VOL 3 (2019) NO 1

e-ISSN : 2549-9904
ISSN : 2549-9610

INTERNATIONAL JOURNAL ON INFORMATICS VISUALIZATION

Design of Location-Based Waste Collecting on Enviro Andalas Waste Bank

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***Abstract*— EnviroAndalas Waste Bank is engaged in worth selling dry waste management at Andalas University. Waste bank management activities include customer registration, waste bank transactions and picking-up of customer's waste. The high number of customers and the transactions result in high workloads for the operators. During picking up customer's waste, oftentlythe operator has difficulty in finding the pick-up location because the customer verbally gives the location instructions. Therefore the purpose of this study is to analyze, design, build, and test information systems for waste bank management at EnviroAndalasWaste Bank. The system development method used in this study is the waterfall method. In this study, the steps of the waterfall method used are requirements definitions, systems, and software design, implementation, and system testing. Application testing is carried out with black box testing and User Acceptance Testing (UAT) by the user. Blackbox testing of the functions has been in line with the initial system design and user requirements. This study resulted in web and mobile-based application on waste-bank management information system with location features that can be applied to the Enviro Andalas Waste Bank.**

***Keywords*— Waste Pickup, Waste Bank**

I. INTRODUCTION

In the previous study, it showed that the average waste generation of Andalas University campus was 0.12 kg/person/ day with the composition of plastic, paper, food waste, yard's waste and other waste. The waste portion that potentially can be recycled from this campus waste reached 80% [1]. Therefore, on September 24, 2014, the Integrated Waste Management Center (PPST) was inaugurated by the Rector of Andalas University. In 2015, the bank had 1819 customers and the total waste saved was around 2,871.26 kilograms. In the collection process, Enviro Andalas Waste Bank is also performing picking up the waste. The high number of customers and transactions resulted in operators start experiencing difficulties, especially at picking-up the waste. Waste Bank operators have difficulties finding the waste pick-up location because the location instructions given by the customers are only by verbal telephone calls. Web and mobile-based information system may become a solution for the needs of Enviro Andalas Waste Bank. Location features in the information system that will be developed help customers and waste bank operators in determining an accurate waste pick-up location.

The customer's waste picking-up service is one of the superior programs offered, and this is one of the priorities in meeting the standards of user satisfaction. [2][3][4]. Utilization of information systems is also a priority in the sustainability of waste banks [5][6][7]. The application of various web-based applications has been introduced to the waste management system in Dhaka [8] and the application of the concept of the Internet of Things (IoT) to the process of weighing waste [9] [10]. Meanwhile, consumer preferences for mobile applications in Indonesia in December 2015 reached 89% of the time of mobile web usage[11]. Based on these facts, the selection of web and mobile-based applications is very suitable in supporting the management of the Enviro Andalas waste bank.

Therefore, the development of web and mobile based application as part of the management of the EnviroAndalas waste bank was carried out in this study. The system was built by analyzing the management system, designing the system, building the system and testing the systems built for EnviroAndalas Waste Bank.

II. Research Method

The software development method adopts the Waterfall method [12]. The first stage is system analysis and system requirements collection, carried out by analyzing user requirements and modeling the proposed new system. The result of this stage is a new business process model that is described by BPMN (Business Process Model Notation). Then the next stage in system design. This system design consists of a database design model (ERD), user interface (UI) and application architecture design.

After the system design stage, the next step is the implementation of all designs in code form. System implementation is done using the PHP programming language with Laravel framework, MySQL as the database, and Basic for Android is used to build mobile applications. At the system testing stage, it is done by black box testing by comparing input data and the data stored in the MySQL database. Also, the User Acceptance Test (UAT) is conducted by application users such as tellers and customers.

III. System Analysis

The system analysis stage describes the current system position, the proposed system, and the system analysis that is modeled using UML (Unified Modeling Language). The UML used to analyze this system applies a case diagram, sequence diagram, and class analysis.

Based on the results of observations and analyses that have been carried out on EnviroAndalas Center for Integrated Waste Management (PPST), obtained information that the waste bank management system that was running in EnviroAndalas PPST had obtained savings that can be seen in BPMN in Figure 1.

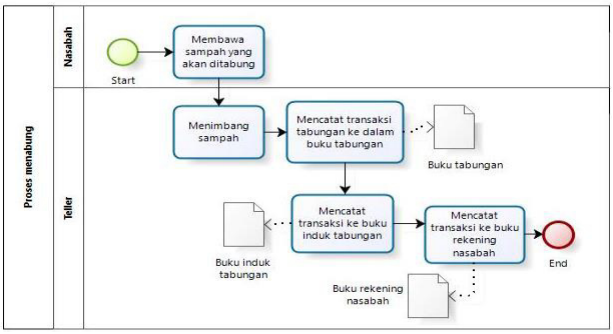

Fig. 1 Deposit transaction business process

On the description of the proposed process, the customer can deposit their waste by asking for picking-up of the waste or delivering the waste directly to the bank outlets/posts. If picking up the waste wanted, the customer shares the pick-up location thru the application, and thru this application, the teller can process the waste pick-up request and record the transaction by the system if the waste has been picked up.

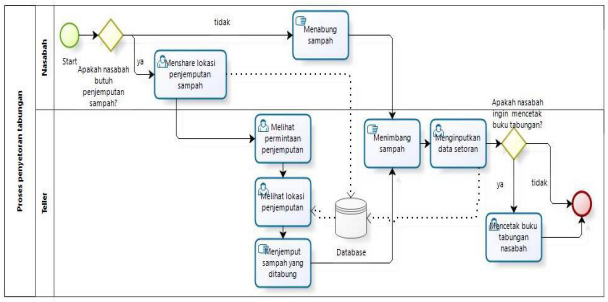

Fig. 2. Proposed Bussines Process for Waste Deposit Transaction

Based on the analysis of the process flow in Figure 2, some functional requirements of the applications can be formulated as shown below:

1. Teller can manage deposit transactions, withdrawals, and trash sales.
2. Customers can send the waste pick-up location.

Based on functional requirements, it was formulated a use case scenario to describe the steps of the user in using the function that is available in the system. The scenario of sharing the waste pick-up location is a flow of the process which is carried out by customer actor to share the waste pick-up locations.

TABLE 1
SCENARIO IN SHARING WASTE PICK UP LOCATION

Use case name	Share Waste Pickup Location
Actor	Customer
Entry Condition	Customer page
Scenario	1. System show customer homepage with the map 2. *Actor click* "pick my rubbish!" button 3. System save customers request to pick up their waste
Exit Condition	Waste pickup location is successfully saved

Sequence diagram for this process is assumed that the user has logged in first before continuing to the next process. This sequence diagram can be seen in Figure 3.

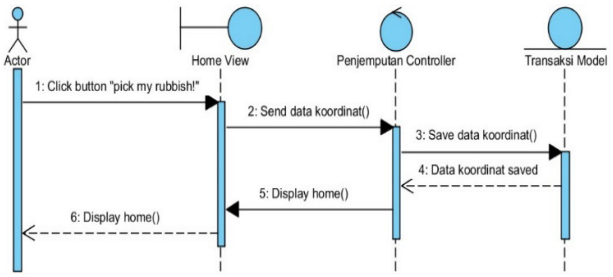

Fig. 3 Sequence Diagram for sharing Waste Pick up Location

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A. *Database Design*

The planned system designs are database design and application architecture. The designed database consists of fourteen tables. Theses tables consist of jadwal_penarikan, paket, jurusan, fakultas, roles, role_user, user, nasabah, sampah, transaksi_sampah, transaksi, pengepul, penjualan, and penjulan_sampah tables.

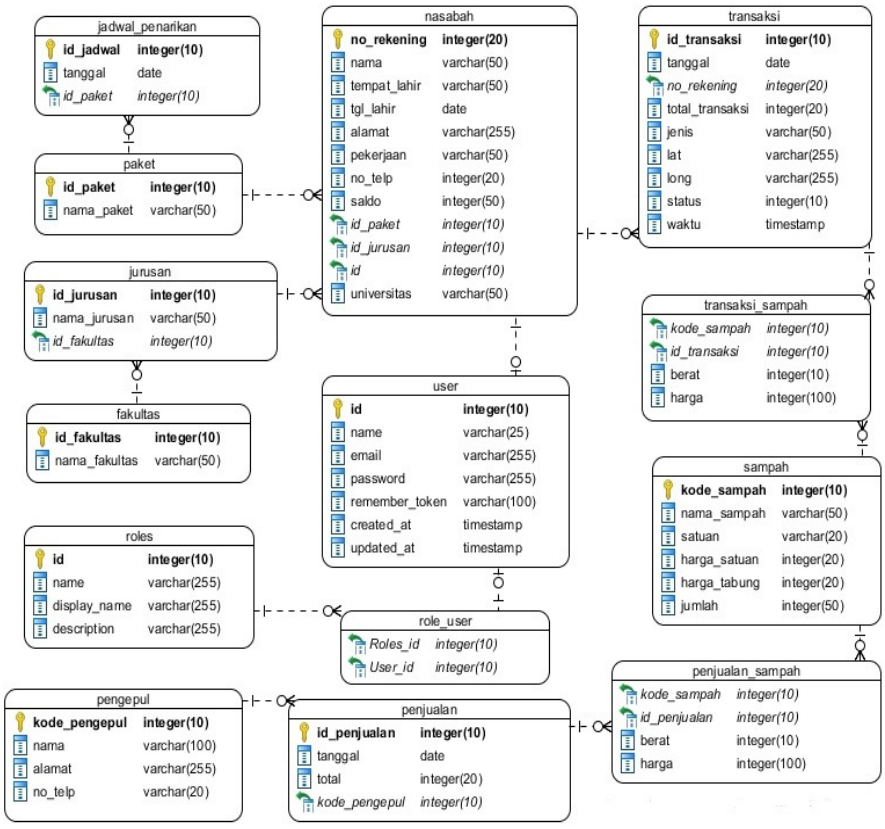

Fig. 4 Entity Relational Diagram

B. *Application Architecture Design*

This application uses the MVC architecture (Model View Controller) with the OOP (Object Oriented Programming) method that has been adopted by the Laravel framework. This architecture separates data (model), a display interface (view) and how to call both using the controller.

The mobile application also adopts the MVC architecture on the server side. The data from a database that has been converted into JSON form is invoked through the controller using *Jquery* or *Ajax*.

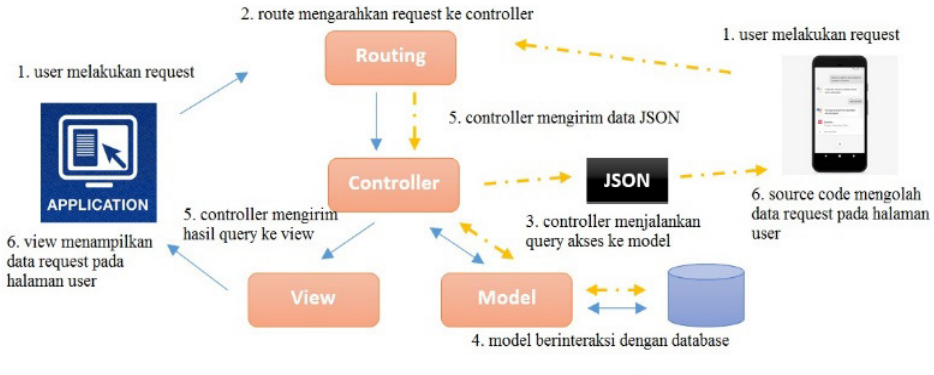

Fig. 5. Application Architecture

flow of web-apps

Flow of mobile-apps

C. System Design

The planned system design are database design and application architecture.

1) *Database Design*
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D. CODING IMPLEMENTATION

The view, model, and controller sections are explained separately based on their respective functions and uses.

Routing is the part that controls the transfer of requests from users. Part of the application routing program code can be seen in Figure 6. On this controller, a Transaction Controller class is created, which contains attributes and methods that can be used to call models, processing the data, and display the view. To enter deposit data, the setor () and storesetor () functions are used. The form is displayed from the view "transaksi. input penyetoran".

```
Class TransaksiController extends Controller
public function setor()
{
   $nasabah = Nasabah::all();
   $sampah = Sampah::all();
   $harga                                    =
Sampah::pluck("harga_tabung","kode_sampah")-
>toJson();
   return   view   ('transaksi.inputpenyetoran',
compact('nasabah',
   'sampah','harga'));
}
public function storesetor(Request $r)
{
   $transaksi = new transaksi();
   $transaksi->tanggal = $r->tanggal;
   $transaksi->no_rekening = $r->no_rekening;
   $transaksi->total_transaksi = $r->totalsetor;
   $transaksi->jenis = $r->jenis;
   $transaksi->save();

   for   (   $a   =   0;   $a   <   count   ($r-
>id_jenissampah); $a++ )
     {
        $test                                    =
transaksi::orderby('id_transaksi','desc')-
>first();
        echo $test;
        echo "<br>";
        $transaksi_sampah          =          new
transaksi_sampah();
        $transaksi_sampah->berat       =       $r-
>berat[$a];
        $transaksi_sampah->harga       =       $r-
>harga[$a];
        $transaksi_sampah->kode_sampah    =    $r-
>id_jenissampah[$a];
        $transaksi_sampah->id_transaksi  =  $test-
>id_transaksi;
        $transaksi_sampah->save();

       $sampah         =         Sampah::find($r-
>id_jenissampah[$a]);
       $sampah->jumlah  =  $sampah->jumlah  +  $r-
>berat[$a];
       $sampah->save();
     }
   $nasabah = Nasabah::find($r->no_rekening);
   $x = $nasabah->saldo + $r->totalsetor;
   $nasabah->saldo = $x;
   $nasabah->save();

   Session::flash('flash_message','Transaksi
penyetoran berhasil
   diinputkan!');
   return redirect('/datapenyetoran');
}
```

E. UI IMPLEMENTATION

UI implementation of the built application. The login page can only be used by a user who has access rights to the waste bank management information system. The home page is the interface page that is displayed when the user has logged in. On this page, the user can see general information needed by the user regarding management of Enviro Andalas waste bank.

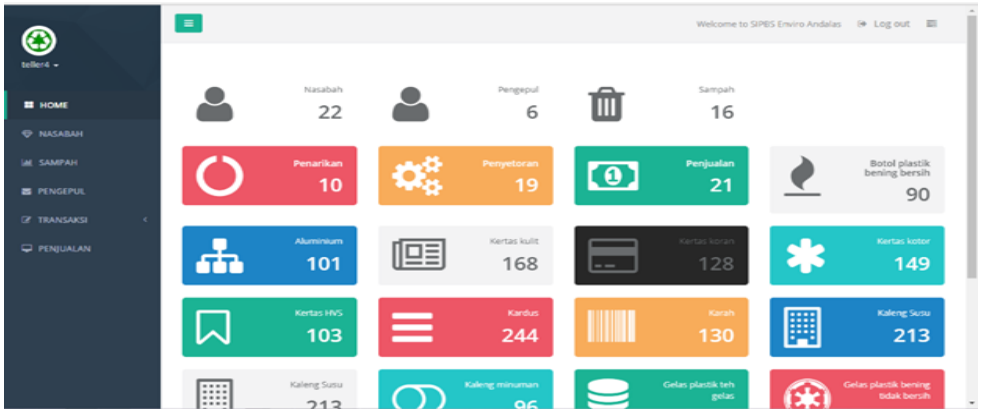

Fig. 8 UI implementation for teller

IV. SYSTEM TESTING

At the testing of collector data input, carried out the input data collector on the web application. The results of testing of the collector data input can be seen in Table 2.

TABLE 2
TESTING FOR DATA ENTRY BY THE COLLECTOR

Case and Success Testing Result	
Input	Collector code: 117 Name: Andre Pradipja Address: Jl. Mutiara No. 56, Tabing Phone No. : 081267363142
Proposed Output	The collector can store the actual data
Observation	The system provides a notification "Data has been saved!"
Result	Appropriate
Case and Alternate Testing Result	
Input	Collector code: 345 Name: Andre Pradipja Address: Jl. Mutiara No. 56, Tabing Phone No. : -
Proposed Output	The system cannot save new data entry
Observation	System show aa notification "*please fill out this field.*"
Result	Appropriate

The test is carried out by filling out the collector data form completely and correctly according to table 2, then pressing the "save" button. If successful, the system displays the collector data input form. The sales data input testing results in Figure 10 and Figure 11 show that the data has been successfully stored in the MySQL database.

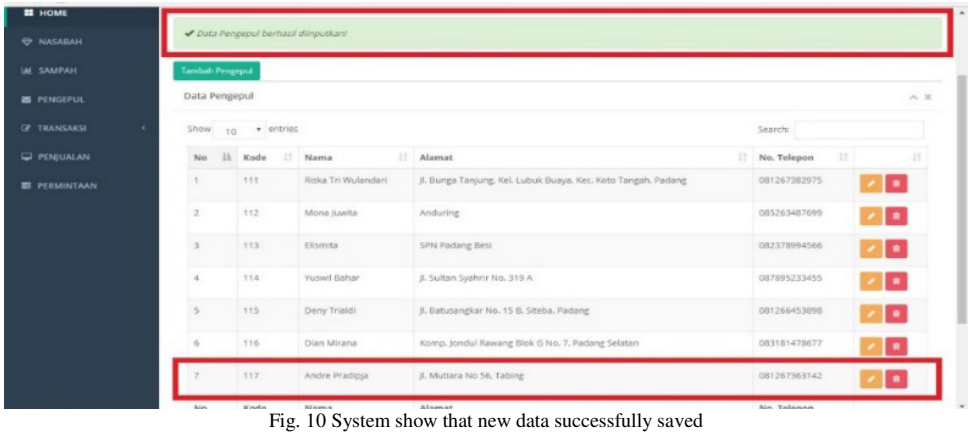

Fig. 10 System show that new data successfully saved

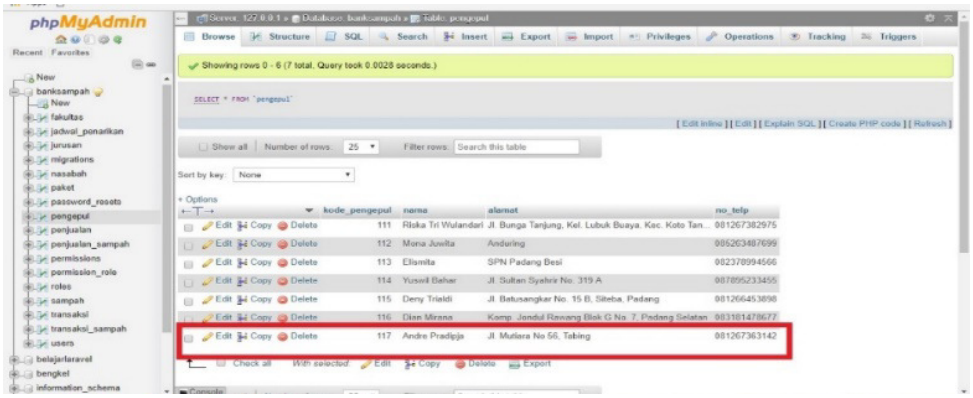

Fig. 11 A new entry is stored in the database

The test was carried out again with the same data but without filling collector data (without telephone number). The system displays an error notification.

V. CONCLUSIONS

The application for waste bank management at Enviro Andalas Waste Bank has been built with the stages of communication, planning, analysis, design, implementation, and testing and concludes as follows:

1. At the stage of analysis, it was formulated the needs of management, customers and teller and functional users.
2. Database design formulates the system has 14 tables. The controller used was 11 controllers and the model used was 13 models.
3. Application testing has been carried out with black box testing which concluded that the application input was consistent with the output generated by the system and UAT produced recommendations had been in line with user needs

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