

AFRETEC NETWORK IDT RESEACH FUNDING PERIODIC NARRATIVE REPORT

Report Submitted By

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INSTRUCTIONS

Partner: Please refer to the original Inclusive Digital Transformation Africa Research Proposal when answering these questions, as relevant. Upon completion, please email this report to CMU-Africa at afretec@andrew.cmu.edu.

GENERAL INFORMATION

Organization Name:

Reporting Period: 2024 January- June July- December

1. REPORTING PERIOD SUMMARY

1.1 Activity Achievements

Outline your key achievements that occurred during this reporting period. What factors do you think contributed to these achievements? Please consider and include achievements that touch on inclusion.

Achievements:

Continual maintenance of the project website www.cssr4africa.org and [wiki](#).

Continual update of a comprehensive 88-page [work plan](#) (see the document history at the end of the report to view the updates in versions 2.13 – 2.19 made in the current reporting period).

Revision of seven [deliverables](#):

[D1.2 Rwandan Cultural Knowledge, version 1](#) (v1.5 – v1.7).

[D2.2 Robot Behavior Specification, version 1](#) (v1.1 – v1.2).

[D3.2 Software Engineering Standards Manual](#) (v1.7).

[D3.3 Software Installation Manual](#) (v1.4).

[D7.3 Open-Source Software Repository](#) (commits on 3 April and 24 June).

[D8.1 Progress Report](#) (v2.0).

[D8.2 Expenditure Report](#) (v2.0).

Completion of four [deliverables](#):

[D3.1 System Architecture, version 1.](#)

[D3.5 System Integration and Quality Assurance](#)

[D4.1 Sensor Tests](#)

[D5.1 Actuator Tests](#)

Creation of a [poster](#) on culturally sensitive social robotics for the CMU Pittsburgh Research Day.

Launch of a survey to acquire cultural knowledge about how to interact respectfully with people in Rwanda. The knowledge that is gathered will be used by our social robots when they engage with people, informing their verbal, non-verbal, and spatial interaction. The survey is available in Kinyarwanda [here](#) and in English [here](#).



Publications

D. Vernon, 2024. "An African Perspective on Culturally Competent Social Robotics: Why DEI Matters in HRI", IEEE Robotics and Automation Magazine, accepted for publication. Preprint available [here](#).

Factors of Success:

Careful, thorough planning (cf. the work plan above) with which all members of the team are thoroughly familiar.

Having a team with critical mass in terms of number and background.

Having a complete, detailed system architecture with which all members of the team are thoroughly familiar.

The involvement of dedicated research assistants at CMU-Africa: Adedayo Akinade, Eyerusalem Birhan, Kleber Cabana, Yohannes Haile, Mihiretab Taye Hordofa, and Tsegazeab Taye Tefferi, all of whom were given intensive training.

The involvement of summer interns at CMU-Africa from 3 June: Heran Equbay, Birhanu Shimelis Girma, Ibrahim Jimoh, Clifford Osano, and Muhirwa Richard.

Hands-on project management, with adjustment of the work plan, when appropriate.

The ability to purchase new and replacement equipment in a timely manner.

Weekly project team meetings and weekly task team meetings.

Weekly individual progress reports and weekly task progress reports.

1.2 Activity Learnings

What key lessons did you learn during this reporting period (e.g. through the process of design and implementation of Activities). Include learnings that touch on inclusion. Outline 3 key lessons that emerged during this reporting period. *Add rows as needed.*

Lesson 1: A detailed, comprehensive, up-to-date work plan is essential.

Lesson 2: Weekly project group meetings work well, but need to be augmented by weekly task team meetings.

Lesson 3: Delays are inevitable: the best laid plans cannot account for all eventualities, e.g., poor performance of components in the Pepper robot, and contingency plans are essential (we have purchase a second Pepper robot and we have also purchased additional sensors and processors, specifically a LiDAR, Raspberry Pi with a GPU, and Lenovo laptop with a GPU).

Lesson 4: It takes time for interns to transition from a group-work mentality to a team-work mentality, in which responsibility is shared.

Lesson 5: It takes time for interns to understand and embrace the rigors of professional practice.



1.3 Progress & Impact

Use the tables below to report numerical targets, results, and relevant explanations or comments. If any internal or external factors may influence progress, please explain. All quantitative indicators should be disaggregated by gender, and where possible and relevant, by age groups, disability status, rural/urban, degree program, etc.

1.3.1: Progress Reporting (Outputs): Progress reporting shows the outputs of the Activity. In the table below, please provide updates on your progress of funded Activities. Examples of progress indicators include the gender representation of students/learners/ faculty receiving support, number of Afretec and non-network universities partnered with, or share of participants who successfully completed training or education out of the total target. *Add rows as needed.*

Progress Reporting	Indicators (quantitative or qualitative)	Target	Results to date (include gender & other disaggregation as relevant)	Comments on progress (any insights, opportunities to adapt, etc.)
Deliverables	Submission to website	23 deliverables	15 delivered	Five of the remaining deliverables are delayed by approx. 3-6 months and three by 8 months. These delays are due to unforeseen software and hardware problems with the Pepper robot, specifically poor sensor resolution, and migration to ROS Noetic. We have purchased additional equipment to compensate and anticipate clearing the backlog by the end of the next period. One of the deliverables, D1.1, has only been partially delivered. It sets out the planned survey but doesn't present the results. The survey is now finished so the deliverable will be completed in the coming period.
Diversity	Balance of female/male research assistants	Equal balance	Three of eight RAs are female	The achievable balance reflects the balance of CMU-Africa students taking robotics courses.
Collaboration	Meetings	Weekly	Approx. 90% of weekly meetings here held	This represents a significant improvement over the previous period, and reflects a much more collaborative environment in the robotics lab.

Please describe any above-mentioned qualitative indicators that show progress. Examples of qualitative progress indicators are development of a training curriculum, signing of an agreement, etc.

1.3.2: Impact Reporting (Outcomes): Impact monitoring shows the changes or outcomes that occur partly or fully due to the Afretec collaboration and program investment. In the table below, please provide updates on outcomes and/or emerging outcomes. Examples of outcomes include: level of student preparedness for and interest in pursuing graduate education in ICT, assessment of faculty engagement in professional development that enhances their teaching, or evidence of increased collaboration with universities or industry locally and regionally. *Add rows as needed.*

Outcomes should relate specifically to the Afretec Network Principles [**Network-Based, Leveraged, Collaborative, Diverse & Inclusive, Transformative and Evidence-Based**] (see Principles section of Afretec Action Plan). Include in Comments to which Principle the outcome is related.

Main changes or outcomes (indicate the level the activity is focusing on— learner, student, faculty, institution, industry, country or region)	Indicators <small>(quantitative or qualitative)</small>	Target	Results to date/contribution to impact <small>(include gender & other disaggregation as relevant)</small>	Comments on impact (any insights, opportunities to transform)
Professionalism	Research assistant productivity	8 RAs/Interns trained	15 RAs/Interns trained	Comprehensive training material and a period of induction are essential
Technical knowledge & skills	Ability to acquire new technical skills and overcome unforeseen technical problems	Independent learning	Clear evidence of independent learning, varying from moderate to outstanding, depending on the research assistant	It is essential to assign individual responsibilities to encourage the acquisition of new knowledge and skills, and to make it transparently obvious when these skills have been acquired, and the degree to which they have
Diversity	Ability to work with people from different cultural and professional backgrounds	100% cohesion in the team	Most RAs work well together	Diversity adds value as it exposes RAs to different standards and expectations regarding both professionalism and technical competence.

Describe any emerging effects or changes that are not captured quantitatively. Include both positive or negative changes that were either intended or unintended.

1.3.3. Ripples of Impact: Your intervention may have ripple effects beyond the level identified above. For example, a program targeting young women or men to pursue education or entrepreneurship opportunities may have an impact on their households or communities. A program targeting university- industry relationships may have an impact on recent graduate job placement. Multi-university knowledge creation projects may impact the visibility of African research collaborations to global funding organizations.

We hope to capture the full range of potential ripples of impact and broader changes of Afretec programs, so we may potentially follow up with impact assessments. Please note if any programs that targeted one level (e.g. learner, student, faculty, institution, industry, country or region) are showing ripple effects on other levels:

It is still too early in the project to expect any significant ripple effect. However, one event that highlight the merits of the research and should create a ripple effect is the acceptance of an article in a high-profile journal highlighting the research, viz. D. Vernon, 2024. “An African Perspective on Culturally Competent Social Robotics: Why DEI Matters in HRI”, IEEE Robotics and Automation Magazine, accepted for publication. This will be published in the next period. A preprint available [here](#).

1.3.4: Additional data collection: Please describe any additional quantitative and qualitative data collection efforts utilized (e.g. key interviews and focus group discussions, pre and post program knowledge assessments, attitudes and practices (faculty or collaboration partner surveys, etc.). This may help identify opportunities to deepen how we capture the impact of this partnership. These efforts could include data collection described in your proposals or any other relevant data collection.

In April we launched a wide-ranging survey in both English and Kinyarwanda to acquire cultural knowledge about how to interact respectfully with people in Rwanda. The knowledge that is gathered will be used by our social robots when they engage with people, informing their verbal, non-verbal, and spatial interaction. Currently, there are 139 respondents. This represents a very significant increase over the number that responded in April. This increase owes much to the recruitment of a Kinyarwanda speaking Intern to promote the survey and assist people taking it.

2. PARTNERSHIP UPDATES

2.1 Partnership Changes

Have there been any key changes (changes with significant impact on partnership or activity success) to any of the following items? Yes No

Items: context, outputs/deliverables; key activities; inputs/resources; monitoring, evaluation, research and learning plan; communications approach; team structure (including staffing), etc.

If yes, please describe:

2.2 Collaboration Update

Please provide an update of your engagement and collaboration with partnership stakeholders (e.g. academic institutions, private sector organizations, government organizations, community groups, civil society organizations, etc.) during this reporting period.

The main unplanned engagement and collaboration arose as a result of the [workshop](#) on Culturally Sensitive Social Robotics for All at the 21st International Conference on Advanced Robotics (ICAR 2023), Abu Dhabi, UAE. Collaboration with the invited speaker, Prof. Barbara Bruno, Karlsruhe Institute of Technology, Germany, and Prof. Birgit Lugin, University of Wurzburg, Germany, and attendee, has progressed over the past six months. We held a first meeting on 9 January 2024 and a follow-up meeting with Prof. Lugin on 21 March. As a consequence, Prof. Lugin's Ph.D. student, Melissa Donnermann, will visit CMU-Africa in October 2024. She will help conduct a Wizard of Oz study to validate our current research hypothesis that a social robot which exhibits culturally sensitive behaviour will be more readily accepted by people who interact with the robot, and that they will respond more positively than would otherwise be the case.

We have also had a meeting with Prof. Rachael Jack, University of Glasgow, UK, on 27 June to explore research collaboration.

3. COMMUNICATIONS UPDATE

3.1 Communications Activities Update

Please describe the marketing and communications outreach that occurred during this reporting period as well as any relevant media links.

Hannah Diorio-Toth is pitching the work being done in the project to Nature Africa. We await a positive outcome.



4. RISK UPDATE

4.1 Risk Update

Please provide an update to the risks, either new, as previously identified in the Proposal or previous Periodic Reporting Template. Consider partnership and activity-level (e.g. capability, capacity), and organizational-level (e.g. affecting management, governance, personnel essential to the functioning of the organization).

Risk	Likelihood	Risk Impact	Risk Mitigation Plan
Inadequate funding for research assistants	Low	High	Pay RAs from alternative funds, e.g., Research Professorship Start-up Fund; agreement has this has already been agreed.
The Pepper robot dies again	Moderate	Low	We have purchased a second Pepper robot.
Unable to resolve an ongoing control problem requiring termination of the inbuilt autonomous life mode on the Pepper robot	Moderate	Low	We have worked with the vendor to identify the problem.
African cultural knowledge are not effective in use cases	Low	High	T6.2 produces a set adjustments which are mented in T1.4.
Implementation of the system architecture for use cases is insufficient	Low	High	T6.2 produces a set adjustments which are mented in T3.5.
Robot sensing and analysis does not perform adequately	Low	High	T6.2 produces a set adjustments which are mented in T4.4.
Robot behaviors do not perform adequately	Low	High	T6.2 produces a set adjustments which are mented in T5.6.
T6.4 Use case evaluation does not achieve sufficiently high user ratings in the evaluation	Moderate	Moderate	T6.2 identifies adjustments; these are implemented in T1.4, T2.4, T3.5, T4.4, and T5.6.



5. NEXT REPORTING PERIOD

5.1 Plans for Next Reporting Period

Based on the Afretec Action Plan and progress updates thus far, please outline your key activities for the next reporting period.

Our priority in the next reporting period is to complete the remaining tasks that were planned for completion in the current period.

- Task 1.2 Rwandan Cultural Knowledge Survey: complete D1.2 by adding the results of the survey.
- Task 4.2.1 Person Detection and Localization.
- Task 4.2.2 Face and Eye Detection and Localization.
- Task 4.2.3 Sound Detection and Localization.
- Task 4.2.4 Robot Localization.
- Task 4.3.2 Speech Event.
- Task 5.2 Animate Behavior Subsystem.
- Task 5.5.2.3 Kinyarwanda Text to Speech Conversion.
- Task 5.5.3 Environment Map Generation.

We expect this to take approximately three to six months.

To facilitate system integration and system testing, CMU-Africa have also decided to explore three tasks assigned to Wits, as follows.

- Task 5.4.2 Scenario Script Language.
- Task 5.4.3 Scenario Script Interpreter.
- Task 5.5.2.1 English Text to Speech Conversion.

The other priority tasks which are due for completion in the next reporting period are as follows (see the [work plan](#)).

- Task 5.3 Attention Subsystem.
- Task 5.5.1 Gesture Execution.
- Task 5.5.4 Robot Navigation.



6. ADDITIONAL INFORMATION

6.1 Additional Information

Please describe any additional information that the Director of the Afretec Network should be aware of.

This is a CMU-Africa periodic narrative report. It does not refer to the progress made by The University of the Witwatersrand over the current period.



NOTE: THE FOLLOWING SECTION IS FOR INTERNAL USE AT CMU-AFRICA ONLY.

Associate Director of Impact to complete this section following submission of the Periodic Narrative Report by the Afretec Partner.

7. REVIEW

7.1 Associate Director of Impact Comments

Please describe any key issues and/or follow-up items and provide a summary of discussions that occurred with partners during this reporting period.