Implementation of Content-based Health Recommender System in Medical Knowledge on Android

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Skripsi ini disusun dan diajukan untuk memenuhi syarat perolehan gelar Sarjana Komputer (S.Kom.) pada Fakultas Ilmu Komputer di Universitas Mercubuana Jakarta. Disamping itu, penulisan skripsi ini juga bertujuan untuk memberikan pengetahuan kepada pembaca.

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Penulis

DAFTAR ISI

Implementation of Content-based Health Recommender System in Medical Knowledge on Android

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Abstract: *Medication errors are among the most serious medical errors that could threaten patients' lives. In this context, drug recommender systems have been developed to assist end-users and healthcare professionals in identifying accurate medications for a specific disease. By using the limitToLast query, we can find drug suggestions for diseases that have the highest clicks "LimitToLast" serves to limit the amount of data to be read that is 1 and is most recent. From this filtering, every time the user clicks on a disease, it will automatically update the "Clicked" child of the disease that the user clicked on. The disease page application that has been successfully created has been equipped with a search bar to look for symptoms that the user wants to know. The accuracy of the recommendation of this technique gives good results by presenting a suitable alternative medicine. This recommendation system is transparent to the user. Providing relevant recommendations gives users a sense of openness and increases their confidence in the recommendations provided. Content-based recommender systems can be highly tailored to users' interests, including recommendations for niche items.*

Keywords: Medical, Recommender System, Health, Technology, Content-based

1. Introduction

Today's healthcare organizations consider increasing efficiency, reducing costs, improving patient care and quality of service, and safety when planning the implementation of new applications based on Information and Communication Technology (ICT). The Health Information System (HIS) is a computer system that collects, stores, manages, or sends this vast amount of information related to an individual's health, clinical care, or the activities of a health-related organization [2].

Recommender systems (RS) suggest items of interest to users of information systems or e-business systems and have evolved in recent decades. A typical and well-known example is Amazon's suggested service for products. We believe the idea behind recommend systems can be adapted to cope with the special requirements of the health domain [3].

Medication errors are among the most serious medical errors that could threaten patients' lives. More than 42% of these errors are caused by doctors who have limited experience/knowledge about drugs and diseases. Another reason lies in the increasing number of available drug information, which has brought obstacles concerning the discovery of relevant drugs and drug-disease interactions. In this context, drug recommender systems have been developed to assist end-users and healthcare professionals in identifying accurate medications for a specific disease.

The development of recommender systems involves experts from various fields, such as artificial intelligence and human computers. Content-based recommender systems try to matchusers to items that are similar to what they have liked in the past. This similarity is not necessarily based on rating correlations across users, but based on the attributes of the objectsliked by the user [4].

The goal of the HRS is to provide users with medical information that is highly relevant to the patient's medical development associated with that PHR. Relevant medical information may be recommended to medical professionals who are working on or are using a particular PHR, and to the public who are ascertaining their PHR. Depending on the user's medical expertise, HRS needs to propose medical information that the user can understand [5]. To mimic these behaviors, the first RS uses an algorithm Recommendations made by the user community to provide recommendations to active users d. NS. Users looking for suggestions. Recommendations Articles that are liked by similar users (with similar hobbies). This approach is known as collaborative filtering; its rationale is for active users. Some users and in the past, these other recommendations will be similar also need to be relevant and interested in the active user.

2. Recommendation Systems

Recommendation System (RS) can be seen as a tool for generating recommendations through building and using user models [6]. Personalization is impossible without a comfortable user model. As with the top 10 selections, the user model always plays a central role when not personalized. For example, looking back at the collaborative filtering approach, users are either profiled directly by element evaluations, or the system uses these evaluations to derive a vector of factor values, and users have different weights for each factor in their model. so. Users can also be described by behavioral pattern data, such as website browsing patterns (for web-based recommend systems) and travel search patterns (for travel recommend systems). In addition, user data can include relationships between users, such as the trustworthiness of relationships between users. RS can use this information to recommend articles to users. Preferred by similar or trusted users.

In content-Based filtering, recommendations depend on the user's former choices. The item description and a profile of the user's orientation play an important role in Content-based filtering. Content-based filtering algorithms try to recommend items based on similarity count [7].

Content-Based Filtering (CBF) attempts to recommend items to active users based on the number of similarities that the user has positively rated in the past. Content-based recommender systems use the description of the items (metadata) and the preferences of the user to make user-specific recommendations [8]. For example, if a user likes a web page that contains the words "mobile," "pen drive," and "RAM," CBF recommends pages related to the world of electronics. The item description and the user's direction profile play an important role in content-based filtering. The content-based filtering algorithm attempts to recommend an item based on its similarity score.

The similarity metric (discussed later) is calculated from the item's feature vector and the user's favorite feature vector from the user's previous record during the recommendation. Next, some of the tops are recommended. Content-based filtering does not require data from other users when making recommendations to one user. Every content-based recommender system needs some initial information to be able to start recommending items to the users [9]. Implicit feedback reduces the burden on users by inferring their user's preferences from their behavior with the system [10].

In this research, the author builds Android Application for Medicine learning media. The application contains medicine knowledge and other health information for users in general, based on medicine documents from doctors that have been monitored by the Ministry of Health. This android application includes texts and photos to visualize material in the application. It is expected to give a measurement of understanding of the material to the user.

As an illustration, the user after logging in will see a list of diseases displayed by the system, after that the user will search for or click on the article of the disease in question, and later the system will process it by accumulating the existing score for each symptom and then displaying it as a recommended drug for the user.

Here's an example: Users have seen "GERD," "Influenza," and "Migraine." The recommendation system may recognize that it has symptoms of cough and dizziness. Then thesystem will bring up ginger as a traditional medicine that is suitable for these symptoms. Userscan expect to receive accurate recommendations for the symptoms.

3. Methodology

3.1 Development Method

The algorithm used in this paper is inspired by the Limittolast algorithm in product recommendation algorithm [11]. The original algorithm provides a wider range of results and gives users more choices. The purpose of the adjustment in the modified algorithm is to narrow the intended category and the results obtained by the user are more in line with the intended topic. The results of this modified algorithm have succeeded in providing other results for users if they want to get alternative medicine, such as in the following scenario: the user searches for a sneezing symptom remedy, then clicks on influenza and accepts ginger as a recommendation. If later, the user wants to search for other alternative, using the same syptoms and same diseases, the algorithm will provide different recommendation, for example honey rather than ginger.

In general, a similarity function is a function that accepts the input of two objects, then calculates the similarity between them, and returns in a form of real numbers. The value returned by the similarity function generally ranges in the interval [0...1]. In this method, similar dimensional two n-dimensional vectors are calculated by looking for the cosine value of the angle between them [11]. A very simple expression is the dot product. To calculate the dot product, we need to use the following formula: $\Sigma_i^d=1piui$ *(where pi is the product feature value and ui is the user interest value in column i).*

TABLE I – USER CLICK CALCULATION

	Feature 1	Feature 2	Feature 3	Feature 4
Product 1	1		1	2
Product 2		1	4	
Product 3	3			1
Product 4	2		1	1

In the table above, the user's interest in product 1 can be estimated to be 2 * 1 + 1 * 1 + 1 * 2 that equivalent to 5. Similarly, the interest in product 2 is 1 * 4 equivalent to 4, and the interest in product 3 is 2 * 3 + 1 * 1 equivalent to 7. Therefore, Product 3 is the top recommendation for the algorithm. To the user.

3.2 Development Cycle

In this research, the author uses Android Development Life Cycle. Application development stages are explained as follows:

Requirement Analysis - In the requirement analysis this phase aims to grab out all the details of the project or we can say that the requirement analysis phase is to capture the detail of each requirement and to make sure everyone understands the scope of the work [12].

Design - The next stage of the Software Development Life Cycle is the Design phase. During the design phase, the technical details of the design are discussed with the stakeholders and various parameters such as risks, technologies to be used, the capability of the team, project constraints, time, and budget are reviewed and then the best design approach is selected for the product [12].

Developing the Product In this phase, the actual development of the product starts according to the designed architecture. If designing is done successfully, then this phase is not much difficult. Developers use different tools, such as compilers, interpreters, and debuggers are used to generate code. The author chose Android Studio as the tool to build the application [13].

Testing In this phase developed product is tested whether it meets the user's requirements, which are documented in the software requirement specification document. Software defects are reported, tracked, fixed, and retested so that the product has gained high quality [13].

3.3 System Design

a. UML (Unified Modelling Language)

UML is one of the most widely used language standards in the world to define requirements, create analysis and design, and describe the architecture in object-oriented programming. In the field of systems analysis and design now incorporates object-oriented techniques and concepts, in which a system is viewed as a self-contained collection of objects that include data and processes [14].

b. Use Case Diagram

After the system and features have been analyzed from a developed Multimedia Application, the analysis result is illustrated in Use Case Diagram in Figure 2.

TABLE 2 – USE CASE COMPONENT

Actors	Use case	Description
User	Search Symptom	Querying the system
	Read Disease Article	Read Shown Article
	Access Recommendation	Get the recommended medicine
System	Gather user data	Log user activities, click count.
	Calculate Scores	Apply LimitTolast method
	Show Prediction	Recommend from accumulated scores

Coming to the conditions on the use cases, the implicit one is that the user must be logged into the system to access recommendations. The flow of control would be the inherent activities of each use case like the processing of the request as soon as the user enters a query for searching the music, the compiling of the list generated from the scores, and showing those with high values, etc [15].

Figure 1 Software Development Cycle

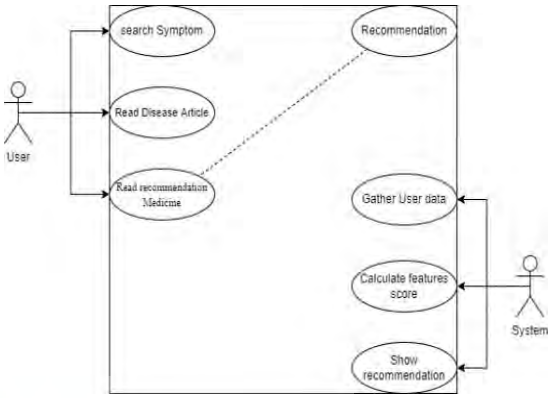


Figure 2 Use Case Diagram

c. Activity Diagram

Activity diagrams are designed to illustrate the flow of various activities between the user and the application from start until the close of the application. The following diagram (Figure 3) shows the event that occurs in interaction in the application of the Application.
The main activities of each service provided are illustrated by activity diagrams. These activity diagrams refer to the workflow of the recommender system. Workflows are presented sequentially and often have conditions specified in control flow lines. The diagram is accompanied by a description of the task initiator and the workflow. An initiator is usually a function module that is called when an operation starts. Some of the functions in this recommender system are [15]:

- initRecSys (…)–create a new instance of the system
- load user profile (…)–authenticates and loads a user profile
- process request (…)–analyses the query entered by the user
- dispResults ()–get the results and display them
- log user activity (…)–article click scores are all logged for further calculation
- get a recommendation (…)–show the recommendations after calculating similarity and prediction scores
- logImpliciteRating (…)–user scoring to the specific article is noted for further calculations

d. Sequence Diagram

A sequence diagram is a diagram that illustrates the interaction between each object in each use case in chronological order. This interaction takes the form of sending a series of data between objects that interact with one another. The following diagram (Figure 4) shows the Sequence Diagram of the application.

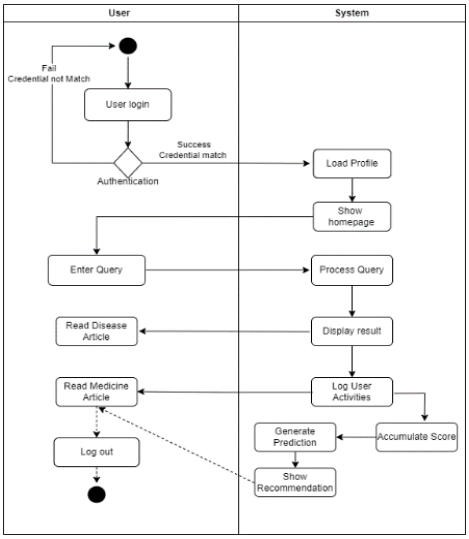


Figure 3 Activity Diagram

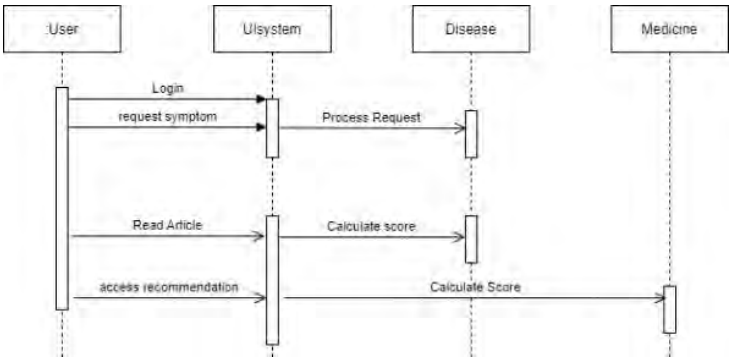


Figure 4 Sequence Diagram

This is where the RecSysUI object works. This is because it is the object with which the user communicates. The RecSysUI class has many visual elements that contribute to the source of data related to user activity. The search button, recommendation viewed section, etc. are all useful for users in log activity. The sequence diagram only describes the nature of the recommender system's behavior, so the user interface elements are abstracted into a single class [15].

a. Recommender Method

According to the click, the system calculates the score using the LimitToLast method, which is connected directly to the drug page and displays recommendations based on drugs that are connected to the disease that has been opened.

By using the limitToLast query, we can find drug suggestions for diseases that have the highest clicks by filtering using the "Clicked" child. The "Clicked" children that are in the "history" are collected using the on-click listener in the itemViewHolder.

"LimitToLast" serves to limit the amount of data to be read that is 1 and is most recent [16]. From this filtering, every time the user clicks on a disease, it will automatically update the "Clicked" child of the disease that the user clicked on

.

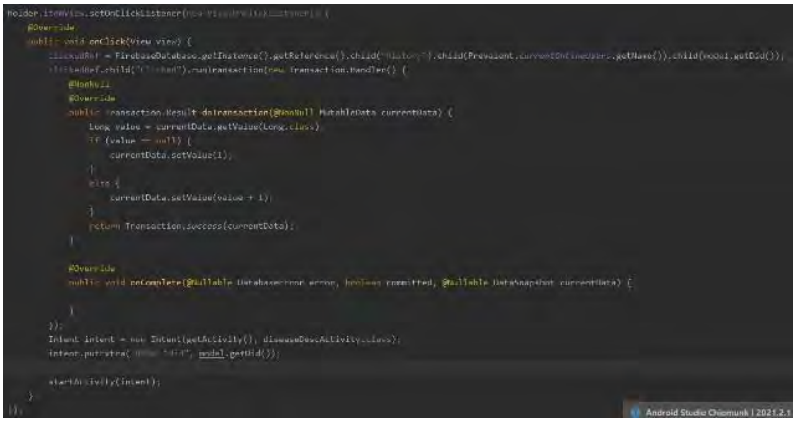


Figure 5 Activity Diagram

3.5 Testing Method

The author has chosen a black-box testing method that can run throughout the software development life cycle and software life cycle testing, namely in regression testing, acceptance testing, unit testing, integration testing, and system testing stages. This type of testing under this technique is focused on testing for the functionality of the software application [17].

4. Result and Discussion

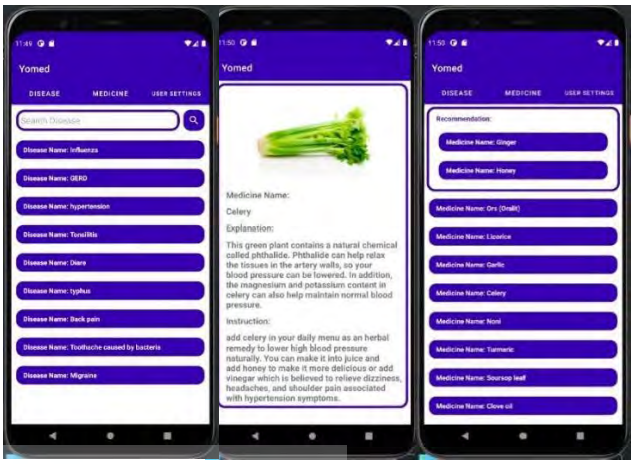
Android application developed by the author contains informative content provided inone application. It consists of medical information, an explanation of the disease, and related symptoms.

The results of this design have been completed with satisfactory results by testing to author relatives, from this recommendation system users can find out what they are looking for quickly because of the short system and the speed of the real-time database [18] when changes occur in the data in the system.

Figure 6 Activity Diagram

A log-in page has been created for user identification and authentication, which is done regularly by entering a username and password combination. not only gives users access to the application but also allows the system to trackuser actions and behavior.

Figure 7 Activity Diagram



The disease page application that has been successfully created has been equipped with a search bar to look for symptoms that the user wants to know. For example, if a user searches for "cough" then only the disease that has that symptom will come out.

In the article section, medicines have been made to be easily understood by users with pictures, explanations of the benefits, the content in these ingredients, to how to make them. The accuracy of the recommendation [18] of this technique gives good results by presenting a suitable alternative medicine. Developed Android application has 4 fragment disease, medicine, user setting, and history.

Black-box testing, as one type of functional testing, is testing without having any knowledge of the interior structure of the application. Typically, when performing a black- box test, a tester will interact with the system's user interface by providing inputs and examining outputs without knowing how and where the inputs are worked upon [19].

6. Conclusion and Future Works

According to the development and test stage of multimedia application from the author, can be concluded that:

The application is created to let users will have the ability to give the first move to do about the disease and have a decent knowledge of medicine. The application and techniques will beefficient, feasible, and user-friendly, which would be less time-consuming [20]. This research is expected to be a basis for interactive mobile applications especially related to the first aid section. the results of this study indicate that the application has succeeded in showing high accuracy of the data obtained from user activities when using the application. The system has focused on users' interests and can provide offers to users personally.

This recommendation system is transparent to the user. Providing relevant recommendations gives users a sense of openness and increases their confidence in the recommendations provided. Content-based recommender systems can be highly tailored to users' interests, including recommendations for niche items. This is because this technique relies on matching the properties or attributes of the database object to the user's profile. The author would also like to release the source code for free. In this way, a new generation of software developers can gain knowledge from the concepts and theories of this field of study.

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Introduction

Turning the app idea into a solid foundation for app implementation is the first and most important step in the Android app development process. Feasibility Assessment Using wireframes, can clearly understand the visual elements of theirapplications, obtain detailed conceptual product sketches to shape ideas, and precisely place design components. To evaluate whether an application concept istechnically feasible, application developers need access to public data through public API licensing. Testing and Deployment One of the important components of application development, you should test at an early stage, usually testing usability, interface and security controls, stress, compatibility and performance.