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The Implementation of Simple Additive Weighting Method for Designing A Web-Based Waste Management Saving Transaction System

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Abstract

The Garbage Bank is an organization initiated for all students to support the management of inorganic waste into something of value so as to create additional income. The increasing number of customers has caused the treasurer to be overwhelmed in ranking customer rankings and to not be on target in determining the best customer with the same amount of waste. In addition, there is no system security in handling the transaction process, so unwanted access can occur. The purpose of this research is to develop a savings transaction system for waste management so that it becomes a green Campus. The decision-making method uses Simple Additive Weighting. The system development methodology used is Rapid Application Development (RAD). The tools used in system design are the Unified Modeling Language. The implementation of this system uses the PHP programming language with the Laravel and MySQL frameworks for database processing. The resulting system can simplify and speed up the process of recording and managing waste bank data.

Keywords: Waste Management, Simple Additive Weighting, Rapid Application Development.

1. Introduction

Waste management in each country varies depending on the socio-cultural conditions of the local community, government policies and regulations, existing infrastructure, and technological approaches. According to Presidential Regulation No. 97 of 2017, Article 5 Paragraph (1) concerning National Policy and Strategy (Jakstranas) for the Management of Household Waste and Household Waste-like Waste states that the target for reducing and handling waste is between 30% and 70% in 2025. One of the waste management policies is stated in Regulation of the Minister of State for the Environment No. 13 of 2012 concerning guidelines for the implementation of reduce, reuse, and recycle through waste banks. The concept and pattern of a waste bank only exist in Indonesia. A computerized system in the form of an application can help and simplify the work of Officers in accommodating waste bank data management. One of the types of information needed by the waste bank is information on the savings of the waste bank unit. The savings transaction system is starting to get complicated in terms of storing customer data, searching for customer data, and calculating savings, so the Garut Garbage Bank requires a savings transaction information system [1].

Waste management at the tertiary level has started to be driven by several universities. As a collection of educated intellectuals, the university should make an important contribution to waste management. The UI GreenMetric World University Rankings is an annual publication of world university rankings held by the University of Indonesia. This assessment is based on the university's commitment and actions towards greening and environmental sustainability. One of the criteria for calculating UI GreenMetric scores is waste (WS). This indicator focuses on university programs for managing the waste they produce, such as recycling, organic water treatment, sewage systems, and regulations on the use of paper and plastic in universities. The establishment of a waste bank on campus is a supporting factor for the WS criteria [2]. According to Satrian Affan, Petronas Environment Management Coordinator, universities are one of the biggest contributors to waste in a city. With permanent human resources who have routine activities, even on holidays, of course they produce various types of waste every day. According to Yepi Suherman, Head of the Cleanliness Department of the Tangsel Parks and Cemeteries Sanitation Service (DKPP), the establishment of waste banks in a number of universities is in line with Tangsel's hygiene program. According to source person, said that the development of waste banks should not only

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focus on the residential community level [13]. However, the school and campus level should have made a policy regarding waste banks because, as we know, the campus is one of the producers of large amounts of waste every day and has the opportunity to be re-produced (recycled). The campus should already have an environmental unit to produce waste from academic and non-academic activities [3].
Efforts to sort waste have been carried out by procuring two types of bins with different colors based on their functions [4][5]. The green bins are for organic waste, while the yellow bins are for inorganic waste. Currently, waste management at the tertiary level includes sorting, collecting, transporting, and final processing of waste. In this waste handling activity, there is no policy from the top management level, namely the General Section of the Rectorate, regarding waste management with the TPS3R system (Reuse, Reduce, Recycle Waste Management) [6][12]. However, the implementation of waste processing has been carried out in several faculties by managing waste into compost, which can be applied to ornamental plants in the campus environment [7]. Each faculty has different rules regarding waste handling. The Faculty of Health Sciences is one of the faculties that is disciplined in separating organic and inorganic waste [8][11]. In addition, some students also brought their own plastic drinking bottles so they could fill the available gallons with water and process plastic waste into items that can be reused as a form of support for environmental concerns [9][10]. The Faculty has also started implementing the sorting of plastic waste, which will be deposited with collectors.

2. Research Methods

The method used in this research is observation, literature study, interviews, literature study. The system development method used is RAD, so that system development can be completed more quickly in 90 days. This system provides an achievement feature so that application users can be more motivated to save waste with the SAW method. The security system is equipped with role-based access control (RBAC) to limit system access and uses AES-256 and AES-128 encryption to overcome cross-site request forgery (CSRF) attacks. UI design is based on the basics of creating UI so that it is easy for users to use. In this study, researchers used the Rapid Application Development (RAD) system development methodology. The tools used in system design are the Unified Model Language (UML) to visualize the shape of the system to be built.

3. Results and Discussion

Based on the results of the researcher's interview with staff related to the waste management system, it was found that the business process of the waste management system is running, which is described in the form of a rich picture as follows: Students register customers with the admin. The administrator inputs new customer data into the system. Students can contact the administrator to request a change to their account password on the system. The administrator enters a new password on the system. Students can edit profiles. Students make garbage deposits at the Events Division. The Events Division sorts waste that has a selling value according to category. If trash is not accepted, the Events Division returns the trash to students. If the trash is received, the Events Division will weigh the trash and record the weight on the waste weight form. The Events Division inputs trash deposits into the system. The Events Division confirms the deposit amount that will be submitted to the Student. The treasurer looks at the waste weight form provided by the Events Division to ensure that the amount of deposit entered is correct. The treasurer validates the garbage deposit on the system. Students can see trash deposits in the system. Collectors take waste deposits to the Treasurer. Treasurer validation of sales of garbage on the system The collector hands over the money to the Treasurer. Students apply for disbursement on the system. The treasurer validates the disbursement of savings in the system. The treasurer handed over the money to the students. Students can view the disbursement history on the system. The treasurer can set the ranking period in the system. Students can see the ranking of customers on the system. Admins can see the ranking of customers on the system. Admins can manage user data on the system. Admins can manage garbage data on the system. Students can view garbage information on the system. The treasurer inputs reports into the system. Deputy Deans can view reports on the system. Deputy Deans can validate reports on the system.
Researchers conducted interviews with Chair of the Garbage Bank, to find out the constraints on the system that is currently running in the field. The following are the disadvantages of the savings transaction system for Sahitya waste management: There is no web-based waste bank savings application, which causes the savings transaction process to take quite some time because the person in charge of the waste bank requires accuracy in calculating the deposit amount according to the waste category being weighed. The process of recording student savings resulting from depositing waste at the Garbage Bank is generally still manual using a savings book, so it is prone to loss or damage, duplication or loss of data, and writing that is often unclear. causing customers to be unable to access waste category information and transaction history information. The waste bank transaction system must meet the following functional requirements: There is authentication when the user logs in. The web system for student actors can provide a change password and forget password feature. The web system on the admin actor can create, read, and update user data. The web system on the admin actor can create, read, update, and delete trash data. The web system can download and upload report data. The web system can create and validate disbursement

data. The system provides a ranking feature to determine the customer with the highest amount of waste weight for a period of three months. The system can activate accounts via email. Meanwhile, the Non-Functional Requirement is that the system can speed up the process of depositing waste in the field so that customers do not have to wait long. The system is easy to use for waste bank administrators and customers. The system reduces errors during the process of inputting reports and disbursing savings made by the administrator.

After knowing the constraints on the running system, the researchers created a business process for a proposed web-based waste management system, which is described in the form of a rich picture as follows: Students register on the system. The administrator must activate the account via email. Students can change their respective account passwords on the system. Students can edit profiles. Students make garbage deposits at the Events Division. The Events Division sorts waste that has a selling value according to category. If trash is not accepted, the Events Division returns the trash to students. If the trash is received, the Events Division will weigh the trash and record the weight on the waste weight form. The Events Division inputs trash deposits into the system. The Events Division confirms the deposit amount that will be submitted to the Student. The treasurer looks at the waste weight form provided by the Events Division to ensure that the amount of deposit entered is correct. The treasurer validates the garbage deposit on the system. Students can see trash deposits in the system. Collectors take waste deposits to the Treasurer. Treasurer validation of sales of garbage on the system The collector hands over the money to the Treasurer. Students apply for disbursement on the system. The treasurer validates the disbursement of savings in the system. The treasurer handed over the money to the students. Students can view the disbursement history on the system. The treasurer can set the ranking period in the system. Students can see the ranking of customers in the system. Admins can see the ranking of customers on the system. Admins can manage user data on the system. Admins can manage garbage data on the system. Students can view garbage information on the system. The treasurer can view reports on the system. The Deputy Dean can download reports from the system. Deputy Deans can validate reports on the system. The Deputy Dean can see a graph on the system.

workshop design. In this phase, the researcher carried out a system design consisting of process design, database design, and User Interface (UI) design. The system process flow is built using an object-oriented system approach with Unified Modeling Language (UML) tools. The activity diagram describes the activity flow of a process formed from a typical course of events in the use case narrative. The activities in this system are: Students open the system, then the system will display the login page, then click registration, then display the registration page. Input the registration form, then click the registration button. The system will validate the user's email. If the email or nim has already been registered, the registration process will fail, and the system will return to the registration page. However, if it has never been registered, the system will save user data to the database and display a notification that the account has been successfully registered. The student opens the email. After that, an activation link will be sent automatically to the user's email. Students click the activation link that has been sent in the email. If the activation is successful, the system will display a successful activation notification. Students open the system, and then the system will display the login page. Then input the email and password and click enter. If the email and password do not match, then the login process fails. If the login process is successful, the system will display the home page. Students open the system, and then the system will display the login page. Then click forgot password, and the system will display the forgot password page. Then, input the registered email and click send email. The system will display a successful email notification. Students click settings, and then the system displays the settings page. Then, click Change Password, and the system displays the Change Password page. Next, input the new password, confirm the password, and click save. The system will display a notification that the password has been successfully changed. Students click settings, and then the system displays the settings page. Then, edit the profile, and the system displays the edit profile page. Next, edit the profile form and click save. The process is successful, and the system displays a notification that the password has been successfully changed. The Event Division opens the web system, and the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display a savings report page. Then, click Add, and the system displays the savings report form page. Then input the savings report form and click save. The system will display a notification that the data has been successfully saved. Treasurer clicking on system validation will display a pop-up alert with the message "Are you sure the validated data is correct?". Then, click OK, and the system displays a notification that the data has been successfully validated. Furthermore, if you want to reject the savings report, click Reject." The system will display a notification that the data has been successfully rejected. Students click the report, and then the system displays the savings report pages.

Treasurer clicking on system validation will display a pop-up alert with the message "Are you sure the validated data is correct?". Then, click OK, and the system displays a notification that the data has been successfully validated. The system will display a notification that the data has been successfully rejected. Students click home, ande then the system displays the main page. Then, click the disbursement application, and the system displays the disbursement request page. Next, input the date and amount of disbursement and click Submit Disbursement." The system displays a pop-up alert that the request has been successfully submitted. The treasurer opens the web system, and the system will display the login page. Then, input your email and password and click login. If the

process is successful, the system will display the dashboard page. Then, click ranking, and the system displays the disbursement page. Then click validation, if canceled it will return to the disbursement page. If the process is successful, the system displays a notification that the data has been successfully saved. Students click home, ande then the system displays the main page. Then, click on transaction history, and the system displays the disbursement history pages. The treasurer opens the web system, and the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Then, click the period, and the system displays the period list page. Then click add period, and the page will display the create period form page. Input the form and click create. Then the data was successfully added. Click edit, then the page will display the period form edit page. Edit the form, and click update. Then, the data was successfully updated. Students click the ranking, and then the system displays the ranking page. Then, the system will calculate the ranking assessment using the SAW method. Select the rating period and click filter, then the system will display a rating list. If the administratorn opens the web system,m then the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Then, click on the user data menu, and the system displays the user table page. Then click the edit icon; the admin edits the user data and clicks save. The system will display a notification that the data has been successfully saved. If the administratorn opens the web system,m then the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Then, click the trash data menu, and the system displays the trash information table page. Then click add goods, and the system displays the form page with the added item data. Enter item data and click Save." The system will display a notification that the data has been successfully saved. Students click the trash info button, and then the system displays the trash info page. Then, click the appropriate waste category, and the system will display a list of the appropriate waste categories. Next, search for the item name, and the system will display the trash name and price per kg. Treasurer clicks the report, and then the system displays the report page. Click PDF Export to display a list of monthly reports. The Deputy Dean clicks the report, and, then the system displays the report page. Click download, and the file will be automatically downloaded. The Deputy Dean clicks the report, and, then the system displays the report page. Click Validation, and then the system will display a successful validation report notification. Click Reject to reject the report. The Deputy Dean opens the web system, and the system will display a login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. All actors click Settings, and then the system displays the Settings page. Then, click logout; if canceled, it will return to the settings page. If successful, the user will exit the system, and the system will display the login page.

Sequence Diagram design, student actor activities, input the registration form on the register form, and click register. Then, the data will be stored in the Student database. Students successfully register on the system. admin actor Click activate on the email. The data will be validated on the student database. Students have successfully activated an account on the system. The actor inputs his email and password on the login page and clicks login. Then, the data will be validated on the Student database. The student successfully logged into the system. student clicks forgot password. Then, students input the registered email and click send. The data will be validated on the Student database. Automatic messages will be sent to the user's email. The student opens the email message and clicks the Create a new password link. Student inputs a new password and confirms the password. Then, click Reset Password." The data will be stored in the Student database. The student successfully saves the new password. Students click the settings menu. Then, click Change password. Students enter the new password and confirm the password. Next, click Save." The data will be stored in the Student database. The student managed to change the password. Students click Edit Profile on the settings page. Students edit the profile form and click Save." The data will be stored in the Student database. Students have successfully updated their profiles. event division actors click add on the savings report page. The event division inputs the savings report form and clicks Save." The data will be stored in the Junk Deposit Database. The treasurer enters the web system, and the data is validated against the DB User. Then, click the report menu. Treasurer, click validation. The data will be stored in DB History Savings. In addition, the treasurer can also click reject. The treasurer successfully rejected the savings report. Students click the report menu. Data will be obtained from DB History Savings. Students managed to see the garbage deposit. Treasurer, click validation. Then, the data will be stored in DB History Savings.

The sequence diagram for disbursement requests explains the activities of student actors clicking on disbursement requests on the home page. Then, input the disbursement application form and click Submit Disbursement." The data will be stored in the Disbursement History database. Students successfully apply for the disbursement of funds. The treasurer enters the web system, and the data is validated against the DB User. Then, click validation on the dashboard page. The data will be stored in the Disbursement History database. The treasurer succeeded in validating the disbursement. In addition, the treasurer can also click reject. The treasurer successfully rejected the disbursement request. student clicks on transaction history on the home page. The data will be obtained from the Disbursement History Database. Students managed to see the history of the disbursement of funds. admin clicks "period, and the system displays the period list page. Then click add period, and the page will display the create

period form page. Input the form and click create. Then, the data will be stored in DB Ranking. Click edit, then the page will display the period form edit page. Edit the form, and click update. Then, the data will be stored in DB Ranking. Sequence diagrams, customer rankings explaining the activities of student actors, and admin ratings on the ratings page. Then, the system will calculate the ranking assessment using the SAW method. Data will be obtained from DB Ranking. Students and admin managed to see customer rankings.

The managing sequence diagram explains the activities of the admin actor when clicking on the user data menu on the dashboard page. Admin, click the edit icon. Next, edit the user data edit form and click save. The data will be stored in the Student database. Students successfully edit user data. In addition, the admin can also click the delete icon. The data in the Student DB will be deleted. Admin managed to delete user data. The waste management sequence diagram explains the activities of admin actors entering the web system and validating data on the DB User. Then, click the trash data menu on the dashboard page. Admin clicks add items and inputs item data on the trash page. Next, click Save." The data will be stored on the Trash database. The student managed to add item data. In addition, the admin can click the edit icon. Then, edit the trash price edit form and click save. The data will be stored on the Trash database. A student successfully edits garbage data. In addition, the admin can also click the delete icon. The data will be deleted from the Trash database. Admin managed to delete user data. Sequence diagrams: see waste information explaining the activities of student actors; click the trash info menu. Students select a category and search for the name of the item. The data will come from the Garbage database. Students manage to see the data for the items they are looking for. Sequence diagram: see the report explaining the activities of the actor treasurer; click the report menu. Treasurer: click add, then select file, and click upload. The data will be stored in the Report DB. The treasurer managed to see the report. Sequence diagram To download report explaining the activities of the Vice Dean actors, click the report menu. Deputy Dean, click download. Data will be fetched from ReportDB. The treasurer successfully downloaded the report. The report validation sequence diagram explains the activities of the Deputy Dean actors. Click the report menu. Deputy Dean, click validation. The data will be stored in the Report DB. The treasurer succeeded in validating the report. In addition, the Deputy Dean can also click reject. The Deputy Dean successfully rejected the report. Sequence diagrams: see graphs explaining the activities of the Deputy Dean actors entering the web system and data being validated on the DB User. The Deputy Dean managed to look at the chart. The logout sequence diagram describes the activities of all logout click actors. The actor successfully logs out of the system.

Statechart Diagram Design: The initial process for registering is for students to open the waste management system, and then the system will display a login page. Then the student clicks Register, and the system will display a list page. The student actor inputs the registration form, then clicks the register button. The system will validate the user's email. If the email has already been registered, the registration process will fail, and the system will return to the registration page. However, if it has never been registered, the system will store user data. The administrator opens the account activation page. After that, click on account activation, and the system will display a successful account activation. When the user opens the system, the system will display the login page. Then input the email and password and click enter. If the email and password do not match, then the login process fails. If the login process is successful, the system will display the home page. Students open the system, and then the system will display the login page. Then click forgot password, and the system will display the forgot password page. Then, input the registered email and click send email. The system will display a successful email notification. Students click settings, and then the system displays the settings page. Then, click Change Password, and the system displays the Change Password page. Next, input the new password, confirm the password, and click save. The system will display a notification that the password has been successfully changed. Students click settings, and then the system displays the settings page. Then, edit the profile, and the system displays the edit profile page. Next, edit the profile form and click save. The process is successful, and the system displays a notification that the password has been successfully changed. The Event Division opens the web system, and the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display a savings report page. Then, click Add, and the system displays the savings report form page. Then input the savings report form and click save. The system will display a notification that the data has been successfully saved. The treasurer clicks the savings report, and the system displays the savings report page. Then click validation and confirmation, and the data will be saved. Click Reject and Confirm to reject the report. Students click the report, and then the system displays the savings report page.

The treasurer clicks the savings report, and the system displays the savings report page. Then click validation and confirmation, and the data will be saved. Students click home, and then the system displays the main page. Then, click the disbursement application, and the system displays the disbursement request page. Next, input the date and amount of disbursement and click Submit Disbursement." The system displays a pop-up alert that the request has been successfully submitted. The treasurer opens the web system, and the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Then, click ranking, and the system displays the fund disbursement page. Then click validation; if canceled, it will return to the fund disbursement page. If the process is successful, the system displays a

notification that the data has been successfully saved. Students click home, and then the system displays the main page. Then, click on transaction history, and the system displays the disbursement history pages. The treasurer opens the web system, and the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. The treasurer clicks the period, and the system displays the period list page. Then click add period, and the page will display the create period form page. Input the form and click create. Then the data will be saved. Click edit, then the page will display the period form edit page. Edit the form, and click update. Then the data will be saved. Students click on the ranking, and the system displays the ranking page in a list order based on the highest weight.
If the administrator opens the web system, then the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Then, click on the user data menu, and the system displays the user table page. Then click the edit icon; the admin edits the user data and clicks save. The system will display a notification that the data has been successfully saved. If the administrator opens the web system, then the system will display the login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Then, click the waste price data menu, and the system displays the waste price table page. Then click add goods, and the system displays the form page with the added item data. Enter item data and click Save." The system will display a notification that the data has been successfully saved. Students click the trash info button, and then the system displays the trash info page. Then, click the appropriate waste category, and the system will display a list of the appropriate waste categories. Next, search for the item name, and the system will display the trash name and price per kg. The treasurer opens the web system, and the system will display the dashboard page. Then, click Report." Select a report to view. Next, the data will be displayed. The Deputy Dean opens the web system, and, the system will display a dashboard page. Then, click Report." On the report page, click download. Next, confirm that the data has been successfully downloaded. The Deputy Dean opens the web system, and, the system will display a dashboard page. Then, click Report." On the report page, click validate. Then, the confirmation and data were successfully validated. The Deputy Dean opens the web system, and the system will display a login page. Then, input your email and password and click login. If the process is successful, the system will display the dashboard page. Students click settings, and then the system displays the settings page. Then, click logout; if canceled, it will return to the settings page. If successful, the user will exit the system, and the system will display the login page.

4. Conclusion

This research produces a savings transaction system for web-based waste management so that customers can register independently and view transaction history in real time. By using the SAW method, the system can assist treasurers in ranking customer ratings in various categories even though the amount of waste is the same. The existence of a security system in this savings transaction system with role-based access control (RBAC) can limit system access, as can AES-256 and AES-128 encryption to overcome cross-site request forgery (CSRF) attacks. There are several suggestions in this research for further development of the system being built, namely: further research can be developed for mobile applications. Adding a chat feature that makes it easier for students to communicate with the admin and fintech features to increase the attractiveness of the system to students.

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