

Research Article

A Waste Recycling Method Based on the Life Cycle Analysis of Products

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Life Cycle Assessment (LCA) is a method for quantifying the effects of different actions to make evaluations and decisions easier. There are various product waste management solutions, but determining which one is best in terms of environmental effects can be difficult. In this regard, recycling is frequently regarded as environmentally beneficial, as it involves the gathering and processing of waste into new products. Inspired by the necessity of recycling, this study proposes a waste recycling system based on product life cycle evaluation to increase the use rate of waste products. The suggested system built the product life cycle workflow using Electronic Product Cycle (EPC) to make the product's complete life cycle scalable and unified. In addition, the proposed system uses a big data normalization approach to preprocess product life cycle data and extract the total weight of product life cycle assessment indicators. Furthermore, the suggested method seeks to demonstrate the usefulness of LCA as a waste recycling tool during the construction of a waste management framework and to identify a gap in research by designing a better framework. The simulation results show that compared with the designed PLA-based waste recycling system, the system has higher reliability, lower LCA complexity, less impact on throughput, and lower cost, meeting the economics of waste disposal requirements.

1. Introduction

Currently, the life cycle assessment (LCA) approach is utilized to examine the environmental impacts of operations. It is a technique for assessing all environmental exchanges that occur during the life cycle of an activity, such as resources, energy, emissions, and waste. The methodologies for doing a proper LCA have been established and standardized in the most recent ISO 14040 standards. It may be used to evaluate a variety of options and integrated into a wider decision-making process that takes into account the environmental consequences of a choice. It is also frequently used to assess the environmental effect of various waste management methods. Currently, environmental protection has become a big problem in the world. The global climate change and environmental pollution and the consequent destruction of the global ecological system will make the survival and development of mankind face a great test. Unreasonable garbage recycling will be a severe hazard to the

social environment. The non-scientific, unjustifiable recycling, handling of electronic trash, and environmental damage are particularly severe [1]. There are a large number of toxic and harmful components in electronic waste. Refrigerants and foaming agents in waste refrigerators, for example, harm the natural environment. Waste displays of televisions and computers not only contain mercury, lead, and other highly toxic and harmful substances, but also kinescope will easily cause an explosion after aging [2]. Many components of computers contain mercury, cadmium, arsenic, and other substances that are extremely harmful to human health. If these discarded household appliances and electronic wastes are not disposed of appropriately, they would substantially harm the social environment, even entering the world's ecological food chain and endangering people's health. The low-carbon economy is an important theoretical tool for coping with the current problems of resource depletion and environmental degradation, and the implementation of enterprise waste trading

and the formation of waste exchange networks are important steps to promote a low-carbon economy. This measure can not only improve the utilization rate of resources but also bring about a double increase in economic and environmental benefits for traders [3]. Waste transactions can provide new profit development areas for businesses as well as cost reductions for company usage [4].

There have been some good research results in the literature review of the problems related to waste recycling. Many scholars focussed on the existing problems in the production process of e-waste disposal and recycling. Some of them proposed e-waste disposal and recycling security monitoring system based on the Internet of things. They introduced and designed the wireless sensor network and RFID technology involved in the monitoring system. In [5], the authors proposed electronic waste disposal and recycling safety monitoring system. Their proposed system can monitor and manage the whole process of waste. In addition, it provides technical support for the daily supervision and fund subsidy audit of environmental protection departments at all levels. According to the study [6], the accuracy of electronic product recovery prediction has a direct impact on business operation costs and service levels. Among the single prediction models, GM (1, 1) model has the characteristics of adapting to the prediction of a few samples and has a good approximation effect on the recent data, but it is sensitive to the trend of the sequence. The FTS model can deal with the noise caused by fuzziness in uncertain data, but the grasp of sequence trend is lagging. They combined the prediction model, GM (1, 1) model, and the FTS model to improve the accuracy and reliability of electronic product recycling prediction by using the advantages of the two models. The research predicts according to the real recovery data of enterprises. The experimental results show that the combined prediction method has a better prediction effect than the single prediction method. On this basis, the study puts forward FTS. The prototype of the recycling prediction system based on the GM (1, 1) combination model and supplemented by other prediction models provides suggestions for enterprises to select appropriate prediction models in practice.

However, the waste recycling methods proposed in the above literature have some problems in practical application, such as poor reliability and the high cost of waste recycling. Therefore, this paper designs a waste recycling system based on product life cycle assessment. In this work, we examine the potential LCA that may be integrated with economic value to estimate the environmental and social consequences of product recycling. Transportation, road vehicle accidents, and traffic congestion are some of the societal issues covered. We have conducted a research report on a program in China with a population of around a million inhabitants. During our experimental work, we have combined two waste management approaches. Our manufacturing system includes the collecting, sorting, and distribution of recyclable materials and the disposal of domestic waste to landfills, and subsequent usage of primary resources. The primary materials are substances that are employed for the first time in a manufacturing process. Secondary materials, on the other

hand, were recovered from trash after being used in a similar or different production system. The main contribution of this paper following:

- (i) Firstly, a waste recycling system based on product life cycle evaluation will be proposed in order to increase the use rate of waste products. The EPC-based product life cycle workflow is designed to make the entire product life cycle scalable and unified, with the overall information of the product represented.
- (ii) Secondly, the APLC21160 logic processor chip is proposed as the fuzzy control's digital processing chip, the DS18B20 as the system's peripheral device, and the 32-bit embedded design approach as the system's output stability.
- (iii) Thirdly, utilizing the assemblability, maintainability, and cost estimation models of the product life cycle model, which can fully describe the performance indicators related to the evaluation and product life cycle.
- (iv) Fourthly, use the ISA/EISA framework mode to design the automatic control module and combine it with the cross-compilation control method to create a reliable design for the waste information security management system.
- (v) Finally, the intelligent waste information security management module is built with Revit software and a SQL server database as the data management engine. The waste information security management system is powered by the Internet of Things, and a waste information security management system based on the B/S framework is constructed.

The rest of this paper is organized logical way: Section 2 shows the related work, Section 3 shows a design of a waste recycling system based on product life cycle assessment, Section 4 shows the overall function design of the waste information security management system, Section 5 shows the feature extraction and scheduling of waste information, and Section 6 shows the experimental design and analysis. Finally, in Section 7, the research work is concluded.

2. Related Work

This study evaluates the different environmental impacts of a recycling system by integrating the kerbside. It is a collection of recyclable items, using the lifecycle assessment approach. Manufacturers with a waste disposal system that includes waste landfill disposal and the usage of primary raw materials in production are then used. After that, the process is developed to include an environmental cost-benefit analysis. The phrase "Lifecycle Assessment" refers to a combination of lifecycle and economic evaluation. From the acquisition of raw materials to production and usage to final disposal, a product's environmental impacts are assessed and analyzed throughout its lifecycle [7]. The assessment described and validated a reliable tool in the field for considering multiple coherent situations of waste management politics based on objective data. This allows for the tool's expansion to include different collection schemes as well as different packaging

recycling systems. As a direct result of the current study's success, the joint-research program with CONAI has been extended for another three years. The concentrate will be on the Italian system for recycling paper and paper products, as well as all plastic packaging [8]. The study focuses on the complete Italian home plastic packaging waste recycling system. The purpose was to evaluate the total environmental efficiency of mechanical recycling of plastic containers in Italy compared to landfilling, incineration, and a few innovative raw material recycling technologies including reduced fluidized bed combustion and high-pressure hydrogenation. The data reveal that recycling scenarios always outweigh non-recycling ones. They also highlighted the beneficial environmental impact of innovative plastic waste management methods that incorporate both raw material and mechanical recycling [9]. This paper has presented a wide review of product life cycle assessment (LCA) and sustainable product packaging during the last three to five years. The life cycle assessment review gives an overview of LCAs completed for a wide range of goods during the previous six to seven years. The results of a five-year national Japanese LCA project are described, as well as the application of the LCA approach to the creation of regulatory and public policies, particularly in the United States and the Netherlands. The main challenges and limits of LCA, particularly the function of weighing considerations, are outlined. Uneven handling of qualitative and quantitative metrics, as well as the lack of a semantic ontology to unify the practice, are two examples. Finally, the benefits and drawbacks of a simplified (abridged) (SLCA) are briefly discussed [10].

3. Design of Waste Recycling System Based on Product Life Cycle Assessment

3.1. Workflow Design of Product Life Cycle Based on EPC. The most common application of the Internet of Things is the formation of EPC, which is based on radio frequency identification (RFID) electronic product codes. Internet of Things awareness layer for EPC-based design system [11]. RFID belongs to the contactless automatic identification technology. The information between the RFID tagged articles to be tracked must be transmitted using an RF electromagnetic wave to complete the contactless transmission. To complete the information transmission and identify the information transmitted, the classification and reader use spatial coupling, which involves changing the magnetic field (electromagnetic field). The EPC Internet of Things is designed for the rapid deployment and management of resources, personnel, and information to effectively improve the performance of intelligent warehousing.

The components in the EPC-based Internet-aware layer are as follows:

- (a) Storage of a standard product digital identifier in the global domain in a tag, known as an RFID tag.
- (b) The incoming information stored in the electronic tag is viewed by the RF identification technology for the logistic warehouse management information system device.

- (c) The program modules (services) with special properties belong to the EPC middleware, and the different functional components of the EPC middleware are customized and integrated by the users according to some application requirements. The function of application layer events, namely, ALE, is to handle the events related to the application layer and is also a very important part of the EPC middleware.
- (d) EPC-IS is the EPC information service, and it is the job of EPC-IS to view information about EPC middleware and store information about EPC middleware processing.
- (e) The object name service, that is, the ONS is an object name service, like a domain name server, where an EPC-IS server storing EPC information is found to use the information in the ONS.

The EPC Internet of Things is depicted in Figure 1.

3.1.1. Data Modeling Layer. The product information can be expressed, and a model of the entire life cycle is required to make the entire life cycle extensible and unified. The model for different purposes is automatically mapped and constructed according to the design model as the product development progresses. The product life cycle model's characteristics include the assemblability model, maintainability model, and cost estimation model, which can fully describe the performance indicators related to the evaluation and product life cycle. The product lifecycle model is depicted in Figure 2.

The standards of product description in industrial automation are measured by STEP standards, and the comprehensive attributes of products are defined from different angles. All the information in the whole life cycle of a product includes the technical performance, structural shape, and manufacturing process of the product. The product data in STEP provides the basis for sharing product data in the full lifecycle because the product data in STEP can represent the whole lifecycle of the product with the same technique. The product lifecycle management system can build an integrated data environment for users and facilitate the unified management of data in a virtual enterprise environment [12, 13].

In the virtual design environment, the product lifecycle data is stored separately, the system provides the data federation mechanism, and all the data are transparent to the users when the users are distributed on the network access data. The electronic warehouse creates a unified index of the data distributed throughout the virtual enterprise. So that the designated data unit can be stored in the appropriate physical space, data addition, deletion, and modification can all be done dynamically. Data can be made unique and uniform using an electronic warehouse. It is not copying and pasting to form a new data unit when different users operate on the same data unit, but rather the image or a reference relationship of the data transmitted by the network, which is the electronic warehouse's uniqueness. When the data is changed, the relevant work nodes may be informed as soon

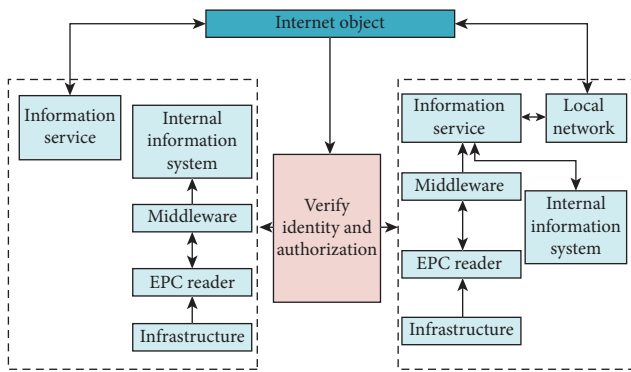


FIGURE 1: EPC Internet of things structure.

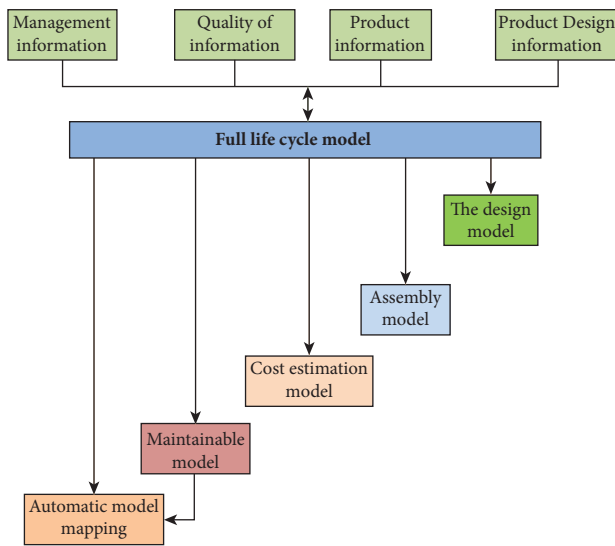


FIGURE 2: Product life cycle model.

as possible, and a locking and unlocking mechanism may be set up to make the data version uniform, which is the uniformity of the electronic warehouse.

3.1.2. Workflow Management Technology. In the distributed and heterogeneous network environment, the business management has the idea of “business process is a business process,” which can be realized by the workflow management technology of the workflow management platform. Workflow management includes the exchange of text files, each media message (task), and the entire process of working tasks between members of the working group, all based on defined rules and congruent objectives.

In order to ensure the correct flow of information, workflow management includes intelligent flow paths and automatic path selection through defined rules. The provision of information tracking and monitoring to ensure a smooth flow of information, real-time tracking, monitoring of the flow of information, and then execution. The necessary operations, such as urging, double-drive, and the ability to combine applications, are available; to be widely used, good application combination ability is required. A reference model for workflow management throughout the product lifecycle is shown in Figure 3.

The design phase and the run phase, which are definition, control, and interaction, are the two phases of workflow in the reference model. Workflow management includes the nature of work, the relationship between superiors and subordinates, and the user’s name, which can transfer the relevant information according to the designated path. Dynamically change the workflow; complete management log; and monitor the status of the workflow. Workflow client nodes, namely, Workflow client, Workflow controller, namely, Workflow management, and Workflow template designer, namely, Workflow designer, make up the Workflow runtime environment.

The system realizes workflow management through data sharing according to the database mechanism. The research and development only need to use the database research and development technology has the workflow and the application system close union merit.

4. The Waste Information Security Management System’s Overall Function Design

4.1. Security Management System for Waste Information.

To optimize the design of the waste information security management system, it is necessary to carry out the automatic control and overall framework analysis of the waste information security management system. The waste information security management analysis is carried out by combining the feature distribution of the waste information security management system. To carry out the reliable design of the waste information security management system, use the ISA/EISA framework mode to carry out the automatic control module design and combine the cross-compilation control method. Establish a conversion model for the control instructions of the waste information security management system. Adopt the APLC21160 logic processor chip as the digital processing chip for the waste information security management system’s fuzzy control, and complete the waste information security management system’s development and design. Adopt the DS18B20 as the waste information security management system’s peripheral component, and use the 32-bit embedded design method to perform the waste information security management system’s output stability analysis. To carry out the automatic compilation and design of the waste information security management system, combine the cross-compilation control technology. The overall design framework of the system is shown in Figure 4.

The waste information security management system software is developed in an embedded PLC and B/S framework, according to the framework of Figure 4, taking into account the characteristics of waste information security management systems. The physical information of the control system’s output is collected using the 32-bit embedded design method, and the sensing information sampling technology is used to collect the control system’s sensing information. The control instruction output conversion of the waste information security management system is designed using the ADI company’s ADSP21160 processor system.

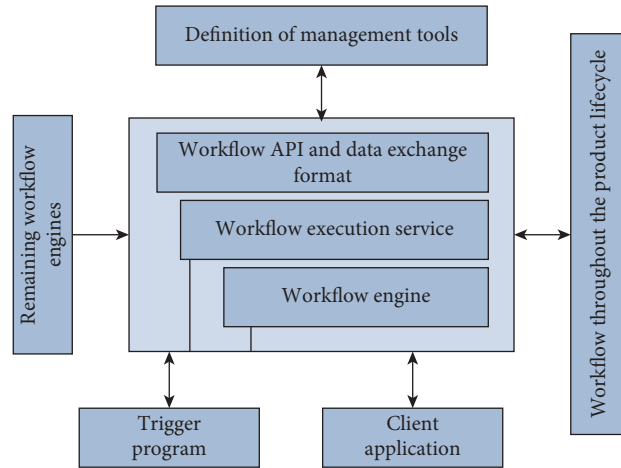


FIGURE 3: Workflow management reference model of product life cycle.

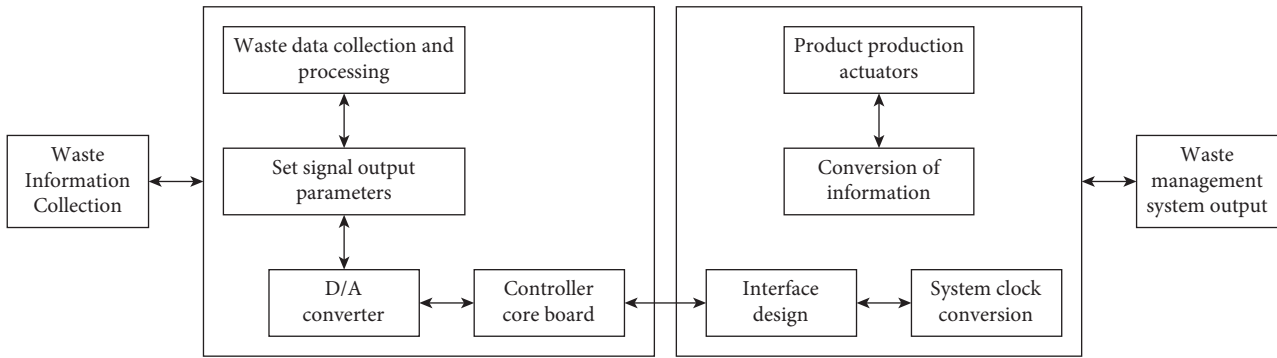


FIGURE 4: Overall design framework of the system.

The intelligent waste information security management module is developed and designed using Revit software and a SQL server database as the data management engine. The Internet of Things is used to power the waste information security management system, and a waste information security management system based on the B/S framework is constructed. Set the output capacity of the waste information security management system as 1240 Kbs, the voltage output range is 200~400 V. Embedded ARM, waste information security management system sensor module design, and waste information security management system program controller ADSP-BF537BBC-5A are used to create the automatic waste information security management system. Figure 5 shows an embedded ARM microprocessor performing information fusion processing for a waste information security management process.

4.1.1. Plan Query Module. The visual management design plan query module provides access to construction simulation animations or images [14, 15]. The progress plan query module in the product production project visualization management system is shown in Figure 6.

4.1.2. Information Collection Module. In the process of progress monitoring, progress information collection is an important part. Effective progress information collection is

the foundation of accurate and timely acquisition of actual progress data. That data and information can also be used for early warning and follow-up progress deviation analysis. It is necessary to collect equipment information, working status information, unit time workload, starting time, and other information when we get the progress information of the project. The schedule query module is shown in Figure 7.

4.2. Product Life Cycle Assessment. The evaluation model is used to perform the auxiliary calculations, and the system software is built on big data to reduce the volume of data and speed up the system evaluation. To improve the automatic evaluation effect of the evaluation model, the logicity of the evaluation model is strengthened using the big data processing product cycle index.

Obtain big data for the entire product life cycle and combine the cost and cycle index. The indicators of the same category or attribute are then merged and deleted according to the evaluation model's requirements, including indicators with only a minor impact on the product. Indicators that are not directly related to the product, as well as indicators that are redundant and reflect the same project. At this point, the attribute differences between this actual product cycle information are huge. As a result, the final evaluation results of the system will be influenced by cycle data with large

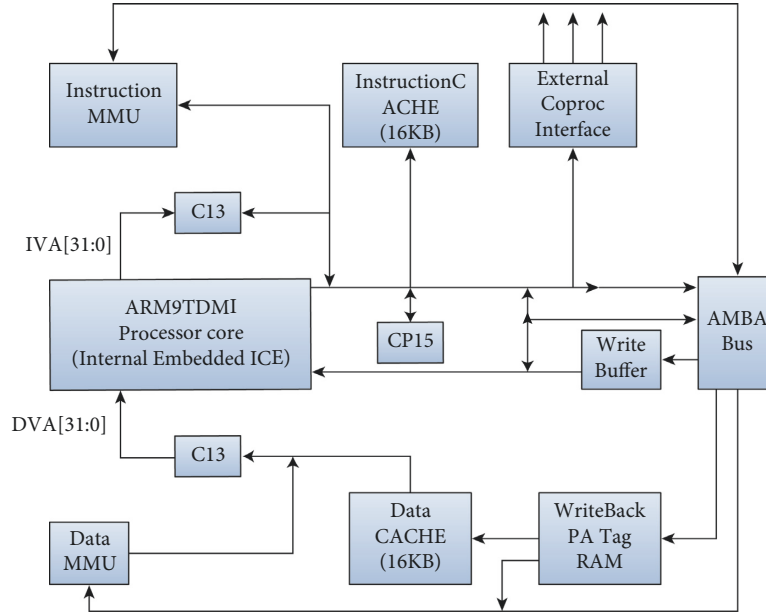


FIGURE 5: Functional module composition of the system.

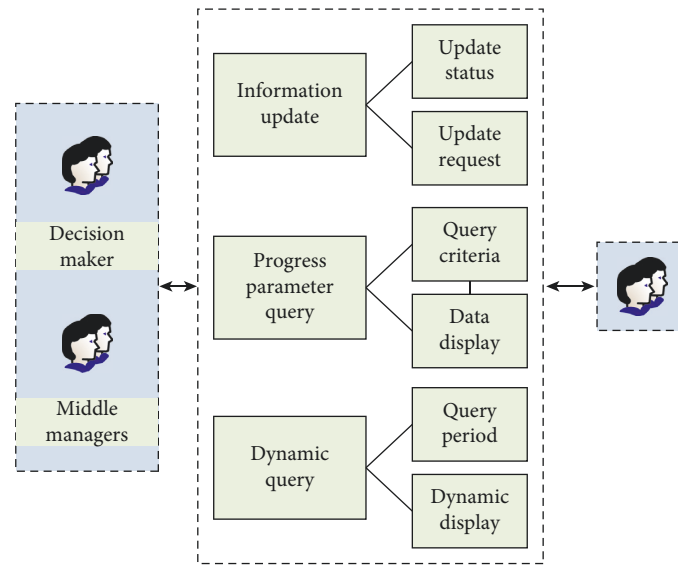


FIGURE 6: Plan query module.

indicators and very small cycle data. The cycle indicators will be normalized after the preparation of the previous two steps [12]. Normalization is the reduction of the attribute values of big data indicators between [0, 1] to reduce the impact of different data orders of magnitude on system evaluation results [16]. Assuming that there is a total of n big data of products after processing if the index attribute variables of these big data are represented by F_n , the big data can be normalized according to following formula:

$$F_n = \frac{W - \min(W)}{\max(W) - \min(W)}. \quad (1)$$

In formula (1): W represents a big data set of the same attributes. When the normalized data are evenly distributed

in the separated state, it is proved that the order of magnitude of the data is reduced, and the product cycle index can meet the conditions of the evaluation model.

4.3. Comprehensive Weight of Product Life Cycle Assessment Indicators. In the process of product life cycle assessment, firstly, the evaluation index data of the product life cycle shall be collected. The original evaluation index data shall be non-dimensionally processed by using fuzzy rough set theory, and the objective weight of the evaluation index shall be calculated. All attribute values for each module of the product life cycle assessment must be obtained using expert scoring theory. The index's membership degree concerning the evaluation module must be provided, as well as the

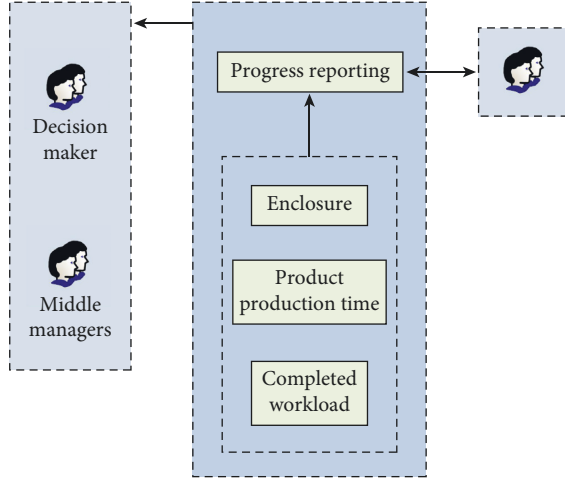


FIGURE 7: Schedule query module.

evaluation index's subjective weight. On this basis, the fuzzy approximate relationship between the two fuzzy sets shall be obtained by synthesizing subjective and objective weights. The specific process is described as follows:

Suppose, in the product life cycle assessment information system (G, H, J, K) , U represents a non-empty finite set. Representing the set $G = \{g_1, g_2, \dots, g_n\}$, o of assessment index data of the product life cycle, defining a fuzzy relationship H of product life cycle assessment index, representing a set of the product life cycle, J represents a non-empty finite set of attributes. Represents K the set of modules of product life cycle assessment, J the set of modules of product life cycle assessment, $F: G \times H \rightarrow U$ represents the attribute value, $F: G \times H \rightarrow U$ represents the information function, and the fuzzy relationship R is defined by the following formula:

$$R = \left\{ F \in U \times U \mid \frac{1}{n} \sum_{i=1}^n |G - G'_i| \leq \chi \right\}. \quad (2)$$

The approximation between the defined object and the object is defined as χ , G'_i represents the attribute value of the transformed product life cycle assessment fuzzy information system.

For a fuzzy relation U on any $x \in U$ and U , given the threshold $\chi \in 0.5, 1$, the upper and lower similarity sets of a variable precision rough set χ of X are defined by the following formula:

$$\bar{R} = U \left\{ x \in U \mid \frac{|X \cap F \cdot R(x)|}{|F \cdot R(x)|} > 1 - \chi \right\}. \quad (3)$$

If $R \subseteq C$, X represents the division generated by all attributes C within each module of PLA, the approximate classification quality shall be represented by formula:

$$\gamma_R(X) = \sum_{i=1}^t \frac{R_\beta(X)}{|U|}. \quad (4)$$

Among them, $X = \{X_1, X_2, \dots, X_t\}$ and U represent the matrix composed of the weight of the superior evaluation index, based on the calculation result of the formula (13), and

use formula (5) to define the membership function of the index relative to this evaluation module:

$$\text{sig}(C_i) = 1 - \gamma_{C-\{C_i\}}(X). \quad (5)$$

In formula $C = \{C_1, C_2, \dots, C_n\}$, the weight of C_i in formula C shall be calculated by using formula (6):

$$\omega(C_i) = \frac{\text{sig}(C_i)}{\sum_{i=1}^n \text{sig}(C_i)}. \quad (6)$$

Combined with the AHP theory, the subjective weight and objective weight of the evaluation index are calculated to obtain the comprehensive weight, and the fuzzy approximate relationship between the two fuzzy sets is obtained which is expressed by formula:

$$\omega = \ell \omega_1 + (1 - \ell) \omega_2. \quad (7)$$

Where, ω_1 represents the subjective weight of product life cycle assessment indicators, and ω_2 represents the objective weight. ℓ stands for taking value according to actual needs.

5. Feature Extraction and Scheduling of Waste Information

5.1. Scheduling of Waste Information. Fusing and processing the big data of the mixed framework system of the waste information management system, taking the pole number of the waste system and the number of amperes needed as the constrained parameters, the characteristics of the waste information is reorganized. Under the mixed framework mode, the clustered scheduling analysis model of the waste information management is obtained as follows:

$$\aleph = \min \eta^2 + \lambda \cdot \sum_{i=1} z_i. \quad (8)$$

Among them, η is the efficiency of waste recovery, λ is the polar number of the waste system, z is the scheduling function of waste information management. The channel equalization model of waste information storage is obtained based on actual load conditions [17]. The waste information is scheduled and the feature compression function of the waste information management is obtained based on the distribution pattern of the armature information of the straight and quadrature axes of the hidden pole rotor. The two key parameters of the external characteristics of the generator are calculated. The spatial distribution feature set of the waste information is obtained as follows:

$$A = \begin{cases} \max & \frac{1}{6} \int_{j=1} \alpha \cdot z_j - \aleph, \\ \text{s.t.} & \int_{j=1} \alpha \cdot z_j = 0. \end{cases} \quad (9)$$

When the output characteristic quantity of waste information is consistent with the actual recycling load condition, the heterogeneous linear characteristic reconstruction output of waste information is obtained as follows:

$$Q = \sum N \cdot z_i + A. \quad (10)$$

The heterogeneous characteristic distribution function of waste information:

$$D = \frac{Q \sum_{i=1} z_i (\omega_1 + \omega_2)}{A}. \quad (11)$$

5.2. Waste Recycling Information Fusion. It is a hybrid framework system for big data fusion of waste information and feature optimization detection. Feature optimization is the extraction of basic parameters such as rated power efficiency and a rated torque of a waste information management system, as well as their combination. The following requirements must be met to obtain the fusion structure of pole logarithm and fundamental frequency parameters of waste information [18, 19]:

$$\text{esup}(e) > \varpi. \quad (12)$$

Among them, ϖ is the basic parameter, and the statistical characteristic vector of waste information association is obtained utilizing no-load EMF scheduling of the electrically exciting part: $F(X_i, P_i, T_j)$, in which, X_i is the corresponding air-gap coefficient, and at T_j time, the waste component is the power of waste information, and P_i is the associated information entropy of waste information, and the output status parameters are obtained by heterogeneous fusion combined with the privilege characteristics of waste information storage

$$\xi = \frac{F(X_i, P_i, T_j)}{\text{esup}(e)}. \quad (13)$$

According to the above analysis, the big data fusion and feature optimization detection of waste information is carried out in the hybrid architecture system to realize the optimal design of the waste information management system.

6. Experimental Design and Result Analysis

6.1. Product Life Cycle Assessment Reliability Test of Different Systems. This system FTS proposed by the authors is used to implement a waste recycling system based on the Internet of Things. The waste recycling system of the GM model is used for the product life cycle assessment experiment. The reliability (%) of three different systems for product life cycle assessment is compared [5, 6]. The comparison results are described in Figure 8.

Figure 8 shows that the reliability of product life cycle assessment using the system described in this paper is higher than that of the waste recycling system based on the Internet of Things. The GM model's waste recycling system is evaluated for reliability primarily when the system evaluates the product life cycle. The membership and the objective weight of the product life cycle evaluation index are calculated first. The state stability vector is obtained by combining the degree of the index in an evaluation module relative to the evaluation module with the expert scoring theory. This improves the reliability of product life cycle assessment [5, 6].

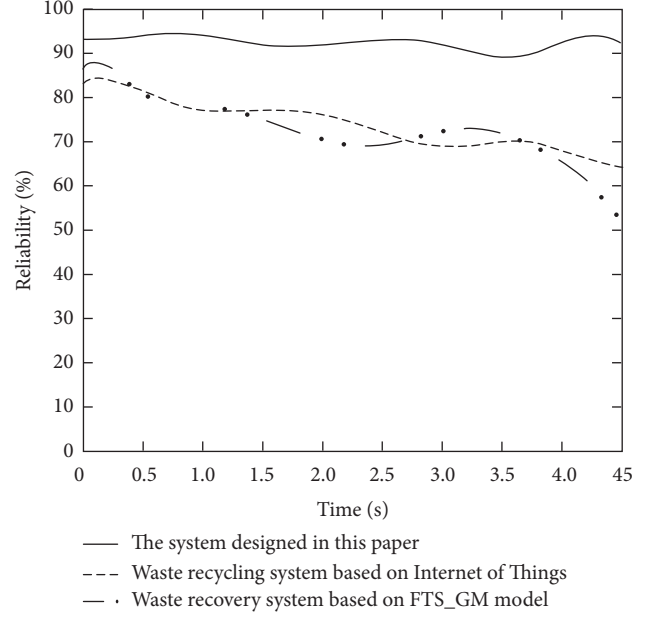


FIGURE 8: Comparison diagram of evaluation reliability of different systems.

6.2. Complexity Testing of Product Life Cycle Assessment for Different Systems. This system and FTS propose a waste recycling system based on the Internet of Things, which is used. For the product life cycle assessment experiment, the GM model's waste recycling system is used. The time complexity (%) of product life cycle assessment is compared for three different systems and the comparison results are shown in Figure 9.

According to Figure 9, the time complexity of product life cycle assessment using the system in this paper is lower than that of the authors' proposed waste recovery systems based on the Internet of Things and the FTS GM model [5, 6]. This is mainly because the system first uses the fuzzy rough set theory to dimensionless process the original evaluation index data, and call all attribute values in an evaluation module a fuzzy set. Synthesizes the subjective and objective weights to obtain the fuzzy approximate relationship between the two fuzzy sets. Introduces the Markov chain theory to establish the probability state transition matrix, the time complexity of product life cycle assessment is low.

6.3. Throughput Test of Different Systems. In the range of system load rate of 50%–70%, the experimental comparison data of system throughput of the three systems are shown in Table 1.

According to the experimental comparison data of system throughput in Table 1, the system throughput of the designed system is greater than that of the other two systems in the range of system load rate of 65%–80%, and the maximum system throughput is 1985 bytes/s.

Table 2 shows the system throughput experimental comparison data between the designed system and the waste recycling system based on the Internet of things and the waste recycling system based on the FTS GM model in the 70%–90% system load rate range [5, 6].

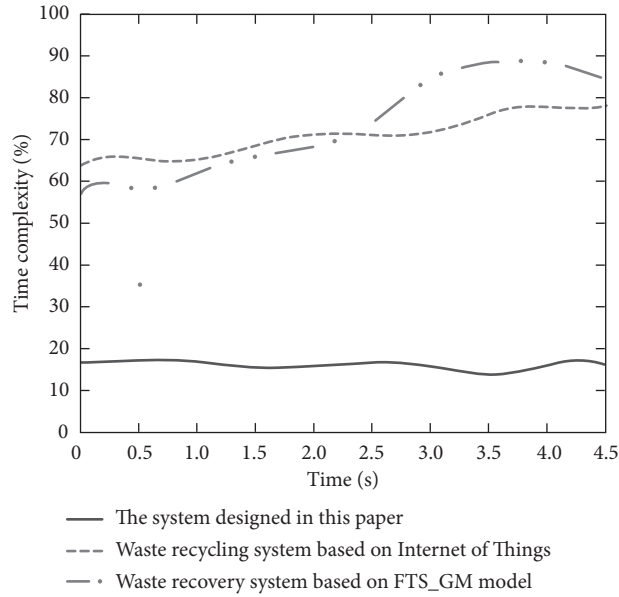


FIGURE 9: Comparison of evaluation time complexity of different systems.

TABLE 1: Comparison data of system throughput experiment.

System load rate/%	System throughput/byte/S		
	Designed system	Reference [5] system	Reference [6] system
50	1452	982	1002
52	1775	855	998
54	1179	972	962
56	1853	953	1085
58	1985	904	930
60	1247	937	987
62	1256	917	1002
64	1274	916	972
66	1659	938	996
68	1024	892	912
70	2236	755	963

TABLE 2: Experimental comparison data of system throughput.

System load rate/%	System throughput/byte/S		
	Designed system	Reference [5] system	Reference [6] system
70	1275	982	957
72	1375	915	982
74	1962	753	902
76	1357	865	756
78	1366	962	786
80	1048	788	842
82	1953	862	811
84	1459	720	874
86	1024	851	710
88	1147	840	809
90	2356	932	735

According to the experimental comparison data of system throughput in Table 2, in the range of system load rate of 80%–95%, the system throughput of the designed system is greater than that of and which effectively proves the effectiveness of the system.

6.4. A Comparative Test of Waste Recovery Cost under Different Systems. After testing the performance of the system, the system designed this time was used as an experimental group, using the waste recovery system based on the Internet of Things, and the waste recovery system based on the

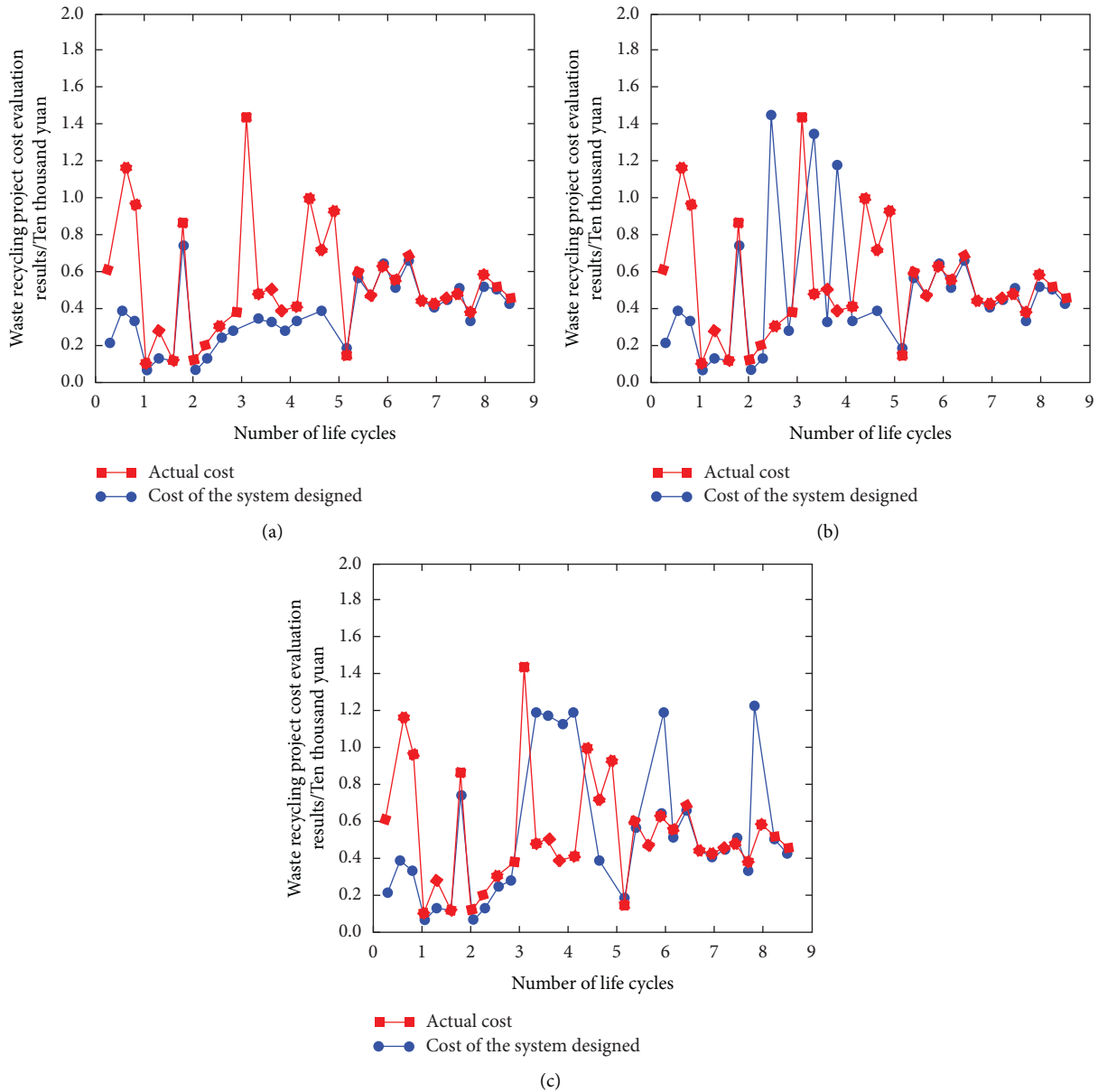


FIGURE 10: Comparison of test results of waste recycling costs of different systems. (a) The system designed in this study. (b) Reference [5] system. (c) Reference [6] system.

FTS_GM model as a control group. The comparing the cost assessment results of product waste recovery projects in multiple life cycles of the three systems. The results are shown in Figure 10 below.

According to the curve in Figure 10, in 9 product evaluation cycles, compared with the actual historical waste recovery cost of the product, the cost of the waste recovery project under the application of the designed system is significantly reduced. But the test results of the two comparison systems are not ideal, the reference design of the waste recovery system cannot improve the high cost of waste disposal problems.

7. Conclusion

Life cycle assessment is a valuable method for examining a wide range of environmental impacts when comparing various scenarios. Because of the wide diversity of LCA approaches and the need for researchers to create project-specific parameters, the results of one LCA are rarely comparable to those of another. A waste recycling system based on product life cycle assessment was designed to solve the problems of low reliability and high cost that existed in the existing waste recycling system. Design the workflow of the whole product life cycle based on EPC using the

APLC21160 logic processor chip as the digital processing chip of the fuzzy control system combined with cross-compiling control technology, the automatic compiling function of the system is designed. Extraction of the characteristics of waste information is the integration of waste recycling information, and waste recycling system design. The simulation results show that the system proposed in this paper is more reliable and can be used more effectively. When the system load rate changes greatly, the system throughput can be maintained at a higher level, and the designed system waste effectively reduces the cost of waste recovery projects. The experimental results show that the designed system has higher applicability, which provides theoretical support for the further study of waste disposal in the future.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no competing interests.

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