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Optimization of Graph Coloring to Determine Culinary Tourism in Samarinda

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Abstract: A problem that often arises is that many places to eat are available, making everyone confused to choose a place to eat and takes a long time to decide on where to eat. Because it requires a system and methods that can be applied to recommend places to eat. Application recommendations for places to eat in this final assignment were made to help everyone in finding a place to eat with the same menu choices. The method used is the Graph Tinting Method, with the application development method used is Waterfall consisting of data analysis, technology analysis, system analysis, information analysis, and user analysis. The results of this study are the making of a restaurant determination application that can recommend places to eat with the same menu. Users can enter menus according to their wishes, then the application will recommend places to eat using a simple line coloring algorithm at the point. After processing, the application will be able to display the results of recommendations for restaurants with the same menu.

Index Terms: Restaurants, Graph Coloring Method

1. Introduction

The problem that often arises is that many restaurants are available so that makes everyone confused to choose where to eat and takes a long time to decide on where to eat. To save time needed to determine where to eat can be used as a place to eat recommendations. The application is an applied tool that functions specifically and is integrated according to its capabilities [1-4]. The application is also a unit of software created to serve the needs of several activities such as game trading systems, community services, advertising or all processes that are almost done by humans [3, 5-8].

If related to the benefits of technology, in this day and age, it is very easy for everyone to be able to search for information on where to eat. The recommendation system is a method for providing recommendations by predicting the value of an item for a user and then presenting items with the highest predictive value [9,10]. With so many sources of information about the place to eat [4,11,12], it will help the public to get information about the place to eat. However, with so much information, it can also make people confused to choose where to eat right to visit. As a result, in choosing a place to eat, it often takes a long time, so this is not an effective thing. Therefore, the application of dining recommendations can be an appropriate solution for everyone by providing a variety of choices for the best dining places to visit.

A recommendation system is a software that aims to help users by providing recommendations to users when users are faced with a large amount of information. Over the last few decades, the recommendation system has been widely applied with various new approaches and techniques, both in the industrial world and in the academic world. The concept of the recommendation system has been used extensively by almost all areas of the business, where a user needs information to make a decision.

The problem in this research is how to make a program to determine where to eat based on the menu choices. One method that can be used to solve these problems is to use a Simple Line Staining Algorithm at the point. It is expected that by using a Simple Line Coloring Algorithm at this point, and optimization recommendation will be obtained which

is the condition where the best combination occurs for the dining partner and the menu as a whole to determine the culinary location according to user input. Based on the background above, the problem in this thesis is "How to apply the graph coloring method to determine where to eat based on the menu choice recommendation in Samarinda?"

Based on the problems mentioned above, the purpose of this final project research is to develop an application to recommend places to eat in Samarinda based on the desktop to find places to eat with the same menu choices.

So that in working on this final project can be more directed, then the focus of this writing research is focused on discussions such as the following:

1. This application is to recommend places to eat in Samarinda based on the choice of a desktop-based menu.
2. The function of this application is to recommend places to eat according to the menus.
3. The algorithm used is a Simple Line Staining Algorithm at the point.
4. Admin can process data in the process of recommending places to eat.
5. Users can search for places to eat based on the menu choices.
6. This study only uses dining and menu indicators.
7. In determining the place to eat, it does not look at the level of popularity/number of visitors who come to the place to eat.
8. In determining where to eat, do not see the closest distance to the place to eat.

2. Literature Review

A. Application

The application is an applied tool that functions specifically and is integrated according to its capabilities. The application is also a unit of software that is created to serve the needs of several activities such as the game trading system, community service, advertising or all processes that are almost done by humans. So it can be concluded that the application is a program that is operated to work on or adjust certain problems.

B. Recommendation System

The recommendation system is a method for providing recommendations by predicting the value of an item for a user and then presenting the item with the highest predictive value.

C. Graph Coloring

1. Graph

In analytic geometry, graphs are used to map out functions of two variables on a Cartesian coordinate system, which is composed of a horizontal x-axis, or abscissa, and a vertical y-axis, or ordinate. Each axis is a real number line, and their intersection at the zero point of each is called the origin. A graph in this sense is the locus of all points (x,y) that satisfy a particular function. [2,13].

2. Dots Coloring in Graph

Vertex coloring is giving color to the vertices of a graph such that no two neighboring vertices (directly related) have the same color. This algorithm starts by labeling the graph points G with v1, v2, ... vn. First, the dot color v1 with color 1, then color dot v2 with color 1, if v2 is not directly related to v1; if v2 is directly related to v1, then color v2 with color 2. The process continues to v3. Color v3 with color 1 if it is not directly related to v1. If v3 is directly related to v1 and not directly related to v2, color v3 with color 2. If v3 is directly related to v1 and v2 then color v3 with color 3. This process continues until all the graphs of G get color [16].

3. Side Coloring in Graphs

Side coloring (edge coloring) is to give different colors to the sides that are directly related so that no two neighboring sides have the same color [16].

D. Database

Database a collection of files that are interconnected and organized or a collection of records that store data and relationships between them [17].

E. Testing

Testing presents 26 anomalies of interest to software engineers in the form of black-box testing and white-box testing [13,18].

3. Methodology

The Waterfall model is a classic model that is systematic, sequential in developing software [14-16]. The research will be carried out through several stages of waterfall development as follows:

1. Requirements Definition includes finding or developing and analyzing possible actions.
2. System and software design (System and Software Design) aims to provide a general description to users about the new information technology system.
3. Implementation and Unit Testing (Implementation and Unit Testing) regarding the process of making applications and applying the methods used.
4. Integration and System Testing (Integration and System Testing) is a stage of transition from the old system to the new system, to go to the new system, then some testing methods that have to be used are a black box and White Box.
5. Usage and maintenance (Operation and Maintenance) is the process of using an application that has been completed, but also the maintenance phase of the system that has been completed in its construction.

Each stage is carried out sequentially from the first step to the last step, each step that has been completed must be reviewed, listed in the research flow in Fig. 1.

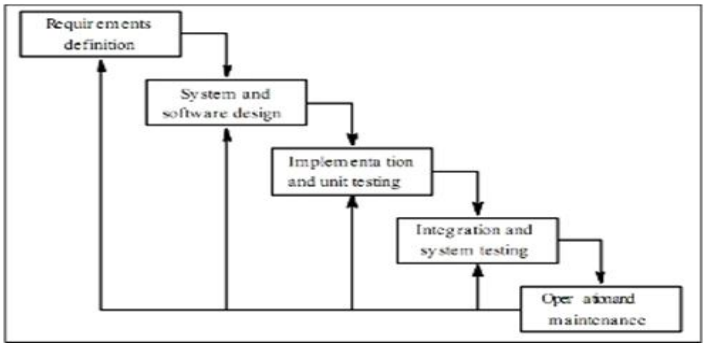


Fig. 1. Research flow

4. Result and Discussion

A. Graph Coloring Process

The graph was first used by a Swiss mathematician named Leonhard Euler to solve the problem of the Konigsberg bridge in 1736. He modeled it into graphs where land was vertex and the bridge was an edge. A graph is a set of pairs (V, E) where V is a non-empty set of vertices and E is a set of edges that connects a pair of vertices. The process of coloring the graph between the dining vertex and the edge of the menu type to determine where to eat with the same menu.

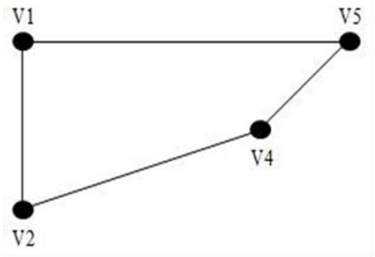


Fig. 2. Fried Goldfish Menu Graph

Remarks Fig. 2
V1: Banjar Fried Chicken
V2: Cinta Rasa Meatball
V4: Magelang Restaurant
V5: Karya Bu Sum Restaurant

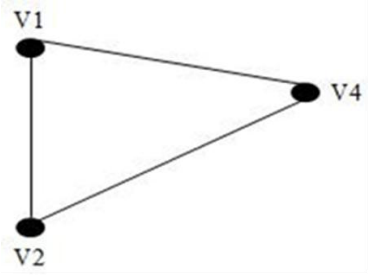


Fig. 3. Fried Chicken Menu Graph

Remarks Fig. 3
V1: Banjar Fried Chicken
V2: Cinta Rasa Meatball
V4: Magelang Restaurant

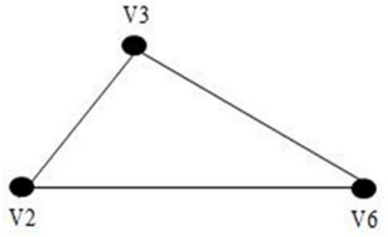


Fig. 4. Meatball Graf Menu

Remarks Fig. 4
V2: Cinta Rasa Meatball
V3: Cak Doy Meatball
V6: Gresik Suroboyo Meatball

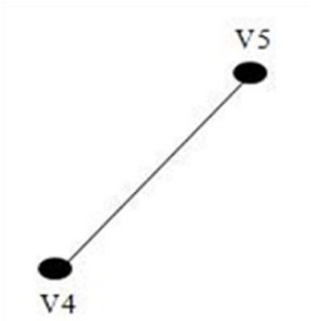


Fig. 5. Mixed Rice Menu Graph

Remarks Fig. 5
V4: Magelang Restaurant
V5: Karya Bu Sum Restaurant

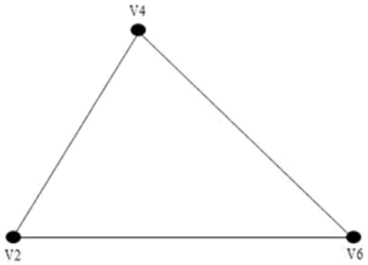


Fig. 6. Egg Menu Graphs

Remarks Fig. 6
V2: Cinta Rasa Meatball
V4: Magelang Restaurant
V6: Gresik Suroboyo Meatball

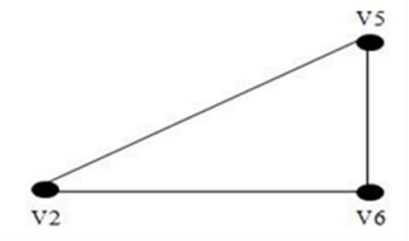


Fig. 7. Graf Chicken Soto Menu

Remarks Fig. 7
V2: Cinta Rasa Meatball
V5: Karya Bu Sum Restaurant
V6: Gresik Suroboyo Meatball

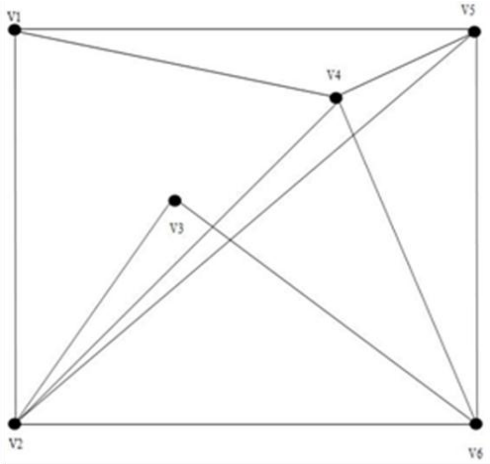


Fig. 8. Graphs of Dining and Types of Menus

Remarks Fig. 8
V1: Banjar Fried Chicken with a menu of Fried Goldfish, Fried Chicken
V2: Cinta Rasa Meatball with a menu of Fried Goldfish, Meatballs, Fried Chicken, Chicken Soto
V3: Cak Doy Meatball with Meatballs menu
V4: Magelang Restaurant with a menu of Fried Chicken, Mixed Rice, Egg
V5: Karya Bu Sum Restaurant with a menu of Fried Goldfish, Mixed Rice, Chicken Soto
V6: Gresik Suroboyo Meatball with a menu of Chicken Soto, Meatballs, Eggs
Edge: Menu Type
1 = Orange, 2 = Gray, 3 = Red, 4 = Blue, 5 = Black, 6 =
Green
Is known:
The points that are directly related to V1 are V2, V4, V5
The points that are directly related to V2 are V1, V3, V4, V5, V6
The point which is directly related to V3 is V2, V6
The points that are directly related to V4 are V1, V2, V5, V6
The points that are directly related to V5 are V1, V2, V4, V6
The point that is directly related to V6 is V2,
V3, V4, V5
Completion Steps:
Step 1: Available color labels are 1, 2, 3, 4, 5, 6
Step 2:
C1 = {1}, C2 = {1, 2}, C3 = {1, 2, 3}, C4 = {1, 2, 3, 4}, C5 = {1, 2, 3, 4, 5},
C6 = {1, 2, 3, 4, 5, 6}

Step 3: i = 1
Step 4: 1 is the first color in C1, so the color of point V1 is color 1
Step 5: Points that are directly related to points that are
at V1 are V2, V4, V5
C2 = {1, 2} - {1} = {2}
C4 = {1, 2, 3, 4} - {1} = {2, 3, 4}
C5 = {1, 2, 3, 4, 5} - {1} = {2, 3, 4, 5}
i = 1 + 1 = 2
Step 4: V2 = 2
Step 5: The point that is directly related to the point in V2 is V3, V5, V4, V6 C3 = {1, 2, 3} - {2} = {1, 3}
C5 = {2, 3, 4, 5} - {2} = {3, 4, 5}
C4 = {2, 3, 4} - {2} = {3, 4}
C6 = {1, 2, 3, 4, 5, 6} - {2} = {1, 3, 4, 5, 6}
i = 2 + 1 = 3
Step 4: V3 = 1
Step 5: The point that is directly related to the point in V3 is V6
C6 = {1, 3, 4, 5, 6} - {1} = {3, 4, 5, 6}
i = 3 + 1 = 4
Step 4: V4 = 3
Step 5: Points that are directly related to points that are
there in V4 are V5, V6
C5 = {3, 4, 5} - {3} = {4, 5}
C6 = {3, 4, 5, 6} - {3} = {4, 5, 6}
i = 4 + 1 = 5
Step 4: V5 = 4
Step 5: The point that is directly related to the point at V5 is V4, V6
C4 = {3, 4} - {4} = {3}
C6 = {4, 5, 6} - {4} = {5, 6}
i = 5 + 1 = 6
Step 4: V6 = 5
Step 5: Points that are directly related to points that are
there on V6 are V3, V5
C3 = {1, 3} - {5} = {1, 3}
C5 = {4, 5} - {5} = {4}
i = 6 + 1 = 7
Step 5: The result i is more than the number of points in the graph, so go to step 6
Table 1 of the G dots and their color

Table 1 Color Results

V (G)	V1	V2	V3	V4	V5	V6
Color Vi	1	2	1	3	4	5

The results of graph coloring are shown in Fig. 9. The result of staining between the dining vertex and the edge menu. As for the results of coloring the graph for dining recommendations by the menu offered, there are 5 colors found in Figure 9, 5 colors obtained in the G graph in this recommendation are used to determine the menu. So, 5 colors are 5 restaurants that have the same menu. For recommendations on this place to eat, in the same color then the place to eat has a different menu.

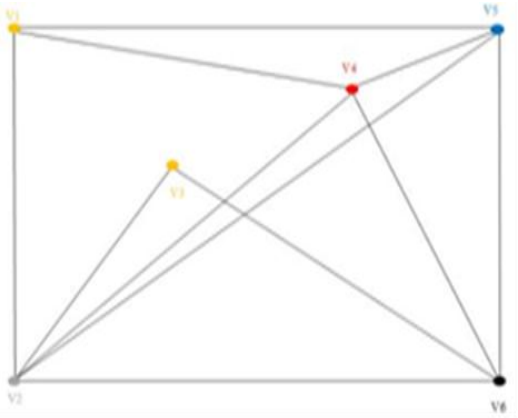


Fig. 9. Graph Coloring Results

Fig. 10 is the result of coloring between vertices: Banjar Fried Chicken, Cinta Rasa Meatball, Magelang Restaurant, Karya Bu Sum Restaurant and edge: fried goldfish menu.

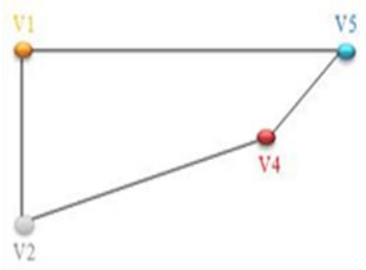


Fig. 10. Results of Graph Coloring of Fried Goldfish Menu

Fig. 11 is the result of coloring between vertices: Banjar Fried Chicken, Cinta Rasa Meatball, Magelang Restaurant and edge: fried chicken menu.

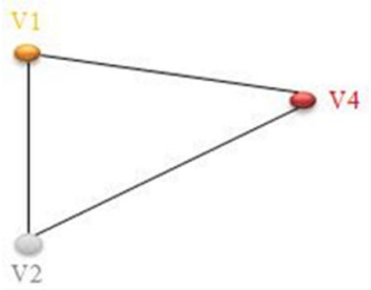


Fig. 11. Results of Graph Coloring of Fried Chicken Menu

Fig. 12 is the result of coloring between vertices: Cinta Rasa Meatball, Cak Doy Meatball, Gresik Suroboyo Meatball and edge: meatballs menu.

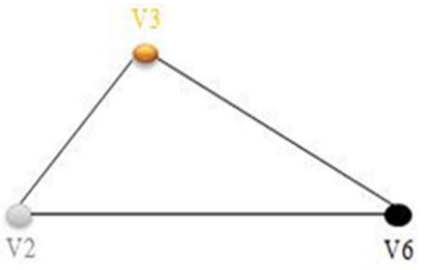


Fig. 12. Graph Coloring Results of Meatballs Menu

Fig. 13 is the result of coloring between vertices: Magelang Restaurant, Karya Bu Sum Restaurant and edge: mixed rice menu.

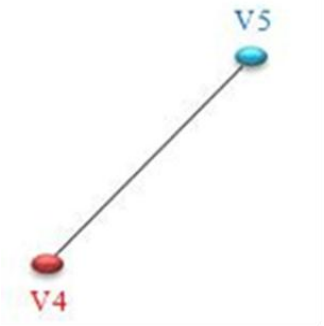


Fig. 13. Results Graph Coloring Mixed Rice Menu

Fig. 14 is the result of coloring between vertices: Cinta Rasa Meatball, Magelang Restaurant, Gresik Suroboyo Meatball and edge: egg menu, and Fig. 15 between vertices: Cinta Rasa Meatball

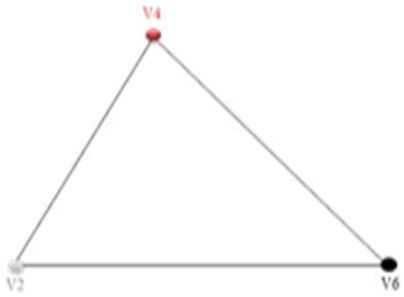


Fig. 14. Results of Egg Menu Graph Coloring

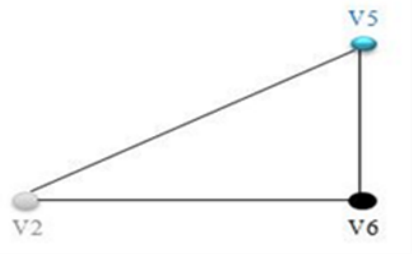


Fig. 15. Results of Chicken Soto Menu Coloring

Fig. 15 is the result of coloring between vertices: Cinta Rasa Meatball, Karya Bu Sum Restaurant, Gresik Suroboyo Meatball and edge: chicken soto menu. Table 2 of the recommendations are as follows.

Table 2 Recommendation Results

Menu	Places To Eat	Address
Fried Goldfish	Banjar Fried Chicken	JL. P. Antasari No. 22
	Cinta Rasa Meatball	JL. A. Yani
	Karya Bu Sum Restaurant	JL. Kini Balu No. 14 Rt. 07
	Magelang Restaurant	JL. KH. Ahmad Dahlan No. 8 Rt. 37
Fried chicken	Banjar Fried Chicken	JL. P. Antasari No. 22
	Cinta Rasa Meatball	JL. A. Yani
	Magelang Restaurant	JL. KH. Ahmad Dahlan No. 8 Rt. 37
Meatballs	Cak Doy Meatball	JL. Wahid Hasyim II Rt. 05
	Cinta Rasa Meatball	JL. A. Yani
	Gresik Suroboyo Meatball	JL. Arief Rahman Hakim
Mixed rice	Magelang Restaurant	JL. KH. Ahmad Dahlan No. 8 Rt. 37
	Karya Bu Sum Restaurant	JL. Kini Balu No. 14 Rt. 07

Egg	Cinta Rasa Meatball	JL. A. Yani
	Magelang Restaurant	JL. KH. Ahmad Dahlan No. 8 Rt. 37
	Gresik Suroboyo Meatball	JL. Arief Rahman Hakim
Chicken Soto	Cinta Rasa Meatball	JL. A. Yani
	Magelang Restaurant	JL. KH. Ahmad Dahlan No. 8 Rt. 37
	Gresik Suroboyo Meatball	JL. Arief Rahman Hakim

B. Implementation

Fig. 16 main menu page displays on the dining recommendation application at Government Tourism Office of Samarinda. There is a Master Button, Recommendation Button, and Exit Button. The main menu page display in "*Bahasa"* Indonesian language.

Fig. 16. Main menu page

Fig. 17 master page views on dining recommendation application at Government Tourism Office of Samarinda. There are Dining Data Button, Menu Data Button, and Exit Button.

Fig. 17. Master Pages

On the dining page, the admin can see the data of existing dining places. On this page there is a search for data textbox so the admin can more easily search for data or view desired data, there is also an Add Button to add data, a Change Button to change data, a delete Button to delete data and an Exit Button to return to the main menu page. The Dining Page View can be viewed as 18.

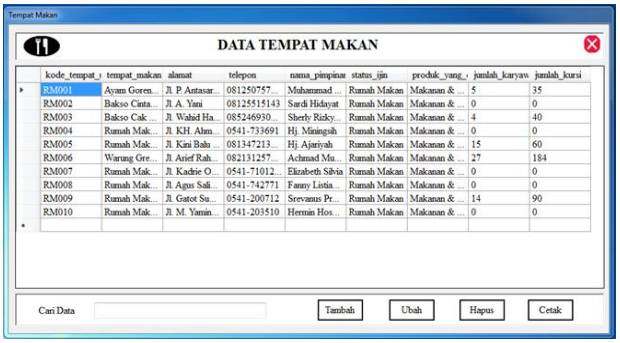


Fig. 18. Pages of dining

On this page, it is used to add or change data for restaurants. There is a Cancel Button to return to the dining room page and a Save Button to save dining room data. Page Display Add Places to Eat can be seen as Figure 19.

Fig. 19. Pages add places to eat

On this page, the admin can see the data of restaurants that already exist. On this page there is a data search textbox so the admin can more easily search for data or see the desired data, there is also a Look Button to see a list of menus and an Exit Button to return to the main menu page. The Display Page List of Places to Eat can be seen as Fig. 20.

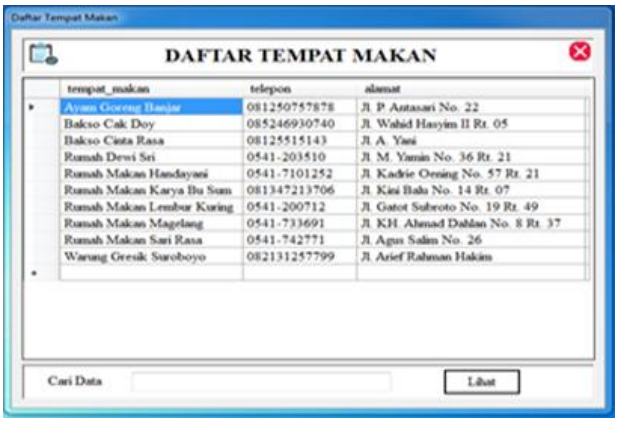


Fig. 20. Page list of places to eat

On this page the admin can see the menu data that already exists, there is also an Add Button to add data, a Change Button to change data, a Delete Button to delete data and an Exit Button to return to the dining list page. Display Menu List Menu can be seen as Fig. 21.

Fig. 21. Page list menu

This page is used to add or change menu data. There is a Cancel Button to return to the menu list page and a Save Button to save menu data. Page Display Add Menu can be seen as Fig. 22

Fig. 22. Page add menu

On this page, the user enters the desired menu name. There is a Process Button to process a search for a place to eat that has a menu from user input and an Exit Button to return to the main menu page. Display Page Search Menu can be seen as Fig. 23.

Fig. 23. Pages search menu

On this page, the user can see the results of recommendations on where to eat. There is a View Menu Button to see a list of menus and an Exit Button to return to the Search Menu page. The Recommended Dining Page Views can be viewed as 24.

Fig. 24. Page recommended places to eat

On this page, the user can see a menu list of recommended restaurants. There is an Exit Button to return to the Dining Recommendations page. Display Page of the Recommended Dining Menu can be seen as Figure 25.

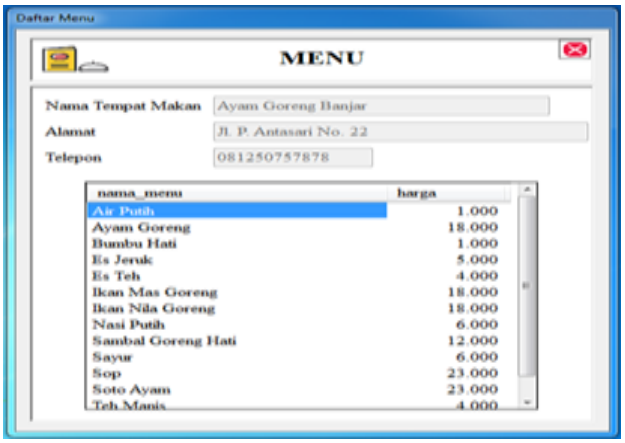
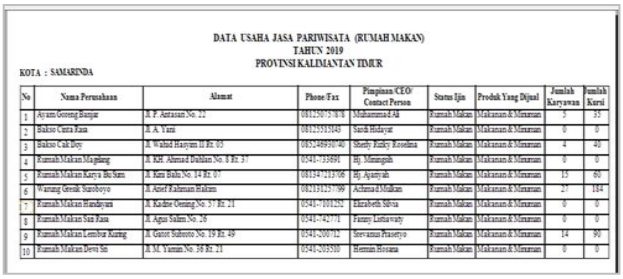


Fig. 25. Pages for recommended dining

Fig. 26 is a printed page view of restaurants data at the Government Tourism Office of Samarinda. The printed page display for restaurants.



DATA USAHA JASA PARIWISATA (RUMAH MAKAN)
TAHUN 2019
PROVINSI KALIMANTAN TIMUR

KOTA : SAMARINDA

No	Nama Perusahaan	Alamat	Phone/Fax	Pimpinan/CEO/ Contact Person	Status Ijin	Produk Yang Dijual	Jumlah Karyawan	Jumlah Kursi
1	Ayam Goreng Banjar	Jl. P. Antasari No. 22	081250757878	Muhammad Ali	Rumah Makan	Makanan & Minuman	5	35
2	Bakso Cinta Rasa	Jl. A. Yani	081253315145	Sardi Hidayat	Rumah Makan	Makanan & Minuman	0	0
3	Bakso Cak Doy	Jl. Wahid Hasyim II Rt. 05	085248930740	Sheely Rizky Rosalina	Rumah Makan	Makanan & Minuman	4	40
4	Rumah Makan Magelang	Jl. KH. Ahmad Dahlan No. 8 Rt. 37	0541-735891	Hj. Meningsih	Rumah Makan	Makanan & Minuman	6	0
5	Rumah Makan Karya Bu Sam	Jl. Ring Road No. 34 Rt. 07	081347123709	Hj. Ajunyah	Rumah Makan	Makanan & Minuman	15	60
6	Warung Gerak Surobayo	Jl. Arief Rahman Hakim	082135127599	Achmad Mudian	Rumah Makan	Makanan & Minuman	27	184
7	Rumah Makan Handayani	Jl. Kadrie Oening No. 37 Rt. 21	0541-7051252	Elizabeth Silvia	Rumah Makan	Makanan & Minuman	0	0
8	Rumah Makan Sari Rasa	Jl. Agus Salim No. 26	0541-742771	Fanny Listawaty	Rumah Makan	Makanan & Minuman	0	0
9	Rumah Makan Lembur Kuring	Jl. Gatot Subroto No. 19 Rt. 49	0541-200712	Sevanna Prasetyo	Rumah Makan	Makanan & Minuman	14	90
10	Rumah Makan Devi Sri	Jl. M. Yamin No. 36 Rt. 21	0541-203510	Herman Hosana	Rumah Makan	Makanan & Minuman	0	0

Fig. 26. Printed Dining Data

Fig. 27 is a printed data menu page display at Government Tourism Office of Samarinda.

DATA USAHA JASA PARIWISATA
TAHUN 2019
PROVINSI KALIMANTAN TIMUR

Tempat Makan : Ayam Goreng Banjar
Telepon : 081250757878
Alamat : Jl. P. Antasari No. 22
Daftar Menu :

No.	Nama Menu	Harga
1	Ayam Goreng	Rp. 18.000
2	Bumbu Hati	Rp. 1.000
3	Sambal Goreng Hati	Rp. 12.000
4	Ikan Mas Goreng	Rp. 18.000
5	Ikan Nila Goreng	Rp. 18.000
6	Sop	Rp. 23.000
7	Soto Ayam	Rp. 23.000
8	Nasi Putih	Rp. 6.000
9	Sayur	Rp. 6.000
10	Es Jeruk	Rp. 5.000
11	Es Teh	Rp. 4.000
12	Teh Manis	Rp. 4.000
13	Teh Tawar	Rp. 2.000
14	Air Putih	Rp. 1.000

Fig. 27 Printed Menu Data

5. Conclusion

The results of research conducted and based on the descriptions discussed in previous chapters, it can be concluded that the application of the coloring method in the graph to make recommendations for places to eat at the Government Tourism Office of Samarinda by using the application development method that is the Waterfall Model. By applying the graph coloring method for dining recommendations at Government Tourism Office of Samarinda, recommendations can be made more easily and can save the time needed in finding food places. Admin in this case the Government Tourism Office of Samarinda to process data in the process of dining recommendations. Users in this case consumers to find places to eat based on menu choices.

The suggestions that can be put forward are as follows: this application will be developed in the future network-based or online-based so that the users of this application can be used anywhere with different users. Business owners can input their menu list so the menu will always be updated. For future researchers, because this application does not look at the level of popularity of dining places, it is expected that further research can add a level of popularity of

restaurants in this application. For further research, because in this study did not look at the closest distance to the place to eat it is expected to be able to develop this research in the future to see the closest distance to the recommended place to eat / zoning system. For further research, because in this application the process of searching for each menu is expected to further research can develop a search for places to eat with many menus inputted so that the results of the recommendation are one place that has a menu that is inputted. As an initial stage of using this recommendation program, training is needed for the admin and user to provide instructions for using and anticipating errors that occur.

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