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The Robot in Residence (RiR) initiative is designed to explore and elucidate the dynamics of human-machine interactions, emphasizing communication across diverse cultural settings.

Each residency period allows the robots to acquire and refine its abilities, subsequently disseminating these enhanced expertise across Africa. This process not only broadens the robot's capabilities but also contributes significantly to an expansive discourse on artificial intelligence, highlighting its role in the broader dialogue surrounding diversity in AI.

ABSTRACT

The project emphasizes the fusion of technology with cultural elements, aiming to enrich cultural understanding, foster inclusivity, and showcase AI's role in safeguarding cultural legacies. It acknowledges the significant influence of robotics and technology in modern life, while addressing the need for inclusivity in technological developments.

We have recognized that not all technological advancements have been inclusive. Many have inadvertently excluded certain cultural perspectives, and this is where the Afro-centric approach comes into play. The Afro-centric perspective would rectify the exclusion of certain cultural viewpoints particularly within Sub-Saharan Africa.

Key objectives involve programming the NAO robot for cultural dances and South African Sign Language (SASL) communication, engaging diverse audiences, and utilizing advanced AI for cultural performance and inclusivity. The project aims to demonstrate the significant role of technology in enriching cultural experiences and promoting a more inclusive technological landscape.

INTRODUCTION

This project represents a pioneering effort to blend technology with cultural heritage, specifically focusing on the integration of robotics and artificial intelligence (AI) with distinct cultural elements. A collaboration with the Goethe Institut, embodies a vision where robots not only interact with humans but also understand and appreciate the diverse tapestry of human cultures.

It focuses on training the NAO robot about South Africa's rich cultural landscape, a nation teeming with varied ethnicities and traditions. The aim is to program the NAO robot to engage with the unique cultures and languages of various South African tribes, starting with the Zulu, Afrikaans, Tswana, Venda, Tsonga and more.

Alongside this cultural immersion, the project also seeks to equip the robot with image recognition capabilities, enabling it to identify and describe images while communicating relevant cultural facts.



The project is grounded in an Afro-centric approach, addressing the historical oversight of African cultures in technological advancements.

Its primary objectives include programming the NAO robot to perform South African dances and communicate using South African Sign Language (SASL), aiming to engage a diverse range of audiences and highlight the importance of cultural diversity in the realm of technological development.

This ambitious goal is set to redefine the intersection of technology and cultural heritage, demonstrating AI's potential in enriching our understanding of diverse cultural narratives.

AIM & OBJECTIVES

The initial aims and objectives of the NAO Robot in Residence program encountered unforeseen challenges due to delays in the delivery of the physical NAO robot to The Goethe-Institut South Africa.

Consequently, the team adapted the objectives to align with the capabilities of the Alpha 2 and DJI RoboMaster S1, which were available alternatives. This adaptation required a flexible and innovative approach to ensure the residency program's core objective of promoting cultural intelligence and inclusivity through technology was still achieved. Despite these hurdles, the team's commitment to the project's vision remained steadfast, showcasing resilience and adaptability in the face of logistical challenges.

The primary aim of the NAO Robot in Residence program is to foster an understanding and appreciation of diverse South African cultures through the innovative use of robotics and AI.

The objectives are as follows:

- *Synchronized movements with RoboMaster:*
Adapt the programming to synchronize movements of RoboMaster quad-robot, demonstrating how robots can mimic human synchronization in cultural dances, showcasing technological prowess in replicating the art of synchronized human movements.
- *Interactive Communication with Alpha 2:*
Program the Alpha 2 Humanoid robot to respond to voice prompts and hand gestures, enhancing its capability to interact in a culturally sensitive and intelligent manner. This aligns with the goal of making robots more responsive and adaptable to human cultural cues.





□ *Cultural Dance Programming:*

Program the NAO robot to perform various South African dances, representing different ethnic groups such as the Zulu, Afrikaans, Tswana, Venda, and Tsonga.

□ *Language and Communication:*

Teaching South African Sign Language (SASL), enabling it to communicate more inclusively.

□ *Image Recognition and Cultural Education:*

Equipping the robot with image recognition abilities, allowing it to identify and describe culturally significant images, and provide insightful facts about them.

These objectives required to be adapted to ensure that the project remains on track with its core mission of integrating technology with cultural expression, despite the shift in the robotic platforms used.

METHODOLGIES

Synchronized movements with RoboMaster

Expanding on the use of the RoboMaster S1, the demonstration highlighted how dance and body expression are integral to cultural expression. The RoboMasters' synchronized movements were programmed to reflect the rhythms found in South African dances, which are a vital part of the region's cultural identity.

In South Africa, dance is more than an art form; it's a means of storytelling and preserving history. Various cultures, such as Zulu, Xhosa, and Tswana, have unique dances that reflect their history, beliefs, and social structures.

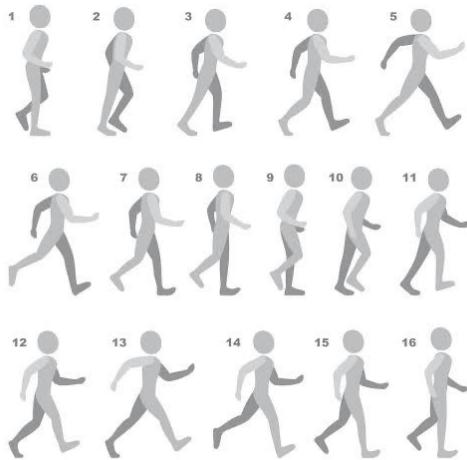
These dances, rich in symbolism and tradition, are often used in ceremonies and celebrations, playing a crucial role in community cohesion and identity.

By programming the RoboMaster S1 to emulate these dances, the project aimed to showcase the diversity and significance of dance in South African cultures, using technology as a bridge between modernity and tradition.

Cultural Dancing

This objective involves meticulously programming the NAO robot to perform a variety of traditional South African dances. Each dance represents a different ethnic group, including Zulu, Afrikaans, Tswana, Venda, and Tsonga. This requires detailed choreography programming and an understanding of the cultural significance behind each dance. The goal is not just to replicate movements but to encapsulate the essence and vibrancy of each culture's dance tradition.

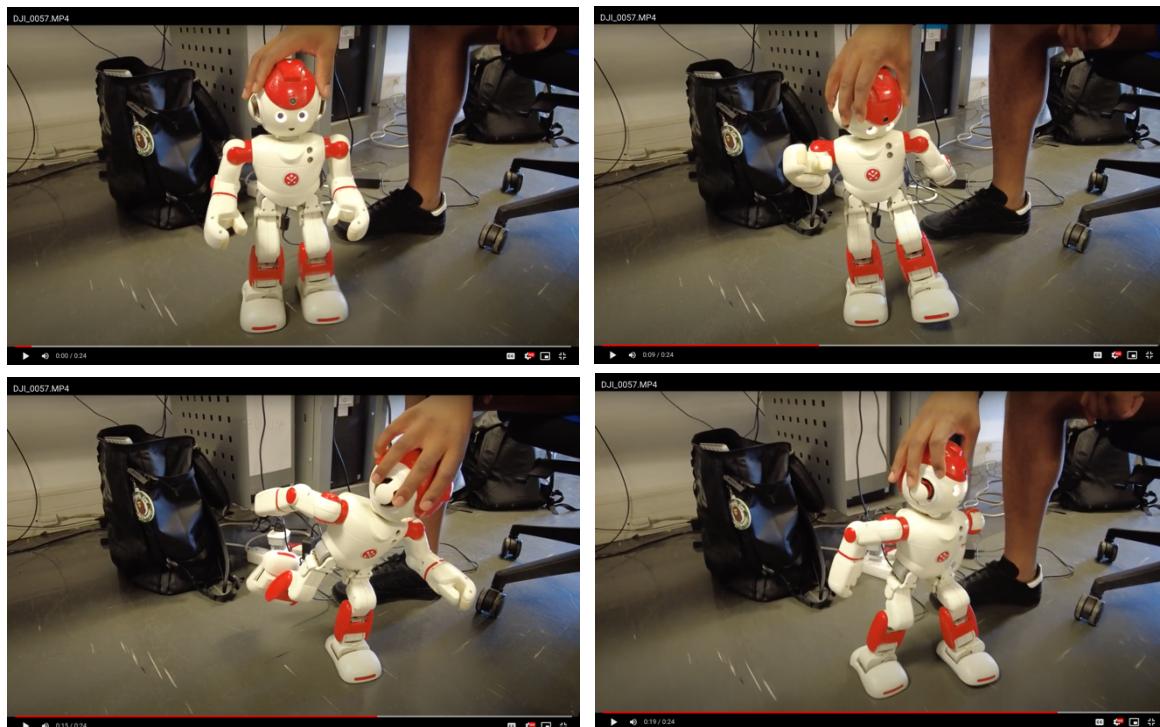
Cultural Dancing - Movement Consideration



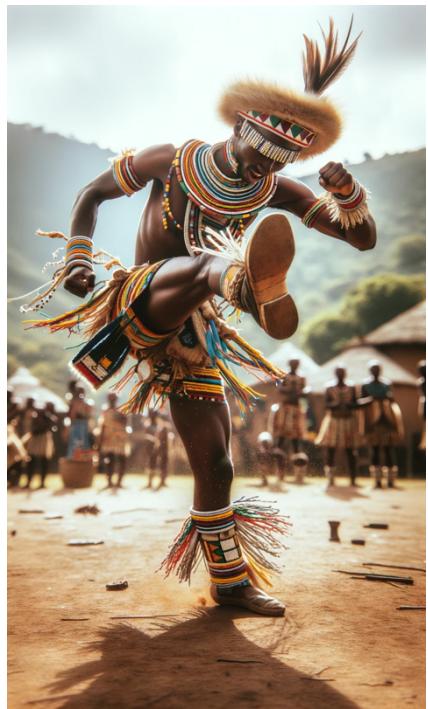
The vector movement sequence depicted provides a structured framework which was utilized in programming movement for Alpha 2. These sequences served as the foundational movements for programming the traditional South African dances into the robot.

Through analysing this step-by-step transitions, the Alpha 2 could be coded to mirror the fluidity and rhythm essential to natural.

This structured approach aids in breaking down complex dance movements into a series of programmable steps, allowing the Alpha 2 to execute them with precision and authenticity.



The Alpha 2's advanced servomotors and flexibility allowed for a more nuanced and accurate replication of the dances, which are integral to the cultural identity of various South African ethnic groups like Zulu, Afrikaans, Tswana, Venda, and Tsonga. By programming these dances into the Alpha 2, the project aimed to capture the essence and vibrancy of each culture's dance tradition.



Continuing from the programming stages of the Alpha 2, the same vector movement sequence was leveraged for programming the NAO robot.

Given NAO's different mechanical structure and capabilities, the transition would require recalibration of the movement sequences to fit NAO's increased range of motion and servo configurations, showcasing the rich diversity of South African cultural expressions through the lens of advanced robotics.

This process entailed using a reference of authentic Zulu dance movements, which are characterized by rhythmic patterns and expressive gestures, to program NAO's movements

With careful attention to the Zulu dance's intricate footwork, vibrant energy, and symbolic gestures, the programming aimed to accurately reflect the spirit and cultural significance

The programming of *Cultural Dance* incorporates vital elements to ensure cultural intelligence and sensitivity.

This approach underscores the importance of not just technical advancement in robotics but also the cultivation of cultural intelligence, allowing the robot to function effectively and respectfully in diverse cultural settings.

CULTURAL AND TECHNOLOGICAL INTEGRATION

Cultural and technological integration refers to the harmonious blending of cultural practices, values, and expressions with modern technology. This concept involves leveraging technological advancements to enhance, preserve, and communicate cultural identities and heritage, ensuring that the development and application of technology are inclusive and respectful of diverse cultural backgrounds.

In the integration of culture and technology within the project, particular emphasis was placed on cultural sensitivity. African traditions are not just practices but the essence of communities and identities. Ultimately, the aim is to create synergies where technology not only coexists with but also celebrates and sustains cultural diversity in an African context.

Bridging Cultures Through Dance, Music and Sign Language



The envisioned project aimed to interweave technological advancements with the rich tapestry of African cultural heritage, emphasizing respect and enhancement of cultural practices through digital means.

It aspired to digitally encapsulate and disseminate traditional dances and languages, thus preserving these vital cultural expressions. Furthermore, the initiative planned to deeply engage with local communities and experts, ensuring technological developments were aligned with cultural sensitivities. An educational program was to be implemented to highlight the significance of cultural preservation in the digital era.

However, due to extensive constraints of time and the inaccessibility of the physical NAO robot, these comprehensive plans could not transition from the ideation phase into practical application, remaining as unactualized concepts within the project.



Image Recognition and Cultural Education:

Incorporating the rich cultural symbolism of Zulu beadwork and other African cultures into the programming of the NAO robot for image recognition and cultural education can significantly enhance the storytelling aspect of traditional Zulu stories and the explanation of symbols in Zulu culture.

The Zulu people, known for their artistic beadwork, use colours and shapes to convey complex messages and meanings. For instance, the triangle is a prominent shape in Zulu beadwork, symbolizing the family unit of Father, Mother, and Child.

The orientation of the triangle also indicates marital status: a triangle pointing down represents an unmarried woman, while one pointing up represents an unmarried man.

Married statuses are indicated by two triangles joined at the base for a married woman and at the points in an hourglass shape for a married man.



Bridging Cultures Through Dance, Music and Sign Language

Moreover, the Zulu people attach specific meanings to colours in their beadwork. Black can signify marriage or sadness, blue symbolizes faithfulness or hostility, green represents contentment or jealousy, and red indicates strong emotions like love or anger. White is associated with purity and spirituality, while pink and yellow have their own complex connotations.



Xhosa beadwork is characterized by specific colouring, with white, blue, and pink being common in conventional necklaces.

The way people dress within Xhosa culture, including the use of beadwork, indicates their social status, family size, region of origin, and ethnic group. Beadwork skirts like the 'isikhakha', made exclusively by women, are still commonly worn today and signify various social statuses.

In all these cultures, beadwork transcends mere decoration; it is a form of communication, a symbol of social status, and a means of cultural preservation. Each culture embeds its unique history, values, and beliefs into the colours, patterns, and styles of beadwork, making it a rich and vibrant expression of African heritage.

This report aims at outlines a project merging technology and cultural expression, aiming to enhance cultural understanding and inclusivity, with a focus on AI's potential in preserving cultural heritage.

Recognizing the lack of inclusivity in many technological advancements, this project adopts an Afro-centric approach to address the cultural exclusion, particularly within Sub-Saharan Africa.

Key objectives involve programming the NAO robot for cultural dances and South African Sign Language (SASL) communication, engaging diverse audiences, and utilizing advanced AI for cultural performance and inclusivity. The project aims to demonstrate the significant role of technology in enriching cultural experiences and promoting a more inclusive technological landscape.



ETHICAL CONSIDERATIONS

Ethical considerations in the project were paramount, particularly in relation to cultural representation and the use of technology. Consideration is placed on ensuring that all cultural expressions and traditions are represented accurately and respectfully, avoiding stereotypes and/or misappropriations.

Cultural Integrity

Ensuring that the representation of each dance and language in the program preserves the integrity and authenticity of the cultural heritage it represents.

Consent and Ownership

Obtaining consent from cultural custodians and communities for the use of their cultural expressions and recognizing their ownership of these cultural assets.

Bias and Representation

Avoiding biases in the programming and representation of cultures, ensuring a balanced and fair portrayal of the diversity within South African cultures.

These points collectively ensure that the project aligns with ethical principles, respects cultural heritage, and fosters a positive socio-technological environment

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CONCLUSION & RESULTS

Link to Google Drive Videos complied:

https://drive.google.com/drive/folders/1oFOICR0QWxgnjChlpE-8Jmw602ejoXZ8?usp=drive_link