Computational Manifestation of the Sri Yantra: Bridging Hindu Sacred Symbolism and Contemporary Architectural Design

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Abstract. The Sri Yantra (Sri Cakra) is one of the most intensely interpreted figures in Hindu sacred geometry, operating simultaneously as a metaphysical diagram, ritual instrument, and latent spatial order. While many authors have attempted to "solve" its geometry—ranging from analytic constructions by Huet and Maxwell to Marma Stana–based and image-derived approaches—these efforts largely remain confined to two-dimensional representation. This paper proposes a computational framework in Rhino–Grasshopper that reconceives the Sri Yantra not as a static diagram but as a parametric and architectural system. The framework reconstructs three geometric families of the Sri Yantra: (1) an analytic Huet–Maxwell reconstruction, (2) a Marma Stana–driven integer-ratio model based on 48 vertical divisions of the enclosing circle, and (3) a golden-ratio / golden-triangle variant aligned with architectural proportion theories. These 2D geometries are systematically translated into three-dimensional architectural assemblies through controlled parameters of selection, repetition, and independent height assignment. The primary findings demonstrate that the under-determined nature of the Sri Yantra enables the generation of stable yet diverse spatial families; that Marma Sthana–based integer scaffolding produces the most architecturally robust and symbolically legible outcomes; and that selective activation of yantric elements allows ritual hierarchies to be mapped onto architectural gradients of light, enclosure, and movement. The resulting morphological atlas positions the Sri Yantra as a metaphysical algorithm capable of supporting contemporary, human-centred computational architectural design while remaining grounded in sacred symbolism and cultural meaning.

Keywords. Sri Yantra, Sacred Geometry, Parametric Modelling, Algorithmic Architecture, Hindu Symbolism, Digital Fabrication, Cultural Heritage

HUMANISTIC COMPUTATION AND INTELLIGENCE, Proceedings of the 31st International Conference of the Association for Computer-Aided Architectural Design Research in Asia (CAADRIA) 2026, Volume 3, 51-60.
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1. Introduction

The Sri Yantra (Sri Cakra) sits at a unique crossroads: it is simultaneously a Cosmo gram, a ritual device traced on floors and altars, and an abstract geometric figure that has long intrigued mathematicians, philosophers, and computer scientists. Over recent decades, several geometric "solutions" have been proposed—from analytic constructions by Huet and Kulaichev, through Maxwell's reconstructions, to Marma Stana–based models and image-derived techniques. However, most of these studies remain limited to the resolution of a precise two-dimensional diagram. For architects and computational designers, a different question becomes critical: if the Sri Yantra is understood not only as an image but as a generative rule system, what architectural possibilities emerge from its internal logic? This question shifts attention from correctness of geometry to productive ambiguity, from diagram as object to diagram as spatial generator. In response, this paper develops a computational framework in Rhino–Grasshopper that reconstructs three distinct geometric families of the Sri Yantra and systematically translates them into three-dimensional architectural typologies. The work is intentionally double-sided: it tests the precision and flexibility of parametric scripting, while also examining how sacred symbolism can be spatialised without reducing it to mere formal abstraction. The contribution lies both in the technical workflow and in demonstrating how culturally embedded diagrams can operate as metaphysical algorithms within contemporary architectural practice.

Translating the Sri Yantra into architectural systems is not intended as an act of formal appropriation, but as a continuation of its historical role as a spatial, ritual, and bodily organiser. Across Hindu practice, the Sri Yantra has always operated beyond representation—structuring movement, orientation, and experiential hierarchy. By rendering its under-determined geometry computationally explicit, this framework allows contemporary architectural design to engage with cultural diagrams as living, adaptable systems rather than frozen icons. The advantage of this translation lies in enabling symbolic continuity while supporting variation, contextual tuning, and human-centred spatial interpretation through parametric means.

2. Literature Review

2.1. SRI YANTRA AS SACRED DIAGRAM AND SPATIAL ARCHETYPE

The Sri Yantra (Figure 1) is traditionally understood as a diagram of Sri Lalita Tripurasundari and the cosmic order she inhabits. Its nine interpenetrating triangles—four upward-facing (Śiva) and five downward-facing (Sakti)—are enclosed by lotus petals, concentric rings, and a square bhupura with gateways, forming a sequence of ritual avaraṇas. Although often represented as a flat diagram, the Sri Yantra has always been spatial in practice. It is inscribed on floors, carved into stone, embedded within temple layouts, and activated through circumambulatory movement. Even as linework, it implicitly organises body, orientation, and progression, suggesting architectural behaviour rather than pictorial representation.

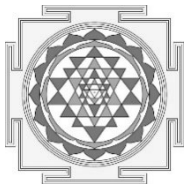


Figure 1: Historical representations of Sri Yantra

2.2. GEOMETRIC RECONSTRUCTIONS: ANALYTIC AND INTEGER MODELS

Huet's analytic approach treats the Sri Yantra as a system of intersecting lines constrained by non-linear equations, while Maxwell demonstrates that the diagram is under-determined, allowing multiple valid configurations. This insight is crucial: it suggests that the Sri Yantra is not a single resolved figure but a family of related geometries. Santhi et al. (2012) generate Sri Yantra images algorithmically, focusing on reproducible 2D outputs. More recently, a Marma Stana–based model anchors triangle vertices to bodily energy points along a vertical axis divided into 48 integer levels. This approach introduces symbolic embodiment into the geometry, allowing integer ratios to stabilise the system while retaining cultural legibility.

2.3. PROPORTION THEORY, GOLDEN RATIOS, AND TEMPLE GEOMETRY

Table 1: Summary of key geometric approaches—analytic, Marma Sthana, image-based, golden-ratio—with their main assumptions, strengths, and limitations. (Table summarises representative approaches rather than an exhaustive taxonomy.)

Approach	**Construction logic**	**Strengths**	**Limitations**
Analytic (Huet / Maxwell)	Solves line–line intersections via non-linear constraints to fix triangle vertices and overlaps.	Very precise; good baseline for checking intersections and sensitivities.	Under-determined; numerically fragile; weak link to body/ritual scales.
Marma Stana (48 divisions)	Uses a 48-step vertical axis (d_0 = 360) with triangle apices/bases anchored to Marma Stana levels.	Integer ratios; easy to script; symbolically legible; backbone of this work.	Depends on one interpretive scheme; not a unique "canonical" solution.
Image-based generation	Algorithmic drawing from target images using rules, thresholds, and iterative refinement.	Fast 2D reproduction; useful for visual validation and graphic outputs.	Raster/illustrative; no guaranteed exact geometry; weak 3D translation.
Golden-ratio / φ-based	Constrains radii, slopes, and grids using φ and golden triangles, linked to proportion theory.	Bridges yantra with architectural proportion and temple overlays.	Historical link speculative; φ-tuning can drift from canonical layouts.

Proportion theory in architecture has long mediated between perception, structure, and cultural meaning. Singh (2018) highlights the tension between fixed proportional canons and adaptable systems. Within Sri Yantra discourse, some authors align its structure with golden ratios or golden triangles, linking the diagram to temple planning traditions and cosmological grids. While such links are often speculative, they open a productive space for architectural reinterpretation—treating the Sri Yantra not as a closed symbol but as an energetic topology that can be sampled, scaled, and spatially reconfigured.

2.4. GAPS FOR ARCHITECTURAL AND PARAMETRIC PRACTICE

From a computational design perspective, three critical gaps emerge:

- Diagram–space gap: Most reconstructions stop at 2D representation, without translation into inhabitable space. In Western contemporary practice, diagrammatic and symbolic drawings such as Daniel Libeskind's Micromegas series have functioned not as literal forms but as generative devices through which spatial experience, light, and narrative emerge beyond the originating graphic (Libeskind, 1983)
- Parametric family gap: The under-determined nature of the Sri Yantra is rarely exploited as a generative design family.
- Humanistic computation gap: Few studies integrate symbolic meaning, bodily experience, and spatial perception with algorithmic rigor, addressing how symbolic diagrams can operate as generative systems producing experiential and cultural meaning rather than purely optimised form (Oxman, 2017). This project situates itself in these gaps: using Grasshopper and scripting to construct parametric families of Sri Yantra geometries, giving them architectural thickness, and doing so in a way that keeps the figure's symbolic and ritual roles in view rather than treating it as a purely abstract dataset.

3. Methodology

3.1. OVERALL WORKFLOW

- Module 1 – Core 2D generator: Implements three geometric families of the Sri Yantra—analytic (Huet–Maxwell), Marma Stana 48-division, and a golden-ratio variant. In the Marma family, geometry is scripted in Python on a reference diameter
- Module 2 – Selector and height pattern: Receives triangles with metadata (names, centroids, Bindu), filters them (e.g., by planetary name), applies rotation, mirroring and optional radial copies, and assigns heights from a user-defined list or pattern.
- Module 3 – Petals, rings, and bhupura to 3D: Uses the 2D petals, rings and Trailokya-mohaṇa bhupura loops and extrudes each layer to independent heights in +Z, producing a full 3D Sri Yantra assembly.

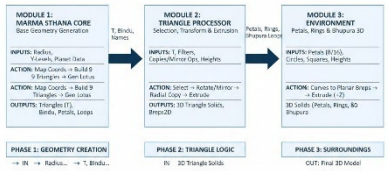


Figure 2: Block diagram of Module 1, Module 2, and Module 3.

3.2. MODULE 1 – MARMA STANA CORE WITH LOTUS AND TRAILOKYA-MOHAṆA

3.2.1. Integer-based vertical framework

The Marma Stana family forms the backbone of the project. The enclosing circle is aligned with a vertical axis of length $d_0 = 360$ units, following the Marma-based Sri Cakra model. Key y-levels for the nine planetary triangles (Ravi, Chandra, Kuja, Budha, Guru, Shukra, Shani, Rahu, Ketu) and the Bindu are encoded as constants taken from the paper.

A simple mapping recentres this axis so that $y = d_0/2$ maps to the origin, with a global scale factor:

$$\text{scale} = 2R / d_0$$

so that any chosen R yields a similar Sri Yantra without altering the internal ratios.

3.2.2. Nine triangles as polyline primitives

Each planetary triangle is specified by a name, an "up"/"down" orientation, top and bottom y-levels, and left/right x-extents. "Down" triangles are constructed with their base at the upper level and apex below; "up" triangles invert this relation. The script builds closed polylines pL, pR, pA, pLand computes centroids using Area Mass Properties.

Module 1 outputs (refer Figure 3):

- C – circle tightly enclosing all triangle vertices,
- T – list of nine Polyline triangles,
- Names – triangle names,
- Centres – centroids,
- Bindu – central point in world coordinates.

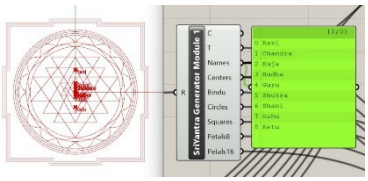


Figure 3: Module 1 output for the Marma Stana family.

3.2.3. Lotus petals, rings, and bhupura

On top of this core, the script constructs:

- Lotus circles: A radius max_r is computed as the maximum distance from centre any triangle vertex. The 8-petal tips sit at

$$R_{lotus8} = max_r\,(1 + \alpha)$$

and the 16-petal tips at

$$R_{lotus16} = R_{lotus8} + \beta \cdot max_r$$

with α and β tuned so petals remain clearly outside the triangles.

- Three outer rings: Radii R_ring1, R_ring2, R_ring3 are spaced outward from R_lotus16 with fixed increments.
- Trailokya-mohaṇa bhupura loops: A base function divides each square side into equal segments and creates a Greek-key-like gateway at the middle third. Offsetting the outer loop inward produces middle and inner tracks with consistent gap and gate depth.
- 8 and 16 petals: Petals are built as smooth, S-curved shapes rather than straight polylines. Two mirrored S-curves meet at common top and bottom points, so neighbouring petals join tangentially, approximated using higher-degree interpolated curves.

The resulting triangles, petals, circles, and bhupura loops form the complete 2D Marma Stana Sri Yantra that feeds into Module 3.

3.3. MODULE 2 – TRIANGLE SELECTOR, TRANSFORMS, AND HEIGHT PATTERNS

Module 2 organises the triangles into parametric patterns that can be spatialised.

3.3.1. Selection by name and optional filters

Triangles T, names Names, and centroids Centres come directly from Module 1. Two basic modes are offered:

- Use All = True: all nine triangles are included.
- Use All = False: a lowercase whitelist is built from Name Filter (e.g., "Ravi", "Ketu", "Shani"), and only matching triangles are selected.

This enables patterns such as "Śiva only," "one planet repeated radially," or custom planetary subsets.

3.3.2. Rotation, mirroring, and radial copies

For each selected triangle, the script can:

- apply a global rotation Angle Offset about the bindu,
- mirror across the Y-axis (MirrorX) and/or X-axis (MirrorY),
- generate Copies number of radial instances by evenly rotating around the centre.

Transforms are implemented explicitly with trigonometric expressions, keeping control over angles and signs. A deliberate "pass-through" case ensures that when Copies = 1, Angle Offset = 0, and no mirrors are active, the triangles are used exactly as defined in Module 1, without resampling. Refer Figure 4

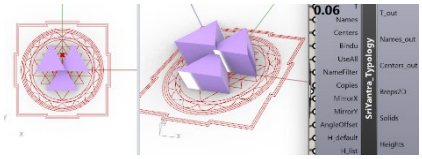


Figure 4: Module 2 examples—single-planet emphasis and multi-copy configurations.

3.3.3. Height patterns and extrusion

Module 2 also assigns height and performs extrusion:

- A base height H_default is used if no list is provided.
- If H_list is present, it is treated as a repeating pattern: each instance uses H_list[idx % len(H_list)]. Designers can script rhythms such as 0.2,0.4,0.1,0.3around the circle.
- Each polyline is extruded along +Z with height |h|, capping planar holes to form closed Breps.

Outputs are:

- T_out, Names_out, Centers_out – transformed 2D triangles,
- Breps2D – planar triangle surfaces,
- Solids – extruded 3D volumes,
- Heights – assigned heights per instance.

3.4. MODULE 3 – PETALS, RINGS, AND BHUPURA FROM 2D TO 3D

Module 3 takes the 2D petals, circles, and bhupura loops from Module 1 and applies a common 3D logic (Refer Figure 5):

- Petals: Each curve (or GH_Curve wrapper) is converted into a planar Brep (Pet8Surf, Pet16Surf) and extruded to heights H_p8 and H_p16 (Pet8Sol, Pet16Sol).
- Rings: The three ring circles are turned into planar discs (RingSurf) and extruded by

H_r1, H_r2, H_r3 (Ring Sol).

- Bhupura loops: Whether supplied as polylines or Breps, the outer boundary is extracted, converted to a planar Brep (SqSurf), and extruded to H_sq1, H_sq2, H_sq3 (SqSol).

Special handling unwraps Grasshopper geometry types and consistently forces extrusions in the +Z direction to avoid mirrored or inverted profiles.

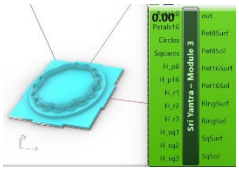


Figure 5: 3D view showing triangles, petals, rings, and bhupura with independent heights.

3.5. OTHER FAMILIES: ANALYTIC AND GOLDEN-RATIO RECONSTRUCTIONS

Alongside the Marma Stana family, two additional reconstructions are implemented:

- Analytic family: Inspired by Huet–Maxwell, triangle vertices are solved numerically to satisfy intersection constraints, generating a more "exact" but algebraically heavy configuration.
- Golden-ratio family: Key radii and triangle slopes are constrained by φ-based ratios and aligned with temple-plan grids, echoing broader proportion theory.

All three families share the same data structure (named triangle polylines with associated centres and Bindu), allowing them to be fed into the same Modules 2 and 3. In this paper, the Marma family is discussed in depth, while the analytic and golden-ratio families primarily appear in comparative overlays. (Final Model refer Figure 6)

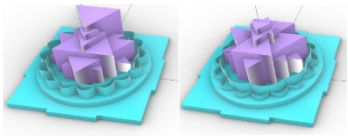


Figure 6: Final Composite model and Parametric Variations.

4. Results And Discussion

4.1. MORPHOLOGICAL ATLAS OF 2D SRI YANTRA VARIATIONS

Across the three geometric families, the project compiles an atlas of 2D Sri Yantra diagrams. The analytic family prioritises exact intersections, giving taut but fragile linework. The Marma Stana family is more forgiving: its integer scaffold stabilises triangle positions and keeps the figure visually "bodied." The golden-ratio family produces slightly stretched or compressed triangles, sometimes recalling temple plans with emphasised axes.

The atlas shows Sri Yantra as a neighbourhood of related diagrams rather than a

single figure. Small shifts in slopes or y-levels redistribute visual weight along particular directions, enabling deliberate emphasis on diagonals, centre, or periphery.

4.2. 3D TYPOLOGIES: PAVILIONS, SANCTA, AND FAÇADES

Through Modules 2 and 3, these diagrams become three main 3D typologies:

- Pavilions: Triangles act as ribs or columns, petals form light roof shells, and rings become benches or stepped plinths; the bhupura reads as a layered perimeter threshold.
- Sancta: Inward-pointing triangles encircle the Bindu; ring heights tune how "deep" or open the core feels.
- Façades: Partial yantra patches are projected onto elevations; triangle heights control shading depth, petals become perforated panels.

Height patterns via H_list make these typologies highly adjustable—Sakti vs. Śiva emphasis, soft outer rings with strong inner ones, or gradual gradients encoding programme and privacy.

4.3. ENVIRONMENTAL AND EXPERIENTIAL OBSERVATIONS

Preliminary readings suggest:

- Light: Raised triangles and petals around the Bindu create a soft central glow in roofs; on façades, alternating heights generate fine-grained shadow rhythms.
- Airflow: Differentiated ring heights form bands of openness and resistance, acting as layered filters for wind and background ventilation.
- Acoustics: Taller central elements with low peripheries gently focus sound towards the Bindu (observed qualitatively).

Though not yet backed by full simulations, these tendencies show that once the yantra has thickness, its layered logic operates as environmental control as well as symbolism.

The evaluation in this study is qualitative and exploratory, relying on comparative spatial reading across parametric variations rather than quantitative simulation. Architectural performance is assessed through visual inspection, sectional logic, and experiential inference related to light, enclosure, movement, and ritual hierarchy. This approach aligns with early-stage computational design research where symbolic and spatial legibility precede optimisation.

4.4. SYMBOLIC LEGIBILITY AND HUMAN-CENTRED COMPUTATION

A persistent question is how recognisable the Sri Yantra should remain once it becomes architecture. In some configurations—especially in plan or roof view—the yantra is still legible; in others, it dissolves into traces such as a stepped bhupura-like threshold, triangular apertures, or a petal rhythm along a façade. The project therefore treats the Sri Yantra as a metaphysical algorithm rather than a fixed icon, using Grasshopper scripts to "listen" to the diagram by selectively activating a single planetary triangle,

exaggerating the bhupura while keeping inner triangles low, or translating ritual inner and outer āvaraṇas into gradients of height, light, and acoustic intimacy. Computation here is kept close to lived experience and ritual narrative, not merely to geometric optimisation.

5. Conclusion

This paper has outlined a Rhino–Grasshopper framework that manifests the Sri Yantra in architectural terms through three linked modules and multiple geometric families. By working with analytic, Marma Stana integer, and golden-ratio reconstructions, the Sri Yantra is treated as an under-determined system rather than a single resolved diagram. The Marma Stana family demonstrates how symbolic points and integer alignments can be encoded into robust parametric scripts, while subsequent modules give triangles, petals, rings, and bhupura loops architectural height and environmental behaviour. The resulting atlas of 2D and 3D variants supports reading the Sri Yantra as a metaphysical algorithm—a layered ruleset that can be instantiated in multiple ways, balancing symbolic clarity and spatial invention. This points toward a broader mode of computational design in which traditional diagrams function as living, parameterised systems, and future work will extend the framework through quantitative environmental analysis, closer links to temple plans and sections, and participatory "tuning" of yantra parameters in communal or ritual settings.

Acknowledgements

This work is carried out under the thesis project titled 'STREE YUGA AARANI' as a part of the requirement of final year thesis at the School of Architecture, REVA University Bandalore, under the guidance of Pradipta Roy Choudhury. Our sincere gratitude goes out to Mr. Manik Chand Jangid whose constant support, encouragement, and belief in our work formed the foundation of this research journey.

Attribution Statement

ChatGPT (OpenAI, 2025) was used for structural composition of the manuscript and refinement of language flow. Grammarly (Grammarly Inc., 2025) was used to correct grammar and syntax.

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