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IRAKACIYA - Don't Be Left in Dark...

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***Abstract* - This paper analyses the smart use of textile through the project 'Irakaciya', implemented as a novel approach for the young designers to create conventional and unconventional products. Using smart yarns that emit, reflects or reacts to light, which can be woven using both traditional and advanced techniques and also implemented in products with other textile techniques. The research gathered highlights how the world of textile can be viewed in a different view point complementary to the tradition, in particular to students who find this area challenging.**

Keywords: Optical Fibre, Textiles, Weaving, smart textile, Product Development

1. INTRODUCTION

Technology enhanced fabric belongs to the domain of smart textiles and wearable technology. Wearable technology is one of the buzz-words of this era. Most of the researches in these fields are aligned with medical applications like smart bands, pedometers or with computing. There are very few ongoing research activities in the field of smart textiles and even fewer in the technology enhanced fashionable clothing and interior products. Fabrics that is to be developed with these new technologies require it to provide added value to the user. The concept of 'smart fabrics' is very nascent and embeds the ability to perform various actions like communication, transform, conduct energy, lighting, etc which is not possible by the conventional clothing.

2. REVIEW OF LITREATURE

Optical fibre (or "fibre optic") refers to the medium and the technology associated with the transmission of information as light pulses along a glass or plastic strand or fibre[1]. Optical fibre[2] can be used for transmitting light from a source to a remote location for illumination as well as communications. In fact, fibres are made to not only transmit light but to glow along the fibre itself, so it resembles a neon light tube. Applications for fibre optic lighting are many, generally based on utilizing the special attributes of the fibre as well as its unique characteristics[8]. Optical fibres are usually associated with optical communication, laser power delivery and other applications that carry light from one point to another[2]. Over the past decade, however, these fibres have found a new niches photonic non-thermal filaments that can be used for applications ranging from glowing art and fashion to infrared security systems to clinical devices[9].

The objective of the project was to develop novel methods to blend technology with fabric in an aesthetic manner as well as to enhance the UX, to specifically explore the scope of illuminated
or light emitting fabric in a both macro as well as micro level, to design the products for the Indian niche market and work with new and smart yarns that emit, reflect or react to light which can be woven using both traditional techniques and advanced technology.

3. METHODS, EXPLORATION AND RESULTS

The method used to incorporate these fibres into textiles are weaving and surface techniques. The optical fibres are woven in weft direction with warp as nylon in order to get transparency effect.

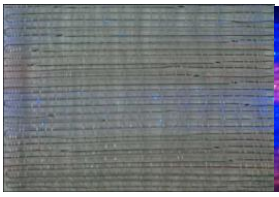

Fig 3.1

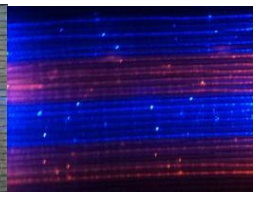

Fig 3.2

In order to overcome the limitations of using Optical fibre in weaving the optical fibre was cut to the width of the sample and the weft was not continuous. The light does not pass through out if the optical fibre bends, hence the fibre was cut to width of the sample. In the other exploration as shown in Fig 3.1, cotton was used in warp and it was observed that the sample was unstable. In order to overcome this issue aluminium wire was used in weft along with the optical fibre, as a result the woven sample was stiff and given a structure to the sample. Light source- 7 to 10 strands of optical fibre are attached to one 5mm LEDs shown in Fig 3.2.

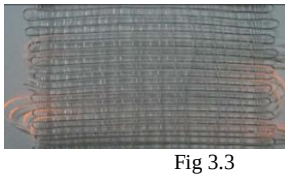

Fig 3.3

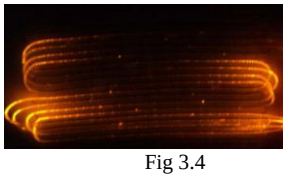

Fig 3.4

In this exploration, shown in Fig 3. 3 and 3. 4 each optical fibre bends after 4 weft strands, hence increasing the bend length. This as a result given unique appearance at the edges of the sample. Light source - Different colour LED are attached at both the ends of the optical fibre.

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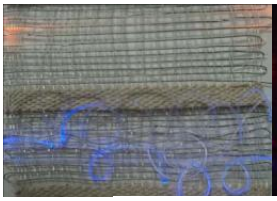
Fig 3.5

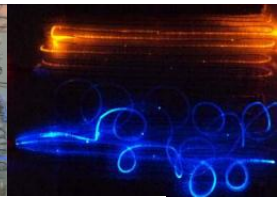
Fig 3.6

Single strand of optical fibre (Fig 3.5) was woven continuously, in other woven sample weft was not continuous. Limitations of optical fibre in weaving is that the light does not emit once the fibre is bends. Hence the fibre glows only at the bends and not throughout and also the light source does not pass for long distance in a single strand of optical fiber.

Looping techniques (Fig 3.6) In this exploration the optical fibre was looped in weft direction. loops formed were uneven and the bends in optical fibre disturbs the uniform lighting in the stands, illumination is brighter at the bends. Another observation is that the optical fibre breaks easily if the loops are developed closely.

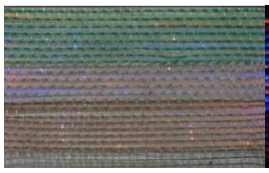
Fig 3.7

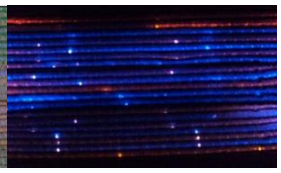
Fig 3.8

In this exploration carried out, the weft was not continuous and along with optical fibre cotton yarns were used, in order to bring in visual interest in the sample even when the optical fibres are not glowing. Here the light source used are10 strands of optical strands are attached to one LED. Alternate strands are attached to one colour. That one fibre glows blue the next one yellow as shown in Fig 3.7 and Fig 3.8.


Fig 3.9

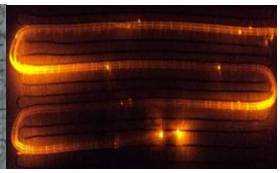
Fig 3.10

In the exploration shown above in Fig 3.9 and 3.10 Two strands of optical fibres are woven continuously but the illuminated sample shown the bend after 3 weft strands, thus decreasing the bending of optical fibres at the edge.


Fig 3.11

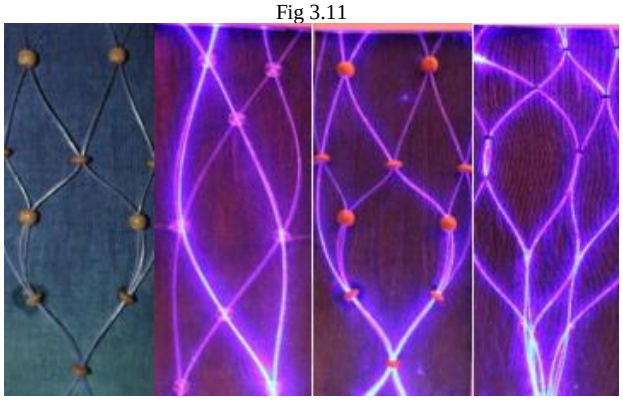
Fig 3.12

The exploration shown above (fig 3.11 and 3.12) was inspired from the fabric manipulation technique called pintuck technique. Similar to the pintuck technique was used in fabric, the optical fibers were attached here on the base fabric by couching technique in the required patterns. 4 to 5 strands of optical fibers are attached to a LED light source at one end of the fibers.

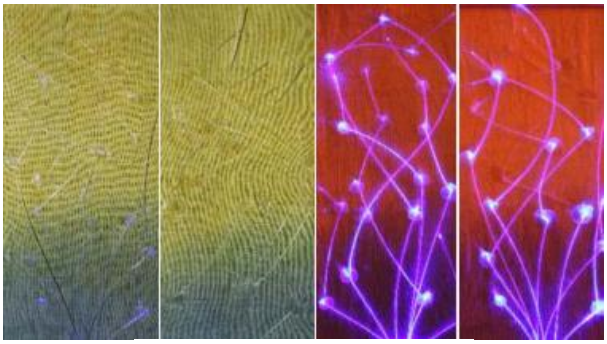
Fig 3.13 Fig 3.14

Optical fibres breaks when it is exposed to high temperature. The following technique was derived from this concept. Certain parts of the optical fibre is touched with a Heat gun and a gum which gives a connecting effect. when the light source is passed through the connecting point transfers light to the next segment thus glows at the intersection points as shown in Fig 3.14..

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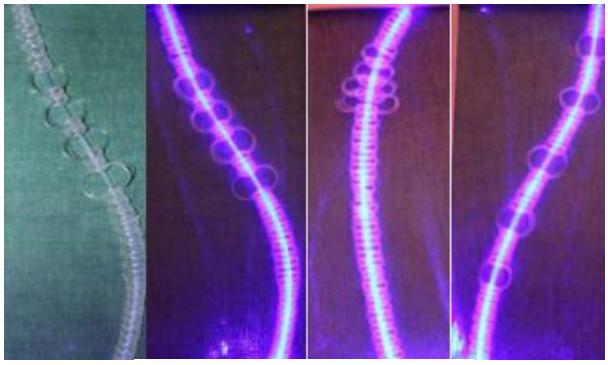

Fig 3.15 Fig 3.16

Macramé technique is used in the Figure shown above. In a macramé technique, four strands are used in which two strands are used as base strand and two strands creates loops in a particular manner to produce the pattern. Since optical fibers cannot be bend, optical fibres are used in the inner strand and nylon wires are used in the other two strands which has a similar appearance to optical fiber and also complements the lighting from the optical fibers shown in fig 3.15 and fig 3.16

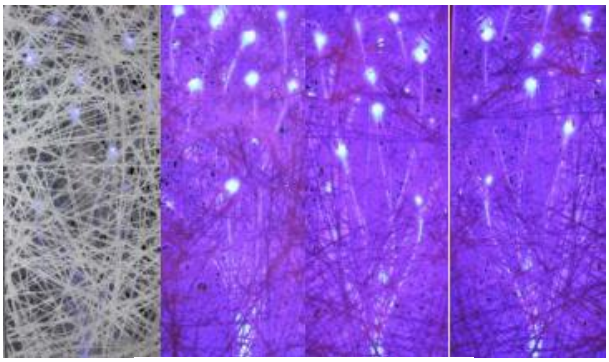

Fig 3.17 Fig 3.18

In the exploration shown above, the outer surface is developed by winding waste yarns with gum on balloon, once the yarns are dried and free of stickiness the balloon inside is busted and removed. A mesh with yarns wrapped in irregular manner was obtained. Inside the yarn mesh, strands of optical fibre were placed in such way that one end of the fibers were connected to the LED light source and the other tip of the optical fibers are left on the surface on the yarn mesh as shown in the fig 3.17 and fig 3.18.

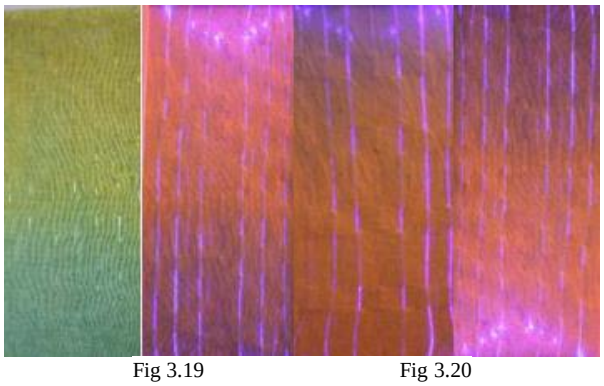

Fig 3.19 Fig 3.20

Embroidery Technique: Instead of using regular embroidery threads for running stitches on a fabric, here optical fibers are used. The optical fibres are stitched on fabric using running stitches with uniform stitch length, increasing and decreasing stitch length and irregular stitch length as shown the fig 3.19 and 3.20.

4. PRODUCT DEVELOPMENT

Developed a range of wall lighting for niche market with optical fibres using weaving and non-loom techniques.

4.1 - Varuna - The night sky...

Varuna- the night sky is a 10'x6' wall lighting/art, developed from taking the sky as the theme. The stripe pattern in this art is derived from a rose image. This art is woven as five different panels each panel with a dimension of 2'x6' size. Here nylon is used as warp and optical fibre (0.50 mm) woven in weft. Different material in weft are used like acrylic yarns and bin bags for black colour, scrubber for silver colour and nylon for transparency effect. The colour palette signifies the night sky. Cost of Manufacturing each is Rs 5,500.

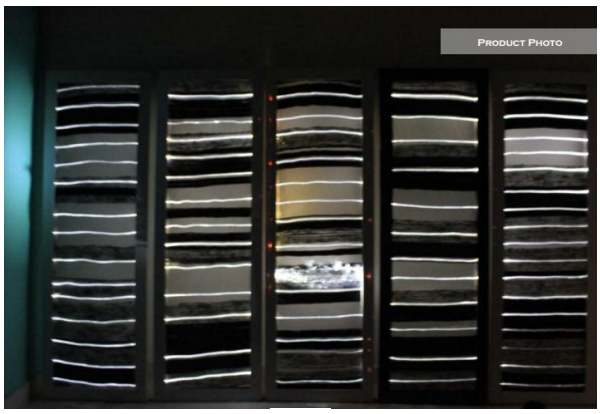

Fig 2.1

4.1.1 Costing -

MATERIALS	PRICE	QUANTITY REQUIRED	COST
Scrubber	1 dozen - 100Rs	15 dozen	Rs 1500
Bin Bag	1 packet - 75Rs	2 packets	Rs 150
Aluminum wire	1roll-65Rs	10rolls	Rs 650
Optical fibers	1meter-20Rs	400m	Rs 8000
Nylon wire	1Kg-160Rs	2Kg	Rs 320

ELECTRICAL MATERIALS	PRICE	QUANTITY REQUIRED	COST
LEDs	1 LED - 1Rs	110 dozen	Rs 110
Wire	1 packet - 120Rs	3 packets	Rs 360
Adaptor	1- 80Rs	5	Rs 400
Jack	1- 5Rs	5	Rs 25
Insulation tape	1-10Rs	5	Rs 50
Heat shrink	1m - 10rs	5	Rs 50

Table 4.1.1

In the Table mentioned in 4.1.1 cost of Raw material used for making the product is described which include Electrical material. In Table 4.1.2 the cost of other material such as frame and Labour cost is shown. Total Material cost incurred is Rs. 18905. Selling price is shown as Rs. 27500.

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FRAME MATERIALS	PRICE	QUANTITY REQUIRED	COST
Wood	1 sq.feet - 10Rs	85sq.feet	Rs 850
Nails	100g - 25Rs	100g	Rs 25
Needle	1- 5Rs	1	Rs 5
Twin thread	1-30Rs	2	Rs 60
DST	1-20Rs	15	Rs 300
Foam Board	1 - 600Rs	5	Rs 3000

LABOR CHARGES	COST/peice	TOTAL COST
Weaving	500Rs/panel	Rs 2500
Electrical Work	3Rs/LED	Rs 300
Framing	50Rs/Frame	Rs 250

TOTAL MATERIAL AND LABOR COST - 18,905 Rs
PROFIT PERCENTAGE - (45%)
- 8,510 Rs

TOTAL COST OF THE PRODUCT - 27,415 Rs
- 27,500 Rs (round off)

EACH PANEL COST - 5, 500 Rs

Table 4.1.2

4.2 - Ritu - The beauty of seasons...
Vasanta (spring-yellow)
Sharada (autumn - red)
Grishma (summer - green)
Shishira (winter - blue)

Ritu - the beauty of seasons is a 8'x4' wall lighting/art, developed from taking the seasons as the theme. Taking inspiration from sand art, the silhouette of tree is attached on the art. This art is woven as four different panels with each panel in the dimension of 2'x4' size . Nylon was used in warp and optical fibre and cotton yarn was used in weft. Nylon as warp is used for transparency effect. The colour palette signifies the seasons. The cost of each panel is Rs 5,500.

Fig 2.4

4.2.1 Costing –

MATERIALS	PRICE	QUANTITY REQUIRED	COST
Cotton Yarn	1 Kg - 120Rs	2Kg	Rs 240
Optical fibers	1meter - 20Rs	400m	Rs 8000
Nylon wire	1Kg - 160Rs	1Kg	Rs 160

DYES	PRICE	QUANTITY REQUIRED	COST
Annota seed	1 Kg - 240Rs	1Kg	Rs 240
Violet Cabbage	1Kg - 34Rs	1 Kg	Rs 34
Turmeric	250 g - 40 Rs	250 g	Rs 250
Alum	1Kg - 80 Rs	4Kg	Rs 240

ELECTRICAL MATERIALS	PRICE	QUANTITY REQUIRED	COST
LEDs	1 LED - 1Rs	110	Rs 110
Wire	1 packet - 120Rs	3 packets	Rs 360
Adaptor	1 - 80Rs	4	Rs 240
Jack	1- 5Rs	4	Rs 20
Insulation tape	1- 10Rs	5	Rs 50
Heat shrink	1m - 10rs	5	Rs 50

Table 4.2.1

FRAME MATERIALS	PRICE	QUANTITY REQUIRED	COST
Nails	100g - 25Rs	100g	Rs 25
Needle	1 - 5Rs	1	Rs 5
Twin thread	1 - 45Rs	2	Rs 90
DST	1 - 30Rs	15	Rs 450
Foam Board	1 - 600Rs	2	Rs 1200

LABOR CHARGES	COST/peice	TOTAL COST
Weaving	500Rs/panel	Rs 2000
Electrical Work	3Rs/LED	Rs 300
Framing	50Rs/Frame	Rs 250
Dyeing	60/Peice	Rs 240

TOTAL MATERIAL AND LABOR COST - 14,634 Rs
PROFIT PERCENTAGE - (50%)
- 7,317 Rs

TOTAL COST OF THE PRODUCT - 22,017 Rs
- 22,000 Rs (roundoff)

EACH PANEL COST - 5, 500 Rs

Table 4.2.2

In the Table mentioned in 4.2.1 cost of Raw material used for making the product is described which include Electrical material. In Table 4.2.2 the cost of other material such as frame and Labour cost is shown. Total Material cost incurred is Rs. 14634. Selling price is shown as Rs. 22000.

4.3 - Chaya - Blending of colors..
Chaya - Blending of colors, is a wall art/lighting developed by taking inspirations from the rainbow in night sky. Gradation effect is he focus in this collection. Individual art works of various sizes are developed with non-loom techniques such as running stitches and exposing optical fibres to heat. The colour palette include the primary colors and its shades. A total of 10 products were developed in this collection and each product costs Rs 1,250.

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Fig 2.7

4.3.1 Costing -

MATERIALS	PRICE	QUANTITY REQUIRED	COST
Poplin fabric	1m -55Rs	0.25m	Rs 13.75
Optical fibers	1meter-20Rs	13 m	Rs 260
Dyes	1 Packet(100g) - 85Rs	34g	Rs 30
DST & masking tape	1-30Rs	2	Rs 60
Foam Board	1 - 600Rs	1/4 Board	Rs 150

ELECTRICAL MATERIALS	PRICE	QUANTITY REQUIRED	COST
LEDs	1 LED - 1Rs	4	Rs 4
Wire	1 packet - 30 Rs	1/2	Rs 15
Adaptor	1- 80Rs	1	Rs 80
Jack	1- 5Rs	1	Rs 5
Insulation tape	1-10Rs	1	Rs 10
Heat shrink	1m - 10rs	0.25m	Rs 2.5

LABOR CHARGES	COST/peice	TOTAL COST
Stitching	75Rs/panel	Rs 75
Electrical Work	4Rs/LED	Rs 16
Framing	50Rs/Frame	Rs 50
Dyeing	60/Peice	Rs 60

TOTAL MATERIAL AND LABOR COST - 832 Rs
PROFIT PERCENTAGE - (50%)
- 416 Rs

TOTAL COST OF THE PRODUCT - 1,248 Rs
- 1250 Rs (roundoff)

Table 4.3.1

In the Table mentioned in 4.3.1 cost of Raw material used for making the product is described which include Electrical material and Labour cost is shown. Total Material cost incurred is Rs. 832. Selling price is shown as Rs. 1250.

5. CONCLUSIONS

The research carried out for 18 week was a completely new experience and learning. It was an opportunity to experiment and explore with new material and experienced talking with young minds about the future of textiles. The research project involved use of optical fibres in textiles with non-loom techniques and weaving techniques. A range of wall lighting developed from the experimentations done. Initially started working with incorporating LEDs in the clothing and home furnishing products but couldn't take it forward because of technical issues. Experiments were carried out with optical fibres, introduction optical fibres in small scale in table top loom which was a great challenge.

There are very few ongoing research activities in the field of smart textiles and even fewer in the technology enhanced fashionable clothing and interior products. As generation passes, technology will become a part of life. Hence the scope of this field is high This is the tip of the iceberg, and there is lot more to explored in this field which will end in development of amazingly innovative smart textiles and development of technology that will undoubtedly change the way the live, forever.

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