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Development of apparel and accessories using discarded denim

Sangita Tomer, Vivek Singh and Nisha Arya

Abstract

The most attractive reality about denims is that they are relaxed, durable, fashionable and really easy to care and keep. With those qualities the affection for denim is developing each day and makes it attraction to humans of all ages, genders and even communities. Being in this sort of trend, it is also one of the most discarded objects of clothing and a very big reason of land fill. Upcycling is the process to make innovative and useful product by using discarded material. Consequently, the present research changed into performed in Hisar districts of Haryana state to solve the problem of landfill by discarded pre and post consumer discarded denim by upcycling. Thirty respondents have been selected purposively from I.C. College of Home Science, CCS Haryana Agricultural University, Hisar as experts on the basis of their knowledge. To asked possibilities for created designs and to developed the upcycled denim apparel and accessories. Selected articles were developed by using different construction techniques along with surface embellishment like as darts, pleats, embroidery, patch work, hand painting and crochet wok. The result was found truly in the favour of environment friendly.

Keywords: Discarded denim, upcycling, apparel and accessories, surface embellishment

Introduction

Denim is a sturdy fabric and originally used as work cloth by the people who needed long lasting clothes. The word “denim” comes from the name of a sturdy fabric called serge, originally made in Nimes, a town in France. Initially, it was called as *Serge-de-nimes*, the name was soon shortened to denim. Over time, this warp-faced twill weave cotton fabric became popular throughout the region, and this popularity spread into neighboring regions also. Jean was given the popularity by two Americans Jacob Davis and Levi Strauss^[1].

Initially used for workmen's garments, denim is now ubiquitous and has even entered the sector of high fashion. It's far a fact that denims which had been designed as paintings clothes for field employees nowadays have end up a style declaration. There may be infrequently any use in the whole global in which denims are not worn. The most appealing fact approximately denims is that they're comfortable, durable, fashionable and really smooth to hold. With these advantages the love for jeans is developing each day and makes it enchantment to people of every age, genders and even communities (Cooper 2016). Denim has become a famous object around the globe with almost two billion pairs of denims offered in line with year on a global degree. On common, clients very own 6 pairs of denims, globally. This market is predicted to growth the following couple of years.

Denims were playing a twin role in India, serving both as a major fashion trend and assisting to break down barriers in view that it's far worn throughout the use's financial strata and in both urban and rural areas. Denims at the moment are taken into consideration as a staple product in apparels no longer most effective within the foremost metropolitan towns of India, however also among all strata of Indian society. Amongst all forms of denim put on, denims are the most popular article among Indian girls. Girls in extraordinary age businesses of all sizes and styles want to put on denims as it is secure, practical, and durable. Additionally, ladies who aren't relaxed with western put on have taken as much as sporting denims by pairing them with Indian ethnic wear like kurti. This mix and fit style is steadily picking up, in particular among women in small towns who come from a traditional history. Due to this popularity of denim in India, denim put on marketplace is anticipated to develop at an increase price of 15% in the close to future^[2].

The main motive force for the growth within the denim market is due to versatility in denim fabric and product line. traditionally denim material become woven into twill weave the usage of cotton indigo dyed warp and white weft, however through the years various innovations

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have taken place in the area of denim production. Primary cognizance regions of innovations are to improve the sturdiness, comfort and style of jeans on one hand and to preserve the conventional appearance and environmental sustainability on the alternative one. Introduction of synthetics and eglantine fibers have improved durability, abrasion resistance and renovation homes of jeans along with its conventional look (Arya *et al.*, 2016) [3].

The research to revitalize discarded denim by using including fee through upcycling, creativity, and sustainability. The fee showed via making use of a 3-dimensional surface at the apparel by using manipulating the material with origami technique and weaving techniques. A conceptual framework for apparel design (FEA- Finite element analysis) concept was used to provide an explanation for, manual, and examine the manufacturing procedure. The task produced a current denim couture collection made with upcycled denim. eventually, the seven seems inside the collection have been analyzed by way of the FEA concept's key components: useful, expressive, and aesthetic. It was determined that artwork element of the denim texture accommodated the pointy creases and correctly retained origami shape. The use of different colorings of blue shade by demise and bleaching performed interesting effects. conventional technique of construction and designing like patch work, weaving smoking and fringing, and use of diverse kind of bead were found to be the creative approaches to decorate the inventive experience and style of cutting-edge denim couture [4].

The designed and developed twelve textile articles via upcycling of discarded and unused fabric and apparel. They gave numerous remedies like washing, stripping, bleaching, dyeing, printing and stitching to converts the fabric waste into elegant products. They said that upcycling is a better substitute to produced elegant merchandise to meet the increasing call for of clients. Furthermore, it's far a greener way of sustainable style of fashion. (Teli *et al.*,2015) [5].

In a research at on innovative use of discarded textiles. Five designs of every favored article have been designed using CorelDraw-12. The pinnacle ranked design of each article i.e. children almirah, laundry bag, table mat, runner, multipurpose package, wall pocket, duffle bag, apron, hand towel, mattress sheet and infant napping bag became prepared the usage of unique designing and embellishment techniques. In phrases of typical look apron became most desired accompanied via laundry bag and multipurpose package. (Seema, 2011) [6].

Denim waste may be categorized as pre and post consumer denim waste. Though every phase of denim style industry contributes towards discarded denim but cutting phase is the primary segment to produce denim waste within the denim fashion units. The wastage in denims stitching happens in the form of defective pieces which are not stitched as in step with general requirements of purchaser. This will be because of sew & meeting defects, terrible ironing and workmanship and many others. Consequently, pre-consumer discarded denim consists of cutting left over, discarded & rejected denim fabrics & garments, and export surplus which might be homogenous. This denim waste is smooth and clean in nature to be used of different purposes. The submit-purchaser discarded denim consists of any form of denim garment that has finished its existence cycle and is now not useful to the consumer in each characteristics and aesthetics, both because they are worn out, damaged, outgrown, or have long gone out of favor. In most instances the jeans which can be fairly suitable can be recovered and reused as second-hand jeans

(Modi, 2013) [7].

It's far estimated that up to 95% of the jeans which might be land filled each year might be reused via right waste control (Thompson 2017). Redesigning is a vital factor of upcycling of discarded denim [8]. Recycling is the remanufacturing, or reprocessing of a material or product with the purpose of lowering waste (Gupta *et al.*, 2015) [9].

Upcycling is particularly a new concept. It is a creative way to transform something precious from valueless. Upcycling of discarded denim is a physical and chemical process of reusing discarded denim by using renovating, re-strengthening and remodeling the denims which aren't in style with more value as in step with modern day fashion via using diverse production, designing and embellishment techniques, that can offer an extended existence to denims (anonymous, 2014) [10].

It has been appeared as one promising way to lessen raw cloth and strength use, and to engender sustainable manufacturing and consumption. For this cause and distinct foreseeable blessings, the idea of upcycling has acquired more hobbies from researchers and industrial employer practitioners in current years. Discarded denim can be upcycled in some of ways. They will be made absolutely from discarded pre-client discarded denims which are left at the manufacturing facility ground and from publish-patron discarded denims i.e. discarded, damaged, out grown and out of fashion denim clothes. They will additionally be a mixture of pre and put up-patron discarded jeans. By way of upcycling denim on this way, designers can offer them a second lifestyles and save you them from ending up in landfill. As what's being thrown away is often stunning and usable for designer who can approach such denim waste in an innovative manner.

Furthermore, upcycling is a good way to make use of time, power and cash invested on jeans consequently can even create sustainability in garb [11].

Consequently, now for environmental and economic reasons, it's far becoming vital to utilize denim waste to their fullest potential. Pre and post consumer denim waste together provide notable opportunity to provide an extensive range of denim articles. Upcycled fashion can address multiple hassles at a time i.e. saving natural assets, environmental pollutants and purchaser's demand for cutting-edge garments (Wang, 2010). Maintaining those facts in mind, the research become planned with the subsequent targets:

To layout and expand upcycled articles the use of discarded denim

Methods and Materials

The important problem of landfill due to discarded denim was carried out to solve by upcycling. Pre consumer discarded denim refers to discarded or damaged or faulty or leftover denim fabrics, format cutting leftovers, unsold denim garments, leftover or damaged or discarded trimmings and fasteners with boutique proprietors, tailors and stores. Post consumer discarded denim discuss with any type of denim clothes those have finished their lifestyle, both because they are broken, out grown, worn out or have gone out of fashion which patron no longer needs and makes a decision to discard them. The work was under taken to design and develop upcycled denim articles using pre and post consumer discarded denim. This work was done on the basis of result of exploratory work and with the help of experts and their preference.

Frequency and Percentage: Frequency and simple percentages were calculated to access construction, designing and embellishment techniques used for upcycling of pre and post discarded denim.

Weighted Mean Score (WMS): Weighted mean scores were calculated to find out the ranks for the preferences of experts for type of upcycled denim articles and created designs in upcycling of discarded denim.

$$\text{Weighted mean score} = \frac{\text{Total weighted score}}{\text{Number of respondents}}$$

Results and Discussion

For the present examine upcycling has been operationally described as a innovative and budget friendly way to upcycle pre and post discarded denim in one-of-a-kind combos to convert discarded denim into an expansion of denim articles of clothing & accessories with improved quality and extra price as in step with client needs by making use of diverse progressive construction, designing and surface embellishment method selected by the experts.

Collection of pre and post consumer discarded denim

The collected discarded denim basically contained waste fabrics, cuttings and garments made of cotton, synthetics and blends. Leftover and damaged trimmings and fasteners were also collected along with pre and post consumer discarded denim. Collected pre and post consumer discarded denim and apparel waste was sorted out by a team of researcher, major advisor and member from major field keeping in mind the quality and suitability of collected denim and apparel waste, trimmings and fasteners for developing different type of upcycled articles. Sorted out denim & apparel waste suitable for developing upcycled articles were washed with detergent and also bleached using liquid bleach as per requirement to make the denim apparel waste clean and free from dirt unwanted stains. Keeping in the mind designing of upcycled articles a few good quality pre consumer apparel wastes was

also collected along with pre and post consumer discarded denim. For denim garment it is an important preparation before washing to separate garment as per their hue of colour i.e. light and dark as dye can bleed and destroyed other garments. For longer color stay of denim, garments were washed and dried inside-out. Finally the garments were dried by hang drying.

Selection of experts

Twenty faculty members and ten P.G. students from I.C. College of Home Science, CCS Haryana Agricultural University, Hisar were selected as experts on the basis of their knowledge regarding specific topic. They were asked to give their preferences for upcycled denim articles and created designs of upcycled denim articles using developed preferential choice index.



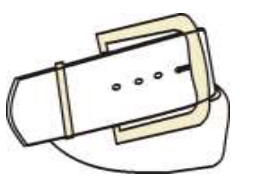

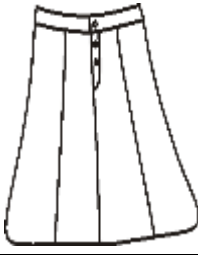








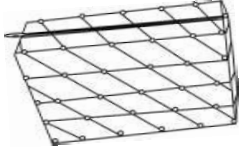



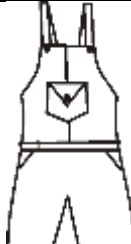
Preferences of experts for upcycled denim articles (Apparel and Accessories)

The preferences of experts were taken for development of upcycled denim articles using pre and post consumer discarded denim. An exhaustive list of three types of upcycled denim articles of apparel and accessories was prepared on the basis of exploratory work. Experts were asked to give their preferences separately for each article. The data regarding preferences of experts for different type of upcycled denim articles i.e. apparel and accessories, home furnishing & accessories and utility articles has been presented in Table 6. It is clear from the data that dungaree dress with WMS 2.75 got I rank and skirt got II rank with WMS 2.70 followed by clutch got III rank with WMS 2.65. The one piece dress got IV rank with WMS 2.60, belt got V rank with WMS 2.55 and jacket got VI with WMS 2.50. The other articles upto XX rank in descending order were shorts with WMS 2.45, kids wallet/coin purse 2.30, Capri 2.25, wrist watch band 2.15, cap, 2.10, jeans 2.05, top 2.04, ear rings 2.03, shirt 2.00, jogger pants 1.91, bracelets 1.90, necklace 1.85, anklets 1.80, house slipper 1.65.

Table 1: Preferences of experts for upcycled denim articles (apparel and accessories) n=30

No.	Apparel and accessories	Wms (rank)	No.	Apparel and accessories	Wms (rank)
1	Anklets	(1.80) XIX	11	Jeans	(2.05) XII
2	Belt	(2.55) V	12	Jogger pants	(1.95) XVI
3	Bracelets	(1.90) XVII	13	Kids wallet/ coin purse	(2.30) VIII
4	Capri	(2.25) IX	14	Necklace	(1.85) XVIII
5	Clutch	(2.65) III	15	One piece dress	(2.60) IV
6	Dungaree dress	(2.75) I	16	Shirt	(2.00) XV
7	Ear rings	(2.03) XIV	17	Shorts	(2.45) VII
8	Hat /caps	(2.10) XI	18	Skirt	(2.70) II
9	House slipper	(1.65) XX	19	Top	(2.04) XIII
10	Jacket	(2.50) VI	20	Wrist watch band	(2.15) X

WMS-Weighted mean score, Highly Preferred 2.34-3.00, Preferred 1.67-2.33, Least Preferred 1.00-1.66 *Multiple Response

Sr. No.	Selected articles (Apparel and Accessories)	Created designs		
		Design 1	Design 2	Design 3
1	Belt			
2	Skirt			
3	Jacket			
4	One Piece Dress			
5	Clutch			
6	Dungarees dress			

Multiple Responses

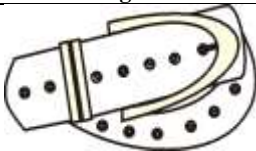

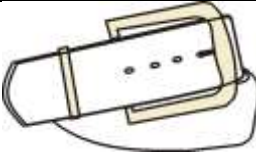

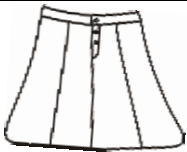




Plate-1 Reated designs for development of upcycled denim articles of apparel and accessories







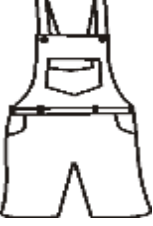


Created designs for development of upcycled denim articles of apparel and accessories

An exhaustive list of upcycled denim articles of apparel and accessories was prepared on the basis of exploratory work to know the preferences of experts for type of upcycled denim articles to be developed. Three designs were created for each

selected article of apparel and accessories which were numbered as design 1, design 2 and design 3. A total of 18 designs were created with the help of CorelDraw. The created designs are presented in plate 1 and data regarding preferences of experts has been presented in Table 2.

Table 2: Preferences of experts for created designs of upcycled denim articles n=30*

Sr. No	Apparel and accessories	Design No.	WMS	Rank
1	Belt	 Design 1	2.02	II
		 Design 2	1.59	III
		 Design 3	2.61	I
2	Skirt	 Design 1	2.31	III
		 Design 2	2.78	I
		 Design 3	2.56	II
3	Jacket	 Design 1	2.74	I
		 Design 2	1.82	III
		 Design 3	2.24	II

4	One piece dress	 <p>Design 1</p>	2.41	II
		 <p>Design 2</p>	2.67	I
		 <p>Design 3</p>	2.38	III
5	Clutch	 <p>Design 1</p>	2.22	II
		 <p>Design 2</p>	2.36	I
		 <p>Design 3</p>	1.80	III
6	Dungaree dress	 <p>Design 1</p>	2.72	I
		 <p>Design 2</p>	2.56	II
		 <p>Design 3</p>	2.24	III

WMS-Weighted mean score, Highly Preferred 2.34-3.00, Preferred 1.67-2.33, Least Preferred 1.00-1.66 *Multiple Responses

Preferences of experts for created designs of upcycled denim articles

The data elucidated in Table 1 depicts the three designs of each selected upcycled article of apparel and accessories. The designs of apparel and accessories were concerned, the design no. 3 of belt got I rank with WMS 2.61, design no. 1 got II rank with WMS 2.02 and design no. 2 got III rank with WMS 1.59. The design no. 2 of skirt got I rank with WMS 2.78, design no. 3 got II rank with WMS 2.56 and design no. 1 got III rank with WMS 2.31. The design no. 1 of jacket got I rank

with WMS 2.74, design no. 3 got II rank with WMS 2.24 and design no. 2 got III rank with WMS 1.82. Design no. 2 of one piece dress got I rank with WMS 2.67, design no. 1 got II rank with WMS 2.41 and design no. 3 got III rank with WMS 2.38. Design no. 2 of clutch got I rank with WMS 2.36, design no. 1 got II rank with WMS 2.22 and design no. 3 got III rank with WMS 1.80. Design no. 1 of dungaree dress got I rank with WMS 2.72, design no. 2 got II rank with WMS 2.56 and design no. 3 got III rank with WMS 2.24.

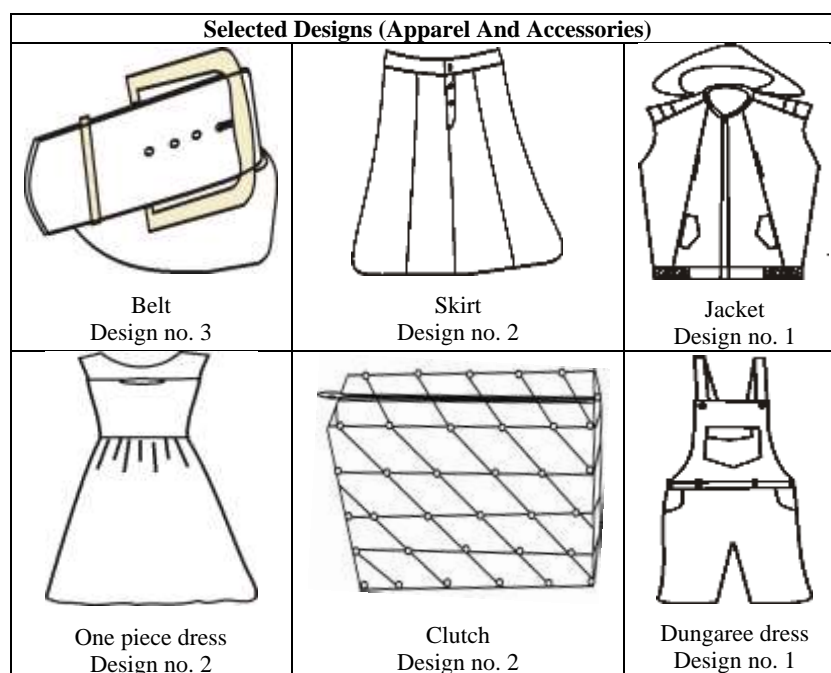


Plate 2: Selected designs for upcycled denim articles

Top ranked design of each upcycled article was selected for development of upcycled apparel and accessories. The selected designs of upcycled denim articles are presented in Plate 2.

Summary

Development of upcycled denim articles.

The construction, designing and embellishment techniques were selected by team of researcher, major advisor and member from major field, keeping in mind the results of existing upcycling practices for discarded denim, suitability of pre and post consumer discarded denim, trimmings and fasteners also. The available literature on upcycling of pre and post consumer discarded denim was also referred for finalization of construction, designing and embellishment techniques.

Different construction techniques used for construction of upcycled articles as per suitability of design of upcycled denim articles were stitching, patch work and crocheting. Darts, pleats, patchwork, appliqué work, quilting, fraying, product dyeing and bleaching were the specific designing techniques, which were used to design the upcycled articles. To enhance the beauty of upcycled articles, hand painting,

hand embroidery and bead work were used as embellishment techniques. For drafting of different apparel, drafting technique as given in the book "Drafting techniques for garment construction" by Pruthi and Singh, 1993 were used.

The top ranked designs of six selected articles of apparel & accessories were developed using pre and post consumer discarded denim. Two upcycled articles from of apparel & accessories were developed by using only pre consumer discarded denim, two with pre and post consumer discarded denim and remaining two with post consumer discarded denim. New textile material was used as per requirement of design. New textile material, surface embellishment material like foam, pasting, belt, buckle stitching threads, embroidery and crochet threads, beads, fevicryl, simple and pearl metallic colors, fasteners were purchased from the market as per requirement of design of upcycled article.

Hence, a total of 6 upcycled denim articles were developed which included two upcycled articles developed by using only pre consumer discarded denim, two by combination of pre and post consumer discarded denim and remaining two upcycled articles were developed by using post consumer discarded denim.

Table 3: Summary of upcycled denim articles in terms of pre and post consumer discarded denim and upcycling techniques

Sr. no.	Type of discarded Denim	Up-cycled denim articles	Up-cycling techniques	After	Final product
1	Pre CDD (cutting leftovers)		<ul style="list-style-type: none"> Stitching Fraying Eyelet with grommets & Belt buckle 		Belt
2	Pre CDD (cutting leftovers)		<ul style="list-style-type: none"> Bleaching Stitching (panels) Fasteners (buttons) Fraying Trimmings (fabric flower) 		Skirt
3	Post CDD (discarded jacket)		<ul style="list-style-type: none"> Hand painting Hand embroidery (Chain stitch & Bead work) 		Embellished Jacket
4	Post CDD (discarded one piece dress)		<ul style="list-style-type: none"> Stitching Crocheting (Sleeves and waste band with tassels) 		One piece dress with crochet work
5	Pre and Post CDD (Cutting leftovers) & jeans)		<ul style="list-style-type: none"> Stitching (quilting) Bead work Fasteners (Zipper) 		Clutch
6	Pre and post CDD (unused dungaree & with discarded jeans)		<ul style="list-style-type: none"> Dyeing Stitching 		Dungaree dress with different hues of blue color

CDD- Consumer discarded denim NTM- New Textile Materials

Cost of developed upcycled denim articles of apparel and accessories

The cost of the developed upcycled denim articles was calculated on the basis of the cost of raw material used and labour charges. The cost of discarded denim and collected trimmings and fasteners was not included as it was collected free of cost. The selling price of upcycled denim articles was calculated by adding 10 percent profits to the cost price of each upcycled article.

The data pertaining to the cost price and selling price of

developed upcycled apparel and accessories is presented in Table 9. The data revealed that the cost of jacket was maximum i.e. Rs. 362.02 followed by the cost of one piece dress i.e. Rs. 270.51. This was due to maximum labour charges involved in beadwork of jacket and crochet work of one piece dress. The cost of belt was Rs 210.05 followed by the cost of skirt i.e. Rs.197.50. The cost of clutch was Rs. 164.50. The cost of dungaree dress was minimum i.e. Rs.161.00.

Table 4: Cost of developed apparel and n=50*

Apparel and accessories	Type of discarded denim	Cost of raw material (Rs.)			Preparation time (Hrs.)	Labour charges	Cost price (Rs.)	Selling price (cost prices +profit 10%)
		New textile material	Stitching and embroidery threads	Embellishment materials				
Belt	Pre CDD	5 (pasting)	10	30 (eyelets with grommets) 60 (Buckle)	1:00	86.37	191.37	210.05
Skirt	Pre CDD	Nil	10	10 (Stones) 30 (Bleaching)	1:30	129.55	179.55	197.50
Jacket	Post CDD	Nil	10	40 (beads) 20 (fabric colors)	3:00	259.11	329.11	362.02
One piece Dress	Post CDD	Nil	30 (Crochet thread)	Nil	2:30	215.92	245.92	270.51
Clutch	Pre and Post CDD	Nil	10	10 (beads)	1:30	129.55	149.55	164.50
Dungaree Dress	Pre and Post CDD	Nil	10	60 (dye)	1:00	86.37	146.37	161.00

Labour charges were calculated on the basis of daily wages of Rs. 691/- for 8 hrs for skilled worker, CDD- consumer discarded denim,

*Multiple Responses

Conclusion

Denims are embraced in to our daily life and preferred by almost all the people irrespective of their age and gender. Pre and post consumer discarded denim was used to make Upcycled denim article. Preferred designs were created by using Coral Draw software. Selected articles were developed by using different construction details, surface embellishment, and hand embroidery along with hand painting.

Thus, the cost of upcycled jacket was maximum due to maximum labour charges involved in execution of these techniques whereas the clutch was minimum due to minimum labour charges involved in stitching of these upcycled articles. Upcycling of discarded denim is the best way to getrid with the problem of landfill along with pollution and convert it in to the useful as well as innovative apparel and accessories.

Recommendation

Upcycling of discarded denim is an innovative way for optimum usage of denim durability and pave wave for versatile end use and market of upcycled denims.

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