

Surveying Rwandan Cultural Knowledge for Respectful Human-Robot Interaction in Africa

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Abstract—Respectful human-robot interaction is informed by local culture. This extended abstract outlines an exercise to acquire cultural knowledge to be exploited by culturally sensitive social robots in Rwanda. The knowledge was acquired by means for an online survey, targetting spatial, verbal, and non-verbal communication. Each type of knowledge in the survey is structured using an cultural knowledge ontology and comprises a questionnaire with 59 questions in English and Kinyarwanda. The survey produced 143 responses (108 in English and 35 in Kinyarwanda) and is part of a broader goal to develop culturally sensitive social robots for African contexts.

Index Terms—Human-robot interaction, social robotics, Rwandan cultural knowledge ontology.

I. INTRODUCTION

A growing body of research underscores the importance of incorporating cultural factors into human-robot interaction (HRI) to enhance user acceptance and engagement [1]–[4]. In Africa, a continent comprising 54 countries with rich cultural diversity, HRI system design must also be informed by local cultures [5], [6]. This diversity presents unique challenges and opportunities for HRI research. As highlighted by Veronica Dignum, “research and development of AI systems must be informed by diversity, in all the meanings of diversity, and obviously including gender, cultural background and ethnicity” [?]. The continent’s varied cultural landscape encompasses different perceptions of time and space, diverse social norms, and a multitude of languages and non-verbal communication styles. These factors significantly influence how technology, particularly AI-powered systems like social robots, are perceived, trusted, and adopted across different African communities.

The CSSR4Africa project¹ aims to fill the gap between current social robotics and culturally sensitive social robotics in Africa, focusing on Rwanda and South Africa. Initially, we are conducting ethnographic research and a cultural survey in Rwanda, with plans to extend to South Africa in the next phase. The survey (to be described below) captures the subtleties of verbal and non-verbal communication, such as appropriate greeting gestures and eye contact norms in

various social contexts. The collected data will form a cultural knowledge base structure using a formal ontology that categorizes the different concepts and relationships within Rwandan culture that can guide robot behavior. Based on this ontology, we developed a questionnaire in both English and Kinyarwanda² to gather extensive cultural knowledge from diverse participants across age groups and regions. For example, the survey questionnaire seeks to establish how age and social status influence interaction norms. This structured cultural information will enable social robots to exhibit acceptable behavior patterns, ensuring courteous and engaging interactions aligned with African social norms, initially in Rwanda. Our next steps are to identify dominant patterns in the answers provided by the 143 respondents and populate the knowledge base for use by the software system that is currently being developed to control two Pepper social robots [?]. In the final phase of the project, we plan on collecting more data to expand our cultural knowledge base and refine our ontology. This will allow us to develop more detailed and culturally sensitive models of robot behaviors for specific interaction scenarios in Rwandan contexts.

II. SURVEY METHODOLOGY

The CSSR4Africa project focuses on an ethnographic study of cultural knowledge in Rwanda and South Africa, with the first phase concentrating on a detailed survey of Rwandan culture. The survey follows a systematic process: developing an initial knowledge ontology to structure the questionnaire, formulating questions to elicit knowledge in each category, designing and implementing data collection methods and response visualization tools, conducting the survey, validating the responses, and extracting consensus perspectives in the responses to each of the questions. Finally, this knowledge will be used to construct a comprehensive cultural knowledge database.

A. Cultural Knowledge Ontology

The cultural knowledge ontology design is a key part of the survey task in the CSSR4Africa project. It provides a clear structure to capture and show the details of respectful interaction in Rwandan culture.

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¹www.cssr4africa.org

²Links to both versions of the survey can be found here: <https://cssr4africa.github.io/news>.

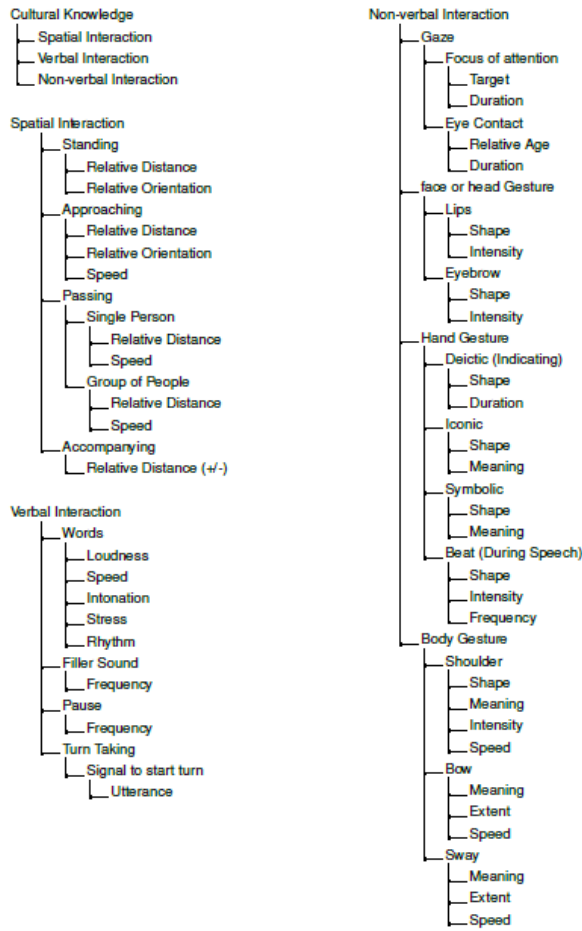


Fig. 1. Cultural Knowledge Ontology for Spatial, Verbal, and Non-verbal Interactions

As shown in the Fig 1, this ontology comprises three parts corresponding to spatial interaction, verbal interaction, and non-verbal interaction. Each part comprises specific elements of cultural norms and behaviors. For example, spatial interaction includes distance and positioning, while non-verbal interaction includes eye contact, facial expressions, and hand movements. Verbal interaction covers aspects like word choice, voice tone, and conversation turn-taking. This comprehensive ontology served as a guide for developing the culturally knowledge questionnaire, ensuring all important areas of interaction are covered. By mapping out these cultural elements, the ontology makes sure that important aspects of Rwandan social norms are fully addressed in the data collection. The cultural knowledge base that will be created from the survey results will be organized using this ontology. This will result in a well-structured and complete resource for future work on culturally appropriate social robots in Rwanda.

B. Questionnaire Development

The development of the survey questionnaire followed several steps: surveying the literature, drafting questions, and finalizing the questionnaire based on the cultural knowledge

ontology. We reviewed relevant studies on cultural competence in robotics and cross-cultural communication to inform our approach, breaking down our main research objective into sub-objectives focusing on spatial interaction norms, verbal communication patterns, and non-verbal cues in Rwandan culture. The process involved brainstorming sessions, reviews, and validation using a checklist from [?]. The resulting bilingual questionnaire in English and Kinyarwanda comprises three parts: (1) personal information for demographic balance, (2) validation of previously gathered cultural knowledge from a preliminary survey of 23 people from eight African countries [?], and (3) identification of culturally sensitive and disrespectful behaviors. This approach allows us to confirm and refine our understanding of Rwandan cultural norms within the broader context of African cultural knowledge.

C. Collection Methods and Ethical Considerations

Our study balances effective data collection with ethical research practices. We identified the study population primarily from Kigali city, chosen for relevant characteristics, cost-effectiveness, and logistical support. Participants aged 18-65, speaking English and Kinyarwanda, were selected using purposive sampling. Data collection sites included university campuses, markets, and cafeterias to ensure diverse representation. Throughout this process, ethical considerations were paramount. We obtained informed consent, maintained anonymity and confidentiality, and designed the survey so that it itself is culturally sensitive. A local research team reviewed questions to avoid offensive content, and all necessary university authorization processes were followed during the piloting phase. This approach ensured research integrity while respecting participants' rights and cultural sensitivities, creating a foundation for robust and ethically sound data collection.

D. Sample Survey Questions

In total there are 59 questions. Table I provides a sample of the questions from the English version of the survey.

E. Pilot Survey

Before launching the survey of the general public in Rwanda, it was piloted at Carnegie Mellon University Africa (CMU-Africa) over a two-month period. CMU-Africa was chosen as the pilot site due to the ongoing nature of the project there and the streamlined process for obtaining legal permission to collect data. We collected 108 responses in English and 35 in Kinyarwanda. This sample size provides valuable insights for refining our survey methodology. The pilot helped us improve the questionnaire, particularly in clarifying cultural terminology and adjusting question sequencing. Notably, we received no negative comments about the questionnaire design, indicating that participants found the questions clear and well-constructed. Moving forward, we will use these pilot results to finalize our questionnaire and sampling strategy for the main data collection phase, ensuring a robust and culturally sensitive research instrument.

TABLE I
SAMPLE QUESTIONS FROM THE RWANDA CULTURAL KNOWLEDGE
SURVEY

| Ontology Category | Sample Question |
|--|--|
| Spatial Interaction > Passing > Single Person > Relative Distance | What distance should you keep when passing someone? |
| Spatial Interaction > Accompanying > Relative Distance (+/-) | When showing someone older than you the way, where should you position yourself? |
| Spatial Interaction > Passing > Group of People > Relative Distance | How should you pass a group of two or more people? |
| Verbal Interaction > Words > Intonation | How should you address someone who is older than you and who you haven't met before? |
| Verbal Interaction > Pause > Frequency | Should you pause before responding when someone asks you a question? If yes, for how long? |
| Verbal Interaction > Turn taking > Utterance | In an interaction where you and someone else take turns to speak, would you signal that you want to speak? If yes, how do you do that? |
| Non-verbal > Gaze > Eye Contact > Duration | If you are explaining something to someone, how often should you make eye contact? |
| Non-verbal Interaction > Gaze > Focus of Attention > Target | If someone is explaining something to you, what is your primary focus of attention, i.e., where do you direct your gaze? |
| Non-verbal Interaction > Face or Head Gesture > Eyebrow > Shape | Would you use a face or head gesture to express agreement? What would the face or head gesture be? |
| Non-verbal Interaction > Hand Gesture > Iconic > Shape | Would you use a hand gesture to express respect? What would the hand gesture be, and which hand would you use: left, right, either, or both? |
| Non-verbal Interaction > Body Gesture > Shoulder > Shape | Is there a body gesture you should not use? What would the body gesture be? |
| Non-verbal Interaction > Hand Gesture > Symbolic > Shape | How should one properly hand over and accept gifts to show respect? |
| Non-verbal Interaction > Body Gesture > Bow > Meaning | Should one bow slightly when greeting someone older to show respect? |
| Non-verbal Interaction > Hand Gesture > Deictic (Indicating) > Shape | Should one use the left hand to point to anything? |
| Non-verbal Interaction > Hand Gesture > Symbolic > Meaning | Should one shake hands with the right hand and use the left arm to support the right forearm to show respect? |

F. Data Analysis Techniques

We are currently working on comprehensive data analysis to build the cultural knowledge base. This involves cleaning and organizing the collected data to ensure accuracy and consistency, and to identify prevalent consensus answers to each question. Both qualitative and quantitative analysis methods are being employed to identify key cultural elements and patterns within the responses. This analysis will form the foundation for developing a detailed cultural knowledge base, which will be used to guide the design and behavior of two culturally sensitive Pepper social robots.

III. CONCLUSION

This study represents an essential step in developing culturally sensitive social robotics for Rwanda and South Africa. The CSSR4Africa project has successfully piloted a survey at Carnegie Mellon University Africa, gathering 143 responses that provide valuable insights into Rwandan cultural norms. The next phase involves expanding data collection in Rwanda

and initiating similar studies in South Africa. Detailed analysis of the results will lead to the development of a comprehensive cultural knowledge database, which will inform the creation of a detailed cultural knowledge ontology. This ontology will ensure that social robots align with local norms. By incorporating these cultural insights, the CSSR4Africa project aims to enhance the acceptance and effectiveness of social robots in Rwanda and South Africa, promoting their successful integration in diverse African settings.

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