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Biomorphic elements in the preservation of Sarawak Bidayuh cultural heritage interior

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ABSTRACT

The Bidayuh community in Sarawak is known for its rich cultural heritage and traditional interior designs that reflect deep connections with nature. However, globalization and modernization pose significant threats to the preservation of these unique cultural elements. Traditional Bidayuh interiors are increasingly at risk of being overshadowed by contemporary designs that often neglect the cultural and aesthetic values inherent in biomorphic elements. This research identifies key biomorphic elements in traditional Bidayuh interiors, such as natural motifs, organic shapes, and traditional materials, and explores their integration into contemporary design to ensure cultural continuity. A qualitative research approach involves analyzing and find out the elements of Bidayuh cultural interior and develop aspect of biomorphic design through visual documentation and architectural analysis to provided guidelines for designers to sustain the legacy of Bidayuh cultural. The findings highlight the adaptability of biomorphic elements in modern interiors, demonstrating that traditional aesthetics can coexist with contemporary design without compromising cultural integrity. This culturally responsive approach fosters cultural pride and continuity among the Bidayuh people, offering a pathway to maintain their unique heritage amidst modern changes. The study provides a framework for designers and cultural practitioners to collaborate in preserving the Bidayuh cultural legacy for future generations.

Introduction

A biomorphic element refers to a design or form that is inspired by or resembles biological shapes, patterns, or structures found in nature (M. and Ishomuddin 2016; Karci Demirkol and Kalayci Önaç 2024; Jamei and Vrcelj 2021). These elements often mimic the curves, contours, and textures of living organisms, such as plants, animals, or even microorganisms (Thampanichwat et al. 2025; Xu et al. 2024; Cosma and Brighenti 2023). In architecture and design, biomorphic elements can be incorporated into various aspects, including building facades, interior spaces, furniture, and decorative objects (Browning, Ryan, and Clancy 2014). They are valued for their ability to evoke a sense of organic beauty, promote biophilic design principles, and create spaces that feel harmonious and connected to the natural world (Ripley and Bhushan 2016; Devina and Asep Ahadiat Gandawijaya 2023); .

The term "Sarawak Bidayuh cultural heritage interior" refers to the traditional and culturally significant aspects of interior spaces associated with the Bidayuh indigenous community in the Malaysian state of Sarawak. The Bidayuh people, also known as Land Dayaks, have a rich cultural heritage deeply rooted in their customs, beliefs, architecture, and way of life.

Biomorphic design, derived from the Greek words "bios" (life) and "morphe" (form), refers to a design approach that takes inspiration from the shapes, forms, patterns, and structures found in nature to create functional and aesthetically pleasing environments. In interior architecture, biomorphic design aims to bring the essence of nature indoors, enhancing the aesthetic, psychological, and functional aspects of interior spaces (AnDarach 2024; Rui and Firzan 2025). Biomorphic design principles have roots in early 20th-century art and architecture, where designers and architects sought to emulate the organic forms seen in natural environments. This approach was influenced by the Art Nouveau movement, which emphasized natural forms and structures (Juhani Pallasmaa 2009; Md Rian and Sassone 2014). Over time, advances in materials and construction techniques have allowed for more sophisticated and varied applications of biomorphic design in interior spaces (AlAli et al. 2023; Yasar and Öktem Erkartal 2025).

Despite the richness of the Bidayuh cultural heritage, there is a significant lack of formal guidelines for preserving and integrating traditional design elements into contemporary interiors. This absence of clear guidelines poses a challenge for architects, designers, and the Bidayuh community in maintaining the cultural integrity of their interior spaces amid rapid modernization and globalization. The lack of documented standards and design principles means that traditional knowledge is at risk of being diluted or lost, especially as younger generations move towards urbanization and adopt modern lifestyles.

This research is based on the theoretical framework of Sarawak Bidayuh cultural heritage interior and biomorphic design. Baruk is a part of Dayak cultural heritages that have proffered the knowledge through its structure by it forms, elements and functions (Yunitha and Guntur 2020). Biomorphic design explores the impact of potential and elements on cultural and societal structures for the Bidayuh community. This study recognized its limitations, including potential constraints in data availability and the limited area of research due to the scarcity of information on Bidayuh architecture elements in Malaysia. The biomorphic design can be one of the approaches to preserve Sarawak Bidayuh cultural. Despite several limitations, the outcomes of this study are expected to offer useful guidelines of characteristic of Bidayuh cultural for the designer to preserve the Sarawak Bidayuh cultural heritage interior involves efforts to safeguard these traditional elements, promote their appreciation and understanding, and ensure their continuation for future generations.

Literature review

The Baruk, a traditional communal house of the Bidayuh people of Borneo, stands as a vital cultural symbol and a remarkable example of indigenous architectural ingenuity. This literature review explores the structure and elements of the Baruk, emphasizing the roof, walls, and floor, while integrating the principles of biomorphic design. Biomorphic design, which draws inspiration from natural forms and processes, offers innovative solutions for preserving and enhancing cultural heritage. By examining how traditional Bidayuh architecture can be enriched with biomorphic principles, this review aims to demonstrate the potential for creating sustainable, aesthetically pleasing, and culturally resonant interior spaces. The fusion of traditional and biomorphic elements not only preserves the cultural integrity of the Baruk but also promotes ecological balance and human well-being, aligning with contemporary architectural practices.

The structure of Baruk

The Bidayuh community have their own identity monument that is a special house that call Baruk and also a symbol of cultural heritage and it has its own specialty not only from its design, but also the function, uniqueness and concept as well (Christizer Tinda 2021). An original baruk Sarawak is believed to be first built in the Kampung Opar in Bau (western Sarawak region) after a disease outbreak which claimed the live of their children that serve as a ritual and ceremony place for traditional Bidayuhs today. Baruk usually had a simple, centric layout of internal space (Zaini, Karsono, and Awang Sulong 2018). There are four deep structures in parameter to prove that is has a structure: building as a container for human activities, as a modifier of given climate, as a cultural symbol and as resource consumption (Yunitha and Guntur 2020). The structures of this house are circular and it built iss about 3 to 5 meters above ground (Backyard Tour 2016).

The architecture elements of Baruk

The Baruk Bidayuh House a symbolic of Bidayuh culture from Sarawak, Malaysia, features distict architectural elements designed to adapt to the tropical environment and reflect cultural values. This literature review focuses on the roof, walls and floor of the Baruk house.

Figure 1. The view of Baruk walls
Source: Asian Itinerary

According Christizer Tinda (2021), Nik Kamaruzaman (2020) and Zaini, Karsono, and Awang Sulong (2018), the shape of the roof is the conical design. This roof design is crucial for water runoff and temperature regulation that the steep pitch allows rainwater to drain quickly, reducing the risk of leaks and water damage. The shape also facilities passive cooling by allowing hot air to rise and escape through the apex, maintaining a cooler interior. The roof" s design often carries symbolic meanings related to Bidayuh cosmology (Zaini, Karsono, and Awang Sulong 2018) that show that the conical shape may represent a connection between the earth and the sky that give symbolizing meaning of unity and protection. The Baruk typically features a thatch roof made from natural material such as palm leaves and sago (Steger 2023; V.K. Sulc 1990) highlight that these materials are locally sourced, renewable and offer excellent insulation against heat and rain. While thatch is susceptible to wear, modern preservation techniques have improved is lifespan (Sunshine Tiki Huts Corp 2021) discuss treatments and regular maintenance that enhance the durability of thatch roofs, ensuring they remain effective in the tropical climate.

Elemets of walls

Figure 2. The view of Baruk Walls
Source: Asian Itinerary

According to Asif et al. (2018), Chister Tinda (2015) and Yunitha and Guntur (2020), the walls of the Baruk house are constructed using bamboo and timber that was natural material chosen for their availability and sustainability. Wall of Baruk has slope around 80 degrees that allow possibility for leaning and allow ventilation into the interiors (Yunitha and Guntur 2020). Guri (2015) enlighten that Bidayuh communities never used iron nails to builds the baruk and it just tight together with ropes made out of tree bark and rattan. The construction of walls often involves traditional weaving and binding techniques that do not require nails or screws (Curk et al. 2025; Rashid and Ara 2015). Bidayuh communities are masters in art of building with bamboo and emphasize that bamboo is lightweight, strong and grows quickly, making it an ideal building material and timber adds structural stability and durability (Bredenoord 2024). Asif et al. (2018) highlight how uniques features of timber application in Baruk architecture. Guri (2015) Bamboo and timber walls provide good thermal insulation, keeping the interior cool during hot days and warm during cooler nights.

Elements of floors

Figure 3. The view of Baruk Floors
Source: Asian Itinerary

According to Christizer Tinda (2021), the floor of the Baruk house is built with bamboo where it will construct 2 feet height post from the ground. Zaini, Karsono, and Awang Sulong (2018) explain that the concept of the floor in traditional architecture of Bidayuh community, such as Baruks, holds significance in representing cosmological beliefs. In the context of Iban architecture, for example, the ground floor of their longhouses symbolizes the underworld, the first floor represents the realm of humans, and the attic or roof signifies the spirit world. However, in Baruks specifically, there is no strong evidence suggesting that the raised floor is directly related to religious beliefs. Instead, the raised floor component in most Austronesian indigenous buildings is more likely a climatic response to allow airflow and efficient rainwater withdrawal. The floor material of the Baruk is primarily made of bamboo laths that are woven together. These bamboo laths are nearly flat, around five centimeters wide, and are firmly tied down using rattan to the joints beneath. Bamboo is a versatile and sustainable material that provides a sturdy and flexible flooring surface for various activities within the Baruk (Yunitha and Guntur 2020). These materials not only provide a practical flooring surface but also contribute to the cultural significance and sustainability of the Baruk architecture.

Biomorphic design

Biomorphism refers to design approach that emulates the shapes, forms and patterns found in nature. According to Fairs (2019), the term “biomorphic” was first used in the context of art in the early 20th century to describe organic forms resembling those in nature. This design approach emphasizes harmony with the natural environment, promoting sustainability and ecological balance (Yunxuan, Ruikai, and Ibrahim 2025; Mba et al. 2024). Biomorphic design often incorporates fluid, organic shapes that mirror the curves and lines found in natural objects, such as plants, shells and bones. Elsayed and Ammar (2020) highlight that these shapes not only create visually appealing designs but also contribute to ergonomic and functional benefits. Biomorphic design frequently employs materials that either come from nature or mimic natural textures and properties. Juahni Pallasmaa (1994) discusses how natural materials can enhance the sensory experience and well-being of occupants.

Methods

This research, as a preliminary investigation to the issue in hand, uses a qualitative approach in evaluating the element that reflect the characteristics of Baruk architecture. Literature review and case study are the methodologies utilized. The literature review will examine case studies and precedent studies to acquire relevant data, which will then be compared to ensure the research's validity. Relevant research will be studied in case studies by picking connected issues related to the study objectives. The studies will be done in response to the second research objective: to promotes the use of biomorphic design to support and preserve the Bidayuh cultural heritage. A study of credible sources, such as published reports, journals, conference papers, thesis papers, and websites, is used in this strategy. It employes many qualitatives method to collect comprehensive and intricate data to create clear and practical guidelines for architects and designers how to intercorporate traditional Bidayuh biomorphic elements into modern elements while preserving their cultural significance.

Case studies

The SSLA Building - Sarawak State Legislative Assembly Building, Malaysia

The Sarawak State Legislative Assembly (SSLA) Building in Kuching, Malaysia, is a striking example of how traditional architectural elements can be harmoniously integrated into

modern structures. Drawing inspiration from the Baruk, the traditional communal house of the Bidayuh people, the SSLA Building incorporates key elements such as the circular form, conical roof, and the use of natural materials. This case study explores how these elements have been adapted within the SSLA Building to reflect cultural heritage while meeting contemporary architectural and functional requirements. By merging the traditional aesthetics and principles of the Baruk with modern design and sustainability practices, the SSLA Building not only honors Sarawak's rich cultural history but also sets a precedent for innovative and culturally sensitive architectural design.

Figure 4 and 5. The facade view of SSLA building and cut section of the building
Source: IOP Science

Architectural design and elements

The SSLA Building's design takes inspiration from the traditional Baruk's circular form, representing unity and inclusiveness. The central dome of the SSLA echoes the communal and ceremonial space of the Baruk, symbolizing the gathering of legislative members. The SSLA features a striking conical roof that resembles the traditional Baruk's roof. This design not only provides aesthetic appeal but also serves practical purposes such as efficient rainwater drainage and enhanced ventilation. The roof's surface incorporates intricate patterns and textures inspired by natural elements, reflecting the region's rich biodiversity and cultural motifs. These patterns not only beautify the structure but also create a connection to the natural environment. The building utilizes locally sourced materials such as timber and bamboo, aligning with traditional construction practices. These materials are sustainable and reduce the environmental footprint of the building. Vegetation on parts of the roof enhances insulation and promotes biodiversity, contributing to the building's sustainability. The incorporation of living walls within the SSLA building brings the natural environment indoors, improving air quality and providing a calming visual aesthetic. These walls symbolize the connection between governance and the land. The interior and exterior walls feature designs and textures inspired by natural forms, such as leaves and vines, creating a harmonious and immersive environment. The use of bamboo and locally sourced wood for flooring creates a warm and inviting atmosphere. These materials are arranged in patterns that mimic natural formations, such as riverbeds, enhancing the building's aesthetic appeal. The floor design incorporates gentle contours and elevations, mimicking the natural landscape and improving ergonomic comfort. This layout encourages movement and interaction among the building's occupants.

Functional and symbolic significance

By integrating elements inspired by the Baruk, the SSLA building preserves and celebrates Sarawak's cultural heritage. The design serves as a modern interpretation of traditional architecture, symbolizing the state's respect for its history and traditions. The circular form and centralized space of the SSLA building symbolize unity and inclusiveness, essential values for a legislative assembly. The design promotes a sense of community and collective purpose among the lawmakers.

The use of natural, locally sourced materials and green building practices reduces the environmental impact of the SSLA building. Features such as green roofs and living walls enhance sustainability and promote ecological balance. The building's design incorporates natural ventilation and lighting, reducing reliance

on artificial energy sources. This enhances energy efficiency and reduces the building's carbon footprint.

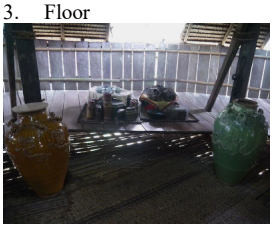
The biomorphic design of the SSLA building creates a visually stunning and harmonious structure that resonates with both modern and traditional aesthetics. The integration of natural forms and materials enhances the building's appeal. The incorporation of biophilic elements, such as living walls and natural materials, improves the well-being of the building's occupants. These features reduce stress, improve air quality, and create a calming and restorative environment.

The Sarawak State Legislative Assembly Building is a prime example of how biomorphic design principles can be integrated with traditional architectural elements to create a structure that is both modern and culturally significant. By drawing inspiration from the Baruk, the SSLA building not only preserves and celebrates Sarawak's cultural heritage but also promotes sustainability and enhances the well-being of its occupants. Despite the challenges associated with implementing biomorphic design, the benefits in terms of aesthetic appeal, functionality, and cultural preservation make it a valuable approach for modern architecture.

Results and discussion

Result from the analysis on the characteristic of Baruk architecture elements. The table below highlights how traditional elements of the Baruk architecture roof, walls, and floors can be preserved and enhanced using biomorphic design principles. By maintaining traditional forms and functions, utilizing sustainable materials, and integrating biomorphic approaches, the Baruk can remain culturally significant while adapting to contemporary needs. This approach ensures cultural continuity, promotes environmental sustainability, and enhances the well-being of occupants.

Table 1. Analysis guideline of Baruk architecture elements

Elements	Form and function	Material used	Biomorphic aapproach
1. Roof 	Conical Shape: Facilitates efficient rainwater runoff and ventilation, essential for tropical climates. Symbolizes unity and central focus. -Steep Pitch: Enhances rainwater shedding and natural ventilation.	Traditional Materials: Thatch from local leaves such as nipa palm or sago palm provides natural insulation. - Modern Materials: Eco-friendly shingles or green roofs for enhanced durability and sustainability.	Natural Patterns: Incorporate patterns mimicking natural forms like spirals and leaf veins. - Green Roofs: Add vegetation to improve insulation, promote biodiversity, and enhance the building's integration with the natural environment.
2. Wall 	The structure of wall was vertical with slope 80 degree and height around (1m-1.5m) provide natural insulation, structural support, and a lightweight construction that is resistant to closing, dividing or protecting a room or area	Traditional Materials: Bamboo and timber, chosen for their abundance, flexibility, and durability. -Modern Adaptations: Use of engineered bamboo or recycled timber for sustainability.	Living Walls: Integrate local plants to improve air quality and create a biophilic environment. -Organic Textures: Use rough-hewn timber or interwoven bamboo to enhance tactile and visual appeal. -Cultural Motifs: Incorporate traditional patterns using modern techniques like laser-cut panels or embossed surfaces.
3. Floor 	Raised Platforms: Enhances ventilation, cooling, and protection against flooding and pests. Creates an elevated communal space. -Natural Flooring Patterns: Mimic natural landscapes and enhance ergonomic comfort.	Bamboo and timber are commonly used for flooring, chosen for their durability and natural beauty. Sustainable alternatives, such as engineered bamboo or recycled timber, can be used to retain the traditional look while improving durability and environmental impact	Ergonomic Design: Introduce gentle contours and elevations to mimic natural landscapes, improving comfort and encouraging natural movement. -Natural Patterns: Arrange flooring materials in patterns inspired by nature, such as riverbed arrangements or leaf-like tessellations.

Conclusions

The guidelines for integrating biomorphic design elements of the roof, wall, and floor of the Baruk provide a comprehensive approach to preserving and enhancing this traditional structure. By maintaining and enhancing natural shapes and using sustainable materials, these guidelines ensure that the Baruk remains culturally significant while adapting to contemporary needs. The investigation demonstrates that biomorphic design has significant potential in preserving and enhancing the interior spaces of Sarawak Bidayuh cultural heritage. By identifying traditional Baruk house architecture elements and developing strategies of biomorphic for their integration into modern interiors, the study provides a pathway for maintaining cultural continuity while embracing sustainable design practices. This approach not only respects and honors Bidayuh traditions but also contributes to the creation of aesthetically pleasing, functional, and environmentally friendly living spaces. As a result, biomorphic design emerges as a valuable tool for the cultural and architectural preservation and innovation of the Bidayuh community.

The integration of traditional materials and motifs ensures that the cultural heritage of the Bidayuh people is preserved and celebrated in modern contexts. Using locally sourced, sustainable materials and incorporating green building practices promote ecological balance and reduce environmental impact. Biomorphic design elements enhance the visual appeal and create environments that improve well-being and foster a deeper connection to nature. These conclusions highlight the potential of biomorphic design to create resilient, culturally resonant, and environmentally sustainable built environments that preserving traditional architecture of Baruk that be the identity of Sarawak Bidayuh culture while embracing modern innovations.

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Author(s) contribution

Mohamad Hafizudin bin Mohd Rizal contributed to the research concepts preparation, methodologies, investigations, data analysis, visualization, articles drafting and revisions.

A Ghafar Ahmad contribute to the research concepts preparation and literature reviews, data analysis, of article drafts preparation and validation.

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