PlaySpace: *Projecting an Augmented Reality Play-space with Socially Interactive Toy Car*

Designing for Children Experiences with Socially Interactive Toy Robot

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ABSTRACT

This paper aims to explore how to design for repurposing in the field of Human-Robot interaction and children. The AR-PlaySpace is a project to create a socially interactive toy for children by embedding a projector within a toy car. The car will then project an augmented reality Play-space in front of and around itself, with the aim of observing creative usages of augmented reality to enhance play.

Our prototype is combining two objects with two distinct purposes: Projecting an augmented reality play-space from a toy in the shape of a car, and a project as the headlights of the toy car, in hoping to observe creative usages of an augmented reality Play-space. We present the result of the User studies, a prototype and discuss the implications of the outcomes to inform further development of the PlaySpace by children. The idea of the prototype and observations from an exploratory study performed with three children aged 9 to 12 presented, and possible applications to other products and domains discussed.

CCS CONCEPTS

• H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous • H.5.2. [User Interfaces]: Theory and methods, Interaction styles, User-centered design.

KEYWORDS

Repurposing; Socially Interactive Toy; Human-Robot Interaction; Children; Design for daily rituals; Experience-driven design method.

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1 INTRODUCTION

In the early years of life, children play in elaborate ways with objects: examining them and manipulating them directly [11]. As their knowledge grows, they give these objects symbolic properties: a toy car turns from an object to bang on a table to something that is moved on the floor while making engine sounds [12].

Toy cars have been popular with young children since the 1950's. They are available in an extremely broad range of designs and sizes, aimed at children of many different ages. They vary from entirely passive toys whose only function may be wheels that roll, through to complex radio-controlled toys. While in many cases the car alone can provide hours of entertainment, there have also been a market for accessories to complement imaginative play with a toy car. Playmats with road and village designs are often used to enhance immersion and provide additional opportunities for play. This project aims to replace the physical playmat with an augmented reality version that is projected directly from the car itself, turning any available surface into a constantly changing and infinitely explorable road and village system.

Our overall project goal is creating a new toy for children by combining two objects with two distinct purposes: a toy in the shape of a car, and a projector as the headlights of the toy car, In hoping to experience creative usages of an augmented reality play-space with the intersection of two distinct purposes. It is a phenomenon that children often assign a product with new purposes and meanings, which are different from its original intended use. Children view

objects surrounding them from different angles. They usually express a desire to play an ordinary toy in a variety of ways. It is a great pleasure to discover those unexpected usages [4, 5]. It is a delightful pleasure for an interaction designer to experiment with new design possibilities and design methods in the diachronic and contextual process of user study [3].

2 RELATED WORK

When first attempting to use a remote-controlled vehicle, children need to adopt a new abstraction of play. They need to discover and master the relationship between the controller and the controlled to achieve a rewarding play experience. The divisions between cause and effect, as well as the sensory-motor skills required for control, are challenging [13]. How researchers have approached designing social robots and what we can learn from the interaction design field for future design? The emerging field of Social Robotic technologies with a particular focus on interaction design methodologies used in the design process [8]. In the early participatory design sessions with children, showing sketches of the new toy and soliciting for potential usages other than as a toy and a projector [5]. We hypothesise that it is possible to expand repurposability by combining two specific functions into one artefact. The new object will be a medium for children to connect the imaginary world and the real world through their interaction with the object [4, 5]. Playing is the purest of human mental activity and an essential part of promoting children's physical, emotional, cognitive, and social development, and should be especially emphasised in childhood.

3 CHALLENGES AND OPPORTUNITIES

The purpose of the PlaySpace is for Children experiences with a Socially Interactive Toy Robot, projecting an augmented reality play-space on floor or wall.

3.1 User Research Challenges

Including children in the design of technologies that will have an impact on their daily lives is one of the pillars of user-centered design [9]. How can we better understand Children's motivations and needs for fun?

The diachronic study, which embraces many generations, that is, from children to parents and even grandparents, enables an estimation of the trend in play culture (Figure 1). Based on the case study, creativity is formed instinctively in childhood [2].

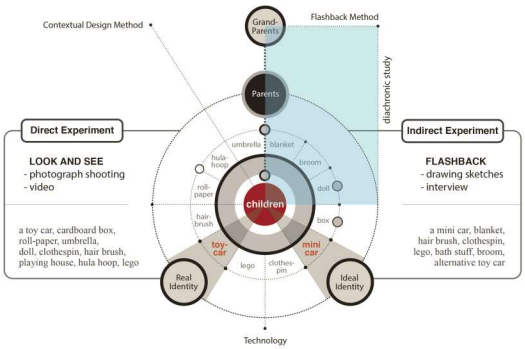

Figure 1. Direct Experiment and Indirect Experiment model.

3.1.1 Context of Children Experience for Fun

Different objects indeed offer children various degrees in the range of repurposability and imagination. Typically, a generic object with less specific purpose could provide more opportunities for repurposing. On the other hand, a particular design may hinder the possibility of being used for a different purpose [4, 5].

3.1.2 Creative Usage and daily rituals

Numerous everyday objects are repurposed by children: an ordinary pencil becomes a magical device that can make wishes come true, or a cuddly toy becomes a living creature that can save the world. The affordances of these physical objects allow them to be used in many different ways (Figure 2). Children shape an imaginary world with everyday objects around them [7].

Figure 2. An Experiment: A child began driving a mini car toy-a keychain charm-across a map in a fairy tale book. When the car arrived at a house at the end of the map, the child put a mini-doll on the house picture of the fairy tale book.

Digital objects, on the other hand, are designed to be multipurpose, but their affordances are harder to perceive. Therefore, designing digitally enhanced tangible objects with repurposability in mind is less straightforward [7].

3.2 Design Challenges

Our design approach is for an applicable design from the perspective of children participation design. The purpose of

this observation in the field (Figure 3) is to understand children experience and describe a design method for a socially interactive toy robot.

Figure 3. One of the traditional Village Games in Camacha, Madeira: Adult (the left and middle), Children (the right).

A toy car is a miniature replicate of a vehicle. As a favourite toy among kids, it offers the imagination and projection to the alternative life, separating from the real world where real harms could happen, e.g. a car accident (Figure 4).

Figure 4. Children imagination with a toy car (A storyboard).

On the other hand, a projector is typically used to present various visual contents, including still images, motion pictures, or live videos. Its purpose is clearly defined, and its repurposability is lower than a toy car [4].

3.3 Evaluation Challenges

How can we evaluate these effects of Children experience with socially interactive toy? While a toy car provides some flexibility to what purpose kids could use it for, the toy car design imposes a limitation on the repurposability, comparing to a cardboard box [4]. In the study, we presented three sketches (Figure 5) [5] in the order of a real car, a toy car, and a toy car with a built-in projector. Children were asked to elaborate what they see from each of the sketches, and what they will do with it [1]. We observe mostly common results from the first two sketches, but surprising feedbacks from the last drawing [4].

Figure 5. User Study with an imagination: Sketches of a real car (left), a toy car (middle), and a toy car with a built-in projector (right) .

We expect to have an analysis done by our on-going Prototype before the Usability test. In the experiment, we plan to present our concept of the toy robot, the design as well as the results from the first user study.

4 PROTOTYPE

The design inspiration of the PlaySpace is for Children experiences with a Socially Interactive Toy car. It is an experience-driven design method involving daily rituals and memorable experiences with social robots (Figure 6). And possible applications to other products and domains are discussed (Figure 7).

4.1 Design Concept

Many AR examples focus on visual layers. However, AR is really about all of the senses, and augmenting what you can see, feel, smell, and hear [10].

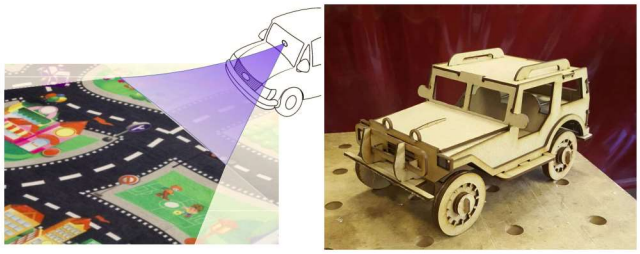

Figure 6. Idea Sketch for a Toy car and 3D model

As the car pushed along the ground, sensors in the wheels detect motion and project a play-space in front of the car with roads to follow and interesting scenery surrounding it. Differential detection of left and right movement would allow for curves to be predicted and projected.

4.2 Interactive Toy Car

How can we better understand Children's motivations and needs for fun? A vibration motor within the car (similar to those in phones) could provide additional haptic feedback

to a simulated road surface. A loudspeaker within the car could provide contextual audio for the simulated area.

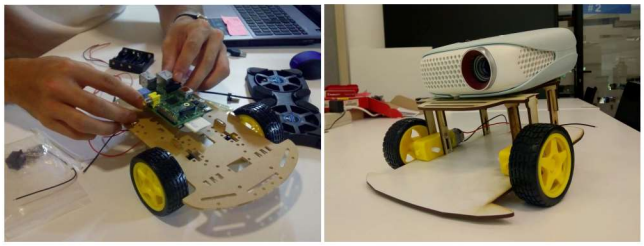

Figure 7. Prototyping with Raspberry Pi integration with a projector. Interactive content would be (Unity, or Processing)

This ideal prototype changes the proposal from a simple amalgamation of unrelated devices to an integrated object where the vehicle and the projector together form a new toy (Figure 8). An Integrating a short-throw projector into the car's body, along with a battery and control circuitry, would allow the car to simply project the image of the play-space onto the ground in front of the car.

Figure 8. Modeling: A Toy Car + Projector = Interactive Toy.

Within the wheels, rotation sensors are used to make the projected play-space react to the movement of the car, so the car appears to drive down the road as it is pushed by the child. Using separate sensors on the left and right wheels allow for differential detection of directional movement, allowing curves and turns to be predicted and projected.

5 CONCLUSION

Our proposed design for children is a combination of a toy car and a projector. In our new design, we plan the projector inside the headlights of the toy car. By combining these two seemingly less-repurposable objects, we hope to achieve greater repurposability. The rationale behind the concept is that the intersection between two orthogonal dimensions may provide a richer design space for children to repurpose the new artefact than the design space of each dimension alone [4].

Our design concept with the car is an ideal prototype for research addressing the design, development and use of interactive technologies for children. The vibrating toy of the interactive vehicle will be the ideal toy for bringing together a toy car and a projector from the variety of toys.

To further enhance immersion, a haptic feedback motor could be added within the car body. Synchronized adequately with metadata in the play-space map, this could provide an additional feel of the texture of the road (or off-road) surface to the hand as it grasps the car. Another easy addition to make would be a small loudspeaker to provide contextual audio cues, again extracted from the play-space map metadata. Driving past a farm, for example, would produce farm-animal noise, etc.

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REFERENCES

[1] Bongkeum Jeong (2016). Interactive Toy Design Combining a Car with a Projector. 2016 KSDS Fall Conference Proceeding, 128-129.

[2] Bongkeum Jeong, and Monchu Chen (2015). The New Understanding of User-centered Design through the Extension of User Definition and Goal. HCIK2015. ACM Digital Library, 26-30.

[3] Bongkeum Jeong, and Jorge Diaz (2014). Interaction Design with Rain as a Toy. 2014 KSDS Fall Conference Proceeding, 110-111.

[4] Bongkeum Jeong, and Monchu Chen (2014). Car Projector: A Children's Toy for Fostering Creativity. International Conference on Affective and Pleasurable Design. Kraków, Poland.

[5] Bongkeum Jeong, and Monchu Chen (2014). Toy Car & Projector: An Attempt to Expand the Repurposability of an Artifact with Specific Form and Purposes. Interaction Design and Children (IDC 2014), Aarhus, Denmark.

[6] Bongkeum Jeong (2014). A Study on Design Methods for Children's Interaction with Tangible Object. In Proceedings of the 2014 KSDS Spring Conference Proceeding, 144-145.

[7] Design for Repurposing: https://designforrepurposing.wordpress.com

[8] UXSR: https://uxsr.weebly.com/

[9] Obaid, M., Baykal, G.E., Yantaç, A.E. et al (2018). Developing a prototyping method for involving children in the design of classroom robots. Int J of Soc Robotics 10: 279. https://doi.org/10.1007/s12369-017-0450-7.

[10] Evans, K., Koepfler, J. (2017). The UX of AR: Toward a Human-Centered Definition of Augmented Reality. User Experience Magazine, 17(5).

[11] Hughe, P. (ed.) (2009). Children, Play, and Development. Sage, 2009.

[12] Goswami, U (2013). The Wiley-Blackwell Handbook of Childhood Cognitive Development, Wiley-Blackwell.

[13] Shachar Geiger, Michal Rinott (2015). cArVATAR-A Novel Remote Control for Toy Cars. TEI 2015, January 16-19 2015, Stanford, CA, USA. DOI: http://dx.doi.org/10.1145/2677199.2680589