

# Computational Model for *Yorùbá Àrokò* Communication System

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## Abstract

This research interrogates the *Yorùbá Àrokò* System (YAS) from a computing perspective. This is with the view to determining the extent to which the communication elements and structure of *Àrokò* can be precisely formulated as computing artefacts. *Àrokò* is a message encoding system used to serve a variety of communication functions in *Yorùbá* societies. The operational terminologies for the concept of *Àrokò* were gathered from experts using a combination of observation, consultation, interview and documented materials and the structure formalised. The elicited information was modelled using formal language and automata theory based techniques. The model and the system designed was validated by demonstrating its use with selected *Àrokò* communication. The grammar of *Àrokò* Language was formulated. The study provides a computational perspective and explanation to the aspects of the process underlining the *Àrokò* system, which in return established a feasible and digital resource for information communication. The study developed a computational model to formally and explicitly represent the concepts embedded in *Yorùbá Àrokò* communication system.

**Keywords:** Computational model, *Yorùbá*, Communication System, *Àrokò*, Symbol-object

## 1 Introduction

*Àrokò* is a collection of objects which are usually packaged and parcelled together. It is a symbol-object that is sometimes sent by the means of a messenger to another person with a purpose of proper message decoding at the receiving end and conveyance of message from the source (Ogundeji, 1997). It is the indigenous system (Mundy and Compton, 1991; Mundy and Lloyd-Laney, 1992) of shared meaning for communication between acquaintances and adversaries in the *Yorùbá*

tradition (Bascom, 1973; Elúyemí, 1987). This communication method employs a set of symbolic objects and signs with mutually understood reasons for communication (Dima et al., 2014). Message representation in the *Yorùbá* cultural heritage can take various forms including visually in artworks as seen in various designs on ancient decorated doors, orally in folklores as seen in different stories relating to tortoise and elephants (Elegbe and Nwachukwu, 2017; Uzochukwu and Ekwugha, 2015), and implicitly in belief and value systems as seen in the use of *é* for elderly people or more than one person and *ó* for someone younger (Ayan-tayo, 2010; Akpabio, 2003). The various heritage in *Yorùbá* land is not fully represented computationally, but various efforts are recently been put in place in recent times to affect this (Folorunso et al., 2010). *Àrokò* is a message exchange instrument that engages the sender, the carrier, and the receiver, which sometimes is in the context of the interaction that has been taking place between the two parties. *Àrokò* can be a continuation of a discussion that has started beforehand, so it can be based and interpreted in the context of an ongoing discourse, though it could also kickstart a discussion between two or more individuals. *Àrokò*, which is a non-verbal means of communication (Metaxas and Zhang, 2013) in *Yorùbá*, is vast and heterogeneous. This makes it an interesting area for research in message representation with an excellent underlying computational possibility in particular (Alimi, 2013; Aziken and Emeni, 2010).

There is a need for a more extensive understanding of the phenomenon being investigated (that is, *Àrokò*) with an elaborate and extensive explanation that presents a model which captures the *Yorùbá Àrokò* communication system. Some of the ancient means of communication are rich in terms of the structure and composition that make up their methods and means of passing across a message. This work is to study the various concepts in *Àrokò* and

see how it is related and connected to the standard concept of communication. There is a need to study *Àrokò* from a computational concept, the articulate computational model for *Àrokò* by studying the various concepts, and seeing how the concept is related to other communication theories. This research focused on the communication principle and structure of selected *Yorùbá Àrokò* communication system with a focus on the following versions: (i) *Ààlè* (ii) *Ètúfú* and (iii) *Agà*. The work does not include ambiguously interpreted objects while information for objects with ambiguity will assume the most widely accepted and known meaning.

## 2 The *Àrokò* System

*Àrokò* has been used to communicate among the indigenous people of *Yorùbá* by conveying messages from one person to another or from one village/community to another. Objects are been packed together and passed from the sender to the receiver. Sometimes, secretive messages are sent (Mehrabian, 1981) using *Àrokò* using animals, messenger, or a friend but mostly sent by hand through a courier or messenger (*ikò* or *iránsé*) (Ogundeji, 1997). The *Àrokò* must be well understood by the receiver. Stone, chewing stick, flywhisk, fruit, parrot, cowrie shell, blood (Nabofa, 1994), fabric, a stick of broom, broom, calabash, kola nut, leaves, and other common things are utilized. *Àrokò*, like many other *Yorùbá* names, appears to be a derivative noun, according to (Ogundeji, 1997). If the term *Àrokò* is seen as the word-formation of two combined verbs *rò* (to think) and *kò* (to agree) preceded by a which is changed to a noun, the result is *Àròkò* rather than *Àrokò*. This usage of *Àrokò* is comparable to how codes and symbols have lately been used. It helps to lessen the usage of spoken words by allowing objects to be utilized to convey information. Some of the objects sent to the receiver are kept for reference purposes (Olómọ̀là, 1979).

In those days, *Yorùbá* used symbols to send warnings, warn a loved one of an imminent threat, alert a partner of a breakup or quarrel (Olatunji, 2013), and inform family members or close relatives of someone's death. *Àrokò* was also utilized in decision-making in *Yorùbá* society if a new king or chief was to be selected and the kingmakers were not in favour of a certain candidate, this was expressed by shaking hands with left hands. Similarly, the ladies of the town wore the wrong sides

of their garments to demonstrate their opposition to the nomination of a new chief or king (Olómọ̀là, 2003). When a couple is looking for a child or children, they employ a variety of methods. When the Ifa priest is consulted and it is discovered that the couple will not have children, eggshells wrapped in cotton wool are packaged and delivered to the parents. The information being passed along implies that the couple will not have children. *Àrokò* is believed to be an idea or thought upon which we have agreed to (Osisanwo, 2009). *Àrokò*, that is, *Àrokò: Ohun tí àjọ̀rò wa kò lé lórí ní à ń pè ní Àrokò* (Odéjọ̀bí, 2019).

## 3 Model Design

At the senders' point, which serves as the source as seen in Figure 1, there is the creation of the message to be sent and the packaging of the objects. The objects to be used to get across the exact information intended are carefully chosen. The various objects are also ordered and arranged in the right way to be able to give the right information to the receiver. The objects are packed and sometimes wrapped together with an object which serves as the encoding of the *Àrokò* message system. The materials are released and transmitted with the aim of the receiver getting the information sent. The sender also chooses the person who will send the objects. The interpretation of some messages is influenced by the identity of the courier. At the receiving end, the objects are received and then rightly interpreted. After it is been opened, it is then processed so as to get the true meaning of what the objects sent is as seen in Figure 1, but Figure 2 has creation, packaging, ordering, messenger's choice (this is used when giving a response to the received objects) as parts of its receiving end because of its ability to respond to give a reply back to the sender.

In *Àrokò*, the right interpretation has constraints in the interpretation of its meaning depending on the senders' and the receivers' profession, and existing conversation between the sender and the receiver, and this serves as the caveat. Table 2 has a list of a few of the gathered materials used in the *Àrokò* communication system.

### 3.1 Àrokò Communication System Model

**Definition 1** The Yorùbá Àrokò System(YAS) is formulated by a five-tuple (5-tuple) defined as:  
 $YAS ::= \langle P, M, L, C, Ct \rangle$

where:

**P is the Package:** This is conceptualised as the envelop inside which the message is enclosed. It is used to wrap the actual message being sent.

**M represents Media:** It is the material that formed the medium through which the message is transmitted.

**L represents Language:** This is the shared system of meaning for encoding the message. It is a symbolic formulation of the human language, in this case, Standard Yorùbá language.

**C represents Content:** This is the encoded message. It is the information encoded in the message that is directed and sent to the receiver or audience of the Àrokò. The content in this Àrokò materials is a union of the individual element of materials (E) used and the relations (R), between the individual elements. It is represented by,  $C = \cup\{E, R\}$ . The relations R, is the union of many non-empty sets  $R_0, R_1, \dots, R_n$ .

**Ct represents Caveat:** This is the restriction or constraint on the interpretation of the content of the message sent. It serves as specific conditions for a particular interpretation of the context of meaning to be derived for the information encoded in the Àrokò object that is sent.

Starting with the basic conception of Àrokò as defined in Section 3.3, an expressively rich computational framework, capable of treating its ontological contents as theoretical objects whose properties and logical components can be clearly defined is developed as seen in Table 3.

The purpose of language is to give material expression to mental objects by rendering them into sensually accessible forms and shapes. From Figure 3, the terminologies used are stated as follows:

$$\begin{aligned}
 M_S &\implies MessageSent \\
 M_E &\implies MessageEncodedInformation \\
 M_T &\implies MessageTransmitted \\
 M_D &\implies MessageDecoded \\
 M_R &\implies MessageReceived \\
 L_1 &\implies LanguageforMessageSent \\
 L_2 &\implies LanguageforMessageEncoded \\
 &\quad Information \\
 L_3 &\implies LanguageforTransmission \\
 L'_2 &\implies LanguageforMessageDecoded \\
 L'_1 &\implies LanguageforMessageReceived \\
 L_0 &\implies MentalLanguage, nativetotheseif \\
 &\quad (formlessandshapeless) \\
 L_1 &\implies Nativelanguageofthecommunityof \\
 &\quad human(HumanLanguage)inirregularforms, \\
 &\quad shapes, norms, format, andstructure. \\
 &\quad (1)
 \end{aligned}$$

A mental language is a linguistic rendering of a mental concept. The rendering gives irregular forms and shapes to the mental concept.

$L_0 = L_1$  - Material

If  $M_S = M_R$

Then (1.) There is no contradiction

(2.) There is no ambiguity

If  $H_S L_0 = H_R L_0$

Then (1.) This expression is completely interpreted

$L_3 \rightarrow$  Efficiency (Precise)

Precise (i.e. got meanings of materials)

$L_2 \rightarrow$  Effective (Informative and correct)

Objective

$L_1 \rightarrow$  Meaningful

Subjective

From the expression here which relates to how the communication system works. The first line means there is no information in the material and also that symbols are in material objects. The next one states that there is no information in symbols. Symbols can be used to encode sensually accessible information. Information is a mental object. There is no sign in symbols and there are no symbols in signs. A sign is a sensually accessible mental object. Speech is a language encoded sound. The sound is the medium (Material). The language

Table 1: Materials Used in Àrokò

S/N	Material	S/N	Material	S/N	Material	S/N	Material	S/N	Material
1.	<i>Ewé Odán</i>	10.	<i>Èsun Iṣu</i>	19.	<i>Àta</i>	28.	<i>Ọfà</i>	37.	<i>Ètù</i>
2.	<i>Eésan</i>	11.	<i>Ọṣé Ṣàngó</i>	20.	<i>Ajè Ìbọn</i>	29.	<i>Ọrun</i>	38.	<i>Àkọ</i>
3.	<i>Iyọ</i>	12.	<i>Aṣọ Obinrin</i>	21.	<i>Awọ Eran</i>	30.	<i>Ṣìgìdì</i>	39.	<i>Èye</i> <i>Ayékòótọ</i>
4.	<i>Koríko</i>	13.	<i>Ọta</i>	22.	<i>Pàkúté</i>	31.	<i>Opa Osugbo</i>	40.	<i>Ewé</i>
5.	<i>Àidan</i>	14.	<i>Ìgbálẹ̀</i>	23.	<i>Ìgò</i>	32.	<i>Omi</i>	41.	<i>Apópó</i> <i>Obì</i>
6.	<i>Apurù Ọḍe</i>	15.	<i>Ehoro</i>	24.	<i>Àhàyá</i>	33.	<i>Iṣu</i>	42.	<i>Ení</i>
7.	<i>Ṣéééré</i> <i>kekere</i>	16.	<i>Ère Ṣàngó</i>	25.	<i>Efun</i>	34.	<i>Òkúta</i>		
8.	<i>Òwù</i>	17.	<i>Ọmọrí Igbá</i>	26.	<i>Ọmo Ayò</i>	35.	<i>Orí Eye</i>		
9.	<i>Kuùku</i> Àg- <i>bàdo</i>	18.	<i>Aṣọ funfun</i>	27.	<i>Tábà</i>	35.	<i>Obì</i>		

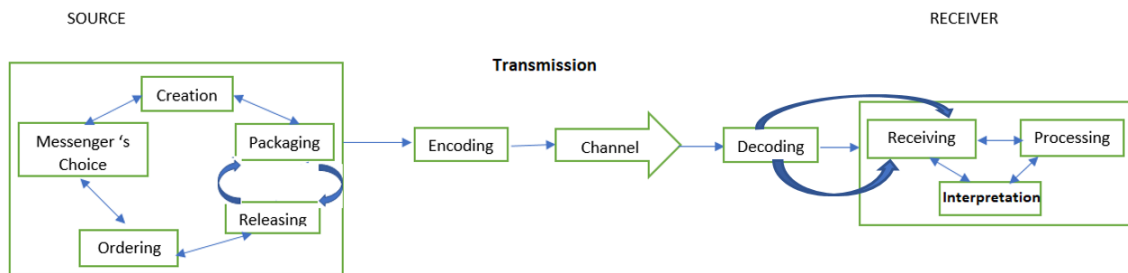


Figure 1: Communication Model of Yorùbá Àrokò Communication System

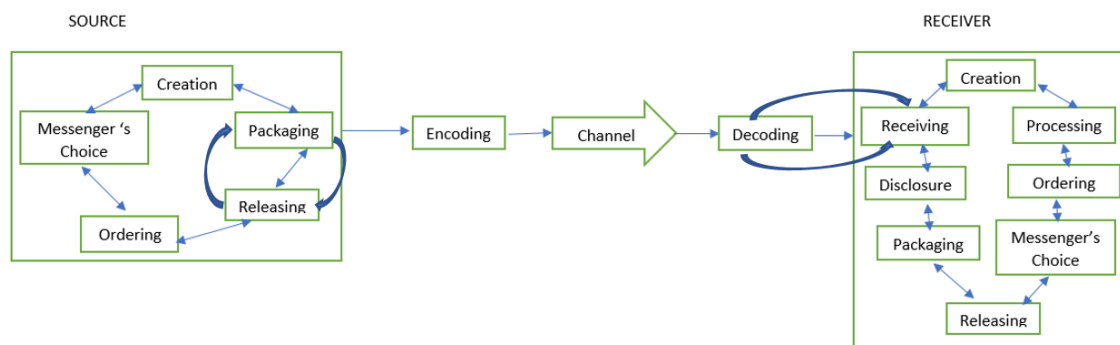
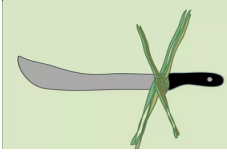
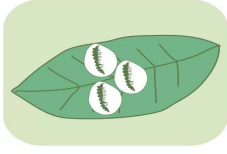
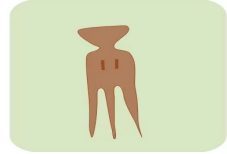
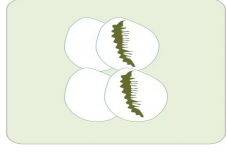


Figure 2: Communication Model of Yorùbá Àrokò Communication System with Feedback Parameter

Table 2: Sample of Àrokò Objects Collected

SN	Àrokò Objects	Description
1.		A weapon wrapped with either palm fronds or grass is used to send a warning of an impending war. The weapon used could either be a cutlass, arrow, or gun.
2.		In Yorùbá numeration and counting, three which stands to <i>ééta</i> . It means something miserable, evil, or bad to befall someone. When three cowrie shells are wrapped in a leaf, it is symbols send to someone owning the sender, that the recipient or receiver of the objects should pay up the debt or face the repercussion.
3.		Òdòyà is the tool used by women in parting the hair, most of the time when they want to plait. It is used to part the hair into the subsection they desire it to be. So, when it is used, it means it is an end to a relationship and that particular relationship cannot be reconciled.
4.		In Àrokò communication, cowries is one of the major materials used in communication. When the cowrie shells have been strung together. It denotes the end of a relationship, particularly between lovers.

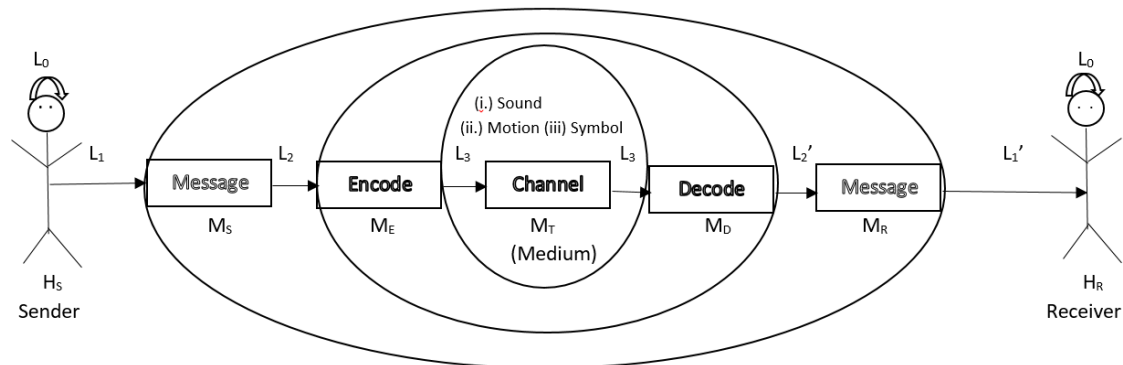
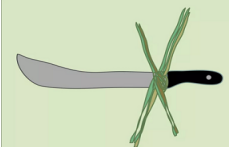
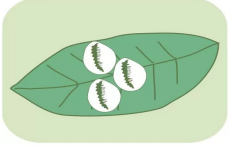
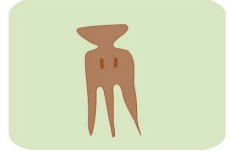


Figure 3: Yorùbá Àrokò Communication System Model

Table 3: Description of *Yorùbá Àrokò* System(YAS) Model

SN	Àrokò Objects	Definition
1.		<p><b>Cutlass(Àdà)</b></p> <ol style="list-style-type: none"> <li>1. Package: Palm fronds or Grass.</li> <li>2. Media: A courier, servant, or messenger.</li> <li>3. Language: Standard <i>Yorùbá</i>.</li> <li>4. Content: Cutlass, arrow, or gun.</li> <li>5. Caveat: If it is sent from a community or friend already in war with another community. It is a call to help and assist in the war.</li> </ol>
2.		<p><b>Cowries (Owó eyọ)</b></p> <ol style="list-style-type: none"> <li>1. Package: Leaf</li> <li>2. Media: It could be through the sender itself or an individual the receiver can closely associate with the sender.</li> <li>3. Language: Standard <i>Yorùbá</i>.</li> <li>4. Content: Three Cowries.</li> <li>5. Caveat: The number of cowries can bring a change in meaning and interpretation of this particular <i>Àrokò</i></li> </ol>
3.		<p><b>Comb (òòyà)</b></p> <ol style="list-style-type: none"> <li>1. Package: Does not necessarily need any package.</li> <li>2. Media: It can be sent through a courier or the sender deliver the material.</li> <li>3. Language: Standard <i>Yorùbá</i>.</li> <li>4. Content: Hairdresser comb (Òòyà)</li> <li>5. Caveat: When a hairdresser comb is sent between friends that have a disagreement, that put an end to their relationship. If the same material is sent between two hairdressers, it means a call to help in plaiting the hair of the sender.</li> </ol>



is used to encode or infuse sensually accessible information into the sound.

Speech = Sound + Language

Noise = Speech – Language

Silence = Speech – Sound

Mental = Language - Material

$L_0 = L_1 - \text{Material}$

When language is removed from speech, what remains is noise.

## 4 System Implementation

In computing, grammar can be defined as the mechanism for formal specification of the elements and structure of a language. Formal means there is a standard and generally accepted standard that everyone adheres to. In modelling the *Àrokò* system of communication, one of the major components involved in the language of the material being sent. To do proper modelling of the language, the grammar of the language is developed. for *Àrokò* system of communication can be derived and there are four major areas on which the production rules will focus on. The first is the one that derives its meaning from the verb of the material being used. The material used is a noun, why the action word, that is the verb gives the meaning of the *Àrokò*. For example, *Òd̀yà* is a noun derived from the verb *yà*, which means to separate. Another example is in the use of *Abèbè*, which is also a noun but derives from the verb *bèbè*, that is to plead. So, when *Abèbè* is sent it is used to plead to the receiver of the material. Therefore, when this material is used, the verb of the material is important.

**Definition 2** Grammar is four-tuple defined as Grammar  $G ::= \langle V_T, V_N, P, S \rangle$

where:  $V_T$  is the non-empty finite set of terminal symbols which are also called the alphabet of the language;

$V_N$  is the non-empty set of non-terminal symbols that form the vocabulary of the language. Each string in  $V_N$  is composed of  $V_T$ ;

P is the finite set of non-empty rules by which each non-terminal is replaced with one or more strings of terminals and non-terminals. They are also called re-written rules; and

S is the start non-terminal symbol. S is an element of  $V_N$ . It is a unique member of the non-terminal symbol to indicate the beginning of an expression.

*Àrokò* communication system starts from the sender as seen in Figure 4, which is the initial state

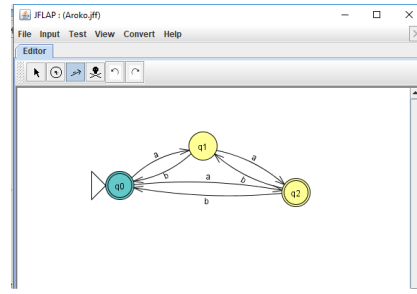


Figure 4: JFLAP Implementation of *Àrokò* Grammar

LHS	RHS
S	→ aA
S	→ aB
S	→ λ
B	→ λ
A	→ bS
B	→ bS
B	→ bA
A	→ aB

Figure 5: Production rules of *Àrokò* Grammar

and can pass through a messenger or directly to the receiver, and the receiver can be the final recipient of the materials, or there could be a response back through the messenger or directly to the sender. The production rules of the grammar of the language are shown in Figure 5.

## 5 Summary

The study for this work stemmed from a desire to learn more about communication systems before limiting it down to non-verbal communication in humans. The distinctiveness of the non-verbal communication system in the *Yorùbá* community was investigated, and it was discovered to be rich in words and symbol interpretation. This brought about the study centering on *Yorùbá Àrokò* communication system which has existed for years among the *Yorùbá* community. The message system of this particular communication system was looked into and a corresponding model for the *Yorùbá Àrokò* was developed.

The study was able to present the formal representation of the concept and means of communication of the *Yorùbá Àrokò* communication system. Artefacts that can be implemented on a computational instrument were developed and this can be re-used for related tasks.

## 6 Conclusion

From the various related work examined so far, it is discovered most works of literature talk about the importance and relevance of *Àrokò* in communication (Sidikat, 2015), and few literatures were able to focus on an aspect or two of the areas in which *Àrokò* can be used, the only computational aspect as known in literatures is the cryptography in terms of the secretive part of the *Àrokò* means of communicating. So, it could be seen from existing pieces of literature that none has been able to give a formal and computational model of the communicative context of *Yorùbá Àrokò* System.

When in need of the proper interpretation and understanding of the meaning of *Àrokò*, the study of signs can not be unconnected from the culture of consideration and the background of existing discussions between the sender and the receiver. It is then the meaning of *Àrokò* can be formulated and explained. This work has presented the study and communication concept analysis of *Yorùbá Àrokò*. The work has been able to present a communication model that can serve as a basis for developing communication systems.

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