Design and Implementation of Various Payment System for Product Transaction in Mobile Application

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***Abstract*— *The development of technology and information has spread to various sectors, especially the product marketing sector and product transactions. The presence of e-commerce brings new changes in the world of business production and marketing. Therefore, changes to the payment method must also follow the scheme of e-commerce, namely payments connected to the internet. The e-payment makes it easy for buyers to transact non-cash and provides convenience for buyers in terms of time and also the ease of purchasing goods because e-payment is very important for e-commerce. the Indonesian market has different characteristics and is quite unique, because in fact the use of credit cards has not been so popularly used. Transactions via ATM transfers are the most dominant payment method used followed by e-money or e-wallet payment methods. In this research, a payment system was tested on local e-commerce applications, the system was built on mobile applications and web services with the REST API, mobile applications as clients and web services as servers. The test was carried out by evaluating the performance of the payment system for thirty users in seven days, the results of this research showed that the performance of the payment system and the authentication process of payment system.*

Keywords—REST API, Web Services, Mobile Application, Payment System, E-commerce

I. INTRODUCTION

Technological developments in the current era have experienced a lot of progress. In the world of business and business, technological developments are very helpful in various ways such as competition and product marketing mobility. One of the developments in information technology is the presence of e-commerce. E-commerce is one platformthat provides or can make online Transaction or also can be a way to shop or trade online or direct selling that utilizes Internet facilities where there are platforms that can provide "get and deliver" services. The existence of an e-commerce system creates a new payment system that is more effective than conventional system payments. Therefore, the electronic payment system is present as one solution to replace cash payments. Sales of goods and services increased significantly with the adoption of the use of e-payment systems so that electronic payments became an increasingly important part of the payment system[1].

e-payment is a system that provides payment services for the purchase of goods or services made through the Internet. The e-payment provides easy transactions between sellers and buyers. The use of e-payment also has benefits for payers, sellers, as well as e-commerce and government. The e-payment can save the transaction transaction data for later as a further analysis material that can determine consumer trends and also the market share of a region of a product. Other benefits of e-payment are fast payment, reduced use of time, cost savings and also increased user and buyer trust [2]. The development and adoption of technology in electronic payment systes involves financial transactions, users assimilated and quality electronic payment technologies tend to shape their own perceptions and expectations [3].

On of the most popular payment form online are credit card and debit. Besides them, there are also alternatives payment methods. Such as bank transfer, electronic wallet or bitcoin walltet [4]. In this study an e-commerce platform was built in the form of a mobile application integrated with the payment system and adapted to the payment model designed. There are three payment models built in this study, among them are payments with e-wallet concept and bank transfer payments. The bank transfer payment consists of two methods namely manual bank transfer with manual verification by the ecommerce admin and the second is payment with the virtual account method that can automatically verify a payment by its system.

This paper discussed design and implementation of various payment system in e-commerce platform. Section 1 discussed the e-payment system in e-commerce. Section 2 discussed material and payment model. Section 3 discussed system design. Section 4 discusses the experimental result. And the last section is section 5 discussed the conclusion.

II. MATERIAL AND PAYMENT MODEL

A. Mobile Application

.The application built on research is an application using the Android operating system. Adndroid operating system runs on devices such as smartphones, tablets and computers.

Android was developed by Google for software developers to develop various kinds of mobile applications. [5]. To develop Android applications using the Java SDK, Android Studio and use the Java programming language and XML for user interface.

B. Server Based on REST API

REST is a software architecture for designing systems from a software. Rest is one of the models that is usually applied to web services. REST uses the terms client and server that are used to separate the user interface and data storage [6]. The uniqueness of REST is the interaction between clients and servers facilitated by a number of verb operational types and Universar Resource Identifiers (URi) that are unique to each resource. Each method GET, POST, PUT, DELETE has special operational meaning to avoid ambiguity. Web-based services that use such REST architectures are called RESTful APIs (Application Programming Interfaces) or REST APIs.

C. Payment Model

We propose a payment system based on a mobile application. The system is proposed by simulating purchasing activities carried out by buyers. The procedure of buying our payment systems is the same as that in a real life. Our main focus is on the purchasing (how customers interact with traders) and the payment process (how money is settled). The buyer must choose one payment method, e-wallet or bank transfer, then the system processes the payment until the order status of the product changes. The main entities involved are buyers, sellers and payment systems. In distinguishing payment methods we use IDs on each payment method and also the order id for products purchased by the buyer so that the system can identify easily.

The details of the information payment mode are as follows. The buyer first signs in to the application to get the token from the server as a security facility when the buyer makes a transaction on the application, the token used uses the jwt token generated by the server [7]. The buyer first chooses the product to be purchased after that the product that has been purchased by the buyer will go through the payment process until the product is received by the buyer, the buyer determines the quantity of the product ordered, this is useful for the seller to know the number of products that will be sent to the buyer. checking the shipping address after the payment info process is done, then the buyer chooses the payment method. in this research, two payment methods are provided, namely automatic and manual checking. payment by automatic checking is authorized by the server using the midtrans payment vendor service. the buyer is given a virtual account number to make payments at the ATM machine or Internet banking, the virtual account number has a certain active period of twenty-four hours. On payment by manual checking, the buyer enters account data and also sends the nominal price of the item purchased, verification is done by the master admin. payment using the e-wallet system first checks the balance of the buyer's balance then the buyer can make a payment if the balance value is more than or equal to the price of the product purchased.

The transaction is successful if the order status has changed, the change in order status depends on the completion of the payment made by the buyer and has passed the verification process by the system.

III. SYSTEM DESIGN

System design is the stage after analysis of the system development cycle. Defining the needs of functional requirements and preparation for design and implementation describes how a system is formed.

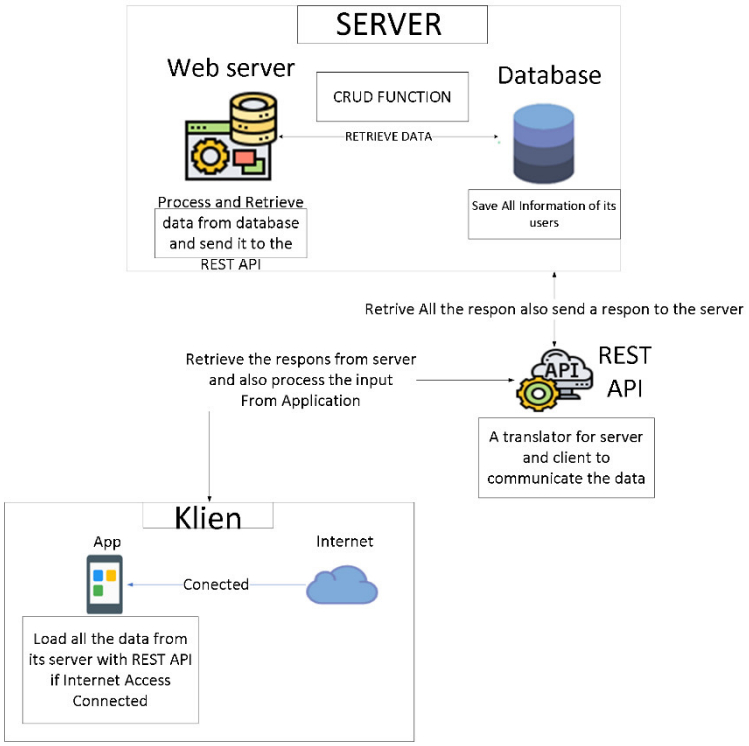

Figure 1. System Design

In the system design this time it is shown that the backend server that is created is a server to process the data received from the client application and send the results to the client application. On the server side there are two entities, namely the web service and also the database. In the web service consists of many functions to process data from the database then produce output that can be accessed by the application via the URi method GET, POST, PUT and DELETE which refers to the architecture of the REST API. The database stores all information from components in e-commerce, which consists of user data, order lists, and also products based on its categories. On the client side, the task is to provide input to the server and display the processed data from the server. The client provides information on purchasing goods and then processes them by the server and the data is stored in the database.

A. Authentication from Client to Server

Security is an important part of every web application, and developers must ensure that they design applications with secure authentication. The server provides an authentication process using JWT (JSON Web Token) [7]. When a user logs in on a mobile application with his username and password, the authentication server usually creates and sends JWT back. This JWT is then forwarded along with the next API call to the server. JWT remains

valid unless it expires or the user logs out of the application. This process can be illustrated in the diagram below on Fig 2 [8].

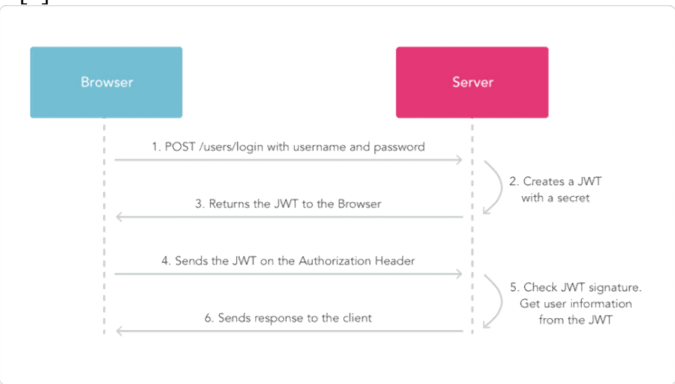

Figure 2. Authentication Diagram with JWT

B. CE-Mart

CE-Mart is a project that simulates real life e-commerce application. There are simmiliar E-commerce application like Tokopedia and Bukalapak [8] that also provides product display, sell and buy products, and there is a admin that verifiy manual payment by buyer. The Payment model mentioned in the previous section and the implementation provided by CE-Mart. Each payment method has different function and need spesification in order to operate properly, we differentiate each payment method using the payment ID when the client sends ordering information to the server.

For payments with automatic verification, the server will send information from the product and the price purchased to the payment gateway. The e-wallet payment process at CE-Mart is shown in Fig 3, the payment process using bank transfer is shown in Fig 4. The payment gateway that has received order information from the server will send a notification to the server that the payment has been successful and the buyer has deducted the balance, this process requires tokens stored on the database when the buyer log in to the mobile application. the server will update the order status changes to "paid" and wait for the process of shipping goods from the seller to the buyer. Payment with the manual payment model requires verification by the admin before the order status changes to the database and sends a notification to the seller.

E-Wallet Process Alghorithm
Client :
Start and Connect
Retrieve Buyer Balance from server
If select Itemthen
Display product information
If buy product then
Add to shop cart
If select shopping cart
Then display order list
If add quantity then
Update quantity
If pressed process checkout button
Go to order form and fill required fields
If Choose Payment Method
Select e-wallet
Checking balances
If balance is enough to proceed payment then
Go to checkout screen
Else Process Payment failed
If pressed checkout button then
Display dialog success order
Read token
If Available then
Send information order to server
Send payment method ID
Reduce balance
Else Not Available then
Re-log to application
Dsiplay previous screen
Else
failed to process payment
dialog failed order
Reload order and internet until display dialog success order.

Server :
If receive order information then
Connect to payment gateway
Read payment method ID
Read Token
Retrieve data message from payment gateway
If data message success
Then reduce balance
Send success message to the client
Change status order to “paid”
Send notification to merchant
Waiting to order processed by seller
If message failed
Then send message failed to client

Figure 3. E-wallet Payment Process

Bank Transfer Alghorithm
Client :
Start and Connect
Retrieve Buyer Balance from server
If select Itemthen
Display product information
If buy product then
Add to shop cart
If select shopping cart
Then display order list
If add quantity then
Update quantity
If pressed process checkout button
Go to order form and fill required fields
If Choose Payment Method
If Choose Automatic Bank Transfer
Back to checkout screen
If pressed checkout button then
Display dialog success order
Send information order to server
Display Payment Information Screen
Retrieve Virtual Account Number from server
Waiting to be paid by buyer
If Paid

Then Retrieve Notification from server
Else
Wait until limit time has reached
If reached limit time
Virtual Account expired
Else if Choose manual payment
Back to previous checkout screen
If pressed checkout button then
Display dialog success order
Send information order to server
Display Payment Information Screen
Fill the required field
Display limit time for payment and total price
If Paid
Then Retrieve Notification from server
Else
Wait until limit time has reached
If reached limit time
Payment status expired

Server :
If receive order information then
Connect to payment gateway
Read payment method ID
Read Token
Retrieve data message from payment gateway
If data message success
Then Send success message to the client
Change status order to "paid"
Send notification to merchant
Waiting to order processed by seller

Figure 4. Bank Transfer Process

IV. Experimental Result

This section will show the result of each payment method and also performance measurement based on real testing by user with total seven days. Each day has various amount of transaction by users. For the purpose of testing applications and payment systems we empower several small and medium micro businesses to fill the product catalog on our e-commerce mobile application. This test displays the process of exchanging information from clients and servers and from the server to the payment gateway.

A. Authenthication Process

Authentication process is done when the application is first run, a successful login process will generate tokens which will be used as a security system when processing transactions and also load balance when using e-wallet. In Fig 5 shows the process of the login in the application.

A token that has exceeded the expiration limit will give a message that the token cannot be used otherwise if one account logs in simultaneously the server sends a message that the token has been used which means that at one time one account cannot process payments and open the main page of e-commerce. The results issued by the system are invalid signatures in figure 6.

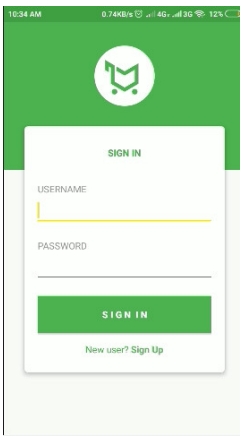

Figure 5. Login Form From Client

Figure 6. Incorrect Token

Testing of expired tokens is done by using tokens that expire from more than 24 hours after being created, this test can be carried out throughout the existing backend system except for the login and user list. The results released by the system are Jwt Expired in figure 7.

Figure 7. The token has expired

if the login is successful then the response from the server is shown in fig 8. after that the token is stored in the database and will be reused when the buyer makes a payment.

Figure 8. Success Login from Server

B. *Payment System*

If the product has been agreed to be purchased by the buyer, then the display on the application towards the checout page, shown in figure 9. On the checkout page, the total price paid by the consumer and the tax charged by the consumer, the customer fill in the address data for product delivery and then choose the method payment with the bank or with the e-wallet after pressing the proceed button to complete the transaction, the system reads the addition of order data and a dialog appears that the transaction is processed and waits for a status change approved by the seller. The system provides a transaction code in the form of a random string, shown in figure 10. If the buyer presses "ok" then the system runs the screen according to the chosen payment method, if the payment chosen is e-wallet / ezpay then the balance is automatically reduced.

The other payment method is manual payment method, where the consumer needs to enter the account number and also the name of the account owner, when the submission is complete the system displays a screen containing information on the payment deadline and account number for payment purposes and is unique for payment. If the product purchased with the manual payment method has been paid, the admin checks the payment for verification.

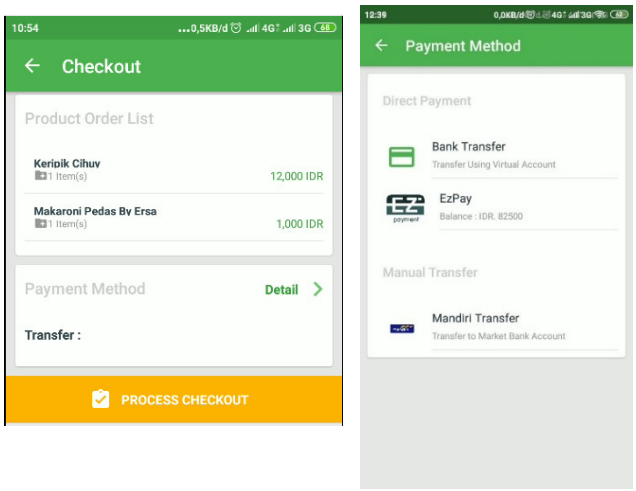

Figure 9. Payment Method

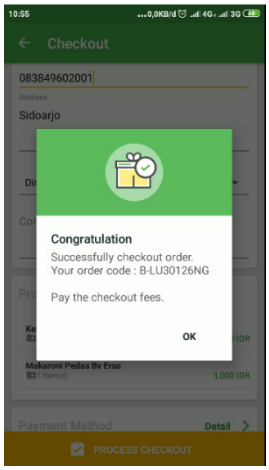

Figure 10. Dialog success order

In the payment test, there is a payment gateway to collect order payments when accessing the API, what is needed is order id and also payment id method.

C. *Performance Measurement*

In our experiments, the server always allows concurrent users to request a payment and all the requests can be executed concurrently. In this test, the system will be accessed by 50 users with seven days experiment. Table I are the test results:

TABLE I. TESTING ALL SYSTEM

Days	Transaction in day	Success Rate	Connect Time (ms)	Load Time (ms)
1	2	100 %	4	174
2	20	100 %	5	250,8
3	18	100 %	5	212,9
4	10	100%	5	190,12
5	13	100 %	5	214,9
6	25	100 %	5,7	254,1
7	10	100 %	5	175,6

from table 1 explains that more transactions in one day can change the traffic of receiving data from the client to the server. This is due to the fact that many payments are made at one time, it will take time for a payment gateway to process longer, because in the payment gateway there is a token check and system checks from the bank to keep the payment process safe.

V. CONCLUSION

Based on the results of the test, a temporary conclusion can be taken as follows:

1. Payment system in this paper uses two methods, namely manual and also payment with automatic verification, namely the e-wallet and also virtual account The workflow of transactions on this application is to use E-wallet for cashless payments and also manual payments. Payments using E-wallet require the process of topping up the balance before the payment transaction process on the product to be purchased. In the manual payment system, verification needs to be done by the admin and then changing the payment status.

2. Tokens from JSON Web tokens (JWT) as the system's basic security for each client application data request.

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