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Structural adaptation of batik parang principles into typographic anatomy and variable font parameters

James David Lumenta, Yana Erlyana*
Visual Communication Design Department, Faculty of Technology and Design, Universitas Bunda Mulia
Jalan Lodan Raya No 2, Jakarta Utara, DKI Jakarta 14430, Indonesia
***Correspondence author:** *yerlyana@bundamulia.ac.id*

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Abstract.
This practice-based design study investigates the structural adaptation of the Batik Parang motif into a variable typeface system. The research examines the visual syntax of Batik Parang, characterized by 45° diagonal rhythms, modular continuity, and compositional hierarchy. By using Panofsky's iconographical analysis and Gestalt perceptual principles to translate traditional visual rules into digital glyph anatomy and OpenType parametric axes. Through an iterative prototyping workflow encompassing grid extraction, stroke modulation, and counterform management, the study developed a functional variable typeface featuring four custom and registered design axes: Motion (slnt), Hierarchy (wght), Continuity (CONT), and Contrast (opsz). Interpolation stability testing demonstrated seamless, artifact-free transitions across coordinate ranges while maintaining x-height consistency and counterform openness. A two-round expert validation with professional type designers and visual communication academics confirmed satisfactory character legibility, perceptual balance, and cultural recognizability without relying on superficial surface ornamentation. This research provides a reproducible parametric model for culturally grounded variable typography in contemporary digital environments.
Keywords: Variable fonts, Typeface design, Batik Parang, Cultural typography, Structural adaptation

Introduction

Batik is one of Indonesia's most significant cultural heritages, embedding aesthetic, symbolic, and philosophical values within intricate ornamental systems (Nan Quddus et al., 2025). Beyond functioning as decorative surface design, batik motifs represent complex cultural narratives, social structures, and localized wisdom. Each motif carries historically determined meanings related to identity, spiritual resilience, and social hierarchy, serving as a non-verbal visual communication system (Budi et al., 2022; Rosanto, 2016). Among these, Batik Parang possesses notably distinct visual and philosophical characteristics (Nan Quddus et al., 2025). Originating within the royal courts of the Javanese palace (keraton), Batik Parang was traditionally associated with nobility, leadership, and perseverance (Pandanwangi et al., 2025). In structural reality, its visual abstraction is derived from the mêlinjo or so fruit (Gnetum gnemon Linn) (Budi et al., 2025). Driven by the Javanese linguistic idiom tumpang suh (symbolizing chaos), the neat, geometric, and diagonal arrangement of this abstracted fruit at a 45-degree angle visually functions as a powerful symbol of sovereign authority and spiritual strength required to organize and manage chaotic or adverse conditions (Bagu et al., 2024; Budi et al., 2022, 2025).

Despite its rich structural logic and philosophical depth, the utilization of *Batik Parang* within modern design practices remains predominantly decorative (Nan Quddus et al., 2025; Rosanto, 2016). Most contemporary applications reduce the motif to a superficial ornament applied to packaging,

fashion apparel, merchandise, or digital backgrounds without integrating its underlying visual rules into the core design system itself (Nan Quddus et al., 2025; Pandanwangi et al., 2025). This creates a significant gap between traditional visual culture and contemporary design innovation; ethnic motifs are frequently detached from their structural potential and symbolic meaning. Within the field of Visual Communication Design, this issue is critical (Nursari et al., 2025). Contemporary design practices increasingly require sophisticated approaches capable of preserving local cultural identity while simultaneously adapting to rapidly evolving digital environments and technological frameworks (Islam, 2025; Sulistyo & Pratama Widiarsa, 2026). This dynamic context prompts an inquiry into vernacular visual cultures, where traditional expressions and localized wisdom can transform rigid, globalized layouts into unique repositories of cultural and spatial identity (Ayoobi et al., 2024; Raden & Qeis, 2023). Furthermore, because typography operates as the direct visual manifestation of a brand's overall image where the distinctive characteristics of individual characters reflect core narrative values (Cheng, 2020), there is an evolving demand within Indonesia's digital economy for comprehensive, uncluttered, and visually engaging resources that can demonstrate the structured application of letterforms (Somai et al., 2025) (Erlyana et al., 2023). This exploration remains deeply tied to contemporary efforts toward cultural revitalization, where type design can actively function as an experimental strategy to affirm cultural identity and bridge local tradition with global aesthetics within the public space (Yunanto & Kristianto, 2025). This intervention responds profoundly to how the user experience with products, services, and artifacts mediates human interactions across interfaces, establishing that typography plays a foundational role in the functionality and personality of digital systems through signs and symbols that convey essential feedback, direction, and informational guidance (Dick & Woloszyn, 2023).

Concurrently, the role of typography in digital media has evolved from a static medium for textual legibility into an adaptive visual language capable of expressing identity, motion, and responsive narrative (Poon, 2021). Driven by rapid technological innovations, type design has undergone extensive computational shifts to enhance layout efficiency in digital spaces (Luthfiasari et al., 2023; Woloszyn & Gonçalves, 2022). The advent of variable font technology (OpenType Font Variations) has transformed typographic workflows by enabling multiple visual attributes, such as weight, width, slant, and custom structural parameters, to coexist within a single, dynamic font file (Go & Mothelsang, 2024; Poon, 2021). In responsive digital environments (websites, mobile user interfaces, and motion graphics), variable typography has become essential, allowing letterforms to adapt fluidly to varying viewport dimensions, user interactions, and spatial constraints while maintaining optical optimization and structural consistency (Go & Mothelsang, 2024; Woloszyn & Gonçalves, 2022). This technological advancement opens a direct pathway for reinterpreting the visual mechanics of Batik Parang (Nan Quddus et al., 2025). The motif's repetitive diagonal rhythm and fluid continuity align naturally with the interpolation principles of variable typography.

This technological advancement opens a direct pathway for reinterpreting the visual mechanics of *Batik Parang (Nan Quddus et al., 2025)*. The motif's repetitive diagonal rhythm and fluid continuity align naturally with the interpolation principles of variable typography. Rather than relying on static typefaces that risk cultural flattening, variable fonts introduce structural flexibility where traditional cultural inflections can break the rigidity of standard Roman types through localized expression (Raden & Qeis, 2023; Woloszyn & Gonçalves, 2022). When mapped alongside practical product interfaces and industrial applications, typography assumes a critical, structural role in upholding brand parameters rather than acting as secondary embellishment (Erlyana et al., 2023). A structural transformation can translate *Batik Parang*'s visual philosophy into responsive typographic behaviors, converting concepts of continuity and momentum into dynamic axes. While globalization and digital standardization risk homogenizing contemporary digital interfaces, culturally grounded variable typography offers a strategic tool to recontextualize regional visual languages within global digital ecosystems (Poon, 2021).

Previous scholarly attempts to integrate Indonesian cultural heritage into typographic design have primarily expanded along two distinct trajectories, yet both present significant limitations. The

first trajectory focuses on the direct translation of ethnic ornaments into static typographic forms, such as the "Garuda Batik" typeface (Lumenta, 2015) and the "Mo' Ramo'" batik font (Islam, 2025). While successfully establishing methods for mapping traditional Indonesian motifs onto the Latin alphabet, these approaches treat cultural motifs as static, surface-level decorations, resulting in over-ornamented character skeletons that disrupt counterform openness and functional legibility on digital screens (Poon, 2021). The second trajectory explores software engineering optimization and responsive font adjustments across interactive layout dimensions (Go & Mothelsang, 2024; Woloszyn & Gonçalves, 2022). While effectively resolving the algorithmic demands of contemporary interfaces, these studies remain decoupled from cultural recontextualization, reflecting a broader trend toward global visual homogenization and stripping typography of regional identity and localized narrative (Poon, 2021). To clarify the scholarly position of this study, Table 1 provides a systematic comparison between the proposed variable typeface design model and existing culturally grounded typographic approaches in Indonesian literature.

Table 1. Systematic Comparison of Culturally Grounded Indonesian Typefaces

Typeface / Project	Design Approach	Structural Adaptation	Digital Functionality	Legibility & Screen Performance
Garuda Batik (Lumenta, 2015)	Literal ornamentation and direct vector mapping.	Static translation of physical batik ornaments onto character stroke skeletons.	Static font file formats (TTF/OTF); no responsive behaviors.	Low readability; complex ornamental lines cause visual crowding on low-resolution screen viewports.
Mo' Ramo' (Islam, 2025)	Promotional, local visual styling and background patterns.	Direct replication of regional background batik patterns onto display letterforms.	Static font file formats (TTF/OTF); fixed stylistic sets.	Counterforms prone to closing at small display sizes; restricted to large headings/promotional signage.
Batik Parang Variable (Proposed Study)	Systemic behavioral transformation & parameterization.	Adaptation of rhythmic continuity, 45-degree angles, and tumpang suh logic into variable axes.	Dynamic OpenType Variations; 4 interactive axes (slnt, wght, CONT, opsz) on a single file.	High readability; Gestalt-stabilized anatomy maintaining open counters even at 72 dpi screen resolution.

Source: Researcher's own analysis (2026)

As established in Table 1, there is an unresolved critical omission in current design literature. Previous studies fail to bridge traditional visual semantics with dynamic font engineering, neglecting the potential of utilizing cultural principles as structural parameters that satisfy distinct functional needs across contemporary digital media. To address this compounding gap, this study shifts the paradigm from literal decorative replication to systemic behavioral transformation. By intersecting the structural syntax of Batik Parang with OpenType variable technology, this research explores how traditional Javanese visual principles can structurally govern multi-axis interpolation systems, thereby presenting a novel, reproducible model for culturally grounded, highly responsive typographic design.

Methods

Research Design

This study employs a descriptive qualitative approach within the discipline of Visual Communication Design. Qualitative design research is highly appropriate for visual communication studies because it

enables a deeper exploration of meaning, symbolism, visual perception, and cultural interpretation embedded within design artifacts. The research specifically focuses on transforming *Batik Parang* visual structures into a contemporary variable typeface system through iterative visual experimentation and typographic analysis. To systematically map the transition of traditional patterns into digital glyphs, this study utilizes Panofsky's iconographical analysis framework, which decodes the visual material through three consecutive layers: pre-iconographical description (primary forms), iconographical analysis (conventional syntax), and iconological interpretation (intrinsic cultural meaning) (Budi et al., 2022).

The study adopts Design Thinking as the primary methodological framework to orchestrate the practice-based research process. This framework is operationalized through five distinct, cyclical phases that bridge cultural interpretation with dynamic font engineering (Erlyana et al., 2023):

1. **Empathize and Define:** These phases leverage visual archaeology through Panofsky's iconographical analysis framework to systematically isolate the cross-directional, 45-degree angular layout, and the repetitive rows of mêlinjo or so fruits embedded in classical Javanese textiles (Budi et al., 2022, 2025). Panofsky's framework decodes the visual material through three layers: pre-iconographical description (primary geometric forms), iconographical analysis (conventional syntactic rules), and iconological interpretation (intrinsic cultural and philosophical meaning).
2. **Ideate:** This phase applies Gestalt perception principles specifically similarity, continuity, and figure-ground balance to abstract the fluid, curvilinear traditional forms of Batik Parang into structured, digital font contexts (Dick & Woloszyn, 2023).
3. **Prototype and Test:** These phases represent the generative core of font engineering, where the abstracted visual layout is translated into a multi-axis design space using Glyphs 3 (Woloszyn & Gonçalves, 2022). Prototyping is governed by three sequential readiness criteria that each design iteration must satisfy before advancing: First, Structural Fidelity, requiring each glyph to reflect at least two of the five core Batik Parang principles (diagonal directionality, rhythmic repetition, modular continuity, hierarchical contrast, or figure-ground balance) verified via vector outline overlay comparison. Second, Typographic Functionality, requiring x-height consistency of ±5% across the character set and open counterforms that do not close at a simulated screen resolution of 72 dpi. Third, Interpolation Stability, requiring all axes to produce continuous, distortion-free transitions across their full ranges.

By structuring the execution model around these programmatic steps, the research ensures that the design practice outlives the software context per se (Cheng, 2020). Within contemporary design research, iterative methodologies are considered essential for developing adaptive and user-centered visual systems capable of responding to digital communication environments (Cheng, 2020).

This research positions *Batik Parang* as a structural visual system rather than merely a decorative motif because contemporary cultural design approaches emphasize the importance of transforming underlying visual logic instead of reproducing surface ornamentation. Consequently, the methodological process focuses on identifying continuity, repetition, directional rhythm, hierarchy, and symbolic movement within *Batik Parang* compositions before translating them into typographic anatomy and variable font behaviors.

Data Collection

Data collection was conducted using a triangulated qualitative approach to ensure conceptual depth, visual consistency, and methodological validity by combining literature studies (on Batik Parang historical semantics, typographic anatomy, and variable font technology), visual observation, and typographic case studies (Cheng, 2020; Go & Mothelsang, 2024; Woloszyn & Gonçalves, 2022). Triangulation was selected because contemporary design research requires the integration of theoretical, visual, and technological perspectives to produce comprehensive design outcomes. The data sources were:

Literature Study

The literature study was conducted systematically to establish the conceptual and theoretical foundations of the research through books, peer-reviewed journals, and typography publications (Erlyana et al., 2023).

1. The first literature category focused on *Batik Parang* and cultural visual studies to understand its historical development, symbolic meanings, and structural composition within Indonesian visual culture (Bagu et al., 2024; Budi et al., 2025). The analysis prioritized directional rhythm, continuity, repetition, and symbolic hierarchy because these characteristics are visually dominant within *Batik Parang* structures (Budi et al., 2022).
2. The second literature category focused on typography and typeface design studies including letter anatomy, readability, spacing systems, typographic hierarchy, and visual rhythm (Cheng, 2020). Typography functions not only as textual communication but also as a visual system capable of conveying identity, brand parameters, and structured layouts across user interfaces (Erlyana et al., 2023).
3. The third literature category examined variable font technology, parametric attributes, and responsive typography configurations within digital media environments (Woloszyn & Gonçalves, 2022). Variable fonts allow multiple visual variations within a single font file while maintaining structural consistency, optical optimization, and lower cognitive load across e-commerce and interactive digital layouts (Go & Mothelsang, 2024; Woloszyn & Gonçalves, 2022).

Visual Observation

Visual observation focused on structural analysis rather than decorative appreciation, mapping the formal geometric attributes of several Batik Parang variations. To ensure structural diversity across scales and ornamental complexity, visual data samples were selected using purposive sampling guided by three criteria: (1) representativeness of the three major Parang sub-variants Parang Barong (large-scale, high-contrast diagonal), Parang Kusumo (floral-inflected continuity), and Parang Klitik (small-scale fine repetition); (2) source reliability, prioritizing archival-quality specimens from museum collections (Museum Batik Yogyakarta and Sonobudoyo Museum) and academic monographs over commercial reproductions; and (3) visual legibility and high resolution to permit structural tracing and vector outline extraction. A minimum of three high-resolution specimens per sub-variant were selected, yielding a primary corpus of nine visual documents in total. These samples were cross-checked against academic references to verify structural authenticity before vector extraction.

Typographic Case Studies

The research analyzed several contemporary variable typefaces and culturally inspired typography projects as comparative references to identify practical design strategies and technological implementation methods (Woloszyn & Gonçalves, 2022). The typographic and structural analysis examined how visual identity can be seamlessly integrated into typeface systems without compromising functional communication, spacing efficiency, and cross-platform reading comfort (Cheng, 2020; Go & Mothelsang, 2024). These comparative studies helped determine strategies for integrating *Batik Parang* principles into typographic anatomy while maintaining structural coherence and legibility (Nursari et al., 2025).

Data Analysis

The collected data were analyzed through a multi-layered interpretative framework integrating cultural analysis, typographic analysis, Gestalt-based perceptual analysis, and technological analysis:

Cultural Visual Analysis

This stage analyzed symbolic meanings, directional continuity, repetitive rhythm, hierarchical movement, and structural relationships embedded within *Batik Parang* motifs (Bagu et al., 2024; Budi et al., 2025). The analysis emphasized transformable visual logic rather than literal ornamental

replication because contemporary cultural transformation approaches prioritize systemic, conceptual reinterpretation over surface decoration (Nan Quddus et al., 2025).

Typographic Anatomy Analysis

This stage examined how *Batik Parang* structures influenced stroke systems, counterforms, terminals, baseline stability, spacing relationships, and character recognition within the typeface (Cheng, 2020). Typographic anatomy analysis was necessary to maintain legibility and structural consistency despite expressive cultural transformations (Nursari et al., 2025).

Gestalt-Based Perceptual Analysis

Gestalt principles including similarity, continuity, closure, proximity, and figure-ground relationships were used to evaluate how audiences perceive the typeface as a unified visual system (Dick & Woloszyn, 2023). Perceptual analysis was critical because the balance between positive strokes and negative counterforms strongly influences reading comfort, prevents visual crowding, and supports the cognitive processing of text blocks on digital screens (Dick & Woloszyn, 2023; Go & Mothelsang, 2024).

Variable System Analysis

This stage evaluated interpolation smoothness, axis responsiveness, dynamic transformation quality, and adaptive behavior within the variable font design space (Woloszyn & Gonçalves, 2022). Variable system analysis ensured that the typeface maintained visual coherence and precise computational transitions while shifting across defined structural coordinates in digital media environments (Woloszyn & Gonçalves, 2022).

Data Validation

To ensure credibility and reliability, the research applied triangulation and iterative validation throughout the design process. Data obtained from literature studies, visual observations, and case studies were cross-validated to maintain conceptual consistency and analytical reliability (Syamala et al., 2025). The research combined cultural analysis, typographic anatomy frameworks, Gestalt perception theory, and software engineering experimentation to produce multidimensional interpretations regarding the relationship between *Batik Parang* syntax and variable typography systems. The typeface prototypes underwent multiple cycles of revision, testing, and redesign to evaluate legibility, structural continuity, visual balance, and adaptive interpolation quality (Woloszyn & Gonçalves, 2022). Evaluation was conducted using two complementary instruments.

The first was a structured visual assessment checklist developed by the researcher, organized around four evaluative dimensions drawn from the study's analytical framework: (a) cultural fidelity, the degree to which Batik Parang's diagonal rhythm, continuity, and hierarchy were perceptible within the letterforms; (b) typographic anatomy integrity, including stroke consistency, counterform openness, x-height stability, and terminal coherence; (c) Gestalt coherence, assessed by evaluating similarity, continuity, figure-ground balance, proximity, and closure across the full character set as a unified system; and (d) variable system performance, measuring interpolation smoothness, axis responsiveness, and absence of structural distortion across the defined design-space coordinates. Each dimension was assessed on a four-point descriptive scale (insufficient / partial / satisfactory / strong), with written commentary required for any dimension rated below satisfactory.

The second instrument was a semi-structured expert feedback form administered to typography practitioners and Visual Communication Design academics, consisting of open-ended prompts targeting legibility perception, cultural recognizability, and functional usability across simulated editorial and screen-based contexts. Expert respondents were asked to evaluate printed specimens at 12 pt, 24 pt, and 48 pt alongside on-screen previews at 1080p resolution, ensuring that assessments covered both display and reading-size performance conditions. Feedback from typography practitioners and Visual Communication Design academics was incorporated into the refinement

process to strengthen the quality, usability, and cultural coherence of the final typographic system (Syamala et al., 2025). Practitioner validation was conducted through a two-round structured review process. In the first round, five expert reviewers, comprising two professional typeface designers with commercial variable font experience, two Visual Communication Design academics specializing in Indonesian cultural design, and one practitioner active in digital interface typography, independently assessed the prototype using the expert feedback form described above. Reviewers were recruited through purposive expert sampling based on a minimum of five years of professional or academic engagement with type design or Indonesian visual culture studies. Feedback was collected in writing and subsequently synthesized through thematic analysis, with recurring observations across three or more reviewers flagged as priority revision items. In the second round, revised prototypes incorporating priority changes were returned to the same panel for confirmatory review, using a focused checklist that targeted only the revised elements. Consensus among at least four of the five reviewers on each revised dimension was treated as the validation threshold for proceeding to the final design specification. This iterative expert validation structure ensured that the final typographic system was grounded in both scholarly rigor and professional practice standards.

Result and Discussion

Analysis of Batik Parang Visual Structure

The visual analysis of *Batik Parang* revealed that the motif possesses a highly systematic compositional structure characterized by repetitive diagonal movement, modular continuity, directional rhythm, and symbolic hierarchy. Unlike ornamental motifs that rely primarily on decorative variation, *Batik Parang* demonstrates a strong structural logic capable of functioning as a dynamic visual system. When examined through Panofsky's iconographical framework, this structural system transcends superficial surface aesthetics by anchoring its formal composition in deeper cultural and functional systems (Budi et al., 2022). The authentic visual expression of this modular textile and traditional pattern layout can be observed directly in Figure 1. The diagonal arrangement repeatedly creates visual momentum that guides the viewer's perception across the composition continuously and rhythmically.

The analysis identified that *Batik Parang*'s diagonal composition generates directional energy through repetitive angular movement. This directional flow visually creates a sensation of progression and continuity because the eye naturally follows the repetitive diagonal rhythm from one motif segment to another. From a visual communication perspective, this continuity establishes a perceptual movement system that can be translated into typographic rhythm and dynamic transformation behavior. In structural reality, this rigorous geometric layout is historically derived from the systematic abstraction of the *mêlinjo* or *so* fruit (*Gnetum gnemon* Linn), rather than random geometric styling (Budi et al., 2025). Driven by the Javanese linguistic idiom *tumpang suh*, which represents a cultural tool to systematically organize potential chaos, the alignment of these elements at a strict 45^0 angle creates a highly governed visual field (Budi et al., 2025).

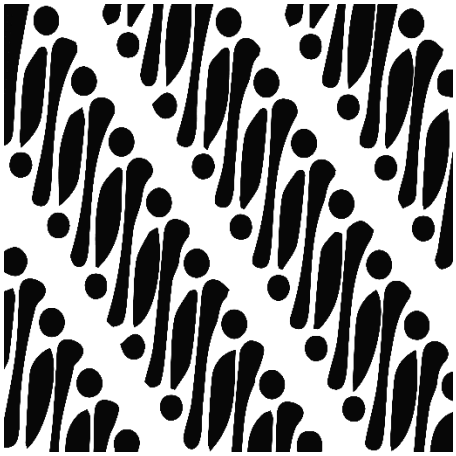

Figure 1. Batik Parang Visual Structure
Source: Re-illustrated by the researcher (2026)

The repetitive diagonal structures also demonstrate hierarchical relationships between dominant and supporting visual forms. Larger diagonal structures function as primary directional guides, while smaller ornamental components reinforce rhythmical consistency and visual cohesion. This multi-layered composition allows a unified coexistence of dominant and secondary components, which maps perfectly to Panofsky's second layer of conventional iconographical syntax where individual visual components must uphold systemic structural rules (Budi et al., 2022). This hierarchy creates a layered visual reading experience in which the audience perceives both macro-level continuity and micro-level ornamental detail simultaneously.

Furthermore, the visual observation process identified the presence of continuous modular repetition throughout *Batik Parang* compositions. The motif demonstrates balance between repetition and variation because repeated visual units maintain consistency while subtle structural differences prevent visual monotony. To map out how this traditional flow works computationally, the explicit geometric lineaments, vector outlines, and compositional grids of the motif are isolated and detailed in Figure 2. This principle became highly relevant within the development of the variable typeface system because variable typography similarly requires consistency across multiple visual states while preserving flexibility and transformation.

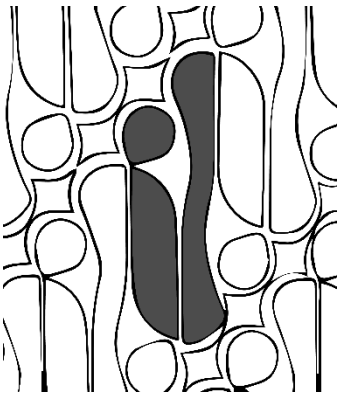

Figure 2. Outline of Batik Parang Motif
Source: Re-illustrated by the researcher (2026)

The structural analysis also revealed strong relationships between positive and negative space within *Batik Parang* arrangements. The spacing between diagonal structures contributes significantly to rhythmical balance and perceptual readability. Rather than functioning as empty space, the negative areas actively support continuity and directional flow. This geometric equilibrium directly reflects the spatial distributions of traditional *mêlinjo* textile alignments, where the surrounding negative space is optimized to maintain visual definition (Budi et al., 2025). This finding became important during the

typographic development stage because spacing systems and counterforms strongly influence readability within typography.

From a Gestalt perspective, *Batik Parang* strongly embodies continuity, similarity, proximity, and figure-ground principles. The repetitive visual units are perceived as interconnected structures rather than isolated ornaments because continuity guides visual perception smoothly throughout the motif composition. Similarity between repeated structures reinforces visual unity, while proximity organizes ornamental relationships into cohesive rhythmic patterns. When integrated into interactive media, these Gestalt attributes directly determine how successfully user interfaces manage visual satisfaction, reducing cognitive fatigue by ensuring that complex elements remain fluidly scannable (Dick & Woloszyn, 2023; Go & Mothelsang, 2024).

The figure-ground relationship within *Batik Parang* also demonstrates visual balance between solid and empty areas. This equilibrium creates perceptual stability despite the dynamic movement generated by the diagonal rhythm. This explicit structural harmony directly answers recent criticisms regarding digital learning and design interfaces, which frequently suffer from cluttered, unappealing layout densities that disrupt user engagement (Syamala et al., 2025). Consequently, the motif successfully combines dynamism and structural balance simultaneously. This characteristic became one of the primary conceptual references during the development of the typeface's variable transformation system.

Additionally, the analysis identified that *Batik Parang* visually communicates symbolic meanings related to resilience, continuity, movement, and persistence. These symbolic concepts are embedded not only through cultural interpretation but also through the structural behavior of the motif itself. This performance aligns with Panofsky's deepest analytical tier, the iconological interpretation, where intrinsic cultural meaning and national identity are carried through the functional mechanics of the artwork rather than literal surface imitation (Budi et al., 2022; Nan Quddus et al., 2025). Therefore, the transformation process within this research emphasized structural reinterpretation rather than decorative imitation because the cultural meaning emerges through directional continuity and rhythmic repetition.

The findings demonstrate that *Batik Parang* possesses structural qualities highly compatible with contemporary variable typography systems. Its rhythmic continuity, modular repetition, and directional flow align naturally with adaptive typographic transformations and responsive digital typography behaviors.

Transformation of Batik Parang into Typeface Anatomy

The transformation process focused on translating *Batik Parang*'s structural logic into typographic anatomy while maintaining functional readability, perceptual clarity, and typographic consistency. Rather than reproducing *Batik* ornamentation literally onto letterforms, the transformation emphasized reinterpretation of directional movement, continuity, rhythm, and hierarchy into anatomical typographic components. The technical workflow and step-by-step extraction of these modular elements into formal typographic attributes are detailed in Figure 3.

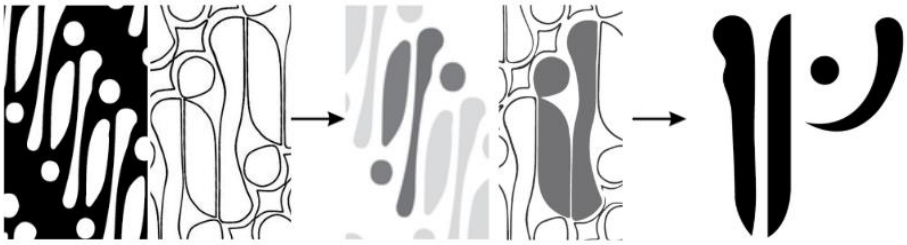

Figure 3. Transformation of Batik Parang into Typeface Anatomy
Source: Re-illustrated by the researcher (2026)

The initial transformation stage involved abstraction of *Batik Parang* structures into simplified visual modules. Complex ornamental forms were reduced into essential directional characteristics including diagonal movement, curvilinear transitions, repetitive rhythm, and hierarchical contrast relationships. This abstraction process was necessary because excessive ornamental detail could negatively affect readability and character recognition within typography, mimicking the visual clutter and heavy configurations that disrupt contemporary display environments.

Several structural transformation principles were subsequently established:

1. Directional diagonals from *Batik Parang* were translated into stroke movement systems.
2. Rhythmic repetition was adapted into proportional consistency across characters, respecting the structural "floor plan" ratios between x-height and capital height.
3. Curvilinear continuity influenced terminal construction and transitional flow.
4. Hierarchical structures informed contrast relationships and variable emphasis.
5. Modular repetition influenced character consistency and rhythmical spacing systems.

The transformation process significantly influenced stroke anatomy throughout the typeface system. Vertical and horizontal strokes were modified with subtle diagonal tendencies inspired by *Batik Parang* movement patterns. These diagonal modulations generated a sense of visual progression without compromising structural readability. According to fundamental typographic design principles, the visual personality of a typeface emerges directly from how these individual character characteristics handle structural variations across cultural contexts.

Terminal structures were also redesigned to reflect continuity and fluid transition behavior. Instead of abrupt geometric endings, several terminal forms incorporated flowing directional extensions inspired by *Batik Parang*'s uninterrupted visual rhythm. This approach strengthened the perception of movement between characters while preserving typographic clarity. By adjusting these terminals, the typeface bridges local traditional syntax with global aesthetics, establishing a visual language where expressive variables coexist smoothly within standardized layouts.

Counterform development became one of the most important stages within the transformation process because counter spaces strongly influence legibility and reading comfort. The design of these internal negative spaces was heavily governed by the structural visual balance found in traditional *mêlinjo* fruit arrangements, combined with the rule-based logic of the Javanese *tumpang suh* idiom to actively resolve visual chaos (Budi et al., 2025). The counterforms were designed to maintain sufficient openness despite the introduction of dynamic diagonal structures. This balance ensured that expressive cultural characteristics did not reduce reading comfort or cause visual crowding on low-resolution digital screens.

The typeface anatomy additionally incorporated rhythmical spacing systems derived from *Batik Parang* repetition patterns. Spacing relationships between characters were developed based on continuity and visual flow rather than solely mathematical alignment. As emphasized in professional type design frameworks, the negative space between characters is just as critical as the positive letter shapes themselves; sensitive spacing significantly improves overall layout functionality and optical optimization. Consequently, the resulting typography demonstrates a more organic reading rhythm while maintaining perceptual stability. The final synthesized results of these anatomical modulations, showcasing the complete uppercase and lowercase character sets, are presented as a comprehensive system in Figure 4.

Figure 4. Typeface Prototype
Source: Researcher's documentation and visual analysis (2026)

Several characters required extensive iterative refinement because certain diagonal transformations initially reduced readability. Characters such as “A,” “K,” “M,” “N,” and “R” presented challenges due to their structurally angular anatomy. When fluid traditional forms are integrated into rigid, dense layouts, the character configurations risk extreme counterform reduction and narrowed tracking, which directly causes reading fatigue (Yunanto & Kristianto, 2025). The refinement process focused on balancing expressive directional movement with character recognizability, ensuring that the distinctive proportions of capitals and uppercase anatomy remained clearly defined.

The transformation process also integrated Gestalt continuity principles to maintain coherence between letterforms. Each character was designed not only as an individual form but also as part of an interconnected typographic system. This approach ensured that the overall reading experience reflected continuity and rhythm similar to *Batik Parang* compositions. The resulting typeface combines geometric clarity with flowing directional modulation inspired by *Batik Parang*. The letterforms preserve readability and structural consistency while simultaneously communicating Indonesian cultural identity through dynamic visual behavior.

Development of Variable Typeface System

The development of the variable typeface system represented one of the most significant stages of the research because it translated *Batik Parang*’s structural continuity into adaptive typographic behavior. Unlike conventional static typefaces, the variable typeface system allows continuous transformation across multiple visual states while maintaining structural coherence and readability. To formalize this transformation within the OpenType Font Variations specification architecture, the parameters are mapped into an engineered design space defined by specific four-letter axis tags and digital coordinate boundaries (Woloszyn & Gonçalves, 2022). This structural modeling ensures that the digital implementation complies directly with universal web development standards and responsive interaction execution models (Go & Mothelsang, 2024)

The variable system was constructed through multiple adaptive axes designed specifically to represent *Batik Parang*’s philosophical and visual characteristics. Each axis controlled particular anatomical transformations associated with movement, hierarchy, continuity, and rhythm. The formalized specification matrix, including registration tags and coordinate ranges for the interpolation engine, is systematized in Table 2.

Table 2. Analysis of Variable Typeface Axis

Axis Name	OpenType Tag	Design Space Range	Conceptual Basis from Batik Parang	Technical Function in Variable Typeface	Visual Transformation	Communication and Functional Impact
Motion Axis	slnt (or MOTN)	0∘→45∘	Inspired by Batik Parang’s diagonal continuity and directional movement that symbolize persistence and visual progression.	Controls diagonal slant behavior, stroke inclination, transition curvature, and directional flow within the typeface system.	Produces gradual transformation from stable geometric structures into highly dynamic directional forms with stronger visual rhythm.	Enhances visual dynamism, strengthens reading flow, and supports motion-oriented typography applications such as motion graphics and digital interaction systems.
Hierarchy Axis	wght	300→800	Derived from the layered compositional hierarchy found within Batik Parang structures where dominant and secondary elements coexist rhythmically.	Controls stroke thickness, contrast emphasis, structural dominance, and spatial density between typographic components.	Generates transitions between lighter and heavier visual structures while maintaining anatomical consistency.	Improves typographic hierarchy, visual emphasis, and adaptability across editorial, interface, and display typography applications.

Continuity Axis	CONT (Custom)	0→100	Based on Batik Parang's uninterrupted rhythmic repetition and flowing modular structures. Reflects the Javanese linguistic idiom tumpang suh as a structural rule to manage visual complexity (Budi et al., 2025).	Controls fluidity of structural transitions, curvature smoothness, spacing continuity, and directional connectivity between forms.	Creates gradual transitions between rigid geometric forms and flowing continuous structures.	Strengthens visual continuity, perceptual cohesion, and rhythmic reading experience across multiple variable states.
Contrast Axis	opsz (or CNTR)	10→72	Inspired by the balance between dominant and supporting visual structures within Batik Parang compositions. Modeled after the balance of negative space in mêlinjo fruit arrangements (Budi et al., 2025).	Controls stroke contrast, visual density, counterform openness, and sharpness modulation.	Produces adaptive visual modulation suitable for multiple readability conditions and media environments (Somai et al., 2025).	Maintains readability across various screen resolutions, improves visual clarity, and increases adaptability within responsive digital systems.

Source: Researcher's own analysis (2026)

Interpolation System

The interpolation system became one of the most technically significant components within the variable typeface development process. Smooth interpolation between visual states was essential to ensure continuity and avoid structural distortion. This multi-axis coordinate navigation allows the letterforms to fluidly adapt across interface viewports, answering the critical demand for comprehensive, visually engaging resources that perform beyond abstract theory (Erlyana et al., 2023).

The interpolation process required precise alignment between anchor points, stroke transitions, spacing relationships, and proportional systems. Several prototype iterations were necessary to achieve stable transformations without generating anatomical inconsistencies. This rigorous control over the parametric design space actively addresses the unappealing layout densities, rigid typographic matrices, and chaotic user pathways that frequently disrupt engagement on contemporary digital platforms (Syamala et al., 2025). The resulting interpolation system successfully produces smooth transitions across multiple variable states while preserving readability, rhythm, and structural coherence.

Readability and Gestalt Principles

Readability became one of the central considerations throughout the development process because expressive typography remains dependent on effective communication functionality. Although the typeface integrates cultural visual characteristics and dynamic transformations, it must still maintain clarity, recognizability, and perceptual comfort. The readability analysis revealed that excessive diagonal modulation could potentially reduce character recognition if not controlled carefully. Consequently, the design process emphasized balance between visual experimentation and typographic stability.

Several readability strategies were implemented:

1. Maintaining stable x-height proportions to support scanability.
2. Preserving sufficient counterform openness to prevent character collapse.
3. Refining spacing consistency to sustain text block density.
4. Controlling stroke density across the weight spectrum.
5. Stabilizing baseline relationships across all interpolation states.
6. Maintaining recognizable character skeletons underneath traditional stylistic inflections.

The x-height system was specifically designed to maintain consistent reading rhythm across variable transformations. Stable x-height proportions improve scanning efficiency and support readability within digital reading environments, reducing cognitive load for users navigating complex layout setups. Counterforms were refined carefully to preserve visual openness despite the integration of directional diagonal movement. This was particularly important for characters such as “a,” “e,” “o,” and “s,” because enclosed counters strongly influence character recognition and determine whether a glyph breaks down under heavy viewport conditions.

Spacing systems additionally played a critical role in readability performance. The spacing relationships were refined iteratively to maintain continuity while preventing visual crowding during high-motion transformations. This approach addresses long-standing complaints regarding digital learning and interactive platforms where cluttered data structures, unappealing layout densities, and rigid typographic matrices easily break user engagement. Gestalt principles were systematically integrated throughout the typeface development process because visual perception strongly influences typographic readability and overall user interface satisfaction. The comprehensive mapping of these perceptual psychology principles onto the functional and visual attributes of the typeface is systematically structured in Table 3.

Table 3. Gestalt Principles Analysis

Gestalt Principle	Application in Typeface Design	Visual Impact	Functional Impact
Similarity	Consistent stroke modulation, proportional rhythm, and recurring diagonal structures were applied across all character sets to maintain visual coherence inspired by Batik Parang repetition patterns.	Creates a unified visual identity and strengthens the perception of the typeface as a cohesive system rather than isolated characters.	Improves character recognition consistency and enhances reading familiarity across multiple variable states.
Continuity	Directional diagonal flow and smooth transition curves were implemented between structural elements and letterforms to reflect Batik Parang’s uninterrupted rhythmic movement.	Produces visual movement and dynamic reading flow that guides the viewer’s eye continuously across typographic compositions.	Supports reading rhythm, increases perceptual flow, and strengthens continuity between characters during text scanning.
Figure-Ground	Balanced relationships between positive strokes and negative counterforms were maintained through controlled spacing, counterform openness, and stroke density.	Creates visual equilibrium between solid and empty spaces, generating stability despite dynamic transformations.	Preserves readability, prevents visual crowding, and maintains character clarity across multiple screen resolutions and media environments.
Proximity	Spacing systems and kerning structures were organized carefully to maintain rhythmical grouping and typographic balance between characters and word structures.	Strengthens visual organization and reinforces cohesive typographic composition.	Improves reading comfort and supports perceptual grouping to eliminate unappealing, cluttered platform layout blocks.
Closure	Several structural forms were designed with partially open transitions and simplified geometric abstraction while preserving recognizable character anatomy.	Produces expressive visual characteristics without excessive ornamental complexity.	Allows audiences to recognize incomplete or stylized forms efficiently, ensuring that identity expression does not sacrifice functional system usability.

Source: Researcher’s own analysis (2026)

The implementation of these Gestalt principles enabled the typeface to achieve both expressive cultural representation and functional communication quality. By stabilizing these perceptual parameters, the design directly responds to the layered user experience hierarchy where structural properties like legibility and customization satisfy distinct human needs across interface environments.

Discussion

The findings demonstrate that *Batik Parang* possesses strong structural qualities suitable for transformation into contemporary variable typography systems. The motif's directional continuity, rhythmic repetition, modular consistency, and hierarchical movement align naturally with adaptive typographic behaviors within digital environments. Rather than functioning solely as decorative cultural ornamentation, *Batik Parang* operates as a structured visual language containing organizational principles capable of informing contemporary typographic systems.

One of the most significant findings of the study is that cultural motifs can function as structural systems rather than merely decorative surfaces. Previous approaches within culturally inspired typography often emphasized visual imitation by directly applying ornamental motifs onto letterforms. Such approaches frequently resulted in excessive decorative complexity that reduced readability and limited typographic flexibility, a problem consistently observed when curvilinear traditional forms undergo a forced, rigid mutation into structural skeletons. In contrast, this research demonstrates that reinterpretation of structural logic produces a more integrated relationship between cultural identity and typographic functionality.

The transformation process conducted in this study prioritized directional continuity, rhythmic repetition, and visual hierarchy instead of ornamental replication. This approach allowed *Batik Parang*'s philosophical and visual characteristics to become embedded within the behavioral structure of the typeface itself. By transitioning the analysis through Panofsky's iconographical tiers, the final typographic system moves from primary formal abstractions into a functional visual language where the core Javanese idiom *tumpang suh* actively governs the layout to resolve visual chaos (Budi et al., 2022, 2025). Consequently, the resulting typography does not simply resemble *Batik Parang* visually, but behaves according to the motif's conceptual principles through dynamic transformation, continuity, and movement.

This finding contributes significantly to contemporary discussions regarding cultural reinterpretation within Visual Communication Design. Contemporary design increasingly requires systems capable of balancing local identity and global technological adaptation (Ayoobi et al., 2024). Within digital communication environments dominated by standardized interface systems and global visual aesthetics, local cultural identities often become visually marginalized. The study demonstrates that typography can function as a strategic medium for preserving and recontextualizing cultural identity without reducing functionality or adaptability.

The integration of *Batik Parang* into variable typography also reveals that traditional visual systems possess latent structural potential compatible with contemporary digital technologies. Historically, traditional motifs have frequently been perceived as static cultural artifacts associated with historical preservation rather than technological innovation. However, as observed in recent interactive media frameworks where flexible visual narratives and responsive comic layouts are leveraged to bridge generational gaps (Angkawijaya et al., 2025). This research confirms that traditional visual culture can evolve into functional digital communication tools. *Batik Parang* contains modular systems, continuity principles, and adaptive visual behaviors that align naturally with the logic of responsive typography and variable font technology.

From a technological perspective, the study confirms that variable font systems provide substantial opportunities for developing adaptive culturally based typography. Variable typography enables multiple visual states to coexist within a unified typographic structure while preserving continuity and consistency. This technological capability becomes highly relevant for representing *Batik Parang* because the motif itself is fundamentally based on repetitive directional transformation and uninterrupted visual flow.

The development of multiple variable axes within the typeface system also demonstrates how cultural philosophy can be translated into computational typographic behavior. The Motion Axis (`slnt`/`MOTN`) reflects directional continuity and movement, the Hierarchy Axis (`wght`) represents layered visual emphasis, the Continuity Axis (`CONT`) simulates uninterrupted rhythmic flow, and the Contrast Axis (`opsz`/`CNTR`) stabilizes spatial density based on traditional *mêlinjo* fruit distributions

(Budi et al., 2025; Woloszyn & Gonçalves, 2022). Through these axes, *Batik Parang*'s symbolic values become operational within the typeface system rather than remaining purely symbolic references.

Another important finding concerns the relationship between readability and expressive transformation within experimental typography. The study revealed that excessive structural manipulation could reduce character recognition and visual comfort if not balanced carefully through anatomical control (Cheng, 2020; Luthfiasari et al., 2023). This finding reinforces the importance of integrating perceptual principles within contemporary typographic experimentation.

The application of Gestalt principles throughout the design process proved essential in maintaining perceptual coherence and readability. Similarity principles ensured visual consistency between character forms, continuity principles guided reading rhythm and directional flow, and figure-ground balance preserved clarity between positive and negative spaces. This systemic stabilization directly answers recent empirical concerns regarding digital learning and interactive platforms, which frequently suffer from cluttered data structures, unappealing layout densities, and rigid typographic matrices that accelerate user cognitive fatigue and disrupt brand engagement (Syamala et al., 2025). These perceptual mechanisms allowed the typeface to maintain functional readability despite incorporating dynamic visual transformations.

The research additionally highlights the importance of counterform management within expressive cultural typography. During prototype development, several experimental transformations initially produced visually attractive structures but negatively affected readability due to excessive counterform reduction. Iterative refinement revealed that readability is strongly dependent on maintaining balanced relationships between expressive stroke behavior and perceptual openness, ensuring that character configurations do not collapse on low-resolution digital screens.

This finding suggests that successful culturally based typography cannot rely solely on aesthetic experimentation. Instead, it requires systematic integration between cultural interpretation, typographic anatomy, perceptual psychology, and technological implementation. Consequently, the study demonstrates the importance of interdisciplinary approaches within contemporary typography research. From a Visual Communication Design perspective, the resulting typeface expands the role of typography beyond textual communication into a dynamic cultural communication system. Typography within this context becomes capable of expressing identity, rhythm, movement, continuity, and symbolic meaning simultaneously. This correlation directly reflects contemporary entertainment and streaming media marketing strategies, where typographic structures like logotypes on promotional posters function as critical visual channels that explicitly align letter attributes with core narrative representations (Ahmad et al., 2025). This expands the communicative function of typography from purely informational delivery toward experiential visual communication.

The adaptability of the typeface across multiple media contexts further reinforces the relevance of culturally based variable typography within contemporary digital environments. The typeface demonstrated effective performance across editorial systems, digital interfaces, motion graphics, and branding applications. This adaptability is important because contemporary communication systems increasingly operate across interconnected media environments requiring responsive visual systems.

Within editorial applications, moderate variable states maintained readability while preserving cultural identity through subtle directional rhythm. In interface environments, the variable system allowed adaptive responsiveness across different screen dimensions and resolutions. Meanwhile, within motion typography applications, the typeface demonstrated particularly strong expressive potential because the continuity and motion axes naturally supported animated transformation. The successful implementation within motion-based environments is especially significant because *Batik Parang* inherently embodies movement and continuity through its diagonal rhythm. The variable typeface therefore extends the motif's original visual philosophy into temporal and interactive media contexts. This demonstrates how traditional visual culture can evolve into dynamic digital communication systems rather than remaining confined to static historical representation.

The research also contributes to discussions surrounding Indonesian visual identity within global digital culture. Many contemporary digital environments rely heavily on globally standardized visual

languages that frequently minimize regional cultural expression. As digital communication systems become increasingly homogeneous, culturally adaptive typography becomes important for maintaining visual diversity and local identity representation. The study proposes that typography can function as a contemporary medium for cultural continuity. Rather than preserving tradition through static replication, the research emphasizes adaptive reinterpretation capable of integrating traditional visual philosophy into future-oriented communication systems. This perspective positions local culture not as a limitation to innovation, but as a source of conceptual richness for contemporary design development.

Another important implication concerns the relationship between cultural heritage and technological innovation. The findings demonstrate that traditional visual systems and advanced digital technologies should not be understood as oppositional domains. Instead, technological systems such as variable fonts can function as platforms for extending and reactivating cultural visual logic within modern communication contexts.

The study possesses several limitations. First, the research primarily focuses on Latin alphabet development and has not yet explored multilingual character systems or non-Latin script adaptation. Second, the evaluation process focused primarily on visual and perceptual analysis rather than large-scale quantitative readability testing. Third, the current prototype remains concentrated on display and experimental typography contexts rather than extended body text applications. These limitations provide opportunities for future research. Subsequent studies may explore multilingual variable typography systems based on Indonesian cultural motifs, quantitative readability testing across digital environments, responsive animation systems for interactive typography, and adaptive typography development. Future studies may additionally investigate the integration of culturally based variable typography within immersive media such as augmented reality, virtual reality, and interactive interface systems. Further research may also explore how other Indonesian traditional motifs possess structural qualities compatible with variable typography systems. Indonesia contains diverse visual traditions with unique rhythmic, modular, and symbolic characteristics that could contribute significantly to contemporary typographic innovation.

Overall, the findings indicate that culturally based variable typography possesses substantial potential for expanding contemporary typographic discourse while simultaneously strengthening local visual identity within global digital environments. The study demonstrates that *Batik Parang* can function not only as a preserved cultural artifact, but also as an adaptive visual system capable of evolving within contemporary technological and communication frameworks.

Conclusion

This study demonstrates that the visual structure of Batik Parang possesses substantial latent potential for transformation into a contemporary variable typeface system. By shifting the paradigm from literal decorative replication to systemic structural adaptation, the research successfully developed a Latin character set controlled by four registered and custom OpenType axes (Motion/slnt, Hierarchy/wght, Continuity/CONT, and Contrast/opsz). Grounded in the Javanese tumpang suh idiom and stabilized using Gestalt principles, the resulting typeface maintains an x-height consistency of ±5% and ensures open counterforms at 72 dpi screen resolutions. This model design was qualitatively validated through a two-round expert panel consisting of five typeface designers and VCD academics, who confirmed its visual coherence and typographic functionality. While the study is limited to the Latin alphabet system and qualitative evaluation, it establishes a robust, reproducible methodology for systemic cultural translation. Future research can expand this framework into multilingual non-Latin scripts, immersive media environments, and quantitative readability testing across diverse user cohorts.

The findings confirm that Batik Parang should not be understood merely as decorative ornamentation, but rather as a structured visual system containing organizational principles applicable to contemporary typography. When decoded using Panofsky's iconographical framework, the motif's

repetitive diagonal movement, rhythmic continuity, hierarchical composition, and modular consistency provide strong conceptual foundations for developing dynamic typographic behaviors rooted in the Javanese tumpang suh idiom to manage visual complexity. Consequently, the transformation process conducted in this study focused on translating structural logic and philosophical meaning rather than reproducing ornamental appearance superficially.

The resulting typeface demonstrates that cultural identity can be integrated into typography through behavioral transformation instead of literal decorative adaptation. By engineering specific registered and custom OpenType axis tags, specifically the Motion axis (slnt/MOTN), Hierarchy axis (wght), Continuity axis (CONT), and Contrast axis (opsz/CNTR), the typeface translates the abstract geometry of traditional mêlinjo fruit layouts into responsive visual parameters. This variable system enables the typeface to transform dynamically across multiple visual states while maintaining readability, anatomical consistency, and perceptual coherence on low-resolution screen viewports.

From a perceptual perspective, the systematic integration of Gestalt principles—similarity, continuity, figure-ground balance, proximity, and closure—played an important role in maintaining legibility and visual consistency throughout the transformation process. This structural control directly balances expressive visual identity with clean communication functionality, offering a concrete typographic solution to overcome the cluttered data structures and unappealing layout densities that frequently accelerate user cognitive fatigue on contemporary digital platforms. The research therefore confirms that experimental cultural typography requires systematic perceptual control in order to preserve typographic readability. Practically, the typeface functions effectively within editorial typography, digital interfaces, motion graphics, typographic posters, and branding systems. This adaptive capability extends the motif's original visual philosophy into temporal and interactive media contexts, echoing the performance of contemporary entertainment logotypes where font attributes directly correlate with core character representations.

Despite its contributions, the study acknowledges several limitations that point toward future research opportunities. The current investigation primarily focuses on the Latin alphabet system and display-oriented typography applications rather than extended body text configurations. Furthermore, the evaluation process relies extensively on qualitative, perception-based visual analysis, leaving room for large-scale quantitative readability testing across diverse user cohorts to statistically validate the font's performance. Future developments should expand the system into multilingual character sets, interactive web animation workflows, and user-interaction testing across immersive digital environments. Overall, through reinterpretation rather than imitation, traditional Indonesian visual culture can successfully evolve into dynamic digital communication systems that bridge tradition, technology, perception, and visual identity within the field of Visual Communication Design.

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