A Computational Interpretative Design Model for Exploring Iranian 2-Dimensional Geometrical Patterns

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Abstract

In Iran, geometric patterns are one of the most ancient decoration methods. This rich tradition has endured for centuries, serving as a testament to its creators' intricate craftsmanship and mathematical acumen. Various geometric patterns and mathematical calculations indicate that traditional geometric patterns are complicated and follow specific rules. These patterns, characterized by their complexity and adherence to precise rules, have fascinated scholars and artisans alike. However, the absence of comprehensive documentation from the original designers poses a significant threat to preserving this invaluable cultural heritage.

Exploring the design process and finding the rules beneath the existing geometrical patterns will help us understand and design these patterns and preserve this valuable heritage from extinction. An understanding of the design process needs a transferable knowledge of computation. Today, with the development of technology, especially computer science, it is possible to draw complicated geometries, analyze existing geometries, and generate entirely new ones. Computational theories and technologies significantly impacted the traditional understanding of design and creativity.

This research endeavors to unlock the secrets of Iranian geometric patterns by delving into their design process and uncovering the underlying principles. Leveraging the power of computational tools and modern technology, particularly in computer science, we aim to breathe new life into this ancient art form. By gaining a deeper understanding of the design process and utilizing transferable computational knowledge, we can develop software tools for algorithmically

modelling these patterns, ensuring their survival for future generations.

Iranian geometric patterns can be broadly categorized into two-dimensional and three-dimensional layers. This research focuses on digitally modeling specific two-dimensional Iranian geometric patterns. While researchers have explored various approaches to generating these patterns, our work seeks to provide a comprehensive and algorithmic framework. Using the Grasshopper program, we employ geometric grammar and algorithmic design to model these patterns. Subsequently, we create Python-based plug-ins for Grasshopper, each tailored to one of the selected patterns, including the ‘star,’ ‘Shamseh,’ ‘Rosette,’ and four prominent Girih patterns in Iranian architecture: ‘Hasht-Chahar-Lengeh’, ‘Hasht-Panj’, ‘Hasht-Bazoubandi’, and ‘Chahar-Lengeh-Almas Tarash’.

Our approach facilitates the faithful reproduction of existing patterns and enables the generation of entirely new designs by manipulating the patterns’ constant and variable parameters. This research has broad implications: Design students can understand geometric pattern principles more deeply, and designers can swiftly generate diverse variations for creative projects.

Studying fundamental geometric pattern principles ultimately opens new avenues for artistic expression, research exploration, and perpetuating this cherished cultural heritage.