

Technological Advancement in Fashion Online Retailing: A Comparative Study of Pakistan and UK Fashion E-Commerce

Sadia Idrees, Gianpaolo Vignali, Simeon Gill

Abstract—The study aims to establish the virtual size and fit technology features to enhance fashion online retailing platforms, utilising digital human measurements to provide customised style and function to consumers. A few firms in the UK have launched advanced interactive fashion shopping domains for personalised shopping globally, aided by the latest internet technology. Virtual size and fit interfaces have a great potential to provide a personalised better-fitted garment to promote mass customisation globally. Made-to-measure clothing, consuming unstitched fabric is a common practice offered by fashion brands in Pakistan. This product is regarded as economical and sustainable to be utilised by consumers in Pakistan. Although the manual sizing system is practiced to sell garments online, virtual size and fit visualisation and recommendation technologies are uncommon in Pakistani fashion interfaces. A comparative assessment of Pakistani fashion brand websites and UK technology-driven fashion interfaces was conducted to highlight the vast potential of the virtual size and fit technology. The results indicated that web 2.0 technology adopted by Pakistani apparel brands has limited features, whereas companies practicing web 3.0 technology provide interactive online real-store shopping experience leading to enhanced customer satisfaction and globalisation of brands.

Keywords—E-commerce, mass customization, virtual size and fit, web 3.0 technology.

I. INTRODUCTION

FASHION industry of Pakistan is playing a significant role in improving the economy of Pakistan, with most retailers using e-commerce platforms to sell their products online [1]. Although e-commerce has gained widespread popularity in Pakistan there are various regulatory, technological and organisational challenges that are limiting the growth of the Pakistani fashion industry [2]. The challenge is to meet the demand of a population with a diverse appearance and specific body measurements. Consumers are dissatisfied with standard body measurements that are frequently used for selling apparel online. Most of the retailers face online returns due to unfit

garments. To meet the needs of consumers in a smart way, innovative technology has introduced programs such as 3D body scanning, virtual avatars, virtual dressing room, virtual mirrors, virtual size, and fit interfaces. This technology gives a feeling of real in-store purchase for fashion e-commerce platforms. The web 3.0 technologies have encouraged consumers to sell mass-customised or made to measure garments online to meet the need of the diverse population [3]-[7].

Pakistan has a potential to improve its e-commerce platform from web 2.0 technologies to incorporate web 3.0 technologies, as made to measure clothing has been common among Pakistani consumers for many centuries [8], [9]. Pakistani e-commerce platforms surveys and previous literature have concluded that virtual size and fit try-on; size and fit recommendation and visualisation is uncommon in Pakistan [10]. The present study aims to introduce virtual e-commerce platforms by considering examples of UK brands utilising such advanced e-commerce technologies for online selling of apparel products. These technology driven interfaces were developed by analysing body-scan data, which was collected by large scale-surveys or by using new 3D body scanning technology. The virtual size and fit platforms are mainly classified as 1) size recommendation: Size recommendations are given by online brands by data entry of basic measurements and previous purchase history is also helpful for retailers to predict size for consumers, 2) fit recommendation: Fit recommendation is provided with the consumer's basic measurements which are matched by similar body measurements online or with other users having similar body types. These users can view each other and comment on the size and fit of a particular garment. Some fit recommendation platforms use size charts that allow consumers to compare them against their own measurements while making online purchases, and 3) fit visualisation: 3D avatars are used by retailers to view personalise images with try-on garments options. Consumers can view tightness and looseness of garments displayed by heat/tension maps. Personalised avatars are created with basic body measurements provided by consumers online [3]. The biggest hurdle in online apparel purchasing is to try-on virtually [11]. Web 3.0 technologies have launched the latest facility of virtual try-on garments boosting improved entertainment and satisfaction value during online shopping [12], [13]. The websites are incorporated with sensory tools and features, virtual fit (through an avatar), size, style and fit

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recommendations and visualisation as well as a virtual wardrobe with personal stylist. These online tools are also termed as Image Interactivity Technology (IIT). These web tools offer high level of interactivity providing both hedonic and functional benefits as well as features of customising a personal model based on individual measurements, uploading a face image, and choosing hair colour and body shape. This technology offers a sensory brick and mortar shopping experience at e-commerce fashion websites. There is potential to decrease the gap between the online and offline shopping environment with these 3.0 technology features. Moreover, retailers would be able to advance direct communication with consumers and garment return rate risk would be decreased [14], [15]. Web 2.0 technologies have been used extensively by all online retailers in Pakistan and UK. However, most of the UK brands have advanced themselves with incorporation of 3.0 technologies to meet the demand of consumers. Digital fashion technology has been further advanced by web 3.0 technologies. Both web 2.0 and web 3.0 technologies have been discussed in literature the review and the findings have been discussed with the latest trends presented by retailers of both Pakistan and UK by utilising both technologies for selling products on fashion e-commerce platforms. As a consequence, this study addresses two main research questions: 1) What are the key features in the existing technology-driven interfaces utilised by UK fashion brands and e-commerce platforms of Pakistani fashion brands?

2) How e-commerce platforms of Pakistani fashion brands can be enhanced to improve consumer satisfaction in terms of virtual size and fit, with examples of technology-driven interfaces utilised by various UK fashion Brands?

II. METHODOLOGY

A qualitative review has been conducted on both Pakistani fashion websites and technology-driven websites utilised by UK apparel brands. Pakistani fashion brands were selected by stratified random sampling. Whereas, virtual size and fit technology interfaces utilised by various established UK brands were discovered through snowball sampling, examining previous research studies [16], [5]. The e-commerce technology used by well-known Pakistani brands for displaying and viewing apparel product and garment selection size and fit tools (see Table I) were evaluated and compared with UK live fashion retail technological websites allowing customers to view and choose garments by using the virtual sizing and fitting technology currently utilised by various renowned UK brands for an enhanced online shopping experience (see Tables II-IV).

III. LITERATURE REVIEW

A. Web 2.0 Technology

Web 2.0 is a participatory platform, through which consumers can download content, as well as contribute and produce new content by uploading. There are more ideas linked with this technology such as tagging, blogs, wikis, and mashups which link both retailers and consumers [17]. Web

2.0 fashion product viewing and service technologies have advanced significantly and have been in use since the fashion industry joined e-commerce platforms.

1) Web 2.0 Fashion Product Viewing Technology

Web 2.0 fashion product viewing technology is acknowledged and available online. It is described as a method of visual merchandising in online atmosphere [18]. Viewing products online offers consumers basic knowledge related to the product and facilitates the decision to make a purchase [19].

a) 2D Image Viewing

To view a product and its features in online fashion retailing, 2D images are commonly seen on a model view or as an outfit view. The 2D product images provided by retailers increase the consumer's intention to purchase a product [19]. The 2D images are not lively and are less engaging than the extensive viewing technology of zoom [20] and product video display [21]. Moreover, styling inspiration is also provided by the model wearing an outfit allowing consumers to imagine themselves wearing the product. Product video is a more charismatic tool for gilded sensory visualisation of the product's characteristics than 2D images [22], [23]. Consumer's intention to purchase is empowered by presenting more sensory features in online platforms. Thus, utilising charismatic media tools can boost consumers' engagement and probability of purchasing product [23]

b) Front, Side and Back Viewing

There is an increased opportunity to sell a product by displaying images taken from various angles, which provide more information for consumers to evaluate before buying a product. The consumer is aided with multiple images of a product which enhance the sensory empowering experiences, thus making up for the absence of palpability in fashion e-commerce [22]. The mental perceptibility increases proportionally to the increase in number of images displayed. Consequently, purchase intention is enhanced [20].

c) Angled Viewing

There is an option of angled viewing in web 2.0, which allows consumers to view the product from various perspectives and with in-depth detail and information. The interactivity and engagement of the consumer increase by viewing the product at different angles. Mental tangibility increases by imagining how the product might look once purchased [24]. With the angled viewing tool, consumers can operate the image they are viewing online. [25] Decision making attribute is enhanced by the provision of a higher level of product involvement.

d) Zoom (Close-UP View)

Zoom provides an option for involvement within the online retail setting, facilitating online consumers with enhanced product presentation and task-related knowledge to purchase a product [26], [27] b. Conversely, there are so many online product viewing tools that, determining which is the most

effective tool with level of interactivity is difficult. Zoom interactivity technology is termed as a low-level tool for online viewing [28]. Zoom technology provides image information which is comparable to viewing a product for real [29].

e) 360° Product Rotation

In-depth interactivity is increased with the product rotation facility in online platforms [30]. Certainly, product rotation lowers the perceptible load, increasing product information, and therefore improving purchase decisions [31].

f) 360° Catwalk Video

The web 2.0 provides catwalk videos to view a garment worn by a model online. These videos are exceedingly sensory combining moving images, sound and more interaction with the online product [32]. Most of the fabric aspects can be visualised. This includes drape, movement and style of garment on the body [21] and enhances the pleasure and enjoyment while online shopping [21]. Although the catwalk video is highly attractive, it does not increase consumers' intention to purchase [33]. While online catwalks are an integral part of displaying a product online, they are no longer an innovative tool in product exhibition [34].

2) Web 2.0 Fashion Service Technology

The fashion e-commerce platforms are not only concerned with technology of product viewing, but also with the service-oriented technology which is introduced by web 2.0. These fashion service technologies enable enhanced knowledge, expediency and admittance to associated amenities and content [35].

a) Product Recommendations

Products are recommended to consumers based on content by fashion e-commerce retailers while online browsing or purchasing. This can initiate better online alterations [36] and product contentment. The recommendation facility offers alternative or added products that may be liked by the consumer [37]. This is achieved by using cookies or algorithms which are run on the consumer's browser within a website. Recommendation is a targeted tool for a specific customer, or a large sample of consumers with similar preferences browsing from same platform [38]. The perceptions are dissimilar on the quality of product recommendations, as the achievement is reliant on conveying an exact, allied recommendation that pursue purchase intention [36].

b) Wish Lists

Products can be bookmarked by using the wish list tool [39]. Wish lists are a personalised space provided by the retailer on a website or an application to save products which consumers may intend to purchase in the future. The wish lists are made by opening an account on a retailer website. Wish list technology also permits users to share their selected items on social media [40]. Sharing products online permits users to gain assistance with the decision to buy a product and aids

with personalised shopping online.

c) Lookbooks

The online latest fashion products campaign is achieved by lookbooks which use graphics to provide inspiration to consumers during the start of new season or collection. This has been shown to improve purchase likelihood [32], [41].

d) Online Magazine

Online magazines or e-magazines are launched by retailers to provide fashion solutions, latest trends and top tips to style garments [42]. E-magazines can improve the level of "fashion consciousness" of a fashion online platform [21] (p.26). Fashion magazines are an extremely appealing mode of online fashion product exhibition that can offer fashion motivation [21] and represent distinct themes associated with a product or a new trend.

e) Blogs

Cultural and political individuality with fashion and styling are conveyed by fashion blogs [43]. Blogs can be authored by retailers or a user. Product promotion is frequently done by retailers via blogs. These blogs frequently display information about product ranges, new season offers, collaborations or sales. Nowadays, blogs are an integral part of conveying the latest information and communicating with consumers to improve traffic on websites. These blogs are also facilitated with guest bloggers or stylists that review brands and products. Recently, pure play fashion retailers such as ASOS and Missguided have frequently been using this blogging facility [44].

f) Hashtags

An online image or phrase is tagged by using the hashtag symbol, which allows tagging a group of users to view a specific product. Hashtag is a mode of fashion service technology, to group words, images or phrases on visual and textual social media platform. Twitter and Instagram are platforms that most frequently use this hashtag technology. There are some specific retailers hashtags such as #Asseonme from ASOS are posted to develop an encouraging image of a brand that is also associated with retailers [45]. An online 'tribe' can be created by using a hashtag, which signifies individual styles of a brands product and allows followers to interact with each other. Similarly, retailers can view traffic and engage with consumers on their social media platform.

Summary of Web 2.0 Technology

The web 2.0 technologies discussed above do not meet the demand of consumers for selecting a garment online as they lack the sensory technology of size and fit recommendation and visualisation leading to uncertainty of selection of right size garments. Thus, there is a need for sensory tools that provide consumers with recommendations online about the right size and style of garments to purchase, and which also provide a virtual online store with virtual try-on options to evaluate a garment fully online with 360-degree rotations. The

next section provides details of advanced fashion e-commerce platforms that can be used to meet the demand of consumers for online fashion shopping.

B. Web 3.0 Technology

Data incorporation is the fundamental source of web 3.0. By utilizing metadata rooted in websites, data can be transformed into valuable information and intelligent agents (IAs) are responsible to locate, evaluate, store or deliver data [46]. IAs are software programs which collect information based on the users' collaboration with the web and accomplish jobs in favour of the user [47].

1) Metaverse Fashion Technologies

The meta-verse is defined as virtual world which is embedded in technology and web-interactions. In meta-verse, users from anywhere can interact with other users as avatars. Locational boundaries are overruled with meta-verse technology as users are connected within the virtual world they are communicating. This allows for playfulness, transfer of knowledge and transactional commerce [48]. The meta-verse fashion technology includes a) Augmented technologies and b) Virtual reality and is utilised by fashion retailers in various forms.

a) Augmented Technologies

Augmented reality (AR) differs from virtual reality through which a person experiences interactions in real time [49]. A marker such as QR code or an image is included in the real environment. The users face or body allows the augmented product to be projected on the users' body and the user is able to view the augmented product on their body on a digital screen. The augmented technologies included two basic categories: 1) Augmented 3D Product View and 2) Virtual Mirror.

- (1) Augmented 3D Product View: Augmented reality delivers a higher level of experiential value during online shopping [50]. AR is a new interactive technology through which consumers can interact with an augmented product over the real image of a person. This technology creates a seamless interactive environment between a person and the viewed product. This field is still under research [51].
- (2) Virtual Mirror: Virtual mirrors deliver a greater level of manifestation than 360-degree spin and motionless images. It is suggested to incorporate virtual mirrors in online retailing, which will act as a medium to minimise gap between the online and offline environments [52].

b) Virtual Technologies

Virtual reality (VR) is associated with cyber technology [53]. VR is a virtual manifestation experience, although not the experience of direct occurrence, but rather the feeling of being engrossed in the virtual atmosphere [54]. Virtual reality is the human perceptibility and the conversation of manifestation [55]. VR technology can incorporate virtual avatars in the virtual fitting rooms of e-commerce platforms [54], [56]. The virtual technologies included four main types

in e-commerce platforms such as 1) Avatars to mix and match for dynamic product view, 2) Virtual fitting rooms, 3) Virtual catwalk and 4) Virtual Body scan.

- (1) Avatars: 3D avatars enhance entertainment qualities for users and encourage consumers to revisit a website. Consumers can mix and match products on avatar for dynamic product view [57], [58]. Formerly, information was limited to product-related features. The consumer's decision-making is highly dependent upon information provided by consumers at this search stage. This technology is a consumer-oriented technology. Shim and Lee in 2011 [57] determined that, avatars permit a greater level of telepresence [53]. Telepresence provides a feeling of physical atmosphere and is described properly and efficiently as a place where users take part with interactive experience. Research suggests that telepresence is enhanced by 3D models [59]. Virtual models can also enhance perceived enjoyment and hedonic value as well as perceived ease of use and usefulness [60], [61].
- (2) Virtual Fitting Rooms (virtual try-on): In contrast with traditional retailing set-ups, virtual fitting rooms improve the experience of consumers with innovation and curiosity [62]. Curiosity is encouraged with virtual fitting rooms which also enhances the probability of both online and offline store benefaction [62]. During customers' transactions, engaging with virtual fitting rooms can also enhance and refine the retailers targeting strategy of collecting users' data for providing a personalised service [62]. Moreover, virtual fitting rooms can improve consumers' empirical attitude. Purchase intention and functional value improves with personalised virtual try-on [28].
- (3) Virtual Catwalk: During the launch of new seasonal products virtual catwalks are frequently used by technology-oriented fashion brands. The virtual reality headsets are used to present a virtual catwalk. Oculus Rift, Samsung Gear and more recently Google Cardboard are big brands names included in the list. Moreover, virtual catwalk is presented by Topshop during fashion week [63], as well as Burberry and Rebecca Minkoff.
- (4) Virtual Body Scan: Professional body scanning equipment is used for 3D body scanning. Positive responses have been concluded by consumers when using 3D body scanning technology [64], [3]. Latest mobile applications have been launched by various companies. Size stream at home is the latest mobile application for body scanning [65]. This technology provides measurements of the human body by taking images of a person wearing a specific suit on its application. This scanning technology was introduced due to inaccuracy in manual measurement methods used by consumers for customisation [66].

2) Intelligent Web 3.0 Fashion Technology

Smart web 3.0 is the advancement of cutting-edge IT that permits amelioration in data assembling, storage, processing,

personalisation and information of virtualisation. Intelligent web 3.0 is the foundation of AI technology which comprises of web mining and web farming technologies [67].

The term web 3.0 or intelligent web is linked with large pools of data utilisation and collection. Web 3.0 is under research and is in an internet evolution stage that permits the incorporation of advanced technologies such as, social networks, big data and IOT (Internet of Things). IOT is the latest internet term in which the internet acts as a medium and connects physical gear with apps to provide services and communication [68]. Moreover, for the fashion community, the intelligent web offers a variety of fashion technologies to facilitate consumer decision making for online shopping. The glimpse intelligent web technologies are listed below.

a) Digital Styling Community (Online styling and fit communities)

The dominant feature of intelligent web technology is digital styling in fashion e-commerce, which has been advanced from web 2.0 to web 3.0. Web 3.0 permits two-way communication between groups of consumers and retailer consumer communication which is also called as user-generated content [44]. The digital styling community tool is used by retailers to guide users based on their online likes on a specific product, which helps retailers to further communicate by sharing more relevant data such as 'like to know it'. Moreover, similar users interact by liking and buying identical products and by sharing their reviews. Consumers share tips and advice online regarding product styling and future use [69], and style inspiration is gained and users can follow each other. There are also active consumers who gain influence as inspiring members of the online fashion community. Fashion blogging provides the digital styling community with examples on how to style a garment. This co-creation connects the supremacy of both crowd and network [35] by ascendance of responses from others.

b) Personalised Digital Styling

- (1) Digital Wardrobe: Consumers are able to organise their wardrobe online via smartphones or tablets via digital wardrobe technology [70]. Recent research anticipated that online retailers would be able to provide a personalised shopping experience to consumers with these digital wardrobes. In 2016, Perry [70] determined that technology optimistic users found it easy to perceive and use.
- (2) Online Personal Stylist: Online personal stylists have been launched with latest applications and websites for online buyers. These online stylists assist consumers by suggesting a variety of garments that suit the users' profile. Dressipi, a website with the personal stylist option, achieves this by asking range of questions regarding choice of colours and personal likes and dislikes in styles, in addition to basic body measurements [71]. Moreover, the application 'Tuesday' has been tested by Mark & Spencer. 'Tuesday' is a custom-built interface which permits Mark & Spencer to market the latest trends

to their customers by gaining a consumer's preference information [72].

- (3) Size Prediction: Size prediction technology collects consumer data regarding height, weight and fit, thus enabling them to predict the size which would fit best when making a purchase online. This satisfies consumers and lowers the perceived risk before deciding to buy online. Mark & Spencer has come up with this size prediction tool recently [73]. Size prediction offers a more personalised shopping experience by eliminating confusion. Moreover, the return of garments bought online would be minimised by this personalised technology [74].
- (4) Size and Style Recommendation: Consumer information includes personal preferences, likes, body shape, body measurements and lifestyle. By gaining user information, with the user's collaboration, the system provides a personal recommendation to online buyers. Previous purchases help provide content recommendations and similar users with identical preferences receive collaborative recommendations [75]. Useful product recommendations are delivered to online users by gathering data on the variety of selected products by size and style recommendation interfaces [75]. Retailers and consumers mutually benefit from personalised technologies [76] as they are user oriented and highly dependent on user information sharing.

c) Artificial Intelligence (AI) Technologies

The process of thought and behaviour placement into a computer is best seen in AI technologies [77]. To deliver convenient, personalised and personified digital interactions AI utilises machine learning, natural language processing, knowledge representation and reasoning with automation.

(1) Image Recognition Styling

The use of algorithms, machine learning and voice activation is utilised by AI to offer aimed products and personalised services. Amazon's 'Alexa', Apple's 'Siri' or IBMs 'Watson' are notable popular examples within consumer culture. This demonstrates the influence of AI for consumers when they shop online and offline [76]. Tailored recommendations are permitted by AI, and consumers respond to the specific information delivered [78]. It is claimed that visual search methods will be used in the future for consuming fashion. Visual search methods are adopted by 20% consumers, as reported by commercial research [79].

Fashion product choices can be made by using both AI and image recognition technology. The online and mobile fashion retailing phenomenon is advancing with these two technologies [80]. However, these two technologies (image recognition and AI) are still under research. Amazon's Alexa, is built with a paired system with the Amazon Echo app which allows users to get personalised recommendations, combined with camera and video function. By using this combination of technologies, Alexa provides recommendations on outfit selections. Algorithms and machine learning utilised by the

system, combined with personal stylists and data on the shape of the human body, aid in providing personalised information to users [81]. This app is the first to introduce a technology which combines AI and image recognition in contemporary fashion consumption.

Summary of Web 3.0 Technology


Web 3.0 technologies with artificial intelligence features have improved the environment of e-commerce for online shopping and are considered by retailers to be cutting-edge technologies that will be aid in improving online sales and meet the needs of a diverse population. This technology has the potential to improve direct communication between retailers and consumers with sensory interactivity, providing a real 'brick and mortar' store for online shopping.

IV. FINDINGS

A. Pakistani Fashion Brands Websites Technology

Pakistani fashion apparel websites have been explored via stratified random sampling. Pakistani fashion brands are in the early stages of Omni channel retailing. It is observed that these brands have physical stores where products are displayed, as well as websites and Facebook pages for brand marketing and direct communication with consumers. Web 2.0 technologies have been used by almost all the fashion retailers. The list of technologies available in Pakistani fashion e-commerce platforms are listed in Table I.

TABLE I
SELECTED PAKISTANI WEBSITES (WEB 2.0 TECHNOLOGIES)

Logo	Clothing Brands URL
SAPPHIRE	Sapphire[82]
	Nishat [83]
	Khaddi[84]
alkaramstudio	Alkaram Studio[85]
	Bareeze [86]
	HSY Studio[87]
	Chen One[88]
	Gul Ahmed[89]
	Junaid Jamshed [90]

1. Web 2.0 Fashion Product Viewing Technology

a) 2D Image Viewing

The Pakistani fashion industry showcases its products all over the world. The most common and essential staple of Pakistani brands is the unstitched garment which makes up the main category on the Pakistani websites explored. The unstitched fabric is displayed with a model wearing a dress in 2D images which demonstrate how consumers may style the product and how they can personalise it with the help of professional tailors in Pakistan. Tailoring is common and economical. The product is bought in pieces such as 3 piece (Shalwar, Kameez and Dopatta), 2 piece (kameez and dupatta or Kameez and shalwar), and 1 piece (fabric bought in metres as per the consumer's wish). These fabrics are embellished with embroidered patterns, digital and rotary printing, as well

as hand embellishment which is found on luxury garments.

The second most important product found on the websites is 'ready-to-wear' which is typically available in Xsmall, small, medium, large and Xlarge. Moreover, luxury prêt-à-porter, separate tops worn with jeans and trousers and lowers can be bought as shalwar, trousers and in pants form. The dupatta is worn in almost all clothes styles. Pakistani women wear the dupatta draped around the neck and shoulders as well as over the head. This item of clothing has a strong cultural significance. Accessories are also displayed in various options such as handbags, jewellery, glasses, clutches, backpacks, camisoles, footwear and wraps. Products are displayed in 2D images, which is evidence that web 2.0 is adopted by fashion brands of Pakistan as shown in Fig. 1.

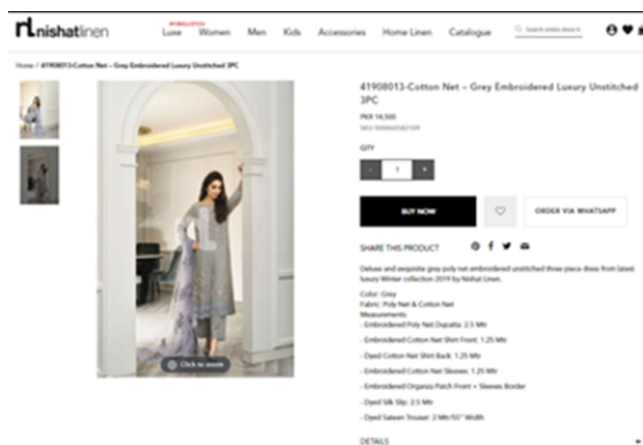


Fig. 1 2D Image [83]

b) Front, Side and Back Viewing

Products displayed in websites can be viewed in three angles: front, back and side. These angles enable consumers to understand the design, style and colour scheme of the products. Product descriptions detail the fabric type, print, embellishment and number of fabrics used in constructing the garment as well as accessories like lace and buttons. When buying a 3-piece or 2-piece unstitched dress, fabric measurement detail is also written in meters. For example: dupatta 2.5 meters, shalwar 2.5 meters and shirt 3 meters as shown in Figs. 2 (a) and (b).

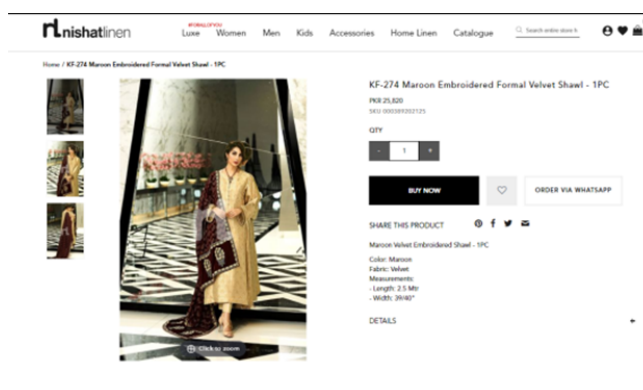


Fig. 2 (a) Front, Side and Back Viewing [83]

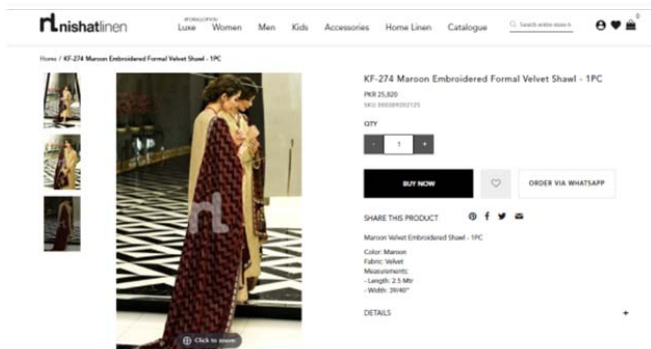
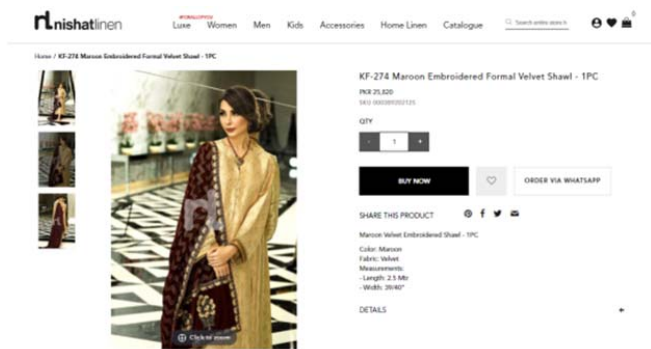


Fig. 2 (b) Front, Side and Back Viewing [83]

c) Angled Viewing and Zoom (Close-up view)

Almost all Pakistani fashion brands present their products with angled viewing and a zoom in option. Thus, consumers can zoom in on a product and can view fine details at various angles as shown in Fig. 3 (a) and (b).

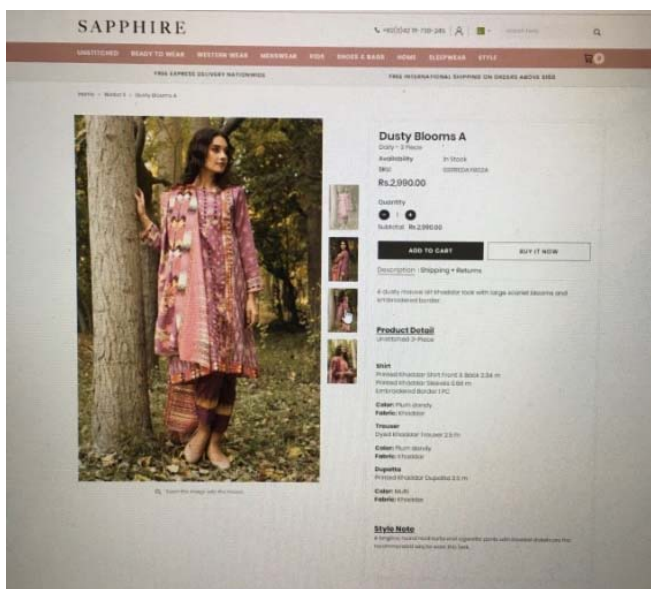


Fig. 3 (a) Angled Viewing and Zoom Option [82]

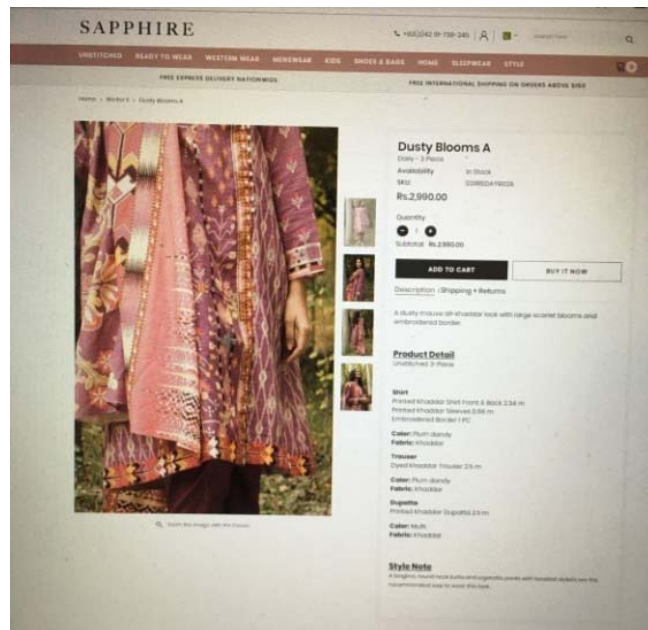


Fig. 3 (b) Angled Viewing and Zoom Option [82]

d) 360° Product Rotation

Sapphire is a well-known brand in Pakistan. It displays products such as Ready-to-Wear, Unstitched Fabric, Formal Wear, Menswear, Kids wear, Western wear, Accessories, Men's Footwear, Women's Footwear, Handbags and Clutches, Fashion Jewellery, Lingerie, Bed Linen & Throws, Cushion Covers, Table Linen and Towels. They have launched an augmented reality application which displays garments on an avatar. Users can rotate the garment fully (360 degrees) and can view the garment at all angles before purchasing. However, this technology still lacks the size and fit visualisation and recommendation system which aids consumers to find the right size while online buying.

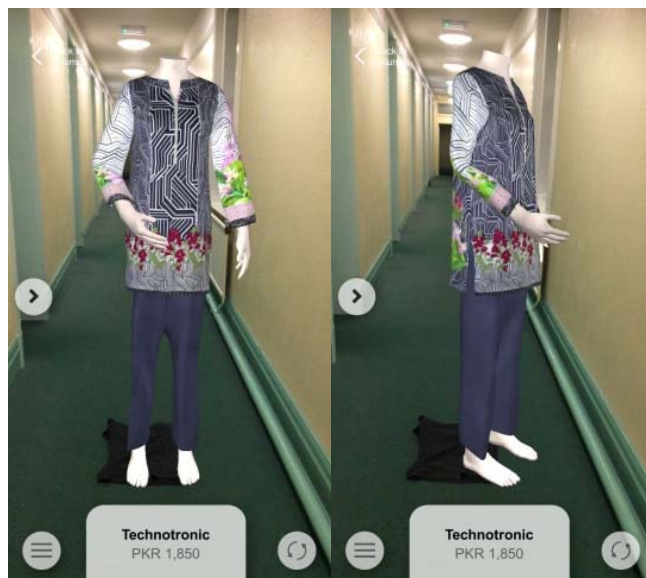


Fig. 4 360-degree Product Rotation [82]

e) *Catwalk Video*

Catwalk videos are fascinating and pleasing to consumers' eyes. Web 2.0 technologies enable retailers to present their new collection in an innovative way by the addition of sounds and lyrics as well as models' catwalks. This helps consumers to pick and choose garments as well as to perceive how a garment will look on them when they wear it as shown in Fig. 5.

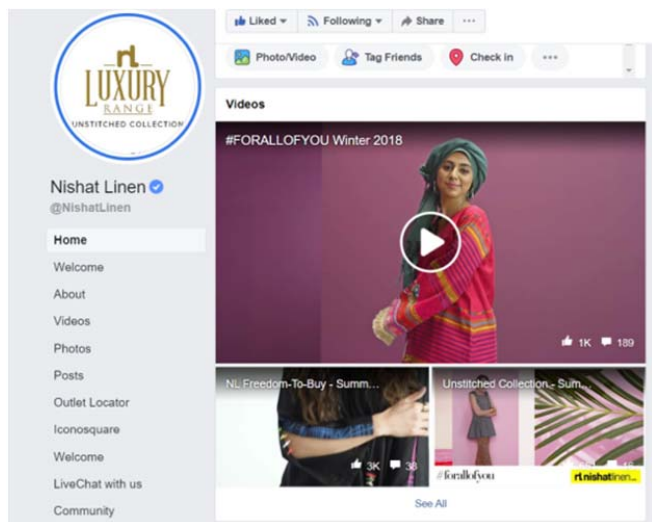


Fig. 5 Catwalk Video [83]

2) Web 2.0 fashion service technology

a) *Wish Lists*

In order to create a wish list, consumers are required to create an account on the brand's website. After creating the account, consumers can choose the garments they like and save them in their wish list. This option is hassle-free, allowing consumers to save time on browsing again to find the product they liked before. This option is available in almost all the fashion brands websites and facilitates the purchase of specific products once the consumer has made up their mind as shown in Fig. 6.

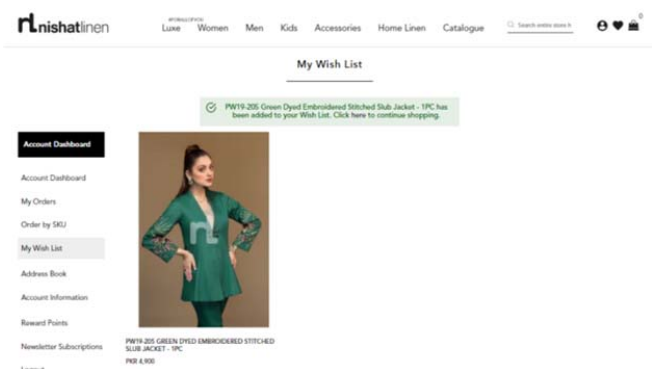


Fig. 6 Wish List [83]

b) *Lookbooks*

Online retailers utilise lookbooks to market their related products that are liked or bought by consumers online. Further recommendations are presented to consumers while browsing.

This option is widely present in almost all the Pakistani brand websites. Consumers use lookbooks as they arouse curiosity and they entertain. Some also prefer to see what their styling options are before making a purchase to validate whether they are making the right decision as shown in Fig. 7.

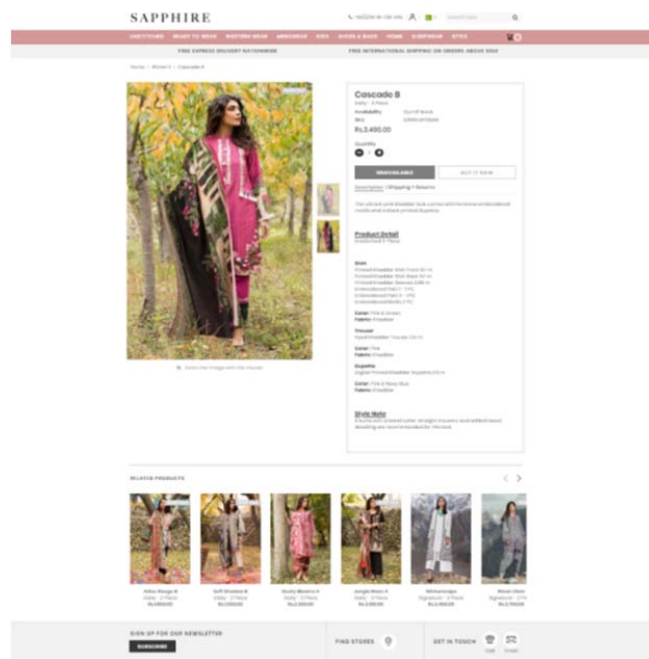


Fig. 7 Lookbooks [82]

c) *Online Magazine*

Pakistani fashion brands sell their products online by uploading an online magazine with descriptions of the latest trends and styles. This is one of the most fascinating tools which enable consumer purchase. Consumers copy styles presented in catalogues that are perceived as trendy and fashionable among friends and family as shown in Fig. 8.

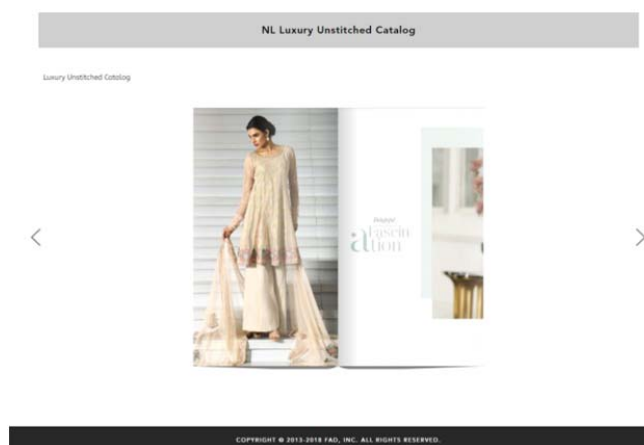


Fig. 8 Online Magazine [83]

d) *Blogs*

Fashion blogging is common in Pakistan; however, it is not utilised in the fashion brands websites. Fashion blogs are

written separately on famous online magazines and online newspaper websites as shown in Fig. 9.

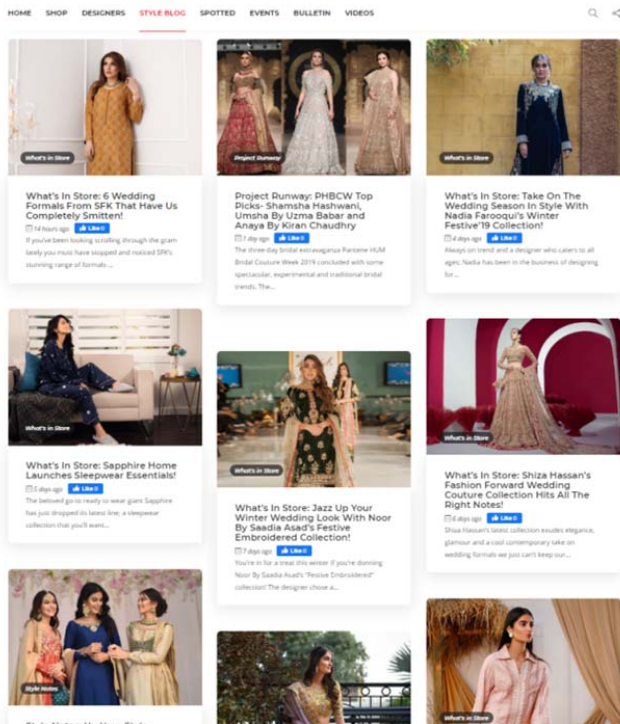


Fig. 9 Blogging [91]

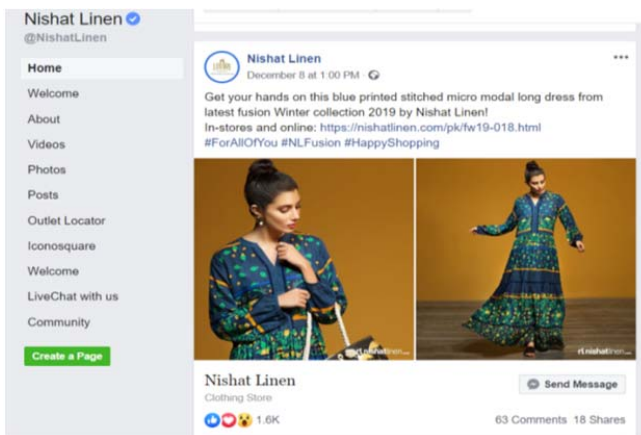


Fig. 10 Hash Tags [83]

e) Hashtags

The use of hashtags on Facebook and Instagram is also common for Pakistani fashion brands. The image shown in Fig. 10, taken from Nishat linen Pakistani brand, demonstrates the use of the hashtag to promote a 2D image of a product as well as tagging the image to their followers: #ForAllOfYou #NLFusion #HappyShopping.

Summary of Web 2.0 Technologies Used by Pakistani Brands

Web 2.0 technologies have been explored to gain an understanding of the level of technology currently used by Pakistani fashion websites to display and view products and

how this can be improved by reviewing web 3.0 technologies and to find out ways to establish new technology in fashion e-commerce platforms.

B. Technology Driven Interfaces Used by Various UK Brands (Web 3.0 Technologies)

The interfaces mentioned in Tables II-IV are used by various UK Brands. The companies offer the platforms to display products. Brands install plugins to allow virtual size and fit technology to be used to sell their products online. The virtual size and fit interfaces are summarised below with the description of their facilities and the level of technology offered.



Fig. 11 Augmented reality application by Zara

1) Web 3.0 Metaverse Fashion Technologies

a) Augmented Technologies: Augmented 3D Product View, Try-on Virtual Mirror and Virtual Store

Fashion brand Zara has launched an augmented reality app that allows virtual modelling live in stores. This technology is used by pointing a smartphone camera to a given space, which allows computer generated images to blend with real world images. Consumers can experience wearing the garment on the phone screen by downloading this app [106] as shown in Fig. 12.

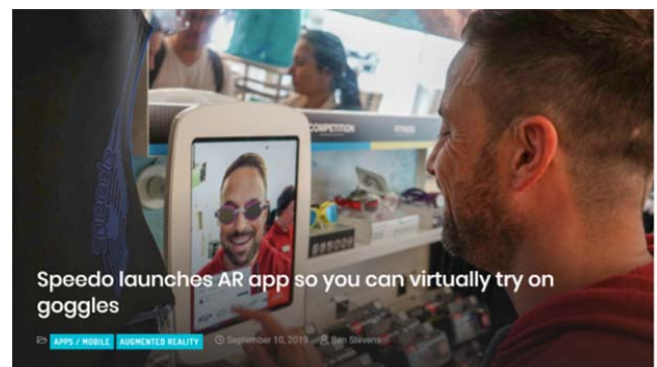




Fig. 12 Virtual Mirror (AR)

Augmented reality can also be experienced by face scanning application which is used by Speedo. The virtual mirror app allows consumers to visualise goggles on their face. Consumers can download the app on Android and

iPhone [107] as shown in Fig. 12.

TABLE II
SIZE RECOMMENDATION WEBSITES (WEB 3.0 TECHNOLOGIES)

Company and Description	Measurement method for size comparison	Platform	Notable Retail Partners
 This website provides consumers facility of garment selection, sizes, styles and outfits through an online questionnaire comprising physical appearances, body confidence, likes and dislikes in garment selection, and contains basic advice on style grounded on the answers of provided. An online questionnaire contains height, weight, bra-size, colour preferences, body shape, and liking of living style, and previous purchase history of well-fitted garment sizes [71].	Questionnaire including height, weight, bra-size, colour preferences, body shape, lifestyle preferences and previous sizes of well-fitted garments	PC and Mobile	BHS, Very, M&S, Debenhams, Boden, Topshop, John Lewis
 The basic measurements are used including belly shape and hip size which is based on consumer prediction about their body. The information provided by the consumer allows the website to find the right size. It is observed that it improved the conversion rate by 2% through AB testing with North Face [92].	Height, weight, age, belly shape, hip shape, bra-size, cup-size, fit preference.	PC	ASOS, JD Sports, M&S, Boohoo Mainline menswear, Betty Barclay, Alexander McQueen, Burberry various brands of USA, China and Europe
 The size of garments was recommended to consumers by using consumer's basic body measurements and body shape information. Consumers can also do double comparisons with various brands and selection product can be done comparatively with other consumers of identical likes and sizes. There is also the option of uploading a user's face picture to find out how outfit would look when it will be worn. This website closed a year ago due to some reasons. However, reviews show that it was preferred by consumers [93].	Height, weight and body shape	PC and Mobile	Fitbay is utilised by various retailers, while using website user get to know about their true size then Fitbay direct them to retailer's external platform for final buying process.
 Me-Ality is a scanner installed at 37 brands of United States which enables to get 200,000 body measurements in 20 seconds. Then a barcode is extracted by the software that is then scanned at the outlet PC, which shows the consumers the recommended sizes for different brands available [94].	200,000 body measurements in 20 seconds	PC	Bloomingdales Gap, Levi's, J.Crew, Old Navy, American Eagle and Brooks Brothers,
 Consumers are required to create a profile for demo that allows them to experience different brands; this platform has various retail partners. By using consumer's basic body data, recommendations are delivered online [95].	Height, weight, age, bra size, body shape, and well-fitted garment brands name and size selected from website.	PC and Mobile	Nordstrom Macy's, House of Fraser.co.uk, Joe's, Guess, Kate Spade, Uniqlo, American Eagle, Oscar de la Renta, Zalando, Future: Adidas, Aldo, Footlocker, Brooks Brothers, Dorothy Perkins
 Fit predictor offers various options to retailers which allow consumers to find best fitting size in seconds. Other options such as the style finder which enables apparel shopping by visual shopping, the outfit maker option which uses a mix and match facility, and an option which enables automated recommendations of outfits are also available [96].	For every technology product offered to retailers they have different procedures of size recommendation.	PC	Farfetch, Bloomingdale's, intermix, Boden, Adrianna Papell and various other retail partners.

A few applications allow consumers to mix and match various retail products online [105] as shown in Fig. 13.

The fashion brand Topshop had a virtual reality fashion show at London Fashion Week which took place at the Tate Modern. The audience was able to view the show from the Oxford Circus store with the collaboration of London VR studio, Inition. Virtual reality headsets were given to customers to view a 360-degree live catwalk of Topshop's latest products [108] as shown in Fig. 14.

b) Virtual Technologies: Mix and Match Dynamic Product View, Virtual Fitting Room (Visualisation), Virtual Catwalk and Virtual 3D Body Scan

There are a few interfaces with virtual fitting rooms which allow consumers to shop online by choosing various garments

from different retailers. Consumers can create their profile and upload their face image to an avatar which can be personalised by entering basic measurements. A virtual catwalk can also be viewed during garment selections. Consumers can mix and match items and can create their own virtual wardrobe [99] as shown in Fig. 15.

Size Stream Company introduced scanning machine for extracting digital body measurements. Recently, scan at home application has been launched by Size Stream Company (size stream at home) to make it easier to use at home as well as economical for consumers. Consumers can scan themselves by wearing a scan suit and then measurements are generated on the phone screen. This application is helpful in customisation of garments online [65] as shown in Figs. 16 (a) & (b) and 17.



Fig. 13 Online Virtual Store



Fig. 16 (a) 3D Body Scanning by Size Stream Mobile Application

TopShop 360° Virtual Reality Catwalk Show

Published by [Sagif Abdullah](#) on August 4, 2019



Fig. 14 Virtual Reality Catwalk Show



Fig. 16 (b) 3D Body Scanning by Size Stream Scanning Machine Software

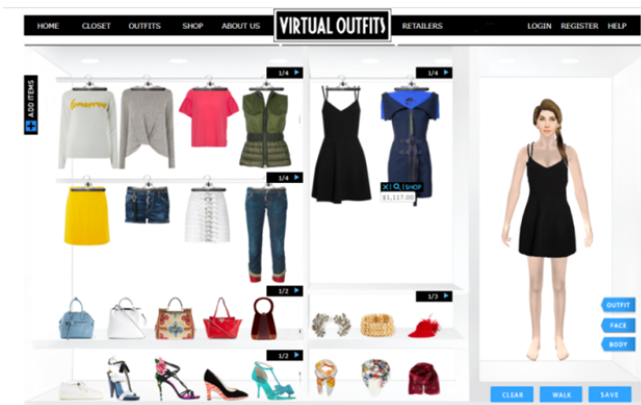


Fig. 15 Virtual Fitting Room and Wardrobe

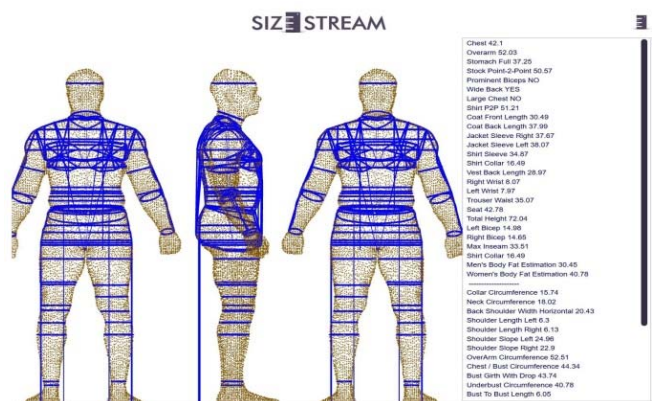



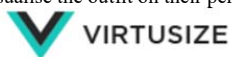


Fig. 17 Size Stream Scanning Digital Body Measurements

TABLE III
FIT RECOMMENDATION WEBSITES (WEB 3.0 TECHNOLOGIES)

Company and Description	Measurement method for size comparison	Platform	Notable Retail Partners
 Styku smart fitting application FitFyle is available to over 100 online stores. To provide recommendation, FitFyle permits users to know their size that fits them on their specific body-type via online platform. This application is consumer driven, and requires no garment measurement to deliver fit recommendation [97].	Size comparison is also available.	Mobile	Available on Shopify app store
 Virtual Fitting Room Basic measurements are provided by consumers and fit is recommended by plotted retailer's size charts. Rakuten Fits Me has not been available since 27 July 2018 direct to retailers [98].	Height, bust, waist, hips and arm length.	PC	LK Bennett, Henri Lloyd, Thomas Pink, Hawes and Curtis, Pretty Green, Viyella, T.M. Lewin, QVC, Sangar, Tamar Collection, Twin Set, Wiggle, Hugo Boss, Michaela Jedinak, Muubaa.
 This platform shows virtual personalised wardrobe of user, selected during shopping and consumers can mix and match brands products apparel and accessories. Consumers can view their own avatar by uploading their face image and body measurements are required and avatar will be in the shape of user body and will show the dress size and it fit as well as user can visualise the outfit on their personalised avatar [99].	Body shape, height, hips, waist and bust measurement to create an avatar...	PC	Various, garments are selected by users. Mix and Match option Dorothy Perkins, Farfetch, Topshop, Miss Selfridge and various brands of USA, China and Europe.
 This platform provide an option to compare brands and it facilitate an option of measuring a stitched shirt online, which aid consumers to find a well-fitted garment [100].	By measuring products online and by comparing brands products.	Mobile	Swedish online retailers such as Acne Studios and Stayhard.

2) Intelligent Web Fashion Technology:

a) Digital Styling Community (Online styling and fit communities)

A few websites in the UK provide consumers with online styling and fit communities. These interfaces require consumers to sign up and answer questionnaires within the website. According to personal likes and measurements, the website facilitates consumers in viewing garments recommended by a personal stylist. Dressipi is one example of an interface providing such services [71] as shown in Fig. 18.

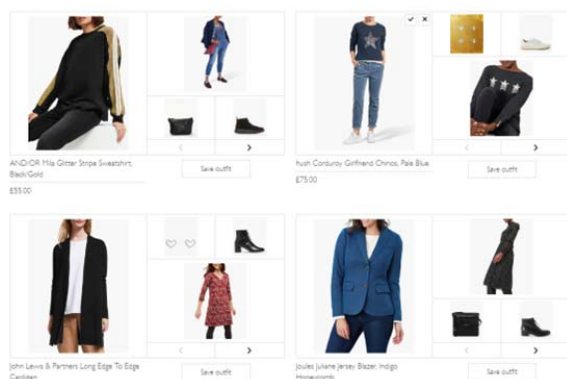


Fig. 18 Online Styling and Fit Communities

b) Personalised Digital Styling: (Digital wardrobe, Online personal stylist, Size prediction, Size and style recommendation)

A few size and fit interfaces have been used by UK retailers

to allow consumers to find out their size using online by size prediction. Size and style recommendations are also given to consumers for personalised shopping. Moreover, users can create a digital wardrobe on an avatar as well as view them in 360 degree rotation [73], [92], [103] as shown in Figs. 19, 20 and 21 (a) & (b).

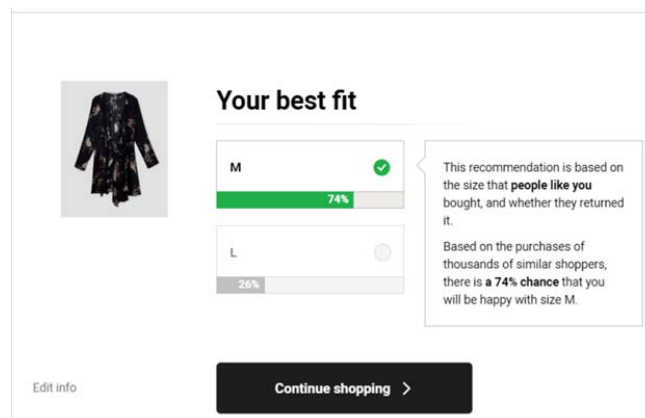


Fig. 19 Size Prediction

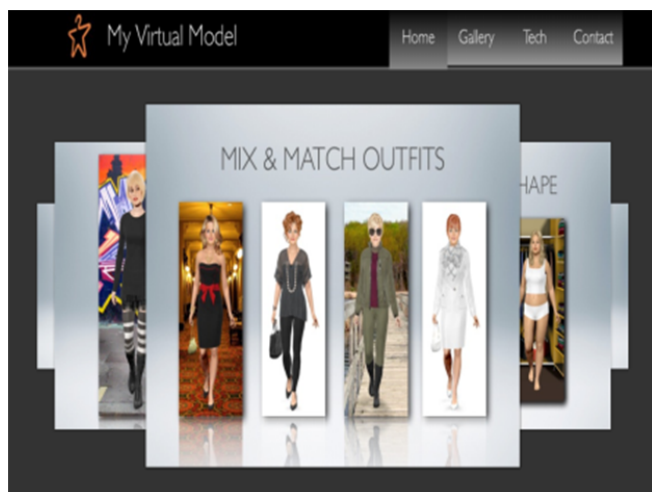


Fig. 20 Digital Wardrobe

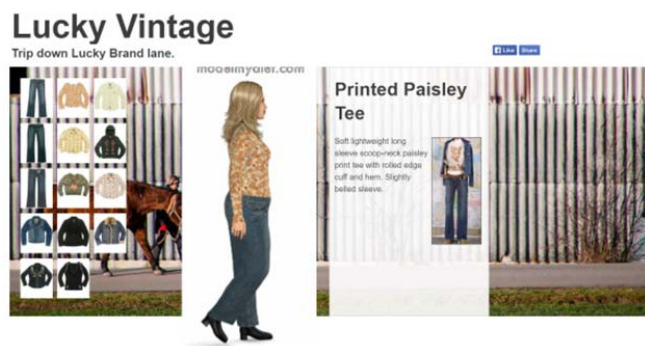


Fig. 21 (a) Size, Style and Fit Recommendation by Viewing Personalised Avatar



Fig. 21 (b) Size, Style and Fit Recommendation by Viewing Personalised Avatar

c) Artificial Intelligence Styling (Image recognition styling)

Image recognition styling and voice recognition in the fashion industry is an under-researched phenomenon. There is still a need to research and explore the ways to embed this technology in retailers' websites and applications. Moreover, as discussed in the literature review, Amazon's 'Alexa', Apple's 'Siri' or IBM's 'Watson' are current examples that this technology is presented for consumer use. Amazon is also offering similar products with voice recognition [109].

Summary of Web 3.0 Technologies Used by UK Brands

Technology driven interfaces have been explored to determine the technologies and utilisation ideas of web 3.0 in e-commerce platform. Each interface discussed above has its own individuality in the presentation of products and web designing. These current examples are useful to learn, and Pakistani software engineers and online retailers can gain insights of the implementation of web 3.0 technology in their fashion e-commerce platforms.

V. DISCUSSION AND CONCLUSION

Pakistani apparel brands are widely utilising web 2.0 technologies in their e-commerce platforms to interrelate and communicate with consumers. There is a need for significant development for dynamic and broader interaction with the customers that will boost the e-commerce industry of Pakistan. Web 3.0 technologies embedded with artificial intelligence and semantics can better analyse the demand and choices through deductive reasoning. Pakistani fashion brands have strong potential to establish web 3.0 virtual size and fit features in their fashion websites. Unstitched apparel is a unique product that is used for constructing personalised garments by consumers in Pakistan. Traditionally, the manual sizing system is still in practice. This can be improved by digitalisation and addition of 3D body scanning technology for e-commerce platforms and the introduction of automated tailoring by utilising these digital measurement applications. 3D body scanning, virtual sizing, and fit interface tools have the potential to improve the quality of personalised garment production and ready-to-wear garments. Therefore, the services of delivering mass-customised products in the international market with the right size and the fitted garment can be improved with advance web 3.0 technologies.

TABLE IV
FIT VISUALISATION WEBSITES (WEB 3.0 TECHNOLOGIES)

Company and Description	Measurement method for size comparison	Platform	Notable Retail Partners	Avatar Options
GLAMSTORM Consumers have a facility to design an outfit and visualise of pre-set avatar model or personal profile model by adding basic body measurements [101].	Height, shoulders, bust, waist and hips.	PC	Users can select various garments.	Body correction with addition of body colour, hair and make-up.
Metail Consumer's basic measurements are used to create an avatar. Users can visualise an outfit and can rotate an avatar 360-degree to fully evaluate the style of garment, and it offers size recommendation. The online website has been closed. However, Eco Shot plugin has been launched (VStitcher and Lotta) permits to stimulate 3D garments on images of real people [102].	Height, weight and bra size.	PC and Mobile	Warehouse, Shop Direct, Evans, House of Holland, Tesco, Dafiti, Little Mistress.	Personal avatar can be created and rotated 360 degree and avatar correction can be done.
My Virtual Model Mix and match option is available on website, new garment looks can be created by selecting current items [103].	Weight, bust size, bust cup, frame, height, body shape.	PC	Various brands are available to select garments.	Hairstyle, skin colour. Age, nose, lips, eyes can be personalised.
QVIT Creation of avatar is available and various garments can be try-on, to see sheer and tension map and colour options (visualise tight and loose garment) [104].	Height, weight, bra size.	PC	Qvit.com offers services to various US brands.	To edit outfit is available but model Cannot be edited and 360-degree rotation can be done.
VIRTUAL OUTFITS This platform shows a virtual personalised wardrobe of users, selected during shopping, as well consumers can mix and match brands products apparel and accessories. Consumers can view their own avatar by uploading their face image and body measurements which are required to create an avatar with the body shape of the user body. This allows to show the dress size and fit, as well as allowing the user to visualise the outfit on the personalised avatar [99].	Body shape, height, hips, waist and bust measurement to create an avatar.	PC	Various, garments are selected by users. mix and match option. Dorothy Perkins, Farfetch, Topshop, Miss Selfridge and various brands of USA, China and Europe.	Personalisation, personal face image, user body measurements, Personalised Avatar, Avatar catwalk
belcurves This platform uses personal measurements, garments selection and material and pattern selection, as well as predicting the best size and fit for users. Users can rotate an avatar 360 degrees and can visualise the garment being worn [73].	Height, bust, waist, hips and arm	PC	Mark & Spencer	Avatar can be created by adding measurements and can be rotated 360 degrees.
STYLEWHILE This application permits to pick a real-life model which is created by adding user measurements, and the mix and match clothes options available. Garments can be tried-on, and this app also permits to shop directly from retailer's shop. Fashion blogger advice is also available [105].	Basic measurements, body type, skin and hair colour.	Mobile application for iPhone users	Saks Fifth Avenue	A personal model can be created or model presented in the app can be used to shop online for a personalised experience. Pictures can be shared with friends while making an online purchase.

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