
IPANDA: A Playful Hybrid Product for Facilitating Children's Wildlife Conservation Education

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ABSTRACT

In this paper, we introduced the concept of a hybrid product which combines a digital game with physical experiences and discussed practical recommendations for hybrid products development in the domain of wildlife conservation for children. IPANDA including hardware and software applications with sensing technology was able to gather real-time environmental data and connected to one virtual wildlife experiencing environmental challenges regarding its living habits.

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KEYWORDS

Hybrid product, wildlife conservation,
Sensing technology, Artificial pet,
Children

Children who play the product can learn about the environment around them and foster wildlife protection awareness. To evaluate our conceptual system, we created a preliminary prototype and conducted user study within the semi-structured interview and Smileyometer. Our striking findings revealed IPANDA as a promising tool to serve as groundwork to encourage children to explore the physical environment and gain potential wildlife protection education.

INTRODUCTION

Wildlife protection is a global concern. Many wildlife is in danger of extinction which is at least 100-1000 times higher than nature intended as a direct result of humans [3]. Although plenty of wildlife locating and monitoring systems via GPS or wireless sensor network have been applied for wildlife protection, the solution for sustained existence of biodiversity mostly lies in transforming the way we think and behave. Therefore, education plays a vital role in influencing people's attitudes and behaviors toward wildlife, especially those of children [2, 9].

However, previous conservation education for kids concerning wildlife hardly break through traditional education scaffolding. As exploration work, we endeavored to employ novel technology, which may provide stimulation for leveraging emotional bonds between children and wildlife to encourage behavior change in a playful way. Just as Tamagotchis evoked a powerful response from their owners all around the world, we hoped to use the attachment to a wildlife product with sensing technology which shares similar living habits as human as a motivator for children to nurture the awareness of environmental factors and wildlife protection.

In this paper, we proposed IPANDA, a concept and development insights for a hybrid product that is expected to foster wildlife protection education for children. To evaluate our concept, we conducted a user study with a prototype to understand the real user experience of IPANDA (Fig. 1). The main contribution of our research is facilitating children's physical activity experience and gaining wildlife conservation education with a hybrid playful product, which is embedded with sensing technology to gather environmental data and influence digital game.

RELATED WORK

There are trends of increasingly use of interactive technologies to foster educational, emotional connections between human and wildlife, with the goal of transforming attitudes to wildlife in zoos [1, 7]. Sarah et al. [10] conducted a workshop with HCI researchers to explore interaction and technologies in zoos, to understand what roles design and technology play in the intersection of the human and animal worlds. However, these studies are limited to the zoo environment, which hardly breakthrough the space constraints to bridge children and wildlife in an emotional and entertaining aspect.

In recent years, children's toys have been increasingly shaped by technological innovations, making a new wave of hybrid products a reality [4, 6, 8]. Combining the physical world with digital technology, it is possible to incorporate the advantages of tactile experience. For instance,



Figure 1: Prototype of IPANDA.

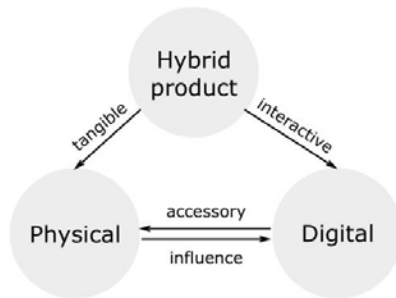


Figure 2: Structure of Hybrid product.

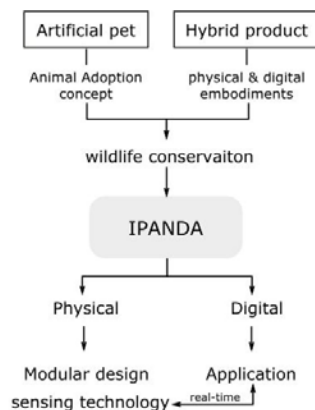


Figure 3: Conceptual framework of IPANDA.

Qiao Jin et al. developed TanCreator [5], a tangible authoring tool which facilitates children to create an intuitive experiment with Augmented Reality (AR) and sensor technologies.

With the concept of Hybrid playful product (Fig. 2), we seek to design a playful interactive experience. Combining with novel technology, it can bridge the digital world with the realistic surrounding and provide an intuitive and joyful way for children to explore the physical world and gain knowledge of wildlife conservation.

IPANDA

Concept

Inspired by adoption mechanism promoted by the World Wildlife Fund (WWF), we seek to apply animal adoption idea into Hybrid products development. Encouragingly, it is a similar concept as artificial pets that can effectively link users to provide companions, pet-caring simulations, benefits in cognitive, emotional and social domains.

Considering plenty of wildlife are facing the danger of extinction, we choose giant panda as a symbolic creature for our hybrid product with the following reasons:

- The giant panda maybe the most powerful symbol in the world when it came to species conservation and considered as a national treasure in China.
- The giant panda is regarded as a peaceful creature that adored by the whole world.
- There are many similarities in living environment between giant panda and human. Sharing the same environmental factors may deepen the connection and awareness.

With these reasons, we seek to use panda as a symbolized wildlife by creating a product in a low-cost way with features based on its living habits, to provide intuitive play experience for children to learn wildlife conservation.

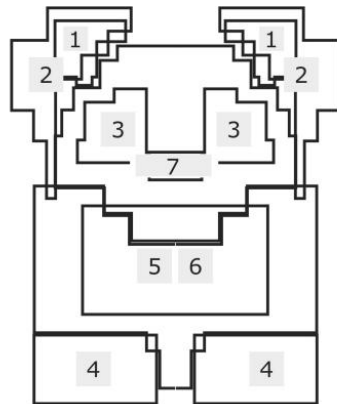
Features

With the concept of hybrid product and artificial pets, we concentrate on the following features which can effectively combine physical product and digital game joyfully and intriguingly (Fig. 3).

- **Tangible:** Tangible toolkits are increasingly applied to children's creativity emotional, physical development. Physical part of IPANDA is portable, touchable to maximize its creation.
- **Sensory:** IPANDA transform the use of sensing technology to empower children to explore surroundings and rise the wildlife conservation awareness. Children can discover how temperature, sound, light, humidity, and air quality influence wildlife (digital & physical character).
- **Low-cost and modularity:** Low-cost tangible materials and modularity design can help market-promotion and post-iteration. We hope to utilize the least cost and resources to educate children with wildlife conservation in a playful and multi-scenario way.

Hardware and software implementation

IPANDA integrates different sensors and actuators to simulate function of multiple parts (Fig. 4).



1.sound sensors 3.light sensors
5.humidity&temperature sensor
6.gas sensor 7.air pump&valve
2&4.analog servos

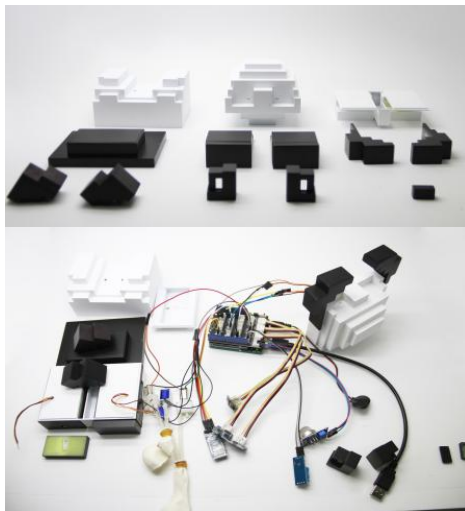


Figure 4: Hardware composition.

For the sense of vision, hearing and environmental temperature, we use light, sound and temperature sensors embedded respectively in eye, ear and backpack modules of the panda. In the trunk, we put DHT11 humidity and temperature sensor to detect air humidity and MQ-135 gas sensor to detect air quality. We use five constants as parameters to define the sensitivity and requirements. All sensor data are processed by an Arduino Uno Board which accordingly gives action commands to the actuator modules.

Four analog servo drivers drive the motion of arms and legs. Both cheeks of IPANDA are integrated with two expandable balloons which connects an air pump and a micro-solenoid air vent valve. A pump will inflate the balloon to show an angry expression. Air escape and return to normal state when the air valves are open.

Furthermore, a bluetooth board is used for transmitting action commands to the software on a pad (a line of tablet computers designed, developed and marketed by Apple Inc). The motion of the virtual panda in the software serves as another implementation part.

Interaction

The strong point of IPANDA is the ability to enclose different functions and interactive experience for children as followed:

- Hands-on assembly. Owing to modular design strategy, IPANDA can facilitate children's practical ability through magnetic stickers and be applied to the various shape of wildlife.
- Physically. By placing it in different environmental place, manipulate it with additional practice [Table 1](#) like touching it, warming it up, etc. or dealing with environmental factors.
- Sensory. With sensing technology, IPANDA can gather physical environmental data and influence the digital panda on the screen based on its living habits.

PRELIMINARY USER STUDY

With our preliminary prototype, we tried to confirm how children play about IPANDA and how this product impact on children's view of wildlife conservation in the real physical context. Therefore, we brought IPANDA into preliminary user study to figure out the above concern.

Participants

We recruited six children (3 males and 3 females, mean age=4.9, sd=1.02). To observe natural behavior, we conducted the user study in an individual home environment. The user study consisted of a 2-day prototype experience session and a followed-up interview. The whole process was recorded and transcribed with the consents of children's parents.

Procedure

The session was started by giving a demonstration and idea of IPANDA to children. Then, children were given an IPANDA product with a tablet running IPANDA application to play with in different situations ([Fig. 5](#)).



Figure 5: Interfaces of IPANDA software.



Figure 6: Child interacts with IPANDA.



Figure 7: Interview with users.

After 2-day test session, we conducted a semi-structured interview with children (Fig. 6) to have more qualitative ideas of IPANDA. Then we utilized Smileyometer published by Read et al. [11] to measure children's satisfaction. We measured our prototype with following macro-topic: (1) Their relationship with IPANDA (2) Ideas of wildlife conservation before and after play.

RESULT

We observed children's reaction such as gaze, facial expression during test, then sorted out interview transcripts. We use Smileyometer results into practical recommendations. In general, IPANDA can encourage children effectively to achieve physical experience and affect children's opinion positively about wildlife. We also confirmed children's satisfaction with IPANDA through Smileyometer strategy Table 2.

It is so exciting that I can raise a panda!

Most children interested in adopting a panda and noticing its behavior changes in different environment. C5 said, "I only saw a panda once in a zoo, now I can play and take care of it!", C2 said, "When my panda is upset, I am so nervous about it that I will try many solutions to help her."

I don't know how to take care of it; the physical part is less interactive.

The main negative opinion was less feedback of physical embodiment and made children feel distractive with it. Although physical panda can influence digital one, it made the whole interaction less immersive. Children may feel disappointed when physical one cannot make right feedback.

Let's make more interaction and wildlife.

Some children attempted to move panda's arms to make more desired feedback. For instance, C1 wanted to interact with physical panda in a tickling way. However, there is no such function owing to the low-tech design feature. Some children also mentioned that they want to choose another wildlife such as whale, white shark or jaguar to raise.

Our findings indicate that physical part which imitating the appearance of lovely wildlife could facilitate children's empathy to build an emotional bond. Furthermore, our observations find negative opinion is that children can hardly find a mechanism of connecting physical and digital section. Combine physical and digital interaction seamlessly is our main challenge.

Based on our above findings, we draw some practical recommendations regarding children's wildlife conservation education with playful hybrid products.

- Mimic wildlife's appearance and do anthropomorphic design can help children build emotional connections with them. They can consider it as a peer or partner, rather than a toy.
- Consider the interaction mechanics following children's education scaffolding which includes reward and real-time feedback to encourage their exploration and learn.
- Design with consideration of multiple scenarios and various wildlife creatures as well as production and marketing.

Table 1: Interaction with digital and physical embodiments according to panda's living habits

<i>Living habits</i>	<i>Sensor</i>	<i>Physical reaction</i>
Poor eyesight	Light	Cover eyes
Cooler temperature	Temperature	Shake foot
Moist above 80%	Humidity	Shake paws
Sensitive hearing	Sound	Cover ears
Fresh and crisp air	Air quality	Swell

Table 2: User's Smileyometer answer through interview

<i>Code</i>	<i>Gender, Age</i>	<i>Smileyometer answers</i>
C1	M,4	really good
C2	F,8	good
C3	M,6	brilliant
C4	F,4	not very good
C5	F,6	really good
C6	M,6	good

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CONCLUSIONS AND FUTURE WORK

In this paper, we developed IPANDA, a hybrid product with environmental sensing technology, which can gather real-time environmental data and give influence to both physical and digital wildlife (parts) based on its living habits. The imitation of lovely panda effectively raised children's enthusiasm and curiosity of wildlife-raising and built a strong emotional relationship.

Compared to previous wildlife conservation education, we were inspired by the concept of animal adoption and mechanisms of the hybrid product. We presented a prototype and suggested several recommendations concerning the application of hybrid product into children's wildlife conservation education. However, we are aware of the limitations of our prototype which lack the flexibility of combining physical and digital content seamlessly to provide more immersive experience. And more effective and precise study should be conducted to focus on the animal conservation motivations. In the future, we will seek the above challenge and try to combine different sensors with different wildlife creatures and environmental situation to offer different interaction. We also need to conduct both qualitative and quantitative user research to improve our prototype rigorously.

Overall, we believe this study is a creative exploration applied animal adoption concept into children's wildlife conservation education. With sensing technology and hybrid product, this work positively affected children's opinions about wildlife and help create strong bonds with wildlife.

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