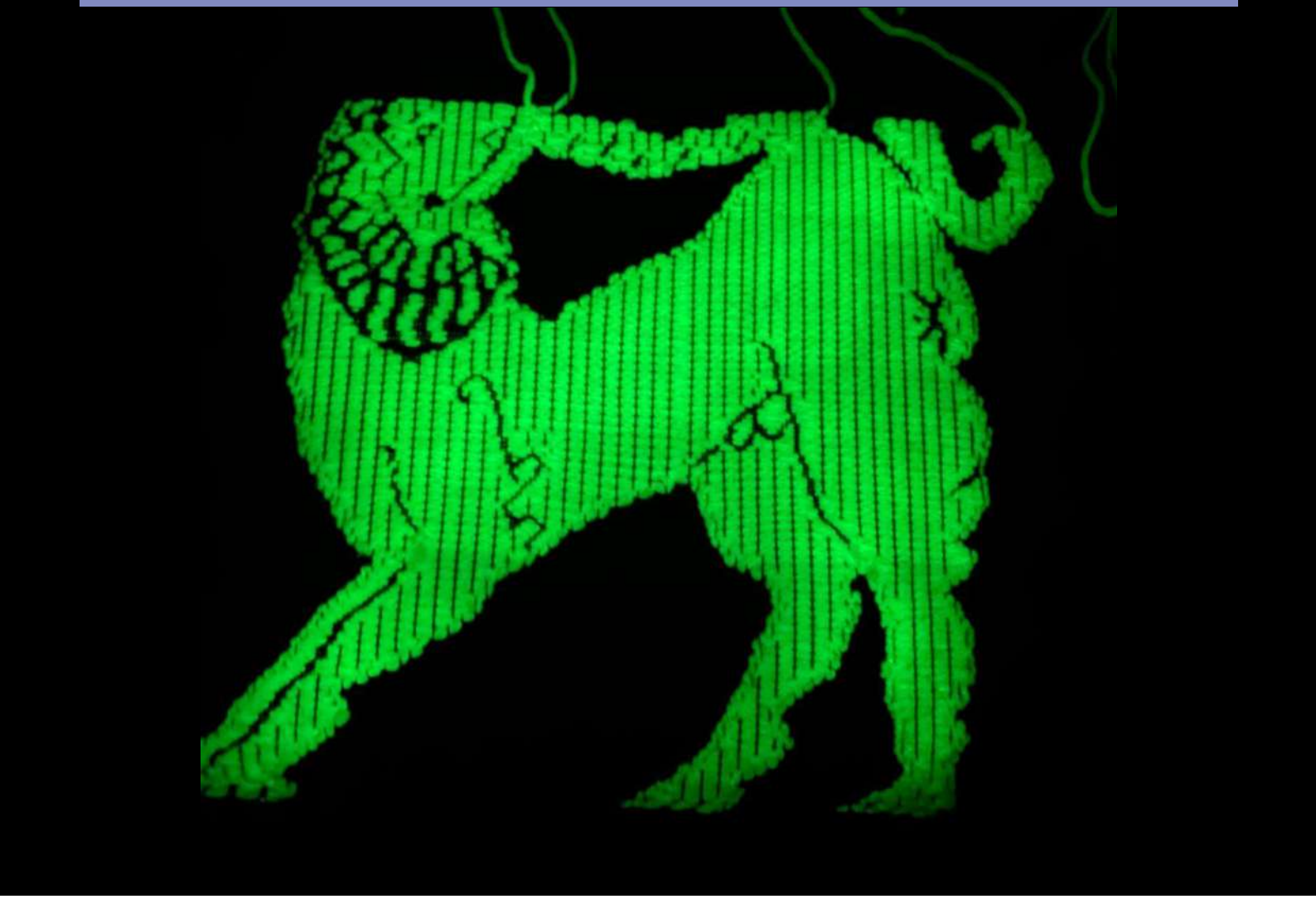
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ILLUMINATING TRADITION: REIMAGINING DUMBARA WEAVING THROUGH PHOTOLUMINESCENT YARN

Introduction

Dumbara weaving is one of Sri Lankan most distinctive handloom traditions, originating from the central highlands and characterised by bold geometric motifs and warp-faced structures. Historically used in royal and temple contexts, these textiles carry strong cultural and aesthetic value. However, Dumbara weaving now faces challenges including limited market adaptation and declining engagement among younger artisans.

This ongoing research investigates a novel approach to extending the relevance of Dumbara weaving by integrating photoluminescent (PL) yarns. These yarns absorb light and emit it in low-light conditions, enabling textiles to transform visually between day and night. The study proposes a shift from static decorative objects to interactive interior elements that respond dynamically to environmental conditions.



Figure 1: Photoluminescent yarn samples demonstrating transition from daylight to glow in darkness.

Research Context and Significance

Traditional craft preservation has largely focused on documentation and replication. While these efforts are important, they do not always ensure long-term sustainability in evolving markets. Recent studies emphasise the need for innovation that respects cultural identity while introducing new materials and applications [1]. At the same time, photoluminescent textiles have been explored in industrial and safety applications [2], [3]. However, their integration into heritage craft systems remains limited.

This study addresses the gap by exploring how Dumbara weaving can evolve through material innovation while maintaining cultural authenticity. It positions traditional weaving as a platform for experimentation, enabling a dialogue between heritage craft knowledge and contemporary textile design.

Concept - Visible by Day, Alive by Night

The central concept of this study is duality in textile perception. During daylight, the textile retains the visual qualities of traditional Dumbara weaving, with subtle textures and culturally rooted motifs. In darkness, selected elements emit a soft glow, creating a transformed visual layer.

PL materials function by absorbing light energy and gradually releasing it under low-light conditions [2]. Previous studies suggest that such materials can alter visual perception, sometimes reversing the prominence of positive and negative spaces [4]. In this context, Dumbara motifs evolve from static decorative elements into dynamic, responsive features, enhancing both spatial and sensory experiences.

Material Innovation

PL yarns are created by embedding light-emitting pigments within fibre structures, allowing them to absorb and emit light without external energy. These yarns are durable, washable, and environmentally friendly, making them suitable for sustainable textile applications [3]. Properties relevant to this study include independent glow capability, structural durability within woven textiles, compatibility with handloom techniques, and variation in glow intensity depending on yarn composition and woven structure.

Although widely used in industrial textile applications, the use of PL yarns in heritage craft practices remains underexplored. This positions the Dumbara study within a novel and emerging area of material-driven craft innovation.

Methodology

This study adopts a practice-led research approach, where making functions as a mode of



Figure 2: Design development based on Sinhala Sarasili motifs adapted for Dumbara weaving.

inquiry [5], [6]. Secondary research comprised a focused literature review spanning Dumbara weaving traditions, PL materials, and precedents in luminous textile design. This review informed the design concept, material selection, and criteria for observing the experimental samples.

Primary research included field visits to Ududumbara and collaborative discussions with weaving families. The process was treated as knowledge exchange and co-development rather than extractive consultation. Artisan knowledge of loom structures, motif significance, yarn behaviour, tension control, production time, and loom limitations informed the design decisions. Ethical protocols included informed consent, transparent attribution, and approval under ethical guidelines. Three Sinhala Sarasili-based design concepts were developed and woven as 22 in. x 22 in. proof-of-concept samples, a scale determined by loom availability and the time-intensive nature of Dumbara weaving.



Figure 3: Comparison of Dumbara textile appearance in daylight and dark conditions.

Key Findings

At the proof-of-concept stage, samples were assessed through observable criteria: structural compatibility, controllability of PL yarn placement, daylight appearance, dark-condition motif visibility, aesthetic balance, and handloom feasibility. The warp-faced structure performed well because its strong linear organisation allowed the luminescent yarns to be positioned within selected motif areas without disrupting the traditional textile surface. A clear visual transformation was observed between day and night conditions: the textiles maintained a subtle and traditional appearance during daylight, while glowing motifs emerged in darkness, creating a layered and dynamic visual effect.

The study also identified technical and production challenges. These included balancing glow intensity without overpowering traditional aesthetics, managing yarn tension within handloom processes, and addressing the time-intensive nature of manual weaving. Collaboration with artisans was essential for maintaining cultural authenticity; however, limited loom availability and extended production times constrained the scale of experimentation.

Applications and Impact

This research expands the application of Dumbara weaving into contemporary design contexts, including luxury hotel interiors, ambient lighting textiles, cultural exhibitions, and sustainable interior decor. The integration of PL yarns enables energy-free illumination while enhancing visual engagement across varying light conditions.

The study demonstrates a transferable model: heritage craft traditions can absorb contemporary material innovation without surrendering cultural authenticity. This repositions Dumbara weaving within design-led markets while strengthening artisan livelihoods. Its main contribution lies not only in product application, but also in establishing a practice-led, community-embedded method for craft revitalisation.

Future Directions

The ongoing study will develop a complete col-

lection of six textile prototypes, followed by controlled evaluation of glow duration, glow intensity, daylight visibility, and dark-condition performance. User-experience testing within real interior environments will also be conducted to evaluate spatial, aesthetic, and emotional impact.

Further research will explore pathways for commercial production and scalability, alongside the integration of digital storytelling tools to enhance narrative value. Future investigations will also examine how transitions between light and dark conditions influence users' perception and engagement with heritage textiles.

Conclusion

This study demonstrates that tradition and innovation can function as complementary pathways. By integrating PL yarns into Dumbara weaving, it introduces a new dimension of temporal textile design that evolves across light conditions. The research highlights the value of practice-led approaches in bridging cultural heritage and material innovation, contributing to the sustainable revitalisation of traditional crafts within contemporary design landscapes.

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