WORM-E: An Interactive Toy Enriching Children's Bodily and Social Play

Figure 1: A child interacting with the soft toy prototype WORM-E.

Figure 2: WORM-E is a soft interactive toy with embedded electronics.

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Abstract

How can children develop a healthy level of body-awareness and social sensitivity in a technology-mediated life full of computers and digital devices? With WORM-E, an interactive soft toy for children, we explore haptic sensations and invite for enhanced bodily and social play experiences through pausing the smartphone usage. To realize the WORM-E prototype, we used e-textile techniques and technologies, including a microcontroller for controlling actuators and NFC (Near Field Communication) tags for communication with a smartphone app. Our project contributes a design exemplar on how the future of play could look like when body movements and haptic material qualities of tangible artefacts are combined with interactions through digital technologies.

Author Keywords

Soft Interactive Toys, Design for Children, E-textiles, Haptic Interaction, Wellbeing, Design for Play.

CSS Concepts

• Human-centered computing~Interaction design

Introduction and Motivation

From the cradle, digital natives are in intimate contact with technologies as computers and smartphones are an integral part of their lives [1]. This is an inevitable fact and can be observed in many children that have

Design Details

Figure 4: Tactile properties of different textiles allow for a rich touch experience.

**Figure 5:** Electronics are hidden but still easily accessible for maintenance.

Figure 6: The stripped off outer skin can be washed or replaced.

been born in the digital age. Yet, we do not know the long-term impacts the technology usage from early-on might have on children's wellbeing (physical, psychological and social) [4]. In short-term it may e.g. information overload, distraction, and isolation [2].

Based on these emerging yet crucial impacts of digital technologies in children's development, we aim at shaping alternative experiences for the offspring of our society through merging physical with digital. WORM-E is a 2m long interactive soft toy that combines e-textile knowledge with the comfortable and haptic characteristics offered by soft toys. Our goal is to engage children in more social and bodily activities without negating smartphones or computers and rather developing a conscious technology consumption and usage behavior. WORM-E is a tangible key to activate new content for physical play after a certain time of smartphone usage. The current activity on the mobile phone is paused and the user is asked to accomplish some physical activities with WORM-E in a playful manner to get rewarded. From the five envisioned interaction scenarios, we implemented a balancing activity to demonstrate and test our idea.

Related Works

Recent research projects investigate how the comfortable character of textiles can be seamlessly combined with e-textiles while providing age-appropriate play experiences for infants and toddlers [1][2]. While these are examples that are mostly hand-held objects enhancing sensorial experiences, other projects done with e-textiles trigger whole-body interaction bringing more people [5]. Similarly, we present a plush toy design that can be used by single or multiple players encouraging whole-body
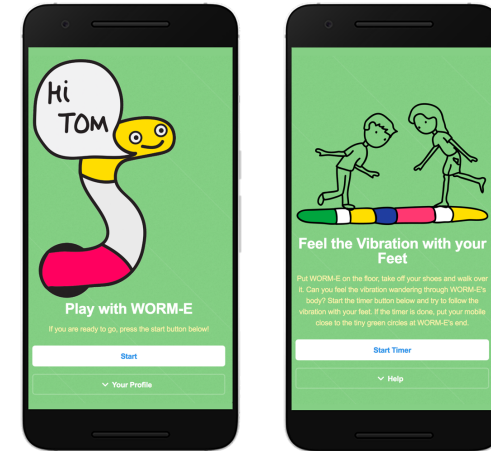
Figure 3: Screenshots of the WORM-E smartphone app.

movements. The smartphone app is a source for new content bridging from the screen to the physical space and the stuffed toy continuously offers physical play experiences ranging from dynamic to calming activities. Thereby, the haptic interactions with the toy are in the focus and the occasional, app-based instructions serve as friendly and open-ended reminders.

Design Process

We are three design researchers working with e-textiles and have collaboratively created WORM-E in a remote process across three countries. The prototype is inspired by early observations on how children play and what characterizes their movements. Our ideation and design phases follow an experimental approach combining methods from somaesthetic interaction design with participatory design methods. We engage with the design through our own bodily experience and involve our target users (children between 4-11 years) through exploring the interaction qualities of various forms via early mock-ups.
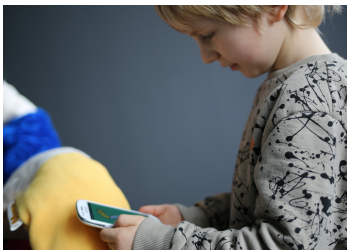
The WORM-E prototype

The current semi-functional prototype can be seen in Figure 2. Its technical details are shown in Figure 10.

Soft Toy Design
Plush toys can be found in almost all children's rooms. They provide a soft and comfortable surface (Figure 4) with endless interaction possibilities. Soft toys can be cuddled, squeezed, thrown, kicked, or serve for other play activities. They usually provide a character that can act as a friend or playmate, that can be a nighttime protector or a companion when away from home. Our digital toy provides all these characteristics. Besides, it has potential to be used by the children for a longer time, during different ages. WORM-E is a 2m long soft toy that provides an animal-like character to enter a toddler's imaginary world, but that can also integrate itself more abstract into the environment of a young teenager (e.g. as a long cushion). It embraces e-textile technologies that are invisibly integrated into it (Figure 5).

Interaction Design and Technologies Used
Children are invited to play with WORM-E after a long time of using the smartphone: the smartphone's screen temporarily shows a pop-up window and a graphical representation of WORM-E appears asking the child to touch the yellow circles at WORM-E's head with the phone (Figure 9). In order to obtain a smooth transition from the smart phone to the soft toy, NFC tags are integrated at both ends of WORM-E under the embroidered circles (Figure 7 and Figure 8) as activity starters. We used circular NFC stickers (38mm, 180 Byte) that are easily trackable through the fabric up to a distance of 2-3 cm. Once the start tag is read, an app opens and the child receives further gaming

instructions on how to get active with WORM-E (Figure 3). From then on, the child is focused on bodily experiences alone or with peers, based on the tactile and embodied qualities WORM-E provides. When the play is finished, the child can track the tag at the green end (Figure 7, left) to collect points and to continue with the activity on the smartphone followed before.

The integrated technology is not visible from the outside for safety and aesthetic reasons. An inner pocket hides the technology layer (Figure 5 and Figure 10) giving also the access to the batteries. It contains a Flora microcontroller, 5 tiny vibration motors, and a battery holder. With those components, we create subtle haptic feedback for a few interaction scenarios.

Different Activity Scenarios for Body and Mind
Based on the results of our body-inspired design process, we came up with 5 interaction scenarios that can be fulfilled either alone or together with peers. The required attention and physical involvement vary; some interaction scenarios require concentration while training bodily awareness, others are pure fun while facilitating social engagement and trusting each other, and one is planned to provide bodily and mental relaxation. The first scenario has been implemented for demonstration and testing purposes. The scenarios are:

Balancing requires walking on WORM-E while following the vibro-tactile stimuli under the feet that guide the balancing activity (Figure 1). The vibration pattern varies in speed, direction, and intensity.
Skipping Rope requires WORM-E to be used as a rope to jump over. It can be played alone, by 2 or 3 children. The game also has various levels, e.g. light indicates jumping speed or if to use one or both legs.
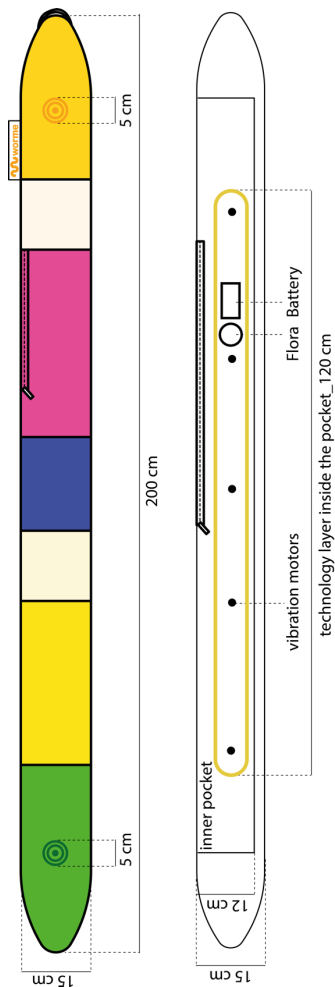
Figure 10: Technical drawing showing the cover (left) and the inner part (right) with the technology layer inside a pocket.

Tug of War creates bodily tension and invites for friendly competition. The players pull the ends of the toy and try to make the "other" team move forward from their position.

Embracing is a calming activity. WORM-E is wrapped around the body/bodies and "hugs" one or more users while sending smooth vibro-tactile stimuli. Additionally, the phone plays an audiobook or relaxing music, and ambient light is turned on.

Swirling requires having one end of WORM-E attached to the shoulder while spinning around. The toy follows the player's movements. This activity stimulates and focuses on body balance. The light in the loose end gets brighter indicating the speed and elapsed time.

Conclusion and Future Work

WORM-E is an interactive soft toy enabling children to engage in social and bodily actions in the physical space without excluding the smartphone totally from their reach. It contributes to a new generation of toy design combining comfortable and tactile characteristics of textiles with digital technologies. The current prototype demonstrates a balancing scenario. Further, we plan to test how multi-sensorial stimuli (e.g. through vibration and LED lights) and intimate interaction with the soft toy can influence the user experience with WORM-E. This will help us to improve the concept design of the toy, explore new enjoyable activities with it and emphasize its tactile and embodied qualities.

Acknowledgements

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