

## CHAPTER 4

### ANALYSIS AND DESIGN

#### 4.1 Analysis

Recommendation system is a system built which the purpose is to facilitate the user by providing information in the form of recommendations for its users. In this project, recommendations are recommended for web-based gadgets. The recommendation system is built with client-server architecture. The client part will be used by the user to login, register or logout, also to access the system content, and get the recommendations. On the server itself the rating will be calculated using the slope one algorithm and give the item recommendation to the user.

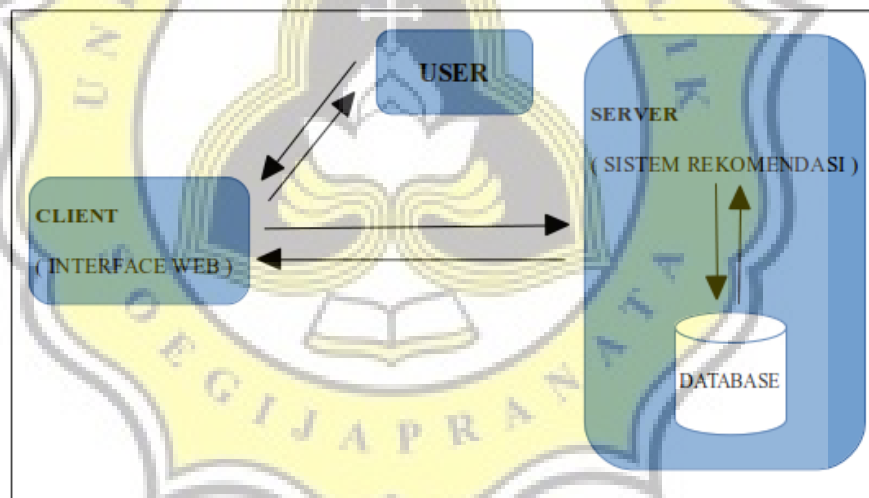


Illustration 4.1 Arsitektur sistem

From the illustration above, the server receives an input from the user and determine the options or the alternatives based on the other existing user data. The data will be stored into the database as the user history, then the server will perform the rating calculation by using slope one algorithm against the user pre-stored in the database in phpmyadmin. The stored database contains data will be saved in the name of tblproduct that contains product names, a table of user will

be saved in the name of users, and a table of rating will be saved in the name of `tbluserrating`. Then the results will be displayed based on the similarity of previous user alternatives using slope one algorithm calculation. The output shown is five recommended product from the rating previously given by the other user.

This project consists of three main objects; User, Item, and Interaction between user and item. Users are subject to recommendation systems. What users can do is to rate and receive the recommendations. There is only one type of user, that users who have registered as a member. Users registered as members will get full access rights. While Item itself is the object that will be recommended to the user. The value of an item is displayed in the form given by the user through the rating. Because the project uses collaborative filtering that recommends items to users based on ratings given by a group of other users. Rating given in the form of numbers with range 1-5.

According to Alex Lin (Irfan, 2010) there are several techniques in developing a recommendation system, including Knowledge Based Recommender System, Content Based Recommender System, Demographic Based Recommender System, and Collaborative Filtering. In collaborative filtering, recommendations are given based on what is obtained between users who have rated or interacted with the system. According to George Karypis there are two techniques, namely User-Based Collaborative and Item-Based Collaborative (2001). User-Based Collaborative is a technique by finding a number of users who have a high relationship, then the system will provide recommendations for a number of items that may be favored by a number of users based on the relationship. In contrast to user-based collaborative, the Item-Based Collaborative sought is a correlation or relationship between items that are preferred by the user, then the related item is recommended for a number of other users.

In the Collaborative Filtering scenario, there is a set of user with a list of  $m$  users  $U = \{ u_1, u_2, u_3, \dots, u_m \}$  and a list of  $n$  Items  $I = \{ i_1, i_2, i_3, \dots, i_n \}$ . Each user  $u_i$  has a list of items  $I_{u_i}$ , which is an expression of his opinion.

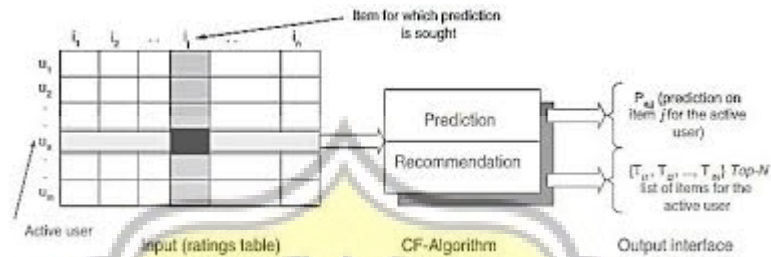


Illustration 4.2 Schema Collaborative Filtering

In the picture above, shows a schematic diagram of the collaborative filtering process. Represented that all  $m \times n$  user-data items as a rating matrix which contains the rating value of the user for each item. Active users  $u_a$  in the above scheme are users who will search for items that they might like using collaborative filtering algorithms. Items that may be liked by the user are represented in two forms (George Karypis, 2001), namely Predictions and Recommendations. Prediction is a numerical value, where  $P_{a,j}$  is the rating prediction value of item  $j$  that may be favored by  $u_a$ . Recommendation is a list of  $N$  items that  $U$  might like. Note that the recommended items have never been bought or rated by  $u_a$ . This is often called top- $N$  recommendation.

The first slope one predictor was introduced for an online rating by Daniel Lemire. The basic idea is to answer the question of how a user will judge a given item. The slope one method uses another user's rating to answer this question.

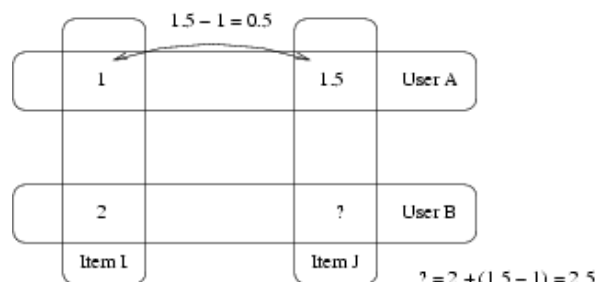


Illustration 4.3 The Basic of Slope One Algorithm

The regression form used by slope one is free parameter regression ( $y = x + b$ ). This form is simpler than the linear regression form ( $y = ax + b$ ) which is commonly used in predicting based on rating. The slope one algorithm works with the intuitive principle of "popularity differential" between items and users.

$$y = x + b$$

where :

$y$  = predictee item ( item yang akan diprediksi)

$x$  = nilai rating awal predictee user

$b$  = selisih nilai rating / jumlah pasangan yang merating

Researcher also modifies the slope one algorithm formula by adding variable  $Z$ . Variable  $Z$  is obtained from the most number of products that have been rated by the user. The purpose of adding the value of variable  $Z$  is so that the results produced have good credibility. Then the slope one algorithm formula used in this project is as follows:

$$y = x + b + z$$

where :

$y$  = predictee item ( item yang akan diprediksi)

$x$  = nilai rating awal predictee user

$b$  = selisih nilai rating / jumlah pasangan yang merating

$z$  = jumlah produk tertinggi yang diberikan oleh user

#### 4.1.1 The Slope One Algorithm

The way Collaborative Filtering works is by filtering information based on the similarity of ratings given by selected users. The information filtering process is carried out using the slope one algorithm. The slope one algorithm gives a prediction of user rating by comparing the value of a pair of items from one user and then comparing it to the user that will be predicted. In this project, users can compare more than one user by way of facing the desired user as a reference, where the items are related. From the prediction results will be sorted from the highest to the lowest value. In this project, the top 5 items will be taken. Like the previous explanation, the modification slope one algorithm works as follows:

$$y = x + b + z$$

where :

y = predictee item ( item yang akan diprediksi)

x = nilai rating awal predictee user

b = selisih nilai rating / jumlah pasangan yang merating

z = jumlah produk tertinggi yang diberikan oleh user

Table 4.1: The Example of Data

ID User	Username	ID Product / RATING									
		9	15	26	33	46	50	62	70	87	93
20	ganis	2	1	1	0	0	2	1	2	0	2
21	yohana	0	0	0	0	5	5	0	0	0	5
22	gun	0	1	3	0	3	4	3	1	1	5
23	tangub	5	2	3	0	3	0	0	2	0	0
24	bet	0	0	0	2	0	0	0	5	0	0

The workings of the slope one algorithm will be exemplified in the explanation below. In the system, the logged in user selects 2 reference users, 3 reference products or comparison products by calculating all products, namely user gun and tangub and 5.0 Elephone P6000 MTK6732 64-bit Quad Core 2GB/16GB Android 4.4 Mobile Phone(Black), 5.5 HD Display Unlocked Smartphones Android 4G GSM USA Worldwide Dual Sim Quad Core - Plum Z550 – Black dan Andy A4.5 - Factory Unlocked Phone - Yezz Wireless (White) products, then only users and products will be counted. As previously explained, the simple equation for slope one is as follows:

$$y = x + b + z$$

where :

y = predictee item ( item yang akan diprediksi)

x = nilai rating awal predictee user

b = selisih nilai rating / jumlah pasangan yang merating

z = jumlah produk tertinggi yang diberikan oleh user

Based on the equation above, the resulting calculation is as below which will be explained in table form.

Table 4.2: The Calculation of selected user and product

User : gun	Nilai
Terhadap produk ref : 15	
9 thd 15	9.5
15 thd 15	0
26 thd 15	10.6
33 thd 15	Tak terhitung
46 thd 15	11
50 thd 15	11.5
62 thd 15	11
70 thd 15	10
87 thd 15	10
93 thd 15	12

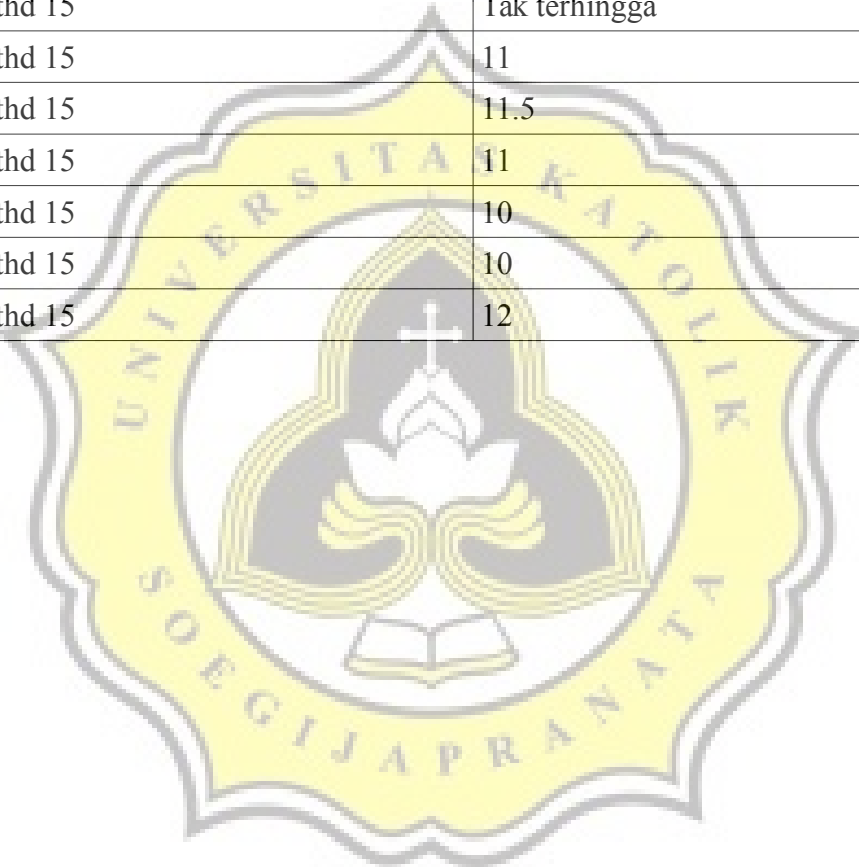


Table 4.3: The Calculation of selected user and product

User : gun	Nilai
Terhadap produk ref : 26	
9 thd 26	8.5
15 thd 26	9.3
26 thd 26	0
33 thd 26	Tak terhingga
46 thd 26	10
50 thd 26	10.5
62 thd 26	10
70 thd 26	9.3
87 thd 26	8
93 thd 26	11

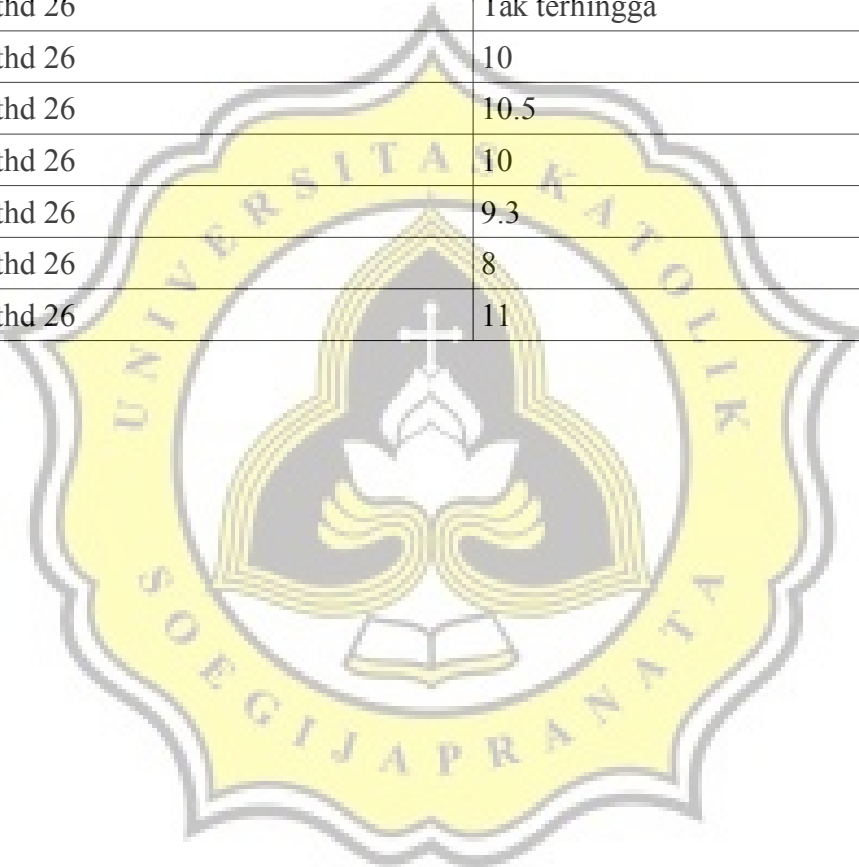




Table 4.4: The Calculation of selected user and product

User : gun	Nilai
<b>Terhadap produk ref : 70</b>	
9 thd 70	9.5
15 thd 70	10
26 thd 70	10.6
33 thd 70	9
46 thd 70	11
50 thd 70	11.5
62 thd 70	11
70 thd 70	0
87 thd 70	10
93 thd 70	12

Table 4.5: The Calculation of selected user and product

User : tangub	Nilai
<b>Terhadap produk ref : 15</b>	
9 thd 15	11.5
15 thd 15	0
26 thd 15	10.3
33 thd 15	Tak terhingga
46 thd 15	10.5
50 thd 15	9
62 thd 15	9
70 thd 15	10
87 thd 15	8
93 thd 15	9

User : tangub	Nilai
<b>Terhadap produk ref : 26</b>	
9 thd 26	11
15 thd 26	9.6
26 thd 26	0
33 thd 26	Tak terhingga
46 thd 26	10
50 thd 26	8.5
62 thd 26	8.5
70 thd 26	9.6
87 thd 26	7
93 thd 26	8.5

Table 4.6: The Calculation of selected user and product

Table 4.7: The Calculation of selected user and product

User : tangub	Nilai
<b>Terhadap produk ref : 70</b>	
9 thd 70	11.5
15 thd 70	10
26 thd 70	10.3
33 thd 70	8
46 thd 70	10.5
50 thd 70	9
62 thd 70	9
70 thd 70	0
87 thd 70	8
93 thd 70	9

The final result of the slope one algorithm is as shown below. The final result is sorted from the highest value with the limit only the top 5 products are displayed. An explanation of the product id will be explained in the table below

User Referensi	Nama Produk	Nilai
gun	Apple iPhone 4s - 8GB - White (U.S. Cellular) Smartphone Clean ESN	12
gun	Apple iPhone 4s - 8GB - White (U.S. Cellular) Smartphone Clean ESN	12
tangub	2016 Latest Mini6 Small Android 5.1 Smart Mobile Cell Phone Touch Screen Can Work Worldwide (Black)	11.5
gun	Alcatel One Touch Fierce 2, 4GB, 5 Screen, Unlocked	11.5
tangub	2016 Latest Mini6 Small Android 5.1 Smart Mobile Cell Phone Touch Screen Can Work Worldwide (Black)	11.5
<b>Waktu Eksekusi</b>	<b>0.57233881950378</b>	

Table 4.8: The Final Result

ID Product	Product Name
9	2016 Latest Mini6 Small Android 5.1 Smart Mobile Cell Phone Touch Screen Can Work Worldwide (Black)
26	5.0 Elephone P6000 MTK6732 64-bit Quad Core 2GB/16GB Android 4.4 Mobile Phone(Black)
26	5.5 HD Display Unlocked Smartphones Android 4G GSM USA Worldwide Dual Sim Quad Core - Plum Z550 - Black
33	5.5 Unlocked GSM Smartphones Android 5.1 MTK6580 Quad Core Dual Sim Quadband-JUNING 3G Cellphone White
46	Acer Unlocked Dual Sim Smart Phone Liquid Z200
50	Alcatel One Touch Fierce 2, 4GB, 5 Screen, Unlocked
62	Amar black 7 Phablet GSM Unlock Pc Tablet 4gb Android Dual Camera Wifi + Calling Option Black 7 2g GSM Android Capacitive Touchscreen Tablet Smartphone Unlocked / A13 1200 Mhz / Dual Camera
70	Andy A4.5 - Factory Unlocked Phone - Yezz Wireless (White)
87	Apple iPhone 4 8GB - White - AT&T
93	Apple iPhone 4s - 8GB - White (U.S. Cellular) Smartphone Clean ESN

Table 4.9: Product Name of example calculation

## 4.2 Design

### 4.2.1 Flow Chart

From the flowchart algorithm slope one below, after the content being displayed, the program will check the user rating data. If the user never gives a rating to an item, then it is required to provide a rating. If the user ever gave a rating, then the rating data can be updated. After that the data will be saved on database.

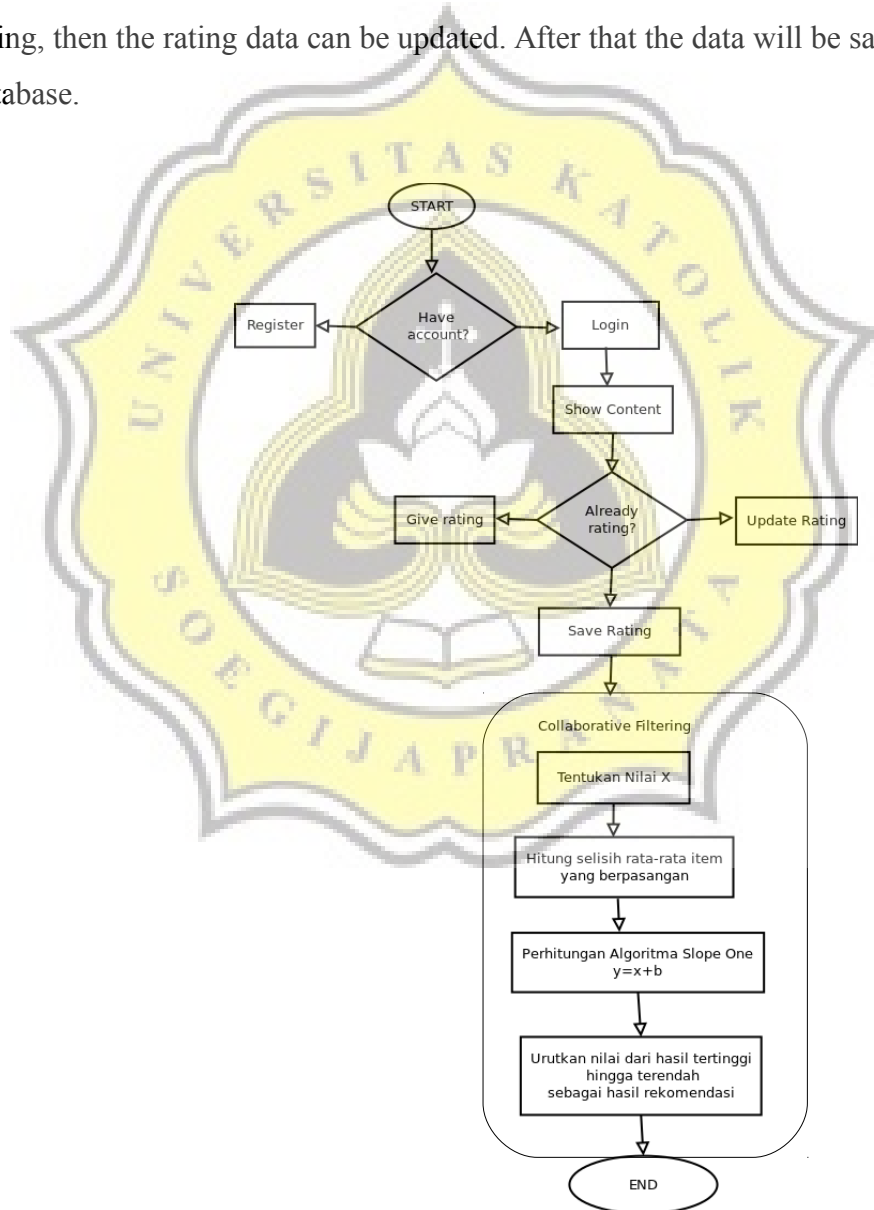


Illustration 4.4 Flow Chart

#### 4.2.2 Database Schema

All product will be saved into tblProduct. After the user logged in, what will be done is to give rating on the product user want to be rated, then select the smartphone data from tblProduct. After the user gives a rating, then insert the rating data into tblUserRating. When the insert process is done, the user no longer to enter the product name and the price, but only with the id\_product.

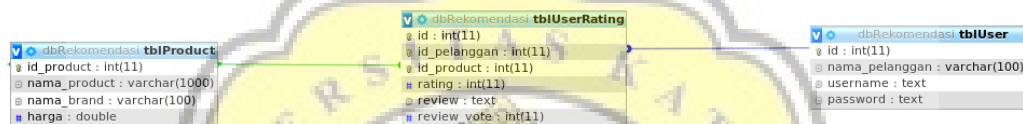


Illustration 4.5 Database Shcema

### 4.2.3 Graphical User Interface Design

Firsly, user member must login with username or email and password that already registered. If a user who is not registered wants to get a gadget recommendation, then the user must register first.

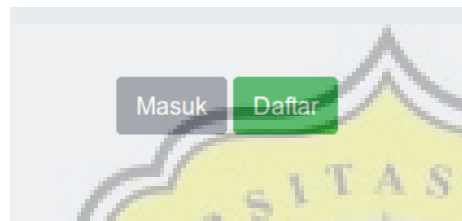


Illustration 4.6 Index Page

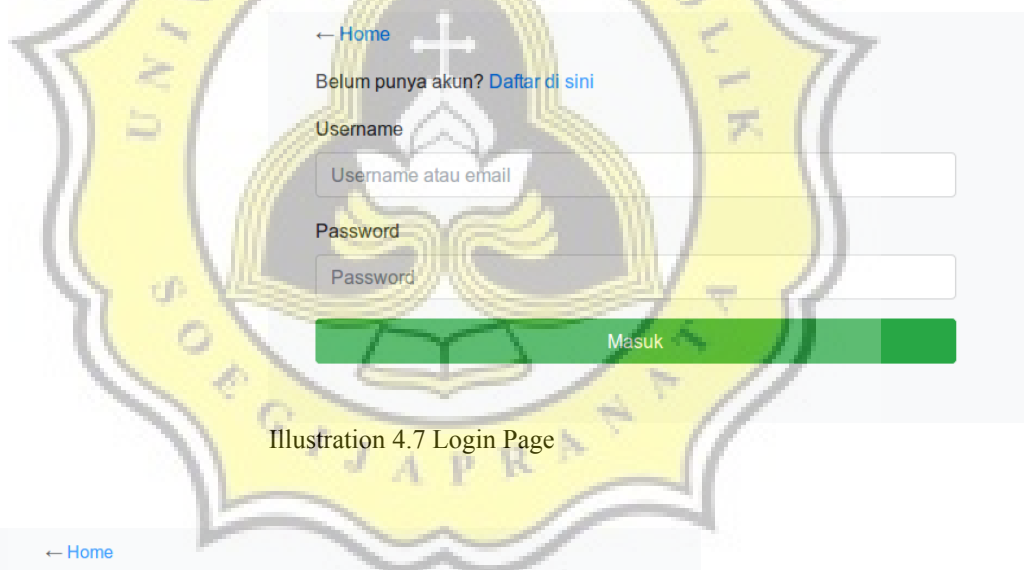


Illustration 4.7 Login Page

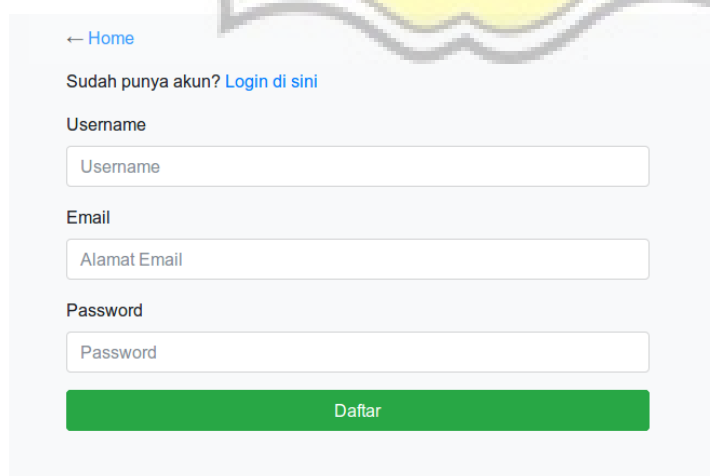


Illustration 4.8 Register Page

The picture below is the system timeline display which consists of 3 menus, namely Input Rating, See Rating, and Recommendation.

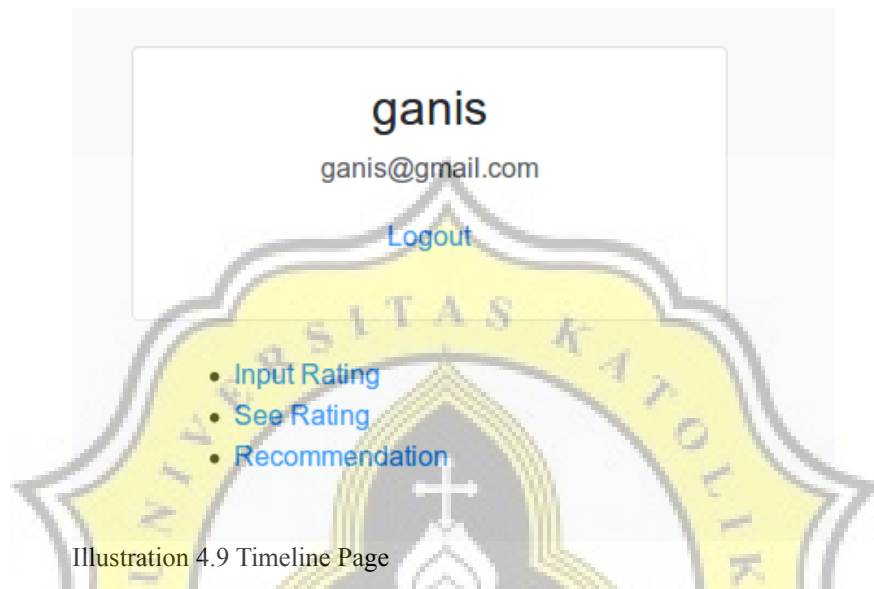


Illustration 4.9 Timeline Page

**Input Rating** : To input a rating on a particular product

Tampilkan hingga: 5

Nomor	Nama Product	Nama Brand	Harga	Action
1	2016 Latest Mini6 Small Android 5.1 Smart Mobile Cell Phone Touch Screen Can Work With Worldwide (Gold)	Phone Baby	79.95	<a href="#">Input Rating</a>
2	2016 Newest 6 Unlocked Indigi M8 White Wireless SmartPhone Android 5.1 (Dual SIM) Unlocked	Indigi	109.19	<a href="#">Input Rating</a>
3	4.5 Inch Unlocked Lenovo A516 Smartphone (White) IPS Screen 854*480pixel 4GB MT6572 Dual Core Android 4.2 Dual Camera with auto Focus and Flash(Rooted + Google Play)	Lenovo	2000	<a href="#">Input Rating</a>
4	5.5 Cell Phone Unlocked Dual Sim Quad Core-JUNING Android 5.1 Smartphone White	JUNING	99.99	<a href="#">Input Rating</a>
5	5.5 Smartphone Dual Sim Unlocked Android 5.1 Quad Core-JUNING Cellphone Black	JUNING	99.99	<a href="#">Input Rating</a>

1

Illustration 4.10 Input Rating Page



See Rating : To see the list of gadget data that has been rated.

Tampilkan hingga :

Nomor	Nama Product	Nama Brand	Harga	Rating	Review	Review Note
1	CLEAR CLEAN ESN Sprint EPIC 4G Galaxy SPH-D700*FRONT CAMERA*ANDROID*SLIDER*QWERTY KEYBOARD*TOUCH SCREEN	Samsung	199.99	2		
2	Nokia Asha 302 Unlocked GSM Phone with 3.2MP Camera, Video, QWERTY Keyboard, Wi-Fi, Bluetooth, FM Radio, SNS Integration, MP3/MP4 Player and microSD Slot - White International Version/Warranty	Nokia	299	1		
3	(LANDVO) 5.0 Capacitive Touch MTK6582 Quad Core Android 4.2.2 3G Phone 512MB RAM 4GB ROM 2MP CAM WIFI GPS - Black	HTM	69.99	5		
4	[XMAS DEAL] [New Edition] Jethro [SC213V2] Flip Quad-band Unlocked GSM Senior & Kids Cell Phone, SOS Emergency Button, 2.4 Large LCD with Large Keypad.	Jethro	79.99	1		
5	[XMAS DEAL] Jethro [SC118] Simple Unlocked Quad-band GSM Senior & Kids Cell Phone, SOS Button, Easy to Use, Light Weight, Large Keyboard [New Firmware Edition],	Jethro	59.99	1		

1

Illustration 4.11 See Rating Page

Recommendation : To see recommendations by inputting the required data.

COMPLETE THE CONTENT BELOW

**User Referensi**

☐ test  
☐ abc  
☐ cardinal  
☐ leonard  
☐ user1  
☐ user2  
☐ user3  
☐ user4  
☐ user5  
☐ user6  
☐ angelina

**Produk Referensi**

Option Produk

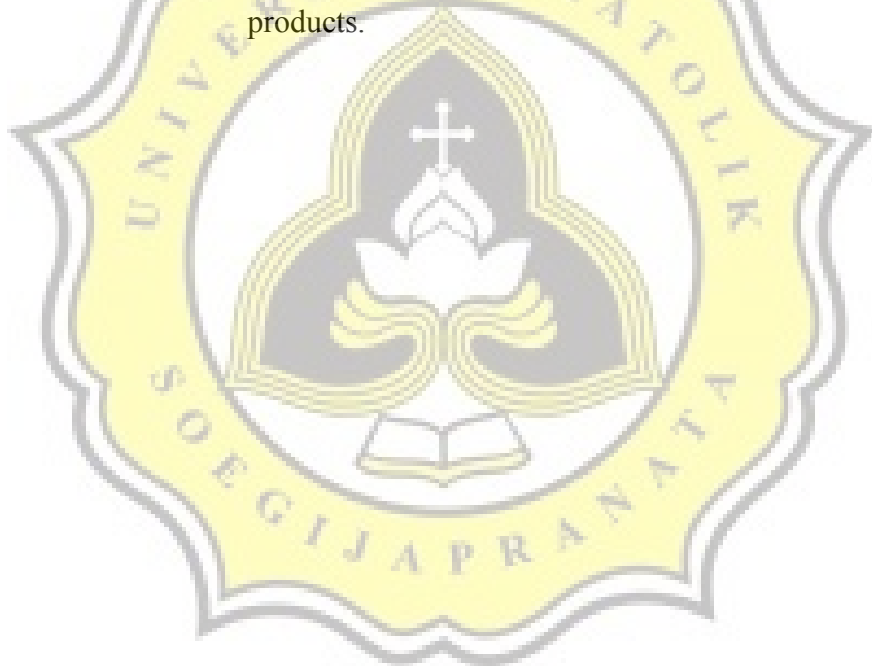
- Pilih -

Illustration 4.12 Recommendation Page

User Reference : All user members are on the database except the user is logged in.

**Product Reference:** All lists of gadgets that have been rated by the logged in user, and user references. In the Slope One Algorithm calculation, reference product is a list of comparative products because the recommendations are based on items or item-based.

**Option Product :** All lists of gadgets that have been rated by reference users. In the Option Products, there are 2 options, namely All Specific Products and Products. Option to choose whether you want to calculate based on all products or only certain products.



User Referensi	Nama Produk	Nilai
abc	Acer Liquid Z410 Andoid KitKat Unlocked Quad-Core Smartphone - Retail Packaging - Brown	3
abc	2016 Latest Mini6 Small Android 5.1 Smart Mobile Cell Phone Touch Screen Can Work With Worldwide (Gold)	2.75
abc	5.5 Cell Phones Unlocked 3G/GSM Dual Sim Android 5.1 Quad Core-JUNING Smartphone White	2.6
abc	Apple iPhone 4 16GB GSM Unlocked 1GHz Cortex-A8 SmartPhone w/ 5MP Camera - Black	2.5
abc	10.6" Inch E-passion Unlocked Smart Phone +Tablet=" Phablet" Android 4.4 Kitkat Gsm,Wcdma Tablet Phone - Unlocked Dual Sim Card,Quad Core- At&t, Cricket,Straight Talk ,T-Mobile,H20,Net10 3g Phone T	2.5
<b>Waktu Eksekusi</b>	<b>1.3521928787231</b>	

Illustration 4.13 See Recommendation

See Recommendation : To display the final result in the form of the 5 highest data that will be a recommendation. The data display will contain the reference user, product name, value and execution time. The product name is the product chosen when choosing reference products or comparison products.