# Softy's Magic Touch: Altering Old Toys into Interactive Friends!

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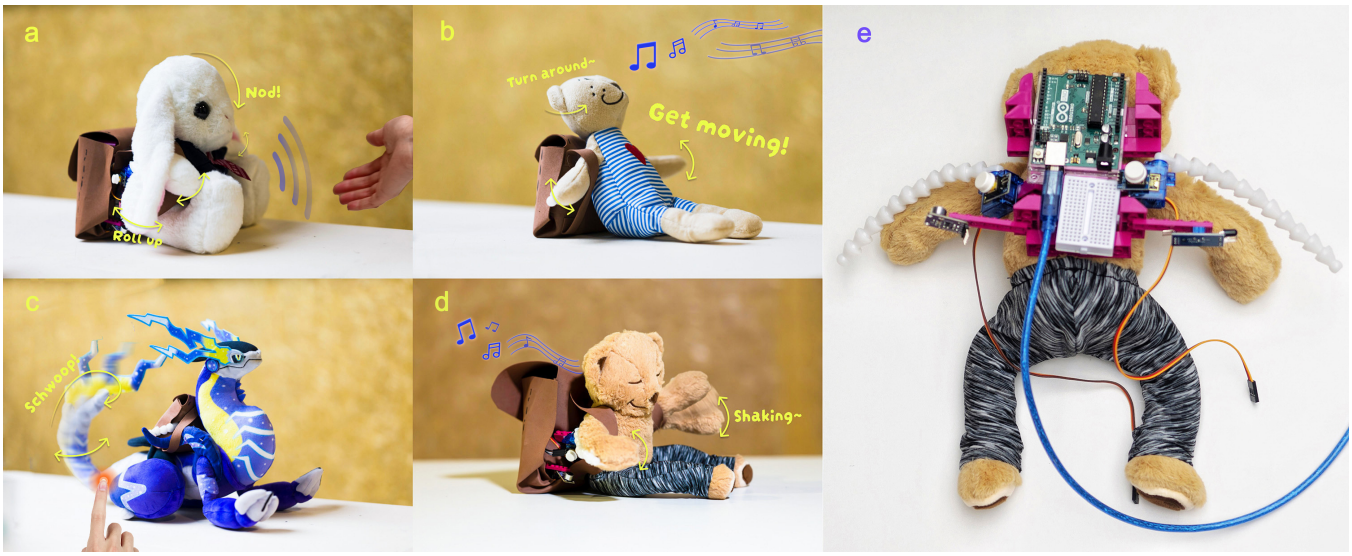


**Figure 1: (a)Children approach, and the toy attached with Softy responds with a hugging motion.(b)(d)Toys attached with Softy dance along with the music.(c)Children use buttons to make the Softy-attached toy wag its tail.(e)The prototype of Softy.**

## ABSTRACT

The phenomenon of children quickly losing interest in their toys, leading to the accumulation and waste of toys is commonly seen. To address this issue, we have developed "Softy" – a modular interactive kit designed for plush toys. Softy comprises various modules and three interaction modes, allowing children to install it on old toys, providing them with the ability to perceive the environment and interact with children. This study aims to rekindle children's interest in old toys by enhancing their interactivity.

## CCS CONCEPTS

• **Human-centered computing** → *HCI theory, concepts and models*; • **Hardware**;



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## KEYWORDS

Modular Interactive Design; Toy Design; Children's Design; Human-Robot Interaction; Everyday Interaction

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## 1 INTRODUCTION

As children's interests change rapidly, their toys start piling up everywhere. Generally, a child's interest in a toy diminishes after a month, and as their attention shifts, they begin to demand new toys. As a result of this continual demand for new toys, parents worldwide face challenges in toy management.

Current toys often lack engagement due to static characteristics and passive nature, leading to children quickly losing interest. Various studies focus on renewing old toys through interactive designs. However, existing designs often exhibit weak interactivity, lacking user input.

To address this, we developed the Softy kit, inspired by the concept of toys coming alive like Woody from "Toy Story." Softy includes a torso module and skeletal modules, using simple materials like Velcro, LEGO bricks, and old toys for prototype development. Modules can be attached to old toys with Velcro and interconnected with LEGO bricks, enabling toys to sense the environment and move. Children can customize skeletal modules for different toys, providing a new interactive experience and rekindling interest in old toys.

## 2 DESIGN PROCESS

### 2.1 Decreased interest in children

A survey of parents revealed that children's attention to toys typically wanes within 36 days. Moreover, about 20% of parents noted that their children's interest in new toys diminishes after just 11 hours of play, and an even smaller proportion (8%) observed that their children's enthusiasm for toys fades within less than an hour [1].

### 2.2 What children need

According to Piaget's stages of development, children in the preoperational stage (ages 2-7) are likely to become tired of toys more easily due to their rapid developmental changes [6]. Therefore, we have defined our primary targeted user group as children in this age range and focused our design efforts accordingly.

Children's toys can mainly be divided into hard and soft toys, with soft toys predominantly being plush toys [7]. These plush toys can aid children's development in two main ways:

**Providing a sense of security and comfort** Under stress, children often treat toys as comfort objects, which is important for their psychological health. Research shows that comfort objects help children regulate their emotions and increase their sense of security [2].

**Social skill development**: By interacting with plush toys, children can practice and simulate social scenarios, such as sharing, caring for others, and expressing emotions. These toys often become the child's "friends," helping them independently explore interpersonal relationships without the involvement of adults or other children.

These aspects correspond to children's previously owned plush toys. Considering these factors, we have tailored our child persona based on the 2-7-year-old age group, positioning the parents as the secondary audience and buyers.


**Figure 2: Persona of children**

Our design approach begins with old toys, narrows to plush toys, extends to flexibility, and finally focuses on how to regain children's interest in old toys through movable methods. At the same time, we found that movable and interactive toys make the world children perceive more dynamic and responsive [5]. This observation has inspired our design concept, leading us out of traditional toy design thinking and into exploring new possibilities. We hope to maintain the characteristics of plush toys in their existing scenarios while giving them completely new forms of interactions, using a 'kit + toy' approach to solve the problem. Given the above, "how to move" has become our key question.

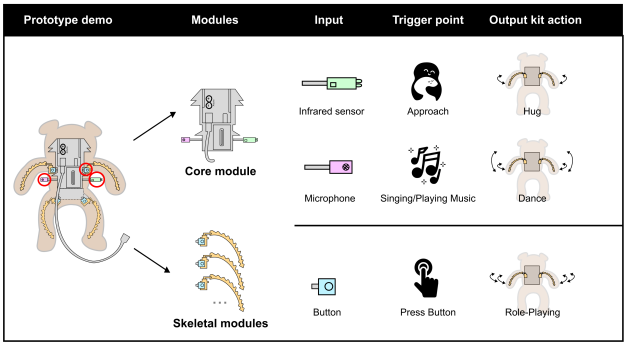


**Figure 3: Hardware Interaction**

### 2.3 Kit design

In the detailed design of the kit, our focus primarily lies on three innovations: interactivity, modularity, and adhesiveness.

*2.3.1 Interavtivity.* In developing interactive modes, our strategy was to create a reactive interaction design that mimics the natural behaviors children exhibit when interacting with regular plush toys. We also considered the importance of cause-and-effect experiences in interactive toys [4]. Thus, Softy's interaction triggers or "causes" include hugging, moving, talking to the toy, and squeezing the toy. Softy's previously mentioned responses to these triggers would be defined as "effects". Such a design approach enables Softy to meaningfully reflect the child's involvement, enhancing the interactive experience [8].

Softy offers three primary modes: Companion mode, Hands-on mode, and Voice Interaction mode, each corresponding to three types of functional modules. The Companion mode utilizes infrared sensors to enable Softy to respond to children's affectionate actions, enhancing the sense of companionship. The Hands-on mode allows children to control Softy via buttons, thus fostering the development of their imagination and allowing them to take control. The Voice Interaction mode triggers Softy's actions through sound, enhancing the experience of musical interaction. These modes collectively create an educational and highly interactive play environment, aiming to stimulate children's interest and growth through diverse interactive methods.

*2.3.2 Modularity.* The purpose of Softy's modular design is to enhance its multifunctionality and adaptability. The modular design is mainly reflected in two parts: the core module and the skeletal modules, which integrate sensors and a motherboard. Additionally, we designed skeletal modules with servos and buttons for the

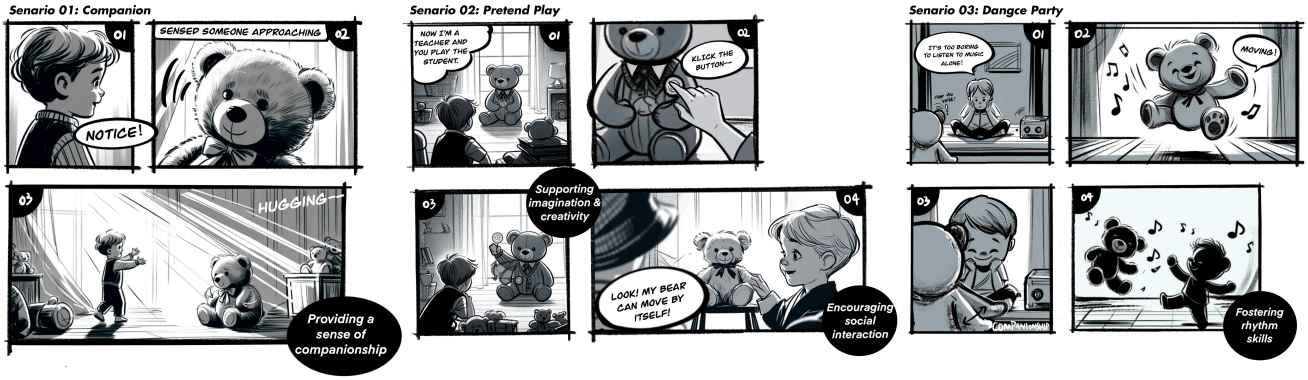


**Figure 4: Three main application scenarios for children using plush toys attached to Softy.**

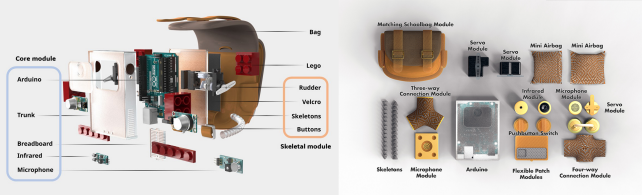


**Figure 5: Display of the dispersed components of the Softy kit.**

flexible control of individual servos. This layout enables Softy to be compatible with different types of plush toys, such as bears, rabbits, or snake-like toys. Children can connect skeletal modules at multiple positions on the core module, thereby driving various plush toys to achieve interactive postures like swinging, wiggling, and even raising their ears. This strategy lays a solid foundation for Softy's flexibility and wide applicability.

Softy's modular design enhances usability an d customizability. The core module's outer shell and skeletal module interfaces use LEGO bricks for swift assembly and personalized adjustments. Implemented codes for interactive modes are integrated into an Arduino system, switchable through buttons. Attaching skeletal modules to the core module activates the toy, enabling interaction with the environment. This design minimizes the learning curve, reduces frustration with complex controls, and enhances the toy's entertainment value.

*2.3.3 Adhesiveness.* Another innovative feature of the Softy kit is its adhesiveness. The Softy kit is not only compact and portable, but it can also be easily attached to a variety of plush toys using Velcro. This method of attachment can be turned into a metaphor for a "soul transfer", allowing children to quickly transfer Softy to different toys, thereby endowing these toys with new life and interactive capabilities. Through this adhesive design, Softy can be easily integrated into children's daily lives. Kids can attach the kit to their favorite plush toys or freely switch between different toys to explore various interesting interactive possibilities. Such flexibility not only makes toys more fun but also encourages children to use their creativity in designing unique ways of interacting with their toys.

Moreover, the adhesive nature of Softy also expands its range of applicability, allowing children to use it with various soft objects in their lives, such as pillows and cloth dolls. This "soul transfer" effect not only makes toys and household items more interesting but also provides a novel way of interaction, enabling children to transform everyday items into imaginative and fun playmates.

## 2.4 Storyboard

Softy is a modular robotic kit that can be attached to any plush toy, specifically designed for children aged two to seven. Our aim is to repurpose children's discarded old toys through technological innovation, breathing new life into these toys, and integrating children's imagination into their daily lives. This empowers children to become the reinventors of their plush toys. Using a teddy bear as an example, we devised three major application scenarios for children using Softy.

**"Companion" Scenario**(Figure 4-1): When a child approaches the toy, Softy will initiate a gentle shaking motion in response. Additionally, Softy can contract the arms of the toy and engage in a hugging action, creating a companionship experience.

**"Pretend Play" Scenario**(Figure 4-2): A child engages in imaginative play in the role of a teacher and wishes for their toy to assume the role of a student. Softy can encourage the toy to emulate student behavior by raising its hand through a limb button press. This fosters children's imaginative and creative development. Additionally, sharing these interactions can promote social engagement among children and their peers.

**"Dance Party Scenario" Scenario**(Figure 4-3): When a child desires to enjoy music alongside a companion, Softy detects the ambient sounds and encourages the toy to engage in movement and dancing. This can inspire children to join in and actively contribute to the development of their rhythm skills.

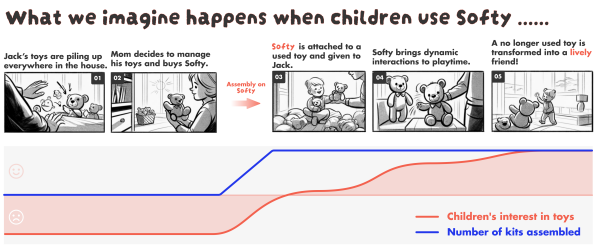


**Figure 6: What we imagine happens when children use Softy.**

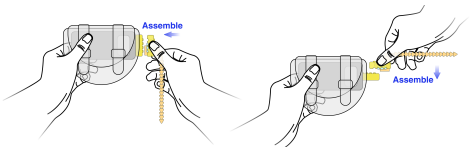


**Figure 7: Skeleton modules can be assembled with multiple degrees of freedom through Lego bricks.**

## 2.5 Results

The Softy Kit includes a range of functional modules: backpack, main control board, mini airbags, microphone, infrared, servo, multiple connection modules, flexible patch, button switches, and skeletal modules. The kit box aims to simplify the learning process, providing pre-assembled components for easy use. It comprises skeletal modules and a torso module, facilitating flexible movement of plush toy parts. The torso module houses the mainboard and essential sensors for core control, while skeletal modules feature servos and buttons for individual servo control, allowing flexible manipulation.

Meanwhile, Figure 6 shows how we envision parents and children using our Softy kit box under our design premise. It demonstrates the process of bringing everything from old toys to soft objects to "life". In this process, as the number of kits increases, the child's excitement gradually builds, and their interest in the toys continually grows, aligning with our initial design intention.

# 3 IMPLEMENTATION

In terms of color design, the kit uses highly saturated warm colors, aimed at attracting children's attention, promoting visual development, and inducing positive emotions [3]. In the overall design, the chosen brown color coordinates with most plush toys, maintaining the aesthetic appeal of the toys and avoiding the placement of discordant objects on children's favorite toys.

Regarding material selection, we used small bears purchased from IKEA. Adhering to a sustainable philosophy, the assembly modules we use are the most readily available sensors on the market, with the cost of a set not exceeding 25 dollars. Additionally, we used recyclable materials; the physical interfaces of the outer shell and skeletal modules are composed of LEGO bricks, supporting rapid physical connections. Children can also use existing LEGO bricks in their possession to change the color and shape of these bricks.

In terms of technical implementation, we used easily accessible electronic components that can be purchased from online stores to achieve interactions. These materials include infrared sensors, microphones, and buttons used as hardware for signal input media, enabling Softy to sense environmental signals. Single-axis or dual-axis servos are used to control the movement of Softy's movable parts in toys. The product prototype uses an Arduino UNO as the core controller, processing signal inputs and outputs. Children can interact with Softy-equipped toys through everyday actions with toys, such as approaching, speaking, singing, and manipulating toy limbs.

# 4 DISCUSSION

With technological advancements in hardware, software, and programmable materials, Softy's future extends beyond a mechanical framework. It will transform into accessories seamlessly integrated with toys, such as teddy bears wearing T-shirts, mini gloves, or playful hats. As children dress up their toys, they can also impart motion. Additionally, we envision Softy being applied to everyday soft objects, like a dynamic scarf promoting social interaction or an ear cover sensing sound. These enhancements inject vitality into old objects, not just toys. The future of Softy shifts from "playing with toys" to "playing with everything," letting children define limitless play possibilities.

Currently, we are eagerly exploring the integration of modular input and output components into large language models. Our goal is to transfer data from these components through a computational module for processing within the language model. This approach is designed to enable the language model to merge with various old toys, augmented by our kit and the creative assemblies of children. Such integration has immense potential to automate and transform any old toy. This aligns them with the interactive modes anticipated by children and thereby introduces new dimensions of engagement and interactions.

# REFERENCES

[1] 2023. . https://www.huffingtonpost.co.uk/entry/millions-of-toys-are-binned-because-kids-dont-play-with-them_uk_5cab5687e4b047edf95dadd8 Accessed: December 7, 2023.
[2] J Bowlby. 1996. Children generate" internal working models of attachment" that influence the organization of their attachment-seeking behaviors. *Psychiatry* 59 (1996), 20–33.
[3] Lois Denissa, Rosida Tiurma Manurung, Olga Catherina Pattipawaej, Izmet Zainal Effendi, and Iman Budiman. 2022. Visual Impact of Color on Children's Excitement Development, Making Exterior Wall Mural at Taruna Bakti Kindergarten Bandung. *Journal of Innovation and Community Engagement (Journal of ICE) e-ISSN* 2776 (2022), 421.
[4] Florian Güldenpfennig, Peter Fikar, and Roman Ganhör. 2018. Interactive and open-ended sensory toys: Designing with therapists and children for tangible and visual interaction. In *Proceedings of the Twelfth International Conference on Tangible, Embedded, and Embodied Interaction*. 451–459.
[5] Wu Guorong and Wang Wei. 2011. Application of human-machine interaction in toy design. In *2011 6th IEEE Joint International Information Technology and Artificial Intelligence Conference*, Vol. 2. IEEE, 275–277.
[6] Jean Piaget. 1976. Piaget's theory.
[7] Margaret Walsh. 1992. Plush endeavors: An analysis of the modern American soft-toy industry. *Business History Review* 66, 4 (1992), 637–670.
[8] Naoya Yoshimura, Yushi Sato, Yuta Kageyama, Jun Murao, Satoshi Yagi, and Parinya Punpongsanon. 2022. Hugmon: Exploration of Affective Movements for Hug Interaction using Tensegrity Robot. In *2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*. IEEE, 1105–1109.