



## An Exploratory Study for Source of Inspiration on Innovative Knitwear Design Collection With Computerized Weft Knitting Technology

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### Abstract

*The research paper aim is to understand the fundamental of knitting technology and to create clothes that accomplish and enhance the typical features of knitwear, integrating traditional knowledge with technological innovation and experimentation. The ability of the designer is to explore innovative knitwear design and develop knitted structures, and to create knitwear collection comprising the women's wear with design process.*

*Today, the ability of designers to explore contexts in an original way, proposing ideas and results that are not just technical solutions of established problems, appreciates in creativity and in fashion design education the ability to solve problems through materials and their constant innovation for clothes, to experiment or to look at old problems in a different way with the aim of going beyond the usual "fashion" idea. This paper describes the Indian design scenario incorporating the methodologies that have characterized the profession of contemporary design. The aim of the paper is to highlight the moments of convergence and differentiation regarding the methodologies and the design process into the different areas of design.*

**Keywords:** Knitting, Technology, Innovation, Designer, Knitwear Design, Structure, Collection, cloth, experiment, Fashion, Idea, methodology, contemporary etc.

### 1. Introduction:

Design and technology are inextricably linked, especially in the case of knitwear, which can do so much more than impressionist woven cloth. In the 1970s and 80s it was clear that design developments achieved technological progress. In fact, designing for knitwear requires interplay between craft, design, technology, fashion and aesthetics. The technology has become more accessible and more responsive to new ideas. So fashion designers have increasingly exploited the technology of knitting within their collections (Black, 2002).

To create knitted fabrics on semi or fully automated fashion a device used as knitting machine. There are numerous types of knitting machines, ranging from simple spool or board templates with no moving parts to highly complex mechanisms controlled by electronics. All, however, produce various types of knitted fabrics, usually either flat or tubular,

and of varying degrees of complexity.<sup>1</sup> Knitting is the process of turning yarn into clothing by the application of specific stitching and knotting methods. Knitting is a method that is mostly done by hand but as technology progressed, there has been a machine that was invented for the purpose (Zoe Maletta, 2009)

Knitting is divided into two main groups. They are: warp knitting and weft knitting. Weft knitting is the more diverse, widely spread, and larger of the two sectors, and accounts for approximately one-quarter of the total yardage of apparel fabric compared with about one-sixth for warp knitting. In weft knitting, the yarns fed into the machine form loops across the width of the fabric. In a weft knitted structure, a horizontal row of loops can be made using one thread and the thread runs in the horizontal direction. Most of

<sup>1</sup> [https://en.wikipedia.org/wiki/Knitting\\_machine](https://en.wikipedia.org/wiki/Knitting_machine)

the knitted fabrics are produced by weft knitting.<sup>2</sup> Process flow chart of weft knitting is shown in fig. 01.

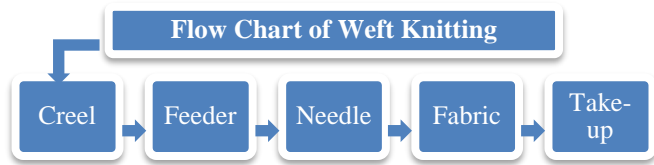


Fig. 01: Flow Chart of Weft Knitting

The different kinds of weft knits are plain, purl and rib. Both weft and warp knitting can be incorporated in the jacquard mechanism to produce fancy knitted fabrics. Knitted fabric is constructed by forming the yarns into loops. The vertical rows of loops stitches in knit fabric are known as wales and the horizontal rows of loops are called courses. The loops are formed by a group of needles or shafts, which are arranged one after the other in the knitting machine on the needle plate. The needles are evenly placed. Sinker is used to pull the needles down, which pulls the yarn into the previous loop. The knitted fabric is pulled down and rolled at the base of the machine and collected for further use.<sup>3</sup> The basic panel of a garment is the following stitches: knit, purl, cast on, and cast off, increase and decrease stitches. Use of a combination of these stitches can provide a many varieties of different knitwear. There are four basic operations that can be performed by needles and can be described by knitting assembly language for v-bed knitting machine. The stitch notations of the weft knitted structural units can be represented using the following methods:

- i) Line diagram
- ii) Symbolic notation on graph paper
- iii) Schematic or diagrammatic notation

**Table 01:** The knit, purl, tuck, float or miss stitches, graphic notation representation, and diagrammatic representation is shown in below table.

a. Knit stitch (structure):														
i) Knit Stitch / Loop	ii) Graphical Notation	iii) Diagrammatic Notation												
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x	x	x												
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x	x	x												
b. Purl stitch (structure):														
i) Knit Stitch / Loop	ii) Graphical Notation	iii) Diagrammatic Notation												
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x	x	x												
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x	x	x												
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c. Tuck stitch (structure):														

i) Knit Stitch / Loop	ii) Graphical Notation	iii) Diagrammatic Notation									
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x	x	x									
x	.	x									
x	x	x									

**d. Float or Miss stitch (structure):**

i) Knit Stitch / Loop	ii) Graphical Notation	iii) Diagrammatic Notation									
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There are two different type of knitting machines i.e. weft knitting machine and warp knitting machine are used in the knitwear industry. Knitted fabrics are produced by two general methods and each method produces a variety of types of knitted fabrics, shown in fig.02.

Types of Knitted Fabrics		
Weft Knits	Specialised Weft Knits	Warp Knits
<ul style="list-style-type: none"> <li>•Single Knits- [a] Single Jersey, [b] Lacoste)</li> <li>•Double Knits- [a] Rib Knit [b] Purl Knit [c] Interlock Knit [d] Cable Fabric [e] Birds Eye [f] Cardigan [g] Millano Rib [h] Ponte</li> </ul>	<ul style="list-style-type: none"> <li>•Intersia</li> <li>•Jacquard Jersey</li> <li>•Knitte Terry</li> <li>•Knitted Velour</li> <li>•Sliver Knit</li> <li>•Fleece</li> <li>•Frencj Terry</li> </ul>	<ul style="list-style-type: none"> <li>•Tricot</li> <li>•Rachel</li> </ul>

Fig. 02: Types of Knitted Fabrics

These knit fabrics have different Features, good comfortable to wear, good texture properties, makes low wrinkle than woven fabrics, it has bulky effect, good elasticity property, easy to sew and wear, low wastage rate then the woven fabric, and has good porosity to air & water.<sup>4</sup> The applications of knitted fabrics are for clothing (Underwear, Sweaters), Home furnishing (Curtains, Towels), Medical textiles (Grip Bandages), Industrial textiles (Wipes, Absorbent Pads).

It has been seen a change in attitude and knitwear has at last begun to be featured in fashion. The technology has become more accessible and more responsive to the new ideas, so fashion designers have increasingly exploited the technology

<sup>2</sup> <https://www.textileflowchart.com/2014/12/process-flow-chart-of-weft-knitting.html>

<sup>3</sup> [https://www.brainkart.com/article/Knitting\\_35591/](https://www.brainkart.com/article/Knitting_35591/)

<sup>4</sup> <https://textilefashionstudy.com/process-flow-chart-of-knitting-technology-features-of-knitted-fabrics/>

of knitting within their collections. This project was to study and analyze the various kinds of openwork in fashion garments. To prepare a knitwear collection with the inspiration, the author attempt to create a range of openwork stitch structures through various knitting techniques with specially selected knitting yarn.

## 2. Aim and Objectives:

- To determine the effect of stitch length on the various rib knitted fabric
- To understand the fundamental of weft knitting design technology.
- To create a knitwear design collection on STOLL M1 software.

## 3. Scopes and Significance of the Study:

The current research area is an exploratory study on source of inspiration for its innovative knitwear design collection on computerized weft knitting technology. The knowledge obtained from the research and experiments would be utilized in developing a final knitwear collection, to create a sophisticated and avant-garde collection with knit design stitch structures which should be attractive and contemporary. It has been observed that the old traditional knitted structures are no doubt an attraction for customer, but incorporating of new knitted structures would always attractive to the customers and therefore the exploration with raw materials i.e. yarn and playing with innovative openwork knitted structures would definitely be change the buying mindset of the todays youth. Modernization based on saleable trends would benefit the knitwear manufacturers and the retailers. The study will largely benefit the society through its innovative design approach; it will attract the market and will earn foreign exchange for our country. The aim is to make openwork knitwear design collection as a profit earning unit and step up measure for boosting the economy of the people of the area.

## 4. Research Methodology:

According to J.W. Best (1999) "Research is considered to be formal, systematic, intensive process of carrying on the scientific method of analysis. It involves a more systematic structure of investigation usually resulting in some of formal record of procedures and report of result or conclusions. In order to achieve the objective of this project, there is a scope of methodological approaches. An exploratory research was carried out to build up the study of this project. Relevant information and data were obtained from reference books, internet websites, journals articles, and trends books, consolidating the style and ideas in the project. This could help in understanding the knitwear technology and knitting design knitwear garment. During creating design and developing of knitwear collections, the reviews and feedback were taken from designers and analyzed in order to understand how design could be applied into clothing. After exploration of the technique in creating openwork, analysis of the runway review and reference of the latest trend forecast, a range of openwork knitted stitch structures were created by various combinations of the yarn and knitting techniques. In order to achieve the avant-garde knitwear collection, some innovative openwork stitches were chosen

to apply in the collection and had been further developed. All boards and flat 2D designs were made on CorelDraw software.

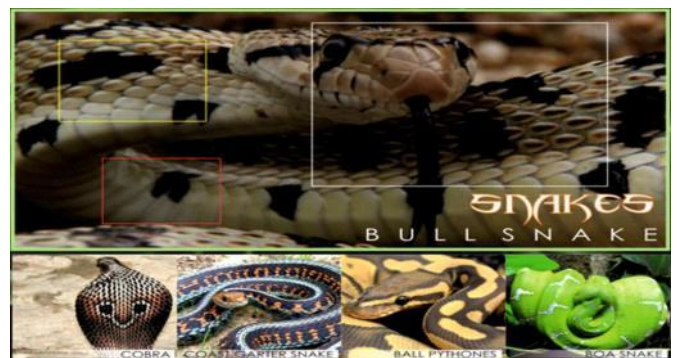
5. **Methods:** The methods for driving design and development process are described with following steps as below;

**5.1 Fashion Trend Study Board:** Innovation is the lifeblood of fashion, while textile developments always provides new inspiration for fashion designers and supports the commercial industry in developing new concepts for fabric structures and fiber types. In addition, trend forecast is the important part in the fashion world. New fashion trends are emerging into every season. Therefore as a commercial fashion designer it works as the product development tools for creative professionals in the fashion and style industries. Its concise reporting and advanced technology tools consistently generate actionable results. Reference for trend analysis sourced from Spin Expo autumn/winter 2012-13, shown in fig. 03.



Fig. 03: Fashion trend study board

**5.2 Inspiration Board:** The designer explains the stages of the knit design process, from developing the initial concept and ideas through the research stage to the exploration of a design theme. It discusses the importance of predicting seasonal trends, new color stories, and the development of new fibers, textiles, and yarns to the designer in the creative design process. It looks at where designers get their initial ideas from, offering inspirational suggestions and showing how ideas can be developed from an original source to inspire the color, pattern, texture, and shape of a garment. To assist you in the design process this chapter includes a selection of garment silhouettes that can be adapted and developed or used to inspire your own designs.<sup>5</sup>



<sup>5</sup> [http://www.fpp.uchile.cl/content/docs/Knitwear\\_Design.pdf](http://www.fpp.uchile.cl/content/docs/Knitwear_Design.pdf)

Fig. 04: Inspiration board

**5.3 Research Board:** Emerald tree boas, as their name suggests, are a tree dwelling species, and scientific name is *Corallus caninus*, spending most of their time high up in the foliage. They prefer to be solitary. They are found in lowland tropical rainforests in the Amazonian and Guianan regions of South America in the countries of Suriname, Guyana, French Guiana, Colombia, Brazil, Venezuela, and Peru. Emerald tree boas are nocturnal ambush hunters. They lie in wait on a branch above the ground, waiting to strike at any unsuspecting small rodents that walk beneath them.<sup>6</sup> The summary of research is shown in fig. 05.



Fig. 05: Research board

**5.4 Client Board:** Further to understand client psychological and demographical behavior, the designer has elaborated customer hobbies and liking in detail in three different parts are shown in below fig. 06.

Top part describes about the accessories i.e. earphone, bluetooth, information watch, goggles, camera or gadgets etc. Middle part describes about the driving sports car, singing, dancing, bike riding, shooting, drinking etc. Bottom part describes about the products usage i.e. luxury sports car, imported guns, laptops, markups, mobile etc.

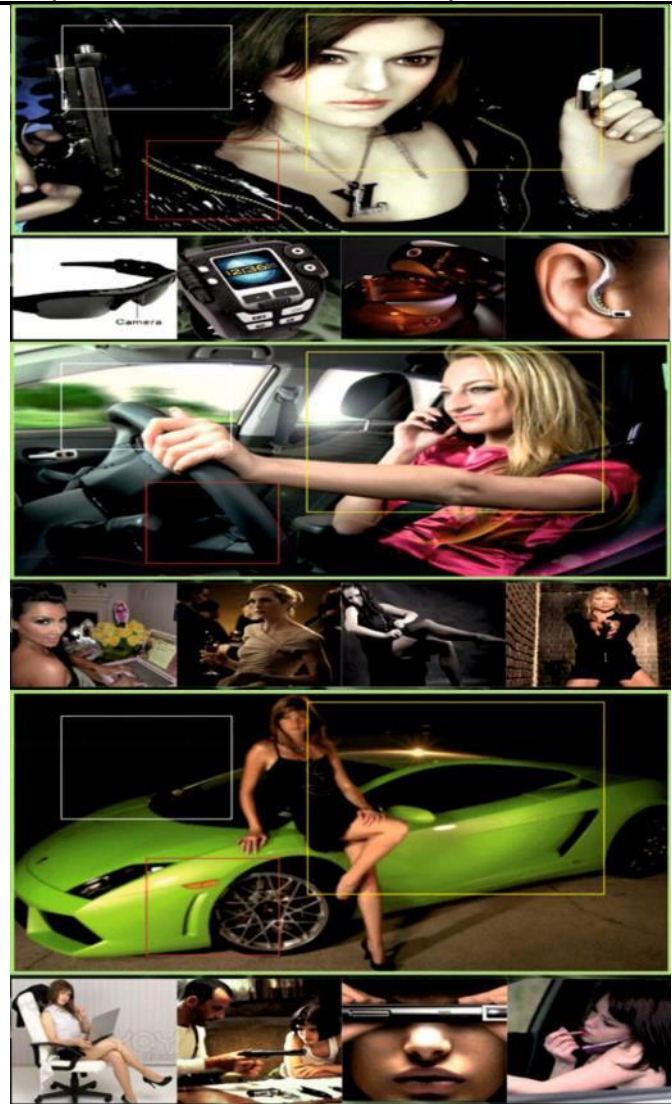


Fig. 06: Client board

**5.5 Texture Board:** These snakes look very similar to the green tree python, and are long and slender but powerful snakes with huge, oversized teeth and jaw muscles. Both species are green with white markings, although the northern snakes (*C. caninus*) can have yellow markings and lighter-colored bellies. Obvious heat-sensing pits along the upper and lower lips and gold or green eyes with vertical pupils.<sup>7</sup> The designer has studied in detail about the snake skin, surface of the outer body taken as reference for developing the various knitted fabric structures through extracting the elements and motifs, shown in fig. 07.



Fig. 07: Texture board

<sup>6</sup> <https://livingrainforest.org/learning-resources/emerald-tree-boa>

<sup>7</sup> <https://a-z-animals.com/animals/emerald-tree-boa/>

**5.6 Colour Board:** The northern population is a brighter, more emerald green, species start out life as a brick red or reddish-orange color and change to their adult green over the course of their first year of life. Their markings are similar in that they're usually stark white, roughly diamond, triangular, or lightning bolt-shaped, and generally evenly spaced down the length of their body. snakes have a full dorsal stripe that connects all the white markings and often black spots bordering the white, Northern emerald tree boas have creamy-white or yellow bellies, and the Amazon Basin emerald tree boas have yellow bellies, color story is shown in fig. 08.

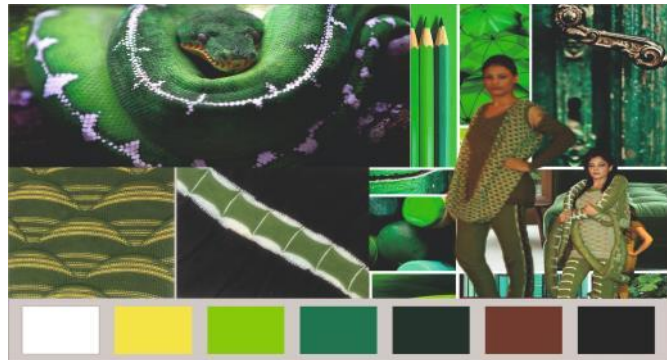


Fig. 08: Colour board

**5.7 Concept Note:** The texture of the fabric surfaces are inspired from the scales of snake and have a reputation for being aggressive. Various fabric panels reconstructed with various knitting techniques for resembling snake scale. The surface design of the fabrics was developed on CMS 3.360 Stoll knitting machine on 7.10 gauges. 100% cotton yarn, 2/20 yarn count, 2 yarn ends were used for size M/12.

**5.8 Design Process:** Before start a new collection designer find out interesting inspiration after detailed research translate into knitwear surfaces and structure design. The multiple important elements are converted in designing for knit design & development of the fabric for a specific garment line, or it may be technique-based and more about developing the fabric before designing the garment or collection with considering season, yarn type, and properties, including color, texture, and stitch structure. Many of the trend information services provide updates on the latest trends in fabric developments, including new techno yarns and fabrics, seasonal color palettes, and new and innovative developments in stitch patterns and structures. The designing of silhouettes, fabric structures, and photoshoot of the final outfits are described in details further.

- ❖ **Style # WKC-01:** The 2D flat sketches of Tunic, Shrug and Legging are designed. Five knitted panels were designed for left & right legs, front & back bodice, and a shrug, shown in fig.-09.



Fig. 09: Digital flat sketch of women's knitted garment design one

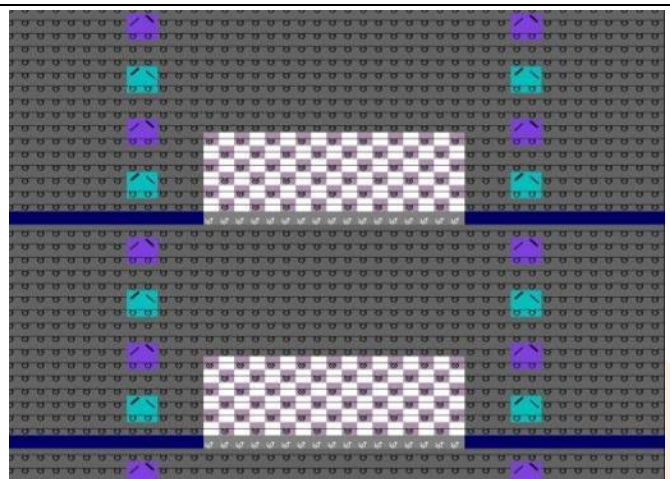
**Table 02:** Technical view, fabric view and photoshoot of knitwear apparel for style WKC-01 shown in below table.

<p><b>Technical view (Shrug):</b> Knit &amp; Pearl structure used for plain surface and Tubular structure technique used for giving gathering effect.</p>
<p>Graphical representation of shrug design on STOLL M1 software</p>
<p>Fabric view: Knit (front side) at left and Pearl (rear side) at right</p>
<p><b>Technical view (Tunic):</b> Knit &amp; Pearl structure used for plain surface and tubular structure used for giving layering effect.</p>
<p>Graphical representation of tunic design on STOLL M1 software</p>



Fabric view: Knit (front side) at left and Pearl (rear side) at right

**Technical view (Legging):** Knit & Pearl structure used for plain surface and separate panel attached manually with big knit loop effect at side seam.



Graphical representation of legging design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right



Fig. 10: Photoshoot of knitted garment on model style one

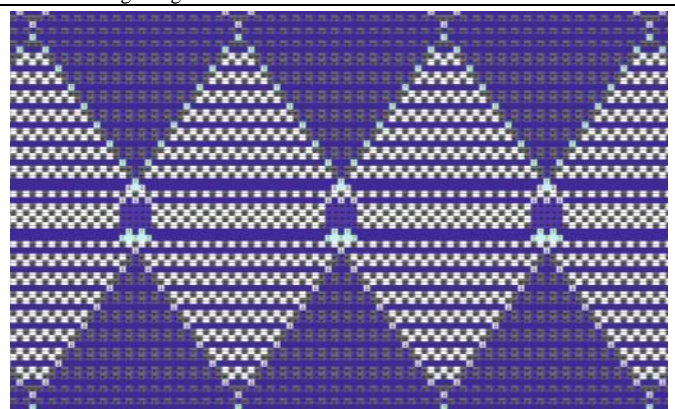
❖ **Style # WKC-02:** Flat sketches of Tunic, Shrug and Legging are designed. Five fabric panels were knitted i.e. left & right legs, front & back bodice, and a shrug, shown in fig.-11.



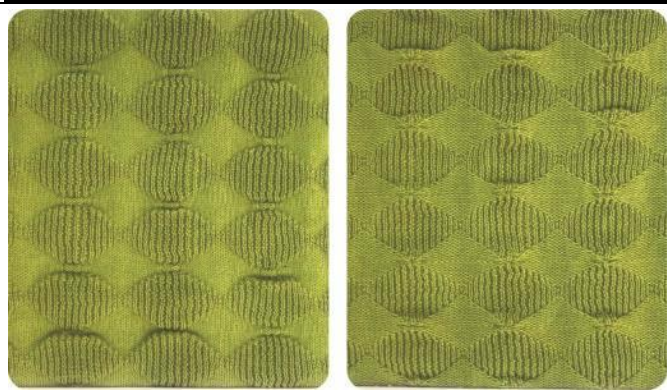
Fig. 11: Digital flat skech of women's knitted garment design two

**Table 03:** Technical view, fabric view and photoshoot of knitwear apparel for style WKC-02 shown in below table.

**Technical view (Shrug):** Knit & Pearl structure and 1X1 Miss structure used for shrug design.

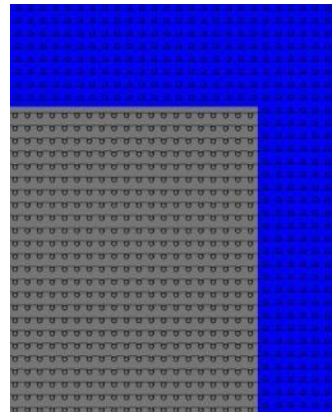


Graphical representation of shrug design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right

**Technical view (Tunic):** Knit & Pearl structure with Pleating technique applied for tunic design.

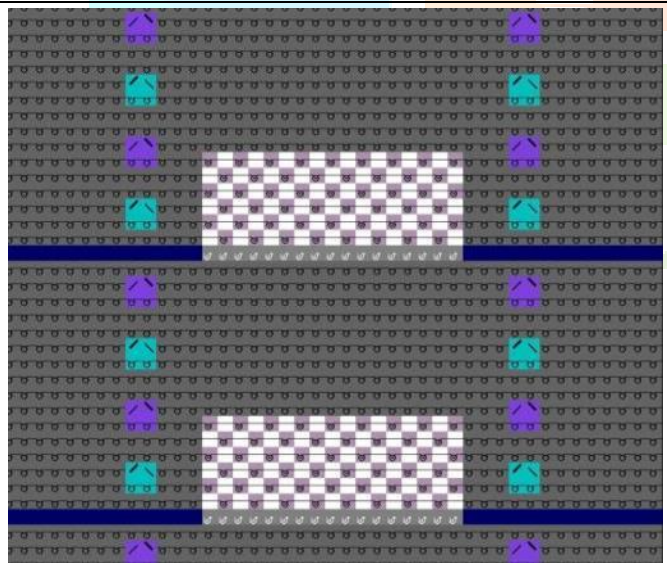


Graphical representation of tunic design on STOLL M1 software

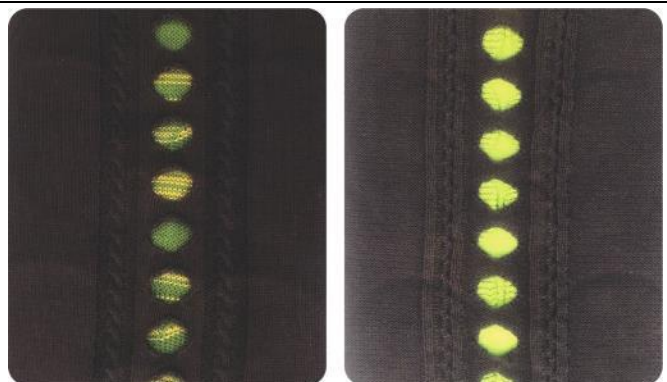


Fabric view: Knit (front side) and Pearl (rear side)

**Technical view (Legging):** Partial knitting technique applied for legging design.



Graphical representation of tunic design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right



Fig. 12: Photoshoot of knitted garment on model style two

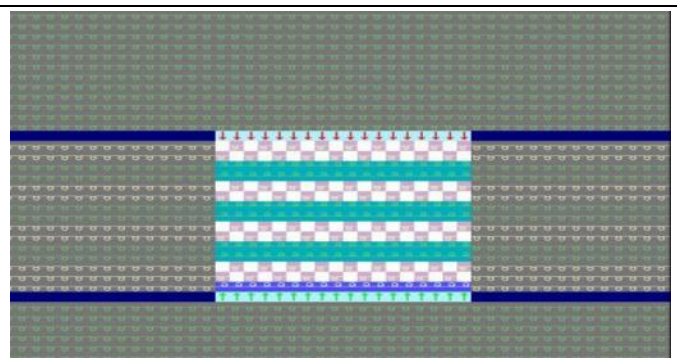
❖ **Style # WKC-03:** The 2D flat sketches of Tunic, Shrug and Legging are designed. Total seven panels were knitted i.e. left & right legs, front & back bodice, left & right sleeves, and a shrug, shown in fig. 13.



Fig. 13: Digital flat sketch of women's knitted garment design three

**Table 04:** Technical view, fabric view and photoshoot of knitwear apparel for style WKC-03 shown in below table.

**Technical view (Shrug):** Knit & Pearl structure and combining of 1X1 cast on technique applied for shrug design.

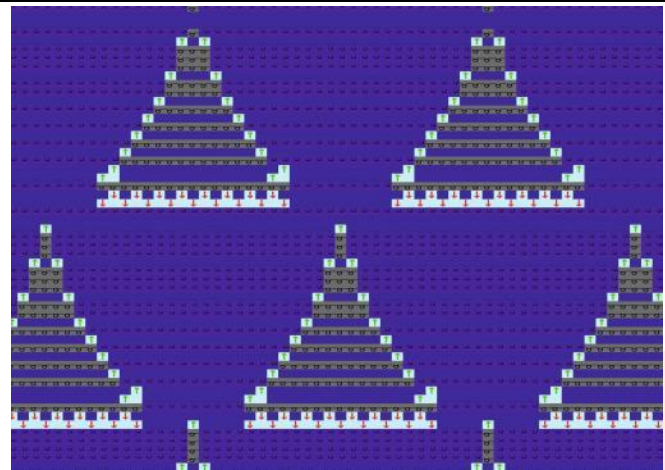


Graphical representation of shrug design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right

**Technical view (Tunic):** Knit & Pearl structure with combining of pleating technique applied for tunic design.

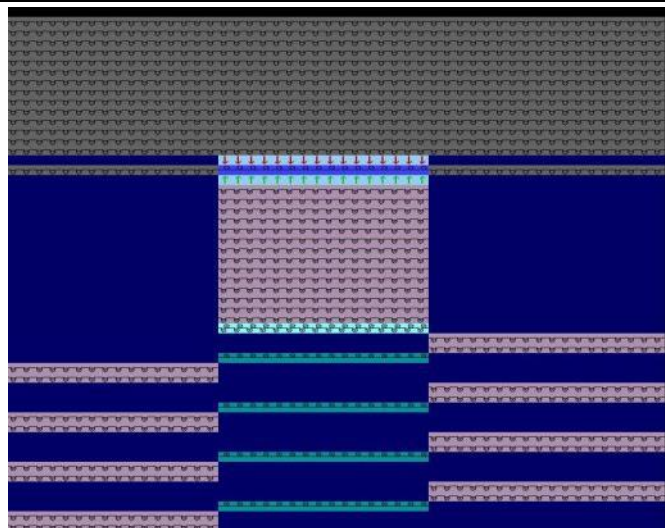


Graphical representation of shrug design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right

**Technical view (Legging):** Partial knitting with combining of Intersia technique applied for legging design.



Graphical representation of legging design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right



Fig. 14: Photoshoot of knitted garment on model style three

- ❖ **Style # WKC-04:** The 2D flat sketches of Tunic, Shrug and Legging are designed. Total eleven panels were knitted i.e. two each for left & right legs, front & back bodice, left & right sleeves, front & back of shrug attached with right sleeve, shown in fig. 15.

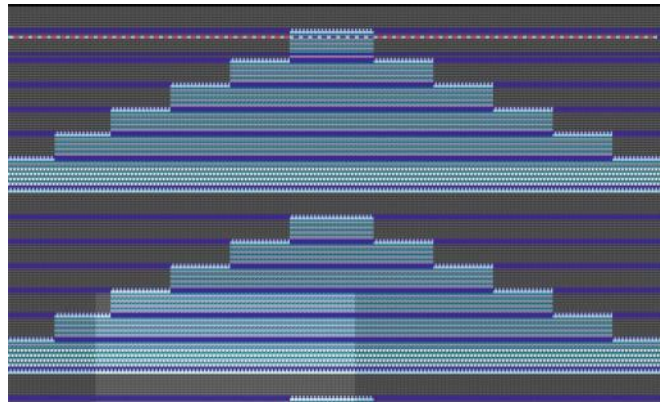


Fig. 15: Digital flat skech of women's knitted garment design four

**Table 05:** Technical view, fabric view and photoshoot of knitwear apparel for style WKC-04 shown in below table.



**Technical view (Shrug):** 1X1 Knit with knit & pearl structure applied for outer wear.

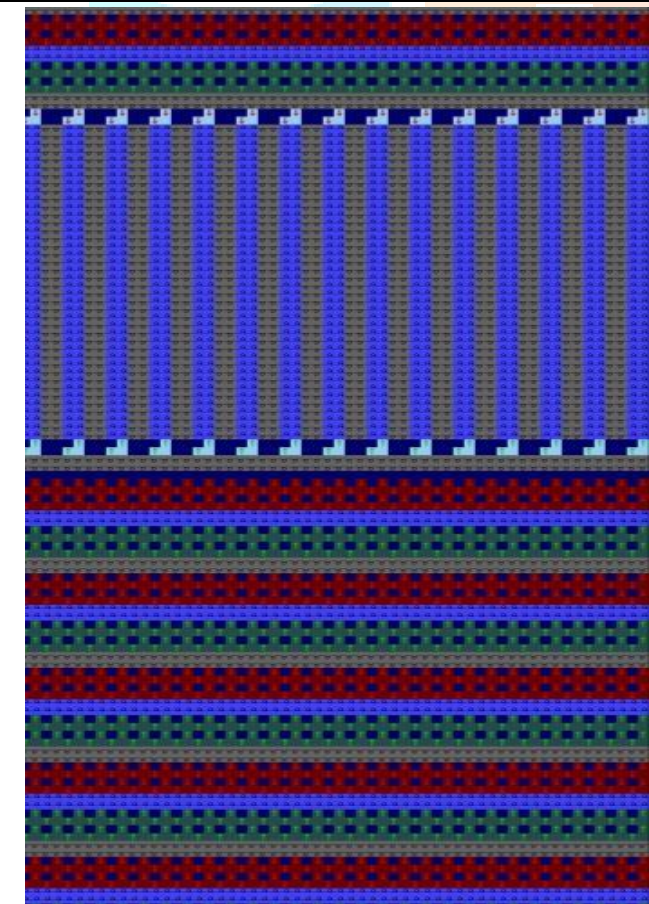


Graphical representation of shrug design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right

**Technical view (Tunic):** Knit & Pearl structure applied for tunic design.

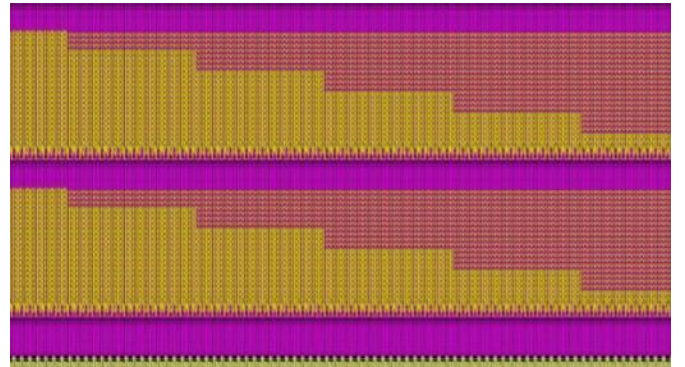


Graphical representation of tunic design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right

**Technical view (Legging):** 1X1 Knit with knit & pearl structure applied for legging design.



Graphical representation of legging design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right



Fig. 16: Photoshoot of knitted garment on model style four  
❖ **Style # WKC-05:** The 2D flat sketches of Tunic, Shrug and Legging are designed. Total nine panels were knitted i.e. two each for left & right legs, front

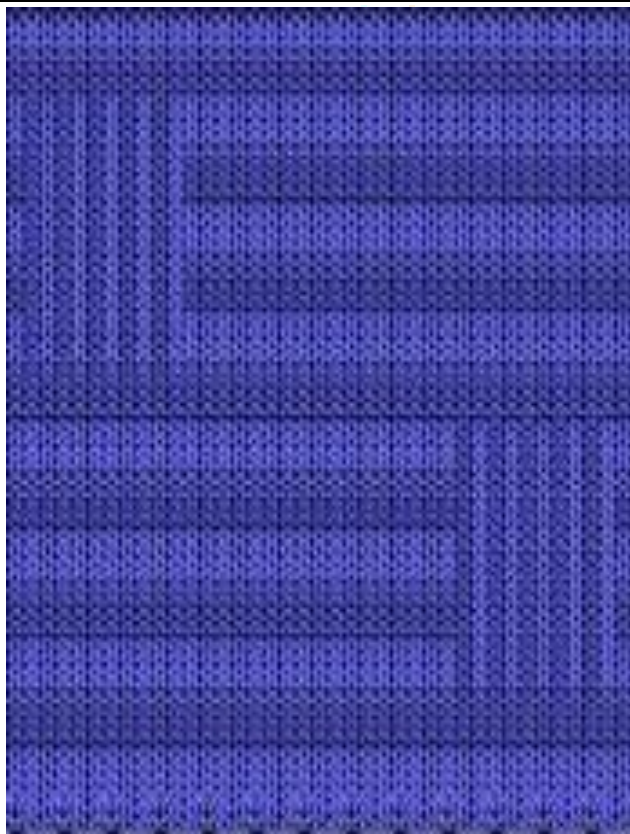
& back bodice, left & right sleeves, and a 3D stole for resembling snake, shown in fig. 17.



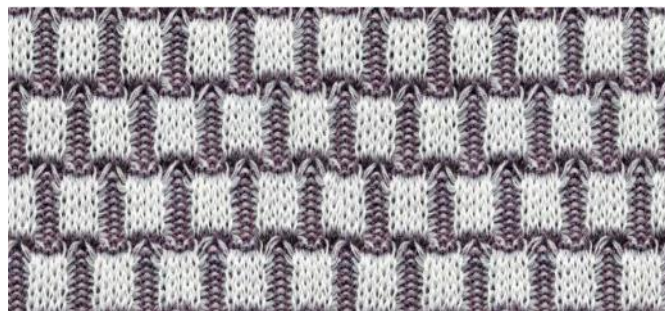
Fig. 17: Digital flat skech of women's knitted garment design five

**Table 05:** Technical view, fabric view and photoshoot of knitwear apparel for style WKC-05 shown in below table.

**Technical view (Tunic):** Knit & Pearl structure and 1X1 pleating technique used for tunic design.

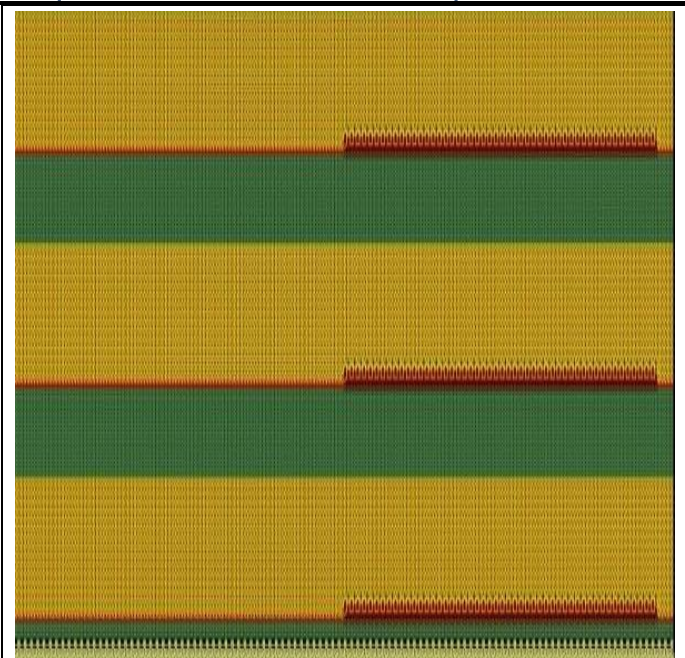


Graphical representation of legging design on STOLL M1 software



Fabric view: Knit (front side) and Pearl (rear side)

**Technical view (Legging):** Tubular Jacquard with cast off technique applied for legging design.



Graphical representation of legging design on STOLL M1 software



Fabric view: Knit (front side) at left and Pearl (rear side) at right



Fig. 18: Photoshoot of knitted garment on model style five

**6. Conclusion:**

The knitwear is one of the most exciting areas in fashion today where craft and digital processes collide to create desirable clothing for knitwear fashion showcasing around

the world. In this paper, it is described to determine the effect of stitch types i.e. Knit, pearl, miss /float, tubular on various length knitted fabrics, understand the fundamental of knitting design, create a knitwear design collection, construction of knitting patterns modernizes the idea of apparels and its accessories with increasing use of technology. The scope of the project can help to learn the procedure of designing and knitting techniques, and provide opportunity to work for knitwear designer, product developer, knitting machine technician, programmer, machine operator, fabric technologist, knitwear garment technologist, yarn developer, spinner & colorist, knitwear consultant, knit agent, knitwear buyer etc. in the knitwear industry. Knitwear today is a wonderful mixer of styles and techniques from which beautiful seamless and cut-sew knitwear garments can be produced in computerized machine for mass production within stipulated time.

Knitwear is in high demand largely because of its features like easy breath, wrinkle resistance, and moisture wicking. It is softer than woven materials, which is increasing demand in variety of applications and sporting activities like aerobics, athletics, football, and cricket can be linked to the rising demand for various sports wears (t-shirts, pants, shorts, etc.).

The knitwear market industry is projected to grow from USD 721.81 Billion in 2022 to USD 1605.69 billion by 2030, exhibiting a compound annual growth rate (CAGR) of 12.10% during the forecast period (2022-2030).

## 7. Reference:

- ❖ Kathie Murphy. (2002). Resin Jewellery. A&C Black London.
- ❖ Zoe Maletta. (25 September 2009). About knitwear. Retrieved 31 January 2011 from [http://www.ehow.com/about\\_5456692\\_knitwear.html#ixzz1Bmehxo9r](http://www.ehow.com/about_5456692_knitwear.html#ixzz1Bmehxo9r)
- ❖ Venice Kichura. (2 September 2009). About Knitting Stitches. Retrieved 31 January 2011 from [http://www.ehow.com/about\\_4772316\\_knittingstitches.html#ixzz1Ccqv51GI](http://www.ehow.com/about_4772316_knittingstitches.html#ixzz1Ccqv51GI)
- ❖ 3. Lisa Donofrio-Ferreza, Marilyn Hefferen. (2008). Designing a Knitwear Collection from inspiration to finished garments. New York Fairchild Books, INC.
- ❖ 4. Best, John, W. (1999). Research in Education, 5th ed., Prentice-Hall of India Pvt Ltd: New Delhi
- ❖ <https://www.marketresearchfuture.com/reports/knitwear-market-6795>

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