

## The RECLAIM game

### Role and function in the project

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### Introduction

The recycling data-game (RDG), which is being developed in the context of the RECLAIM project, aims at supplementing and supporting the training and optimization of AI algorithms for the material identification, segmentation and categorization module of the Portable, Robotic Material Recovery Facility (prMRF) developed by the project, while actively engaging the community of players in the project's activities. It aims to operate as a data collection hub and implement enjoyable information dissemination about recycling.

The RECLAIM digital game is designed and developed by the Institute of Digital Games at the University of Malta in collaboration with the project partners.

The game combines gamification and social computing technology with data collection procedures. It highlights the related challenges and encourages citizens to participate in project activities through a citizen science approach. It further provides the means to communicate general principles of AI and Data Science to the public.

The purpose of the RDG is threefold: a) to promote awareness and increase social sensitivity in the recycling process, implications, and challenges, b) to involve citizens in the data-analysis process and address scientific challenges, and c) to engage citizens in material recovery research and the project's activities.

Designed for easy accessibility, the RECLAIM game will primarily be available on mobile phones, enabling a wider audience to join in the mission.

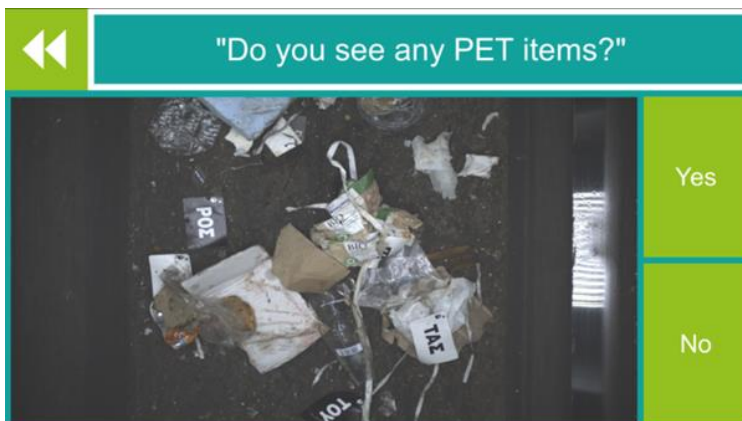
### The process: steps taken

A prototype of the game is currently being developed. We are now on the 5th version of the prototype and testing it on mobile phones. For the development of the game, we are using the powerful and established Unity game engine, which is deployable across a broad range of platforms and will therefore allow us to easily adapt the game for many types of devices, including smartphones, tablets, laptops, or PC.

Through the game, the players will be involved in appropriately designed data-annotation and reviewing activities based on real world material (images) captured by cameras installed in the project's prMRF. Players will engage in tasks such as "Locate the correct items", "Paint over the correct items", or "Count how many items of this material you can spot in this picture" (see images below). Players will also have to solve puzzles relevant to real-world environmental and recycling issues and facts, such as information about recyclable materials, the financial impact of recycling, the cycle and process of recycling, policies around the world, and the impact of recycling in real-life.

We tried to ground the design of the game on realistic and relevant to the community goals, objectives, and needs, while at the same time keeping it fun and engaging for the players. It was essential, therefore, to examine the preferences and practices of both the target group, as well as those of experts in the field of environmental sustainability, waste management and recycling, and data annotation, specifically in the partner countries of the project. To this end, three focus groups were conducted involving experts in recycling, AI, robotics, digital games, and education, and an online survey open to the public was further disseminated. Through the analysis of the data gathered, a set of game requirements was defined, such as the type of challenges, missions, and rewards, the narrative and educational content of the game, the environmental messages, and the game format.

To address the educational and information content of the game regarding waste management, recycling, and relevant environmental issues, and ensure the validity and authenticity of the game content, a team of experts from the partner institutions collaborated closely for the design of the game. Specifically, ISWA (International Solid Waste Association, <https://www.iswa.org/>) provided information, material, and resources relevant to waste management, recycling, and implications, and HERRCO (Hellenic Recovery Recycling Corporation, <https://www.herrco.gr/en/about-us/>) provided general information about recycling and waste management, information of local interest (Greece), and insights on the target group needs and requirements.



## Key Challenge

The key challenge for any Citizen Science game is to sustain the long-term engagement and participation of the players. To this end, the technical specifications, the user interface, and the tasks themselves are carefully designed, while we also aim to support the development of a community of practice among the players, and the experts and scientists involved in the project, and link achievements in the game with real-world issues and implications.

For the future, our goal is the development of a more robust version of the game, for the purposes of initial tests and the broader evaluation of the impact of the RDG. The developed mini-games have mainly focused on the technical aspects of collecting annotations from users and have been treated as isolated case-studies. The ultimate goal is to combine these modules with other types of content and synthesize more interesting and rich experiences for the player. The RDG is heavily dependent on an underlying, central database which supports various aspects of its operation. A rough outline of this database is that 1) it stores a collection of data-items that can be used to synthesize content for the players, including the annotation challenges, information content and knowledge challenges and 2) it stores the players' responses to various challenges, which can be utilized to train better AI models for the automation of recycling processes. This database will be developed in the coming months. The coming months we will also focus on collecting content relevant to recycling, waste management, and environmental and social impact, and preparing them in a way that is playful and challenging for players.

## Who is working on what

Antonios Liapis is a Senior Lecturer at the Institute of Digital Games, University of Malta. He received the Ph.D. degree in Information Technology from the IT University of Copenhagen in 2014. His research focuses on Artificial Intelligence in Games, Human-Computer Interaction, Computational Creativity, and User Modelling. He has published over 130 papers in the aforementioned fields and has received several awards for his research contributions and reviewing effort. He serves as Associate Editor for the IEEE Transactions on Games, and has served as general chair in four international conferences.

Konstantinos Sfikas is a PhD student at the Institute of Digital Games. His background is in Architectural Design, Game Development and AI. His PhD research focuses on the application of AI methods, such as Evolutionary Computation and Machine Learning, to design-related problems. He has been involved in several research projects that included applications of AI to various fields such as Game Design and Development, Architectural Design and other Engineering disciplines.

Iro Voulgari is a postdoctoral researcher at the Institute of Digital Games. She has a background in Education Sciences and has worked on several projects involving the design, implementation, and assessment of learning technologies and digital games in teaching and learning. Her research focuses on game-based learning, game studies, and digital literacy.

## Success factors

One of the main indicators of success of the Recycling Data-Game, after deployment, will be the number of registered users. Our goal is to reach at least 2000 unique registered users. Beyond that, other aspects that will be considered are the duration of player engagement per session and long-term, their achievements and progress, their submitted annotations, their responses to the puzzles, the quality of the player experience and the satisfaction of the players. We will look at satisfaction through multiple dimensions such as the game interface, as well as whether their motives for engaging with the game were addressed through their gameplay.

A core goal of the RDG is, of course, to collect user-generated data for re-use in the AI algorithms of the project. The resulting efficiency of the AI models and the degree of optimization resulting from user-generated data will therefore be another important indicator of success.

## Short explanation what is citizen science

The aim of the RECLAIM Recycling Data Game is to leverage current trends in using gamification for the purposes of citizen science. Citizen science games are “gamified applications, which enable the public to contribute to scientific research by collecting and/or processing scientific data” (Miller et al., 2022). They involve the public with challenges and problems of the scientific community and engage them in the co-creation of knowledge in various fields such as medicine or biology. Players can help solve complex problems such as the analysis and coding of large volumes of data (e.g., videos, images). Citizen science games have contributed to the research process and have led to scientific discoveries such as the cases of Foldit or Eyewire and may also help support scientific literacy and increase awareness of and engagement with real-world issues.

## References

Miller, J. A., Gandhi, K., Gander, A., & Cooper, S. (2022). A Survey of Citizen Science Gaming Experiences. *Citizen Science: Theory and Practice*, 7(1), Article 1. <https://doi.org/10.5334/cstp.500>