

Research on the Mode and Strategy of Interaction Design between Human and Plant

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Abstract:

In order to explore the interaction design mode and design strategy of people and plants, and analyze the multiple roles of plants in human life, according to the biological properties of plants and the interaction design principles, we combed out the interaction design mode facing plants, proposed the interaction design strategy of people and plants, and analyzed the feasibility trend of the future development of human plant interaction from a technical perspective. This paper aims to expand the object of interaction design, supplement the method of human plant interaction design, and enrich people's experience of plants.

Keywords:

Human Plant Interaction, Interaction Design, Plant, Design Research

1. Introduction

Plants are an indispensable part of our lives. For a long time, the relationship between humans and plants has been firmly established in the natural world. Plants have always been in a passive position, often seen merely as decorations, food, and medicinal materials, while their role in design has been overlooked. However, as living standards continue to improve, people have started to pay attention to the potential roles of plants in other aspects. For example, plants can not only provide aesthetic value but also have positive effects on human health, emotions, and cognition. The development of interactive design has redefined the role of plants in design, providing ideas and methods for research in these areas. However, currently, there is a lack of systematic patterns and feasible design strategies in research on human-plant interaction.

2. The Multiple Roles of Plants in Human Life

In indoor spaces, plants are highly popular decorations. Besides beautifying the indoor environment, plants can also help purify the air and absorb harmful substances, thereby improving indoor air quality. Numerous studies have shown that plants can lower people's blood pressure and heart rate, reduce stress and fatigue, and enhance

work efficiency and attention [1]. Plants can also create a relaxing and cozy atmosphere, enhancing people's sense of happiness and quality of life. In public spaces, the application of plants is increasingly being emphasized. People tend to feel more relaxed and pleased when in proximity to natural environments, and incorporating plants in public spaces can evoke such a natural ambiance. During the process of urbanization, public spaces often appear monotonous and lack vitality. Introducing plants can make them more vibrant and interesting, providing people with places for leisure and social interaction. For example, adding plant landscapes to urban parks can attract more people to engage in park activities, increasing park utilization. Additionally, it can provide various ecological services such as flood prevention, air purification, and water purification. With the continuous development of technology, the application of plants in digital products is also gaining attention. Plants can be used as user interface elements in digital products. For instance, plant textures can be used as backgrounds to simulate page-turning effects in e-books, or plants can be utilized in mobile applications to represent task progress and completion.

Furthermore, plants have wide applications in virtual reality (VR) and augmented reality (AR) technologies, as shown in Figure 1. Three-dimensional models of plants can be used to create virtual natural landscapes or digitally add plants to real scenes in AR applications, enabling users to interact with digital plants.



Figure 1. The combined application of plants and AR technology.

3. Plant Oriented Interaction Design Mode

In interactive design, it is essential to tailor the design to the specific characteristics and attributes of different objects. When it comes to plants as the design object, they possess vitality and variability that distinguish them from traditional artificial products. Therefore, designers need to fully consider the characteristics of plants in the design process to achieve better interactive effects. The following discussion will explore four aspects of interaction design patterns for plants.

3.1. Consideration of the plant's growth cycle

The life of plants follows a certain pattern and exhibits distinct growth cycles. Therefore, when designing interactions with plants, it is necessary to consider the plant's growth process, including germination, growth, flowering, and other stages. In the context of digital products, synchronized functionalities can be designed to align with the growth of plants. For example, the experience points of a game character could gradually increase as the plant grows. In indoor and public spaces, interactive methods related to plant growth can be devised, such as showcasing the plant's growth stages through gesture-based interactions.

3.2. Combining the environmental needs of plants

Different plants have varying requirements for environmental factors such as light, temperature, and humidity. Therefore, in the design of plant interactions, it is necessary to consider the specific environmental needs of plants and develop corresponding functionalities. For example, in digital applications, functionalities can be designed to control indoor lighting and temperature to aid in plant growth. In indoor and public spaces, environment monitoring features related to plant growth can be designed, such as detecting indoor temperature and humidity and adjusting airflow accordingly.

3.3. Creating scenes of interaction with plants

The application of plants in indoor and public spaces can provide people with a sense of comfort and pleasure. When considering design options, interactive scenarios involving plants can be created. For example, games and activities related to plant growth can be designed, such as a plant-themed puzzle game where players can learn about the plant's growth process while completing the puzzle, promoting interaction and socialization between humans and plants.

3.4. Consider the way plants interact with humans

In the interaction between plants and humans, it is necessary to consider different interaction modes, such as voice interaction, gesture interaction, touch interaction, etc. (see Figure 2). In digital product applications, suitable human-machine interaction methods can be designed. For example, visual representations of plant growth status can be created, allowing users to understand the plant's growth situation by touching the screen. Additionally, by incorporating social elements such as allowing users to share the plant's growth progress and interact with other users, user engagement and social interaction can be further enhanced.



Figure 2. Voice interaction, gesture interaction, touch interaction.

4. Design Strategies for Interaction Between Humans and Plants

The interaction design patterns for plants refer to the design patterns and methods specifically developed for the interaction between humans and plants, aiming to improve the interaction effects and experiences between humans and plants, and laying the foundation for the future development of plant interaction design.

Currently, there have been relevant studies on human-plant interaction theories. "Patterns and Opportunities for the Design of Human-Plant Interaction" systematically analyzes existing works on human-plant interaction. It identifies the core design paradigms across dimensions such as human-plant interaction system

architecture, plant I/O coupling, plant interfaces and operation techniques, application environments, and scales [2]. This research provides a theoretical basis for the future development of human-plant interaction design. The “Botanical Printer” project, through experimentation, summarizes the characteristics of plant media. In existing human-plant interaction products, the focus is more on the design of interaction methods and the role of plants in the interaction [3].

Interaction design for plants differs from the traditional product-centric design approach, where the design outcome can be completely tailored to user needs through technical means. In human-plant interaction design, the subjective behavior of users and the biological attributes of plants simultaneously influence the design solution, while ensuring the survival of plants. The plant attributes include inherent plant properties and the characteristics of different plants. We need to first find the connection points between plants and user goals and design based on that foundation. Additionally, in the use of technology, we must consider whether it is potentially harmful to the plants rather than solely focusing on user goals.

4.1. From the perspective of human plant interaction design

First, determine user needs and application environment. Before starting the design process, it is important to identify the target users and application environment and consider the applicable user groups. This is typically done through user research to ensure that the product aligns with the users' actual needs. The application environment is also a critical factor to consider. For example, it would be difficult to choose tropical plants for design in cold environments.

Second, select plants and understand their sensory and responsiveness. In design, the morphology of plants plays a significant role as it can influence users' perception and acceptance of the plants. Therefore, designers need to select suitable plant species for interaction and design their morphology accordingly. Plant morphology design can take into account aspects such as the plant's appearance and growth habits to make the plants more user-friendly and facilitate interaction.

Third, design the plant's growth environment. The growth environment of the plant is also an important factor to consider in human-plant interaction design. By designing an appropriate growth environment, the plant can thrive, improve growth efficiency and quality, and better meet users' needs and expectations. Designers need to consider factors such as light, water, fertilizer, and air for the plant's growth environment to ensure optimal growth in the interaction design. Technologies such as sensors can be used to detect the plant's growth status and automatically adjust the corresponding environmental parameters to maintain healthy plant growth.

Fourth, interaction mode design. Interaction mode design is a crucial aspect for designers to consider in human-plant interaction design. Designers need to choose suitable interaction modes that make it easier for users to interact with the plants. Some common interaction modes include touch, sound, and light, which allow users to interact with the plants through perception. Additionally, incorporating technologies such as sensors can enable more complex interaction modes.

Fifth, design user experience. Human-plant interaction should be based on research on user experience. Designing user experience is a key task in human-plant interaction design. Designers need to consider user needs and expectations and design accordingly. For example, interactive forms based on touch may not be suitable for plants like cacti. When designing for plants like *Mimosa pudica*, the plant's movement

properties need to be taken into account to prevent unexpected plant movement from distracting users or causing ambiguity in their perception, affecting the interactive experience.

Through user experience design, users can more easily interact with plants and enhance their attention and interest in plants, leading to better interaction effects.

4.2. From the perspective of plant properties

First, designing feedback for plant growth status Designing feedback for plant growth status is a crucial aspect of human-plant interaction design. Users can understand the health condition of plants by observing their growth status, which enhances their interaction with the plants. Therefore, designers need to incorporate the design of feedback for plant growth status into the interaction design. Various sensors, indicators, and lights can be used to provide users with intuitive and reliable information about the plant's growth status.

Second, uncontrolled and unpredictable Plant growth possesses certain characteristics of being uncontrolled and unpredictable. Therefore, the design should have inherent logic, and when the design exhibits plant-like characteristics, participants can perceive it as having an uncontrolled and unpredictable state. At the same time, it quietly operates behind people's perception. Users cannot precisely anticipate how much transformation will occur between input and output.

Third, simplicity of functionality Plants, as natural organisms, typically have relatively simple structures and functions. Therefore, in the design process, conveying simplicity of functionality is more effective in expressing plant-like characteristics, while excessive functionality may impair the sense of interaction. Designing an interactive form with a limited number of functions generates a stronger sense of plant-like qualities.

Fourth, Suitable for “non-place” locations Cultural artifacts with a high level of plant-like qualities are more suitable for locations that do not require constant attention or long-term engagement. Within an urban context, these places are similar to non-cultural sites such as train stations. French anthropologist Marc Augé refers to these places as “non-places”, which are typically created to meet people’s temporary needs.

Fifth, these locations do not foster a sense of “place” but are more prevalent in non-cultural, non-historical environments where the sense of belonging is low. Therefore, the shape of plant-like objects can be intentionally designed to suit non-location areas within home [3].

5. Technical Realization

With the continuous development of technology, human-plant interaction design is gradually becoming a reality. The feasibility of technology is an important prerequisite for human-plant interaction design. Currently, the rapid development of technologies such as artificial intelligence, machine learning, and neuroscience provides technical support for human-plant interaction design.

Artificial intelligence (AI) technology can enhance plant recognition and monitoring capabilities through the analysis and processing of big data. Human-plant interaction systems can accurately and quickly identify and analyze the appearance, morphology, and growth status of plants using computer vision technology, providing

data support for plant growth and management. Machine learning technology can analyze and learn from plant growth data, providing intelligent decision support for plant growth and management. Through machine learning, models can be established for plant growth, providing personalized management plans for plant growth. Additionally, machine learning can analyze plant growth data to predict growth trends and the probability of disease occurrence, enabling timely measures to ensure plant health and growth. Neuroscience technology can provide theoretical support for human-plant interaction design by studying the neural system of plants and exploring their perception and response mechanisms. Neuroscience technology helps us understand plant perception and response mechanisms, investigate plant behavior patterns and modes of expression, and guide the design of human-plant interaction systems.

In addition to technological feasibility, technological influencing factors are also important considerations in human-plant interaction design. Firstly, technology impacts user experience and perception. Human-plant interaction systems need to design user-friendly interfaces and interaction methods that allow users to easily use and manage the systems. Secondly, technology affects plant growth and management. Human-plant interaction systems need to consider the personalized needs and growth environment of plants to provide scientific management solutions. Finally, the use and management of technology also need to address issues such as data security and privacy protection.

6. Conclusions

This article delves into the multiple roles of plants in human life and the design patterns and strategies of human-plant interaction. We believe that considering plants as important interactive objects can create a better living experience for humans. By analyzing existing technologies and market trends, we believe that human-plant interaction design based on smart devices and sensors is feasible and has great potential for development.

The research presented in this article is significant for advancing the development of human-plant interaction design and enhancing the connection between humans and the natural environment. Future research and design should focus on exploring deeper levels of interaction between plants and humans, discovering broader application spaces for plants, and enhancing their value and contributions in daily life. It is hoped that more researchers and designers will join in the exploration of this field, collectively driving its further development.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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