Vrije Universiteit Amsterdam

Honours Programme, Research Paper

Using crowd-sourcing techniques to tag objects from the colonial period exhibited in Dutch museums

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A report submitted in fulfillment of the requirements for the Honours Programme, which is an excellence annotation to the VU Bachelor of Science degree in Computer Science

June 9, 2024

Abstract

Crowd-sourcing is generally used to delegate a task, such as tagging images, to an anonymous crowd. However, for jobs that require a certain background knowledge, it makes more sense to outsource this job to a small group of experts. In the context of colonial heritage that originates in Africa, this poses a challenge since expert communities in rural Africa may not have access to the Internet. We propose using a voice-based interface to get in touch with source communities and find out more about the purpose of selected objects that are now exhibited in Dutch museums. We developed an Interactive Voice Response (IVR) system in which people can answer questions about the chosen colonial heritage objects. In our evaluation, we use conceptual content analysis to extract relevant keywords that can be integrated in the database to create a polyvocal representation of each object. Our findings in the Netherlands also indicate that people have a basic understanding of the selected colonial heritage objects, but are unable to provide additional information. Nonetheless, the IVR system proves to be a reliable option to extract information about these objects.

1 Introduction

When using crowd-sourcing to tag items, there is one part of the world population that is virtually never taken into consideration: communities that do not have access to the Internet. According to the World Bank [1], in 2020 about 60% of the world population had access to the Internet. In sub-Saharan Africa, it was only 30% of the population [2]. As a result, it is difficult for people in this part of the world to access and contribute to information outside of their local context. It is imperative to consider their point of view, particularly when it comes to objects that originate from these communities. How can we ensure that their voices are heard and how can we include their perspectives in our data bases?

In this project, we narrow these questions down and aim to use nichesourcing, "a specific type of crowdsourcing where complex tasks are distributed amongst a small crowd of amateur experts" [3], to extract information about objects originating from Ghana and exhibited in Dutch museums.

In Ghana, only about 58% of the population had access to the Internet in 2020 [1]. According to the Digital 2022 report on Ghana [4], the number of mobile connections is equivalent to 140% of the total population. This number is probably not representative of the entire population, as many individuals use multiple mobile connections. However, it indicates that more people have access to the telecommunication network than to the Internet. Consequently, we have chosen to make use of the mobile network to engage with the source community.

Although about 79% of the population in Ghana is literate [5], we are aware that there is the possibility that individuals or entire source communities may not be confident in reading or writing. For this reason, we chose a voice interface for our experiment. We developed an Interactive Voice Response (IVR) system using Twilio's Programmable Voice API. Participants can call the provided number to answer questions about pre-selected objects, enabling us to embed their knowledge in the database.

2 Problem statement

This study is part of a larger project that aims to explore a voice-based method to reach and interact with communities that do not have access to the Internet. In addition, one of the broad goals is to understand how perspectives on colonial heritage objects differ in the global north and south, with a specific focus on the Netherlands and Ghana.

This paper aims to identify and propose an effective method and approach for using nichesourcing in areas with low Internet connectivity. The primary focus of this study is to develop a robust methodology and technical implementation. While we test our voice application in the Netherlands, conducting the experiment in Ghana or another sub-Saharan country is out of the scope of this research. By prioritizing the development of a methodological framework and implementation, this research seeks to create the building blocks for performing voice-based crowdsourcing targeted at expert communities.

We propose to address the following research questions through the experiment described in Section 4.

- **RQ1** Is an IVR system a reliable option to extract information about colonial heritage objects displayed on printed images?
- **RQ2** How can we include participants' responses in the database to create a polyvocal representation of each object?

We believe that answering these questions will provide insights for implementing the proposed method in real-world scenarios.

3 Related Work

A Dialogue with Linked Data: Voice-based Access to Market Data in the Sahel

Boer, Gyan, Bon, *et al.* [6] investigate how market data in Mali can be made accessible to the local population. In their paper, the authors focus on a voice-based system to allow people with low literacy levels to have access to these data. First, the market data deployed by RadioMarché have been converted to linked data in RDF format. According to Boer, Gyan, Bon, *et al.* [6], Linked Data is advantageous in this context, since it consists of resources rather than textual uni-dimensional terms. The market data in the form of generated audio files was then accessible to the local population through the W3C VoiceXML Standard [7].

The described system from Boer, Gyan, Bon, *et al.* [6] is extremely relevant to the project presented in this paper. We share the goal of making Linked Data accessible to communities in Sub-Saharan Africa who may lack internerather thannd have low literacy levels. However, in our project, the data is already available as Linked Open Data in RDF format, so no conversion is necessary Instead of making market data accessible, our goal is to extract information about colonial heritage.

Tibansim: Information Access for Low-Resource Environments

Dittoh, Akkermans, Boer, *et al.* [8] explore the possibilities of an information delivery system hosted in low-resource areas. One of the challenges of connecting rural communities that the authors identified is the fact that often the local population does not judge the information to be locally relevant [8].

Furthermore, Dittoh, Akkermans, Boer, *et al.* [8] used the Kasadaka platform [9] developed by Researchers from the Vrije Universiteit Amsterdam and the University of Amsterdam. Kasadaka enables the development and hosting of voice-based information services, targeted at low-resource environments [8]. As we developed the interactive voice response system used in our experiment, we took the information on Kasadaka's approach and experience into account.

Is data sharing the privilege of a few? Bringing Linked Data to those without the Web

Guéret, Boer, Bon, *et al.* [10] presents a way to prevent the growth of the digital divide when it comes to the Semantic Web. The authors investigated the question of how to make data sharing possible for people without Web access. The paper presents the idea of installing groups of micro-servers to access Linked Data instead of using Web-Browsers. These microservers can be used to store locally relevant data and they can interact with each other and connect to the Internet, whenever possible. We considered this technique of making information available to rural communities when designing our experiment. However, we chose to focus on implementing a system that can be easily transferred to different countries and used in different contexts. Nevertheless, microservers could be useful in making the pictures of the objects available to the source communities, rather than requiring a person to present the images. This could be highly valuable for future work. Particularly, the combination of sharing data using microservers and extracting information using a voice-based system could be further investigated.

4 Research Design and Methods

With the subsequent experiment, our aim is to address the research questions previously outlined.

While the findings of this research are applicable across Sub-Saharan Africa, Ghana has been selected as the case study for this paper. We created a questionnaire on colonial heritage objects that originate in Ghana and are now exhibited in Dutch Museums of the Wereldculturen Collective[11]. Since this questionnaire must be accessible in low-resource environments, we make use of the better connected telecommunication network. Consequently, participants can access the questionnaire hosted on Twilio's Programmable Voice API with a phone call.

4.1 Objects and sample populations

First and foremost, it is crucial to determine which objects in the Museum Database we want to include in our questionnaire. A search for the term "Ghana" yields 4,443 records. We prefer to gain in-depth knowledge about the perspective of the source community on a few selected objects rather than obtaining superficial opinions on a large number of objects. For this reason, we selected three objects for this experiment. If this approach proves effective, we can develop a long-term version of this interface covering more objects.

We aimed to include a variety of objects to cover a multitude of fields. In particular, we selected objects, such as the drum, that people in the Netherlands are likely to recognize as well. We have chosen the following objects in Figure 1 for the experiment.

(a) Drum (b) Pot (c) Fertility Doll

Figure 1: Chosen objects from museum database [11]

While conducting the experiment in the source communities in Ghana is not within the scope of this research, we decided to carry out a test run in the Netherlands to make sure our system is feasible. We aimed to include 10-15 participants from our sample population of people living in the Netherlands.

4.2 Survey Questions

In this section we will discuss in detail the questions we designed for the IVR. All participants will be asked the following three questions about each object:

1. What do you see? Please describe the object.
2. According to you, what is the purpose of this object? What could it be used for?
3. Do you know about any rules in terms of how the object needs to be treated? What should, or should not be done with it?

The first question aims to ensure that participants correctly identify the object in question. It is also interesting to see what details participants emphasize, for instance, the color of the object, the

estimated age, the different materials used, or even specific decorations that might be of importance. The first question thus requires each participant to take a close look at each object. The second question then aims to get a better understanding of what each object is used for. More specifically, we want to find out what the purpose of each object is, or what the participants in the Netherlands know about the purpose. The third question aims to identify rules in terms of how the object should be treated. For instance, there might be cultural norms that dictate cleaning and maintenance rituals. In particular, object 3 is a fertility doll that people might confuse with a toy doll for kids. Thus, the third question is vital to prevent misuse due to a misconception or lack of knowledge of these types of cultural rules.

4.3 Call Procedure

To provide a clear understanding of what a phone call to the system may look like, we modeled the call flow in Figure 2. In addition, there is a mock call outlined in the Appendix.

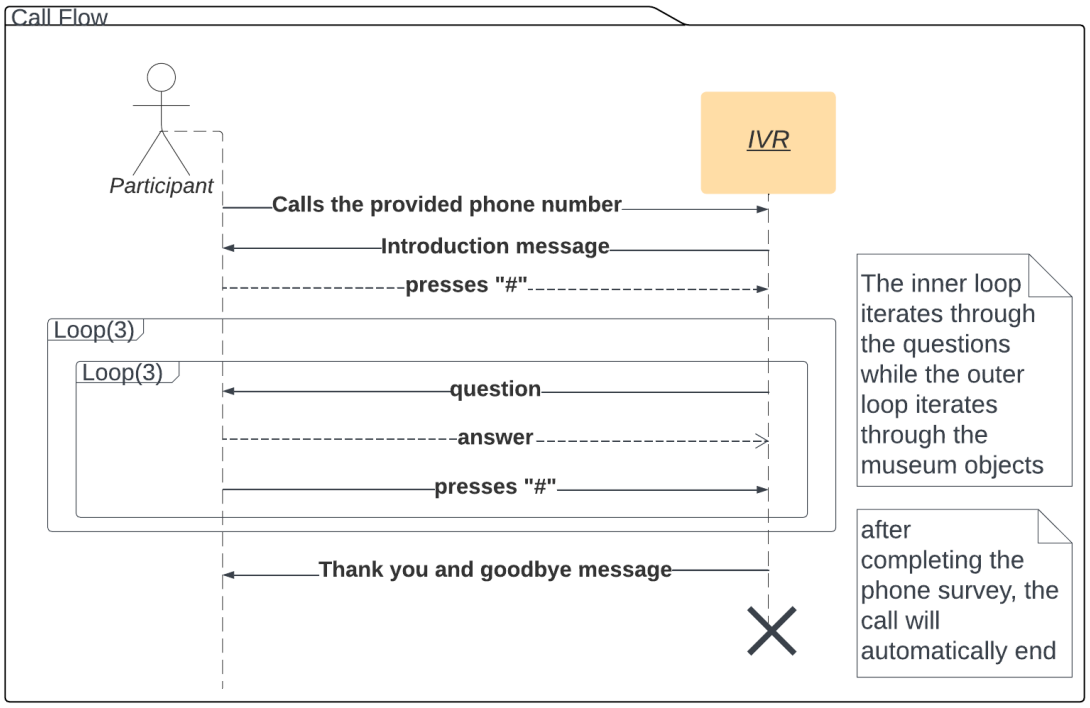

Figure 2: Call Flow

4.4 Interactive Voice Response

As mentioned above, we decided to use Twilio as our platform to host the IVR and store call recordings. It is possible to host the service on (private) servers and only connect the code written in your programming language of choice to the phone number provided by Twilio. For our purpose, it was more convenient to use 'Twilio services'. Twilio uses Node.js as their back-end framework together with specific commands that are then further translated into VoiceXML. Figure 5 shows the function that receives the call, outputs the welcome message, records the participant's answer, and then redirects the call to the next function.

```
1  exports.handler = function(context, event, callback) {
2   // setting up some TWiML to respond to with this function
3   let twiml = new Twilio.twiml.VoiceResponse();
4
5   const welcome_message = 'Hello, thank you for participating in describing '
6      + 'objects from Ghana that are now displayed in Dutch Museums. Your '
7      + 'responses will be kept anonymous and confidential. Only general '
```

```
    + 'findings will be shared. If you agree to the previously described '
    + 'terms, please say yes and then hit the hash sign.';

// output the message
twiml.say(welcome_message);

// record the participants response
twiml.record({
    // redirect to the question 1 after the participant pressed '#'
    action: '/object1/question/1',
    finishOnKey: '#'
});

// we return the Twiml voice response after the function was invoked
return callback(null, twiml);
};
```

The entire code can be accessed at this GitHub repository.

4.5 Conceptual Content Analysis

Generally, this research follows a qualitative approach, as our objective is to gain more detailed knowledge of the chosen objects. However, it is important to keep in mind the idea of nichesourcing: the goal is to outsource the task of tagging museum objects to the expert community in a systematized form. In particular, we need to evaluate the submitted answers in a way that allows us to extract tags that have been mentioned multiple times. For this purpose, we decided to perform a *Conceptual Content Analysis*. The different concepts on which we focus are *appearance* and the *purpose* of the objects, as well as any *rules* in terms of how the objects should and should not be treated. The questions were designed so that each question aims to represent one of the concepts. The coding scheme was then decided after seeing the data. We chose to code for frequency instead of existence, since we cannot assume that every single participant is an expert in the field. The more people mention the same code, the more likely it is that this codeword is relevant.

5 Results

The following section presents the findings of our experiment in the Netherlands, following the conceptual content analysis described above. In addition to analysing the participants responses, we will draw comparisons with the information available in the Wereldculturen [11] database.

In our analysis, we first present the identified codewords, followed by a detailed categorization of the data collected. We will then continue to interpret the numerical data obtained in the context of this study.

The analysis focused on uncovering key themes and patterns related to selected objects originating in Ghana. The identified codewords are organized into three sub tables (1), representing the colonial heritage objects. Each table is divided into three sections that indicate which question the codewords belong to. In appendix 2, there are bar chart representations of each subtable. It is also important to mention that Table 1 only includes codewords that appeared at least twice in the recorded answers.

Table 1a displays the codewords related to Object 1, the drum. The most frequently identified codewords in this category include 'drum' and 'instrument', indicating that the participants successfully identified the object displayed. Similar conclusions can be drawn from the codewords highlighted in Table 1b/c.

It is important to mention that even though different words may have been used, they were essentially describing the same notion. For instance, people described the second object as some type of 'pot' or 'container.' In order to make sure that the general idea is captured, we are visualizing the extracted codes in Bubble / Venn diagrams. The size of each bubble indicates how many participants mentioned the respective codeword. The color shows in the context of which question the word or phrase was said, and the distance between the bubbles shows how closely related the different codes are. For example, when describing an object, the codewords 'green' and 'blue' would be very close, if not intersecting,

Object 1		
Q1	Drum	12
	Instrument	5
	Color: brown	5
	Material: animal skin	4
	Material: tension ropes	4
	Age: old	3
Q2	Music	9
	Instrument	3
	Ritual / ceremony	3
Q3	Treat with care	4
	Limit exposure to air	2
	Use only as instrument	2

(a) Drum

Object 2		
Q1	Pot with lit	9
	Figures at the top of the lit	7
	Container / Bowl	4
	Material: clay	3
	Material: metal	2
	urn	2
Q2	Storage	10
	Store food	8
	Store valuables (jewelery)	2
	Religious / spiritual	2
Q3	Treat with care	2
	Fragile lit	4

(b) Pot

Object 3		
Q1	Figure of person	7
	Big head	7
	small, spread out arms and legs	3
	prominent facial features	2
	Sex: female	4
	statue	3
Q2	Fertility	3
	Religious purposes	5
	Depicts a god	4
	decoration	3
	toy	2
Q3	Treat with care	4
	Limit exposure to air	2
	Use only as instrument	2

(c) Fertility doll

Table 1: Codeword frequency

since they both describe the color of the item. It is necessary to emphasize that the bubble diagrams outline our interpretation of the numerical data shown in Table 1.

Figure 3 shows a bubble diagram as described in the previous section. It is apparent that most of the participants agree that the first object seems to be a drum. This is in line with the information available in the Wereldculturen database, were the object is described as a so-called "atumpan" drum.

The participants then went on to describe different properties such as the assumed age, the materials that have been used, or the different colors of the object. Furthermore, the area of the bubbles shows that there are more common words in the answers of the first question than in the second and third. This was anticipated since appearance is generally more objective and easy to describe. In contrast, the opinions about the purpose of an object may be more dependent on the individuals' worldview and life experiences. We can observe that the codeword 'instrument' was mentioned as an answer to the first and second questions. Thus, there seems to be a relation between the process of identifying an object and its purpose. The majority of people voiced that the object's purpose is to make music. Some also mentioned that the object may be used in a ceremonial context, but none of the participants was able to give a detailed description of what such a ritual would look like and how the object is used in that context. According to

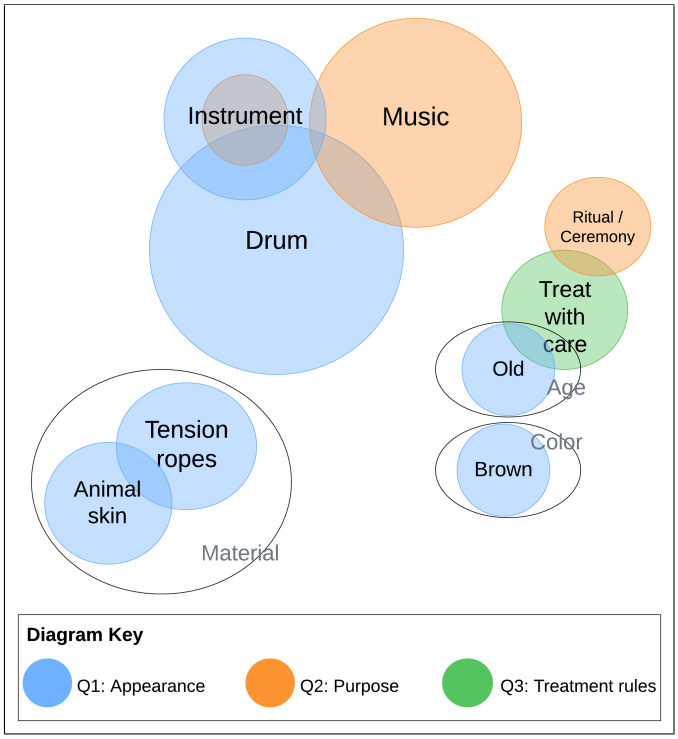

Figure 3: Bubble diagram for Object 1

the museum, the "atumpan" drum is used to communicate with others at a distance. Moreover, the drum is an indispensable element in the music culture of the source communities and often forms the heart of the ensembles that accompany various music and dance performances. After listening to the recorded responses, it was apparent that the participants struggled to answer the third question. Many simply stated that they do not know of any treatment rules. The general consensus of the people who elaborated more was that the object should be treated with care. However, the reasons as to why the object needs to be treated with care differed. While some participants argued that the age of the object was an indicator, others mentioned its supposed ceremonial importance. According to the museum, playing the "atumpan" is in many cases reserved for (semi)professional drummers who are recognized by the community as true artists.

Overall, the clusters in Figure 3 show that all recorded answers contain some common codewords and that most of them, such as 'drum', 'instrument' and 'music' are highly related. Furthermore, the partipants' answer generally matched the information in the Musuem database.

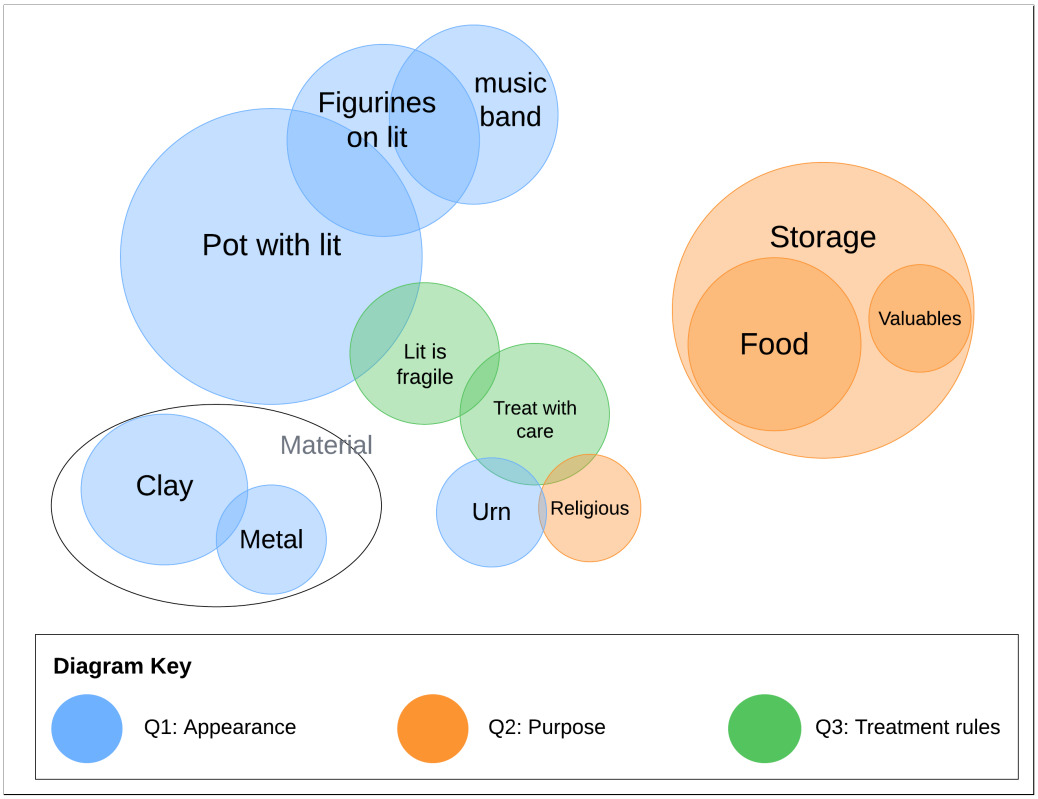

Figure 4: Bubble diagram for Object 2

Figure 4 shows the bubble diagram for the second object. Most of the participants agreed that the picture of object 2 displayed a pot, or container, with a lit. The museum also describes the object as a type of pot called "kuduo". When describing the appearance of the object, many participants focused on further describing the decorated lid. They identified figurines that resemble people who sit together and play music. The correlation between the pot, and what is depicted on its lit, is visualized as intersections in Figure 4. In addition to the description of the lit, some of the participants made assumptions about the material of the object. A few participants said that they believed the object was metallic, but more people assumed that it was made out of clay. According to the museum, the pot is in fact made of brass or bronze. When they were asked about the purpose of object 2 (second question), the majority of the participants answered that it is probably used for storage. However, there was a disagreement on what exactly would be stored in the object. Some thought it would be used to store foods such as sugar and others assumed that the object would be used to store valuables, such as jewelry. According to the Wereldcultured database, "kuduo" are indeed intended for storing valuables. Another fraction of the participants claimed that the object would be used for religious purposes and described it as an urn, storing the ashes of deceased relatives. Similarly to the

observations in the answers about the first object, the participants were hesitant to answer the third question. Again, many participants voiced that they do not know how the object should or should not be treated. Some of them noticed that the lit, or more specifically the figurines on top, look fragile. As a result, the participants concluded that the second object should also be treated with care. According to the museum, the pots have a religious function and play an important role in the personal ritual of their owners on important occasions and moments in their lives, such as in fertility rituals [11]. Offerings are also placed in the kuduo as part of purification rituals. When the owner died, his kuduo was buried with them, filled with gold dust and beads. Kuduo were used in various rituals, for example, in the 'N'Toro' ('soul-washing') rites, female puberty rituals, funeral rituals and twin celebrations.

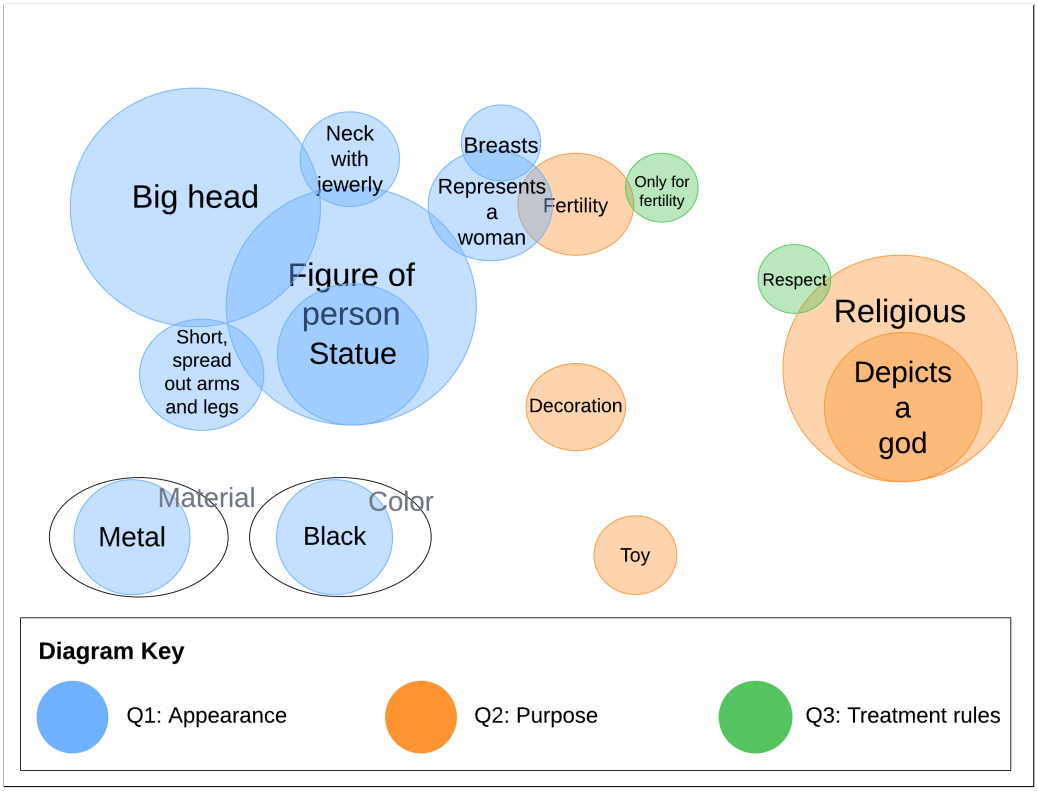

Figure 5: Bubble diagram for Object 3

Figure 5 shows the bubble diagram for the last object we used in this experiment. Compared to Figure 3 and Figure 4, we can see that there are many more blue bubbles, and the orange and green bubbles are more spread and not clustered around a common point. That means that the participants had more to say about the appearance of object 1 and were not in agreement about the purpose and treatment rules of the object. Overall, the participants voiced that the object looks like a figure of a person or a small statue. Most of them pointed out that the figure had a disproportionately big head. According to the museum database, the large head is usually related to the moon as a typical feminine symbol. A few participants said that the figure has short, spread out arms and legs, and is wearing jewelery around its neck. It was also said that the object has breasts and is thus a representation of a woman. Similarly to the description of the other two objects, participants mentioned the material of the object, namely assuming that it was made of metal. Regarding the second question, about the purpose of the object many participants assumed that the object had a religious meaning and depicts a god. Because of that, a couple of participants argued that the object needs to be treated with respect. However, there was no clear consensus. Some thought that the object was purely used as decoration, and others mentioned that it could be a toy. A few participants mentioned that the object could be a fertility doll. With regard to question three, these participants also said that the object should be used only for fertility and not for any other purposes. The museum provides some further information about the fertility dolls their origin. The name of these dolls, Akua'ba, is said to originate in an Akan legend about a woman, named Akua, who consulted a fortune teller because of

her infertility. She was advised to carve a wooden doll and cared for it like for a real child. She was mocked by fellow villagers and her wooden child was named Akua'ba (child of Akua). However, when she did indeed become pregnant and had a daughter, this doll was generally recognized as a cure for infertility. Once the doll has fulfilled its function, it is kept at the home altar [11].

6 Discussion

In this section, we interpret and contextualize the findings presented in the results section, addressing the research questions outlined at the beginning of the study. Our analysis revealed several key insights into the knowledge people residing in the Netherlands have about colonial heritage objects. In addition, we were able to get a better understanding of how effective the IVR is to tag objects exhibited in museums.

We observed that the participants in the Netherlands were able to correctly describe the selected objects, using the information in the musuem database as a baseline. Furthermore, some participants showed more in-depth knowledge regarding the purpose of the objects. However, none of the participants knew about any rules in terms of how the objects should be treated, other than with care. All of this suggests that there is a basic understanding of cultural heritage objects, but, as expected, the participants were not able to provide reliable novel information.

> **RQ1**: Is an IVR system a reliable option to extract information about colonial heritage objects displayed on printed images?

Our study found that an Interactive Voice Response (IVR) system is indeed a reliable option to collect data about colonial heritage objects displayed on printed images. The reliability of the system was evaluated based on several criteria, including accuracy of the retrieved information, accessibility and user engagement. Participants were able to successfully use the IVR system to share their knowledge and perception concerning the selected objects, demonstrating that the system can function effectively without requiring internet access or high literacy levels.

Evidence from our findings shows that:

- Accuracy: The IVR system provided accurate information about the objects, as confirmed by cross-referencing with the museum database. However, no novel knowledge was gained by performing the experiment. This was to be expected since we did not assume that people residing in the Netherlands can be seen as an expert community regarding colonial heritage objects that originate in Ghana. In addition, participants seemed to struggle to answer question 3 for any of the selected objects. This could have two reasons: it could either be because the question was badly formulated, or, because the sample population does not have valuable information to add. In this case, we assume that it is the latter, but this would need to be confirmed by comparing our results to the information provided by the source community in Ghana.

- Accessibility: The system was online without interruptions during the period of the experiment. In other words, it was always accessible to the participants and they were able to answer the questions at their convenience. Nevertheless, it is important to consider that the accessibility might differ in low-resource environments. We cannot guarantee that the telecommunication network has a constant high connectivity.

- User Engagement: The participants generally showed high levels of engagement with the IVR system, indicating its potential for broader application. Despite that, we noticed that some participants seemed to be confused about how to use the voice-based interface. For instance, one participant thought that every question 1 was about object 1, question 2 was about object 2 and so forth. When the first round of questions was over, the participant noticed their mistake, hung up and called again after. This shows that we need to revise the welcome message and extend it with better explanations to make sure the participants understand how to use the IVR.

Overall, these results suggest that the IVR system can serve as a practical tool for extracting information in regions with limited digital infrastructure.

RQ2: How can we include participants' responses in the database to create a polyvocal representation of each object?

Generally, there are two approaches that we can use when adding the information to the database:

1. Quantitative: We can focus on extracting keywords that are relevant to the object, based on the amount of mentions, and add them as simple tag words.

2. Qualitative: We can use individual responses that are valuable and attach their input as some sort of story to the object in the database. This can either be a textual representation of the answer, or the original audio file if the participant agrees.

Of course, it is also possible to use a mix between both methods, but we believe that it is preferable to focus on one of them to follow a systematized approach instead of arbitrarily choosing case by case.

For our experiment we chose to follow a quantitative approach, using conceptual context analysis. This seemed to be the more suitable method, since people in the Netherlands are - presumably - less likely to have a valuable story to add. Our results support this hypothesis.

The extracted codewords shown in Figure 1 could now be integrated as tags in the museum database. If we conduct the experiment in Ghana as well and perform the same conceptual context analysis, we would indeed be able to create a polyvocal representation of each object.

6.1 Limitations

While our study provides valuable insights regarding interaction with communities without Internet acess, it is important to acknowledge certain limitations of the experiment and the analysis.

First, we are highly dependent on the connectivity of the telecommunication network. This limitation may impact the accessibility of the Interactive Voice Response system for rural communities.

Second, we worry that colonial heritage objects might not be relevant or a priority for the source communities. A similar issue has been identified by Dittoh, Akkermans, Boer, *et al.* [8]. This could be mitigated by providing a monetary incentive at first to encourage community members to participate in the experiment.

Third, we need to consider the language barrier when using the IVR system in Sub-Saharan Africa. In general, it is likely that we cannot directly translate some words, phrases, and terms, which can potentially corrupt the meaning and validity of the results.

Additionally, the time needed to listen to and analyze the recorded answer makes it difficult to use this approach as a tagging method for the museum. There would need to be an automated system that analyzes the responses and highlights codewords that have been said multiple times. However, using a purely quantitative approach to the qualitative data results in potential loss of important information.

6.2 Future work

This research project is relevant to many different fields. Since the design of our experiment focuses on people that do not have Internet access and with differing levels of literacy, we hope that our voice-based solution will encourage other researchers and businesses to connect this part of the world. Our results may also be valuable to the Pressing Matter Project [12] to encourage societal reconciliation with the colonial past, recognizing that many people living in the Netherlands only have a basic understanding of colonial heritage objects.

In the continuation of this project, we hope to conduct the experiment in Ghana to compare the responses of the source community with those we gathered in the Netherlands. In this study we assumed that these source communities are amateur experts regarding the objects. An analysis of the answers in the two sample populations will show whether this assumption is correct.

Apart from these more general implications and contributions to knowledge, the results of this experiment can help to set up a permanent adaption in the form of a mini-exhibition in community centers. The objects can can be shown through pictures or potentially 3D prints. A phone number could then be offered for visitors to or call. The information and opinions provided could then be

analyzed and added to the museum database. Whether the newly gained information should be reduced to codewords follwing the conceptual content analysis, or whether it should be added as simple stories will need further evaluation.

7 Conclusion

The primary aim of this research was to evaluate the reliability of an Interactive Voice Response (IVR) system for extracting information about colonial heritage objects displayed on printed images and to explore how participants' responses can be integrated into a database to create a polyvocal representation of each object.

The findings from our study demonstrate that the developed IVR system proved to be a reliable tool to extract information about selected objects. It actively caters to those with limited technological proficiency and varying literacy levels. This indicates that IVR systems can function efficiently without the need for internet access, making them a viable option for use in Sub-Saharan Africa. Participants' responses were successfully collected and relevant codewords were extracted. These can now be added to the database to create a polyvocal representation of each object. This approach allows for a more inclusive and diverse understanding of the cultural and historical significance of the objects.

The results of this study have several important implications. The IVR system actively helps to bridge the digital divide by providing an accessibly way to extract information in regions with limited internet connectivity. Moreover, by including multiple voices and perspectives, our method enhances the representation of cultural heritage. While the study offers promising insights, there are certain limitations to consider. To further proof the validity of our proposed system, it is necessary to conduct the experiment in Ghana, or another Sub-Saharan country. Future studies should explore the long-term impact of using IVR systems to interact with communities without access to the Internet and potentially varying levels of literacy.

Final Thoughts: In conclusion, this research highlights the potential of using voice-based systems in low-resource environments. By integrating participants' responses, we can create a more inclusive and dynamic representation of cultural heritage. We hope that this work will inspire further research and development in this area, ultimately leading connecting the so far unconnected to the world of information exchange.

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Appendix

A.1 Mock Call

The following dialogue presents a mock call to the voice interface.

SYSTEM: Hello, thank you for participating in describing objects from Ghana that are now displayed in Dutch Museums. Your responses will be kept anonymous and confidential. Only general findings will be shared. If you agree to the previously described terms, please say yes and then hit the hash sign.

CALLER: Yes! [*presses '#'*]

SYSTEM: Let's begin with object number 1 in the red frame. Please record your answer after the beep and then hit the hash sign. Question 1: What do you see? Please describe the object.

CALLER: I can see... [*speaks and then presses '#'*]

SYSTEM: Question 2: According to you, what is the purpose of this object? What could it be used for?

CALLER: [*speaks and then presses '#'*]

SYSTEM: Question 3: Do you know about any rules in terms of how the object needs to be treated? What should, or should not be done with it?

CALLER: [*speaks and then presses '#'*]

SYSTEM: Let's continue with object number two in the yellow frame. Question 1: What do you see? Please describe the object.

. . .

SYSTEM: Thank you for completing this survey and helping us to get a better understanding for how people perceive colonial heritage objects. The call will now automatically end.

A.2 Bar charts for codeword frequency

The columns are colored based on the questions. The columns of codewords that were mentioned in the first question are red, and the columns for question two and three are green and blue respectively.

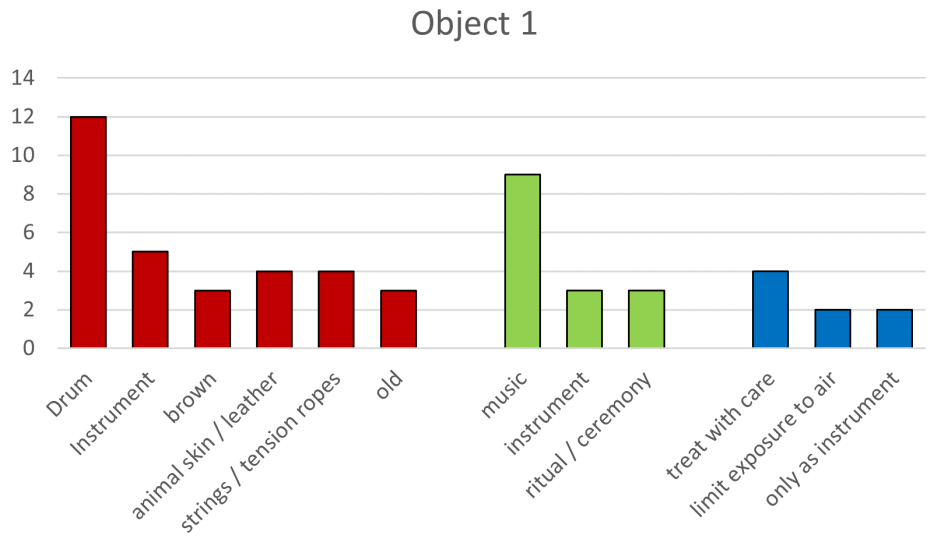

Figure 6: Codeword frequency for Object 1

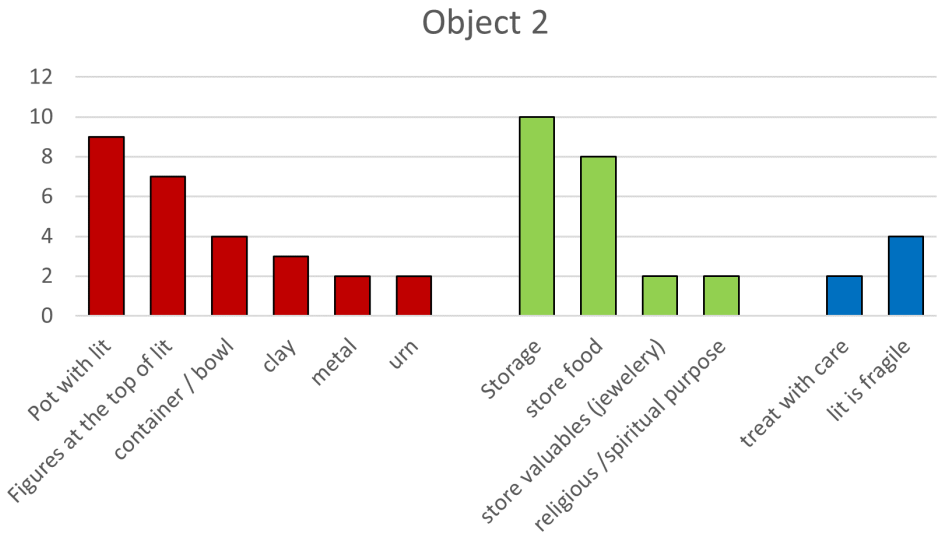

Figure 7: Codeword frequency for Object 2

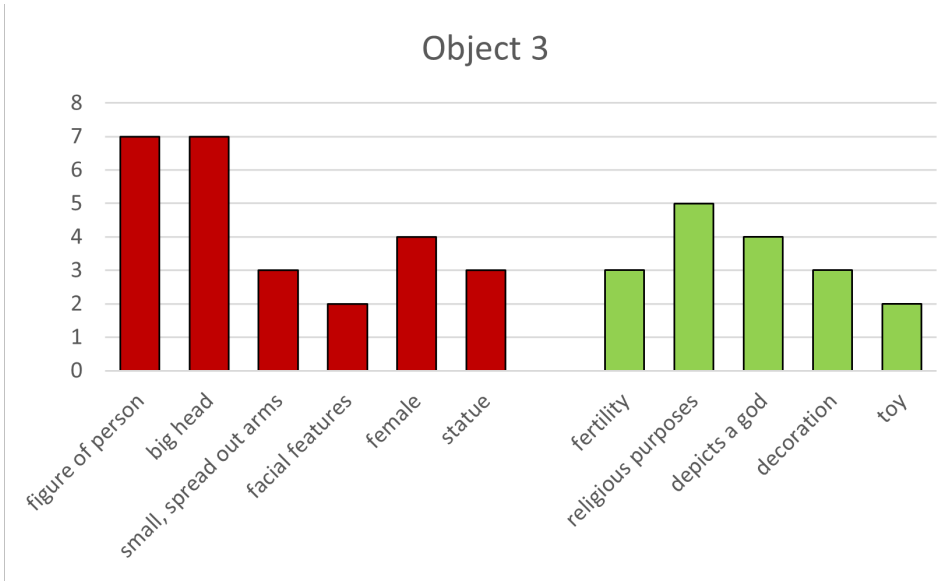

Figure 8: Codeword frequency for Object 3