Research on Resident Garbage Sorting and Recycling System Based on Green Environmental Protection Technology

ChuanDong Yu¹*, Nan Du²
¹YanTai Vocational College, ShanDong YanTai 264000, China
²DONG-EUI University, ShenYang 110031, China
*Corresponding author e-mail: Chuandong_163@163.com

Abstract. Separate collection of garbage is an important means of reducing, harmless and recycling urban household garbage, and is of great significance to the growing garbage threat. The current urban garbage collection work is gradually carried out, but the actual results of the corresponding classification collection work are not obvious. This article studies the classification and collection mode of residential area based on the concept of environmental protection priority, and hopes to provide a reference for the study of garbage collection mode.

1. Introduction
The level of garbage classification and management represents the degree of urban development and is an important factor to promote the sustainable development of cities. Whether a city is developed depends on the level of garbage treatment to a certain extent. As China's urbanization process continues to accelerate, the urban population has risen sharply, and urban domestic waste has also increased year by year, which has placed an increasing burden on urban waste disposal. As a gathering place for China's social and economic development and residents' lives, the city's sustainable development needs the support of residents' garbage classification. According to statistics, the amount of waste generated by residents in China is increasing at a rate of 8% to 9% each year. The substantial increase in the amount of waste generated has caused many cities to face the dilemma of waste siege. The concept of environmental protection priority the classification of garbage collection in residential areas adheres to the principle of putting people first and regards environmental protection as an important support for social and economic development. When conflicts occur with economic development, environmental protection priority is realized, thereby achieving the sustainability of economic development and environmental protection. The author believes that implementing the logistics management model of urban domestic waste and supervising the recovery, transportation and disposal of waste is one of the effective countermeasures to solve the "bottleneck" problem of waste classification.

2. Functional positioning of urban garbage collection system
The Internet of Things is an object-to-thing connected network formed by combining various information sensing devices, such as radio frequency identification devices, ZigBee terminals, infrared sensors, global positioning systems, laser scanners, and the Internet, to achieve Object identification, location, tracking and monitoring. At present, China's Internet of Things technology is maturing, and it has been explored and applied in environmental monitoring, logistics and warehousing, and smart homes.
Because the Internet of Things technology has the characteristics of effectiveness and dynamics, it is very suitable for the dynamic process of urban waste recycling management. It can strengthen the collection, analysis and prediction of relevant information, and use information to carry out dynamic evaluation and monitoring. From artificial and passive management to technology, Active management transformation has completely changed the passive situation in which urban domestic waste management and recycling lag behind social needs [1].

The urban waste sorting and recycling system based on the Internet of Things, based on radio frequency identification technology, uses ZigBee module to realize wireless communication of data, make full use of other related technologies of the Internet of Things, integrate advanced hardware equipment and perfect software system. Its functions are: 1. Realize the dynamic tracking and monitoring of the whole process of garbage from the source to the disposal terminal; 2. Realize the collection, analysis and accumulation of information and data; 3. Realize the intelligent deployment of garbage removal vehicles.

3. Waste separation and recycling system based on Internet of Things
The Internet of Things is based on the wireless sensor network (WSN) and radio frequency identification technology (RFID). It is a physical interconnection network based on the computer Internet. Its purpose is to achieve real-time sharing and intercommunication of global item information. The garbage classification and recycling system based on the Internet of Things is an information system that uses the Internet of Things technology to realize identity recognition, information collection, and aims at the classification and recycling of garbage in the residential area and supervision and management. Identify the resident ID card through the bag picking machine and record the number of bag picking. Perform user identification on the intelligent sorting trash can, record the type and weight of the thrown trash, and transmit the data to the data centre in real time. The cleaning and recycling staff will perform garbage collection according to the optimized cleaning route of the data centre. The data centre analyses the classification of users based on the collected user information and related garbage data. The structure of an intelligent waste sorting and recycling system based on the Internet of Things is shown in Figure 1. It is mainly composed of classification support module, classification processing module, clearance module, data centre and other parts.

![Figure 1. Structure diagram of garbage classification and recycling system based on Internet of Things](image-url)

As can be seen from Figure 1, the system has the following characteristics. (1) Recycling objects are garbage classified by residents, which are roughly divided into three categories: recyclable garbage, kitchen waste, and non-recyclable garbage. Different types of garbage have different treatment methods. (2) Residents in the main body of recycling are responsible for sorting the garbage at the source, the
recycling bank is responsible for all garbage recycling, stores provide the exchange of goods, and the government provides support. (3) In the recycling process, residents classify garbage, and different types of garbage recycling vehicles are used for classification and recycling. The garbage trucks are operated by the government cleaning team and are divided into resource recycling vehicles, food waste recycling vehicles, and general garbage trucks. Garbage collection trucks send garbage to different garbage disposal companies. (4) Recovery of power is through market encouragement and government guidance. The government’s mandatory and punitive measures have forced residents to classify waste; recycling companies receive subsidies for recycling funds; the driving force for production companies to reduce the amount comes from the extended producer responsibility system and subsidies; the government can reduce the burden of waste disposal systems and cost [2].

3.1. Terminal design
The dry / wet garbage collection box, regional dry / wet garbage centralized collection station, dry / wet garbage transportation station, dry / wet garbage transportation vehicle and dry / wet garbage disposal plant involved in the above dry / wet garbage disposal monitoring system are used as the whole. The subordinate terminals of the waste sorting and recycling IoT management system should be embedded in the corresponding IoT equipment to realize the information interaction between each terminal and the terminal and the central control centre. The electronic label of the recycling bin is set on the dry / wet garbage recycling bin to record the specifications, location or relevant information of the community owner of the recycling bin, and record the pouring time and the volume or weight of the garbage when the garbage is poured. Sensors, electronic tag readers, wireless data communication modules and regional processing modules are installed in the regional garbage centralized recycling station. Among them, the electronic tag reader is connected with the electronic tags of the recycling bins on each garbage collection bin through radio frequency wirelessly, and is used to read the information recorded in the electronic tags of the recycling bins. Send back to the central processing module. The sensor uses an inventory monitoring sensor to detect the amount of garbage collected in the recycling bin in real time and determine whether the recycling bin is full. If it is, the sensor sends out audio or video signals and activates the wireless data communication module to send the full signal to the garbage. The central processing module is shown in Figure 2.

Figure 2. Functional structure diagram of classification processing module

3.2. Flowchart of garbage collection
(1) Recycling objects are all urban waste, and old objects need to be digested in the second-hand market before entering the garbage comparison and classification recycling network to improve recycling efficiency.
(2) Residents in the recycling body are responsible for sorting garbage at the source, the recycling bank is responsible for all garbage recycling, stores are responsible for providing commodity exchange, and the government provides guidance support.

(3) In the recycling process, residents can recycle garbage after sorting it, and the recycling bank collects it in a centralized manner and processes it by renewable resource enterprises. Non-recyclable garbage enters the garbage disposal system and is handled by the recycling bank.

(4) Recycling power is centred on market incentives, supplemented by government guidance. Residents get economic incentives, businesses get more consumers and improve their corporate image, the government reduces the burden of garbage disposal and obtains corresponding taxes, and recycling banks receive revenue and government subsidies through waste recycling. Figure 3 shows the recycling process.

![Garbage Collection Network Diagram](image)

Figure 3. Garbage collection network diagram

4. Research on garbage classification and recovery algorithm

The impact of various education, supervision and incentive measures on the classification results of household waste reduction can be attributed to social factors, individual factors, internal factors and natural factors, and then the social factors and individual factors can be subdivided into For the subcategory, the weights are respectively calculated by the analytic hierarchy process, and then revised. Finally, the quality of the waste reduction classification in the two communities of Garden and Sunshine Garden is evaluated, and the functional relationship between the waste output and each factor is further obtained: $Y = b^*X(i)$. And establish a mathematical model that can adjust related parameters [3].

Applying the idea of AHP and constructing a paired comparison matrix $A$ of the three factors of education, supervision and motivation among social factors based on relevant literature data:

$$A = \begin{bmatrix} 1 & 1/5 & 1/9 \\ 5 & 1 & 9 \\ 9 & 1/9 & 1 \end{bmatrix}$$  \hspace{1cm} (1)$$

The maximum characteristic root $\lambda$ of the matrix $A$ is 3.0254 by using the "single value solving method" in excel. In order to perform the consistency test of the judgment matrix, the consistency index needs to be calculated:
Find the corresponding average random consistency index $RI$, when $n = 3$, $RI = 0.58$. There is an equation $Y = b^* X(j)$ where $(j = 1, 2, 3, 4)$, so the model established is

$$Y = 0.5254^* X_1 + 1.0508^* X_2 + 2.6268^* X_3 + 1.5763^* X_4$$

Through the analysis of the model built, various educations play a leading role in the reduction of waste classification; among personal factors, the type of household registration has a great influence.

5. Recommendations for garbage classification

5.1. Strengthen the planning and construction of supporting facilities for sorting and recycling of municipal solid waste

From the research results, it can be seen that "environmental facilities and services" have the largest comprehensive impact on residents' behavior, and the convenience of sorting and recycling facilities is a key factor affecting residents' domestic garbage disposal behavior. However, the construction of the back-end sorting collection and transportation system in most cities in China is lagging behind; the existing construction plans only stipulate in principle the construction of the garbage sorting collection and transportation system. Inadequate back-end classification collection and transportation facilities and low efficiency will seriously affect the enthusiasm of front-end classification of residents. Therefore, it is recommended that cities in China include clear domestic waste classification and recycling facilities and system planning in the planning and construction, and speed up the establishment of a complete domestic waste classification and treatment system of "classified release, classified collection, classified transportation, and classified treatment". At the same time, the construction of renewable resource recycling sites and standardized resource recycling systems should be accelerated to improve the convenience of recycling facilities or services.

5.2. Carry out extensive publicity and education related to household waste sorting and recycling through various channels

Studies have shown that public propaganda and education are the most significant factors influencing residents' household garbage disposal behavior. The more publicity and education channels and frequency of garbage classification and waste recycling that residents are exposed to, the greater their participation in household garbage classification and waste recycling high. Therefore, it is recommended that the government and other management departments strengthen the publicity and education related to household waste classification and waste recycling through media, school education, advertising and other publicity and education channels, and make full use of television, billboards, mobile client, mobile Internet and other media. Promote the knowledge and information of domestic waste classification and waste recycling, promote green and civilized living habits, through the training of units, schools, and communities to increase residents' awareness of environmental protection and willingness to participate, and enhance residents' knowledge level of classification and recycling knowledge.

5.3. Improve the legal system and establish a long-term incentive and restraint mechanism

Clear management laws for waste classification are the prerequisite for successful waste classification. Based on the successful experience of waste classification management in Japan, a sound legal system is the guarantee for the successful realization of waste classification. Therefore, we can learn from the experience of Japan, constantly improve and perfect the legal system of garbage classification management, clarify the responsibilities of various departments, and strengthen law enforcement. Implemented detailed rules for garbage classification management, and made clear provisions on how
and when to throw similar specific garbage classification behaviours, and guide residents to regulate garbage classification behaviours in accordance with laws and regulations. At the same time, establish a long-term incentive and restraint mechanism, use incentives to brake the public to participate in waste classification management; make corresponding penalties for violations and violations, and accelerate the formation of a waste classification system based on the legal system, promoted by the government, and participated by all people [4].

6. Conclusion
Separate collection and transportation of garbage is a long-term and arduous task, which not only involves the improvement and implementation of policies and management, but also requires advanced equipment to support [2]. The residential waste sorting and recycling system based on the Internet of Things technology makes use of the advantages of the Internet of Things technology in the collection, transmission and processing of information, and applies it to the process of waste classification and waste recycling, which can effectively help solve the difficulty of waste classification and optimize vehicles scheduling and other issues. Fundamentally control the overall amount of garbage, reduce the pressure of urban garbage disposal, and can better meet the needs of garbage disposal under the development of modern information technology.

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