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Application of KNN (K-Nearest Neighbor) in the Medical Dental Equipment Recommendation System at Rantauprapat Hospital Web Based

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Abstract

The development of information technology currently has a very important role and can be utilized in facilitating all human activities from various aspects, including activities that take place in the health sector such as hospitals which already use many information systems specifically designed to handle various supplies or inventory. At the Rantau Prapat Regional Hospital, data collection on medical equipment supplies still uses manual methods, namely visiting and recording the equipment that needs to be equipped to each polyclinic one by one, which takes quite a long time and the medical equipment inventory team has difficulty prioritizing which tools must be equipped first for each polyclinic, so that continue to maintain the number of treatment numbers in each clinic, especially in dental and oral clinics. Therefore, we need a system for recommending dental medical equipment based on the dental diseases frequently suffered by patients and the number of treatments per year. In building a web-based dental medical tool recommendation system, researchers used the K-Nearest Neighbor (KNN) algorithm method to classify new objects based on attributes and training samples. The working principle of KNN is to find the shortest distance between the data used and its K closest neighbors in the training data and produce more accurate and effective data.

***Keywords**: Data Collection, Recommendation System, Web, K-Nearest Neighbor (KNN)*

1. Introduction

The development of information technology currently has a very important role and can be used for convenience, such as in processing data and information [1]. Where the existence of information technology in everyday life makes it easier for all human activities from various aspects, including activities that take place in the health sector such as hospitals which already use information systems specifically designed to handle various supplies or inventory [2], [3].

Rantau Prapat Regional Hospital was founded in 1957 in Labuhanbatu, has a dental and oral clinic that prioritizes patient comfort. However, the number of treatments at this polyclinic has decreased drastically due to a lack of supplies of medical equipment. Rantau Prapat Regional Hospital's dental and oral clinic needs repairs, additions and updates to medical equipment to improve services to patients. Several dental diseases commonly suffered by patients in dental clinics, such as caries media and pulp gangrene, require adequate equipment [4]. However, the lack of equipment and damaged equipment, such as dental units and handpieces, worsen the quality of service and lengthen patient waiting times. As a result, patients are often referred to other hospitals for further examination [5].

The lack of medical equipment at the Rantau Prapat Regional Hospital's dental and oral clinic is due to a minimal budget and inventory data collection which is still done manually, which takes a long time. This manual process makes it difficult for hospitals to prioritize equipment that needs to be equipped or repaired, thereby impacting services, especially in dental and oral clinics. Like Bajawa Regional Hospital which uses a recommendation system to determine poly goals, Rantau Prapat Regional Hospital also needs a similar system. This system will help prioritize the medical equipment needed in each clinic, especially in dental and oral clinics, to increase procurement and service efficiency [6].

To overcome the decline in treatment in dental clinics, a web-based dental medical tool recommendation system was created that takes into account the dental diseases that patients often suffer from. This system uses the K-Nearest Neighbor (KNN) algorithm to classify and recommend medical equipment according to needs, so that it can improve services at the Rantau Prapat Regional Hospital dental clinic.

2. Research Method

The research method used by the author uses the Mixed Method Research method, which can be interpreted as a combination of qualitative methods and quantitative methods [7][8] and uses the waterfall method as the system development method. In general, the waterfall method has steps, namely analysis, design, writing, testing and implementation and maintenance [9].

2.1. Identify the Problem

To complete this research the author carried out several research methods in collecting reference data including:

a. Observation
   Observation or what is usually called observation is a data collection method that is carried out by directly observing the object of the problem to be studied through eye observation. went to the location of the Rantau Prapat Regional General Hospital.
b. Interview
   This stage was carried out by researchers collecting data through the dental and oral polyclinic at Rantau Prapat District Hospital, such as asking directly so that the information we wanted was clear, the researcher conducted interviews with the dental and oral polyclinic, namely Mrs. Drg. Dorlina Siahaan Sp.Perio, as the person in charge and dental specialist at and Mrs. Leha as head of the dental and oral clinic at Rantau Prapat Regional Hospital.
c. Literature Review
   Data collection using library research is carried out by collecting and studying previous discussions or research related to the research discussed by the author with the aim of strengthening the material discussed and supporting the validity of the data obtained by the author.

2.2 System Development Model

The steps for the waterfall method as a system development method are as follows [10] :

a. Requirements Definition
   The author chose to conduct observations and interviews at the dental and oral polyclinic at Rantau Prapat Regional Hospital with nurses, doctors/persons in charge especially at the dental and oral polyclinic. The results of the observations and interviews were that the number of treatments at the dental and oral polyclinic at Rantau Prapat Regional Hospital was decreasing due to the presence of equipment. which affects the reduction in treatment rates, so that many patients are referred and cannot be treated by doctors and specialists. This interview aims to collect data that will be used for the need to create fields in system development.
b. System and Software Design
   After analyzing system requirements, the next stage is to think about and design the system to be built, one of which is creating documents. Creating this document will help programmers to implement the system to be built. In this design stage there are also designs for use case diagram, Class diagram and activity diagram.
c. Implementation and Unit Testing
   At this stage, the system that has been designed will be implemented in code form and built according to the design that has been prepared systematically and where this system will be built using the KNN (K-Nearest Neighbor) algorithm, which is useful for making research easier to determine what dental medical equipment is. It is only recommended to use PHP program code, HTML and MySqL database.
d. Integration and System Testing
   After the program creation is complete, the next stage is to test the system. The testing stage is that the system will be tested on users so that it is known whether the system is running as it should
e. Operation and Maintenance
   This maintenance is for developers to make repairs to software that is already in operation for undetected errors. This research does not reach the operation and maintenance stage.

3. Result and Discussion

The results of this research are to develop a recommendation for dental medical equipment at Rantauprapat Hospital using the KNN (K-Nearest Neighbor) method. This research produced several pages such as the admin login page, account registration page, main user management page, add user data page, criteria page, alternative page, training page, KNN method page, recommendation results page, and logout page.

3.1. Analyze software requirements

a. Analysis Stages
   System design is an activity that follows the activity analysis process, so that the design process is the core of every process. There are two actors in the system being built, namely the poly admin and the inventory admin. The activities that can be carried out by each admin are:
   1. Admin can log in
   2. Admin can access the user management page
   3. Admin can add user data
   4. Admin can access the criteria page
   5. Admin can add criteria data

6. Admin can access the subcriteria page
7. Admin can add sub-criteria data
8. Admin can access alternative pages
9. Admin can add alternative data
10. Admin can access the training page
11. Admin can add training data
12. Admin can access the KNN method page
13. Admin can access the recommendation results page
14. Admin can log out

b. Use Case Diagram

Use case diagram admin

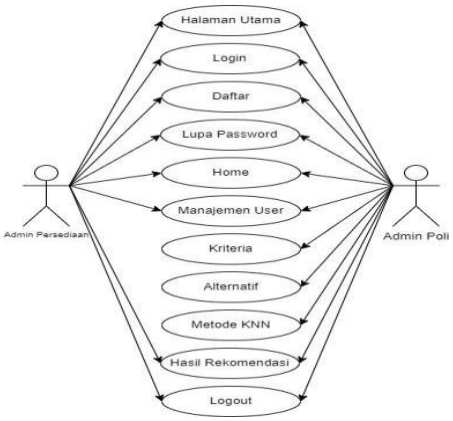

Fig. 1: Use case diagram admin

c. Class Diagram

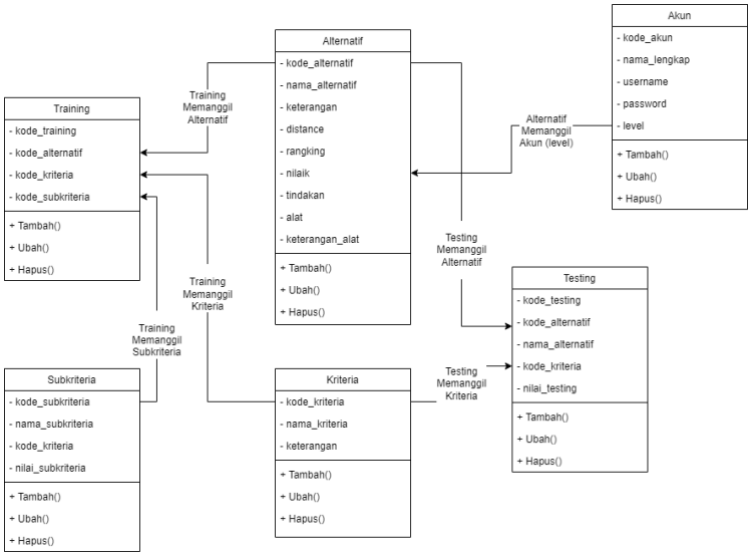

Fig. 2: Class Diagram

d. Activity Diagram

1. Activity Diagram Main Page

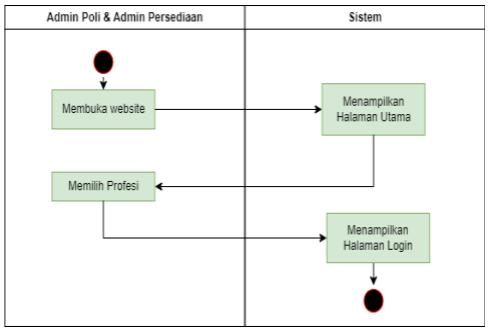

Fig. 3: Activity Diagram Main Page

2. Activity Diagram Login

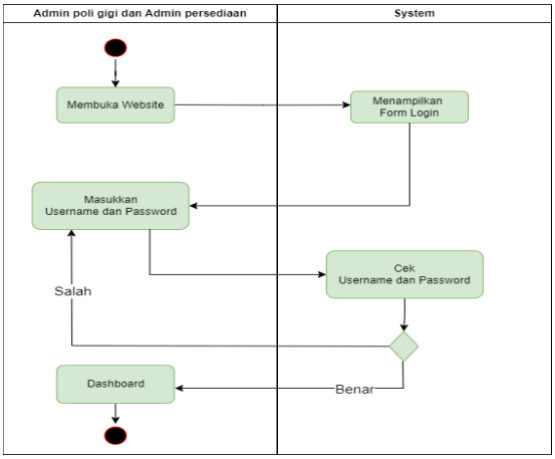

Fig. 4: Activity Diagram Login

3. Activity Diagram Forget Password

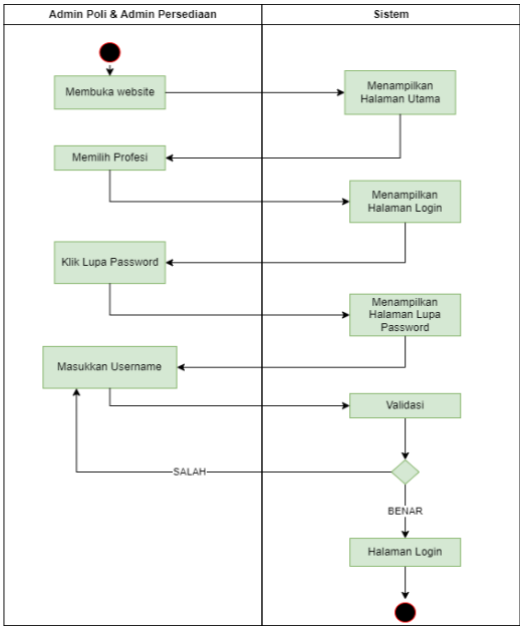

Fig. 5: Activity Diagram Forget Password

4. Activity Diagram Registration

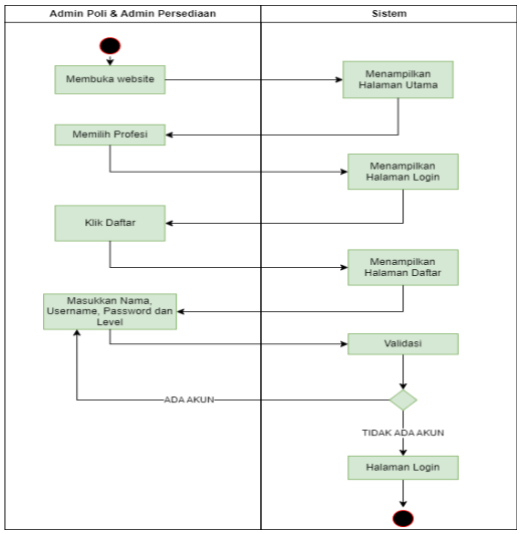

Fig. 6: Activity Diagram Registration

5. Activity Diagram Manage Users

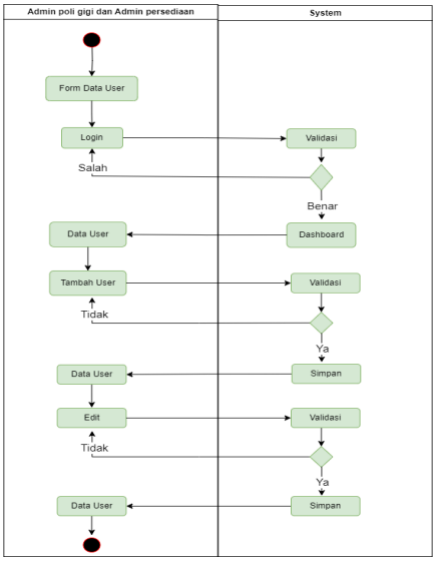

Fig. 7: Activity Diagram Manage User

6. Activity Diagram Criteria

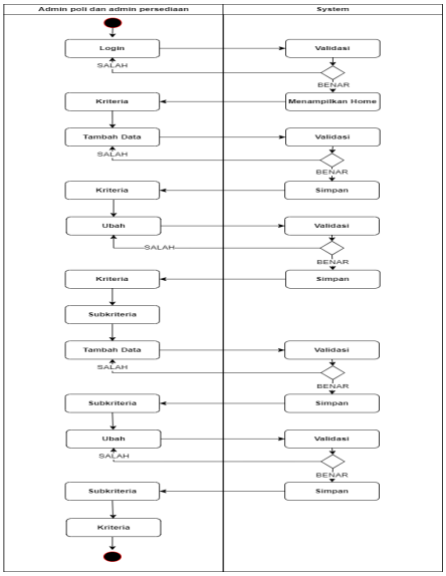

Fig. 8: Activity Diagram Criteria

7. Activity Diagram Alternative

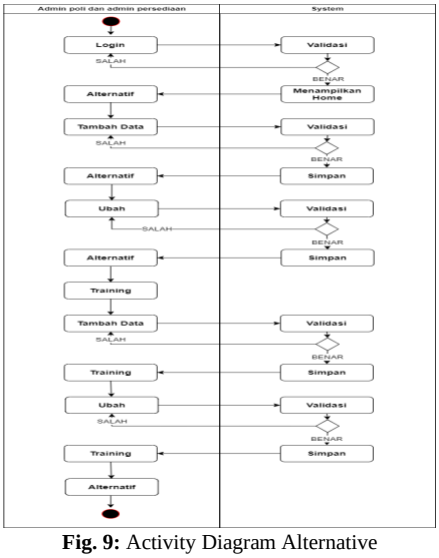

Fig. 9: Activity Diagram Alternative

8. Activity Diagram KNN Method

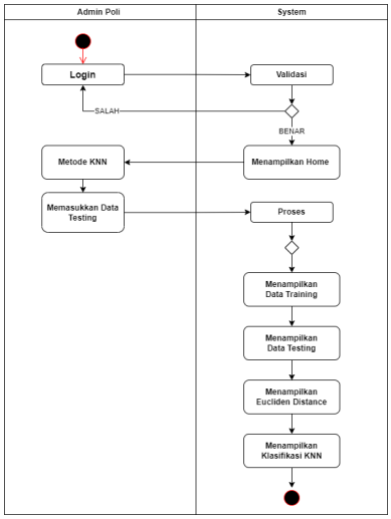

Fig. 10: Activity Diagram KNN Method

9. Activity Diagram of Recommendation Results

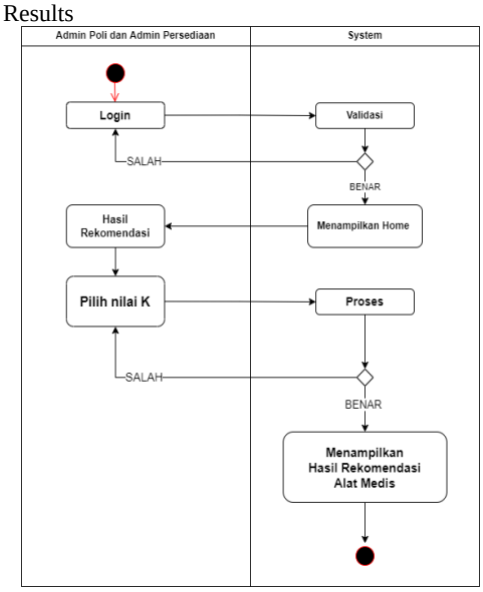

Fig. 11: Activity Diagram of Recommendation Result

10. Activity Diagram Logout

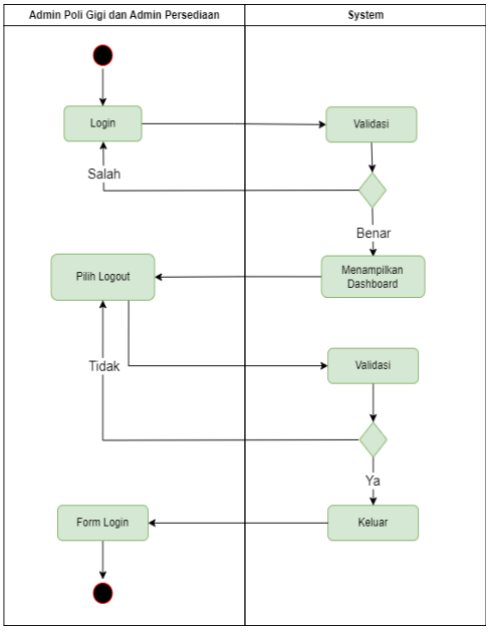

Fig. 12: Activity Diagram Logout

3.2. System Implementation

1. Main Page
   On this main page, actors are asked to choose a profession by clicking the profession button to enter the login page.

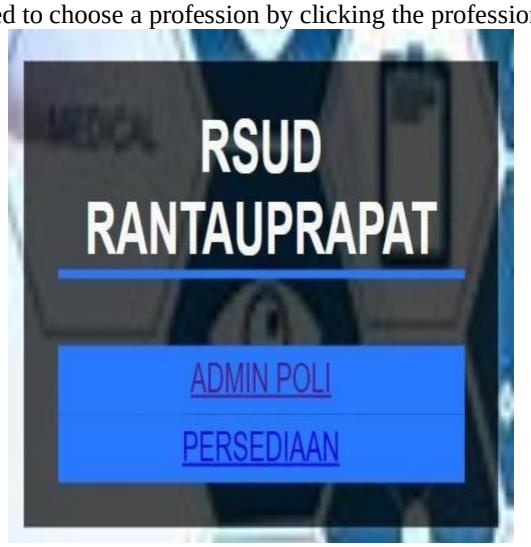

Fig. 13: Main Page

2. Login Page
   In the login display, the actor is asked to enter a username and password, then click the login button to enter the system.

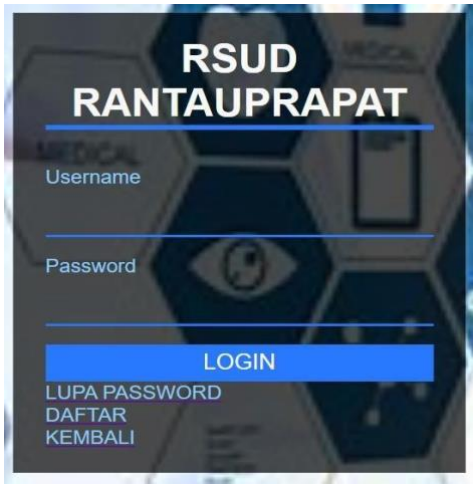

Fig. 14: Login Page

3. Forget Password Page
   In the forgotten password display, the admin can fill in the username to reset the account so that he can re-register in the system. After filling in the username, click reset account to delete the account. If successful, the actor will automatically go straight back to the login page and re-register. Likewise if the actor clicks again.

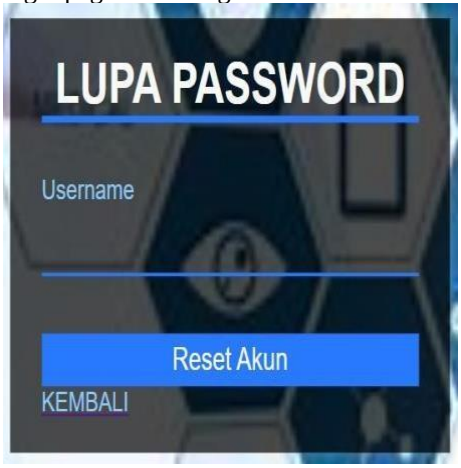

Fig. 15: Forget Password Page

4. Registration Page
   Before logging in, the actor must register an account to be able to log in to the system. On this list page, the actor can fill in the full name, username, password, level and click the register button to save the account data in the database. If successful, the actor will automatically return to the login page and log in.

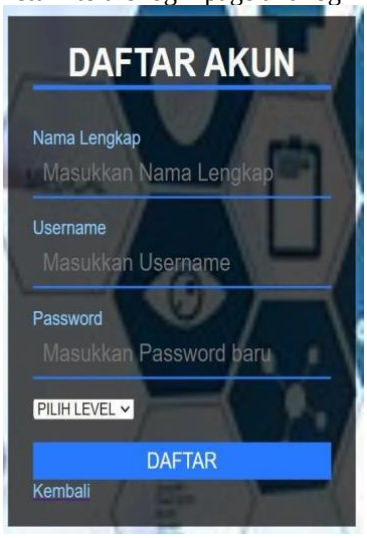

Fig. 16: Registration Page

5. Home Page
   This home display only contains info on the agency and system that is currently open.

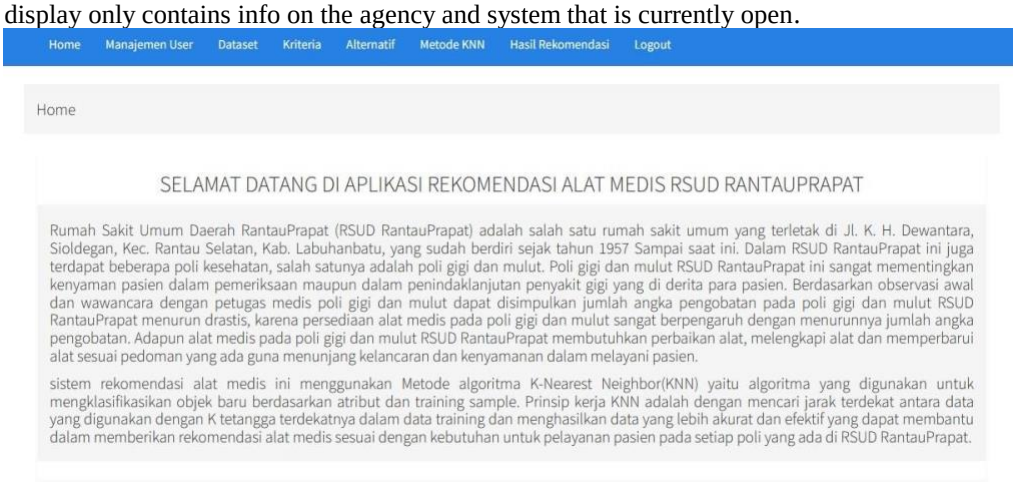

Fig. 17: Home Page

6. Management User Page
   The User Management view contains admin data who can access this system. In User Management, admins can also add, change and delete admins.

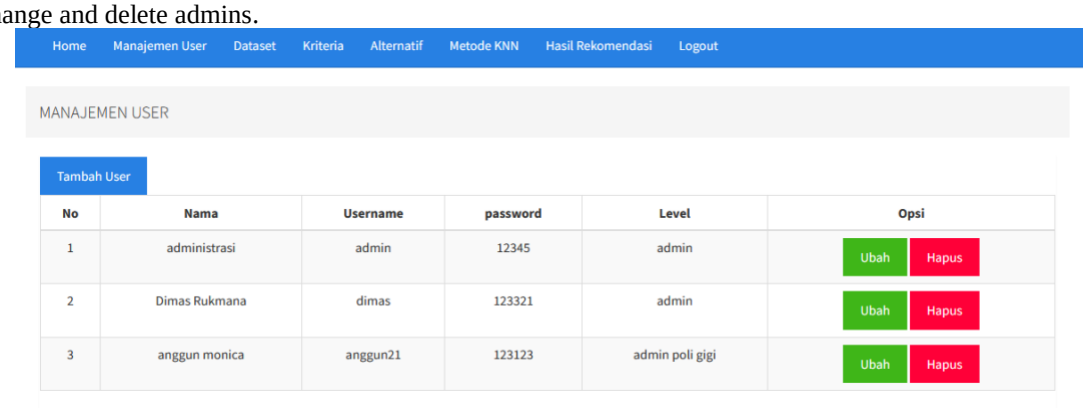

Fig. 18: Management User Page

7. Criteria Page
   In this criteria display, the admin can add criteria data as a supporting attribute in the system by simply clicking the add data button.

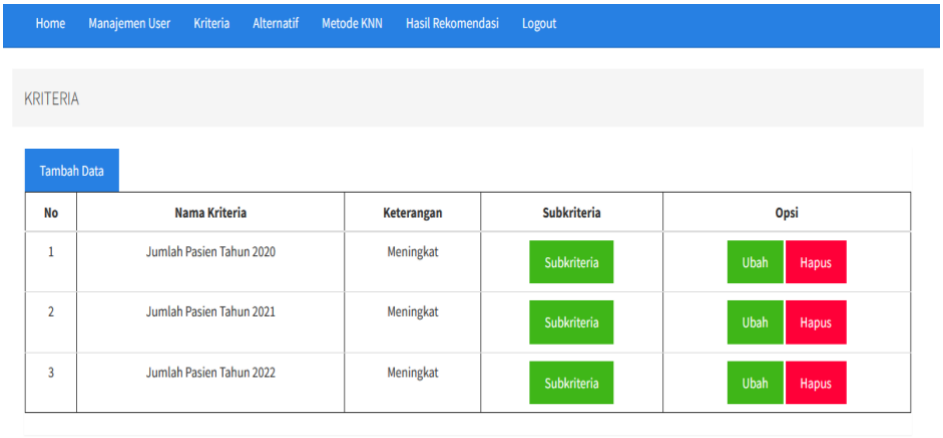

Fig. 19: Criteria Page

8. Sub criteria Page
   This sub-criteria functions to add criteria values to make it easier for admins to enter training data. Click the add data button to enter or add value data to the criteria.

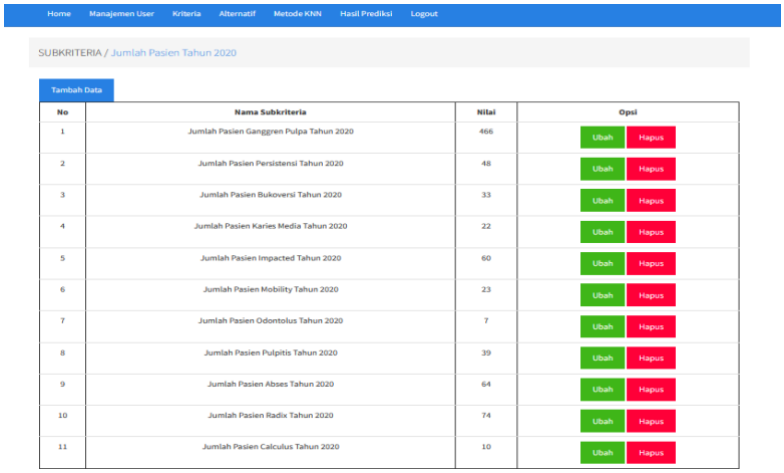

Fig. 20: Sub Criteria Page

9. Alternative Page
   In this alternative view, the admin can add, change and delete alternative data

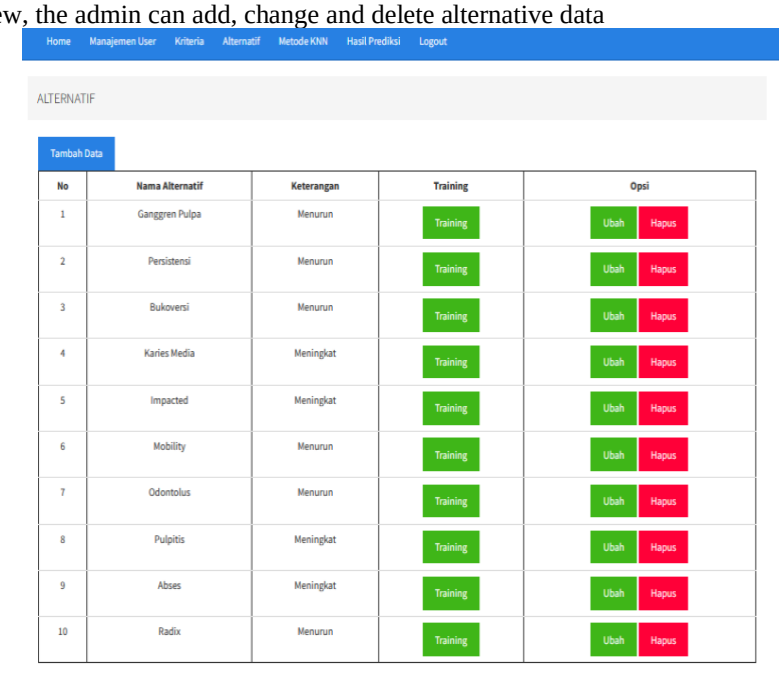

Fig. 21: Alternative Page

10. Training Page

The training page is an image of the training form page which is in the alternative menu and so this form can be accessed by actors (poly admin and inventory admin). In this training view, the admin can add, change and delete training data.

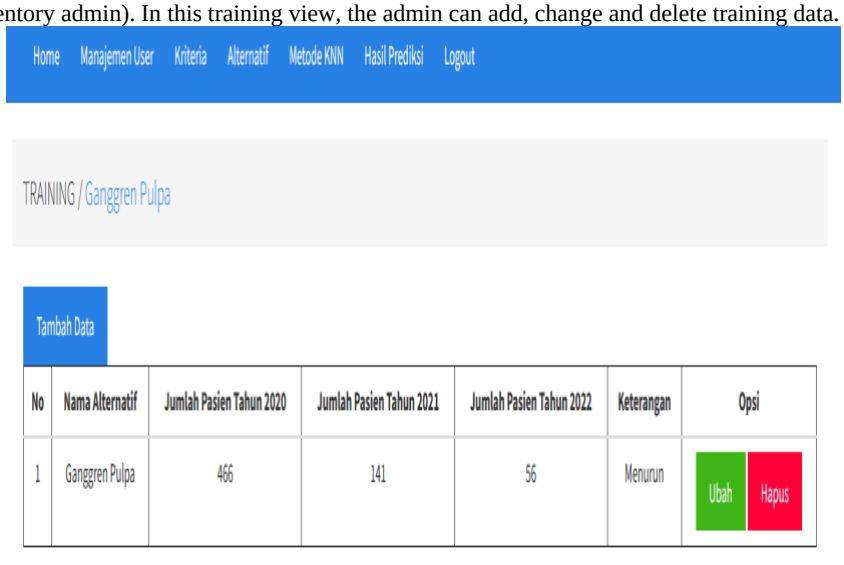

Fig. 22: Training Page

11. KNN Method Page

In the KNN method display, the admin must first enter the testing data to be included in the testing data, after entering the data, click process method to save and display the testing data. On this KNN method page the admin can also see other data such as training data, testing data, eucliden distance, K-Nearest Neighbor classification.

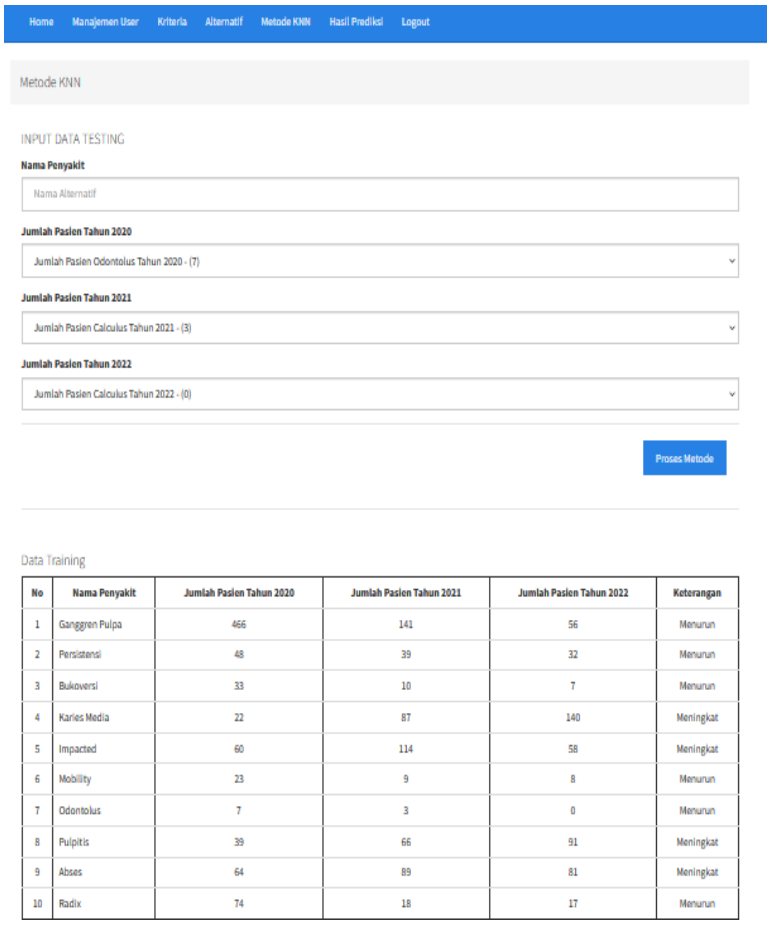

Fig. 23: KNN Method Page

Data Testing

No	Nama Penyakit	Jumlah Pasien Tahun 2020	Jumlah Pasien Tahun 2021	Jumlah Pasien Tahun 2022	Keterangan
1	Calculus	10	3	0	?

Eucliden Distance

No	Nama Penyakit	Jumlah Pasien Tahun 2020	Jumlah Pasien Tahun 2021	Jumlah Pasien Tahun 2022	Distance
1	Ganggren Pulpa	217156	19881	3136	490.07
2	Persistensi	2304	1521	1024	69.63
3	Bukoversi	1089	100	49	35.19
4	Karies Media	484	7569	19600	166.29
5	Impacted	3600	12996	3364	141.28
6	Mobility	529	81	64	25.96
7	Odontolus	49	9	0	7.62
8	Pulpitis	1521	4356	8281	118.99
9	Abses	4096	7921	6561	136.30
10	Radix	5476	324	289	78.03

Klasifikasi K-Nearest Neighbor

Kode	Nama Penyakit	Distance	Rangking	Keterangan
A07	Odontolus	7.616	1	Menurun
A06	Mobility	25.962	2	Menurun
A03	Bukoversi	35.185	3	Menurun
A02	Persistensi	69.635	4	Menurun
A10	Radix	78.032	5	Menurun
A08	Pulpitis	118.987	6	Meningkat
A09	Abses	136.301	7	Meningkat
A05	Impacted	141.280	8	Meningkat
A04	Karies Media	166.292	9	Meningkat
A01	Ganggren Pulpa	490.074	10	Menurun

Fig. 24: KNN Method Page

12. Recommendation Result Page

The recommendation results display shows that the admin must select the K value (number of nearest neighbors), then click on the process method to process and get recommendations for medical equipment.

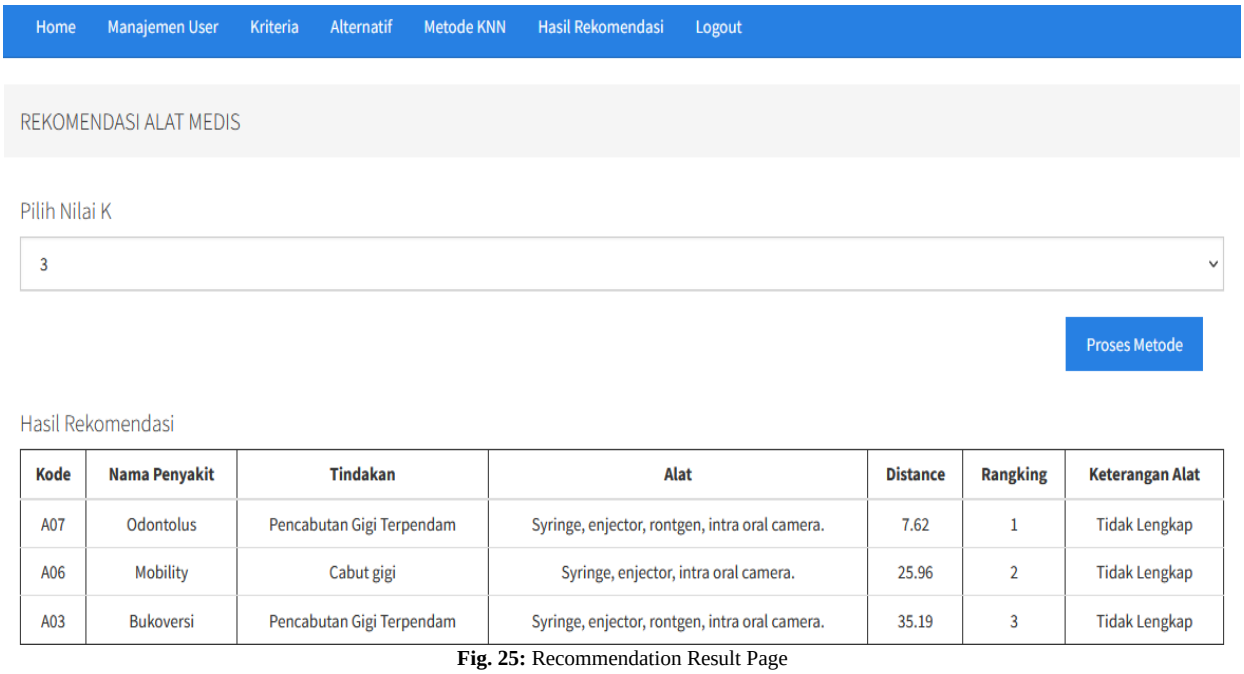

Fig. 25: Recommendation Result Page

13. Logout Page
    If the admin logs out it will automatically return to the login page

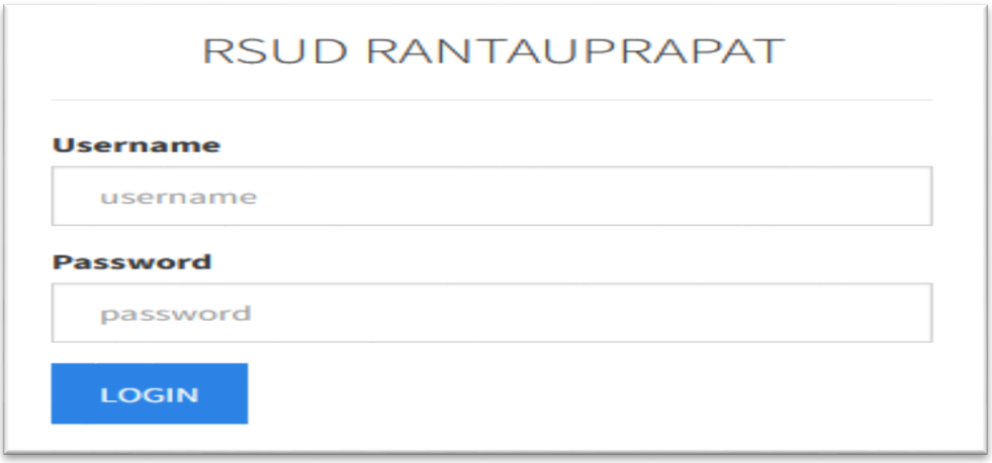

Fig. 26: Logout Page

4. Conclusion

The development of information technology currently has a very important role and can be utilized in facilitating all human activities from various aspects, including activities that take place in the health sector such as hospitals which already use many information systems specifically designed to handle various supplies or inventory. At the Rantau Prapat Regional Hospital, data collection on medical equipment supplies still uses manual methods, namely visiting and recording the equipment that needs to be equipped to each polyclinic one by one, which takes quite a long time and the medical equipment inventory team has difficulty prioritizing which tools must be equipped first for each polyclinic, so that continues to maintain the number of treatment numbers in each clinic, especially in dental and oral clinics. Therefore, we need a system for recommending dental medical equipment based on the dental diseases frequently suffered by patients and the number of treatments per year. In building a web-based dental medical tool recommendation system, researchers used the K-Nearest Neighbor (KNN) algorithm method to classify new objects based on attributes and training samples. The working principle of KNN is to find the shortest distance between the data used and its K closest neighbors in the training data and produce more accurate and effective data.

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