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IMPLEMENTING HYBRID FILTERING ON KOREAN DRAMA RECOMMENDATION THROUGH K NEAREST NEIGHBOR ALGORITHM

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IMPLEMENTING HYBRID FILTERING ON KOREAN DRAMA RECOMMENDATION THROUGH K NEAREST NEIGHBOR ALGORITHM

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Abstract
Over time, many cultures from South Korea entered Indonesia, such as music, food, and drama series. From year to year, the number of Korean dramas released increased as well as fans of the Korean drama. Therefore, the researcher aimed to create a system that might help K-drama lovers to sort recommendations regarding favorite dramas. The researcher designed the system, starting from collecting data to calculating adjusted cosine similarity. Based on the results of the user acceptance testing and the answers of the respondents, it can be concluded that the Korean drama recommendation system website's function is effective and provide suggestions based on user ratings.
Keywords: Hybrid filtering, Korean drama, K Nearest Neighbor algorithm

INTRODUCTION

Over time, many cultures from South Korea entered Indonesia, such as music, food and drama series. From year to year, the number of Korean dramas released increased as well as fans of the Korean drama.

Korean dramas appear in various genres, such as romance, friendship, comedy, mystery and so on. In 2017, the total korean dramas released amounted to 81 dramas, in 2018 amounted to 126 dramas, and in 2019 reached 104 dramas (Mydramalist, 2021).

In Indonesia, based on the results of a survey of the Indonesian Institute of Sciences (LIPI) quoted by katadata.co.id on November 30, 2020, showed 842 respondents out of 924 respondents surveyed or equivalent to 91.1% chose to watch Korean dramas during the Covid-19 pandemic. This number increased by 3.3% from before the Covid-19 pandemic. 8% of respondents were new viewers of Korean dramas who had not previously been exposed to Korean drama shows and had never watched Korean dramas (Septadinusastra, 2021).

With the Covid-19 pandemic, many people are interested in watching Korean dramas to fill their free time. To make it easier for them to find dramas to watch, a recommendation system can be created that can adjust the user profile in their calculations. Can be seen in Figure 1, on the website mydramalist.com, they only recommend drama based on user input by clicking make a recommendation.
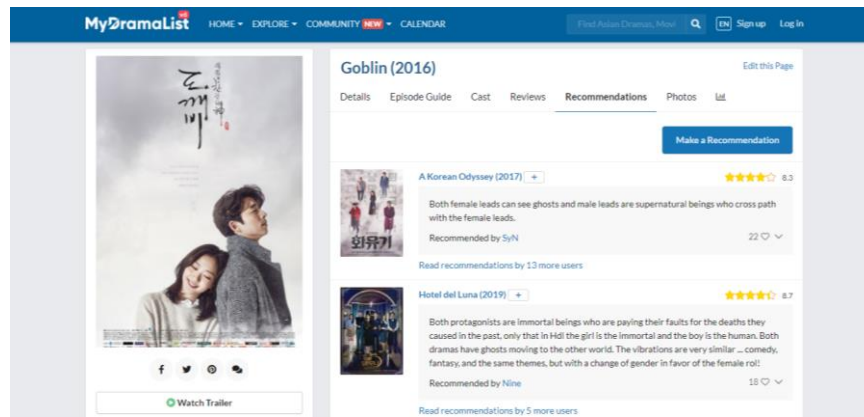
Figure 1. Recommendations in mydramalist.com

A recommendation system can be defined as a program that aims to provide recommendations for items (products or services) that are best suited to a particular user (individual or business). The recommendation system predicts user interests based on related information about the item, the user and the interaction between the item and the user. Recommendation systems are often used to look for predictions, such as books, music, movies, etc. (Kristanto, Herwindiati, & Hendryli, 2021).

Based on the recommendation method that is often used, the recommendation system is divided into several classifications, namely content-based recommendation, collaborative-based recommendation, and hybrid-based recommendation. For example, it can be seen in Figure 2, on the mydramalist.com website, contains details of the drama which includes synopsis, ratings, genre, number of episodes and so on. The recommendation system made using the hybrid filtering method becomes a difference in the calculation of recommendations that will be given to the user.

Figure 2. Drama details in mydramalist.com

Nearest Neighbor is an approach to finding cases by calculating the proximity between a new case and an old case i.e., based on matching the weight of several existing features (Ndaumanu & Arief, 2014).

Based on the background above, a system will be designed that will recommend Korean dramas using hybrid filtering methods and nearest neighbor algorithms. Hybrid filtering methods that will be used are item-based collaborative filtering and content-based filtering.

Recommendation System

A recommendation system is an application for providing and recommending an item in making a decision that is desired by the user (Ungkawa, Rosmala, & Aryanti, 2013). The application of recommendations in a system usually predicts an item, such as movie recommendations, music, books, news and so on that attract users (Fadlil & Mahmudy, 2007).

Korean Drama

Korean drama according to the Great Dictionary of Indonesian (KBBI) is a Korean story or scene depicting a conflict or emotion, specially arranged for a theatrical performance. The criteria of Korean dramas that will be included in the calculation of recommendations are genre, ratings and players.

Genre data that will be used for example, such as romance, comedy, medical, family, thriller, mystery, law and so on. All genres in drama will be included in the calculation, as well as all drama players. As for the rating, the user input will be used as a calculation of the average rating in the drama.

Collaborative Filtering

Collaborative filtering is a concept in which the opinions of other existing users are used to predict items that a user may be liked/ interested in (Ricci, Rokach, Shapira, & Kantor, 2011).

The quality of recommendations given using this method depends heavily on the opinion of another user (Neighbor) on an item. Later it was known that doing neighbor reduction (Reduce neighbor so that only a few users who have the highest similarity alone will be used in calculations) is able to improve the quality of recommendations given (Adomavicius, Kamireddy, & Kwon, 2007).

There are two main approaches in collaborative filtering methods, mentioned as follows.

User-based collaborative filtering

This approach relies on the fact that a user follows a larger group (Whose individual behavior is the same). Recommendations are based on items that are often purchased/liked by various members of the group. The most commonly used method is the nearest neighbors method. Based on items that have been selected by a user's closest neighbor, items that are likely to be selected by that user in the future are predicted (Surendra & Raja, 2011). Algorithms that are often used include Pearson correlation coefficient (PCC) algorithm and vector space similarity (VSS) algorithm.

Item-based collaborative filtering

This approach relies on relationships between items, analyzed from historical information so that the purchase of an item directs the purchase towards another item (Group of items). Recommendations are because a user tends to choose items like those he or she has selected in the past (Deshpande & Karypis, 2004).

Implement and test the item-based collaborative filtering method with the following steps:
1) Processing the rating data of an item to obtain user data that has rated the item.

2) Calculate similarity between items using the adjusted-cosine similarity method based on the user's rating. The adjusted cosine similarity equation is used to calculate the similarity values between items. This similarity calculation is a modification of the calculation of vector-made similarities which by looking at the fact that each user has a different rating scheme. Sometimes the user gives a high rating to item a on the other hand the user gives a very low rating on item b. Therefore, for each rating reduced by the average rating given by the user.

$$sim(i,f) = \frac{\sum_{u \epsilon U}(R_{ui} - \bar{R}_u)(R_{uj} - \bar{R}_u)}{\sqrt{\sum_{u \epsilon U}(R_{ui} - \bar{R}_u)^2} + \sqrt{\sum_{u \epsilon U}(R_{uj} - \bar{R}_u)^2}}$$

Information:

$sim(i,f)$ = The similarity value between item i and item j.

$u \epsilon U$ = Set of u users rating item i and item j.

R_{ui} = User rating u on item i.

R_{uj} = User rating of u on item j.

$\bar{R}_u$ = Average value of user rating u

To calculate the similarity value between 2 items, a user set is required that rating the item. The resulting value in the adjusted-cosine similarity equation is ranging from +1 to - 1. Items are considered colluding if the similarity value between the two items is close to +1, and vice versa the item is considered non-colluding if its similarity value is close to -1.

3) Perform calculations of user rating predictions on an item using the weighted sum method. Here is the formula of the weighted sum algorithm:

$$P(u,j) = \frac{\sum_{i \epsilon j}(R_{u,i} * S_{i,j})}{\sum_{i \epsilon j}|S_{i,j}|}$$

Information:

$P(u,j)$ = Prediction for user u on item j

$\Sigma_{i \in j}$ = Set of items similar to item j

$R_{u,i}$ = User rating u on item i

$S_{i,j}$ = Similarity value between item i and item

Content-based filtering

Content-based recommendation systems use the availability of content (often also referred to as features, attributes, or characteristics) of an item as a basis for recommendations (Ricci et al., 2011). For example, a movie has content such as genre, author, year of release, etc., or a document file has content in the form of writing in it (Wijaya & Alfian, 2018).

In general, content-based filtering methods have 2 common techniques in making recommendations, namely heuristic-based and model-based. Cosine similarity, Boolean query, TF-IDF (Term frequency-invers document frequency) and Clustering belong to the heuristic-

based group while those included in the model-based group are Bayesian classifier &clustering techniques, decision trees and artificial neural networks (Adi, 2010).

This design uses cosine similarity techniques that can assess the similarities between dramas that have been passed by users with dramas that have not been passed by the user with the formula:

$$\cos(\theta) = \frac{A \cdot B}{||A|| \cdot ||B||}$$

Hybrid recommendation

Hybrid filtering is a technique that promotes several recommendation techniques. Hybrid filtering techniques:

1) Weighted: Values on recommendations between multiple techniques are combined based on certain parameters.
2) Switching: The system combines 2 techniques in turn
3) Mixed: Recommendations from several recommenders put together.
4) Cascade: A recommendation bests the results of other recommendations.
5) Feature Augmentation Output: from one technique used for input from another technique.
6) Meta-level: The model learned from one recommender is used for input on another recommender.

The technique used in this recommendation system is switching technique. Content-based filtering methodwill be used when the user has given a rating to a minimum of five plays, otherwise the item-based CF method will be used in the calculation.

Algoritma K Nearest Neighbor

Nearest Neighbor is an approach algorithm for finding cases by calculating the proximity between new cases and old cases that is based on matching the weight of several existing attributes and having similar criteria (Utomo & Suhari, 2013). The formula used as a distance measure for this numerical data is cosine similarity:

$$\cos(\theta) = \frac{A \cdot B}{||A|| \cdot ||B||} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2} \sqrt{\sum_{i=1}^{n} B_i^2}}$$

Information:

$A \cdot B$ = vector *dot products* of A and B, calculated by $\sum_{i=1}^{n} A_i B_i$

$||A||$ = Vector length x, calculated by $\sqrt{\sum_{i=1}^{n} A_i^2}$

$||B||$ = Vector length x, calculated by $\sqrt{\sum_{i=1}^{n} B_i^2}$

This size is good for data with a high degree of similarity although it is often used alongside other approaches to limit the dimensions of the problem. In defining the size of the distance between k, some algorithms use to determine which k is closest.
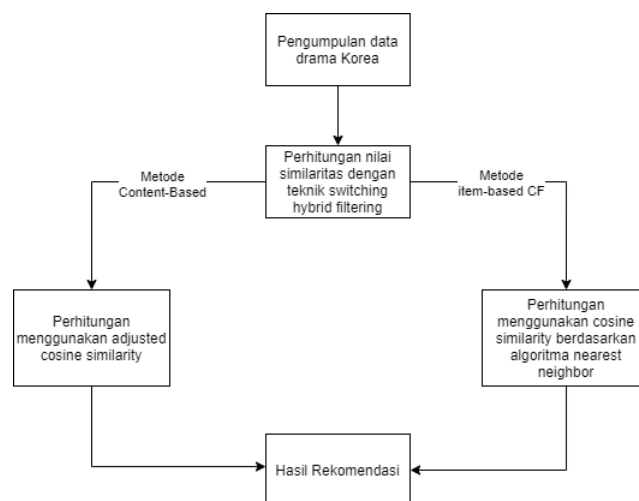
METHOD

Designed System

The system is a Korean drama recommendation program using item-based collaborative filtering and content-based filtering methods with nearest neighbor algorithms.

Users who have given a rating of at least five drama titles, will be given recommendations with content-based filtering methods and if not, then the collaborative filtering method will be used.

The role of the nearest neighbor algorithm in this design is to approach looking for cases by calculating the proximity between new cases and old cases.

The content-based filtering method will be calculated proximity based on the genre and cast of the Korean drama. As for item-based filtering will be calculated the similarity between the rating of an item with items that have been rated other users. Here's the general scheme of the system.

Figure 1. Research Flow

The testing method carried out in this decision support system application is Black Box Testing by programmers who aim to find out if this application is already running well and in accordance with expectations. Blackbox Testing, then conducted User Acceptance Testing on prospective users of the application.

RESULTS AND DISCUSSION

Black Box Testing

Black Box Testing is done by programmers to find out if the application is running properly in accordance with its function. Black box testing can be seen below, with 60 respondents as samples.

Table 1. List of Questionnaire Questions

No.	Question
1.	Is the appearance of this recommendation system website attractive?
2.	Is this website running smoothly?
3.	Is the website easy to use?
4.	Are tutorials for using websites easy to understand?
5.	Do the recommendations of Korean dramas on this website match the criteria sought?
6.	Is this website able to facilitate the selection of Korean dramas to be watched?
7.	Is this website good enough?

Is the appearance of this recommendation system website attractive?

Table 2. Accumulated Respondents' Answers to Question Number 1

Information	Shoes	Frequency	S
SS	5	26	130
S	4	29	116
KS	3	5	15
TS	2	0	0
STS	1	0	0
	Sum		261

Percentage = 175 / 300 x 100% = 87%

Is this website running smoothly?

Table 3. Accumulated Respondents' Answers to Question Number 2

Information	Shoes	Frequency	S
SS	5	29	145
S	4	27	108
KS	3	4	12
TS	2	0	0
STS	1	0	0
	Sum		265

Percentage = 265 / 300 x 100% = 88.34%

Is the website easy to use?

Table 4. Accumulated Respondent Answers to Question Number 3

Information	Shoes	Frequency	S
SS	5	32	160
S	4	27	108
KS	3	1	3
TS	2	0	0
STS	1	0	0
	Sum		276

Percentage = 276 / 300 x 100% = 92%

Are tutorials for using websites easy to understand?

Table 5. Accumulated Respondents' Answers to Question Number 4

Information	Shoes	Frequency	S
SS	5	35	175
S	4	19	76
KS	3	6	18
TS	2	0	0
STS	1	0	0
	Sum		269

Percentage = 269 / 300 x 100% = 89.67%

Do the recommendations of Korean dramas on this website match the criteria sought?

Table 6. Accumulated Respondents' Answers to Question Number 5

Information	Shoes	Frequency	S
SS	5	28	140
S	4	28	112
KS	3	4	12
TS	2	0	0
STS	1	0	0
	Sum		264

Percentage = 264 / 300 x 100% = 88%

Is this website able to facilitate the selection of Korean dramas to be watched?

Table 7. Accumulated Respondents' Answers to Question Number 6

Information	Shoes	Frequency	S
SS	5	29	145
S	4	25	100
KS	3	6	18
TS	2	0	0
STS	1	0	0
	Sum		263

Percentage = 263 / 300 x 100% = 87.67%

Is this website good enough?

Table 7. Accumulated Respondents' Answers to Question Number 6

Information	Shoes	Frequency	S
SS	5	28	140
S	4	28	112
KS	3	4	12

TS	2	0	0
STS	1	0	0
	Sum		264

Percentage = 264 / 300 x 100% = 88%

Table 8. Score Interpretation Criteria

Percentage	Information
0% - 20%	Very Bad
21% - 40%	Less Good
41% - 60%	Pretty Good
61% - 80%	Good
81% - 100%	Excellent

User Acceptance Testing

Testing by users is carried out to prospective users of the recommendation system website by distributing a questionnaire consisting of 8 questions. The following is an item-based collaborative filtering method tested by user 301.

Table 9. Test *Rating* Data

	Move to Heaven	Hospital Playlist	Flower of Evil	My Mister	Prison Playbook	Average
user 34	4	5	4	4		4.25
user 35	5	4			5	4.66667
user 301	5	4	5			4.66667
user 312	3	5			3	3.66667

Table 10. Results of cosine similarity calculations

	Move to Heaven	Hospital Playlist	Flower of Evil	My Mister	Prison Playbook
Move to Heaven		-0.9716	1	1	1
Hospital Playlist	-0.9716		-0.4648	-1	-1.11425
Flower of Evil	1	-0.4648		1	0
My Mister	1	-1	1		0
Prison Playbook	1	-1.1142	0	0	

Table 11. Weighted *sum* predicted weight results

	My Mister	Prison Playbook
user 301	2	2.25683
	Flower of Evil	**My Mister**
user 35	1.27431	0.33333

The recommendation given to user 301 is My Mister, while for user 35 is Flower of Evil.

Method Testing

Testing methods are done by comparing manual calculations and recommendation output results on the website. The first test, collaborative filtering, is implemented when the user has not rated at least five drama titles.

Table 12. Rating Data

	Drama A	Drama B	Drama C	Drama D	Drama E	Average
user 1	4	5	4	4		4.25
user 2	5	4			5	4.66667
user 3	5	4	5			4.66667
user 4	3	5			3	3.66667

Calculates the similarity values between items using the adjusted cossine similarity algorithm

$$sim(i,j) = \frac{\sum_{u \in U}(R_{ui} - \bar{R}_u)(R_{uj} - \bar{R}_u)}{\sqrt{\sum_{u \in U}(R_{ui} - \bar{R}_u)^2} + \sqrt{\sum_{u \in U}(R_{uj} - \bar{R}_u)^2}}$$

$$sim(a,c) = \frac{(4 - 4.25)(4 - 4.25) + (5 - 4.6)(5 - 4.6)}{\sqrt{(4 - 4.25)^2 + (5 - 4.6)^2}\sqrt{(4 - 4.25)^2 + (5 - 4.6)^2}} = \frac{0.2225}{0.2225} = 1$$

Table 13. Similarity Value Results

	Drama A	Drama B	Drama C	Drama D	Drama E
Drama A		-0.9716	1	1	1
Drama B	-0.9716		-0.4648	-1	-1.11425
Drama C	1	-0.4648		1	0
Drama D	1	-1	1		0
Drama E	1	-1.1142	0	0	

Calculate the predicted weight

Once we get the similarity value between items, the last step in generating a recommendation is to calculate the value of the predicted weight using the weighted sumalgorithm.

$$P(u,j) = \frac{\sum_{i \in j}(R_{u,i} * S_{i,j})}{\sum_{i \in j}|S_{i,j}|}$$

$$P(u2,dd) = \frac{\sum_{i \in j}(R_{u,i} * S_{i,j})}{\sum_{i \in j}|S_{i,j}|} = \frac{(5 \times 1) + (4 \times (-1)) + (5 \times 0)}{|1| + |-1| + |1|} = 0.33$$

Table 14. Prediction Weight Results

	Drama C	**Drama D**
user 2	1.27431	0.33333

From the table above, it can be seen that those that have a value weight that is close to 1 with a positive range are items that will be recommended, so that user 2 gets a recommendation of drama d.

The next test is content-based filtering, implemented when the user has given a rating to a minimum of five drama titles. All genres and 2 main players will be included in the calculation.

Table 15. Titles that have been*rating*

Heading	**Gender**	**Rating**
Hospital Playlist	Friendship, Life, Medical, Romance	5
Crash Landing on You	Comedy, Drama, Military, Political, Romance	4
18 Again	Comedy, Drama, Fantasy, Life, Romance, Youth	4
While You Were Sleeping	Comedy, Drama, Fantasy, Mystery, Romance, Thriller	5
Dr. Romantic	Drama, Medical, Romance	3

Table 16. Titles that have not been rated

Heading	**Gender**
Vagabond	Action, Crime, Melodrama, Mystery, Thriller
Dr. Romantic 2	Drama, Medical, Melodrama, Romance
Sky Castle	Drama, Family, Mystery, Psychological
Weightlifting Fairy Kim Bok Joo	Friendship, Comedy, Romance, School, Youth, Sports
I Hear Your Voice	Thriller, Mystery, Law, Romance, Drama, Supernatural

Cosine similarity can assess the similarity between dramas that have been passed by users with dramas that have not been rated by the user.

$$\cos(\theta) = \frac{A \cdot B}{||A|| \cdot ||B||}$$

Table 17. Normalization of Genre Criteria

No	Heading	Gender															
		And	Co	Cr	Dr	Ago	Fri	Li	With	Mel	Me	My	After	Dogs	Ro	Th	I
1	Hospital Playlist	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0
2	Crash Landing on You	0	1	0	1	0	0	0	0	0	1	0	1	0	1	0	0
3	18 Again	0	1	0	1	1	0	1	0	0	0	0	0	0	1	0	1
4	While You Were Sleeping	0	1	0	1	1	0	0	0	0	0	1	0	0	1	1	0
5	Dr. Romantic	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0
6	Vagabond	1	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
7	Dr. Romantic 2	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0
8	Sky Castle	0	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0
9	Weightlifting Fairy Kim Bok Joo	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0
10	I Hear Your Voice	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0

The process of calculating similarity values

Sim [1,6] = Similarity between the title of drama 1 and title 6.

$$A \cdot B = (0 \times 1) + (0 \times 0) + (0 \times 1) + (0 \times 0) + (0 \times 0) + (1 \times 0) + (0 \times 1) + (0 \times 0)$$
$$+ (0 \times 1) + (0 \times 0) + (0 \times 0) + (1 \times 0) + (0 \times 1) + (0 \times 0) + (0 \times 1)$$
$$+ (0 \times 0) + (0 \times 0) + (1 \times 0) + (0 \times 0) + (0 \times 0) + (0 \times 1) + (0 \times 0)$$
$$+ (0 \times 0) + (0 \times 0) + (0 \times 0) + (1 \times 0) = 0$$

$$\left\|A\right\| \cdot \left\|B\right\| = \sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} \times \sqrt{1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2} = 6$$

$$\cos(\theta) = \frac{A \cdot B}{\left\|A\right\| \cdot \left\|B\right\|} = \frac{0}{6} = 0$$

Table 18. *Content-Based Filtering* Calculation Results

Drama	Hospital Playlist	Crash Landing on You	18 Again	While You Were Sleeping	Dr. Romantic	Total
Vagabond	0	0	0	0.40089	0	0.40089
Dr. Romantic 2	0.33333	0.30861	0.28867	0.28867	0.7303	1.94958

Sky Castle	0	0.1543	0.14434	0.28867	0.18257	0.76988
I Hear Your Voice	0.14434	0.26726	0.25	0.625	0.31623	1.60283
Weightlifting Fairy Kim Bok-Joo	0.28868	0.26726	0.25	0.25	0.15811	1.21405
Rating User	5	4	4	5	3	?

The value of k taken is 3, because $k = \sqrt{n}$, with n is the number of titles that have been dirating, because of the result of, then added 1 so that the value of k becomes odd. $\sqrt{5} = 2$

Recommendations include Dr. Romantic 2, I Hear Your Voice, Weightlifting Fairy Kim Bok-Joo.

CONCLUSION

Based on the results of the previous discussion it can be concluded that:

1) The Hybrid Filtering method (Item-based Collaborative Filtering and Content-based Filtering) has been successfully applied in determining the recommendations of Korean Dramas with similarity calculations based on Korean dramas that have been rated by users.
2) The design of this recommendation system website has been successfully done and with this website can help users in choosing Korean dramas to watch.
3) Based on the results of user acceptance testing that has been conducted and from the results of respondents' assessments, it can be concluded that the function of the Korean drama recommendation system website can run well and can provide recommendations according to user rating.

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