International Conference on Artificial Reality and Telexistence
Eurographics Symposium on Virtual Environments (2020)
K. Kim and B.-K. Seo (Editors)

Virtual Reality Training for Proper Recycling Behaviors

Tiffany D. Do[1] , Dylan S. Yu[2], Alyssa Katz[2], and Ryan P. McMahan[1]

[1]The University of Central Florida
[2]The University of Texas at Dallas

Abstract

We present an immersive virtual reality (VR) application that is designed to train users in recycling behaviors. In this demonstration, users play a recycling game in which they are awarded for proper recycling procedures. The application provides users with visual and auditory feedback as well as various interaction cues. Prior research shows that VR experiences can influence behavior in the physical world and can be particularly powerful in behavior modification. This application aims to transfer real recycling behaviors to participants and can be used to study the effects of VR on behavior modification.

CCS Concepts

• ***Human-centered computing*** → ***Human computer interaction (HCI);***

1. Introduction

Although many people see the value in recycling, they are often unaware of which items are recyclable or compostable and what the proper pre-disposal steps to recycling are. For example, removing bottle caps and rinsing residue from containers is necessary in many recycling systems. Cheang et al. [CCS*19] described how users tended to put unclean plastic articles (e.g., has residual food) in general recycling, which can contaminate other recyclables in the same bin. Chaeng et al. also described the necessity of educating users in pre-disposal steps such as separating, cleaning, and compressing recyclables that promote the efficiency of recycling.

Virtual reality (VR) has been successfully used in training applications and can be particularly powerful in influencing behaviors. For instance, VR training has improved behaviors in fire safety [ÇG19], negotiation [BHB*12], and surgery [YNPT15]. Broekens et al. [BHB*12] noted that VR was effective in inducing cognitive and behavioral changes in well-defined settings. Similar to these studies, practicing proper recycling behaviors in the virtual world may promote such behaviors in the physical world. Sattar et al. [SSL*19] found that the repetition of hands-on practice in VR improved the learning motivation of medical school students compared to traditional learning materials. In a pilot study of our application, a participant mentioned that they did not recycle much previously but had started to recycle more after using the application and becoming more aware of proper recycling behavior.

2. VR Recycling Cyberlearning Experience

The application places the user in an immersive VR environment, which includes four types of waste bins: trash, recycling, compost, and e-waste. The user can start the game by starting a timer in the room. The application spawns various types of items upon the start of the game and lasts three minutes. The goal of the game is to place items in the correct bin and possibly perform some pre-disposal tasks that promote proper waste disposal technique. The user receives auditory and visual feedback depending on their actions and are scored accordingly.

Figure 1: *An image of the application showing positive feedback.*

2.1. Apparatus

The application was developed using Unity and requires a SteamVR-compatible system. The user interacts with objects using SteamVR-compatible controllers and travels throughout the virtual kitchen by real walking. In our demo, we used a Valve Index VR setup and a Windows machine with an Intel i7-7700k processor, 32GB ram, and NVIDIA GeForce GTX 1080. A short video can be found at: https://youtu.be/05YOfECX3jE

2.2. Tasks

There are tasks within the application that allow the user to score points. Points are calculated based on the performance of the user in terms of placing the items into the correct bins and taking the proper pre-disposal steps before disposing of them. The main objective of the game is to score as many points as possible. While all objects need to be thrown into the correct type of waste bin to receive points, some objects have pre-disposal steps. Correctly completing these steps will earn the user more points, while disposing of the item without completing these steps will alert the user that they have missed a pre-disposal step. Examples of these tasks include removing the lids of items, washing objects with residue, or flattening objects. These additional tasks must be completed in a certain order and have interaction cues to let the user know that there are possible additional steps to take. These interaction cues include symbols such as arrows or water symbols.

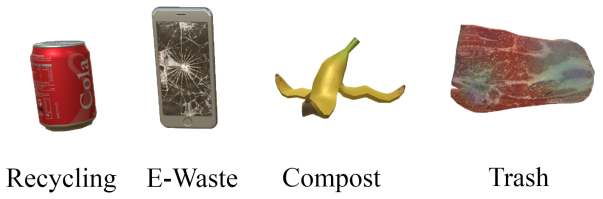

Figure 2: *An example of each type of waste category.*

The following list describes the pre-disposal tasks that exists for certain items: 1) washing cans/bottles, 2) removing caps 3) flattening bottles 4) flattening boxes.

Figure 3 shows a series of pre-disposal interaction cues for a plastic bottle. In order to properly recycle a plastic bottle, the user must remove the cap, rinse out the bottle, and then collapse the bottle. Hu et al. [HME*20] indicated that interaction cues are an underexplored research area in mixed reality and could provide implications for the design of training applications. We plan to investigate the effects of different interaction cues. For example, using auditory or animated interaction cues could affect recycling behaviors or performance of the user within the game.

Correctly sorting an item and performing all pre-disposal tasks (if any) will display a green thumbs up and play a positive sound. Similarly, incorrectly sorting an object into the wrong bin will display a red thumbs down and play a negative sound. The application also allows the user to correct mistakes. If the user sorts items into the wrong bin, they are able to remove the item and place it into the correct bin. Similarly, if they dispose of an item without completing proper pre-disposal steps, they will be able to remove the item and complete pre-disposal steps.

3. Conclusion and Future Work

In conclusion, we have developed an application that can be used to influence recycling behaviors of users. This application includes interaction cues and visual and auditory feedback that helps the user learn proper recycling behavior. In the future, we intend to run user studies that will evaluate the effect of the application on environmental behaviors and attitudes compared to traditional learning materials such as informational flyers or video. We also intend to investigate the effects of different interaction cues and feedback.

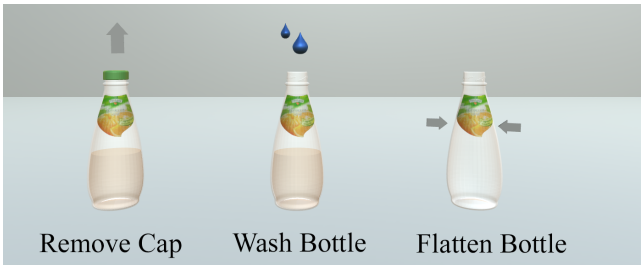

Figure 3: *Examples of interaction cues for pre-disposal steps of a bottle.*

Acknowledgments

The authors would like to thank Maoming Tang, Tao Wang, and Santhrupth Prasanna for their help in developing and debugging the application.

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