Development of a Cooking Support System Aimed at University Students Living Alone

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Abstract. It is common for people to start cooking for themselves when they go away to university. It is important to acquire knowledge of foods and to experience cooking while young. With this in mind, we have developed "Cookma" a cooking support system using microblog. Cookma supports step-by-step improvement of cooking abillity and increase of recipe repositories by a recipe recommendation function that considers cooking difficulty. Cookma both motivates students to cook, and supports continuation by a dish photo sharing function via microblog and a gamification function. Evaluation experiment results showed the following three points: (1) It is possible for Cookma to motivate users to cook habitually by a recipe recommendations that considers cooking difficulty. (2) Sharing dish photos on a microblog can motivate users to cook habitually. (3) Game-like elements of replies between a user and a Cookma bot can motivate users to cook habitually.

Keywords: Cooking support · Recipe recommendation · Microblog · Gamification

1 Introduction

It is common for people to start cooking for themselves when they go away to university. However, students do not usually make a habit of cooking for themselves on a regular basis. According to a report from the Cabinet Office of Japan, 23.1 % of university students cook once per week or less, and 20.3 % do not cook at all [1]. In other words, 43.4 % of university students almost do not cook.

The reason is that cooking is troublesome for them, and they have no habits of cooking [2]. On the other hand, since only 6.4 % of students actually dislike cooking, there is possibility to make students to cook habitually by some motivation [3].

In recent years, there has been an increase in food outsourcing. It is difficult to keep a nutritional balance by only eating out [4]. Self-management of eating habits is necessary for a healthy life. Therefore, it is important to acquire knowledge of foods and to experience cooking while young.

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In recent years, use of social networking services (SNS) has become widespread among young adults. According to a report by the Ministry of Internal Affairs and Communications in 2015, 49.3 % of people in their twenties or younger are using Facebook, and 52.8 % are using Twitter [5].

Thus, we have developed a cooking support system, called Cookma, using microblog. Cookma supports step-by-step improvement of cooking abillity and increase of recipe repositories by a recipe recommendation function considering cooking difficulty. Cookma both motivates students to cook, and supports continuation by a dish photo sharing function via microblog and a gamification function.

2 Related Work

Several studies have been conducted on searching for and recommending cooking recipes. In research by Takahashi et al., there are proposals concerning recipe searches using semantics, ingredient substitutions, and pictures and videos [6].

A recipe recommendation system by Nakaoka et al. aimed at increasing recipe collections, recommends recipes that include inexperienced ingredients and cooking methods with priority [7]. Lertsumruaypun et al. proposed a recipe recommendation system using onomatopoeic words [8]. A system developed by Mizuno et al. focused on property of ingredients [9]. Wakao et al. introduced serendipity-like elements to recipe recommendation [10]. Our system structures a search method focused on cooking difficulty. This method automatically calculates the cooking difficulty of recipes, and then recommends recipes based on the user's cooking ability.

Kuramoto et al. aim to increase working motivation using breeding game [11]. "Habitica" To-Do management service using gamification helps people improve living habits by showing real-life tasks as monsters that have to be conquered [12]. Our system assimilates gamification consulting these examples.

As a system supporting cooking using SNS, there are Cookking by Wiel et al. [13]. Cookking shares recipes and make ranking in collaboration with SNS. Our system aims at motivating students to cook for themselves by photo sharing on SNS, according to their knowledge.

3 Cookma

We describe the Cookma cooking support system in this section. Cookma supports a user's cooking habit through replies between a Cookma bot and users on Twitter. The purpose of Cookma is to help improve cooking ability, to motivate a user to cook, and to support continuation of cooking. A recipe recommendation function that considers cooking difficulty plans step-by-step improvement of user's cooking ability and increase of recipe repositories. A dish photo sharing function and a gamification function plans to motivate users to cook and continuation support.

3.1 Design Policy

The design policy of Cookma is as follows:

User friendliness to encourage daily usage
We need to design Cookma so that users, namely, university students living alone will use this system routinely because Cookma encourages healthy cooking habits. Accordingly, we used Twitter which is widespread among young adults, as the front-end for Cookma.

Adaptation based on diversity and improvement of user's cooking ability
Due to the wide range of cooking ability among students, it is necessary that recipes are recommended that take into account a user's specific ability. Because cooking ability improves with continuous use of Cookma, Cookma must recommend recipes that gradually increase in difficulty in order to raise the user's ability.

Supporting improvement and continuation of cooking motivation
Cookma has to continuously motivate users to cook for themselves. Cookma encourages continuous use by a dish photo sharing function and a gamification function.

3.2 System Configuration

Figure 1 shows system configuration of Cookma. Cookma consists of a "Cookma bot", a "Cookma server", and "Users." The Cookma bot obtains a user's tweet and sends ingredient-related words extracted from the tweet to the Cookma server. The Cookma server receives the words from the Cookma bot and searches for recipes in accordance with the user's cooking ability from a recipe database. Recipe titles and recipe urls are then sent to the user through the Cookma bot. The cooking difficulty calculation module classifies recipes into five groups ranked by difficulty. The users prepares the recommended recipes, and sends dish photos to the Cookma bot. In this study, we used Cookpad data as a source for the recipe data. Cookpad[1] is the most popular recipe sharing service in Japan.

Figure 2 shows an image of the bot in use. In Fig. 2, the bot extracts "Chinese cabbage" as an ingredient, and recommends a recipe using Chinese cabbage. The user prepares the dish and sends photo to the bot.

3.3 Recipe Recommendation Function

This function extracts ingredients from a user's tweet and recommends recipes to the user. There are three processes involved in this function flow. First ingredients words are extracted. Next, the recipe database is searched. Finally recipes are recommended.

[1] http://cookpad.com/.

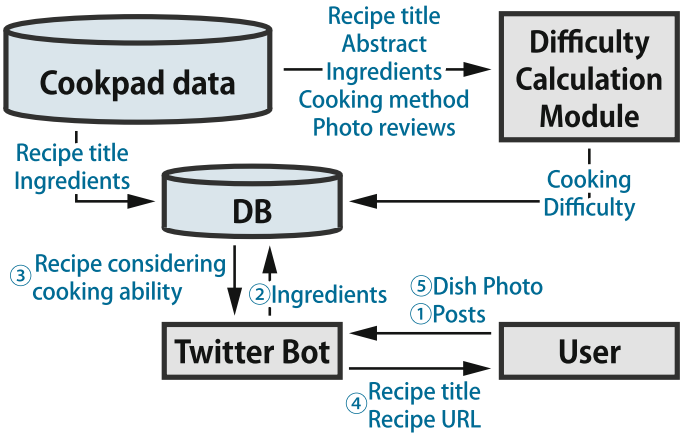

Fig. 1. System configuration.

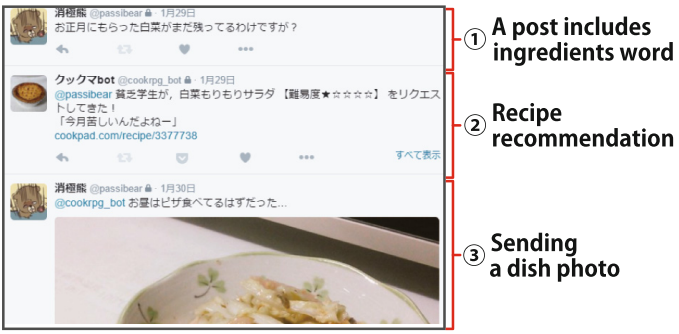

Fig. 2. Usage example.

Ingredients extracting process

In this process, the system extracts words classified as "food" from a user's tweet using morphological analysis. We used the Japanese language morphological analysis JUMAN[2] as a morphological analysis engine for our experiment.

Recipe search process

In this process, the system searches recipes using extracted ingredients words from the recipe database. Because the system considers a user's cooking ability, the difficulty calculation module ensures that recipes of the correct difficulty level are selected for the user.

Recipe recommendation process

In this process, the system selects a recipe from results of recipe search, and recommend recipe title and recipe url to users. Because Cookpad data does

[2] http://nlp.ist.i.kyoto-u.ac.jp/index.php?JUMAN.

not include recipe url, the system obtains recipe url on Cookpad website at each recommendation. If users are dissatisfied about the recommended recipe, they can demand other recipes.

3.4 Dish Photo Sharing Function

This function takes dish photos sent by users, and shares them with other users. There are two processes in this flow. First, dish photos are saved. Next the photos are shared with other users. The dish photo sharing function is used to motivate users.

Dish photo saving process
In this process, the system saves on the server dish photos of foods cooked by users. Cookma uses the photos to confirm that users actually cooked the foods.

Dish photo sharing process
In this process, the bot tweets dish photos received from users and shares them with other users. The tweet includes the identification of the person who prepared the dish. Figure 3 shows an example of dish photo sharing. In this case, the bot is tweeting a photo of yogurt received from a user.

3.5 Gamification Function

This function motivates people to keep cooking, and support continuation of cooking by using gamification. This function uses levels and experience points to encourage users to cook.

Levels and experience points
When users send a dish photo, they obtain experience points according to the difficulty of the recipe that was prepared. If users cook often, resulting in raising to new levels, Cookma will recommend more difficult recipes.

Nicknames for cooks
Cookma creates nicknames for users, such as “assistant cook,” and “experienced cook.” The nicknames change when the user advances to a new level.

Recipe recommendations by imaginary characters
Recipe recommendations from the bot take the form of imaginary characters suggesting dishes for users. For example, “a footballer boy” requesting a dish with the caption “I’m hungry!”

4 Cooking Difficulty

In this study, we used Cookpad data as the data source for recipes provided to users. However, Cookpad data includes no information about cooking difficulty. We have to define difficulty automatically based on recipe information. We describe a method for calculating cooking difficulty in this section. Policies of calculation are as follows:

Fig. 3. Screenshot of a photo sharing function.

1. To easily calculate cooking difficulty easily based on a large number of recipes.
2. To classify cooking difficulty into wide ranges; from easy to difficult.

We use five data items from Cookpad to calculate difficulty. The data used were as follows:

- number of ingredients in a recipe,
- number of steps involved in the preparation of a recipe,
- number of characters of cooking method in a recipe,
- number of photo reviews[3] for a recipe,
- the existence, or nonexistence, of phrases in recipe title and an abstract that indicate easiness.

The above data items were used in the following formula to determine a difficulty score.

$$\begin{aligned} Difficulty = {} & MIN(the\ number\ of\ ingredients,\ 20) \\ & + MIN(the\ number\ of\ steps,\ 20) \\ & + MIN(the\ number\ of\ characters,\ 1000)\ /\ 100 \\ & - MIN(the\ number\ of\ photo\ reviews,\ 600)\ /\ 60 \\ & - the\ existence\ of\ phrases\ that\ indicate\ easiness\ *\ 10 \end{aligned}$$

[3] Cookpad users make interested recipes and send photo reviews to recipe authors.

In this formula, values for the number of ingredients, the number of steps, and the number of characters are first added. Then, values for the number of photo reviews, and the existence or nonexistence of phrases that indicate easiness are subtracted.

In case that values about ingredients, steps of cooking method, and characters of cooking method are high, cooking difficulty might be also high because the recipe is complicated. In case that values about photo reviews and phrases which shows easiness are high, cooking difficulty might be low.

If the values for ingredients, steps, and characters are high, the difficulty value may also be high because the recipe will be complicated. If the values for photo reviews and phrases are high, the difficulty value might be low.

Outliers of values for ingredients, steps, characters, and photo reviews (about 1 %) are excluded from the formula. Values obtained from the formula for ingredients and steps are calculated in 0–20. Other values are calculated in 0–10. Finally, the cooking difficulty score is calculated in –20 – +50. Cookma classifies recipes into five ranks based on the difficulty score. Classification rules are as follows:

- < -2: rank 1 (easiest), 6,878 recipes
- -2 to $< +11$: rank 2, 61,087 recipes
- $+11$ to $<+24$: rank 3, 49,058 recipes
- $+24$ to $< +37$: rank 4, 7,961 recipes
- $\geqq +37$: rank 5 (most difficult), 1,320 recipes

Most recipes are classified as rank 2. There are 61,087 recipes. Difficulty rank 5 has the fewest number of recipes, only 1,320.

This calculation method was created using investigation results from a difficulty calculation method used in an existing study [14].

5 Evaluation Experiment

5.1 Summary of Evaluation Experiment

The purpose of this experiment was to evaluate whether each function of Cookma could motivate students to do their own cooking, and then support them in efforts to continue cooking for themselves. For this evaluation, we developed the following three hypotheses, and then tested them.

Hypothesis(1). The recipe recommendation function provides recipe recommendations properly.
Hypothesis(2). The dish photo sharing function motivates users to cook.
Hypothesis(3). The gamification function motivates users to cook.

Because the purpose was to evaluate each function, the experiment was carried out for three days: from Friday to Sunday. Participants were university students (eight men, two women) who use Twitter and live alone. The experiment tasks were as follows:

1. Follow the Cookma Twitter bot
2. Tweet a text that includes desired ingredients.
3. Cook recipes recommended by Cookma, and send dish photos once or more times

When the experiment began, we set all participants to level 1 (lowest). Therefore, in the early stages of the experiment, Cookma recommended only easy recipes regardless of the user's cooking ability. When users prepare recipes, some reordering of recipes and substitutions of ingredients are permitted. In the experimental period, one of the co-authors used Cookma, posted tweets with ingredients, and sent dish photos. That is because we plan to inform users how to use the dish photo sharing function. This author was not included as a participant. After the experimental period, we asked each participant to complete a questionnaire using the 5-point Likert scale, and free description.

5.2 Experiment Results and Considerations

In experimental period, all participators tweeted with ingredients words and cooked recommended recipes. Table 1 shows the number of recipe recommendation, the number of demand of other recipes, and the number of cooking recipes. The bot recommended recipes 21 times most. Users cooked recipes 3 times most. Table 2 shows the result of questionnaire survey using the 5-point Likert scale. Figure 4 shows an example of replies between a user and the bot. In this case, recipe recommendation and dish photo sharing were done about recipe using onion.

During the experimental period, all participants tweeted ingredients words and prepared the recommended recipes. Table 1 shows the number of recipe recommendations, the number of demands for other recipes, and the number of recipes cooked by each user. The largest number of recipes recommended by the bot was 21. The largest number of recipes actually cooked by users was three. Table 2 shows the results of the questionnaire survey using the 5-point Likert scale. Figure 4 shows an example of replies between a user and the bot. In the example shown in Fig. 4, the recipe recommendation and cooking, was for a dish that included onions.

Evaluation of the recipe recommendation function. Items (1) to (4) in Table 2 show the evaluation results of the recipe recommendation function.

Survey item (1), "Dialogues with the bot using replies are easily comprehensible," had a median of 4 and a mode of 4, 5. From the free description answers, we obtained the following opinions: "Using Cookma is simple and easy to understand." "It wasn't at all confusing to operate." These remarks show that Cookma is user-friendly.

Survey item (2), "The timing of recipe recommendation is appropriate," had a median of 4 and a mode of 4. From the free description answers, we obtained the following opinion: "There was a response to my tweet after only a short time."

Table 1. The number of recipe recommendations and the number of recipes cooked.

	The number of recommendations	The number of demands for other recipes	The number of recipes cooked
User A	21	8	3
User B	13	3	2
User C	12	5	3
User D	16	1	1
User E	1	1	1
User F	9	0	1
User G	3	1	1
User H	4	1	1
User I	15	9	1
User J	3	2	1

Table 2. Results of questionnaire survey.

	Question items	Evaluation					Median	Mode
		1	2	3	4	5		
(1)	Dialogues with the bot using replies are easily comprehensible	0	1	1	4	4	4	4,5
(2)	The timing of recipe recommendations is appropriate	0	3	1	6	0	4	4
(3)	Recommended recipes are possible to cook	0	0	2	4	4	4	4,5
(4)	You would like to cook recommended recipes	0	0	2	7	1	4	4
(5)	I feel resistant to sharing my dish photo	1	4	1	4	0	2.5	2,4
(6)	Sending dish photos to other users motivate me to cook for myself	1	1	4	3	1	3	3
(7)	Viewing dish photos sent by other users motivate me to cook for myself	0	1	1	5	3	4	4
(8)	Experiment points motivate me to cook for myself	0	2	1	3	4	4	5
(9)	Nicknames motivate me to cook for myself	0	3	1	3	3	4	2,4,5
(10)	Requests by imaginary characters motivate me to cook for myself	0	3	3	2	2	3	2,3
(11)	I want to use Cookma continuously	0	0	1	7	2	4	4

- Evaluation: 1: Strongly disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly agree.
- "Evaluation" is the number of people.

On the other hand, we also obtained the following opinion: "Recommendations also came to me when I did not want them." These remarks show that we must

Fig. 4. Screenshot of the replies between a user and the bot.

also use clock time and tweet content when deciding whether Cookma should or should not recommend recipes.

Survey items (3) and (4), "Recommended recipes are possible to cook," and "You would like to cook recommended recipes," had a median of 4 and a mode of 4, 5. From the free description answers to the question item "What recipes do you want to?" we obtained the following opinions from users who are not in the habit of cooking for themselves: "Simple recipes which have a few cooking steps." "Recipes should not require too many ingredients." These remarks show that Cookma recommends recipes appropriately to users who do not normally cook for themselves.

From these results, we were able to prove correct hypothesis (1), "The recipe recommendation function provides recipe recommendations properly."

Evaluation of the dish photo sharing function. Items (5) to (7) in Table 2 show the evaluation results of the dish photo sharing function.

About survey item (5), we obtained the survey results divided like or dislike. The survey item (5), "I feel resistant to sharing my dish photo," had a median of 2.5 and a mode of 2, 4. From the free description answers, we obtained the following contrasting opinions: "I'm a little embarrassed, but I don't worry about it." "I have to prepare dishes that are visually appealing." These remarks show that it would be advisable to make dish photo sharing optional.

Survey item (6), "Sending dish photos to other users motivates me to cook for myself", had a median of 3 and a mode of 3. Survey item (7), "Viewing dish photos sent by other users motivates me to cook for myself," had a median of 4 and a mode of 4. From the free description answers to question item (7), we obtained the following opinions: "Viewing dish photos makes me want to cook something too." "It energizes me to view what other users cook." These remarks show that viewing dish photos by other users motivates users to cook for themselves.

From these result, we were able to prove correct hypothesis (2), "Dish photo sharing function motivates users to cook." However, because some users do not want to share their own dish photos, we should make this feature optional.

Evaluation of gamification function. Items (8) to (10) in Table 2 show the evaluation results of gamification function.

Survey item (8), "Experiment points motivate me to cook for myself," had a median of 4 and a mode of 5. From the free description answers, we obtained the following opinion: "Raising levels is fun." These remarks show that obtaining points through cooking motivates users to cook more.

Survey item (9), "Nicknames motivate me to cook more," had a median of 4 and a mode of 2, 4, 5. From the free description answers, we obtained the following opinions from users who gave low ratings: "Because there is no actual feeling involved with recieving nicknames." "I was not conscious of that." These remarks show that nicknames may motivate users to cook as experiment points. However, it is necessary to improve how nicknames are presented.

Survey item (10), "Requests by imaginary characters motivate me to cook for myself," had a median of 3 and a mode of 2, 3. From the free description answers, we obtained the following opinions from users who gave high ratings: "If the characters recommend recipes, I will try to make the dishes for them." "It was a fun way to get recommendations." On the other hand, users who gave low ratings described following opinions: "I cannot empathize with strangers." "I can't picture in my mind or relate to imaginary characters." These remarks show that imaginary characters can, in some cases, motivate users to cook in some case. However, it is necessary to improve how we present the imaginary characters.

From these result, we were able to partially prove correct hypothesis (3), "The gamification function motivates users to cook" partly. However, we should rethink how to improve the presentation of nicknames and how to represent the characters.

Overall evaluations of cookma. Survey item (11), "I want to use Cookma continuously," had a median of 4 and a mode of 4. From the free description answers, we obtained the following opinions: "I want to raise my level and be challenged with more difficult recipes." "There is no sense of obligation, so I think it's easy to continue." The experiment period was short, however, the results do indicate that Cookma can motivate users to cook for themselves, and Cookma can support users to continue cooking for themselves, and to become better cooks.

6 Conclusion

In this paper, we have developed the "Cookma" cooking support system aimed at university students living alone. The conclusions of this study are as follows:

1. It is possible for Cookma to motivate users to cook habitually by a recipe recommendations that considers cooking difficulty.
2. Sharing dish photos on a microblog can motivate users to cook habitually.
3. Game-like elements on replies between a user and the Cookma bot can motivate users to cook habitually.

Hereafter, we will improve our system, and evaluate over the long term.

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References

1. Cabinet Office of Japan: Report of university students' reality and conscious about food (2009)
2. Momma, K., Washio, S.: Survey on university students toward dietary habits and menu model for one day. Bull. Paper Kyoto Women's University Department of Living and Welfare **10**, 11–20 (2014)
3. Hori, M., Hirashima, M., Isobe, Y., Nagano, H.: Research on the cooking habits among college students. Bull. Paper Gifu City Women's Coll. **57**, 61–65 (2008)
4. Process of food outsourcing rate. http://www.anan-zaidan.or.jp/data/
5. Ministry of Internal Affairs, Communications of Japan: Effect of social media spreading, White Paper Information and Communications in Japan, 209 (2015)
6. Takahashi, T., Ide, I.: Food and Computing: 2 recipe and menu search. IPSJ Mag. **52**(11), 1376–1381 (2011)
7. Nakaoka, Y., Satoh, T.: Proposal of a recipe recommendation system for the increase of a repository based on ingredients bias and cooking methods. In: Proceedings of Multimedia. Distributed, Cooperative, and Mobile Symposium (DICOMO 2014), pp. 1653–1660. IPSJ, Japan (2014)
8. Lertsumruaypun, K., Watanabe, C., Nakamura, S.: Onomatoperori: Recipe Recommendation System Using Onomatopoeic Words, IPSJ SIG Technical Report, 2009-DD-73, 6, 1–7 (2009)

9. Mizuno, Y., Kojiri, T., Yokoi, S., Ide, I., Seta, K.: Alternative ingredient generation support based on similar recipe presentation. In: Proceedings of the 75th National Convention of IPSJ. 6ZE-8, 4, pp. 779–780. IPSJ, Japan (2013)
10. Wakao, K., Oku, K., Hattori, F.: Fusion-based approach for serendipity-oriented recipe recommendations. In: Proceedings of the 75th National Convention of IPSJ. 3P–2, 1, pp. 681–682. IPSJ, Japan (2013)
11. Kuramoto, I., Katayama, T., Shibuya, Y., Tsujino, Y.: A virtual aquarium based on EELF with subjective competition for keeping workers' motivation. IPSJ J. **50**(12), 2807–2818 (2009)
12. Habitica. https://habitica.com/static/front
13. Eelco, W., Martin, M., Suleman, S.: CookKing: a king of healthy, fun and social cooking. In: Proceedings of the 7th International Conference on Advances in Computer Entertainment Technology (ACE 2010), pp. 110–111. ACM, New York (2010)
14. Tsujimoto, T., Yoshino, T.: Proposal of self-cooking support system using microblog. In: Proceedings of IPSJ Kansai-Branch Convention 2016. G-08, pp. 1–4. IPSJ, Japan (2015)