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Devising an Image Processing-Based Technique for Preserving Cultural Motifs

Angkush Kumar Ghosh[1]*, Liu YAN[2], and Sharifu Ura[1]
[1] Division of Mechanical and Electrical Engineering, Kitami Institute of Technology, Japan
[2] Graduate School of Engineering, Kitami Institute of Technology, Japan
* Corresponding Author's Email: ghosh-ak@mail.kitami-it.ac.jp

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Extended Abstract

Preserving cultural motifs not only safeguards heritage but also fosters SME innovation, supports education, and enables the development of culturally significant products, all while enhancing global recognition and research [1,2]. As shown in Fig. 1, achieving this vision requires addressing two essential aspects: first, digitizing the physical motifs, and second, storing the digitized motifs in a digital marketplace, can be called the Digital Manufacturing Commons (DMC) [3], for seamless access and utilization by various stakeholders. To accomplish this, we must first understand the nature of cultural motifs themselves. Most motifs exhibit a degree of symmetry, often through repetition or the combination of simpler designs to create complex patterns (see Fig. 2a). Such symmetry and geometry can be effectively captured using parametric methods or point cloud algorithms [4]. However, this approach raises an important question: how do we capture the "beauty of imperfection"? For instance, a flower motif may seem symmetrical at first glance, but a closer look reveals slight inconsistencies in the petals, reflecting the human craftsmanship behind it (see Fig. 2b). These subtle imperfections are part of what gives the motif its cultural and historical value. While parametric and point cloud algorithms can model geometric precision, they can be cumbersome when it comes to encapsulating these subtle, human-made imperfections. Therefore, the digitization method must not only replicate precise geometry but also encapsulate these imperfections to ensure a complete and authentic digital representation. Equally important is the format in which these digital models are stored. A versatile data format is crucial—raster or vector graphics may suffice for educational purposes, but product development may require point clouds (Text or CSV), STL, or DXF files. Policymakers must also address system administration, access control, and trust to ensure the DMC is a credible platform. Although this study does not focus on policymaking, it remains an essential element for the successful preservation and broader application of cultural heritage in the digital realm. Nevertheless, this study devises an image processing-based technique to digitize cultural motifs, as shown in Fig. 3. The technique traces paths from images using a brightness cutoff detection method, processes the paths by cleaning or adjusting points, and converts the result into a vector format. The vector format can be exported into various other formats and decomposed into elementary point clouds if needed. This approach has been applied successfully to digitize several Nakshi Kantha motifs from Bangladesh (one

example is shown in Fig. 3), effectively capturing both their geometric structure and handcrafted imperfections. The digitized outcomes contribute to the DMC and thereby may facilitate culturally enriched product development as shown in Fig. 3. The findings of this study could play a pivotal role in preserving Bangladesh's traditional motifs, promoting global recognition, driving education, research, innovation, new product development, and supporting SMEs, given the support of policymakers and stakeholders.

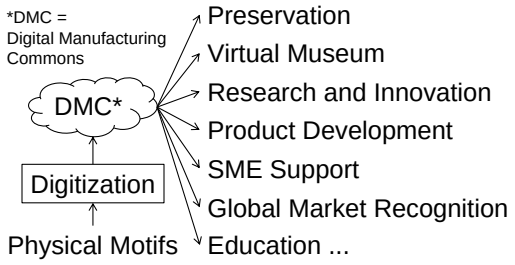

Figure 1: A motif preservation framework.

Figure 2: Examples of Naskhi kantha motifs.

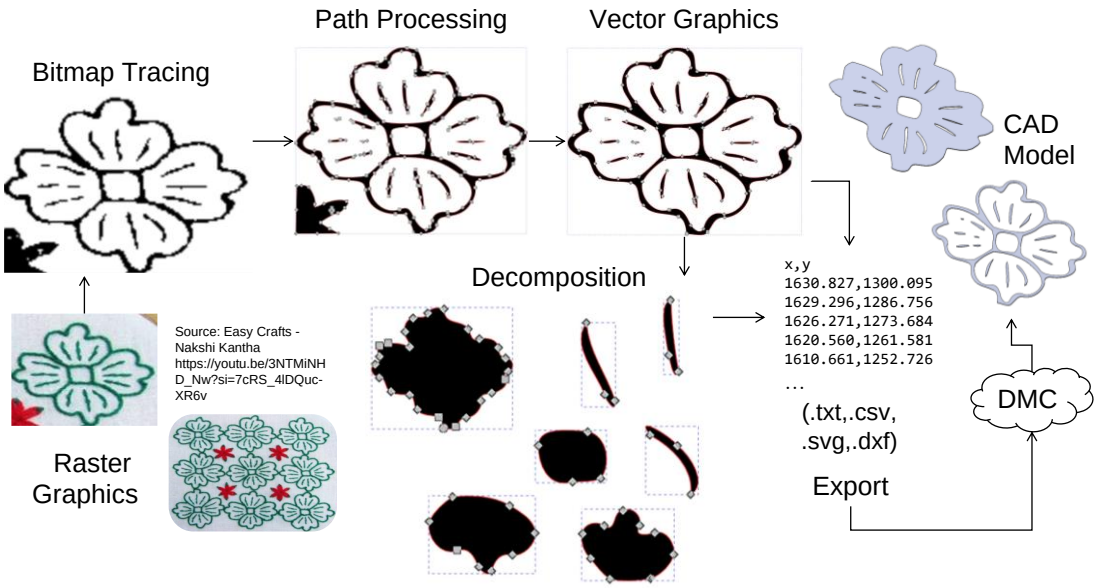

Figure 3: The image processing-based technique for digitizing a motif.

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