DIGITALIZATION 4.0 IN HANDICRAFT INDUSTRY IN INDIA

Abstract

In the field of design, the contemporary computer's computing tools are being driven by skilled craftwork and customisation, which provides new paradigms for the modelling and production of conventional objects. Craft-specific CAD tools provide beginning users new chances to engage in the design process. Because they work with traditional crafts, computational technologies used in conjunction with digital manufacturing are increasingly being included into professional art and design. Both traditional handicrafts and modern challenges are reflected in the hybrid combination of design tools, digital manufacturing, and traditional craft skills. The possibilities for craft work and the ability of craftsmen to be more creative in the future are increased by the integration of design tools with traditional crafts.

Keywords: Craftwork, CAD Tools, Handicraft Industry, Jewellery Modelling.

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I. INTRODUCTION

The Indian handicraft industry includes the creation of delicate handicrafts using a variety of raw materials in various regions of the nation. Jewellery design and manufacturing, stone work, wood carving, glass etching, clay work, metal and leather work, textile printing and embroidery, etc., are the main industries in this sector. Many artists desire to employ CAD and digital fabrication to maximise their crafting abilities. This may be accomplished by using computers to aid in the design and creation of handmade goods. A customised CAD tool that offers ways of designing with traditional manufacturing is being developed, and a combination of traditional handcrafting and digital production is the second hybrid technique being used. First strategy improves design opportunities for novice to expert designers using traditional production techniques, and second strategy serves to move traditional crafts to the digital domain to a large extent.

Digital manufacturing techniques have expanded, making it possible to easily translate free-form handmade goods into tangible objects. The use of contemporary CAD software to develop craft-specific CAD tools is prompted by the trend toward digital manufacture of traditional craft objects. The creation of CAD tools tailored to a particular trade would allow designers to reorganise both digital and real-world components. Modern CAD tools, however, which were mostly created in an industrial setting, don't have a way to include conventional procedures and techniques for making handcraft goods. By implementing all the necessary sequential procedures in software, these CAD tools might be tailored for designing traditional craft into CAD paradigms. The industry-specific CAD tools would help digitally build the goods via computer aided manufacturing. Craftsmen tend to their practises while employing sophisticated CAD/CAM technologies, which are being used more and more in industry to boost productivity and shorten the time it takes to produce new products. While craftspeople aren't necessarily eager to replace their current abilities with new CAD/CAM tools, the dearth of visual aids in more conventional approaches is drawing them towards CAD. Additionally, things created by machines are starting to challenge handicrafts.

II. TRADITIONAL HANDICRAFT PRODUCT

Figure 1

III. PRINTED TANGIBLE ARTIFACTS

Figure 2

The application of CAD/CAM to craft work is not disallowed in this context as a breach of traditional skills and may be utilised as a tool to help artisans develop their artwork and get access to digital production. But because industrial packages are out of the reach of most artisans, it is vital to create a library of freely accessible tools that may be utilised by craftspeople to push the boundaries of design in certain application areas. As a result, the notion of automating craftsmanship may be considered, which introduces the merging of CAD/CAM to the confluence of craftwork and technology. Here, giving designers tools is more important than automating anything.

Traditional Handicrafts	Culture/ Craft	Production Methods	Modern Manufacturing Methods		
			Layered Manufacturing	Laser cutting	CNC Machine
Furniture	Wood crafts	Wood Carving, Relief Carving		✓	✓
Pottery & Clay objects	Ceramic crafts	Moulding	✓	✓	
Metal wares	Metal crafts	Casting and Die Striking	✓	✓	✓
Jewellery	Indian Traditional Jewellery	Clay Moulding, Stamping,	✓	✓	
Leather Products	Leather Work	Stamping		✓	
Handprinted Textiles & Scarves	Textile Printing	Stamping		✓	✓
Stone Carving	Stone Work	Engraving,		✓	✓
Latticed Screens	Wood crafts	Fret-working, Etching		✓	✓
Chicken Embroidery	Embroidery Work	Needle Movement			✓

1. **Wire Jewellery:** One of the earliest methods used to create handcrafted jewellery is the twisting and wrapping of wire. While the modern jeweller needs specific skills to create this artwork, all jewellers in the past were able to use this entirely handmade approach. In this method, various gauges of wire are wrapped, bent, and twisted into a loop or other ornamental form. Then, wire components and forms are mechanically joined to one another

without soldering or heating the wire. These shapes may be generated using parametric forms, which allows for a large number of possible permutations. The modelling procedure starts with choosing the motif shape from the library, followed by form creation and parameter description using an interface designed specifically for wire jewellery with the chosen theme. Therefore, a variety of jewellery designs in this particular type of jewellery will be created using this parametric CAD programme.

Following are the steps in jewellery modelling:

- Shape geometry is used to parameterize the fundamental geometric forms.
- The shape is traced when the shape coordinate points are defined in the form (x; y) =[x (t); y (t)].
- On a plane that is perpendicular to the geometric shape, a cross-section profile is created.
- A decorative shape of wire jewellery is made by producing a twist or sweep, then a parameter of shape and twist.
- The number of wires in the wire strand (N), the radius of the wires (Rw), and the number of turns in the wire strand (n) are the modelling parameters other than those that define the curve.

2. **Carved Jewellery:** Jewellery that has been carved typically has a few tiny interior holes created by a thin, sharp tool on sheet metal. The traditional class of Indian carved jewellery is produced using this CAD paradigm. Through multilayer manufacturing and CAD, the fabrication of jewellery has been digitised. AutoCAD is used to implement the paradigm in the Active X and Visual Basic Application (VBA) development environment.

Figure 3

3. Traditional Wire Jewellery

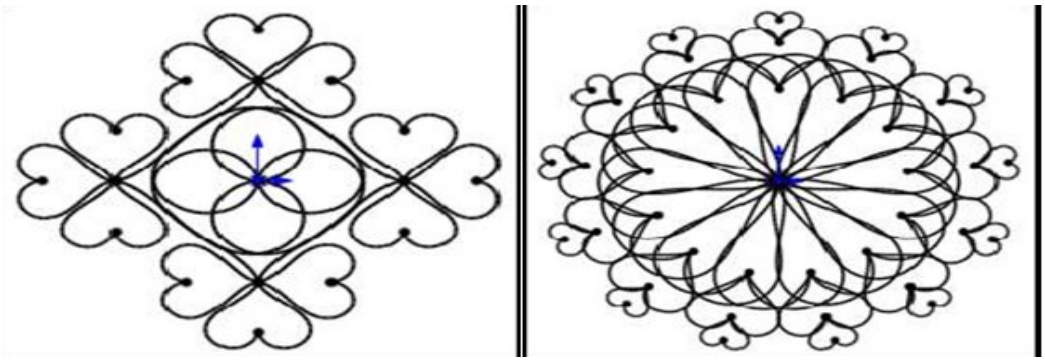

Figure 4

IV. PATTERNS GENERATED FROM DECORATIVE SHAPES

Figure 5

V. A RENDERED IMAGE AND 3D PRINTED MODEL

1. The following processes in jewellery creation are programmed to be carried out automatically in a CAD environment:
2. A voxel element that has been parameterized as a voxel signature and is represented as V-P/L/H/X/Y/R, where V stands for voxel, P stands for the
3. maximum number of valid points, L stands for size, H stands for height, stands for the inclination of the voxel element's side surface, X and Y stand for variants, and R stands for the radius of the centre hole.
4. According to the size of the jewellery type, a CAD block with a rectangular array of the voxel in rows and columns (R and C) is created.
5. Making a polar array of the block in the plane around a perpendicular axis that passes through any one of the legal points (Pt) for an angle () and a number (N).
6. Jewellery model rendered.
7. Real objects are produced via digital fabrication and layered manufacturing.

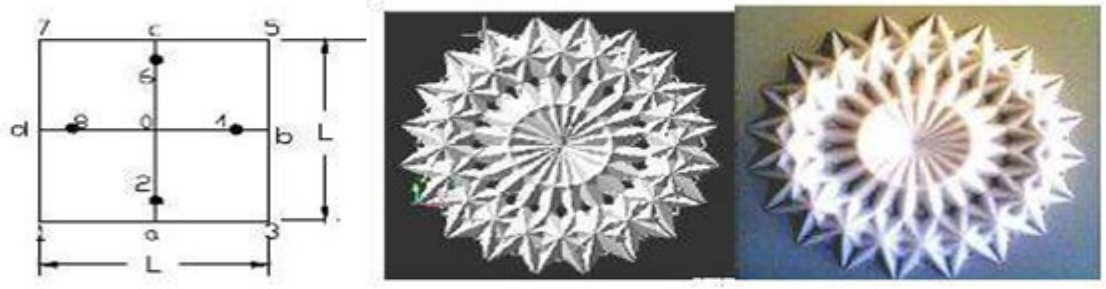

Figure 6

VI. SHARANPUR WOODCRAFT

World-renowned for its woodcrafts, Saharanpur in Uttar Pradesh is known for its distinctive style of floral designs carved in low relief on Sheesham wood. Wood is reduced by expert hands using a tool-assisted technique called carving. Using a CNC milling machine, this CAD paradigm creates carved sculptured surfaces for woodcrafts.

Floral designs from Saharanpur are usually produced using compass drafting and are focused on circular geometry. A flower pattern is hierarchically divided into identical petals during CAD modelling. This representation scheme makes use of CAD as a design tool to assist designers and artists in manipulating a collection of basic motifs and placing them in a certain sequence to create a pattern. The following are the modelling phases that must be carried out programmatically:

- Modelling of a petal on a planar map with three intuitive modelling parameters: R (Size of the motif), r (Size of the centre part of the motif), and n (number of petals).
- A floral design using a petal motif as its polar array.
- The sculptured surface is enveloped in a motif.
- Utilizing a CNC machine for digital manufacturing.

VII. SAHARANPUR WOODCRAFT

Figure 7

VIII. PIERCED SCREENS

Islamic star-patterned traditional latticed screens are utilised as a decorative feature for ornamental goods and interior design. A star is thought of as a group of line segments that are connected at their termini. The star designs for conventional latticed screens are produced as periodic and repeating arrangements of a particular motif or group of related compound motifs. Additionally, a compound-motif is thought of as a collection of several star/rosette patterns. The created patterns are 2D in nature and are mapped on a material's flat surface to create displays that are 212 D. Following are the modelling steps:

1. The parameters determining the motif's shape are r (the motif's size), n (the number of rays), (the star's shape), t (line thickness), and w. (width of rosette).
2. Compound motifs with a centre motif in interaction with surrounding motifs are created in the topic of a star shape motif.
3. Row and column offset determine the arrangement of a motif or compound motif in a design.
4. Digital manufacturing that involves material removal from a planer surface utilising laser/water jet cutting.

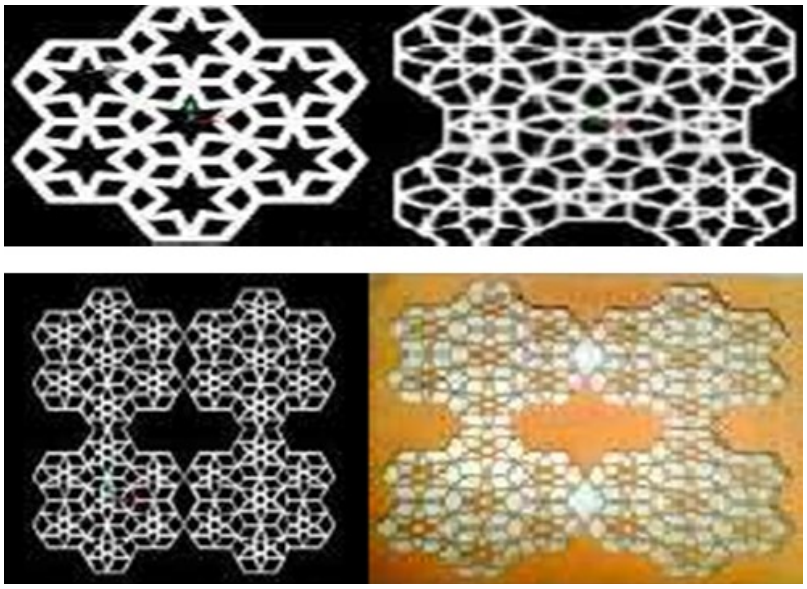

Figure 7

IX. CONCLUSION

To build an intersection between technology and tradition, traditional crafts need to be taken advantage of for their immense potential and high degree of uniqueness. Complex geometries that were previously impossible to design and create with traditional production methods are now achievable using CAD/CAM software. With the right craft-specific technologies, digital manufacturing enables individuals to conserve their traditions, support on going conventional practises, and develop new ideas. Without replacing tradition, digital

technologies are helpful in expanding traditional labour and improving traditional abilities. Using automated processes, today's digital technology also enables users to vary the creation of commodities.

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