The Magic Mode of Everyday Objects: Bridging the Digital and Physical Environments of Play with Monnom

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ABSTRACT

We present an online digitally-enhanced environment Monnom (https://www.playmonnom.com) for children. Monnom offers body-object interaction and its system only requires a webcam. Its algorithm recognizes physical objects within view and drives the interaction with a digital canvas. By moving around and adding objects to their physical space, children can fictionalize its meaning and create their own place(s) within it with feedback from the digital environment.

CCS CONCEPTS

• **Human-Centered Computing**; • **Human computer interaction (HCI)**; • **Interaction Techniques**;

KEYWORDS

Physical activity, Spatial interaction, Design for play, Interactive play environment

ACM Reference Format:
İpek Kay, Gizem Ünlü, and Mine Özkar. 2021. The Magic Mode of Everyday Objects: Bridging the Digital and Physical Environments of Play with Monnom. In *FabLearn Europe / MakeEd 2021 - An International Conference on Computing, Design and Making in Education (FabLearn Europe / MakeEd 2021), June 02, 03, 2021, St. Gallen, Switzerland*. ACM, New York, NY, USA, 3 pages. https://doi.org/10.1145/3466725.3466770

1 INTRODUCTION

Children use their imagination to see their surroundings in their own way. They construct their own rules and manipulate everyday objects for play, and create narratives [1, 2]. Narrative activities range from telling to enacting, from construction to deconstruction, from negotiation to immersion [3]. In a scenario where a wooden spoon takes part in a magical world with wizards using magic wands, the reciprocal process between real and fictive worlds is through engagement with objects. Most current interactive digital environments, however, are virtual playgrounds that use technology to produce sounds, graphics or actions. Even when these attributes elevate the potentials of the products for children's engagement with them, they allow interactions where children can use only their eyes and hands. They do not necessarily support bodily movement and full-scale sensorimotor activity [4]. Moreover, these environments follow the rule-based form of play. Interactive technologies can in fact offer more freedom and unique feedback to children with opportunities to intervene. It is possible to create bridges between embodied experience and the construction of meaning, with the awareness of the role of the body and spatial narration in a child's experience. Throughout the study, "narration" refers to story construction, as both a process of meaning-making with symbols and place-making via spatial transformation using objects. The term "digitally-enhanced" refers to environments where digital technologies support the physical world.

Our aim has been to contribute to the existing designs of digitally-enhanced settings for children of 4-8 years to create alternative play scenarios in particular by stimulating their bodily movement and narration. The decision on the age group depended on a few factors. The age of four is a critical time for development when children's perspective-taking abilities develop [5]. They begin to show more interest in how their peers play. Moreover, they also begin to sustain their attention for longer periods of time [6] so that they are able to keep track of both their physical play and what they create digitally. The "cooperative play" period also starts at that age [7] and social competencies reach a level that enables play as a group.

2 DEMO DESCRIPTION

2.1 Description of the Project

Monnom is an online digitally-enhanced physical environment that encourages children to use their fine and gross motor skills while they play with their own physical objects in their physical space. It is designed for playing individually or as a group, based on the theoretical framework that we presented in a previous study [4]. The system works on a computer, a tablet or a phone that has a webcam and is connected to the internet. Through the webcam, its algorithm perceives objects with certain parameters of color and depth analyses. It translates them into predefined digital patterns using various themes. In each theme, four patterns match four colors (red, yellow, blue, green). Either a digital screen or projected surfaces for display to provide the may be used. Patterns provide children a simple language through which they can assign new meanings to the physical environment. Children's digital compositions are synchronously displayed to them for the reciprocal connection between the digital and physical environments. The spatial framework consists of the three inherent axes of the body, each defined by a binary opposition (i.e., up/down, front/back, right/left), leads into the primary dimensions of any given place (i.e., verticality, frontality, and horizontality) [8]. This spatial interaction encompasses whole-body interactions and interactions in space. In Monnom, the technology inside the system allows

FabLearn Europe / MakeEd 2021, June 02, 03, 2021, St. Gallen, Switzerland

ACM ISBN 978-1-4503-8989-1/21/06.
https://doi.org/10.1145/3466725.3466770

children to make their own spatial composition in both physical and digital environments. While children can resize patterns in the digital world by coming closer to the webcam or stepping back, they can also replace patterns in the digital world through moving right and left in the physical environment. Through this scenario, physical objects become haptic controllers to drive interaction with the digital world such as a mouse or a touchpad. Children may physically move around and add objects to the physical space while engaging with the digital play environment. They may also explore colors and textures found in their daily environment by playing and exploring with them. These spatial interactions trigger full-body movement and active engagement in children's surroundings. Even though the system uses a webcam, our image processing method only recognizes the coordinate, size, and color data of objects and does not record children's personal data.

2.2 Target Audience

The audience is educators working in pre-K and K-2 level schools, museums, after-school programs, and other formal/ informal learning environments, as well as families interested in supporting children's bodily engagement while interacting with the digital environment. In schools, children's learning and peer communication can be supported by digital content directly related to the school curriculum. It is possible to explore how particular objects can be used to elicit particular interactions, by having teachers organize them in various ways or allowing them to adjust particular parameters. In museums, educational and artistic activities can be supported by artistic content.

2.3 User Study

The offline version of the system has been assessed with 67 children (4-12 years old) in two different settings, one at a museum and one at a school, children played as a group, in the 2019-2020/Fall. In a previous study [9], we presented the study setup and our preliminary findings. To summarize the offline settings: We designed soft objects in four different colors. For easy manipulation and supporting open-ended narrative play, we made their shape simple, i.e. pillow and blanket, that are also familiar to children's daily environments. For the museum, we designed patterns as silhouettes that are from eight different art pieces of the museum's collection in collaboration with their education department. For the school, we designed play patterns in two themes according to the school program in order to create a shared and familiar interest among the children. The online version of the system has been assessed with 162 children (6-8 years old) at online-remote schooling with their class teachers during the COVID-19 pandemic, in the 2020-2021/Fall. Children played from their homes during their online class. The digital platform they used, allowed only one participant to share her/his screen at the same time. They used their own objects, i.e. pencils, pencil cases, pillows, toy cars, clothing items, notebooks, colorful papers,and even vegetables such as tomatoes and green peppers. Our user studies have been done to see whether Monnom supports children's bodily movement despite its reliance on the screen as an interaction surface, and whether, during physical engagements, it supports children's narrations as planners and players, and lastly whether it supports children's peer communication. User studies were conducted real time and physically for the offline version whereas for the online version, it was through feedback from class teachers who used Monnom during their online class.

2.4 Observations: Meaningful Screen Interaction

Children followed various interaction paths while playing with Monnom. These included individual and group play, spontaneous play and goal-directed play where children define their goals. With both online and offline prototypes, the children immediately grasped the interaction system. In the offline setup, we recorded children's activities and the digital content that children created. Our video analysis showed that during play with Monnom children interact with physical objects continuously. Their exploration of the effects of physical objects added to the excitement of the play. This continuous visual feedback from the image on the screen provided a dynamic relation between seeing and doing. Over time, children seemed to collect objects for creating their own color palette. The majority did not look at the digital screen for half of the duration. Children experienced the offline version of Monnom in a more controlled setting with given and limited numbers of objects. On the other hand, children who played with the online version from their own environment, explored their own rooms as a repertoire of objects.

In the offline setting, children played in groups. We observed that making the biggest pattern became a goal for some children and they preferred the biggest object (blanket or biggest pillow) and tried to locate themselves in front of the screen. Children who chose to play with each other were mostly whose knew each other before or classmates. They preferred to create composition together both in both environments. For example, a child picked a blue object and drew waves on the digital screen to be followed by his playmates who joined him to create a sea with other blue objects. The result was: "Wow, we made such a big sea". The same child then went to the object box to take a red object, he said, "I will add red fish". After he added red fishes, he pretended to be a fish by using a red blanket as a cloak in the physical environment. This short episode shows that, with feedback from a digital environment by moving around with objects, children can fictionalize the meaning of that space. While multiple objects usage encourages negotiation with others, it also supports children's self-reflection. In the online version, even though children played alone, classmates participated in the player's creation process by telling what they see, what they would like to see by giving directions i.e. "I would like to see a bigger sun on the right side". For the online version, children played in different lighting settings, the system sometimes failed to recognize colors correctly in a darker environment. Since the system perceives colors, other objects of the perceived color incidentally in the player's background sometimes changed the digital compositions beyond their controls. Most of the children indicated that they wanted to play with more colors, and some children stated that it would be more fun if they saw the objects they showed, on the digital screen. Teachers indicated that Monnom provides them to talk about spatial qualities, far, near, right, left, colors, size, numbers, and also motivated children to talk about the theme.

3 CONCLUSION

Observations noted above are a part of a larger study aimed at evaluating the user experience of Monnom. While it is similar to current digital environments in terms of using a screen as an interaction surface, it encourages children to physically move while they play with their own physical objects in their physical space. While they are fictionalizing the meaning of that space, Monnom offers a body-object interaction where the body frames the scene, controls, and improvises the play with unique rules and play materials. This allows children to observe the results of their actions on the augmented scene. It may enhance their understanding of the causal links by spatial experiences, therefore it supports children's spatial narration. We plan to add additional features to make Monnom developmentally suitable and intriguing for older children. In parallel, a technical goal is to develop the image processing to perceive more colors and be adaptable to a broader range of light conditions.

4 REQUIREMENTS

To run Monnom, the requirement is a computer (alternatively a tablet or a smartphone) that has a webcam and is connected to the internet. We recommend projecting the digital content on a large display.

ACKNOWLEDGMENTS

We gratefully acknowledge the invaluable support of Can Hoşgör in developing the Monnom software and Ufuk Aydın in designing the interface and user experience of Monnom. We would like to thank the children who participated in our study and their teacher.

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