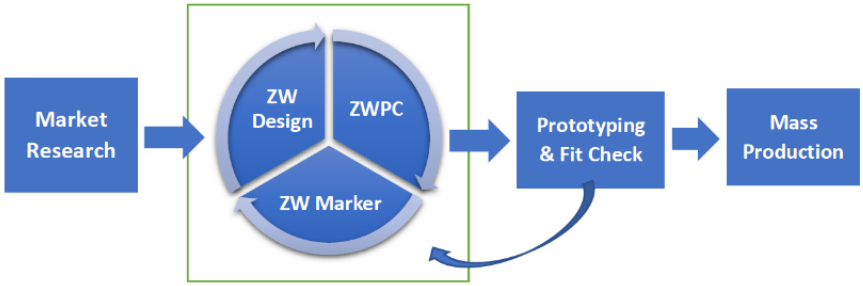

Fig.1: Proposed ZW Apparel Design Process

5. Originality

This work is original in its kind as it, for the first time, applied ZWPC into mass production system; no previous worked addressed this before.

References

[1] Carrico, M., & Kim, V. (2014). Expanding zero-waste design practices: A discussion paper. International Journal of Fashion Design, Technology and Education, 7(1), 58–64.

Session 2A

Chair – Dr. Abu Sadat Muhammad Sayem, Manchester Fashion Institute

Keynote - Professor Deepti Gupta, Indian Institute of Technology Delhi,
Digitalisation of Clothing Design Process: Challenges and Opportunities

Wasana Chathurangani Uduwela, Open University of Sri Lanka,
Applicability of Natural Language Based Requirement Elicitation Approach for Mass Customization in Apparel Industry

Dr Evridiki Papachristou, International Hellenic University, Greece,
How Demand for Custom-Clothing Changes E-fashion Business Models

Jayne Mechan, Manchester Fashion Institute, Manchester Metropolitan University,
'Phygital' Phenomenon as a Fashion Concept

Keynote

Digitalisation of clothing design process: challenges and opportunities

D. Gupta*
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Key Words: Apparel supply chain, Apps, artificial intelligence, machine learning

Abstract:

The apparel supply chain is witnessing dramatic changes due to technological developments in all steps of garment production. The industry is moving from a low tech, skill driven sector into a technology driven segment of manufacturing. Mass production is passe' while customization is in. Control of design, style and fit, which till now rested with some remote elusive "experts", is shifting right into the hands of the consumer through easy to use mobile Apps. All this has been facilitated by the digitalisation of garment making steps, right from mapping body measurements to pattern making to fit evaluation. Artificial intelligence (AI) and machine learning (ML) enabled features are adding further to the complexity (or ease?) of decision making.

Substitution of traditional methods by digital methods of garment production is blurring the boundaries between designers and technologists. Design and creativity are now getting intrinsically combined with software skills. However, designers, pattern makers and fit experts are unable to keep pace with technology, thereby creating a phase lag between what tools are available and what is known by the user. These rapid technological changes are posing challenges for the industry as well as academia who are responsible for training personnel for the industry. Therefore, there is an urgent need for the apparel industry, designers and technology developers to work in tandem so as to maximize the benefits to all concerned. This lecture will list out the latest technological developments in the field of garment manufacturing and highlight the issues emerging out of the same.

Applicability of Natural Language Based Requirement Elicitation Approach for Mass Customization in the Apparel Industry

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Key Words: Apparel industry, Configurator, Mass Customization, Natural Language Processing

1. Introduction

Digital methods augment co-design in the process of Mass Customization (MC), which helps to satisfy customers' diversified needs in the apparel industry [1]. Despite many efforts to improve application of digital tools in co-designing, obtaining accurate requirements of the product is a serious issue. It leads to increase the product development cycle time and cost, as more iteration need to be run to gather correct requirements from the customer [2][3]. The study aims to explore potential enhancements of digital tools to elicit the exact requirements of a product by minimizing the product development cycle time, cost and risk.

3. Methodology

Product configurators are widely accepted toolkit to meet customer needs in the context of product customisation [4]. Hence, a comprehensive review of literature was carried out to explore the potential opportunities of configurators to enhance the interactive requirement elicitation. Nine out of 492 articles reviewed were selected for study. Because of limitations, not all research databases were searched to identify configurator potentials. Then, digital tools and research publications related to elicit the customer requirements of the apparel product were reviewed with the purpose of finding the previously extracted opportunities which are not yet applied in the apparel industry.

4. Results and Key Findings

Nine potentials of configurators were extracted to enhance interactions with customers in the apparel industry. According to the study, the usage of the Natural Language (NL) based requirement elicitation approach for the apparel industry was not even researched yet.

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How demand for custom-clothing changes e-fashion business models

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Key Words: Fashion-on-demand, customisation, on-line purchase

1. Research Gap Identified

The pandemic is amplifying a trend that has been disrupting the clothing sector for decades - fashion-on-demand. The COVID-19 crisis is shifting consumer needs and preferences. In order to respond to trends and consumer demand, data analytics and a new breed of start-ups to adopt made-to-order production cycles are needed. Fashion on demand to reduce waste and react rapidly to trends, was identified from [1,2] as one of the ten trends for the fashion industry to watch. Moreover, according to Gartner [3], a growing number of brands are promoting items that appeal to consumers ′demand for unique or individual items.

2. Aim and Objectives

The objective of the authors research was to identify the reasons fashion on demand are only seen in Greece in a restricted scale. It is about defining the attitude of consumers towards e-commerce and their predisposition towards a new platform of personalized products with the corresponding cost and the required delivery time. Questions like “How can a production process save the company and the environment from risk, stock and huge consumptions of energy?”, “How can the needs of well informed and demanding costumers be satisfied?” and “How can the technology and digital transformation be used so that a clothing company can offer customized products?” are explored in depth.

3. Methodology

A primary research has been conducted. The distribution of the questionnaires was held via the Google Form platform which enables the creation and distribution of questionnaires as well as the processing of responses and lasted from March 2019 until May 2019. The answers were anonymous, and the final sample includes 550 answers.

4. Results and Key Findings

Analysis of the responses of the survey reveals that consumers do not find what they are looking for in the market, which ends up with not spending much of their income in fashion goods. In addition, the internet is not the primary driver of fashion products consumption due to lack of trust. However, the process of a collaborative e-business platform received positive response.

5. Originality

Up to the authors’ knowledge, such a survey with more than 500 answered questionnaires on customer behaviour towards personalised clothing and co-creation has never been conducted in Greece before**.**

6. Research Implications and Limitations

Due to the pandemic crisis, results may have been different if the same survey would be conducted in 2020. However, the results show a tendency towards a new e-business.

Acknowledgements

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'Phygital' Phenomenon as a Fashion Concept

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Key Words: 'Phygital' fashion, digital fashion, avatar, fashion practice, fashion phenomenon

1. Research Gap Identified

The concept of fashion as an overarching set of processes; resulting in physical product is being challenged; with innovators The Fabricant, Atacac and Carlings disrupting the concept of traditional physical fashion outcomes. Furthermore the significance in the shifting climate of the fashion industry is acknowledged by Murphy who predicts "a digital-only fashion industry will be larger than the physical fashion industry"[1] provoking discourse of what fashion can be. Moreover, McDowell [2] cites how "the current crisis could open up more opportunities for digital fashion, which has mostly existed on the fringe of the industry". Within this phenomenon, digital bodies employed as representations are also emerging, with examples such digitally generated influencers Miquela Sousa and Shudu expanding the role of avatars in fashion processes and sitting alongside physical catwalk models [3].

However, research into digital technologies for mainstream fashion has, to date, typically embedded assumptions that the end goal predominantly requires a *physical* product for *physical* consumers. The scope of this research challenges the current relevance of this assumption through comparative analysis of 'phygital' fashion entities. 'Phygital' is a contemporary acronym in urban use as a marketing term for tools and techniques merging physical and virtual experiences to engage users/consumers [4]. The hypothesis of this study employs 'phygital' as a concept, from which to analyse fashion practices, addressing the gap caused by binary (physical-digital) approaches to fashion research.

2. Aim (and Objectives)

The project aim is to explore the 'phygital' phenomenon as a concept in the context of contemporary fashion practices engaging in activities of non-traditional fashion outcomes.

3. Design/Methodology/Approach

This research establishes 'phygital' in its current context and tests the notion through comparative analysis of fashion practices across the digital/physical boundaries of traditional end-product. Thematic analysis of products and processes resulted in the proposal of a 'Phygital' Fashion Conceptual Framework (PFCF).

4. Results and Key Findings

The notion of 'phygital' approaches to fashion outcomes were analysed and three core groupings of end-product entities were created. Furthermore, the investigation revealed sub-categories and variables of the groupings where-by processes, channels to market and a broadening of fashion product outcomes informed the structure of the PFCF. The findings indicate a clear trend towards alternative practice and a blurring of traditional boundaries of end-product outcomes.

5. Originality

The secondary research identifies that binary perspectives of physical or digital fashion are now problematic. In addition, the research findings provide the Phygital Fashion Conceptual Framework (PFCF) from which to provoke discourse to establish the validity of the 'phygital' phenomenon as a fashion concept.

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Session 2B:

Chair – Dr. Priscilla Chan, Manchester Fashion Institute, MMU

Barbara Shepherd, Manchester Fashion Institute, Manchester Metropolitan University,
'Fit for purpose': PPE Sustainable Design Evaluation in a Clinical Setting

Dorota Watson, University of West London, UK,
Celebratory Communities of Practice expedited through Covid; Fashion Marketing and Promotion – a new way forward?

Dr. Sarif Ullah Patwary, Kansas State University, USA,
Consumers' Discourse of Clothing Sustainability Aspect on Social Media

Jessica Saunders, London College of Fashion, University of the Arts, UK,
Do e-textiles for Fashion require specific Legislation and Developmental Guidelines to avoid Harmful Waste?

Samit Chakraborty, North Carolina State University, USA,
Automatic Defect Detection of Print Fabric Using Convolutional Neural Network

'Fit for purpose': PPE Sustainable Design Evaluation in a Clinical Setting

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Key words: PPE, redesign, wearer trial, apron, sustainability

Abstract

This research aimed to evaluate the perceived acceptability of a re-designed sustainable PPE protective apron in an acute healthcare setting during the COVID-19 pandemic. PPE production and its disposal is quickly becoming another sustainability issue for the fashion industry which is already the second biggest polluter on the planet. This redesign incorporated the UN SDG 12th Sustainable Goal of "Responsible Consumption and Construction. Using "Design Thinking" and action orientated "Innovation Frameworks" redesign options and prototypes were explored, and a sustainable raw material was sourced to produce a new base material for the existing apron to be manufactured locally in Manchester. Simon [1] and Keeley [2] proposed that design thinking was crucial in the development of a framework that could provide a comprehensive structure to guide creative and technical teams. The research team drew on this concept as outlined by Luotola et al. [3] in the development and implementation of redesigned PPE in clinical environments by focusing on understanding problems which gives rise to solutions as a direct result of understanding the needs of the end user. The current research process employed a similar methodology to Micheli et al. [4] who followed the key attributes of design thinking, by using creativity and innovation, user-centeredness and involvement, with problem solving, iteration and experimentation and interdisciplinary collaboration to redesign PPE during the COVID-19 pandemic. Surveys were carried out to capture clinical staff views on the garment suitability and on the sense of psychological safety associated with the re-designed apron compared to its predecessor. This work was completed virtually in a 12-week timeframe with all stakeholders as a direct result of the COVID-19 restrictions. The key findings from the wearer trial were that overall participants reported feeling more confident in the new sustainable apron design. This research involved collaboration with the Greater Manchester NHS trust, in combination with the local government authority and local plastics manufacturers, to identify end users' needs, assess product performance by specified criteria, whilst taking into consideration manufacturing constraints and determining the overall costs for UK manufacturing. This research project has laid the foundations for continued collaboration on the development of PPE. This research illustrates an important example of how universities in general, and Manchester Fashion Institute can use their technical and scientific expertise alongside their infrastructure to provide sustainable practical solutions to the global COVID-19 health emergency.

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Celebratory Communities of Practice expedited through Covid; Fashion Marketing and Promotion – a new way forward?

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Key Words: Community, online, showcase, collaborative, interactive

1. Research Gap Identified

How adverse external factors foster cross course and school collaborations, creating communities of practice.

2. Question (and Sub-question) answered

Do communities of practice support student experiences through adverse external factors? Are online showcase activities effective? What does effective mean?

3. Methodology

The study is being conducted through multiple methods (quantitative and qualitative), interpretation of data (number of hits and longer virtual visits) and focus group responses through a deductive approach. Communities of Practice (CoPs) serve as the conceptual framework [1]; the students operate within a studio environment, progressing through their study levels until they are fully integrated into the fashion marketing and promotion community; this community collaborating with the wider creative arts community in the school. The conceptual framework is underpinned by the theoretical framework of Social Constructivism (CS); highlighting the significance of culture and its background in assimilating how society constructs knowledge as explored through theories developed by Bandura, Bruner, Piaget and Vygotsky. CS underpins the students navigation through their studies, scaffolding their learning and gaining knowledge [2].

4. Results and Key Findings

Highlighting the importance of level 6 showcases; the extension of their reach through the significant increase of attendees compared to physical events. Virtual interactive initiatives attract a wider more diverse audience; the online platform reflecting industry practice. Lastly, to ensure their effectiveness and success; the planning and infrastructure has to be rigorous promoting online platforms as a viable showcase experience.

5. Originality

The online ArtsFest was a direct response to external factors (Covid-19) affecting final year showcases. This is the first time showcases had to be re-defined in HE in the UK, due to government guidelines regarding participatory physical events. This is a seminal piece of work analysing *effectiveness* through virtual 'hits' and reviewing the audience reached/ analysing perceived success by interaction with key participants.

6. Research Implications and Limitations

This is an ongoing piece of research; the next stage is to create a grounded theory [3] through focus groups with the graduates and current level 6 students. Extending the virtual showcase activities for the next academic year, extending research as to how this practice echoes industry practice. Further implications include the impact on future showcase activities/ events? Will physical events be redefined?

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Consumers' Discourse of Clothing Sustainability Aspect on Social Media

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Key Words: Sustainability, social media, environment, clothing, textile

1. Research Gap Identified

The production and consumption of textiles and apparel (TA) adversely impact the environment and the TA industry is considered as a major player for global climate change [1]. Driven primarily by fast fashion along with the improved purchasing power of the world population, the TA industry is continuing to grow overwhelmingly. Consumers, as an important stakeholder, can play a vital role to curb TA-related environmental damage using Word of Mouth on Social networking sites (SNSs)- a modern, popular and powerful tool to enhance individuals' environmental awareness [2]. Previous studies supported consumers' knowledge gain of TA industry-related environmental sustainability via SNS engagement [3], but it did not capture insights from consumer to consumer interactions.

2. Aim and Objectives

The purpose of this study was to explore consumers' responses through an SNS platform-based interaction while engaging with TA-related environmental information.

3. Methodology

One group pretest-posttest experiment was conducted with 46 U.S. participants aged 18-35 (millennial cohort) using a convenience sampling strategy. The experiment included interaction with TA environmental sustainability information on an experimental Facebook page over two weeks. The content, developed from available sources (e.g., YouTube, websites), was posted on the Facebook page. It included four main aspects of TA environmental sustainability: water, energy, chemical, and waste issue. The content was posted in three different formats: video, infographic, and weblink. The content analysis was applied to the qualitative data (participants' comments and replies) to facilitate coding, categorizing, and identify a theme.

4. Results and Key Findings

The three most frequently mentioned themes emerged from participants' responses regarding personal responsibilities and purchasing decision were: conscious consumption, long-term use, and buying less. Besides, three major themes emerged from participants' response related to the TA industry's responsibilities were: eco-friendly production, following regulations, and proper disposal. Sustainable TA brands and retailers can persuade consumers to buy and to inform about the impact of consumers purchasing behavior via SNSs.

5. Originality

Unlike previous studies, this study did not investigate the impact of SNSs on the TA industry, rather it involved consumers, using a popular SNS, as a vital driving force to encourage the sustainable supply chain of the TA industry. A thought-provoking response was observed on how consumers can behave pro-environmentally if they exposed to adequate information about their consumption decision.

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Do e-textiles for Fashion require specific Legislation and Developmental Guidelines in order to avoid Harmful Waste?

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Key Words: e-textiles, waste, legislation, design for disassembly, circular design

1. Research Gap Identified

E-textiles are a rapidly expanding body of materials, with extensive prototyping and market testing being carried out globally for fashion, military and medical applications. This is leading to novel combinations of nano materials, electrical components and fibers. A small number of researchers have identified the need for regulation and highlighted the potential environmental impact of e-textiles [1-3]. Partially covered by a myriad of directives and legislation within the EU and UK, there is a call for action to address the disposal and waste aspects of e-textiles [4][5]. The EU WEEE directive [6] instigated in 2006 to address electronic waste management provides clear and actionable outlines for electronic devices with emphasis on producer and user responsibilities. The same cannot be said for the complex directives and legislation relating to fashion and textile waste. The Pulse report [7] identifies the need for producer responsibility in fashion and the World Economic Forum [8] states there is currently no "credible" recycling for fast fashion, add e-textiles to fast fashion and the potential impact is chilling. The EU and UK have sought to explore the effects of nano-materials, however there is currently no specific direction on disposal of nano-composite materials other than to include it among REACH legislation [9]. This research addresses the gap within current textile, fashion apparel, electronics and nano-materials legislation.

2. Question (and Sub-question) answered

Does current legislation in the UK cover the disposal of e-textiles particularly in the fashion arena to such an extent that e-textile waste will not harm the environment in future? The research demonstrates that guidance and legislation is necessary specifically in relation to fashion e-textiles to avoid a future of clearing up toxic waste following their disposal. Having established the need for legislative review, this research forms the basis of a sustainable framework for e-textile waste legislation in the UK and subsequent white paper.

3. Methodology

Triangulate secondary research to develop a conceptual framework, test in workshops and interviews with key industry leaders, producers and researchers to establish viewpoints and individual needs, leading to discussion on a proposed framework and a legislation outline.

4. Results and Key Findings

This research has identified a gap in UK/ EU legislation regarding e-textiles and that there is a need for clarification.

5. Originality

The research indicates that there is no substantial legislation in the UK or EU in relation to the lifecycle and disposal of e-textiles and provides original insights into developing effective legislation.

6. Research Implications and Limitations

The research will contribute to the reduction or neutralisation of the environmental impact of the emerging e-textiles sector particularly in fashion apparel. Initially this will be UK wide but may inform legislation on an EU and global level. Bringing legislation together that specifies e-textiles will mean this exciting new breed of materials will not slip through legislative net and cause catastrophic environmental impact in the future.

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Automatic Defect Detection of Print Fabric Using Convolutional Neural Network (CNN)

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Key Words: Defect detection, printing, colour spot, misprint, neural network

1. Research Gap Identified

Automatic defect detection is a challenging task because of the variability in texture and type of fabric defects. Although, there has been research on patterned fabric defect detection, these defects are related to weaving faults such as holes, and warp and weft defects. But, there has not been any research that is designed to detect defects that arise during rotary screen printing such as color spot and misprint.

2. Aim (and Objectives)

- Developing a high-quality print fabric database, which covers both defect free and defective knit fabric images with floral and dot print designs.
- Detecting colour spot and misprint defects in the fabric automatically using Convolutional Neural Network

3. Methodology

Three hundred and eighty fabric images were collected from industry members. Initially, the total dataset was split into 40 (train): 30 (validation): 30 (test) ratio and then image augmentation (5x) was carried out to expand the train dataset from 152 to 760. Images were labelled to annotate the defect free fabric image as 0, colour spot as 1 and misprint as 2. CNN algorithm was used and the parameters were hypertuned to run the model using python code. The proposed CNN model was compared with VGG16 and VGG19 models.

4. Results and Key Findings

The results in Table 1 show that VGG16 outperformed all other models. Fig. 1 shows the training and validation loss for sigmoid activation function. Fig. 2 shows the confusion matrix of VGG16, where the model showed 56%, 73% and 62% accuracy on detecting defect free, color spot and misprint images respectively.

Table 1: Model Accuracy

Model	Test Accuracy
Proposed CNN	48.50%
Vgg16	62.28%
Vgg19	60%

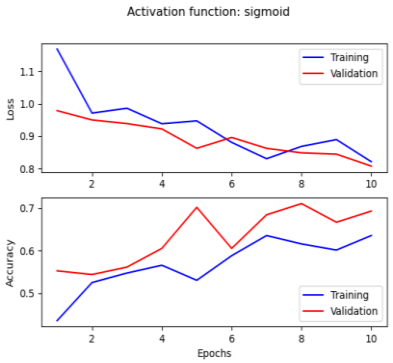

Fig. 1: Loss and Accuracy

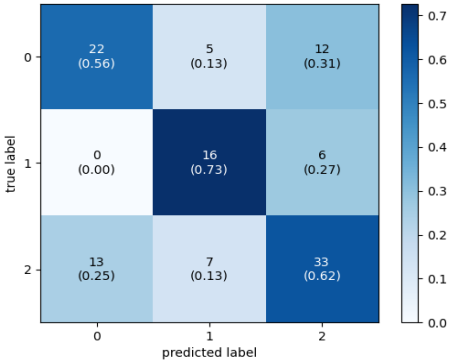

Fig.2: Confusion Matrix

5. Originality

This research consisted of a primary research dataset.

6. Research Implications and Limitations

Testing of this model during in a fully operational production setting in order for simulate real-time defect detection would be preferred. In future studies a larger dataset could be used and more defect types could be included.

Session 3A:

Chair – Professor David Tyler, Manchester Fashion Institute, MMU

Keynote - Dr Tracy Mok, The Honk Kong Polytechnique University,
Understanding Human Fashion Images: A Parse-pose based Study

Invited - Dr. Sofia Scataglini, University of Antwerp, Belgium,
Digital Human Modelling (DHM) for Connecting Smart Apparel Design and Fashion Design: from Beauty to Practice

Dr Rong Liu, The Hong Kong Polytechnic University,
3D Fluid-Solid Interaction Model for Pressure Transmission and Hemodynamic Analysis of Customized Elastic Compression Stockings

Keynote

Understanding Human Fashion Images: A Parse-pose based Study

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Key Words: Deep learning, 3D modelling, human parsing, human pose estimation, clothing recognition.

1. Research Gap Identified

There is an ever-increasing amount of fashion image data available on the Internet nowadays, and the rate of growth itself is also increasing. It is necessary to have some ideas about the image contents before we can effectively manage and make use of such a large amount of image assets. Recently, the development of deep learning techniques has shown great performance on many image understanding tasks, such as image classification, object detection and semantic segmentation [1]. Inspired by the successes of DL techniques, we envision real-world applications through DL techniques to better understand fashion photos in this research.

2. Aim and Objectives

The aim of this study is to research on an overall platform for fashion image understanding. It aims to understand the detailed and high-level information in the images, including segmenting the regions of interests, extracting size and shape information of human presented in the images, recognising the fashion items and further recognising the fine-grained attributes of fashion items.

3. Methodology

In this research, a human parsing and pose estimation-based fashion image understanding architecture has been proposed. Human parsing is the basic block of the platform, where pose estimation is used to optimize human parsing. Both human shape customization and clothing category and attribute classification work on top of human parsing results. Human model customization uses human parsing and pose estimation results to extract critical features for model customization. Clothing classification makes use of human parsing and pose estimation to localize the clothing regions for classification and feature extraction.

4. Results and Key Findings

For the human size and shape extraction from images, experiments have shown that the size measurements using our method have less than 3% difference with the scanned models, satisfying the size tolerance of the clothing industry. For understanding fashion information from human photos, an image similar recommendation experiment has shown that our feature extraction performs much better than traditional feature extraction.

5. Originality

Based on human parsing and pose estimation, we proposed an overall platform to understand information from fashion photos about the human subjects and the fashion items presented in the images.

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Invited Talk

Digital Human Modelling (DHM) for Connecting Smart Apparel Design and Fashion Design: from Beauty to Practice

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Key Words: Beauty, aesthetics, smart apparel design, fashion design

Abstract

Since the fifth Century B.C, Polykleitos of Argos (fifth Century B.C.), was the first sculpture that translates beauty to practise realizing the first stature "kanon" meaning "rule". For him in fact, beauty is in the human proportion, symmetry and anthropometry [1]. Later on the doctrines of Hippocrates and Plato, Galen said that "Beauty, Chrysippus feels, resides not in the commensurability (symmetria) of the constituents (i.e., of the body), but in the commensurability of parts, such as the finger to the finger, and of all the fingers to the metacarpus and the wrist (carpus), and of these to the forearm, and of the forearm to the arm, in fact of everything to everything" [1].

From ancient Greek to nowadays we are looking to find and work to achieve a garment that is fashionable empathic, transmitting feeling, emotion and beauty through aesthetics.

But at the end, we must not neglect its functionality. In some way we need to be smart or putting "intelligence" on the realization. In some sense we need to create "smart apparel human centred design" using Digital Human Technologies and their Models. Moreover, digital human model in apparel design plays a fundamental role for garment co-design workflow. Technological and design issues together with aesthetical one need to be considered for maintaining the functionality of the garment.

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3D Fluid-Solid Interaction Model for Pressure Transmission and Hemodynamics Analysis of Customized Elastic Compression Stockings

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Key Words: Elastic compression stockings, fluid-solid interaction, venous flow, tissue pressure

1. Research Gap Identified

Elastic compression stockings (ECSs) have been widely applied as a valid auxiliary modality for prophylaxis or treatment of chronic venous diseases of lower limbs. Their medical effectiveness could be achieved through augmenting muscular pumping action and improving venous return [1]. Effective pressure transmission by ECSs to the deeper tissues and vascular system is highly essential for achieving the aforementioned therapeutic purposes. However, few existing studies have addressed the efficacies of the pressure transmission and venous hemodynamics of ECSs within the limb tissues.

2. Aim

This study aims to numerically simulate and analyse the tissue pressure, stress transmission, and hemodynamic properties, including venous velocity induced by the customized ECSs with different mechanical properties through developing a three-dimensional fluid-solid interaction model (3D-FSI).

3. Methodology

3D leg model was constructed based on Magnetic Resonance Imaging (MRI) through applying Mimics Research 20.0. ECSs' mechanical properties were tested by using INSTRON® and Kawabata KES-FB1 system. The interface pressure and tissue stress were further simulated and calculated by using ANSYS-LSDYNA software. The flow variations were computed by the developed coupled model of static structural and fluent systems.

4. Results and Key Findings

The simulated maximum and minimum tissue interface pressure were approximate 3600 Pa at the ankle and 2000 Pa at the calf, respectively (Fig. 1A) for Class-II ECSs for medical use (RAL standard). The tissue stress distributed heterogeneously from the skin (2400 Pa) to the fibula and tibia (200 Pa) (Fig. 1B). The maximum flow velocity of peroneal vein increased by 0.21 m/s, 0.23 m/s for small saphenous vein, and 0.24 m/s for great saphenous vein under mechanical exertion of gradient pressure by the ECS (Fig. 1C).

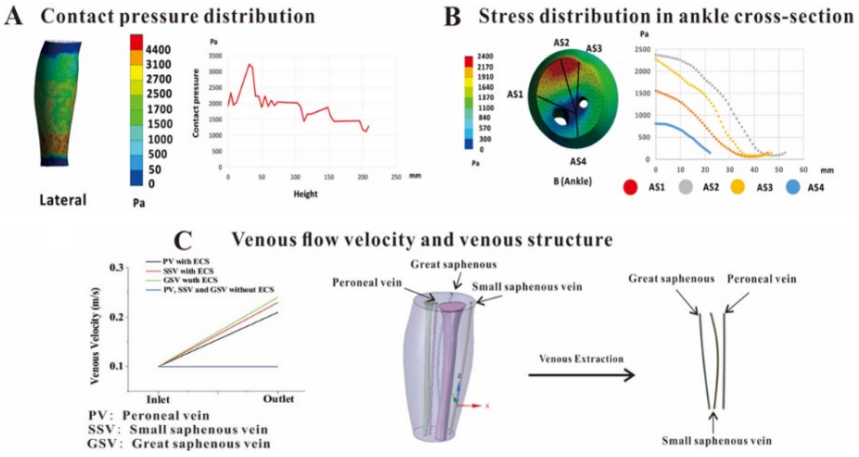

Fig. 1: Mechanisms of 3D-FSI model. (A) Interface pressure. (B) Tissue stress transmission. (C) Venous mechanisms

5. Originality

This study provides a novel solution to digitalize and visualize the biomechanical effectiveness of compression garment on the human body, which demonstrated the pressure transmission function of ECS within the soft tissue and effects on the vascular system. This study contributes to further analysing and optimizing the mechanical and morphologic design of ECSs for specific end uses.

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Session 3B:

Chair – Dr. Phoebe Apeagyei, Manchester Fashion Institute, MMU

Dr. Nidhi Goyal, Royal University for Women, Bahrain,
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Rebecca Neary, Manchester Fashion Institute, Manchester Metropolitan University,
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Limitations of 3D body Scanner in Data Processing and Measurements

Fashion Runway Gets its Speed: A Bahrain Perspective

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Key Words: Brand strategy, consumer, designer, digitization, fashion show

1. Fashion industry in Bahrain: Then and Now

Back in the days, before the mall-culture took over the country, most people would get clothes stitched in Manama (capital, Bahrain) *souq*. The late 1980s marked the beginning of fashion designers in Bahrain. The year 2000s, witnessed the advent of malls and fashion retail business gained momentum with evolution of mall culture. Mass Internet adoption in the Gulf Cooperation Council (GCC), took off around the mid-2000s. Fashion presentations and shows are important marketing activity that provide a platform for the designers to present their work and generate business. However, from Bahrain perspective, fashion has been modest and fashion shows/weeks, may be 20 years ago, did not exist. The GCC consumer is among the most connected and digitally savvy in the world. Does such a high usage, propel the designers to expand the power of runways for their business and recognition in the region and in the global market?

2. Aim and Objectives

- To understand the fashion industry and its evolution in Bahrain
- To study the fashion shows and transition to digitised / virtual show

3. Methodology

In order to understand the fashion industry, evolution of fashion show and digital impact, in Bahrain, both primary and secondary data was collected and evaluated. Sample of designers, academic and other organisations viz. modelling agency, were selected by purposive sampling technique. Survey (cross sectional) with structured questions in the interview schedule was used. The Secondary data was collected from online library, journal articles and press releases. The data was analysed, qualitatively, and presented.

4. Results and Key Findings

The past few years saw a notable rise in the number of fashion players in Bahrain and designers like Hala Kaiksow gaining an international recognition. With the economic support and guidance from *Tamkeen*, and setting up of fashion education, Bahrain is establishing its own indigenous fashion industry. The first fashion event being organised in Bahrain was in 2008 by Bahrain Fashion Week, with one local designer. However, before that, fashion shows were hardly organised as a public event, due to the cultural restrictions. Progressively, with western influence, fashion design education in Bahrain, and growing number of fashion designers; marketing strategies changed, modelling agencies started operating and fashion shows gained importance. In 2013, there appeared Bahrain International Design Week. In 2015, Arab Fashion Council was formed, and Arab Fashion Week was organised, in Dubai. With internet penetration exceeding 90% in Bahrain, and growing tech savvy population, fashion designers received the opportunity. The first virtual show was organised in 2020, aired on YouTube, provided a greater opportunity to all designers amidst COVID-19. However, face to face client interaction would be a miss. More such experiments of virtual shows would be conducted to reach the right customer at right time!

To conclude, fashion industry in Bahrain will continue to adopt digital technology in the modern set up and especially, when customers are increasingly online. Research shows that fashion runways will continue to play an important role but need to present a right mix of virtual and real shows. Designer's website, blogs, social media platforms, YouTube channels and above all, the omnichannel approach, are the various digital tools, facilitating the designers to achieve the consumer centricity. The demand from the local region should grow where digital can play a pivotal role, required for the designers' recognition.

5. Originality

The research work presented is an original work and has not been published elsewhere.

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BIFT x MMU – A Digital Fashion Collaboration during a Pandemic

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Key Words: Virtual mobility, digital pedagogy, cross-cultural communication, digital fashion

1. Research Gap Identified

This case study focusses on post-digital creative education [1], in a virtual learning environment. It presents an international cross-cultural exchange utilising digital and physical fashion technologies, within sustainable and social fashion contexts. The project explores conceptualisation, production and communication of collaborative fashion outcomes during Covid 19.

2. Question (and Sub-question) answered

a) How MMU & Beijing Institute of Fashion Technology students fulfilled an international collaborative and sustainable brief, within a virtual design environment, during the 2020 pandemic.

b) What pedagogical structure and digital opportunities were given to allow for a successful exchange, and how the digitisation of education has impacted the variety of student approaches to fashion practice.

c) Why integration of digital and physical outcomes are important in future-facing fashion contexts, and how students value each of these outcomes.

d) How documentation of digital outcome production, can verify and refine technical fashion communication, from conceptualization to garments to exhibition, through international student exchange.

3. Design/Methodology/Approach

This is a case-study methodology utilising qualitative and quantitative data analysis. Qualitative data includes reviewing recorded accounts of the student experience of cross-cultural and 'phygital' collaboration using Kolb's reflective cycle. Quantitative data includes comparison of student attainment and the percentage of students that chose to integrate CLO-3D into their collaboration.

4. Results and Key Findings

Qualitative analysis found that virtual exchange granted new opportunities for students to develop an value new skills & technologies. This improved cross-cultural communication, using design process and development as their primary language. Internal reviewers and partners at BIFT highlighted this as an important co-operative international learning opportunity, developing virtual mobility and global career ready skills. Quantitative analysis shows 21% of students utilised CLO-3D in their collaboration, 79% opting to use a blended approach to their work. Student attainment has risen to an average mark of 72% within the BIFT x MMU collaboration and 68% within the unit overall.

5. Originality

This is to certify that to the best of my knowledge; the content of this paper is original. I certify that the intellectual content of this thesis is the product of current and ongoing projects with MMU & Beijing Institute of Fashion Technology staff and students. All the assistance received in preparing & sources have been acknowledged.

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Impact of Design Details on the Simulation of Garments

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Key Words: Garments, 3D simulation, Design, CLO 3D, Optitex PDS

1. Research Gap Identified

At this point, very little research has been done using different 3D apparel simulation system with actual fabric data applied and investigating the impact of the design lines of the garments on the simulation. Some researchers have used the Fast system to analyse fabric properties, but since then 3D system requirements for fabric properties have been changed and updated [1].

2. Question (and Sub-question) answered

Do design details have any impact on the simulation of a garment when compared to an image of the real garment?

a. Do design details impact the appearance of garment drape, regardless of whether the garment is real or virtually simulated?
b. Do design details impact the appearance of garment drape based on the software used?

3. Methodology

Three slightly different designed garments (shift, princess, and fit and flare skirt dress) were chosen and engineered for this study from a basic block created to fit an Alvanon ASTM Missy 10 straight dress form. Accordingly, 2D patterns were created for all three designs using Gerber Accumark PDS system.

For this study, 100% wool gabardine fabric was chosen. Actual fabric properties were tested using the CLO fabric testing kit and ASTM standard testing apparatus as required by Optitex and applied to the virtual environment for each software system for accurate simulation.

All three designed garments were constructed both physically and virtually using CLO 3D and Optitex PDS system. A survey was developed for answering research questions using Qualtrics and sent to industry professionals. Finally, survey data were collected and analysed using JMP software.

4. Results and Key Findings

To answer the research questions, images of the actual and virtual garments in three different designs and simulated in two different systems, were included in the survey for evaluator's response. Findings suggest that different designs of the garments did not impact the drape regardless of the garment being real or virtual. Results suggest however that design details of garments did impact the drape appearance of the garments based on the software used.

5. Originality

The fashion industry needs to be able to depend on a virtual image that can appropriately guide garment decisions. Hence, it is important to understand to what extent these 3D visualization software systems can simulate the drape appearance of apparels realistically when required fabric parameters are used.

6. Research Implications and Limitations

It is evident through previous and this study, that software systems are getting better in their ability to replicate real garments. However, since fabric properties are not defined in a standard way across all the systems, widespread adoption may be hindered.

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Limitations of 3D body Scanner in Data Processing and Measurements

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Key Words: 3D body scanner, accuracy, reliability, measurements.

1. Research Gap Identified

Over half of the total women in the U.S. face difficulties in finding well-fitted apparel. 3D body scanning has significant uses in this particular area that will benefit consumers by delivering measurements for custom-made clothing. Even though the 3D body scanner reduces the time and cost of measuring the human body, the accuracy and reliability of the measurements still need to be verified [1].

2. Aim and Objectives

The aim of this study is to find out challenges in acquiring accurate and reliable data from the 3D body scanner. Therefore, our objective is to suggest possible solutions to overcome the limitations of the 3D body scanner in processing and delivering images, and measurement data.

3. Methodology

In order to achieve the aforementioned aim and objective, this study extensively reviewed the relevant literature from year 2000 to 2020 and summarised key findings with possible solutions.

4. Results and Key Findings

In order to transform a 3D body scan, as captured by the hardware, which is typically less than perfect. A study indicated that the data captured by whole-body-image-capture systems were typically noisy, and had areas of occlusion which causes a number of problems related to the reconstruction of the whole-body surface, collecting useful anthropometric information, animating body models. The inconsistency and inaccuracy of data collected with the 3D body scanning method with capturing of high-quality-surface-images are caused by some variables associated with the human body, e.g., variable skin colour, body-fat, body-hair, and other properties such as texture, reflectance of the body surface, etc. [2]. Also, 3D-body-scanned measurements showed different levels of reliability for different parts of the body such as the groin, natural waist circumference, armpit, etc. [3].

5. Recommendations

To overcome the limitation of 3D body scanner, the following issues need to be addressed and resolved:

1. Method development to determine the scan data integrity.
2. Ensure correct placement of landmarks extracted from core body dimension.
3. Improvement of existing software to ensure proper capturing of body surface beyond skin colour variation, and presence of body hair, body-fat, etc.
4. Development of the algorithms to provide accurate, visually satisfying, and useful data for quantitative surface and geometrical analysis
5. To acquire precise measurement, capture time should be as short as possible since people may move, breathe, or sway.

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