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Web and Mobile Data Management System for Garongan Asri Garbage Bank: A Case Study

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Abstract

This research addresses the inefficiencies of manual garbage data management by developing a dual-platform system: a website-based application for Garongan Asri Garbage Bank staff and a mobile application for customers. Utilizing the waterfall method for systematic development, the project involved stages of analysis, design, coding, testing, support, and maintenance. Key technologies used include the Bootstrap framework, Visual Studio Code, Android Studio, and MySQL database. The resulting website application enables staff to efficiently manage garbage data, while the mobile app allows customers to access their disposal history. The effectiveness of these applications was confirmed through black box testing, demonstrating their functionality and suitability for improving garbage data management and customer service.

Keywords: garbage bank, moile, waterfall, website

1. INTRODUCTION

Garbage is still one of the problems that Indonesia continues to strive to manage well until now. Not only the government should be responsible for this problem, but the community should also participate [1]. With a dense population, Sleman Regency can generate a significant amount of garbage, with an average of 738.71 tons of garbage per day. The largest component of organic garbage is 62.41%, followed by plastic 27.63%, paper 7.77%, fabric 0.22%, metal 0.90%, and glass 0.83% [2].

A garbage bank is an organization that handles garbage management, which includes the collection of garbage that has been sorted by type to transportation to a recycling plant or garbage shredder. Garbage bank serves as a business model for the community and helps the government in overcoming the garbage problem in Indonesia [3]. In Sleman, there are many garbage banks that are still operating today. Garongan Asri Garbage Bank is one of them, which was established in 2021 and is still operating today. The location is in Garongan Village RT 02 RW 18, Kembang Hamlet, Wonokerto Village, Turi District, Sleman Regency.

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The goal of garbage management is to give people, government agencies, and companies the opportunity to take part in efforts to reduce the amount of garbage disposed, recycle, and reuse garbage, better known as Reduce, Reuse, and Recycle (3R) [4]. Garbage banks, which have evolved into social and non-profit organizations, are one of the solutions for more efficient household garbage management as they can produce profitable and economically valuable outcomes [5], [6].

The problem that arises is that there are still many people who are not aware and lack education about the importance of sorting garbage before disposal[7]. In addition, the mindset of the Indonesian people that garbage must be disposed of can also cause a buildup of garbage in landfills. Over time, the accumulation of garbage will result in piles of garbage and can cause unpleasant odors that harm the surrounding community[8]. According to previous research, the majority of garbage banks are currently recorded manually using books[9]. Manual management can lead to problems such as the need to store a lot of paper or documents to record and the risk of loss. In addition, the recorded data may not be effective and efficient [10]. Building a system to manage garbage bank data collection is a solution to the problems encountered in several previous studies.

As a result of the research conducted [11], an application was developed that is intended to be used by garbage bank staff and customers. By using this application, garbage bank staff can easily pick up garbage by knowing the location of the customer. In addition, customers can also view transaction history, garbage bank pickups, and savings books. The study conducted by [3], produced a system that can be accessed in real time by garbage bank staff and customers. The system categorizes customers based on their profile and gender. Garbage bank staff are responsible for customer data and information on garbage deposited by customers. However, research conducted by [12] found that the application made it easy for garbage bank staff to manage the garbage bank. In addition, garbage bank customers can also use this application to register, view the garbage catalog and see the remaining balance.

By leveraging technology, the implementation of REST API in the web and mobile-based garbage bank data application will provide a more effective and efficient solution to existing issues. This application is designed to facilitate garbage bank staff in managing their activities. Additionally, customers can easily use this application to interact with the garbage bank. Hopefully, with this technology, garbage management can be more organized and contribute to environmental conservation efforts.

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2. METHODS

2.1. Research Methods

In this research, the waterfall method is part of the System Development Life Cycle (SDLC) method, which is a software system development process that uses models and methodologies from previous system development [13]. The most commonly used software development model for system development is the waterfall method, which is also often referred to as the classic life cycle [14]. Analysis, design, coding, testing, support and maintenance are all processes that are carried out sequentially in the waterfall method [15], as shown in Figure 1.

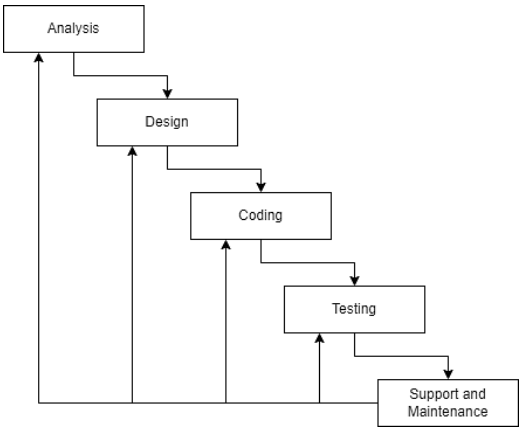

Figure 1 Waterfall Methods

1) Software Requirements Analysis is conducted to determine the specifications of user software user requirements. The author uses Unified Modeling Language (UML) to illustrate the functions and workflow within the system. Additionally, the author also uses Entity Relationship Diagram (ERD) to describe the relationships or connections between databases within the system to be developed.
2) Design, software design focuses on the designing of software program. To facilitate the creation of the program in the next stage, this phase is used to analyze representation needs. The author uses a prototype to illustrate the design of the application that will be created using Visual Studio Code and Android Studio tools. This prototype also helps the author in coding in the next stage.
3) Coding, the design is implemented into a software program to create a computer program in accordance with the design. In the development of this application, the author utilizes Visual Studio Code with the support of the Bootstrap framework to create a website. For the mobile application

development, the author uses Android Studio, and in the database creation, the author uses MySQL as a database with the help of the phpMyAdmin tool.

4) Testing. software and functional testing aims to minimize errors and ensure that the tested components operate effectively. In this research, the author use black-box testing methods to ensure that the developed application functions as intended.
5) Support or Maintenance, errors that arise and are not detected during software testing can lead to changes. Although it cannot create new software, it can repeat the development process from specification analysis to modifying existing software. However, not for the creation of new software.

2.2. Data Collection

There are several ways that the author uses in obtaining data, namely:

1) Observation, data collection is carried out by directly visiting the Garongan Asri waste bank located in the Garongan Village RT 02 RW 18, Kembang Hamlet, Wonokerto Village, Turi District, Sleman Regency.
2) Interview. data was collected through interviews with Mrs. Sri Supatmi Khotijah, the chairwoman of the Garongan Asri garbage bank to obtain relevant information for this research. In the interview, the author obtained information about the types of garbage that can be collected in this garbage bank, such as plastic garbage, HD plastic garbage, oil plastic garbage, instant coffee wrap, cardboard, and much more. Additionally, the majority of customers at the Garongan Asri garbage bank are housewives in the Garongan Hamlet.

3. RESULTS AND DISCUSSION

3.1. System Design

3.1.1. Unified Modelling Language (UML)

In object programming, the Unified Modeling Language (UML) is one of the standard languages used to define requirements, perform analysis and design, and define architecture[16].

1) Use Case Diagramis used in Unified Modeling Language (UML) to illustrate interactions with the system being used [16].

Figure 2 shows the use case diagram where the staff has login access, menage customer data, and track garbage disposal history. In order to manage customer data and track garbage disposal history, staff are required to login using an ID and password that only belongs to the staff. This is necessary to maintain the security of the stored data from unauthorized access.

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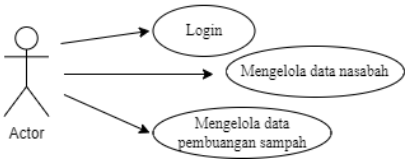

Figure 2 Staff Use Case Diagram (Indonesia)

Figure 3 shows the use case diagram where customers can login and fill in garbage disposal data. Customers need to login using the ID and password provided by the staff before accessing the garbage disposal history. After successfully logging in, the customer can see the garbage disposal history and add garbage disposal data by filling in some required data.

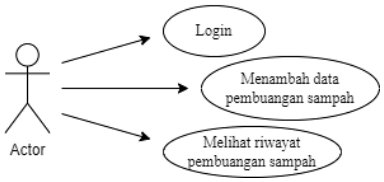

Figure 3 Customer Use Case Diagram (Indonesia)

2) Activity Diagram show the process of a software system[16].

Figure 4 shows the workflow that occurs during the login process that can be executed by staff and customers. Before being able to access the application, staff and customers must login using their ID and password. If the ID and password used match the data stored in the database, then staff and customers can access the application. However, if they do not match, they cannot access the application and need to try again by entering the correct ID and password.

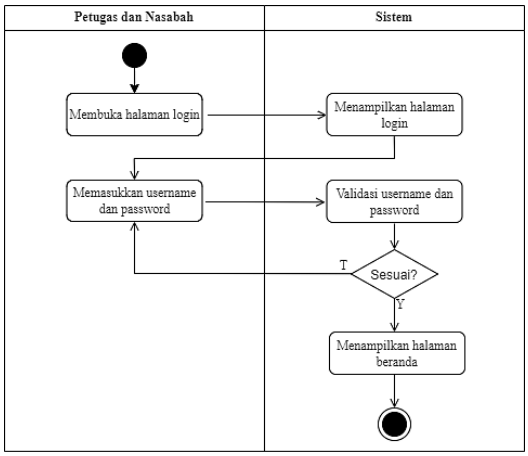

Figure 4 Login Activity Diagram (Indonesia)

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Figure 5 shows the workflow that occurs when staff adding new customer data. To add new customer data, staff need to select the menu to add customer data. Next, the staff will fill in some of the required data. If the data filled in is complete and appropriate, the system will save the data into the database after the staff presses the "Simpan" button.

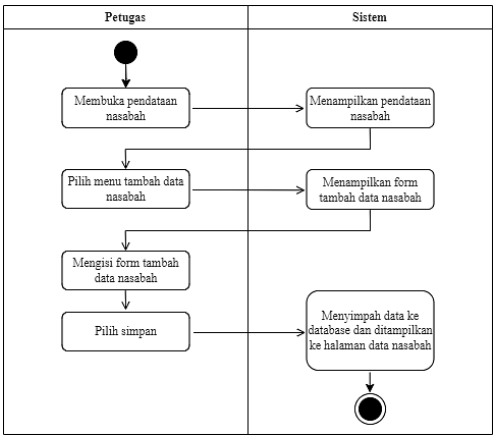

Figure 5 Add Customer Data Activity Diagram (Indonesia)

Figure 6 shows the workflow of the garbage disposal history activity diagram by the staff. Staff have access to see garbage disposal history by selecting the garbage disposal history menu, the system will show garbage disposal data. If the staff wants to add garbage disposal data, the staff can select the add garbage disposal data menu, so the system will show a form that allows the staff to fill in the required data. After that, the staff only needs to press the "Simpan" button so that the data is archived into the database.

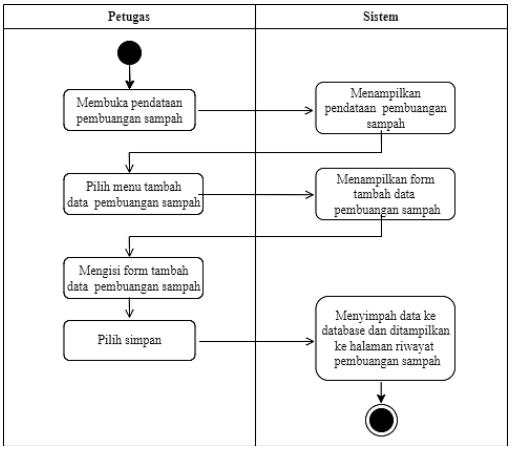

Figure 6 Garbage Disposal History Activity Diagram (Indonesia)

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3.1.2. Entity Relationship Diagram (ERD)

In the process of creating a database, entity relationship diagrams are used to show the relationship between data and each other and show how the database works[17]. The author uses erd to show the relationship between staff and customers and the primary key of each entity. For example, the staff entity has several attributes with the primary key id_petugas, the customer entity has several attributes with the primary key id_nasabah, and the garbage disposal data entity has several attributes with the primary key id_sampah and the secondary key id_nasabah. In this application, staff can manage customer and garbage disposal data. While customers can see and add garbage disposal data, as shown in Figure 7.

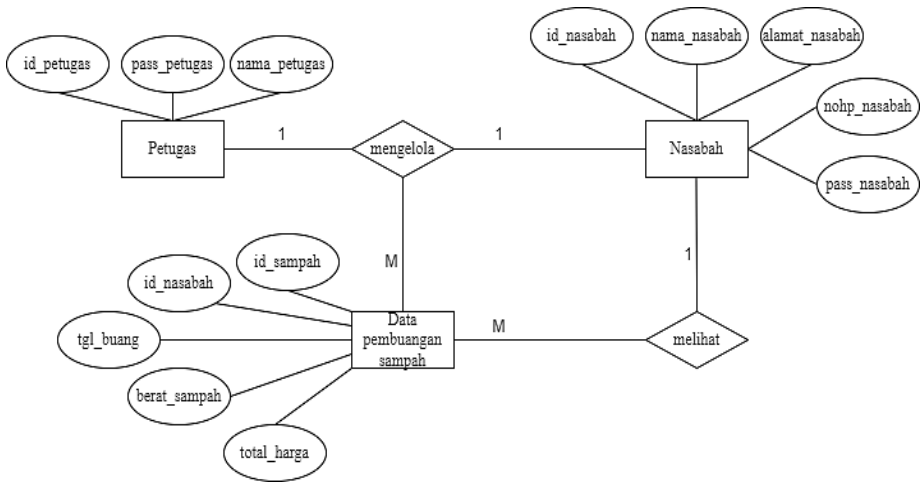

Figure 7 Entity Relationship Diagram (ERD) (Indonesia)

3.2. Implementation

The Garongan Asri garbage bank website has revolutionized the way garbage bank staff manage customer and disposal data, making the process more streamlined and efficient. At the heart of this system is a user-friendly interface, as depicted in Figure 8, which enables staff to view and manage a comprehensive list of all registered customers. This page is equipped with a suite of functional buttons, facilitating various actions such as adding new customer data, updating existing customer information, deleting records of inactive members, and exporting customer data into a PDF file for easy documentation.

Delving deeper into specific functionalities, Figure 9 illustrates the process for adding new customer data, a task that has been greatly simplified by the website. Staff can now easily input personal data of new members, and with the click of the

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'Simpan' (Save) button, this information is securely stored in the database, thereby mitigating the risks associated with manual record-keeping.

Figure 10 offers a glimpse into how staff can seamlessly update customer data, a task that is much more efficient compared to the previous manual methods. Similarly, Figure 11 presents the interface for managing the history of garbage disposal data. This section of the website includes buttons for adding new garbage disposal data, updating or deleting existing entries, and exporting this data to a PDF file, thus providing a comprehensive tool for effective data management.

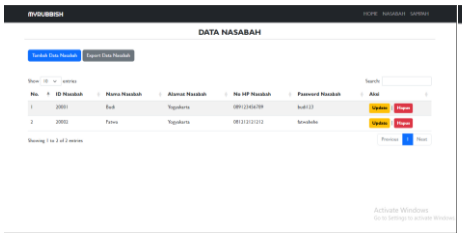

Figure 8 Interface of Customer Data

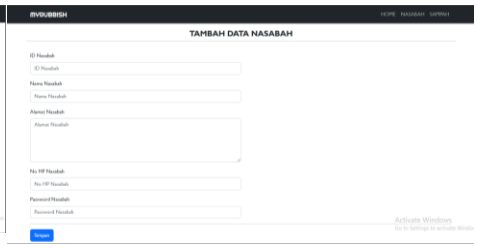

Figure 9 Interface of Add Customer Data

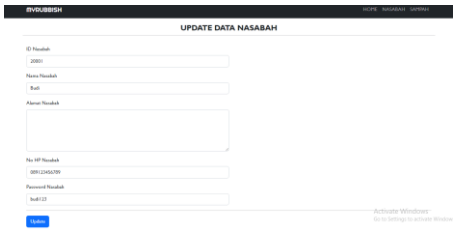

Figure 10 Interface of Update Customer Data

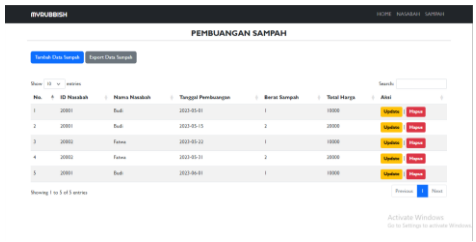

Figure 11 Interface of Garbage Disposal History

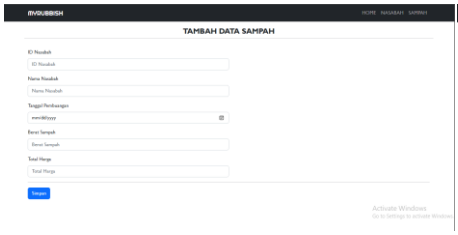

Figure 12 Interface of Add Garbage Data

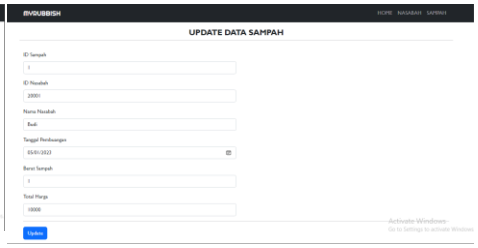

Figure 13 Interface of Update Garbage Data

Moreover, Figure 12 highlights the ease with which staff can input data on garbage disposed of by customers. The system ensures that the disposal data is not only

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easily added but also securely stored in the database, eliminating concerns over data loss or oversight. Finally, Figure 13 showcases the functionality for updating garbage disposal data as needed, with a search feature that allows staff to effortlessly locate and modify specific disposal records.

The Garongan Asri Garbage Bank has extended its digital capabilities to customers through a mobile data collection application, enhancing the user experience and accessibility. This application allows customers to actively engage in the garbage disposal process by enabling them to view their disposal history and add new garbage disposal data directly from their mobile devices.

Once customers log in to the application, they have immediate access to their garbage disposal data. Figure 14 illustrates the garbage disposal history page, which displays comprehensive details such as id, name, date of disposal, weight of the garbage, and the total price. This feature ensures that customers have a transparent and up-to-date record of their garbage disposal activities, all conveniently accessible through their phones.

Additionally, the application simplifies the process of adding new garbage disposal data. As depicted in Figure 15, during the garbage deposit process, customers can input the necessary data into the garbage disposal data collection page. Fields to be filled include essential information like the date, weight, and type of garbage being disposed of. Once the data is entered, customers can easily save their entries by pressing the "save" button. This functionality not only empowers customers to contribute to data accuracy but also enhances the efficiency of the garbage bank's data collection process, making it more streamlined and user-friendly.

Figure 14 Interface of Garbage Disposal History

Figure 15 Interface of Add Garbage Data

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3.3. Testing

The author uses black box testing to make sure that the software created has good software quality and the system created is in accordance with its functions[18]. After testing conducted by users, it can be said that this application performs its functions well, as shown in Table 1.

Table 1 System Functional Testing Table

Numb	Testing Items	Results	Status
1	Interface of Customer Data	Can show data on all registered customers Successfully	Succesfully
2	Interface of Add Customer Data	Can show a form to add a new customer that contains the customer's personal data	Succesfully
3	Interface of Garbage Disposal History	Can show the history of garbage disposal	Succesfully
4	Interface of Add Garbage Data	Can show a form to add data id, name, date of disposal, weight of garbage, and total price	Succesfully
5	Interface of Update Custumor Data	Can show a form to update the customer's personal data	Succesfully
6	Interface of Update Garbage Data	Can show a form to update the garbage's data	Succesfully
7	Interface of Garbage Disposal History (Mobile)	Can show the history of garbage disposal	Succesfully
8	Interface of Add Garbage Data (Mobile)	Can show data id, name, date of disposal, weight of garbage, and total price	Succesfully
9	Button Simpan	Can save the entered data	Succesfully
10	Button Update	Can update existing data	Succesfully
11	Button Hapus	Can delete existing data	Succesfully

Table 1 summarizes the results of a comprehensive functional testing conducted on a system designed for managing customer and garbage disposal data. The testing encompassed various interfaces and functionalities, each assessed for performance and effectiveness.

Firstly, the system's "Interface of Customer Data" was tested and successfully demonstrated its capability to display comprehensive data on all registered customers, indicating robust data aggregation and presentation functionalities. Similarly, the "Interface of Add Customer Data" effectively showed a user-friendly form for entering new customer information, including essential personal data, reflecting the system's efficiency in handling new data entries.

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Further testing revealed that the "Interface of Garbage Disposal History" reliably displayed the history of garbage disposal activities, signifying the system's adeptness in tracking and presenting historical data. This was complemented by the "Interface of Add Garbage Data," which accurately provided a form for inputting key garbage data, including ID, name, date of disposal, weight of garbage, and total price, demonstrating the system's comprehensive data capture capabilities.

Additionally, functionalities for updating data were also tested. The "Interface of Update Customer Data" and the "Interface of Update Garbage Data" both successfully displayed forms to modify existing records, ensuring the system's adaptability and responsiveness to data changes. The testing extended to mobile interfaces as well, with the "Interface of Garbage Disposal History (Mobile)" and the "Interface of Add Garbage Data (Mobile)" efficiently displaying respective data and forms, indicating a seamless transition of functionality to mobile platforms.

Lastly, key operational buttons such as "Simpan" (Save), "Update," and "Hapus" (Delete) were tested, each performing their intended functions successfully — saving entered data, updating existing records, and deleting data as required. the functional testing of the system yielded highly satisfactory results across all tested items, showcasing the system's effectiveness and reliability in managing customer and garbage disposal data. The successful operation of both web and mobile interfaces, along with the efficient functioning of key features, underscores the system's robustness and suitability for its intended purpose.

3.4. Discussion

The web-based application is primarily used by the garbage bank staff for managing customer profiles and recording garbage disposal transactions. During the data collection process, staff members input critical customer information including names, addresses, cellphone numbers, IDs, and passwords. These credentials are subsequently used by customers to access their accounts on the mobile application. When recording a garbage disposal transaction, staff capture various details such as the customer's ID, the identity of the person disposing of the garbage, the date of disposal, the weight, and the total value of the disposed garbage. This comprehensive data collection is designed to streamline customer data management and the recording of garbage disposal, enhancing overall efficiency and organization.

Conversely, the mobile application is customer-centric, offering users a convenient platform to view their garbage disposal history and input new disposal data. When logging a disposal event, customers are required to provide details such as their ID, name, date of disposal, the weight of the garbage, and its total price. This

feature empowers customers to actively participate in the management of their disposal data. It also allows them to track their garbage disposal activities effortlessly, fostering a more interactive and engaging relationship between the garbage bank and its customers.

These dual platforms — web-based for staff and mobile-based for customers — represent a cohesive ecosystem that significantly improves the operational workflow of the Garongan Asri Garbage Bank. By facilitating efficient data management and user-friendly customer interaction, these applications serve as valuable tools in modernizing and enhancing the efficiency of waste management services.

4. CONCLUSION

This study has successfully developed a comprehensive data collection system for the Garongan Asri Garbage Bank, tailored to meet the needs of both staff and customers. Employing the waterfall method, the application development was methodically executed through a series of sequential stages, ensuring thoroughness and attention to detail. The resulting application significantly enhances the efficiency of garbage bank staff in managing data, effectively reducing the risk of data loss by securely storing all information in a database.

Moreover, the implementation of this system has notably improved the quality of garbage bank services. It facilitates quicker service delivery while simultaneously ensuring the security and confidentiality of customer data. The effectiveness and reliability of the application have been affirmed through rigorous black box testing, which verified that the application functions smoothly and fulfills its intended purposes accurately. This advancement in the Garongan Asri Garbage Bank's operations represents a significant step forward in modernizing waste management services, providing a model for similar institutions aiming to enhance their data management and customer service processes.

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