ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering | e–ISSN: 2067 – 3809
Tome XIX [2026] | Fascicule 3 [July – September]

[1.] Solagbade P. ADISA, Emmanuel A. OLAJUBU, Caleb O. AKANBI, Jacob B. EKUEWA

DIGITIZING YORUBA CULTURE: A MOBILE APPLICATION MODEL FOR E–ENCYCLOPAEDIA

[1.] Federal Polytechnic Ede, Obafemi Awolowo University Ile–Ife, Osun State University, Federal Polytechnic Ede, NIGERIA

Abstract: This study explored the digitization of Yorùbá cultural heritage through the development of a mobile application model for a Yorùbá e–Encyclopaedia. Cultural data were collected from selected cities in Yorùbáland, including Ilé–Ifẹ̀, Ògbómọ̀ṣó, and Ọ̀yọ́, using in–depth interviews with elders and record inspections. The mobile application was modeled with Unified Modeling Language (UML) and implemented using Python and MySQL. An administrative section, developed with HTML5, PHP, and MySQL, was integrated to enable administrators to review and approve user–submitted information, such as town names and cultural records, before inclusion in the system. The performance of the application was evaluated using response time and throughput as key metrics. Findings showed an average response time of 16.80 milliseconds, with throughput values ranging from 148 to 2.16×10^7 bps depending on network signal strength. The results demonstrate that the developed Yorùbá e–Encyclopaedia is efficient and effective in enhancing global accessibility to Yorùbá history and culture, thereby supporting cultural preservation and informed decision–making.

Keywords: Yorùbá culture, e–Encyclopaedia, Cultural Heritage Digitization, Knowledge Management, Decision Support.

INTRODUCTION

Information technology has become a major driver of economic growth and societal development in both developed and developing nations. Countries with limited advancement in information technology often face challenges in achieving sustainable development, as access to information plays a central role in shaping knowledge, decision-making, and cultural identity. Information is not only an economic resource but also a vital vessel for preserving and promoting cultural heritage (Adewumi & Sani, 2025). For instance, access to accurate cultural information can prevent costly socio-economic missteps. A business enterprise planning to establish a pork meat industry in northern Nigeria, where pork consumption is prohibited by Islamic tradition, would face inevitable failure without prior knowledge of the cultural and religious context. Such examples underscore the importance of accessible and reliable cultural information for informed decision-making.

Encyclopaedias have historically served as essential reference tools for disseminating knowledge across disciplines. The term encyclopaedia, derived from the Classical Greek enkyklios paideia (meaning "well-rounded education"), represents a repository of general or specialized knowledge. While traditional print encyclopaedias provide valuable content, they are constrained by physical reach, static content, and limited accessibility. In contrast, digital encyclopaedias, particularly mobile-based platforms, offer a dynamic and globally accessible alternative. The word itself is defined by Encyclopaedia Britannica as "a reference work that contains information on all branches of knowledge or that treats a particular branch comprehensively" (Encyclopaedia Britannica, n.d.). This study situates the development of a Yorùbá cultural e-Encyclopaedia within this context, addressing the gap in digital representation of Yorùbá history and culture.

The Yorùbá language is spoken by approximately 47 million people worldwide, including first- and second-language speakers, across Nigeria, Benin, Togo, and diaspora regions such as Brazil, Cuba, and Trinidad and Tobago (Database of Spoken Languages [DBS], 2024). It is one of Nigeria's major languages and is widely used in education, media, and cultural practices. Its significance is not only linguistic but also cultural, as language and heritage remain deeply intertwined. Culture, broadly defined in anthropology as the patterns of behavior, thought, and expression that members of a social group learn and share, encompasses language, belief systems, customs, rituals, and governance structures. These attributes distinguish one community from another and serve as the foundation of identity (Blom, 2005; John, 2012). For the Yorùbá people, culture and language are inextricably linked, underscoring the need for a robust digital platform to preserve and disseminate this heritage. The rapid evolution of mobile technology provides a suitable platform for this endeavor. From the first handheld mobile phone demonstrated by Motorola in 1973 to the

widespread adoption of smartphones in the 21st century, mobile devices have become indispensable tools for communication, education, and information dissemination. Today, advances in mobile technologies, such as GSM, GPRS/EDGE, GPS, Wi-Fi, and Bluetooth have expanded their capabilities far beyond telephony to include applications for education, business, and cultural preservation. Digital platforms are increasingly recognized as efficient means of reviving fading African traditions and customs, further highlighting their role in cultural sustainability (Guardian, 2024). However, digital inclusion challenges persist, particularly in Nigeria, where the high cost of smartphones limits accessibility to mobile-based cultural resources (Nairametrics, 2024).

Despite the cultural significance of the Yorùbá people, their traditions, history, and norms remain underrepresented in globally accessible digital media. This lack of representation not only affects cultural preservation but also has socio-economic implications, such as reduced tourism and investment in Yorùbáland. To address this gap, this study focuses on the development of a mobile-based e-Encyclopaedia that documents and disseminates Yorùbá history and culture. The system is designed to serve as an educational and research tool while also providing reliable cultural information to investors, policymakers, and tourists. By enhancing the accessibility of Yorùbá cultural knowledge, the e-Encyclopaedia has the potential to foster cultural preservation, support socio-economic growth, and contribute to Nigeria's internally generated revenue.

The objectives of this study are to elicit cultural data from selected cities in Yorùbáland (Ilé-Ifẹ̀, Ògbómòṣọ́, and Ọ̀yọ́), develop a mobile application model for a Yorùbá e-Encyclopaedia based on the elicited data, and evaluate its performance using response time and throughput as metrics. This study seeks to develop an easily accessible application that will promote the propagation of Yorùbá culture on the Internet while also serving as a decision-support tool for investors by providing insights into suitable locations and types of investments across towns in Yorùbáland.

RELATED WORKS

Several studies have demonstrated the role of mobile technologies in enhancing access to information across diverse domains. For instance, Phillip (2007) developed a mobile healthcare delivery system (MHDS) where mobile devices facilitated secure access to medical records, illustrating the potential of mobile platforms in sensitive and high-value sectors. Similarly, Simon (2012) examined mobile learning (m-learning) supported by PDAs, mobile phones, and web servers, emphasizing the importance of content adaptation and interoperability standards such as XML, SCORM, and XHTML. These works reveal that mobile technologies can transform traditional knowledge dissemination but were largely domain-specific (health and education), leaving cultural heritage relatively underexplored.

In the heritage domain, Corcho et al. (2022) designed and evaluated a mobile application for the UNESCO heritage site "Padova Urbs Picta," highlighting how mobile tools can enhance visitor engagement. Ramos Jiménez et al. (2025) extended this approach by establishing criteria for designing mobile applications to support cultural heritage tourism in Riobamba, Ecuador. Both studies affirm the value of mobile applications in tourism and cultural promotion but are geographically restricted to Europe and Latin America, with limited focus on African contexts.

User experience and interactivity have also been emphasized. Othman et al. (2024) analyzed a cultural heritage progressive web app using a hybrid UEQ-IPA approach, identifying key usability metrics for improving satisfaction. Meanwhile, Scandurra et al. (2025) introduced *InHeritage*, a gamified application integrating augmented reality (AR) and virtual reality (VR) to preserve cultural heritage in the metaverse. While these studies demonstrate innovative design and immersive technologies, they are resource-intensive and may not suit regions with limited digital infrastructure, such as parts of Sub-Saharan Africa.

Recent initiatives in Africa and beyond point to a growing recognition of cultural preservation through digital tools. UNESCO (2022) provided global policy guidelines for safeguarding intangible cultural heritage in the digital era, while Xinhua (2024) reported Namibia's launch of a mobile archival app to protect its heritage. Similarly, HumanIPO (2024) documented Nigeria's Centenary Project mobile app designed to showcase national history. These examples highlight progress but tend to focus on commemoration or high-level policy rather than localized, community-driven cultural repositories. Complementing these, Martusciello et al. (2025) proposed a reference architecture integrating generative AI and AR into cultural heritage apps, while Zhou et al. (2023) emphasized cloud-based cultural informatics for interoperability. However, both studies remain more conceptual or infrastructure-driven, with limited grounding in indigenous African cultural contexts.

Despite the breadth of these studies, several gaps remain. First, most cultural heritage mobile applications focus on tourism or museum contexts, with limited emphasis on community-driven cultural knowledge preservation. Second, there is insufficient representation of African indigenous cultures, particularly the Yorùbá, in globally accessible digital platforms. Third, while advanced

features such as AR, VR, and AI are promising, they may not be practical in regions with unstable connectivity, necessitating lightweight, accessible designs. Finally, few studies integrate an administrative approval process to ensure cultural data accuracy and authenticity, which is critical in preserving the integrity of heritage content.

These gaps highlight the need for a mobile e-Encyclopaedia that not only digitizes Yorùbá cultural knowledge but also balances accessibility, authenticity, and performance. The present study addresses this by eliciting cultural data from Yorùbáland, developing a mobile application model with an administrative backend, and evaluating its technical performance.

3. METHODOLOGY

This study adopted a design science research (DSR) approach, which is suitable for developing and evaluating information systems artifacts. The research process was divided into three major phases: data collection, system design and development, and system evaluation.

A. Data Collection

Cultural data were elicited from selected cities in Yorùbáland, namely Ilé-Ifè, Ògbómòsọ́, and Ọ̀yọ́. Primary data were gathered through in-depth interviews with elders, cultural custodians, and community leaders. The interviews focused on cultural practices, traditions, town histories, and heritage symbols. Secondary data were collected from archival records, published works, and cultural documentation available in local repositories. The combination of oral and written sources ensured data triangulation and improved validity.

B. System Architecture

The proposed Yorùbá e-Encyclopaedia system adopts a three-tier architecture comprising the presentation layer, application logic, and database layer (Fig 2). This architecture ensures scalability, reliability, and efficient interaction between end-users and administrators.

At the presentation layer, two main interfaces are provided:

- **Mobile Application**: Designed for general users, the mobile app enables seamless access to Yoruba cultural heritage information. Built with React Native (or Flutter as an alternative), it communicates with the backend through RESTful APIs.
- **Web Portal**: Intended for administrators, the web-based application developed using PHP and HTML5/CSS3/Bootstrap provides functionalities for verifying, approving, and updating content.

The application logic layer acts as a middleware that processes user and admin requests. It is implemented using Python (Flask framework) for handling mobile API requests and PHP for web requests. This layer ensures secure authentication, validation of input data, and coordination of information flow between the presentation layer and the database.

The database layer serves as the central repository of cultural heritage content. It is implemented using MySQL due to its robustness, scalability, and compatibility with both Python and PHP environments. The database stores historical records, town descriptions, cultural practices, multimedia content, and user-generated contributions.

In operation, users interact with the mobile app to search or contribute cultural information. Requests are routed through the application logic, which retrieves or stores data in the database. Similarly, administrators access the system via the web portal, where they perform moderation, content management, and system monitoring.

This layered architecture provides a clear separation of concerns, enhances system maintainability, and ensures that both mobile users and administrators can efficiently interact with the Yoruba e-Encyclopaedia platform.

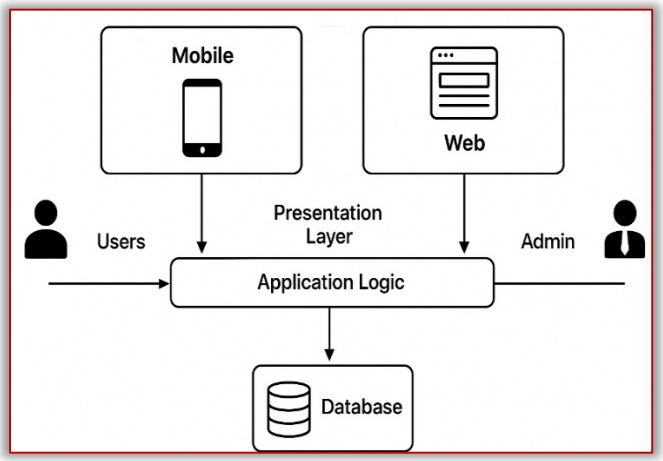

Figure 1: System Architecture of Yoruba e–Encyclopaedia Mobile Application Model

System Design

The mobile application model for the Yorùbá e-Encyclopaedia was designed using the Unified Modeling Language (UML)(shown in Fig 3,4,5) to capture system requirements and workflows. The model included both the user-facing mobile application and an administrative back-end system.

- **Mobile Application Development (User Section)**: Implemented using Python for the core logic and MySQL as the database management system. The mobile app interface was designed to support interactive access to cultural information, search functionality, and multimedia content. The flowchart shown in Figure 6 describes how user can move within the application. User has two operations to perform to either view the existing information or add missing information.

When user sent a query to view the existing information via the network then network send it to server. If it is request to view existing information then result would will be received by displaying it for the user via the mobile device. If it is request to add missing information then the information will be added and process end.

— **Administrative Back-End (Admin Platform):** Developed with HTML5, PHP, and MySQL. This module allows administrators to review, verify, and approve new submissions from users, such as the addition of towns, historical facts, or cultural practices, before publication. The flowchart shown in Figure 3.6 describes the movement of the Web administrator within the application and also explains the main function of the administrator. Admin sent query to the server through network then, server processed it, since two queries can be sending from admin, either to add more information or check the information added by the user. If the admin sent a request to add more information, then the record will be added to the server. If the request is to check the record sent by the user, then the admin checks the correctness of the information before granting it. If the information is not correct then the admin discards it but if admin can assure the correctness of that information the admin granting it and update the record.

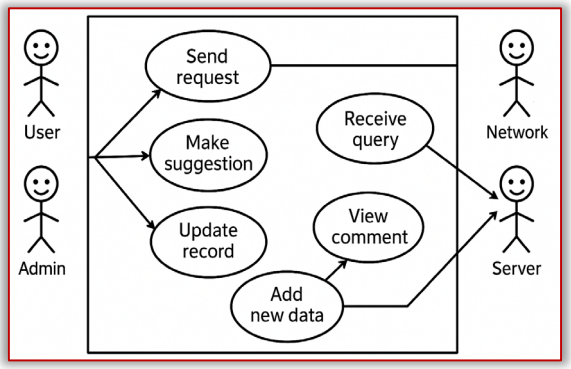

Figure 2: Use case Diagram

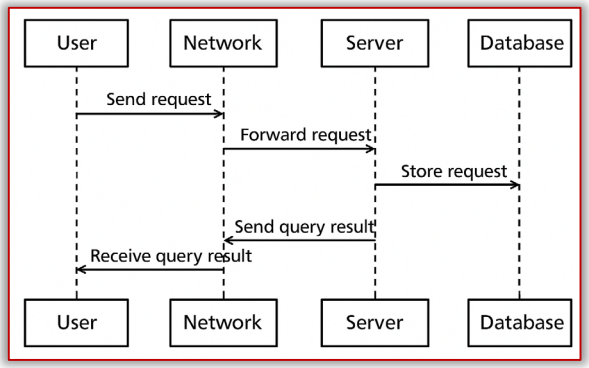

Figure 3: Sequence Diagram

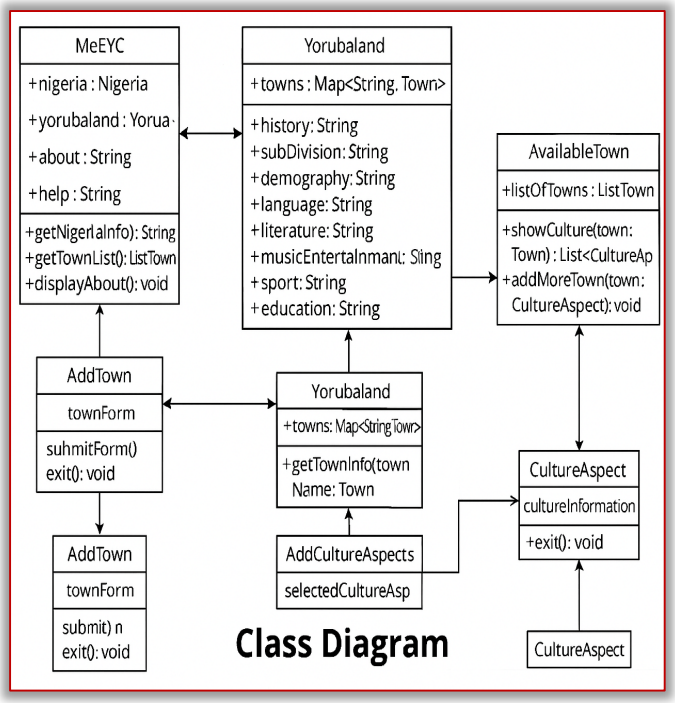

Figure 4: Class Diagram

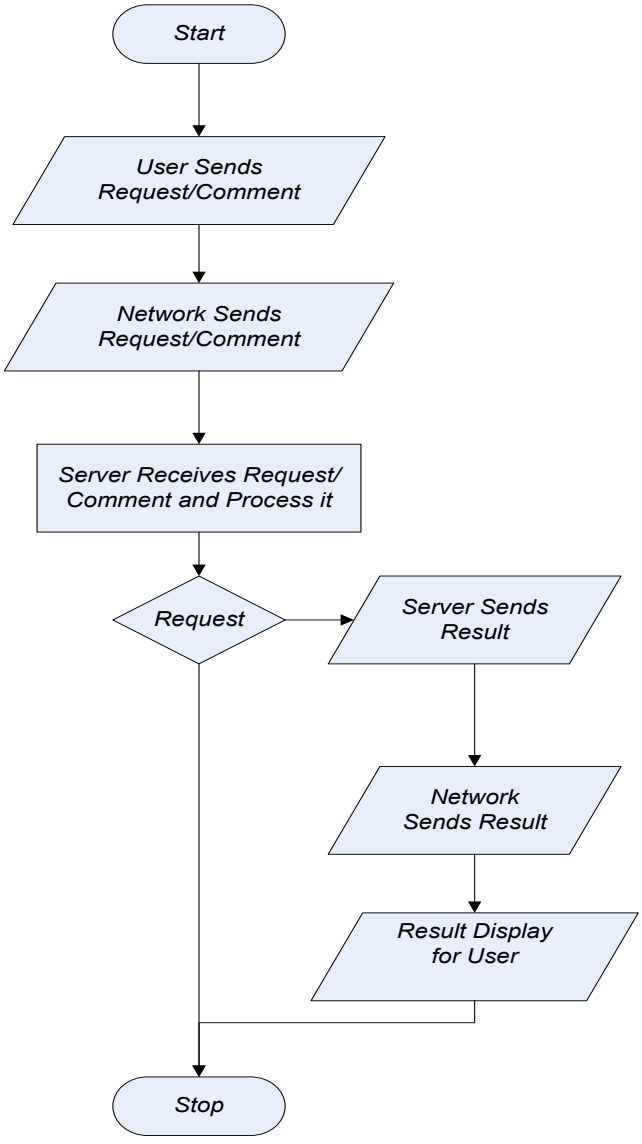

Figure 5: Flowchart For User Operation

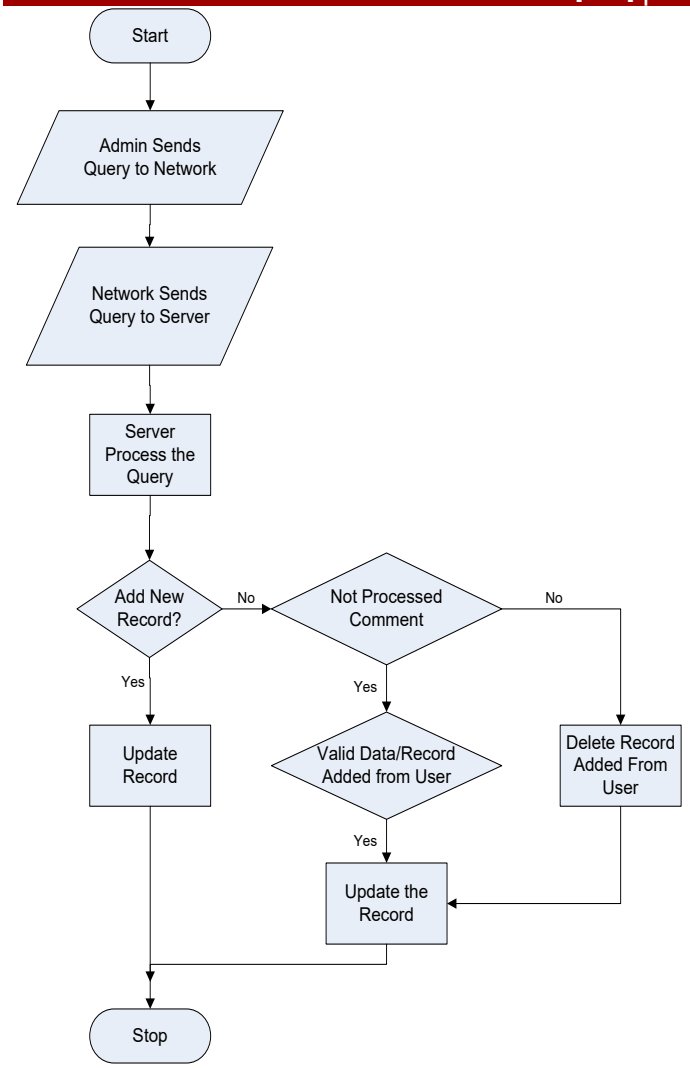

Figure 6: Flowchart for Admin Operation

D. Implementation

— **User Interface:** User decides on operation to perform; either to views an existing query or send a missing subject. User views an existing information by launching the application and go to specific information he/she intends to view as shown in Figure 7(A), then the information displayed base on clicked item. For example, in figure 7(B) shown that the user clicked 'Nigeria' from the list of item displayed when the application was opened. Then, the user also clicked on 'history' just to check the history of Nigeria and is shown in figure 7(C). When the user clicked on 'Yoruba Land' on figure 7(A), the alphabet from A to Z will be displayed showing the first character of each town in Yoruba land. When the user clicks on 'I' the system displayed the list of towns starting with 'I' shown in figure 7(E). Figure 7(F) displayed the occupation information of Ile-Ife as one of their aspects of culture.

Adding new town screen is used to suggest additional town that was not found on the system at the time of visiting. The user can made his/her suggestion known to admin, in other to check it for the approver, which will be available for the consequent users. User clicks on add new town button (Figure 8A) and a form will be displayed, then user fills the form and submit (Figure 8B).

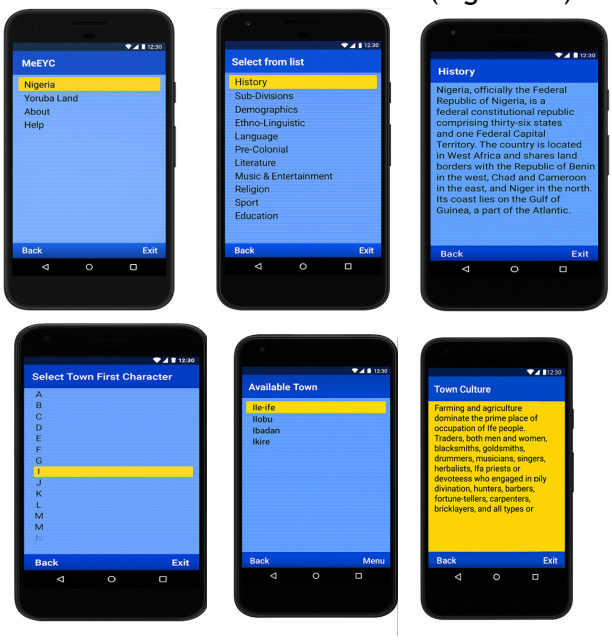

Figure 7: User interface

New culture can also be added by the user, when the user have cultural information about a particular town that was not available on the application then the user can make his/her suggestion by adding it to the database, then, admin will administer it and make it available for the subsequent users if the information is correct. User clicks on add new culture button and a form will be displayed then user fills the form and submit, an acknowledge page will be displayed as shown (Figure 8C).

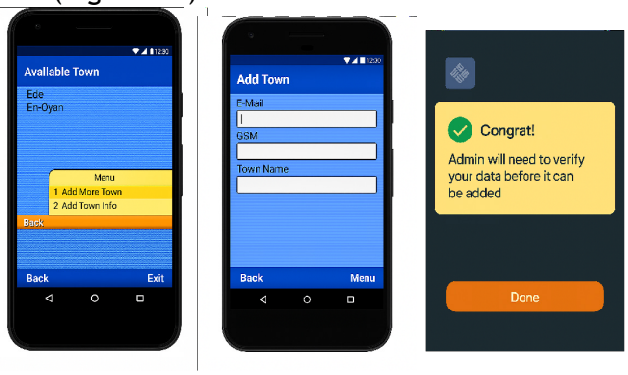

Figure 8: Add New Details

— **Admin Interface:** The Admin Interface is designed to operate on a personal computer equipped with a web browser and internet connectivity. This page enables administrators to thoroughly review information submitted by users and approve it if deemed appropriate. Additionally, the admin can contribute new data regarding towns or cultural aspects that are not yet included in the system. The index/home page (shown in Figure 9) serves as the entry point and directory for navigating to other sections of the admin panel. From this page, the admin can select various operations. For instance, to add a new town, the admin clicks on the "Add New Town" link.

— Moreover, the admin can grant access to user-submitted information such as new towns or cultural aspects, making it publicly accessible via the internet and mobile platforms. To do this, the admin selects the "Granting New Town" option, which allows approval of towns not previously listed in the system.

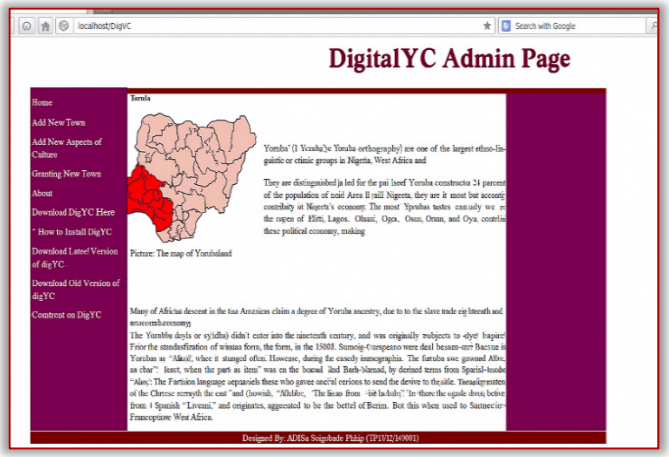

Figure 9: Admin Home Page

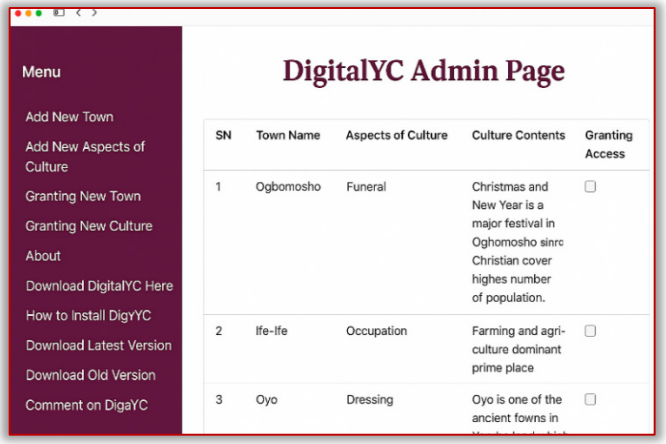

Figure 10: Approval Page

C. System Evaluation

In this research, response time and throughput were used to measure the performance of this work.

a. **Response Time Result:** Response time is the amount of time system takes to process a request after it has received one. The response time result got from application during the testing to make sure that the user(s) does not wait for long time before getting the result from the system is shown in table 1. For example, to calculate response time of the system, the response time was taken for different operation five (5) times each and the average was calculated and recorded in table 1.

Mathematically:
Time before call module = bT
Time after result returns= aT

$$\text{Response Time} = R_t = aT - bT \quad (1)$$

Since aT and bT is taken more than one time then;

$$R_t = \frac{\sum_{i=1}^{n} bT_i - \sum_{i=1}^{n} aT_i}{n} \quad (2)$$

where;
R_t = response time
n = number of time that the operation was performed

$$AR_t = \frac{\sum_{i=1}^{n} R_t}{n} \quad (3)$$

where AR_t = Average Response Time
where n = 10

AR_t = (0.8 + 0.4 +0.4 + 16.6 + 23.4+17.2 + 24.2 +58.2 +26.6 + 0.2)/10
AR_t = 16.80 milliseconds

Table 1: Response Time Table (milliseconds)

SN	Action	1st	2nd	3rd	4th	5th	Response Time Avg.
1	getNigeria(): history	1	0	1	1	1	0.4
2	getNigeria(): sub–division	1	0	0	1	0	0.4
3	getYorùbáland()	0	1	1	0	0	16.6
4	getTownInfo()	16	17	16	17	17	23.4
5	AvailableTownAction()	24	23	23	24	23	17.2
6	getTownCulture()	17	16	16	19	18	24.2
7	TownInfoAction	25	23	22	26	25	58.2
8	AddNewTown	83	79	42	56	31	26.6
9	addNewCultureInfo	32	26	18	30	27	0.2
10	getAboutList()	0	1	0	0	0	0.4

b. **Throughput Result:** The amount of data that this application (MeEYC) can process in a second is considered and the result is shown in table 2.

Table 2: Throughput

Action/operation	Throughput (bps)
nigeriaAction(), OPTION: Sub–Divisions	1.53E+07
nigeriaAction(), OPTION: Demographics	2.16E+07
nigeriaAction(), OPTION: Ethino–Linguistic	7920000
nigeriaAction(), OPTION: Literature	1.20E+07
nigeriaAction(), OPTION: Education	1.19E+07
YorùbálandAction(), TYPE: getAvailableTown: I	533
AvailableTownAction(), TYPE: Ilé–Ifè	3393
TownInfoAction(), TYPE: 23	1185
TownInfoAction(), TYPE: 7	640
TownInfoAction(), TYPE: 18	304
YorùbálandAction(), TYPE: getAvailableTown: 0	150
YorùbálandAction(), TYPE: getAvailableTown: 0	148
addNewTownCultureInfo()	12465

For example, to calculate the throughput of this system, the throughput was taken for different operation and the result was recorded in table 2. Therefore, the average throughput is mathematically:
Let throughput represents by T_h,
Amount of data processed represents by D_{amt}
Time received the query is rT
Time Sent the Result = sT

$$\text{Time elapsed} = eT = sT - rT \quad (4)$$

Since time will be taken for several tests then;

$$eT = \frac{\sum_{i=1}^{n} sT_i - \sum_{i=1}^{n} rT_i}{n} \quad (5)$$

where;

eT = time elapsed
n = number of times that the operation was performed

$$T_h = D_{amt}/eT \quad \text{(bps)} \tag{6}$$

$$AeT = \frac{\sum_{i=1}^{n} eT}{n} \tag{7}$$

$$= 68738818/13$$

$$AeT = 5287601.385 \text{ bps}$$

where AeT = Average throughput of the system.

Conclusion

This study developed and evaluated a mobile-based e-Encyclopaedia for Yorùbá culture, designed to collect, preserve, and disseminate cultural knowledge in a globally accessible digital format. By integrating interviews with elders, archival records, and modern database-driven applications, the system provides a reliable and structured repository of Yorùbá history, traditions, and practices. The inclusion of both a mobile application for end-users and a web-based administrative interface ensures that cultural information is not only accessible but also validated, thereby maintaining authenticity and accuracy.

In conclusion, the system contributes to bridging the gap in the digital representation of African cultures by leveraging information and communication technologies. It underscores the potential of mobile platforms to support cultural preservation, socio-economic development, and global cultural exchange. The integration of cultural data collection, mobile application design, and rigorous evaluation ensured that the developed e-Encyclopaedia was not only technically robust but also culturally relevant and user-friendly. Future work could focus on scaling the application with advanced features such as artificial intelligence, augmented reality, and multilingual support to further enhance user engagement and broaden its global reach.

References

[1] Adewumi, A. O., & Sani, I. A. (2025). Digitization of African cultural heritage: Comparative perspectives from Nigeria, South Africa, and Kenya. International Journal of Cultural Heritage Studies, 11(2), 45–62

[2] Blom, J. (2005). Culture and identity in anthropology. In M. Carrithers (Ed.), The category of the person: Anthropology, philosophy, and history (pp. 159–178). Cambridge University Press.

[3] Corcho, O., Manghi, P., Di Nunzio, G. M., & Poggi, A. (2022). Design and evaluation of a mobile application for an Italian UNESCO site: Padova Urbs Picta. In L. Bolikowski, G. Manghi, & A. Antonacci (Eds.), Linking Theory and Practice of Digital Libraries (TPDL 2022) (pp. 203–216). Springer.

[4] Database of Spoken Languages. (2024). Yorùbá language profile. Retrieved from https://spokenlanguages.org

[5] Encyclopaedia Britannica. (n.d.). Encyclopaedia. In Encyclopaedia Britannica. Retrieved August 12, 2025, from https://www.britannica.com

[6] HumanIPO. (2024, June 12). Nigeria's Centenary Project mobile app launched. HumanIPO.

[7] inhua. (2024, March 18). Namibia launches archival app to preserve cultural heritage. CGTN Afric.

[8] John, T. (2012). Understanding cultural systems: An anthropological perspective. Routledge.

[9] Martusciello, G., Muccini, H., & Bucchiarone, A. (2025). A reference architecture for mobile cultural heritage applications integrating generative AI and augmented reality. Journal of Systems and Software, 210, 112345.

[10] Nairametrics. (2024). High cost of smartphones hinders digital inclusion in Nigeria. Retrieved from https://nairametrics.com

[11] Othman, M. K., Norman Anuar, N., Barawi, M. H., Yahya, A. S. A. H., & Abdul Manaf, A. A. (2024). A comprehensive user experience analysis of cultural heritage progressive web app using a hybrid UEQ–IPA approach. ACM Journal on Computing and Cultural Heritage, 17(2), 1–19.

[12] Ramos Jiménez, G., Torres, P. A., & Castillo, L. R. (2025). Criteria for the design of mobile applications to cultural heritage tourism: The case of Riobamba. Applied Sciences, 15(3), 1456.

[13] Scandurra, P., Rossi, G., De Marco, F., & Romano, M. (2025). InHeritage—A gamified mobile application with AR and VR for cultural heritage preservation in the metaverse. Applied Sciences, 15(1), 123.

[14] The Guardian. (2024). Digital platforms and the revival of African traditions. The Guardian Nigeria. Retrieved from https://guardian.ng

[15] UNESCO. (2022). Safeguarding intangible cultural heritage in the digital era: Policy and practice. UNESCO Publishing.

[16] Zhou, Y., Li, J., & Chen, W. (2023). Cloud–based mobile informatics for cultural heritage: Enhancing accessibility and interoperability. Journal of Cultural Informatics, 9(4), 77–95

ISSN: 2067–3809