*IOSR Journal of Computer Engineering (IOSR-JCE)*
*e-ISSN: 2278-0661, p-ISSN: 2278-8727, Volume 28, Issue 3, Ser. 1 (May. – June. 2026), PP 83-90*
*www.iosrjournals.org*

# Development Of A Web Based System For Automatic Conversion Of English Numerals To Igala Numerals

Sani Felix Ayegba
*Department Of Computer Science*
*Salem University, Lokoja*

***Abstract***
*Many indigenous African languages including Igala possess distinct numeral system that is grossly underrepresented in contemporary computational technologies. This study focuses on the development of a computational model for automatic conversion of English numerals to their corresponding Igala numerals. The objectives of the study includes: digital inclusivity, language preservation and advancing research in computational linguistics. A rule based approach was deployed to capture the structural and morphological features of Igala language. The research methodology involved detailed analysis of the rules for the construction of Igala numerals, system design and implementation, testing and evaluation across a wide range of numeric values. The model was implemented using PHP, a server side scripting language, HTML, CSS as client side scripting languages and MYSQL database as backend. The model was tested on 10,000 randomly generated English numbers. Evaluation results showed that 99.6% accuracy was achieved, a clear indication that the system effectively converts English numerals to correct Igala numeral forms with high accuracy.*
***Keywords/Phrases:*** *Computational model, English numerals, Igala numerals, server side scripting language, client side scripting language, backend.*

Date of Submission: 16-05-2026 Date of Acceptance: 26-05-2026

## I. Introduction

Language is a crucial instrument for communication, preservation of culture and transmission of knowledge in human society. Numerals are important part or component of a language. Numeral is the tool by which people express quantity, age, price, measurement etc. Trade, record keeping and day to day interaction involves the use of numerals. Numeral system is a mathematical notation used for representing numbers of a given set using digits or symbols in a uniform manner (Agbeyangi e tal., 2016). Numeral system serve as the foundation for mathematics and computations and all arithmetic operations depends on it. It is a sociolinguistic factor that portrays the cultural and linguistic identity of a group of people(Mbah e tal., 2014). Meaningful linguistic discuss in any language makes reference to quantity, size, time, distance and weight in numbers, therefore counting or numbering is an essential component of a language (omachonu, 2011). Numeral systems of many African countries including the Igala speaking region of Nigeria have faded into obscurity due to the dominance of global languages like English (Oyebade, 2010). This poses a serious threat to the younger generations, a threat that does not cause physical bruises but leads to identity crises as the youths gradually lose touch with their traditional numeral system (Mbah e tal., 2014).

Igala is the language of the ethnic group located at the eastern tributary of the Confluence of rivers Benue and Niger. They are the ninth linguistic group in Nigeria (Sani e tal., 2017). Geopolitically they are characterized as belonging to the middle belt or North Central region of Nigeria. Igala has a unique numeral system featuring a combination of decimal (base-10) and vigesimal (base-20) structure (Omachonu, 2011). The system includes distinct forms of basic numerals as well as compound structures for higher values.

Igala numeral system uses derivational methods such as addition and multiplication to generate other complex numerals (omachonu,2011). Some numbers like 20, 50, 200, 400 referred to as base numbers serve as building blocks for constructing other bigger values. Igala numeral system has a morpho-derivational structure. This means that computational system designed for its conversion must include relevant linguistic rules rather than simple direct substitution (Omachonu, 2011). Studies by Mbah e tal. (2014) shows that although there exist substantial structural similarities between Igala and other Nigerian languages such as Igbo and Yoruba, they differ significantly in their numeral derivation.

### Rationale for the study

Urbanization, globalization and exposure to western education has reduced the usage of local numerals, this has resulted in excessive dependence on English numerals by the Igala especially the younger ones. The use of Igala numerals in day to day activities has been grossly reduced. Intergenerational transmission failure has seriously contributed to this ugly trend as many Igala children especially those growing outside the traditional homeland are not exposed to learning to count in their mother tongue with appreciable fluency. Older generation with knowledge of Igala system of counting do not consistently pass down the knowledge. Eludiora & Auwal (2021) posited that in a very short time numeral system of many African languages might lose contact with the new generation due to fast influence of western education. According to Omachonu (2011) Igala numeral system has become an endangered aspect of the language. This situation if left unchecked might lead to complete extinction of this component of Igala cultural pride and identity. It is therefore imperative that urgent steps be taken to redress this ugly trend by developing a web based system that can automatically translate numbers rendered in English to its igala equivalent to facilitate the learning of Igala counting system. This is the main thrust of this study. This system will contribute immensely to the preservation of Igala language by digitizing its numeral structure. The system will also serve as instructional tool for students and teachers. Furthermore, the use of the system will result in improved communication and localization. Additionally, the system will enable the integration of Igala numerals into technology; this will reinforce the cultural pride and identity of Igala speakers.

**Limitations of study**

This study is limited to the numerical system of Igala language counting from one to a thousand (1-1000). Igala language has both cardinal and ordinal numerals. The study is also limited to the conversion of cardinal numbers.

## II. Literature Review

Ejegba (2025) carried out a comprehensive analysis of numeral formation in Igala language. The study outlined the additive, multiplicative, and quasi-vigesimal patterns of construction. It also pointed out that, while numbers 1-9 use direct lexical patterns, numbers greater than 10 require compositional operations, such as addition (e.g., 12 =10 + 2) or multiplication (e.g., 60 =20 x 3).

In a study titled "Igala Numeral System – Preliminary Observations", it was noted that Igala makes use of morphological operations to generate complex numerals. It was further observed that there are similarities in the way other Niger-Congo languages and Igala form numeral structures Ejeba (2016).

In a comparative research by Omachonu (2012) English, German, Yoruba, and Igala numeral systems were examined. It was observed that English uses a purely decimal system, whereas Igala uses a combination of decimal and vigesimal approaches.

Although there are a number of linguistic works and computational models for translation of English to Igala language using different machine translation approaches (Sani, 2014; Sani, 2016; Sani, 2023; Sani e tal., 2016; Attah e tal., 2020; Inah & Sani, 2025), no computational model for the automatic conversion of English numeral to Igala numeral has been proposed or implemented. It indicates a clear research gap and justification for this research. This research aims to bridge the gap by developing a rule-based computational model for automatic conversion of English numerals to Igala numerals.

Although no computational model exists for numeral conversion in Igala, several related systems exist for some Nigerian languages.

Mustapha et al. (2023) proposed a computational model for the automatic conversion of Hausa digits into Hausa numerals using a rule-based approach and lexicon lookup. A high level of accuracy was achieved, indicating that rule-based methods are efficient for African languages with scanty or limited datasets.

Eludiora & Auwal (2021) proposed the development of a web based Hindu-Arabic to Hausa transcription system that translates Hindu-Arabic numerals to Hausa numerals. The system was designed using context Free Grammar (CFG) and Unified Modeling Language (UML) and implemented using python programming language. Testing and evaluation was carried out using Mean Opinion Score (MOS) approach. Evaluation result showed that high level of accuracy was achieved.

Isaac & Odetunji (2022) proposed and implemented a system that converts English numerals to Yoruba using context-free grammar and production rules.

Ninan et al. (2017) proposed, designed and implemented a computational model of Igbo numerals in number-to-text conversion system. The system converts cardinal numbers (from 1-1000) to their corresponding standard Igbo numbers. The model was designed using Context Free Grammar (CFG), sequence and activity diagram. Evaluation of the model was done through administration of questionnaires. Accuracy of 100% was reported. The model served as a useful platform for teaching Igbo language.

Agbeyanji et al. (2016) proposed a web-based Yoruba numeral translation system. The system translates cardinal numbers, both in text and figures, to Yoruba standard numbers. Automata theory at UML was used in the design. It was implemented using Google Web App Engine with Python. Evaluation was carried out using Mean Opinion Score (MOS), and the results gave 100% recall on the test datasets.

## III. Methodology

The study adopted a design and implementation research approach. The approach focused on the analysis of English – Igala numeral system, the design of appropriate algorithm and conceptual architecture, the implementation of the proposed rule-based English to Igala numeral Converter and evaluation of its performance.

**Algorithm**

A lookup table called *igala_umerals* with three columns (*id, english_numeral and igala_numeral*) was created in mysql database to hold numbers 1-99 and their corresponding Igala equivalent. These were called base numbers. Higher numbers between 100 and 1000 are generated from the base numbers by the application of explicitly defined rules from the rule base.

START
10 GET input
Validate input by confirming it is numeric
If *input* is numeric and <=99 then
Check lookup table for *input*
If found
Return igala_numeral
End if
Otherwise
Display invalid *input*, re-enter
Return to line 10
End if
If *input* is numeric and >=100 then
Tokenize *input* and store result in an array called *input_array*
Calculate length of *input_array*, call it *n*
If *n* > 3
Display *input* is out of range
Return to line 10
Otherwise
If *n*=3 then
*Value0 = input_array[0]*
*Value1 = input_array[1]*
*Value2 = input_array[2]*
Concatenate *Value1* and *Value2* to form a base number, call it *combined*.
*Combined* is a string variable
Invoke a function to convert *combined* to an integer, call it *new_combined*
check lookup table for the *igala_numeral* corresponding to *new_combined*
If found
Apply rules from rule base
Rule 1: If *Value0* = 1 and *igala_numeral* < 20 then
Return "ógwúmélū-nyọm" + "-" + *igala_numeral*
Otherwise
Return "ógwúmélū-nyi" + "-"+ *igala_numeral*
End if

Rule 2: If *Value0* = 2 and *igala_numeral* < 20 then
Return " ógwọkọnyọm" + "-" + *igala_numeral*
Otherwise
Return " ógwọkọnyi" + "-"+ *igala_numeral*
End if
Rule 3: If *Value0* = 3 and *igala_numeral* < 20 then
Return " ólí-mẹ́fà-nyọm" + "-" + *igala_numeral*
Otherwise
Return " ólí-mẹ́fà-nyi" + "-"+ *igala_numeral*
End if

.
.
.
Rule n

**Conceptual Architecture of RBEN-INC**

The conceptual architecture of the **RBEN-INC** which stands for rule based English numeral to Igala numeral converter is presented in Figure 1

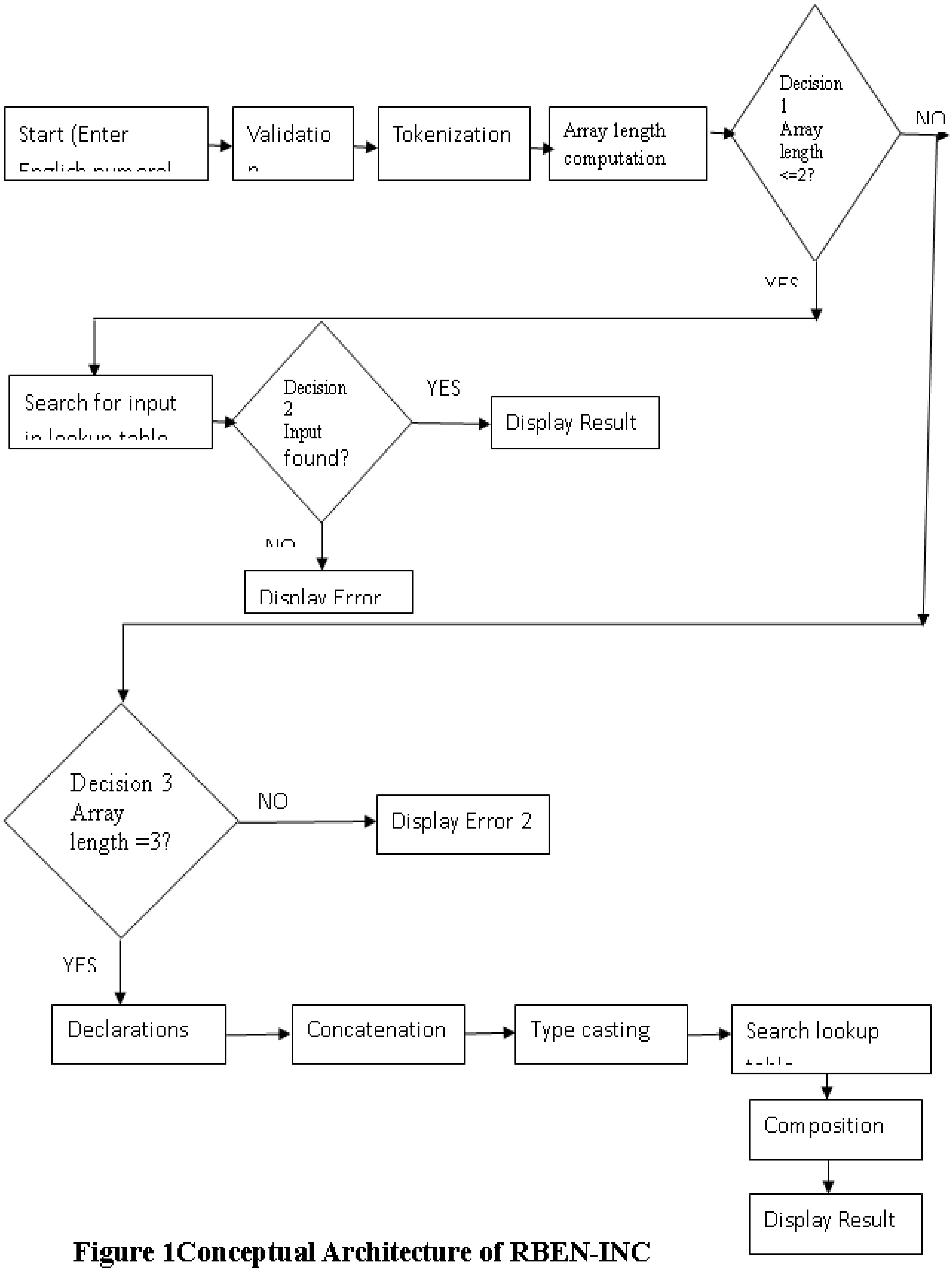


**Figure 1Conceptual Architecture of RBEN-INC**

The structure of RBEN-**INC** above has the following phases:
**Phase (1) –English-numeral input:** The input to the system consists of English numerals.
**Phase (2) –Validation:** This involves confirming that the input is a numeric value.
**Phase (3) –Tokenization:** This operation involves splitting the input number into individual digits. The individual digits are stored in an array.
**Phase (4) –Array Length Computation:** In this phase the length of the array used to store the individual digits is computed.
**Phase (5) –Decision 1:** This operation involves checking the value of the length of the array computed and making relevant decision based on its value.
**Phase (6) –Lookup table check 1:** Here if the value of the length of the array is <= 2, a lookup table operation is performed to search for the corresponding Igala numeral of the input.
**Phase (7) –Decision 2:** This operation involves checking the result of the lookup table check and taking relevant action.
**Phase (8) –Display Result 1:** If the outcome of Decision 2 is a yes implying that the input value exist in the lookup table, the corresponding Igala numeral of the input is retrieved and displayed.
**Phase (9) –Display Invalid input:** If the outcome of Decision 2 is a NO implying that the input value does not exist in the lookup table, an error message is displayed signifying that the input is invalid.
**Phase (10) –Decision 3:** If the outcome of decision 1 is a NO, the next action is to check whether the length of the array is equal to 3 or not.
**Phase (11) –Declarations:** If the outcome of decision 3 is a yes the contents of the array is assigned to three variables as follows:
*Value0 = array index 0*
*Value1 = array index 1*
*Value2 = array index 2*
**Phase (12) –Concatenation:** Concatenation means joining two or more piece of data end to end to form a single continuous value. In this phase *value1* and *value2* are concatenated to form a value which is the last two digits of the input.
**Phase (13) –Type Casting:** Type casting is the process of converting a value from one data type to another. The result obtained by concatenating value of *value1* and *value2* is a string, in this phase it is converted to integer by invoking relevant function.
**Phase (14) – Lookup table check 2:** Here the integer number obtained in phase 13 is searched for in the lookup table and the Igala numeral equivalent of it is retrieved.
**Phase (15) – Composition:** In this phase, rules are applied from the rule base and the Igala word for the value in the array index 0 (value0) is concatenated with the value of the Igala numeral retrieved from the lookup table to form the corresponding Igala numeral for the input.
**Phase (16) – Display Result 2:** The Igala numeral obtained in phase 15 is displayed in the GUI.
**Phase (17) – Display Error 2:** If the length of the array is greater than 3, an error message "Input is out of range" is displayed.

**System design and implementation**

The model was designed using the conceptual architecture depicted in figure 1. The rule base engine was implemented using PHP and the frontend using HTML and CSS in responsive mode. The table for storing base numbers (1-99) was created in MYSQL database. Figure 2 shows the home page when the application is launched.

When a user enters a number, for example 577 in the textbox and clicks the RỌIDA button, the models checks the validity of the value entered and generate the corresponding Igala equivalent if the value is valid. The result is displayed as shown in figure 3.

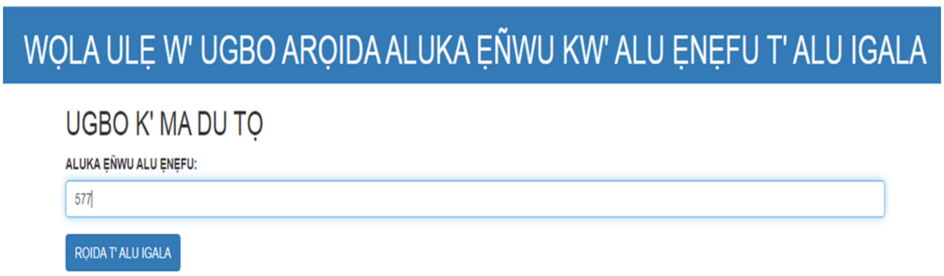


Figure 2: System home page

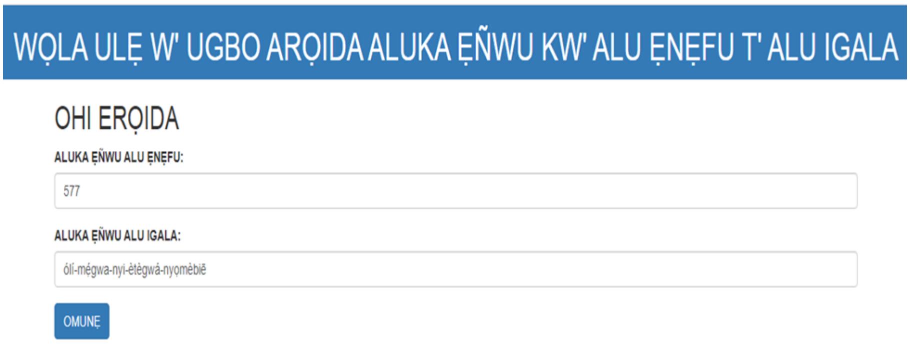


Figure 3: System Result Display Page

**Test and Evaluation**

In this study testing and evaluation was carried out to ascertain the correctness and the usability of the developed system for the automatic conversion of English numeral to Igala numeral. The evaluation process was centered on verifying that the system correctly interprets English numeric input and generates accurate Igala numeral equivalent in accordance with established linguistic and numeral rules.

A php code called *test_data_generator.php* was developed to generate 10,000, 3 digit random numbers between 100 and 999. Each random number generated was provided as input to the RBEN-INC application and the corresponding Igala numeral was produced as output. This was achieved by invoking a looping function called *loop_rben_inc.php*. Each English numeral and corresponding Igala numeral output were stored in a MYSQL database table called *rben_inc_output.*

Figure 2 shows sample entries in the *rben_inc_output* table.

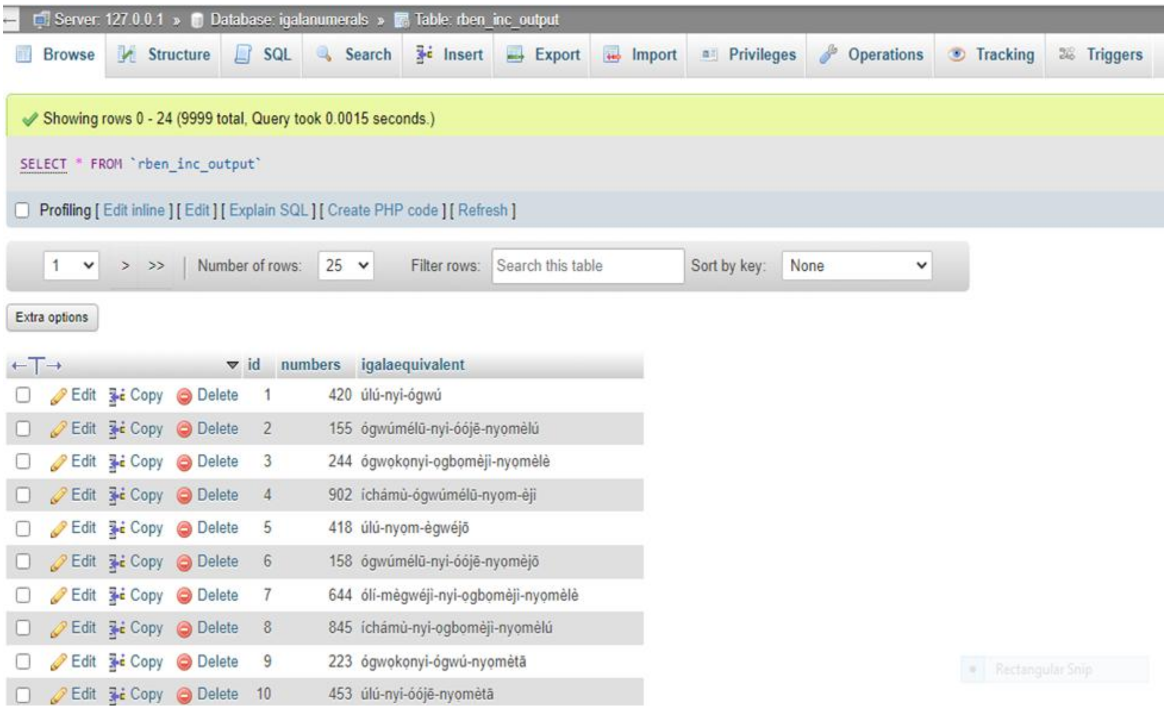


Figure 2: Sample output from generated random numbers

Data in the *rben_inc_output* table was exported to Microsoft Word and formatted. Two copies were produced and sent to two independent Igala native speakers for evaluation. An output is either correct or incorrect. A rating scale of 0 and 1 was adopted, 1 for correct output and 0 for incorrect output.

The number of 1s and 0s each table returned by the independent evaluators were counted. Table 2 shows the result of the counting.

Table 2: Evaluation Report

| Evaluator | Number of 1s | Number of 0s |
|---|---|---|
| Evaluator 1 | 9,965 | 25 |
| Evaluator 2 | 9,950 | 50 |

Average number of correct conversions= (9,965 + 9,950) /2= 9,957.5
Accuracy = Average number of correct conversions ÷ Total number of conversions
= 9,957.5 ÷ 10,000
= 0.99575
% accuracy = 0.99575 x 100
= 99.575 %

**Discussion of Results**

Accuracy evaluation revealed 99.6% correctness with almost all test input producing correct Igala numeral equivalent. The outputs produced were consistent with Igala numeral formation rules indicating that the encoded linguistic rules adequately capture the numeral structure of the language. The high performance validates the suitability of the rule based approach used in building the model.
It is evident from this result that the model performed satisfactorily.

**Key findings**

The findings of the study are summarized as follows:

1. The study demonstrated that an automated system for English to Igala numeral conversion is both feasible and effective.
2. The success of the system clearly indicates that Igala language can be formally represented and processed using computational methods.
3. The rule based approach effectively captures the syntactic and morphological properties of Igala language enabling correct numeral formation.
4. The result confirmed the suitability of rule based method in numeral conversion task for low resource language where annotated dataset is scarce.

## IV. Conclusion

The study concentrated on the development of a computational model for automatic conversion of English numerals into their corresponding Igala numeral forms. An accurate and consistent conversion across a wide range of numerical values was achieved by the system. The study shows that Igala numeral system can be effectively represented computationally. The study contributes to the preservation and promotion of Igala cultural and linguistic heritage. Furthermore, it lays the foundation for the development of digital tools that can enhance the effective dissemination of knowledge in Igala language.

## References


[1]. Agbeyangi, A. O., Eludiora, S. I., & Popoola, O. A. (2016). Web-Based Yorùbá Numeral Translation System. IAES International Journal Of Artificial Intelligence (IJ-AI), 5(4), 127-134.

[2]. Attah Joshua, Sani F. A & Urah, R (2020) Example Based Machine Translation Of English-To-Igala Language. International Journal Of Trends In Research And Development. Volume 7(1), ISSN: 2394-9333. Pages 32-35. Www.Ijtrd.Com

[3]. Ejeba, S. O. (2025). Numeral Formation In Igala: Morphological Structure, Arithmetic Logic And Typological Insight. Journal Of Universal Language, 26(2):39-64, Eissn: 2508-5344. DOI:Https:Doi.Org/10.22425/Jul.2025.26.2.39.

[4]. Ejeba, S. O. (2016) Igala Numeral System: Preliminary Observations. In Book: The Numeral Systems Of Nigerian Languages (Pp.339-48). DOI:10.2307/J.Ctvh8qznv.33

[5]. Eludiora S. I., Auwal M.A (2021) A Hindu-Arabic To Hausa Number Transcription System. Malaysian Journal Of Computing, 6 (1): 727-744, Eissn: 2600-8238 Online. DOI:10.24191/Mjoc.V6i1.11526.

[6]. Inah, E.M, Sani, F (2025) Development And Evaluation Of English-To-Igala Neural Machine Translation Using Deep Learning. International Journal Of Innovative Science And Research Technology, Volume 5, Issue 8. ISSN No: 2456-2165.

[7]. Isaac, O. E, Odetunji, A.O. (2022). Machine Translation System For Numeral In English Text To Yorùbá. Ife Journal Of Information And Communication Technology, Volume 6.

[8]. Mbah, E. E., Ndubuisi, O. A., & Monday, A. (2014). A Comparative Analysis Of The Numerals And Counting Systems Of Igbo And Igala. Research On Humanities And Social Sciences, 4(26), 61-65.

[9]. Mustapha, R, Ibrahim, F, Lawal And Muhammad, A. A (2023) Automated Conversion Of Numeral To Words In Hausa Language. Gadau Journal Of Pure And Allied Sciences. Gadau J Pure Alli Sci, 2(2): 140-145 (2023), ISSN: 2955-1722, DOI: Https://Doi.Org/10.54117/Gjpas.V2i2.100

[10]. Ninan, O., Iyanda, A., Elesemoyo, I., & Obasa, E. (2017). Computational Analysis Of Igbo Numerals In A Number-To-Text Conversion System. Journal Of Computer And Education Research, 5(10), 241-254. Doi:10.18009/Jcer.325804

[11]. Omachonu, G.S Derivational Processes In Igala Numeral System:Some Universal Considerations. Journal Of Universal Languages 12-2, September 2011, Pp 81-101

[12]. Omachonu, G.S (2011) Igala Language Studies. LAP LAMBERT Academic Publishing Gmbh & Co. KG, Saarbrucken, Germany, ISBN: 978-3-8465-5822-5.

[13]. Omachonu G.S, Igala Language Studies And Development: Progress, Issues And Challenges, Text Of A Paper Presented At The 12th Igala Education Summit Held At Kogi State University, Anyigba- Kogi State, Nigeria. 28th -29th Dec. 2012.
[14]. Oyebade, F.O. (2010). The Imperative Of Documenting Counting Systems In African Languages: A Window Into The Cognitive Process Of Computation.
[15]. Sani F.A (2023).Development Of English-Igala Machine Translation System Using Neural Machine Translation With Attention Mechanism. Journal Of Management Technology. Volume 19, August 2023. Pages 91-105.DOI: 10.62254/Jmt.2023.19.1.7
[16]. Sani F.A (2016). English To Igala Machine Translation System, Phd Dissertation Submitted To Universidad Azteca, Mexico.
[17]. Sani F. A., Musa U, Benson-Iyare J. C, Abu O. (2017) Igala Language Spell Checker.Current Journal Of Applied Science And Technology, 23(1): 1-9, 2017, Article No.CJAST.35445, ISSN: 2231-0843SCIENCEDOMAIN International, DOI:10.9734/CJAST/2017/35445.
[18]. Sani F.A., Musa U., Negedu P.O. (2016). Design And Implementation Of A System For Automatic Translation Of Igala To English Language. International Journal Of Scientific Research In Science And Technology (IJSRST). 2(3). 212 - 216.
[19]. Sani, F. A., Osuagwu O. E., Njoku D. O. (2014). Machine Translation Of Noun Phrases From English To Igala Using The Rule-Based Approach. West African Journal Of Industrial & Academic Research. 1(11), 17-26.