Recommendation System Implementation for Partners Exercise in Fitness Center on Fit Partners Design Application Using Hybrid Content-Collaborative Reciprocal Algorithm

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Recommendation System Implementation for Partners Exercise in Fitness Center on Fit Partners Design Application Using Hybrid Content-Collaborative Reciprocal Algorithm

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ABSTRACT

People often quited exercising due to the lack of exercise partner or the absence of people with similar workout preference. Hybrid content-collaborative reciprocal algorithm searches for users based on the user profile by finding the value of the level of support. First, algorithm will look similar to the current user, called SU (similar users). After that, it will search who have interacted with SU, called CU(*candidate users*), called EOI. This value is based on indicators the conversation intensity via chat, giving positive emoticons during a conversation via chat, seeing prospective partners profile, sharing the information or tips, comparison of the number of conversations and responses given via chat, similarity of age, gender, workout type, body type, distance, and workout time, giving rating, friends of prospective fitness partners, and sending request as a partners. After testing the accuracy of the algorithm, the success rate is shown to be 50%. This low percentage is due to some of the recommended workout time is not according to the current user time workout, besides that into consideration current users refuse is no clear profile of the user who recommended such as a profile picture and completeness of the data themselves.

Hybrid algorithm-content collaborative Reciprocal not use weighting, that one user could have been more like the fellow exercising an age closer to him, but differed with others, it could be because of the similarity of the body. Because of these differences in preferences hybrid algorithm-content collaborative Reciprocal not accommodate the weight of each indicator.

Keywords : hybrid content-collaborative reciprocal; dissimilarity measurement; EOI; uncertainty reduction theory;

INTRODUCTION

Based on data from four fitness centers (Gold's Gym, Synergy Fitness, Celebrity Fitness / Celebrity Fitness Express, Ade Rai Fitness) which has 50 branches, the number of members who registered as many as 23,000, but the number of active members only amounted to 8,020 [12], the difference is very big, which means that the number of members who are not active for 14.980. There are several factors that led to this case, for example, a person does not have partners to go to the gym to exercise, so lack of motivation to do exercise. Based on the results of research in 96 respondents in Surabaya [14], there is ENOUGH influence of the need for fitness partners towards the motivation of someone to do exercise at fitness center in the community of Surabaya. The above results indicate that the presence of no unresolved issues, namely the absence of media that helps a person to find a partner to exercise, especially in Surabaya.

Based on research [3], Indonesia was ranked fifth in the list of smartphone users in the world, with a total of 47 million users. From the total number of smartphone users around the world, users of the Android platform was ranked first with the highest. Based on the above conditions, the authors take advantage of these conditions to resolve the problems experienced by a person in finding a partner to exercise with a way to build a media that can be a tool that solve these problems. Aids in the form of an Android-based mobile application that can help you find your work out partner on exercise.

DOMAIN OVERVIEW

We are working with android application, namely FitPartners. The user interaction on this application consists of four steps :

1. Creating a user profile – New users register to the application and provide information about themselves such as their age, gender, location, workout type, body type, and workout time.
2. Browsing the profiles of other users for interesting matches.
3. Expression of Interest – If user A performs one of the eight indicators of EOI to the user B, then the interaction between the user will be recorded as EOI.

PRELIMINARY RESEARCH

This step is used to identify the factors - factors that affect someone in increasing its reliance on someone or to reduce the uncertainty between them [16]. This theory have 9 axioms, there are :

1. Verbal communications
2. Non-verbal affiliative expressiveness/warmth
3. Information Seeking
4. Self Disclosure
5. Reciprocity
6. Similarity
7. Liking
8. Shared Networks
9. Communication Satisfaction.

Variabel	Sub-Variabel	Indicators
Uncertainty Reduction Factors	Verbal communications	- The conversation intensity via chat
	Non-verbal affiliative expressiveness/warmth	- Giving positive emoticons during a conversation via text message
	Information Seeking	- Seeing prospective partners profile - Seeing prospective partners profile picture - Seeing sports activity of prospective partners
	Self Disclosure	- Sharing the information or tips
	Reciprosity	- Comparison of the number of conversations and responses given via chat
	Similarity	- Similarity of age, gender, workout type, body type, distance, and workout time
	Liking	- Giving rating to the prospective partners - Commenting on prospective

Variabel	Sub-Variabel	Indicators
		partners
	Shared Networking	- Friends of prospective fitness partners
	Communication Satisfaction	- Sending request as a partners - The number of days of the conversation via chat - Appointment to workout together

Table 1. Variable and variable descriptions

Population and Sample

In this research, researchers used probability sampling technique, namely cluster sampling technique, because of the population is spread out and have different characteristics (for example, residential areas, a fitness center membership active status) of each element of the sample.

Because of the unknown size of population, then we used Cross-sectional (Snedecor GW & Cochran WG, 1967) formula to determine the sample size.

$$n = z^2*(p*q) / e^2 \dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

n : Total sample

z : Association error standard (1.96)

p : presentation estimation, the percentage who answered disagree estimated 50%

q : Estimate the percentage who answered agree, 100%-p = 100%-50% = 50%

e : Error tolerance, in this study the error tolerance of 10%, meaning that if all the data has been collected there by 90% the correct data, and 10% of data error.

So therefore,

$n = 1.96^2*(50*50) / 10^2 = 3.84 * (2500) / 100 = 96$

By using the above calculation, obtained a sample of 96. By using clustering sampling method with proportional system (population number for each cluster influential in determining the number of samples in the cluster), then the sample is divided by region of residence, namely Surabaya East, North Surabaya, Surabaya West, South Surabaya. Here is the deployment of the number of samples for each area of Surabaya.

Wilayah	Jumlah Pusat Kebugaran	Jumlah Sample
Surabaya Barat	21 buah (31.35%)	30 responden
Surabaya Selatan	19 buah (28.35%)	27 responden
Surabaya Timur	7 buah (10.45%)	10 responden
Surabaya Utara	20 buah (29.85%)	29 responden
	67 buah	96 responden

From the table 1, we have 14 indicators described by uncertainty reduction theory. We do questionnaire to the 96 respondents in Surabaya which is divided into 4 parts, West Surabaya, East Surabaya, South Surabaya, and North Surabaya.

The result of the questionnaire is described below,

1. Verbal Communication

    a. The conversation intensity via chat (Score : 290)

2. Non-verbal affiliative expressiveness/warmth

    a. Giving positive emoticons during a conversation via text message (Score : 286)

3. Information Seeking

    a. Seeing prospective partners profile (Score : 315)

    b. Seeing prospective partners profile picture (Score : 302)

    c. Seeing sports activity of prospective partners (Score : 300)

4. Self Disclosure

    a. Sharing the information or tips (Score : 315)

5. Reciprosity

    a. Comparison of the number of conversations and responses given via chat (Score : 305)

6. Similarity

    a. Similarity Age (Score : 347)

    b. Similarity Gender (Score : 284)

    c. Similarity Workout Type (Score : 330)

    d. Similarity Body Type (Score : 275)

    e. Similarity Distance (Score : 319)

7. Liking

    a. Giving rating to the prospective partners (Score : 306)

    b. Commenting on prospective partners (Score : 299)

8. Shared Networking

    a. Friends of prospective fitness partners (Score : 318)

9. Communication Satisfaction

    a. Sending request as a partners (Score : 317)

    b. The number of days of the conversation via chat (Score : 313)

    c. Appointment to workout together (Score : 312)

We chose 9 indicators that have the highest value of the results of the questionnaire, there are :
1. The conversation intensity via chat
2. Giving positive emoticons during a conversation via text message
3. Seeing prospective partners profile
4. Sharing the information or tips
5. Comparison of the number of conversations and responses given via chat
6. Similarity of age, gender, workout type, body type, distance, and workout time
7. Giving rating to the prospective partners
8. Friends of prospective fitness partners
9. Sending request as a partners

To attribute content-based selected all indicators, because according to a study conducted earlier, we got factors to be considered a person in choosing associates workout at the gym, ie gender, age, location, physical appearance, sports activities same.

These indicators will be used for the calculation of the hybrid content-collaborative reciprocal algorithm.

DISSIMILARITY MEASURMENT
This step is to calculate the dissimilarity between users [5]. The dissimilarity between user measured with their attributes from user profile, there are age, gender, workout type, body type, distance(KM), and workout time.

Proximity Measures for Binary Attributes
One approach involves computing a dissimilarity matrix from the given binary data. This measurement is used to

measure workout type, consisting of weight training, aerobic, rapid power motions (rpm), and treadmill workout.

$$sim(i,j) = \frac{q}{q+r-s}$$ ……………………………………..(1)

[Jiawei, 2011 : 68]

From equation (1), we can calculate the similarity of workout type attribute. So if we want to get the dissimilarity, we can calculate by (1-sim) [Jiawei, 2011 : 67].

Euclidean Distance
Euclidean distance is the calculation of the distance of 2 pieces point in Euclidean space. Euclidean space introduced by Euclid, a Greek mathematician from around the year 300 BCE. This measurement is to calculate the dissimilarity distance position (Kilometer) attribute between 2 users.

$$d(i,j) = \sqrt{(x_{i1} - x_{j1})^2 + (x_{i2} - x_{j2})^2 \ldots + (x_{ip} - x_{jp})^2}$$ …………..(2)

[Jiawei, 2011 : 69]

From equation (2), we can calculate the dissimilarity distance attribute.

Dissimilarity for Attributes of Mixed Types
We can calculate the dissimilarity of age, gender, body type, and workout time with this equation.

1. If the attribute type is numeric, then we can calculate it with equation (3).

$$d_{ij}^{(f)} = \frac{|xif - xjf|}{maxxhf - minxhf}$$ ………………………….(3)

2. If the attribute type is nominal or binary : $d_{ij}^{(f)} = 0$, if Xif=Xjf, otherwise $d_{ij}^{(f)} = 1$

So, after we get all the dissimilarity of 6 attributes (age, gender, workout type, body type, distance, and workout time), we can calculate the dissimilarity between 2 users by equation (4).

$$d(i,j) = \frac{\sum_{f=1}^{p} \delta_{ij}^{(f)} d_{ij}^{(f)}}{\sum_{f=1}^{p} \delta_{ij}^{(f)}}$$ …………………………….....(4)

where the indicator $\delta_{ij}^{(f)} = 0$ if either (1) xij or xjf is missing (i.e., there is no measurement of attribute *f* for object *i* or object *j*), or (2) xij = xif = 0 and attribute *f* is asymmetric binary; otherwise $\delta_{ij}^{(f)} = 1$.

WORKFLOW INTERACTION BETWEEN USER DATA STORAGE
This section describes how the process of recording the results of interactions made by the user into the database. All data will be stored in the database table member_rekap_member.

The Conversation Intensity Via Chat Indicator
On this indicator, EOI is done each time user do the interaction via chat. If there is a user A and user B, user A sends a message to B, then on the table member_rekap_member will be updated with the code of the user A as fkmember1, and user code B as fkmember2, each one message sent from the user A and B, then the total_kirim1 column value increased by 1, and vice versa.

Giving Positive Emoticons During a Conversation via Chat Indicator
On this indicator, EOI is done each time user do the interaction via chat. If there is a user A and user B, user A sends an emoticon positive to B, then on the table member_rekap_member will be updated with the code of the user A as fkmember1, and user code B as fkmember2, every 1 emoticons positive sent from user A and B, it will be checked on the positive emoticons list in table of positive emoticons, if there are on the list, then in total_skor_emotikon1 column value increased by 1, and vice versa.

Seeing Prospective Partners Profile Indicator
On this indicator, EOI is done each time user clicking on other users' profiles. If there is a user A and user B, user A click on the user profile B, then the member_rekap_member table will be updated on total_view_profil2 column with increasing value by 1, and the code of the user A as fkmember1 and B as fkmember2 user code, and vice versa.

Sharing The Information or Exercise Tips Indicator
On this indicator, EOI is done each time user clicking on exercise tips to other users. If there is a user A and user B, user A click on tips posted by the user B, it will be increased the value by 1 in the table member_rekap_member column total_view_tips2 with the code of the user A as fkmember1, and user code B as fkmember2, and vice versa.

Comparison Of The Number Of Conversations And Responses Given Via Chat Indicator
On this indicator, EOI is done each time user do the interaction via chat. The term used is reciprocity, each user will get 1 value in case one of reciprocity. Reciprocity detected through short messages which, if user A sends a message, and reply to user B, meaning that it is said to be one of reciprocity. If user A sends 5 messages to user B, and user B replies one message, it is still said to be one of reciprocity. At the time of message delivery occurs, it will be calculated between user A and user B, there is what reciprocity, after which it will be updated in the table member_rekap member on the column timbalbalik with the code of the user A as fkmember1, and user code B as fkmember2, and vice versa.

Giving Rating Indicator

On this indicator, EOI is done each time user rates another users. If there is a user A and user B, when user A rates user B and between grades 1-5, it will be updated in the table with a rating2 member_rekap_member column A on fkmember1 user code and user B on fkmember2, and vice versa.

Friends of Prospective Fitness Partners Indicator (Mutual Partners)

On this indicator, EOI is done each time user did send request approval to other users. If there is a user A and user B, user A send requests to user B, and then user B approved it. It will be calculated how many partners who have become friends of the user A is also a friend of the user B (mutual friend), After that, the amount will be entered into the database with an update on a table with a column member_rekap_member   total_mutual_partner   with fkmember1 code and fkmember2 according to records.

Sending Request as a Partners Indicator

On this indicator, EOI is done each time user performs requests as a friend, approval, and reject partner. If there is a user A and user B, user A did send a request to the user B, it will be updated in the table member_rekap_member with A as fkmember1 user code and user code B as fkmember2 and the addition of value in the column kepuasan_komunikasi1. If the user B does approval to send a user request, the user A will get 1 point and is updated by the same mechanism. If user B does reject partner, then the user A will get a value of -1 and will be updated by the same mechanism.

HYBRID CONTENT-COLLABORATIVE RECIPROCAL RECOMMENDER

The two most common recommendation techniques are content-based and collaborative filtering. Content-based filtering is recommendation system which resulted in a recommendation that use the preferences of the user and item information [7]. Collaborative filtering is a process of selecting or evaluating items by using the opinions of other users [15]. Both approaches have their advantages and drawbacks, hybrid recommenders combine them to address the limitations of each approach [7].

Algorithm

This recommender have 2 steps to generate ranked list recommendations. First, we determine the current user is U, we find another users that similar to U, we call it set of Similar Users (SU), we give a threshold (<=0.5) and limit the size of SU, that is 10 lowest dissimilarity value to U. After that, we retrieve the users, that have been interacted with SU by 8 indicators (the conversation intensity via chat, giving positive emoticons during a conversation via chat, seeing prospective partners profile, sharing the information or tips, comparison of the number of conversations and
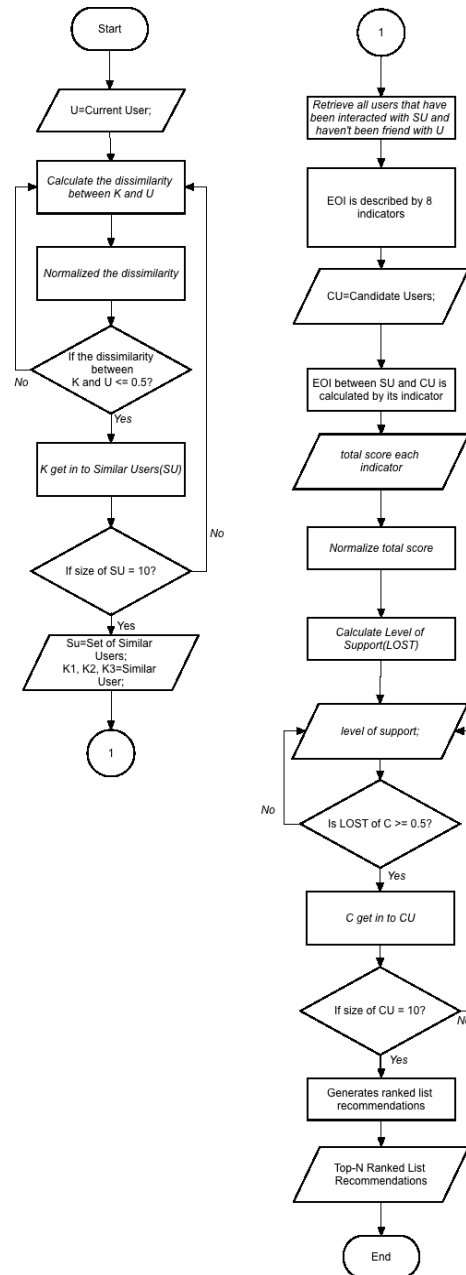

Figure 1: How hybrid content-collaborative reciprocal algorithm works

responses given via chat, giving rating, friends of prospective fitness partners, and sending request as a partners).

Hybrid content-collaborative reciprocal algorithm is a combination algorithm of the basic algorithm of content-based and collaborative filtering. The workings of the algorithm is based on the similarity of users, and interaction from the user. Figure 1 described how hybrid content-collaborative reciprocal algorithm works. Given the user U, we find another users that similar to U by calculating the dissimilarity with "Dissimilarity Measurement".
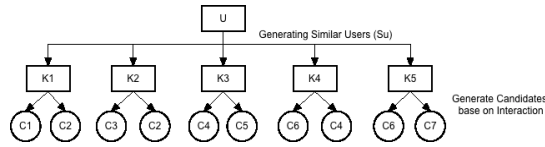
Figure 2: Generating CU

The dissimilarity between users calculated using dissimilarity measurement. After that the value each attribute is normalized with range [0,1]. Then calculated the dissimilarity between K with the user U using dissimilarity measurement mixed type attributes. Then we retrieve the lowest dissimilarity value between users with 2 boundaries, the first if the dissimlarity users K with U obtained less than or equal to 0.5 then the K categorized as Similar User (SU), the second one, if the total of existing users SU reaches 10, then the search similar users stops, if SU doesn't reach 10 users, then take all similar users with a dissimilarity of less than or equal to 0.5.

After we have generated SU, then we retrieved all users that have interacted with SU by 8 indicators of EOI, and have not been friend with U (Table 2). We name it as Candidate Users (CU). Then we calculate the score each indicator between SU and CU. After we get all the scores of each indicator, the scores is normalized [5], and then all indicators score are averaged, so we get Level of Support between SU and CU. C will get into CU, if C has level of support greater than or equal to 0.5. Next will be sorting the candidate, taken Top-10 candidate users. Top-10 Recommendations Ranked list which was given to the user U. Selected a total of 10 recommendations due to a growing number of recommendations are given, then the success rate will be smaller than the recommendations given, ideally N recommendations given between 10-30 recommendation, with the highest success rate there are at number 10 [1].

No	Similar Users	Candidate Users	I1	I2	I3	I4	I5	I6	I7	I8
1.	K1	C1	a1	b1	c1	d1	e1	f1	g1	h1
2.	K1	C2	a2	b2	c2	d2	e2	f2	g2	h2
3.	K2	C3	a3	b3	c3	d3	e3	f3	g3	h3
4.	K2	C2	a4	b4	c4	d4	e4	f4	g4	h4
5.	K3	C4	a5	b5	c5	d5	e5	f5	g5	h5
6.	K3	C5	a6	b6	c6	d6	e6	f6	g6	h6
7.	K4	C6	a7	b7	c7	d7	e7	f7	g7	h7
8.	K4	C4	a8	b8	c8	d8	e8	f8	g8	h8
9.	K5	C6	a9	b9	c9	d9	e9	f9	g9	h9
10.	K5	C7	a10	b01	c10	d10	e10	f10	g10	h10

Table 2. Examples of mapping the value of each - each indicator

No	Candidate Users	I1	I2	I3	I4	I5	I6	I7	I8
1.	**C1**	a1	b1	c1	d1	e1	f1	g1	h1
2.	**C2'**	a2+a4	b2+b4	c2+c4	d2+d4	e2+e4	f2+f4	g2+g4	h2+h4
3.	**C3**	a3	b3	c3	d3	e3	f3	g3	h3
4.	**C4'**	a5+a8	b5+b8	c5+c8	d5+d8	e5+e8	f5+f8	g5+g8	h5+h8
5.	**C5**	a6	b6	c6	d6	e6	f6	g6	h6
6.	**C6'**	a7+a9	b7+b9	c7+c9	d7+d9	e7+e9	f7+f9	g7+g9	h7+h9
7.	**C7**	a10	b10	c10	d10	e10	f10	g10	h10

Table 3. Calculation of the value of the same candidates

From the table 4, we normalized the value of each indicator. Level of support gained from the average all indicator scores. After getting the level of support, the sorting is done in order to get ranked CU Recommendations list. The next is taken as the Top 10 candidates who have rated the level of support is more than equal to 0.5.

EXPERIMENTAL

Data

In this section is to test the level of success of the recommendations given and any indicators of interactions made right - really affect one's judgment in choosing mates exercise. Test the recommendation made to 10 people, with a recommendation to the informant by the method of interview. The data used is the real data of active users of the period 12 November 2015 to 18 November 2015 by a total of as many users as 75. The data is retrieved and made 10 recommendations on the calculation of the user, and the recommendation is given in the form of recommended users profile capture results, and given to 10 speakers.

No	Candi-date Users	I1 Norm	I2 Norm	I3 Norm	I4 Norm	I5 Norm	I6 Norm	I7 Norm	I8 Norm	Level of support
1.	**C1**	a1 norm	b1 norm	c1 norm	d1 norm	e1 norm	f1 norm	g1 norm	h1 norm	X1
2.	**C2'**	a24 norm	b24 norm	c24 norm	d24 norm	e24 norm	f24 norm	g24 norm	h24 norm	X2
3.	**C3**	a3 norm	b3 norm	c3 norm	d3 norm	e3 norm	f3 norm	g3 norm	h3 norm	X3
4.	**C4'**	a58 norm	b58 norm	c58 norm	d58 norm	e58 norm	f58 norm	g58 norm	h58 norm	X4
5.	**C5**	a6 norm	b6 norm	c6 norm	d6 norm	e6 norm	f6 norm	g6 norm	h6 norm	X5
6.	**C6'**	a79 norm	b79 norm	c79 norm	d79 norm	e79 norm	f79 norm	g79 norm	h79 norm	X6
7.	**C7**	a10 norm	b10 norm	c10 norm	d10 norm	e10 norm	f10 norm	g10 norm	h10 norm	X7

Table 4. Normalization of data each - each indicator on each candidate and the calculation of the level of support

Speakers are asked to decide whether to accept the recommendation or not, and asked to answer the questions - questions provided.

Result

Recommendations given to a certain number of users with a maximum number of 10, with the level of support is more than equal to 0.5. Given recommendations to respondents, respondents were asked to respond to the recommendations given, whether accepted or rejected. Given 18 recommendations to 10 U users, the result is as much as 9 recommendations were successful, and 9 recommendations were unsuccessful. Therefore the success rate (SR) of the results of this algorithm is 50%. The reason of interviewees reject the recommendations is because the workout time of the recommended users is different with user U, besides that into consideration user U refuse is unclear recommended user profile such as a picture of yourself and completeness of the data themselves.

From 8 indicators, the interviewees refuse that "giving positive emoticons during a conversation via chat" indicator as a consideration in choosing a fitness partners, and accepted 7 indicators as a consideration in choosing a fitness partners.

Hybrid content-collaborative Reciprocal algorithm not use weighting, because the different preferences of each user, that one could have been more like the fellow exercising an age closer to him, but differed with other users, it could be because of the similarity of the body. Because of these differences in preferences hybrid algorithm-content collaborative Reciprocal not accommodate the weight of each indicator.

CONCLUSIONS

Based on the design and implementation of which has been carried out and described in the previous chapters in this study, the authors can draw conclusions as follows:

1. It has been implemented hybrid content-collaborative reciprocal algorithm on FitPartners application (available on Google Play Store) with 50% success rate. The low of success rate is because the workout time of the recommended users is different with user U, besides that into consideration user U refuse is unclear recommended user profile such as a picture of yourself and completeness of the data themselves.

2. Hybrid content-collaborative Reciprocal algorithm not use weighting, because the different preferences of each user, that one could have been more like the fellow exercising an age closer to him, but differed with other users, it could be because of the similarity of the body. Because of these differences in preferences hybrid algorithm-content collaborative Reciprocal not accommodate the weight of each indicator.

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