

# Home Intelligent Waste Recycling Product Design

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## Abstract

In the context of the widespread attention of garbage classification, the collection and treatment of household garbage has always been a headache. The research object of this project is young office workers. From the perspective of service design concept, it integrates the user pain points and user needs in the family intelligent household garbage classification and recycling service system by constructing the service scenario and service flow chart. Under the guidance of service design theory, it studies and analyzes the user portrait, user journey map and service blueprint. Combine tangible products with intangible services, and the "user-centered" service idea is applied to the garbage recycling system, and finally design the design of intelligent garbage recycling products classified from the source of garbage generation and the online design scheme.

**Keywords:** smart home, garbage recycling, garbage sorting

## 1. Introduction

### 1.1 Background

At present, at least two-thirds of the cities in China are facing the dilemma of being surrounded by garbage, which seriously affects the residents' quality of life and environmental hygiene. Garbage is the discarded items generated by people in production and life that have lost their use value. In densely populated cities, the collection and disposal of household waste has always been a headache. Although the traditional centralized landfill and incineration methods have solved the problem of garbage disposal to a certain extent, they have also caused serious pollution to the environment. Promoting the popularization of waste separation and resource recovery, changing traditional disposal methods, turning waste into treasure and realizing the resourceful use of waste are important tasks facing society today. In the work of garbage classification, from the source of garbage classification to the final process of garbage disposal, household users are often unable to effectively participate in garbage classification. This project improves the user experience in the process of waste classification and recycling in terms of service system design, and combines online service experience with offline products.

In the process of promoting waste separation, the design of waste recycling products based on service design can enhance people's initiative of waste separation. Improving product design and user service experience can motivate people to actively participate in waste separation and recycling. The application of household intelligent recycling products in waste classification reduces the difficulty and complexity, improves the efficiency and accuracy of classification, and effectively improves the awareness and implementation of waste classification. Combining user experience and technological innovation, it promotes waste classification as a convenient, fun and beneficial way of life, saves land resources, reduces pollution, and shapes environmental awareness to promote social concern and sustainable development. Therefore, it is of positive theoretical significance and practical value to study the application of household intelligent recycling and innovative design thinking in waste classification and disposal.

### 1.2 Research Content and Methodology

This research starts from the plight of household garbage classification and recycling, researches and analyzes the existing garbage recycling products, and designs the household intelligent classification and recycling garbage can design with 1-2 person family as the use scenario, young office workers as the target group, and source part of the classification process. Through the research to understand the way, habits, attitudes of users in garbage classification, as well as their process in the process of garbage classification, to make and get the pain points and opportunity points existing in the process of garbage classification; to draw the user experience journey map, and to derive the user needs. Understand user expectations of services in the waste sorting system and establish service processes. Satisfy these needs by improving product functionality and provide direction for the design of smart

recycling products for home use. The research methods used in this paper are observation method, literature research method, user experience journey, stakeholder analysis, and service blueprint.

## **2. Design Analysis Studies**

### *2.1 User Needs Analysis*

Through the research and analysis of the behavioral characteristics of the users in the garbage recycling, to determine the target users and characteristics of the analysis, to determine the 1-2 person family with the ability to consume the young office workers as the target user population, the young office workers have strong consumption ability, and produce more garbage, the acceptance of intelligent products is higher, this paper focuses on the generation of meal waste, courier cartons, plastic bottles, and other recyclable garbage and difficult to handle Battery waste cosmetic bottles and other garbage for the user model classification habits research, so as to build a user portrait.

Combined with the actual scene when young groups use the garbage can, the four phases of garbage throwing behavior are split, which are the phases of garbage generation, garbage classification in progress, garbage recycling completion, and garbage putting, forming a user journey map. Then the user needs, user emotions, user pain points and opportunity points involved in the whole recycling garbage stage of young office workers were analyzed. In the garbage generation stage, users may have problems such as not being able to classify the garbage at the first time, and the opportunity point is that it can guide users to change their lifestyles to reduce the generation of garbage; in the garbage classification stage, users may have problems such as troublesome classification work and inaccurate classification results, so as to discover the opportunity points such as intelligent garbage classification and recycling and opening of garbage cans, etc.; in the garbage recycling completion stage, users may have the following problems At the stage of garbage collection, users may have problems such as not having enough sorting bins, not having differentiated garbage bags, etc. The opportunity lies in the design of multi-sorting modules. To sum up, when analyzing the design of household garbage cans for young office workers, as shown in Table 2.1, we should start from specific pain points such as the morning commute time is too tight to throw garbage in time, lack of knowledge of garbage classification, etc., and analyze the opportunity points specifically for the pain points in order to satisfy the needs of the target users.

### *2.2 Household Waste Recycling Product Study*

Existing intelligent sensor trash can, most of the use of high-precision optical sensors, based on the height of the trash can barrel on the user's action capture, open the lid action to facilitate the user to throw the garbage; the biggest feature of the existing products can be realized automatically change the bag, the user does not need to contact the garbage directly.

Young office workers use smart garbage cans to pay more attention to its ease of use, functionality and appearance design. The demand for ease of use mainly includes the provision of a convenient way to dispose of garbage; the demand for functionality is analyzed to include intelligent identification of garbage types; and the demand for appearance is mostly simple and beautiful. Through the comparison and analysis of user needs and existing products to find out the direction of improvement, the existing intelligent garbage cans on the market achieve intelligent throwing, but for the target users need to be designed from the classification of intelligent, instant classification functions.

### *2.3 Research on the Environment of Use*

There are multiple scenario areas in the home where different waste collection categories need to be considered. In the kitchen area, consideration needs to be given to the ability of young workers to quickly and easily sort and dispose of waste during cooking and food preparation. In the living room/living room area for rest and recreation, people need to easily dispose of their trash while watching TV, playing games, or gathering with friends. Similarly, intimate areas such as bedrooms or offices often require the disposal of paper, packaging materials and other small trash.

Bathroom areas are mainly used for discarding paper towels, makeup wipes and other bathroom waste to ensure a neat and sanitary bathroom environment. At the entrance of the home or in the hallway area, people usually need to dispose of mail, delivery packaging and other trash entering the home. By analyzing multiple scenario areas in the home and sorting and processing waste according to recycling categories, it can meet the waste management needs of young workers in different scenarios, while improving the tidiness and hygiene of the home environment.

### 3. Service Process Analysis

Through the preliminary research and analysis, we establish the target users as young office workers, and present the stakeholders in the smart recycling bin service system in a visual way, divided into key users, internal and external stakeholders, with young office workers as the core service object, and the stakeholders as APP users, managers, operators, supervisors, partners, manufacturers, etc., and the external layer as the government and the environmental protection organization, etc. The government has prestige and appeal, while the environmental protection organization can realize the social function value as the regulator. The outer layer is the government and environmental protection organizations, etc. The government has the prestige and appeal while the environmental protection organizations can realize the value of social functions as regulators.

After analyzing the stakeholder relationship, the service system mainly provides garbage recycling service for target users by combining offline product entities and online software APP, and through the combination of product equipment and APP, it can realize the functions of garbage recycling classification, garbage can monitoring, and rewarding for recycling and putting in garbage cans. The mobile terminal provides intelligent management of garbage cans through information flow and user flow, as well as behavioral data record feedback and points exchange, online shopping mall shopping, user socialization and other services, while the backend management terminal mainly analyzes users' recycling information and information feedback through information flow.

Through the analysis of the various processes in the household intelligent recycling bin service system, it visually demonstrates the foreground and background functions of the customer visibility line during the whole user experience process. The analysis of the entire garbage classification process stages and behavioral disassembly, can be derived from the service focus on the target population and offline intelligent garbage can equipment, online APP, in-depth analysis of the foreground technology and background behavior of household garbage classification and recycling system. The core of the whole service focuses on how the target user group can complete the household garbage classification and recycling behavior through the offline smart garbage can hardware equipment and the online APP software platform, and its successful operation highly relies on the close synergy between the front-end interaction technology and the back-end support behavior. The core of the household smart recycling product service system is that users can complete garbage sorting through the offline smart bucket and online APP, and its smooth experience relies on the clear division of labor between the front and backstage. The frontend (visible to users) interacts directly with users: before sorting, the APP displays the status of the bin; during sorting, the screen on the bin recognizes the type of garbage in real time and guides the user to put it in, which is intuitive for the user to operate; after sorting, the APP provides the recycling records, points rewards, redemption malls and community activities. The backstage (invisible to users) provides strong support: before sorting, it monitors the status of the bucket, manages user accounts.

### 4. Design Development

#### 4.1 Design Positioning

The following aspects need to be considered when designing and analyzing home scenes for young office workers as target users. Young office workers usually have a tight schedule, and the design positioning should focus on the convenience of the product so that it can be easily integrated into their lifestyles. Garbage disposal should be simple and quick, easy to operate, and not take up too much time and energy. Target users are more familiar and receptive to technological products. Intelligent technologies can be integrated into the garbage cans, such as sensor recognition and automatic sorting, to provide an intelligent waste management experience.

Based on the needs analysis and service system construction targeting typical users, different design options are analyzed to finalize the solution. A household intelligent sorting and recycling bin is designed to focus on solving the source problem of garbage sorting. By combining users' needs for function, form and color, it helps users recycle waste at the source by optimizing the service design in order to reduce the pressure of waste disposal at the end. The design of the product includes two parts: the physical household smart recycling bin and the mobile application. For the design of the physical product, it covers functional design, appearance form, basic structure, human-machine dimension and color material analysis. The design of the mobile application includes information architecture and interface design.

#### 4.2 Offline Product Design for Household Intelligent Recycling

By adopting a modularized design, it is divided into three large modules and one small module. Each module can be used individually to accommodate a recycling category, and the corresponding module is automatically used according to the category of garbage, thus realizing the convenience and flexibility of garbage sorting as well as the fine management of garbage sorting at source. It is able to automatically identify and categorize the garbage

items to be put into the garbage without the need for users to manually sort them. Realized through sensor technology and intelligent algorithms. Uses image sensors, weight sensors, and infrared sensors to detect garbage features such as appearance, weight, and infrared reflection. After comparing with the pre-stored garbage classification data, the garbage category is automatically recognized. According to the garbage category, it is put into the corresponding storage area, such as recyclables, wet garbage and hazardous garbage.

Real-time monitoring and management of garbage cans is achieved through various sensors and smart technologies to improve the accuracy and efficiency of waste separation and recycling. Smart garbage cans can be equipped with capacity sensors to monitor the filling of the garbage cans in real time. By accurately grasping the capacity of the garbage cans, garbage collection and disposal can be carried out in a timely manner, avoiding overflow or overfilling of garbage. With the help of image recognition, object recognition and other technologies, smart trash cans can accurately recognize the type and classification of garbage. Users do not need to manually sort the garbage, improving the accuracy and convenience of garbage sorting. It can record and monitor the placement tracking and classification of garbage, and transmit the data to the backend system for analysis. By analyzing and feeding back this data, users can understand the trend of waste generation, the effectiveness of classification and the results of recycling. It can be connected to the Internet for remote management and control. Users can monitor the garbage cans, set parameters, and remotely control the opening and closing of the garbage cans through cell phone applications or cloud platforms to realize remote operation and management of the garbage cans.

#### 4.3 Household Smart Recycling Online Product Design

The design concept of APP shows the vitality of nature's colors and conveys an environmentally friendly, low-carbon, recycling and sustainable living concept. At the same time with the auxiliary colors of blue and green in line with the concept of green recycling design, the interface prototype is designed using the iPhone model as a carrier, the design meets the trend of young office workers and environmental protection and recycling of the APP interface. The user opens the APP and triggers the interactive behavior. Firstly, they need to log in or register, and enter the homepage after logging in; the homepage includes a guide to garbage classification, a garbage recycling calendar, a map search area, and a product recommendation area, which exist independently and are easy for users to recognize. The solar powered feature converts sunlight into electricity through a solar panel mounted on the trash can and stores it for use in the trash can. The bin is equipped with a built-in battery or battery pack to store the converted electricity and provide power. The advantages of solar power are that it is a renewable energy source that reduces dependence on traditional energy sources, and that it can be used in unpowered environments, which increases applicability and flexibility and reduces operating costs.

The navigation bar at the bottom of the homepage is distributed with the function icons of the five modules. Among them, the center of the navigation bar is the points account module, which is also a special feature for recording garbage collection. The user connects to the account through the smart trash can home system, and after confirming the connection, it records the type of garbage and begins to collect information on recycling delivery behavior. After the user completes the door-to-door recycling or community delivery, the background automatically calculates the recycling category and weight and converts the points to the personal account, and the APP interface displays the recycling information and the points obtained. Users can exchange the points for prizes or art and environmental protection activity services through the mall section to promote environmental protection and waste recycling behavior.

#### 5. Conclusion

This paper designs a household intelligent recycling trash can construction service system. Firstly, the process of garbage classification and recycling is decomposed, and the behavioral journey of young office workers is sorted out. Finally, the design ideas and directions of household intelligent garbage recycling products are proposed based on the principle of improving user experience, with the goal of realizing the classification and recycling of garbage and alleviating the pressure on the end, and subconsciously guiding the users to take the classification and recycling of garbage as a habit. From the perspective of design, the recycling of household garbage is integrated into the product system, and the combination of "online + offline" mode improves the user's participation in garbage recycling.

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