






Social Robotics in the Museum: a case for human-robot interaction using RFID Technology

Daniel Carvalho based on peer reviews by **Dominik Haggmann** , **Sebastian Hagenauer**  and **Alexis Pantos** 

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The paper “Exploiting RFID Technology and Robotics in the Museum” (Dimitriou et al 2023) is a relevant contribution to museology and an interface between the public, archaeological discourse and the field of social robotics. It deals well with these themes and is concise in its approach, with a strong visual component that helps the reader to understand what is at stake.

The option of demonstrating the different steps that lead to the final construction of the robot is appropriate, so that it is understood that it really is a linked process and not simple tasks that have no connection. The use of RFID technology for topological movement of social robots has been continuously developed (e.g., Corrales and Salichs 2009; Turcu and Turcu 2012; Sequeira and Gameiro 2017) and shown to have advantages for these environments. Especially in the context of a museum, with all the necessary precautions to avoid breaching the public’s privacy, RFID labels are a viable, low-cost solution, as the authors point out (Dimitriou et al 2023), and, above all, one that does not require the identification of users. It is in itself part of an ambitious project, since the robot performs several functions and not just one, a development compared to other currents within social robotics (see Hellou et al 2022: 1770 for a description of the tasks given to robots in museums). The

robotic system itself also makes effective use of the localization system, both physically, by RFID labels and by knowing how to situate itself with the public visiting the museum, adapting to their needs, which is essential for it to be successful (see Gasteiger, Hellou and Ahn 2022: 690 for the theme of localization). Archaeology can provide a threshold of approaches when it comes to social robotics and this project demonstrates that, bringing together elements of interaction, education and mobility in a single method. Hence, this is a paper with great merit and deserves to be recommended as it allows us to think of the museum as a space where humans and non-humans can converge to create intelligible discourses, whether in the historical, archaeological or cultural spheres.

References:

Dimitriou, A. G., Papadopoulou, S., Dermenoudi, M., Moneda, A., Drakaki, V., Malama, A., Filotheou, A., Raptopoulos Chatzistefanou, A., Tzitzis, A., Megalou, S., Siachalou, S., Bletsas, A., Yioultis, T., Velentza, A. M., Pliasa, S., Fachantidis, N., Tsagkaraki, E., Karolidis, D., Tsoungaris, C., Balafa, P. and Koukouvou, A. (2024). Exploiting RFID Technology and Robotics in the Museum. Zenodo, 7805387, ver. 3 peer-reviewed and recommended by Peer Community in Archaeology. <https://doi.org/10.5281/zenodo.7805387>

Corrales, A. and Salichs, M.A. (2009). Integration of a RFID System in a Social Robot. In: Kim, JH., et al. Progress in Robotics. FIRA 2009. Communications in Computer and Information Science, vol 44. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-03986-7_8

Gasteiger, N., Hellou, M. and Ahn, H.S. (2023). Factors for Personalization and Localization to Optimize Human-Robot Interaction: A Literature Review. Int J of Soc Robotics 15, 689-701. <https://doi.org/10.1007/s12369-021-00811-8>

Hellou, M., Lim, J., Gasteiger, N., Jang, M. and Ahn, H. (2022). Technical Methods for Social Robots in Museum Settings: An Overview of the Literature. Int J of Soc Robotics 14, 1767-1786 (2022). <https://doi.org/10.1007/s12369-022-00904-y>

Sequeira, J. S., and Gameiro, D. (2017). A Probabilistic Approach to RFID-Based Localization for Human-Robot Interaction in Social Robotics. Electronics, 6(2), 32. MDPI AG. <http://dx.doi.org/10.3390/electronics6020032>

Turcu, C. and Turcu, C. (2012). The Social Internet of Things and the RFID-based robots. In: IV International Congress on Ultra Modern Telecommunications and Control Systems, St. Petersburg, Russia, 2012, pp. 77-83. <https://doi.org/10.1109/ICUMT.2012.6459769>

Reviews

Evaluation round #1

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Version of the preprint: 1

Authors' reply, 26 April 2024

In the attached file, comments of the reviewers are presented in gray and the responses in white. You will also find a pdf with all changes of the original manuscript marked (Track changes was activated) and a small comment that associates each change with a specific comment of one of the reviewers (e.g. if you see R1.Q1,

the change in the document results from Reviewer 1, Question 1). We have also prepared the final manuscript in the PCI Journal format.

We would like to thank the reviewers for their valuable comments. We have tried to address all comments and to our opinion the paper has been significantly improved. So, once again, we would like to thank the reviewers. As a general comment, we would like to state that this paper presents a summary of technical and practical achievements – each of which is presented analytically in a separate technical paper. As a result, the specific paper appears “brief” and with many “missing” details. Nevertheless, the review has given us a guide to complete this puzzle in some directions, making the final paper more meaningful. So, thanks once again for the comments.

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Decision by [Daniel Carvalho](#), posted 17 October 2023, validated 17 October 2023

Dear authors,

Thank you for your paper. As you can see below, the reviews are essentially positive, which reflect the quality of your proposal. I would advise you to revise some of your points, especially the structure of the article, as per recommendation of two reviewers. Likewise, I believe that your paper would benefit if the conclusion was expanded in order to fully address the results that were achieved and even some future challenges that you hope your robot will achieve, as one reviewer states as well. Nevertheless, an interesting read with a lot of potential. I am looking forward to the final version.

Reviewed by [Dominik Hagmann](#) , 12 August 2023

Review on “Exploiting RFID Technology and Robotics in the Museum”

The paper details the outcomes of a project co-funded by the European Union and Greek national funds, focusing on the integration of advanced technologies in the field of cultural heritage. The primary technologies explored include the Internet of Things (IoT), Robotics, Big Data analysis, and Artificial Intelligence (AI), with a particular emphasis on RFID (Radio-Frequency Identification) technology.

The paper's content is unusual since it has not been segmented into traditional sections like “Introduction,” “Methods,” “Results,” etc. Instead, the text is structured around specific topics, references, and other details.

Overall, the paper contributes valuable insights into the ongoing conversation around technology's role in preserving and enhancing cultural heritage. It serves as an exemplary model of how interdisciplinary collaboration can lead to innovative solutions and offers inspiration for future projects in this domain.

Nevertheless, I think some points should be addressed, which cover essential aspects of the paper, ranging from practical concerns to ethical considerations and technical details:

- Long-term Availability and Updates: What is the long-term availability of the systems implemented in this project? How often will updates be required (and available) over the next 10 years to keep the systems up to date?
- Impact on the Labor Market: What is the impact of such digital systems on the labor market, particularly in museums and cultural institutions? Considering the current discussion around AI, mostly with regard to large language model-based chatbots like ChatGPT (although I'm aware that such things are not discussed in the paper), it would be interesting to address the question: may this technology be perceived as a threat or support to employees? E.g., there has even already been some feedback from the museum, etc. - if not, a general assessment would certainly be sufficient.
- GDPR-related Measures: Do the GDPR-related measures described in the project also apply to the personnel within the museums or cultural institutions? Why or why not? What are the legal and ethical considerations in implementing these measures in the context of personnel?

- Machine Learning Algorithms: The paper briefly mentions machine learning algorithms used in the project. Could you provide a more specific description of the techniques and methods used, even if only in one or two sentences?

If these points could be addressed in 1-2 sentences each, this would indeed help to clarify the questions at hand and may help to strengthen the paper (at least I hope so).

Anyway, I think the paper should definitely be accepted!

Reviewed by [Alexis Pantos](#) , 16 October 2023

This is generally well written article with an ok structure and description of the work. It attempts to accommodate a large body of work and makes good use of earlier publications to direct the reader to additional detail. The description and title are appropriate to the content and the authors show an awareness of similar efforts to apply RFID tags within a museum context. Some aspects of the text might benefit from rephrasing or reduction to improve flow and clarity. Conversely some elements might benefit from additional clarification or identification of future work. For example the article could be strengthened by including a discussion on how the success of the robot prototype has been, or will be measured.

The references include a mixture of academic articles and relevant popular media references which helps to contextualise the current project well, however the referencing style changes throughout the body text and should be standardised. The body also includes multiple references lacking the a,b,c. suffix present in the reference list.

Figures are relevant to the text, but some may be better presented as compound figures with sub-elements (e.g. a,b,c) and referenced from the body text.

Overall this appears to be an interesting project that could benefit from some minor adjustments to the text and some additional clarifications. Further comments and suggestions are included as tracked changes along with this review.

[Download the review](#)

Reviewed by [Sebastian Hageneuer](#) , 25 September 2023

The article has an interesting topic: RFID technology inside a museum to help the staff and visitors as well as a social robot that offers guided tours for adults or quizzes for the younger audience. Although the premise of the article is pretty interesting, the article itself is way too short and leaves a lot of questions open.

- In the beginning, several museums are listed, that already use this technology. Without reading the cited book, I can not understand in which way their use differs from the use described in this article. A closer discussion of the presented examples would help to better understand what is new here in the CultureID project

- The same goes for the examples of the social robots. So summarizing with the previous point, the introduction needs to be more extensive and informative to the reader. Also why does the CultureID project exist? What problem is tried to be solved?

- Section 1 is merely a paragraph and does not explain the technology sufficiently. What are the problems with RFID technology? Are there any security risks, for example if I bring my own RFID reader/writer? What is the environmental impact of using these chips?

- Section 2 is quiet interesting, but I would like to learn more about the restrictions of RFID when attaching it to artefacts in the museum. The article metioned that it is difficult with metallic material. Why? Are there any solutions or did you just not attach a chip on metallic objects after all?

Coming back to the point of the environmental impact of these chips in visitors tickets. Where there any discussions about this? Is there a way to properly recycle these tickets? Can you tell us more about the app, how it functions and what one can do with it?

Also the statistics are very relevant, but we do not learn anything from it. Did they have any impact yet and if yes, which ones? What is expected from collecting these statistics?

- Section 3 more or less omits readable text and utilizes bullet points, which - in my opinion - are not suitable for a scientific paper. Again, further questions arise. What was the experience of the users with the robot? What happens if multiple people try to talk to the robot? How long does its battery last, can it speak multiple languages? How do "discussions" with adults look like? What are the benefits?

- Section 4 is again too short. The conclusion of a research paper is where you wrap up your ideas and leave the reader with a strong final impression. It has several key goals: 1. Restate the problem statement addressed in the paper (there was no problem to begin with), 2. Summarize your overall arguments or findings (this was done, albeit way too short), 3. Suggest the key takeaways from your paper (missing).

To summarize: I think the topic of the paper is very interesting and clearly the project has done a lot of good work to make this possible and running. Unfortunately, the quality of the paper needs improvement.