Exploration of the Application of Artificial Intelligence Technology in the Transformation of Old Objects

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Abstract: With the rapid development of technology, artificial intelligence (AI) is increasingly being applied in various fields. In today's context of resource scarcity, pursuit of sustainable development and resource reuse, the transformation of old objects is particularly important. This article analyzes the current status of old object transformation and the opportunities brought by the internet to old objects and delves into the application of artificial intelligence in old object transformation. The focus is on five aspects: intelligent identification and classification, intelligent evaluation and prediction, automation integration, intelligent design and optimization, and integration of 3D printing technology. Finally, the process of "redesigning an old furniture, such as a wooden desk, through AI technology" is described, including the recycling, identification, detection, design, transformation, and final user feedback of the old wooden desk. This illustrates the unlimited potential of the "AI + old object transformation" approach, advocates for people to strengthen green environmental protection, and drives sustainable development.

Keywords: Artificial Intelligence (AI); Old object transformation; Environmental protection

1. Introduction

With the advancement of technology, artificial intelligence (AI) has gradually become a focal point of attention in various industries and integrated into our daily lives. It has not only achieved remarkable application results in fields like smart manufacturing, smart healthcare, and smart education, but also demonstrated its strong potential and value in areas such as artistic creation, bringing more possibilities to artistic expression. Meanwhile, the pursuit of sustainable development and resource reuse has always been a hot topic, attracting widespread attention. In 2021, the National Development and Reform Commission issued the "14th Five-Year Plan for Circular Economy Development," stating that "developing a circular economy is a major strategic direction for China's economic and social development" [1]. The circular economy, with efficient resource utilization and recycling as its core, follows

the principles of reduction, reuse, and recycling. Characterized by low consumption, low emissions, and high efficiency, it is essentially a green, low-carbon, and sustainable economic development model [2]. As an important component of resource recycling, the recycling of second-hand products helps reduce resource waste, lower environmental pollution, and brings new opportunities for economic development [3]. Upcycling, largely sourced from recycled second-hand products, is a crucial part of the circular economy. Both are closely related, aiming to achieve effective resource utilization and promote sustainable development by reducing resource consumption and waste generation. The application of AI technology further facilitates this process, accelerating resource recycling and the green transformation of the economy by optimizing resource management and promoting changes in consumption patterns. In this context, the integration of upcycling, an environmentally friendly and economical concept, with AI technology, opens up new possibilities for our lives.

2. Concept and significance of upcycling

Explaining the meaning of upcycling from an environmental perspective refers to the process of transforming discarded, seemingly valueless items into something new and useful through creative redesign. This not only avoids waste but also realizes the repeated use of resources, conserving them and contributing to environmental protection [4]. This concept carries multiple significances. Firstly, it turns waste into treasure, preventing the earth from crisis due to resource depletion, emphasizing everyone's responsibility for environmental protection and green development. Secondly, it stimulates creativity and imagination. Every discarded item carries a story and the upcycler transforms it into a new artwork or utility item through inspiration. This process tests the creator's hands-on ability and innovative thinking, sparking boundless imagination and enriching life with creativity.

3. Current situation and challenges of upcycling

In modern times, with the rise of environmental awareness, upcycling has gained increasing popularity and shows broad development prospects. However, it also faces a series of challenges.

3.1. Instability of the upcycling supply chain

The raw materials for upcycling rely on the supply of second-hand items, and the instability of this supply chain can affect market operations. The main reasons include the scattered sources of waste items, diverse varieties, difficulties in fine classification, transportation challenges, low recycling value, limited reuse applications, poor market environment, and immature artistic processing of some old items.

3.2. Incomplete recycling system and model

In 2023, China's total recycled volume of ten types of renewable resources, including scrap steel, scrap non-ferrous metals, scrap plastics, waste paper, scrap tires, discarded electrical and electronic products, scrapped motor vehicles, waste textiles, waste glass, and waste batteries, reached approximately 376 million tons, showing an increase of 1.5% compared to 2022 [5]. Despite the rising total recycling volume and the expanding scale of the waste material recycling industry, it faces issues such as the low recycling rate of low value-added renewable resources (such as waste textiles, waste glass, and packaging materials). There is an urgent need to establish a stable and reliable recycling system and model to promote effective resource recycling.

3.3. Low brand recognition

Currently, there are various upcycled products in the market, such as using empty glass bottles to decorate various food items, repurposing idle buckets as planters, and transforming unusable canvas bags into refreshed goodies with paintbrushes and inspiration. However, these are common upcycling practices in daily life, where people recreate the value of an item at low cost through DIY. Most of these activities are spontaneously carried out by individuals during their free time or by art lovers, without establishing brand recognition. Although there are some online platforms dedicated to upcycling, their brand awareness is relatively low, requiring resources for market promotion.

3.4. Reliance on manual labor and low efficiency

Traditional upcycling heavily relies on manual labor and the upcycler must possess craftsmanship and ideas. Transforming an item can be time-consuming and inefficient, and sometimes technical limitations make it difficult to meet the growing market demand. Additionally, handling complex discarded items like old appliances and furniture requires high-level professional knowledge and skills. Therefore, improving the efficiency and quality of upcycling has become an urgent issue to address.

4. Opportunities brought by the Internet to the transformation of old items

(1) Initiate the "Internet + Recycling" model for transforming old items. This model will be beneficial to expanding and optimizing the supply chain for transforming old items, as well as increasing the influence of such transformations, calling on people to pay attention to environmental protection and low-carbon concepts.

(2) Establish an old item recycling and collection system, set up a hierarchical model of "online and offline stores - old item processing factories", and build an efficient collection network for waste items to improve collection efficiency.

(3) Initiate the "Internet + Promotion" model for transforming old items, providing one-stop services. Brand promotion can be done through e-commerce, enhancing publicity efforts and delivering brand messages. Apart from increasing brand awareness, we should also improve the credibility and service quality of the old item transformation brand, track user experience, and promote "trade-in" programs where the "new" refers to valuable new products made from transformed old items.

(4) Initiate the "AI" model for transforming old items to improve efficiency. AI can be used to quickly generate ideas, providing designers with more inspiration and helping them improve work efficiency. AI technology lowers the threshold for creativity, allowing more and more people to experience becoming a "creator". Anyone can easily put their desired old item transformation results on paper, significantly saving on design costs.

5. The application of artificial intelligence in the transformation of old items

AI technology plays a crucial role in the transformation of old items. The application of AI in this field mainly focuses on the following five aspects.

5.1. Intelligent identification and classification

AI technology can be used for the identification and classification of old items. Through image recognition and

machine learning algorithms, different types of old items can be quickly and accurately identified. This helps divert old items from landfills or recycling stations, providing raw materials for subsequent transformations. This reduces reliance on human resources and greatly improves the efficiency and accuracy of old item transformations. For example, JD Ambati, the founder and CEO of EverestLabs, stated in an interview, "Our AI can provide precise data on the shape, size, weight, material, packaging type, commodity value, and even brand information for each recyclable item that flows through the factory".

EverestLabs, a company with an independent industrial 3D vision system, has established a proprietary dataset containing over 5 billion recyclable objects to train its recognition algorithm. Their data and robotics platform, RecycleOS, can classify objects with over 95% accuracy. Additionally, the development of AI has facilitated the implementation of smart recycling machines in multiple cities. These machines can identify four major categories of items: paper, metal, plastic, and fabric, including specific items like newspapers, faucets, drink bottles, and plush toys [6]. After users deposit waste items, the camera inside the recycling machine takes a photo, and an AI risk control model determines if the item meets deposit requirements. The machine quickly weighs and verifies the item. Upon successful verification, users receive corresponding rewards. When the recycling machine is full, built-in sensors send information to the logistics platform via the Internet of Things. The system then automatically allocates transport vehicles and plans the best route to ensure timely clearance.

Furthermore, integrating AI technology into the transformation of old furniture allows for intelligent sorting and classification. Old furniture can be transferred to the "old item processing factory" where AI performs image recognition again, quickly identifying information such as color, material, texture, and style of the old furniture, providing a basis for subsequent transformations.

5.2. Intelligent evaluation and prediction

AI technology can evaluate the value of old items, helping users understand their condition, remaining lifespan, and predict their potential and market value after transformation. This aids people in better selecting and transforming old items to achieve their maximum economic value.

5.3. Automation Integration

During the transformation of old items, sometimes interpolation and combination of old items are required. For complex disassembly and assembly tasks, AI automation technology, such as robotics, can be integrated to assist in completing these complex tasks and improve transformation efficiency.

Additionally, AI can optimize the transformation process through algorithms, reducing labor costs. For example, a certain mobile phone manufacturer announced its first smart recycling robots for mobile phones, named "Taz" and "Dave". These robots are primarily used for dismantling and recycling metal materials from mobile phones, such as copper from the mainboard, aluminum and titanium from the back cover, gold from the camera, and rare earth elements from acoustic components.

The Australian furniture brand Eva transformed 16,000 discarded mobile phone cases into a sofa, which was displayed at CASETiFY STUDiO in Sydney's CBD. Combining innovation and environmental protection, Re/CASETiFY™ poured contemporary creativity into the sofa design named Re/Treat, hoping to provide a space to relax the mind and emotions before continuing the journey towards sustainable development. Chengdu artist Liwei Yang loves to transform ordinary daily items into impressive artworks. He used 2,200 discarded mobile phone cases to create a colorful parasol, evoking childhood memories and continuing the second life of

Re/CASETiFY™ products.

5.4. Intelligent design and optimization

Artificial intelligence art can create excellent artworks by learning from existing data and artistic paradigms [7]. AI technology can provide intelligent design suggestions and optimization solutions for the transformation of old items based on user needs and preferences within artistic paradigms. This not only improves the transformation effect but also saves creation time and cost, providing creators with ideas. For example, in clothing transformation, AI can intelligently recommend suitable transformation plans based on the user's body shape, preferences, and temperament. For instance, for an outdated shirt, AI can analyze its color, pattern, and cutting, and propose new design concepts, such as adding fashionable decorative accessories, changing the collar, cuffs, and length variations, to give the old clothing a new look.

5.5. AI + 3D printing + transformation of old items

AI can quickly analyze design drawings, optimize production processes, and even perform real-time monitoring and adjustments during production. 3D printing, on the other hand, can rapidly turn AI-optimized designs into physical objects. From personalization, multifunctionality, and sustainability to cost reduction, 3D printing has already proven to be a great helper for artists in the creative world. Combining AI with 3D printing to give new life to old items is also an exploration of creativity [8].

For example, in November 2023, the Japanese design group Honoka exhibited an innovative 3D-printed furniture series at the Designart Tokyo exhibition. Named the "Tatami Transformation Project", the series uses a unique material made from a mixture of straw from discarded tatami mats and biodegradable resin. Manufactured using the ExtraBold large-scale 3D printer, the furniture incorporates elements of traditional Japanese craftsmanship, such as weaving, lattice, or knitting effects. The products include lampshades, lighting fixtures, tables, stools, etc., in a variety of colors, with a translucent characteristic that gives them a unique texture.

6. Case study analysis

Taking a typical case of transforming an old item, such as a wooden desk, through AI technology to redesign it in a way that meets both modern aesthetic and practical needs. The transformation process of this case includes recycling, identification, detection, design, transformation, and finally, user feedback.

6.1. Recycling phase of old wooden bookshelf

Wood can be sorted and recycled through scrap stations or smart recycling machines.

6.2. Old item detection phase

The AI model first performs a deep detection on the "old item - wooden desk". This includes detection of various aspects such as color, material analysis, structural analysis, and the extent of external damage. Through machine vision and deep learning technology, AI accurately evaluates the condition of the old item and generates a data report to provide data support for subsequent transformation designs.

6.3. Design phase

Based on artistic paradigm standards, AI design software automatically generates multiple transformation plans

according to the detection results of the "old item - wooden bookshelf," combining modern aesthetics and practical needs. These plans include not only exterior design but also structural optimization and functional enhancements for customers to choose from, with the customer selecting a final optimized plan.

6.4. Manufacturing phase

In the manufacturing process, the AI model combines 3D printing and robotic manufacturing technology to implement the design plan. Through a precise manufacturing process, it ensures that the transformed item meets the design requirements and has high durability, achieving the ideal effect for the customer.

6.5. Evaluation phase

The evaluation of the AI model in the case of transforming old items mainly focuses on the following aspects:

(1) Accuracy evaluation: By comparing the AI model's design plan with manually designed plans and the actual effect of the final product, the accuracy of the AI model in detecting and designing old items can be evaluated. If the design plan and final product are highly consistent with the expected goals, it indicates high accuracy of the AI model.

(2) Efficiency evaluation: The application of the AI model can greatly improve the efficiency of transforming old items. Through automated design, automated manufacturing, and other processes, it reduces manual operation steps and time costs. Therefore, efficiency is one of the important indicators for evaluating the application of AI models in transforming old items.

(3) User feedback evaluation: The success of the final product also needs to consider user feedback. By collecting user feedback on the product, the advantages, disadvantages, and improvement directions of the product can be understood. If users are highly satisfied with the product, it indicates that the application of the AI model is successful.

(4) Environmental protection evaluation: Applying AI technology in transforming old items can not only improve resource utilization but also reduce waste generation. Therefore, environmental protection is also an important indicator for evaluating AI model applications. By comparing and analyzing resource consumption and waste generation before and after the transformation, the contribution of the AI model to environmental protection can be evaluated.

7. Conclusion and Future Prospects

The application of AI in transforming old items brings new possibilities and convenience to our lives. AI technology not only more efficiently identifies, evaluates, designs, and transforms old items, achieving their maximum economic and environmental value, but also integrates artistic creation with technology. In the future, it is hoped that the application of AI technology in the field of transforming old items will be more widespread and in-depth, realizing the intelligent and efficient transformation of old items. Let creativity change lives, and with the concept of sustainable development deeply rooted in people's hearts, transforming old items will become a more common way of life. It can penetrate smart cities, smart communities, revitalize villages, and contribute to saving resources and protecting the ecological environment for the earth.

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