Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 59 Issue: 06:2026
DOI: 10.5281/zenodo.20700646

COMPUTATIONAL SHAPE GRAMMAR-BASED ANALYSIS OF OJUDE PUBLIC SPACE TYPOLOGIES IN ILORIN CITY, NIGERIA

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Abstract

This study examines the spatial typologies of Ojude public spaces in Ilorin City, Nigeria, using a computational shape grammar framework to understand their spatial logic and cultural significance. The study addresses the problem of the gradual transformation and loss of spatial–cultural identity of traditional Ojude spaces due to modernization and the absence of systematic computational tools to model their spatial logic. A computational shape grammar methodology was employed to encode spatial rules and typological structures. The population comprised traditional Ojude public spaces in Ilorin, while the sample included five typologies: Ojude Oba, Ojude Balogun, Ojude Wasi, Ojude Magaji, and Agbo-Ile. Data were analyzed through spatial typology mapping, vocabulary element extraction, and rule-based grammar modeling of form generation, transformation, and motif encoding. Findings reveal a clear hierarchy among Ojude types, with Ojude Oba as the ceremonial core and Agbo-Ile as the smallest family-centered courtyard. Despite variations in size and function, recreation, communal gathering, and Islamic learning are consistent features across typologies. The study concludes that Ojude spaces embody socio-cultural and behavioral influences on community life, particularly children's development. It recommends integrating computational shape grammar models into heritage preservation and urban design strategies to sustain these culturally significant public spaces.

Keywords: Computational Shape Grammar; Ojude-Ilorin City; Public Space Typologies.

1. INTRODUCTION

Public space typologies have long been central to global architectural and urban design discourse, particularly through computational approaches such as shape grammar. As a rule-based method of generating and analyzing forms, shape grammar decodes how architectural and urban spaces evolve across cultural contexts. Stiny (2006) emphasizes its capacity to translate cultural knowledge and spatial logics into generative design rules. Globally, it has been applied to classical urbanism, Islamic courtyards, and vernacular housing, showing how cultural meaning is embedded in geometry and spatial organization (Low, 2017). More recently, shape grammar has been advanced in African contexts, such as the Yoruba Architectural Design Generative System (Olakanbi, 2025),

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which applies machine learning and grammar rules to Yoruba-Agboile courtyard architecture, and the Development of Parametric Shape Grammar for Hausa Zankwaye architecture (Olakanbi, 2025). These works demonstrate the growing relevance of computational frameworks for integrating heritage with sustainable futures.

2. LITERATURE REVIEW

In Africa, traditional public spaces reflect deep social cohesion, ecological adaptation, and cultural values. From Benin palace squares to Yoruba communal compounds, they embody governance, heritage, and environmental stewardship. Afon et al. (2020) describe these spaces as lands reserved for entertainment and socio-cultural preservation, while Falade (2017) highlights their governance functions in Yoruba urbanism. Mukarubega (2019) stresses the opportunities and challenges of capturing such logics digitally, particularly in contexts where intangible cultural rules shape spatial meaning. Complementary studies extend this digital heritage discourse, including generative shape grammar approaches for Suakin architecture in Sudan (Olakanbi & Rayis, 2016), and computational-analytical mappings of Hausa houses (Olakanbi et al., 2025), which demonstrate how grammar-based models preserve cultural authenticity while enabling adaptive transformation. This reinforces the potential of computational grammar for African vernacular heritage. Within Nigeria, Ilorin provides a rich context for exploring these issues. Its Ojude typologies embody Yoruba and Fulani influences, serving historically as ceremonial courtyards, defensive spaces, and socio-political hubs (Chisholm, 1911; Omoiya, 2009). However, modernization and rapid urban pressures are transforming these spaces, eroding their spatial and cultural integrity (Adegbile & Okewole, 2020). The geometries, thresholds, and symbolic markers that once distinguished Ojude are increasingly replaced by generic urban layouts (Lawal, 2018; Osasona, 2020). At the same time, recent computational research in African architecture, such as the Design of Generative Models for Yoruba courtyard language (Olakanbi & Rayis, 2025), shows how spatial logic, hierarchy, and symbolic patterns can be encoded into flexible systems of rule-based generation. This combination of cultural erosion and computational opportunity highlights two interrelated problems in Ojude spaces: the loss of spatial-cultural identity and the lack of systematic tools to model their transformations.

Computational shape grammar offers a potential solution by encoding cultural rules of proportion, orientation, hierarchy, and access, while also providing transformation mechanisms such as scaling, rotation, and substitution for adaptation (Nochian et al., 2015; Zhu et al., 2021). These tools build on prior African-focused scholarship that demonstrates how shape grammar can generate context-sensitive typologies while preserving symbolic meaning (Olakanbi, 2025; Olakanbi et al., 2025). Addressing both cultural erosion and unsystematic transformation requires computational frameworks that integrate heritage values with contemporary needs. Therefore, this study investigates whether Computational Shape Grammar formalism can accurately classify and generate novel Ojude Public Space Typologies, Ilorin Historical City, Nigeria. By addressing these problems through computational shape grammar, the analysis of Ojude public space typologies in Ilorin can move beyond documentation toward actionable models of

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preservation, adaptation, and innovation. Grammar rules offer a pathway to not only decode the cultural and spatial DNA of these spaces but also to regenerate them for sustainable urban futures in Ilorin City.

The objectives are to: (i) identify and classify the spatial typologies of Ojude public spaces in Ilorin, (ii) analyze their spatial components such as courtyard geometry, edges, access points, and functional zoning, and (iii) develop rule-based representations that explain their generative spatial structure

3. METHODOLOGY

This study adopts a qualitative and computational research design based on computational shape grammar analysis to investigate the spatial typologies of Ojude public spaces in Ilorin City, Nigeria. The design is appropriate because the research focuses on identifying and interpreting spatial patterns, cultural meanings, and rule-based structures embedded in traditional public spaces rather than measuring numerical variables. The study systematically identifies and classifies the spatial typologies of Ojude public spaces in Ilorin, including Ojude Oba, Ojude Balogun, Ojude Waasi, Ojude Magaji, and Agbo-Ile, using documented spatial characteristics such as size, location, and surrounding features. It further analyzes their spatial components, including courtyard geometry, boundary edges, access points, and functional zoning, by extracting vocabulary elements that define their spatial organization. These elements are subsequently translated into computational shape grammar rules to explain the generative logic, spatial hierarchy, and transformation mechanisms underlying the formation and evolution of Ojude public spaces. The implication of adopting this research design is that it enables the systematic decoding of the spatial and cultural logic embedded in traditional urban forms while providing a structured computational framework for modeling, preservation, and potential regeneration of these culturally significant spaces in contemporary urban planning and design.

3.1 Study Area

Ilorin is a guinea savannah region characterized by very scanty trees and little or no grass cover. The climate is generally warm, with temperatures ranging from 68° to 86°F (20 to 30°C). Savannah regions typically experience a 6–8 month wet summer season and a 4–6 month dry winter season. Climate is an important environmental factor influencing children's engagement in outdoor play and learning within Ojude spaces. Ilorin City, Nigeria, was selected for this study because it is an ancient city with numerous historical sites. These sites include several Ojudes such as Ojude Oba in Ilorin West, Ojude Balogun Alanamu in Ilorin West, Ojude Balogun Ajikobi in Ilorin West, Ojude Balogun Gambari in Ilorin East, and Ojude Balogun Fulani in Ilorin South (Omoiya, 2009). Historically, many of these Ojudes served security purposes (Omoiya, 2009). They were often guarded by Dongari (slaves) who protected the territories under each Balogun (warlord) against external aggression and internal insurrection (Chisholm, 1911). The strategy was that these guards would weaken or incapacitate intruders at the Ojude before the Baloguns confronted them (Omoiya, 2009). Ojude Oba, located in Ilorin West,

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occupies a large expanse of land and is completely tarred and floored. A major feature within the space is the Central Mosque, where people gather every Friday for prayers. The Ojude is also surrounded by two important markets, Oja Oba and Oja Ago. Recently, the Durbar festival was staged at Ojude Oba on the second day of Eid-Kabir, an annual event that adds significant cultural vibrancy to the space. In addition, a religious festival is held there on the last day of Ramadan. Consequently, Ojude Oba performs religious, socio-cultural, and economic functions within the city. Ojude Balogun Fulani in Ilorin South is another important Ojude. Although smaller than Ojude Oba, it is surrounded by traditional buildings and filled with sand rather than paved surfaces. Islamic and cultural events are commonly organized there, attracting people from various areas. One notable event frequently held at this Ojude is Maolud Nabiy (the celebration of the birth of the Holy Prophet). Thus, the space serves ceremonial, security, and residential functions. Ojude Balogun Gambari, located in Ilorin East, is also smaller than Ojude Oba and remains untarred. Although a market exists nearby, the area is predominantly residential, with many inhabitants living around these traditional public spaces. Similarly, Ojude Alanamu and Ojude Ajikobi in Ilorin West are characterized by surrounding residential buildings and are used for Islamic preaching, particularly during Ramadan. Other traditional spaces include Ojude Waasi, typically located close to mosques, and Ojude Magaji, which functions as a neighbourhood public space with hundreds of examples across Ilorin. Agbo-Ile represents the smallest form of Ojude, consisting of open courtyards within extended family compounds and widely accessible to children. Overall, these traditional public spaces serve ceremonial, spiritual, socio-economic, and psychological functions for children and the broader community as shown in figure 1.

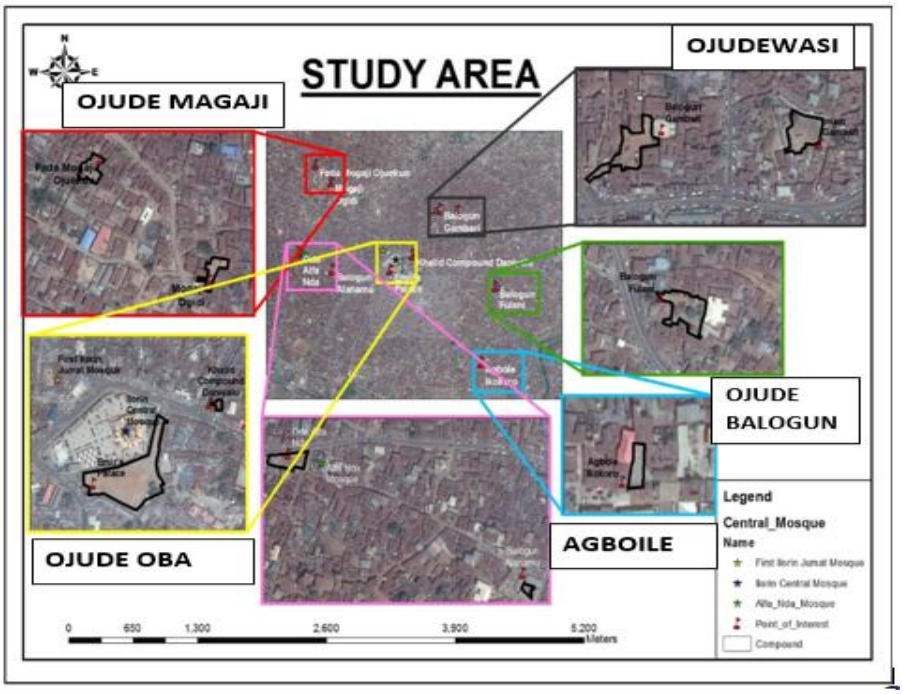

Figure 1: Map showing Ilorin City, Highlighting the Ojudes (Google map)

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4. ANALYSIS OF OJUDE PUBLIC SPACE TYPOLOGIES IN ILORIN CITY, NIGERIA

Ojude Oba

Ojude Oba is located in Ilorin West and covers a large expanse of land. It accommodates a larger number of children compared to other Ojudes. A large mosque—the Central Mosque—is situated within the space, attracting people from far and near for Friday prayers. The Ojude is also surrounded by two important markets in the city, Oja Oba and Oja Ago. The Durbar festival is usually staged at Ojude Oba on the second day of Eid-Adha, an annual event attended by many prominent personalities from different walks of life. In addition, a religious festival is held there on the last day of Ramadan. These activities demonstrate that Ojude Oba serves religious, socio-cultural, and economic functions as shown in table 1 and 2.

Children visit the Ojude daily to participate in religious activities because it houses the Central Mosque. Both adults and children also gather there for socio-cultural activities such as moonlight storytelling, running, and biking. The space further performs economic functions due to the presence of Oja Oba, the oldest market in Ilorin. Children commonly gather at the Ojude every evening during weekdays and engage in various forms of play. During weekends, from morning to evening, they participate in activities such as running, football, and horse riding. The wide land area contains both tarred and untarred surfaces, where children use the tarred areas for biking and the sandy areas for playing football as shown in figure 2 and 3.

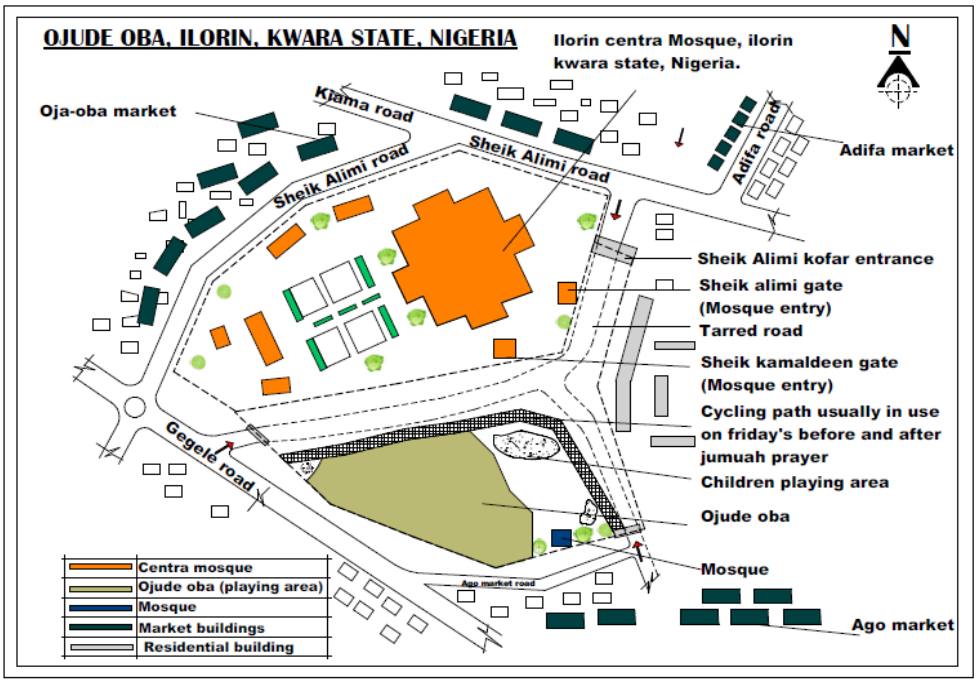

Figure 2: Site plan showing children activities in relation to the neighbouring markets, central mosque and residents around Ojude Oba

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Figure 3: The children play with used tyres at the Ojude Oba show sandy and the tarred road that formed part of the space

Table 1: Ojude Oba Spatial Typology

Ojude Spatial Typologies	Description	Symbolic Representation (Vocabulary Elements)
Courtyard Geometry (Size, Proportion, Orientation)	0.5–1.5 hectares; large, centrally located; half hardscape, half sandy surface; oriented at the city core	☐ Large Courtyard (central ☐, balanced)
Edge Definition (Fences, Walls, Natural Boundaries)	Surrounded by three major markets (Oja Oba, Oja Idi-ape, Oja Ago); natural features (🌳 trees, garden with horses/tortoises); strong sense of place attachment	■ Solid Market Boundaries + 🌳 Natural Edge
Access Points (Gates, Pathways, Thresholds)	Easily accessible within 400m/5 minutes; adjoining roads on three sides; mixed pedestrian and vehicular access	🚪 Multiple Entry Gates + ▬ Pathways + 🚗 Road Fronts
Functional Zoning (Ceremonial, Recreational, Gathering Areas)	Used for royal festivals 🎉 (Durbar during Eid-Adha); recreation ⚽ (football, alo, ten-ten); gathering; 🕮 Madrasat (Islamic learning); children's play	🎉 Ceremonial Zone + ⚽ Recreation + 🕮 Learning + 👪 Community Gathering

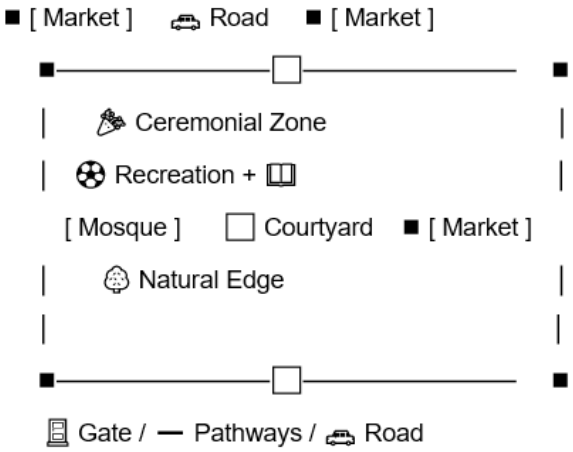

Figure 4:▲ Symbolic Layout of Ojude Oba (Vocabulary Diagram)

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Table 2: Vocabulary Elements Applied

N/s	Vocabulary Elements (Labels)	Symbol	Description
1	S (Spatial Elements)	□	Main Ojude Oba space (0.5–1.5 ha) & Courtyard (core geometry)
2	B (Boundaries)	■	Boundaries defined by markets & roads
3	E (Edges)		Natural edges with trees and garden features
4	P (Paths)		Access via multiple gates/roads
5	PW		Pathway
6	V		Vehicular road
7	CS		Ceremonial festival space
8	R		Recreational play
9	M		Learning (Madrasat)
10	CG		Communal gathering

Ojude Balogun

Ojude Balogun in Ilorin is smaller than Ojude Oba and is surrounded by traditional buildings. The space is filled with sand and has no tarred sections. The Baloguns are traditional chiefs or warlords and are classified into four groups, each associated with a specific tribe in Ilorin. Ojude Balogun Fulani belongs to the Fulani tribe, Ojude Balogun Gambari to the Hausa tribe, while Ojude Balogun Alanamu and Ojude Balogun Ajikobi are associated with the Yoruba tribe. A typical example of these Ojudes is illustrated in Figure 4.5. Despite their tribal distinctions, the four types of Ojude Balogun share similar characteristics and physical features that influence children's activities, as shown in Figures 6 (a) and (b) and table 3 - 4.

Islamic and cultural events are commonly organized within these Ojudes, attracting children and adults from different areas to witness and participate in the activities. Observations from the site show children engaging in various forms of play at Ojude Balogun Fulani. Children creatively interact with the physical properties of the space, especially the sandy surface, which forms the main environmental feature of the Ojude. They use the sand to create and recreate play elements, generating unique play experiences within the environment.

One important event frequently held in these Ojudes is Maolud Nabiy, the celebration of the birth of the Holy Prophet. Through such events, the Ojude functions as an important ceremonial space within the community. In addition to ceremonial roles, the Ojude also performs security and residential functions. Among the Balogun Ojudes, only Ojude Balogun Gambari and Ojude Balogun Alanamu have markets located nearby. Generally, many residents live around these traditional public spaces, making them important communal environments that support social interaction, cultural expression, and children's everyday activities.

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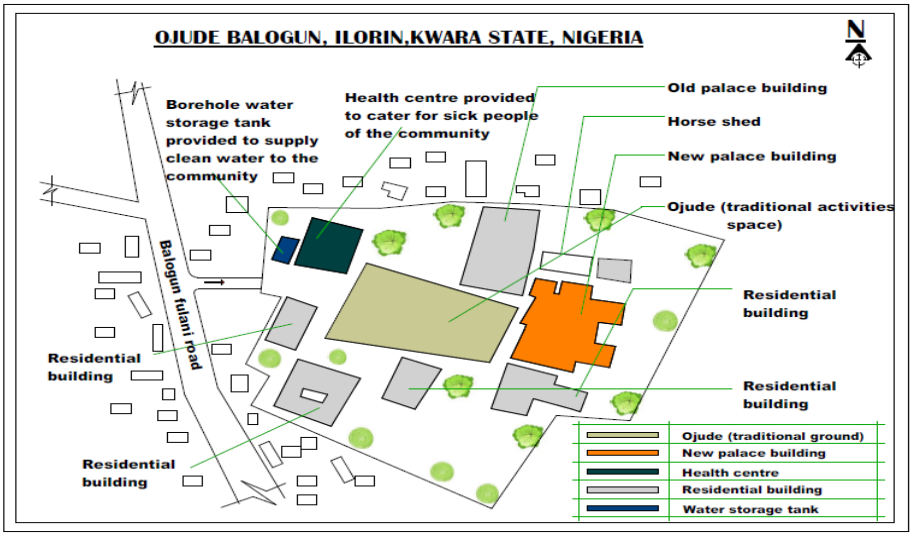

Figure 5: A typical site plan Ojude balogun showing children activities area in relation to the neighbouring residents around it

Figure 6: (a) Children playing in (a) Ojude Balogun Fulani

Figure 6: (b) Children playing in (b) Ojude Balogun Gambari

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Table 3: Ojude Balogun Spatial Typology

Ojude Spatial Typologies	Description	Symbolic Representation (Vocabulary Elements)
Courtyard Geometry (Size, Proportion, Orientation)	0.4–1.0 hectares; smaller compared to Ojude Oba; located near Ojude Oba; compact orientation	□ Medium Courtyard (nested near core)
Edge Definition (Fences, Walls, Natural Boundaries)	Natural edges 🌳 (trees, sand); markets (Oja Alanamu, Oja Gambari) adjacent; sense of place attachment	■ Market Edge + 🌳 Natural Boundaries
Access Points (Gates, Pathways, Thresholds)	Decorated 🚪 elaborate entrances; accessible within 500m; major road in front	🚪 Elaborate Gate + ━ Pathways + 🚗 Road Front
Functional Zoning (Ceremonial, Recreational, Gathering Areas)	Informal recreation ⚽ (football, alo, ten-ten, moonlight tales); acrobatics (takitiobo); communal gatherings 👥	⚽ Recreational Core + 🤸 Acrobatics + 👥 Gathering Zone

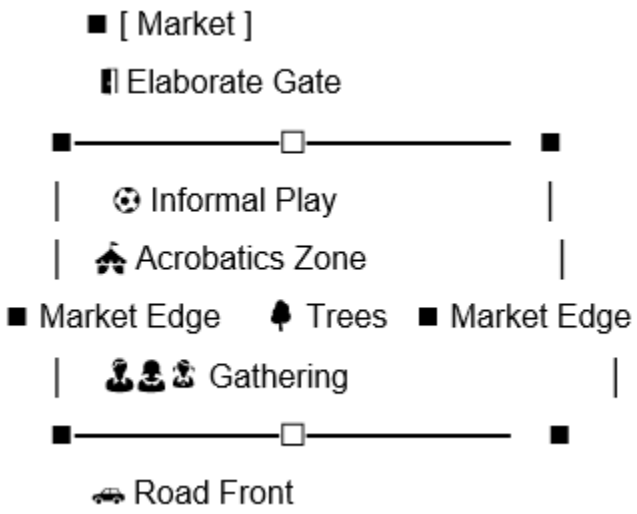

Figure 7:▲ Symbolic Layout of Ojude Balogun (Vocabulary Diagram)

Table 4: Vocabulary Elements Applied

N/s	Vocabulary Elements (Labels)	Symbol	Description
1	S (Spatial Elements)	□	Courtyard (core geometry)
2	B (Boundaries)	■	Boundaries defined by markets & roads
3	E (Edges)	🌳	Natural edges with trees and garden features
4	P (Paths)	🚪	Access via Decorated entrance gates/roads
5	PW	━	Pathway
6	V	🚗	Vehicular road
7	R	⚽	Recreational play
8	M	🕮	Learning (Madrasat)
9	CG	👥	Communal gathering

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Ojude Waasi

Ojude Waasi is characterised by a mosque close to it as showcased in Figure 8. Islamic preaching is normally organised, especially during the month of Ramadan. During this period child followed their parents to learn about the norms and ethics of Islam which is the predominant religion in Ilorin. However, the activity in this space is dominated by children play shown in Figure 9 and table 5 -6 for the remaining months after Ramadan.

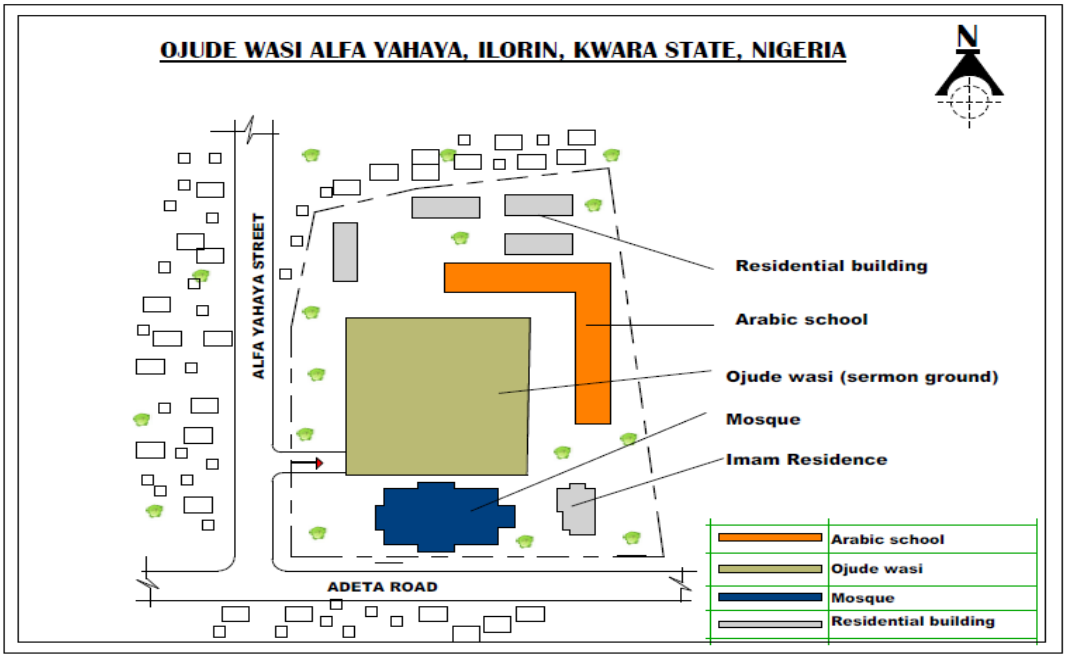

Figure 8: Ojude Wasi showing other important buildings around the space

Figure 9: Ojude Wasi showing children playing around and interacting with adults

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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Table 5: Ojude Wasi Spatial Typology

Ojude Spatial Typologies	Description	Symbolic Representation (Vocabulary Elements)
Courtyard Geometry (Size, Proportion, Orientation)	0.5–1.0 hectares; medium-sized open space; often aligned close to the mosque; serves as temporary congregation zone	☐ Medium Courtyard (adjacent to 🕌 Mosque)
Edge Definition (Fences, Walls, Natural Boundaries)	Surrounded by residential clusters 🏘; soft boundaries 🌳; open and communal without heavy walls	🏘 Residential Edge + 🌳 Natural Boundary
Access Points (Gates, Pathways, Thresholds)	Walking access 🚶; freely permeable; mosque frontage as symbolic threshold 🚪	🚪 Symbolic Threshold + ━ Pathways
Functional Zoning (Ceremonial, Recreational, Gathering Areas)	Used periodically for Ramadan 🌙 sermons; Islamic programs 🕮; informal recreation ⚽ (football, ten-ten); children's collective play 👫	🌙 Ramadan Use + 🕮 Islamic Learning + ⚽ Recreation + 👫 Children's Play

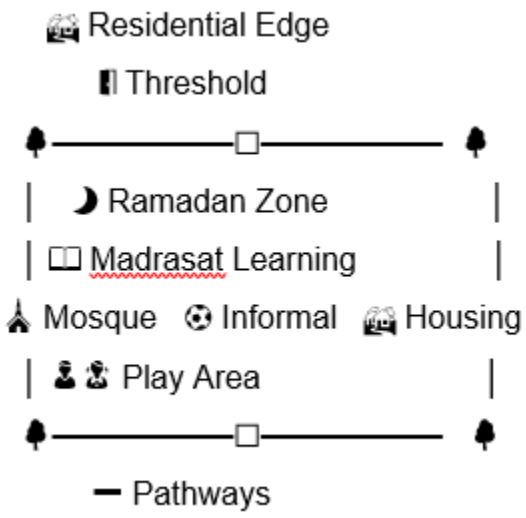

Figure 10:▲ Symbolic Layout of Ojude Wasi (Vocabulary Diagram)

Table 6: Vocabulary Elements Applied

N/s	Vocabulary Elements (Labels)	Symbol	Description
1	S (Spatial Elements)	☐	Courtyard (core geometry)
2	R (Boundaries)	🏘	Residential edges
3	E (Edges)	🌳	Natural edges with trees and garden features
4	P (Paths)	🚪	Access via multiple gates/roads/ Symbolic threshold (mosque-front)
5	PW	━	Pathway
6	V	🚗	Vehicular road

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7	CS		Ceremonial festival space
8	R		Recreational play
9	M		Learning (Madrasat)
10	CG		Communal gathering/ Children's collective play
11	MA		Mosque adjacency
12	RD		Ramadan/periodic use

Ojude Magaji

Ojude Magaji is another type of public space in Ilorin attached to the resident of district head, also known as Magaji. Ojude Magajis is more of neighbourhood public space in the traditional concept with hundreds of its types available within Ilorin, with specific historical sites in Ilorin city. It has historical background related to mermaids and is also bounded by a market called Idi-ape market.

The children of the market user are the major user of the space as shown in Figure 11, where they engage in all types of creative and exploratory play as depicted in Figure 12 and table 7 and 8.

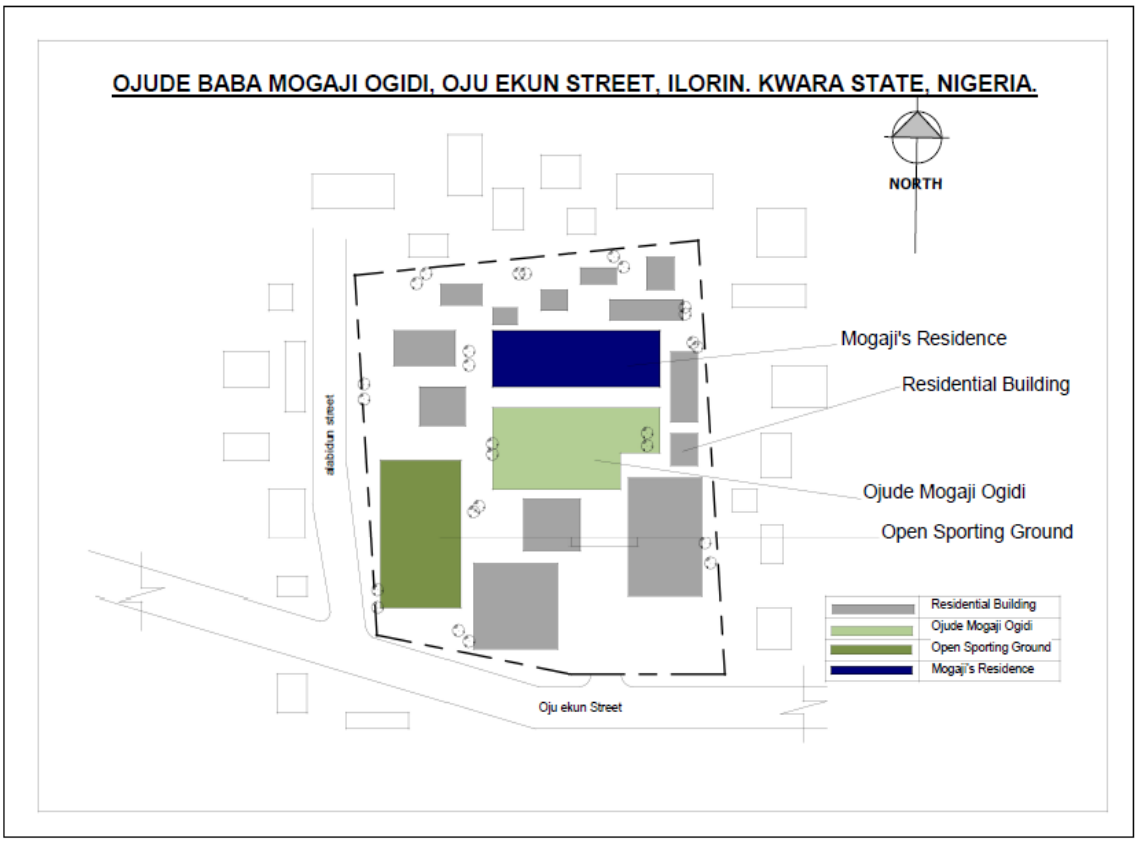

Figure 11: Ojude Magaji showing the space in relation to the neigbouring residents

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Figure 12: Ojude Magaji showing children interacting with their peers

Table 7: Ojude Magagi Spatial Typology

Ojude Spatial Typologies	Description	Symbolic Representation (Vocabulary Elements)
Courtyard Geometry (Size, Proportion, Orientation)	0.5–1.0 hectares; medium-sized communal space; embedded within a district; collective orientation for both adults and children	☐ Medium Communal Courtyard
Edge Definition (Fences, Walls, Natural Boundaries)	Surrounded by residential compounds 🏘; mosque proximity 🕌; soft natural edge 🌳; sense of shared district identity	🏘 Residential Edge + 🌳 Natural Soft Edge + 🕌 Mosque
Access Points (Gates, Pathways, Thresholds)	Freely accessible 🚶; walkable distance; permeable pedestrian entries 🚪; community-owned access ways ━	🚪 Open Gateways + ━ Community Pathways
Functional Zoning (Ceremonial, Recreational, Gathering Areas)	Mixed use: ⚽ informal play (football, ten-ten), 🕮 Islamic learning (Madrasat), 👪 collective adult-child gathering	⚽ Recreation Zone + 🕮 Learning Zone + 👪 Community Gathering

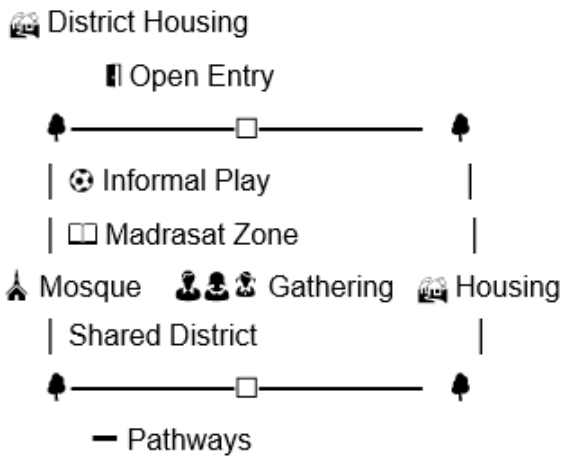

Figure 13: ▲ Symbolic Layout of Ojude Magagi (Vocabulary Diagram)

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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Table 8: Vocabulary Elements Applied

N/s	Vocabulary Elements (Labels)	Symbol	Description
1	S (Spatial Elements)	☐	Courtyard (core geometry)
2	R (Boundaries)		Residential edges
3	E (Edges)		Natural edges with trees and garden features
4	P (Paths)		Access via multiple gates/roads/ Symbolic threshold (mosque-front)
5	PW		Pathway
6	V		Vehicular road
7	CS		Ceremonial festival space
8	R		Recreational play
9	M		Learning (Madrasat)
10	CG		Communal gathering/ Children's collective play
11	MA		Mosque adjacency
12	RD		Ramadan/periodic use

Agbo-Ile

Agbo-Ile is a traditional residential large open courtyard within the setting of extended family houses. Figure 14 shows an example of a typical Agbo-Ile within neighbourhood. It is common and most accessible to children because there are more than a thousand of it within Ilorin Metropolis

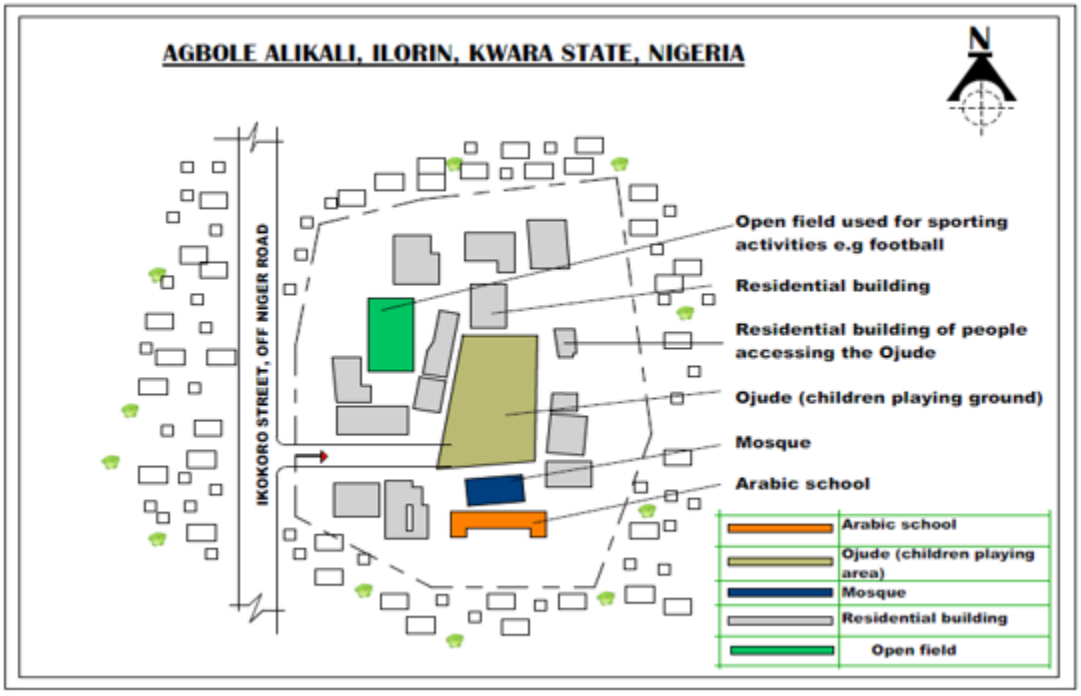

Figure 14: Agbo-Ile showing children playing football, hide and seek

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Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 59 Issue: 06:2026
DOI: 10.5281/zenodo.20700646

Having highlighted the attributes of different kinds of Ojudes, Table 9 -10 summaries main characteristics of Ojudes such as purpose and functions, access, sizes, locations, design and children activity in the spaces.

Table 9: Agbo-Ile Spatial Typology

Ojude Spatial Typologies	Description	Symbolic Representation (Vocabulary Elements)
Courtyard Geometry (Size, Proportion, Orientation)	0.1–0.5 hectares; smallest of the Ojudes; enclosed or nested courtyards within family compounds; oriented inward for children	☐ Small Enclosed Courtyard
Edge Definition (Fences, Walls, Natural Boundaries)	Enclosed by extended family houses 🏠; edges partly natural 🌳 (trees, grasses, sand); some surfaces hardened with concrete ■	🏠 Family Compound Edge + 🌳 Natural Feature + ■ Hard Surface
Access Points (Gates, Pathways, Thresholds)	Proximity-based access 🚪 for children; open and communal to family members; pathways ━ connect courtyards to homes	🚪 Family Gate + ━ Local Pathways
Functional Zoning (Ceremonial, Recreational, Gathering Areas)	Primarily for 👦👧 children's play (cycling tyres, football, ten-ten, moonlight tales); 🕌 Islamic learning corner (Madrasat); informal recreation ⚽	👦👧 Play Zone + 🕌 Learning Niche + ⚽ Informal Play

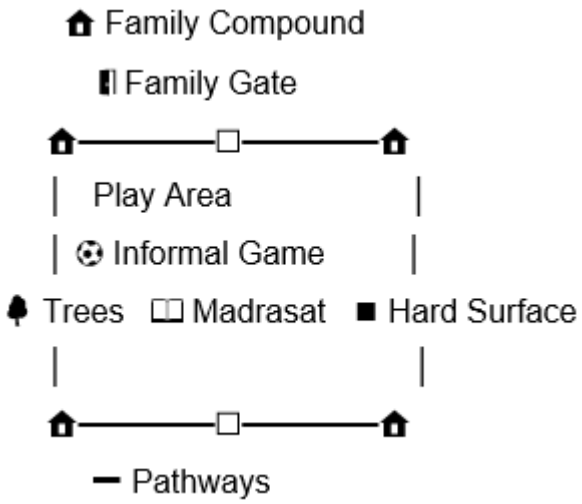

Figure 15: ▲ Symbolic Layout of Agbo-Ile (Vocabulary Diagram)

Table 10: Vocabulary Elements Applied

N/s	Vocabulary Elements (Labels)	Symbol	Description
1	S (Spatial Elements)	☐	Courtyard (core geometry)
2	R (Boundaries)	🏘	Residential edges
3	E (Edges)	🌳	Natural edges with trees and garden features
4	P (Paths)	🚪	Access via multiple gates/roads/ Symbolic threshold (mosque-front)
5	PW	━	Pathway
6	V	🚗	Vehicular road

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
Vol: 59 Issue: 06:2026
DOI: 10.5281/zenodo.20700646

7	CS		Ceremonial festival space
8	R	⚽	Recreational play
9	M	🕮	Learning (Madrasat)
10	CG		Communal gathering/ Children's collective play
11	MA		Mosque adjacency
12	RD		Ramadan/periodic use
13	S	■	Hardened surfaces (concrete)
14	H		Family houses (enclosure)

4. RESULTS AND DISCUSSION

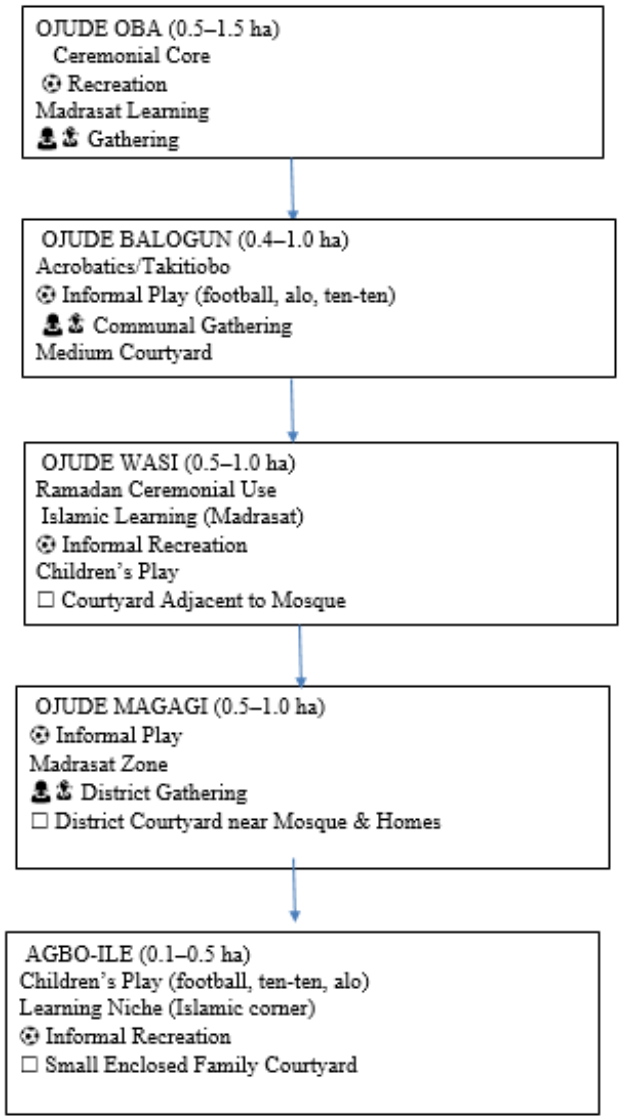

Figure 16: Comparative Conceptual Model of Ojude Public Spaces in Ilorin

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
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DOI: 10.5281/zenodo.20700646

Comparative Vocabulary Hierarchy

- ☐ **Courtyard Geometry** → progressively smaller from **Ojude Oba** (largest, ceremonial) → **Agbo-Ile** (smallest, child-centered).
- 🎉 **Ceremonial /** 🌙 **Religious Functions** → strongest in Ojude Oba (Durbar) and Ojude Wasi (Ramadan).
- ⚽ **Recreation &** 🧒🧒 **Play** → consistent across all categories, but localized in **Agbo-Ile**.
- 🕮 **Learning (Madrasat)** → distributed across all types, but scaled from communal (Ojude Oba, Wasi, Magagi) to intimate (Agbo-Ile).
- 🧍🧍🧍 **Gathering** → broader in **Ojude Oba** and **Ojude Balogun**, localized in Magagi, familial in Agbo-Ile.
- **Edges & Access** → Ojude Oba and Balogun linked to **markets/roads**, Wasi and Magagi linked to **mosques/residential clusters**, Agbo-Ile enclosed by **family houses**.

Table 11: Ojude Spatial Typologies in Ilorin City

Ojude	Courtyard Geometry	Edge Definition	Access Points	Functional Zoning
Ojude Oba	0.5–1.5 ha; central; half hardscape, half sandy; aligned with Ilorin core	Bordered by Oja Oba, Oja Idi-ape, Oja Ago; trees, gardens, horses, tortoises; strong place attachment	Accessible within 400 m/5 min; roads on three sides; pedestrian and vehicle entry	Durbar festivals; formal & informal activities; recreation, culture, Islamic learning; collective play (football, alo, ten-ten)
Ojude Balogun	0.4–1.0 ha; smaller; communal orientation	Near Alanamu and Gambari markets; natural edges with trees and sand; place attachment	Freely accessible; decorated entrances; main road at front	Informal play (football, alo, ten-ten); acrobatics (takitiobo); community gathering
Ojude Wasi	0.5–1.0 ha; periodic open spaces around mosques	Residential edges; open spaces	Walking access for nearby residents; mosque-adjacent; pedestrian thresholds	Ramadan gatherings; sermons; Islamic programs; informal play (football, ten-ten); Madrasat learning
Ojude Magagi	0.5–1.0 ha; district-level communal	Surrounded by residences; mosque nearby	Walkable; proximity to residents; informal thresholds	Communal interaction; children & adults; Islamic learning; informal play (football, ten-ten)
Agbo-Ile	0.1–0.5 ha; small, enclosed; hard surface	Enclosed by family houses; trees, grasses, sand	Access through compounds; proximity-based; household thresholds	Children's play; informal collective play; Islamic education; family gatherings

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online):0493-2137
E-Publication: Online Open Access
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DOI: 10.5281/zenodo.20700646

Table 12: Ojude Oba Spatial Typology

Dimension	Description	Symbolic Representation
Courtyard Geometry (Size, Proportion, Orientation)	Large central courtyard, 0.5–1.5 ha; half hardscape, half sandy; aligned to city core; ceremonial hierarchy emphasized	☐ Large Square (central orientation)
Edge Definition (Fences, Walls, Natural Boundaries)	Edges defined by three major markets (Oja Oba, Oja Idi-ape, Oja Ago); trees, gardens, horses, tortoises; strong cultural attachment	■ Bounded Edges 🌳
Access Points (Gates, Pathways, Thresholds)	Entry within 400 m; roads on three sides; multiple pedestrian & vehicle gates	🚸🚗 (multi-entry from 3 sides)
Functional Zoning (Ceremonial, Recreational, Gathering Areas)	Spaces for Durbar festivals, recreation, informal gatherings, football, alo, ten-ten, and Madrasat learning	🎉 Ceremonial + ⚽ Recreational + 📖 Learning

Table 13: Ojude Oba – Shape Grammar Rule Applications

Ojude Typology Element	Form Generation Rules	Transformation Rules	Motif Encoding
Courtyard (0.5–1.5 ha, central)	Ceremonial symmetry; central hierarchy	Scales for crowds; road alignment	Durbar, royal motifs
Edges (markets/mosque/trees)	Repeated stalls, boundaries	Natural or built edges	Islamic calligraphy
Access (roads/gates)	Royal–public gate hierarchy	Rotates to cardinal roads	Hausa–Fulani carvings
Zoning (ceremony/play/learning)	Ceremonial–recreation symmetry	Hardscape or sand zones	Festival motifs (horses, drums)

Table 14: Ojude Balogun – Shape Grammar Rule Applications

Ojude Typology Element	Form Generation Rules	Transformation Rules	Motif Encoding
Courtyard (0.4–1.0 ha)	Compounds repeat around space	Scales for communal gatherings	Balogun warlord motifs
Edges (markets/trees/sand)	Symmetry of stalls, shade	Natural shade or kiosks	Cowries, gourds
Access (gates/road)	Ceremonial vs pedestrian hierarchy	Rotates to main road	Hausa arch motifs
Zoning (acrobatics/play)	Repeated play courts	Stage or recreation zones	Acrobatics symbols

Table 15: Ojude Wasi – Shape Grammar Rule Applications

Ojude Typology Element	Form Generation Rules	Transformation Rules	Motif Encoding
Courtyard (0.5–1.0 ha, mosque-adjacent)	Symmetry with mosque frontage	Scales for congregations	Islamic star motifs
Edges (residential/mosque)	Hierarchical mosque–house alignment	Mosque wall or open edge	Qur'anic inscriptions
Access (mosque threshold)	Central mosque gate hierarchy	Rotates to qibla	Arch, prayer symbols
Zoning (Ramadan/play)	Prayer > play hierarchy	Seasonal prayer scaling	Ramadan lantern motifs 🌙

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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ISSN (Online):0493-2137
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Table 16: Ojude Magagi – Shape Grammar Rule Applications

Ojude Typology Element	Form Generation Rules	Transformation Rules	Motif Encoding
Courtyard (0.1–0.5 ha)	Symmetry in family units	Scales to extended family	Lineage, compound motifs
Edges (houses/trees)	Repeated enclosure edges	Trees substitute walls	Yoruba gable motifs
Access (gates/paths)	Hierarchical thresholds	Rotates with layout	Totems, door carvings
Zoning (play/learning)	Repeated play corners	Play–learning substitution	Moonlight, child symbols

Table 17: Agbo-Ile – Shape Grammar Rule Applications

Ojude Typology Element	Form Generation Rules	Transformation Rules	Motif Encoding
Courtyard geometry (0.1–0.5 ha, family-enclosed)	Symmetry within nested family units	Scaling to extended family size	Family lineage and compound motifs
Edge definition (houses, trees, grasses)	Repetition of house edges forming enclosure	Substitution: trees or walls	Yoruba gable-end motifs
Access points (family gates, small paths)	Hierarchical family thresholds	Rotation aligning with compound layout	Household totems and door carvings
Functional zoning (children play, learning)	Repetition of play corners in courtyard	Substitution: play and learning zones	Moonlight tale and child symbols

5. DISCUSSION

The findings of this study in the table 11 - 17 reveal that Ojude public spaces in Ilorin possess identifiable spatial hierarchies and components that can be systematically analyzed using computational shape grammar. In line with the study objectives, the research identified and classified key typologies—Ojude Oba, Ojude Balogun, Ojude Wasi, Ojude Magaji, and Agbo-Ile—and examined spatial elements such as courtyard geometry, edges, access points, and functional zoning. The results show that these spaces follow a generative spatial logic in which larger spaces like Ojude Oba function as ceremonial and socio-economic centers, while smaller spaces such as Agbo-Ile support neighborhood and family activities.

These findings largely agree with previous studies on shape grammar and generative urban design. X. Wang (2020) demonstrated that urban spatial patterns can be extracted and transformed into rule-based systems capable of reproducing urban forms. Similarly, M. Mandić (2015) argued that shape grammar enables the decomposition of urban forms into spatial elements and rules for typological classification. The results also align with Ling Yang (2023), who showed that rule-based generative methods can preserve historic spatial patterns. Furthermore, the morphological interpretation corresponds with the computational urban morphology approach of P. Schirmer, which emphasizes that traditional urban spaces contain underlying spatial rules. However, unlike many studies focused on formal urban blocks, this research highlights culturally embedded public spaces as generators of urban form. Future research should integrate GIS, parametric modeling, and AI to further simulate and preserve traditional spatial systems.

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6. CONCLUSION

The study concludes that Ojude spaces embody socio-cultural and behavioral influences on community life, particularly children's development. It recommends integrating computational shape grammar models into heritage preservation and urban design strategies to sustain these culturally significant public spaces.

References

1) Adegbile, M. B., & Okewole, I. A. (2020). Urban heritage and the transformation of public spaces in Nigerian cities. *Journal of African Urban Studies, 12*(2), 45–60.

2) Afon, A. O., Adepoju, O., & Adegun, O. B. (2020). Traditional public open spaces: Concept, values and functions. *Journal of Contemporary Urban Affairs, 4*(1), 89–102. *https://doi.org/10.25034/ijcua.2020.v4n1-9*

3) Chisholm, H. (Ed.). (1911). *Encyclopædia Britannica* (11th ed., Vols. 1–29). Cambridge University Press. *https://archive.org/details/encyclopaediabri11chisrich*

4) Falade, J. B. (2017). Traditional public spaces and urban governance in Yoruba cities. *International Journal of African Architecture, 5*(1), 33–50.

5) Lawal, M. O. (2018). Socio-cultural meanings of thresholds in Yoruba urbanism. *Nigerian Journal of Built Environment Research, 9*(3), 55–72.

6) Low, S. M. (2017). *Spatializing culture: The ethnography of space and place*. Routledge. *https://doi.org/10.4324/9781315671277*

7) Mukarubega, A. (2019). Computational tools for African vernacular architecture: Challenges and opportunities. *African Journal of Architecture and Planning, 4*(2), 77–93.

8) Nochian, A., Tahir, O. M., Maulan, S., & Ngesan, M. R. (2015). A comprehensive public open space categorization using classification system for sustainable development of urban public open spaces. *Modern Applied Science, 9*(6), 1–16. *https://doi.org/10.5539/mas.v9n6p1*

9) Oloukoi, G., Jeje, L. K., & Akinluyi, F. O. (2014). Urban flood risk and adaptation in Nigeria: A case study of Ilorin. *Journal of Environmental Planning and Management, 57*(9), 1387–1405. *https://doi.org/10.1080/09640568.2013.819599*

10) Omoiya, M. B. (2009). *The socio-cultural role of Ojude Balogun Fulani in Ilorin South*. Ilorin: University of Ilorin Press.

11) Osasona, C. O. (2020). Vernacular courtyards in Nigeria: Cultural logics and contemporary relevance. *Journal of Architecture in Africa, 8*(1), 20–39.

12) Stiny, G. (2006). *Shape: Talking about seeing and doing*. MIT Press.

13) Zhu, Y., Zhang, X., & Zheng, Y. (2021). A classification framework for public open space using spatial and functional characteristics: Integrating big data and hierarchical clustering. *Sustainable Cities and Society, 69*, 102853. *https://doi.org/10.1016/j.scs.2021.102853*

14) Adegbile, M. B., & Okewole, I. A. (2020). Urban heritage and the transformation of public spaces in Nigerian cities. *Journal of African Urban Studies, 12*(2), 45–60.

15) Afon, A. O., Adepoju, O., & Adegun, O. B. (2020). Traditional public open spaces: Concept, values and functions. *Journal of Contemporary Urban Affairs, 4*(1), 89–102. *https://doi.org/10.25034/ijcua.2020.v4n1-9*

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16) Falade, J. B. (2017). Traditional public spaces and urban governance in Yoruba cities. *International Journal of African Architecture, 5*(1), 33–50.

17) Lawal, M. O. (2018). Socio-cultural meanings of thresholds in Yoruba urbanism. *Nigerian Journal of Built Environment Research, 9*(3), 55–72.

18) Nochian, A., Tahir, O. M., Maulan, S., & Ngesan, M. R. (2015). A comprehensive public open space categorization using classification system for sustainable development of urban public open spaces. *Modern Applied Science, 9*(6), 1–16. *https://doi.org/10.5539/mas.v9n6p1*

19) Oloukoi, G., Jeje, L. K., & Akinluyi, F. O. (2014). Urban flood risk and adaptation in Nigeria: A case study of Ilorin. *Journal of Environmental Planning and Management, 57*(9), 1387–1405. *https://doi.org/10.1080/09640568.2013.819599*

20) Osasona, C. O. (2020). Vernacular courtyards in Nigeria: Cultural logics and contemporary relevance. *Journal of Architecture in Africa, 8*(1), 20–39.

21) Stiny, G. (2006). *Shape: Talking about seeing and doing*. MIT Press.

22) Zhu, Y., Zhang, X., & Zheng, Y. (2021). A classification framework for public open space using spatial and functional characteristics: Integrating big data and hierarchical clustering. *Sustainable Cities and Society, 69*, 102853. *https://doi.org/10.1016/j.scs.2021.102853*

23) Schirmer, P. (2015). *Urban morphology and computational analysis of spatial structures*. Journal of Urban Design, 20(4), 1–15.

24) Mandić, M. (2015). Analysis of shape grammar application as a tool for urban design. *Urban Design International, 20*(3), 215–228. https://doi.org/10.1057/udi.2015.8

25) Wang, X. (2020). Generative urban design using shape grammar and block morphological analysis. *Frontiers of Architectural Research, 9*(4), 702–717. *https://doi.org/10.1016/j.foar.2020.09.001*

26) Yang, L. (2023). A generative urban space design method based on morphological analysis and shape grammar. *Land, 12*(6), 1167. *https://doi.org/10.3390/land12061167*

27) Low, S. (2017). *Public space and urban culture: Spatial practices and social meaning*. Routledge.

28) Olakanbi, A. B. (2025). *Yoruba architectural design generative system: A machine learning approach using shape grammar and Teachable Machine models*. *International Journal of Advanced Natural Sciences and Engineering Researches*, *9*(4), 5–27. Retrieved from *https://as-proceeding.com/index.php/ijanser/article/view/2620*

29) Olakanbi, A. B., Abdullahi, A. L., Zakari, A., Yaradua, A. M., Nseabasi, A. E., Danlami, N. J., & Hassan, T. A. (2025). Computational analytical mapping of spatial organization in Kano Metropolis: A shape grammar approach to traditional Hausa houses. *SSR Journal of Artificial Intelligence (SSRJAI)*, *2*(2), 63–85. https://doi.org/10.5281/zenodo.15763824