BingoFit: A Bingo Clothes Presentation System for Utilizing Owned Clothes

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Abstract. When we select clothes to wear, various factors such as weather, place, and occasion, in addition to personal preferences, must be considered. It is also essential to view the overall balance of the outfit by properly combining items such as tops, bottoms, and outerwear. However, it is not easy to consider a combination of various clothing items daily. For example, people tend to wear certain clothes frequently, or they might forget clothes in the back of their closet and stop wearing them, resulting in an uneven dressing style. We focus on a bias in the wearing of clothes and research to promote clothing utilization by having people wear all their clothes more regularly. In this study, we propose and implement the "BingoFit" system, which presents a user's clothes using the bingo style. The user uses the BingoFit system by filling in squares showing clothes on a bingo card and then wearing the clothes shown. We conducted experiment tests to use our system during multiple seasons. Then, we found that using BingoFit to select clothes helped them discover new combinations of clothes and encouraged them to wear infrequently worn clothes, thereby promoting their use of the clothes they owned.

Keywords: Clothes, Bingo, Coordination, Fashion

1 Introduction

Clothes are one of the means of expressing individuality, and a person's impression and clothes mutually influence each other [1][2]. When we select clothes to wear, various factors such as weather, place, and occasion, in addition to personal preferences, must be considered. It is also important to consider the overall balance of the outfit by properly combining items such as tops, bottoms, and outerwear. However, it is not easy to combine various clothing items daily. For example, people tend to have fixed clothes to wear during the week, or they might forget clothes in the back of their closet and stop wearing them, resulting in an uneven dressing style. By choosing clothes unevenly, people cannot utilize all of them, which limits their range of outfits.

To solve this problem, several studies have tried to support fashion coordination by using the user's wearing history [3][9]. They store the user's past clothing combinations and suggest optimal coordination for the user. In addition, the suGATALOG system

[9] compares several combinations by swapping the top and bottom images. However, these methods do not focus on encouraging clothing coordination.

Our work aims to solve this problem of bias in wearing clothes. We focus on enjoying fashion coordination and encouraging the users to wear all their clothes more regularly. In this study, we propose "BingoFit," a clothing presentation system that incorporates the bingo game into fashion coordination and utilizes the fun of combining clothing. In addition, we also implement a prototype system and show its usefulness based on an experiment.

2 Related Work

Several studies have been conducted to provide coordination support based on information about clothing and its past wearing history. Tsujita et al. [3] proposed the "Complete Fashion Coordinator," a system that uses photos of clothes taken in the past and suggests optimal coordination based on the clothing's wearing history and weather data. The system also allows users to receive feedback and evaluations of their coordination from their friends via social networking services. Fukuda et al. [4] proposed "Clothes Recommend Themselves," a system that recommends clothing coordination that the wearer's emotions and reason for wearing based on the garment's characteristics and the wearing history. Evaluation experiments suggest that the system reduces the burden of thinking about daily coordination and allows users to enjoy coordinating their outfits. Cheng et al. [5] classified clothes by impression using neural network learning and automatically found appropriate clothes by inputting the wearing situation into the system. Iwata et al. [6] also recommend suitable coordination for a given garment by learning from photos in fashion magazines.

These studies focus on reducing the time and effort of daily clothing selection based on information about clothing and the past wearing history and do not address the issue of eliminating bias in the number of times certain clothes are worn. In addition, the specific clothing recommendations are intended to encourage passive choice for the user and do not encourage the user to act voluntarily. This research aims to broaden users' coordination options by coordinating their clothes differently from the past and eliminating bias in their clothing selection.

Some research applied bingo games. Tietze [7] led a bingo game for university students in which tasks were presented in bingo squares to advance understanding of the content of a class. The experiment showed that students who completed the bingo task achieved higher grades than the average, suggesting that the application of bingo has a beneficial effect on learning. Kuwamura et al. [8] proposed the Bingo Survey, in which interactive bingo is applied to a survey form to solve the problems of lack of credibility and respondent withdrawal in online surveys. The results of an online survey revealed that the proposed method improves respondents' motivation and increases the number of valid responses. Based on these studies, this research is expected to apply bingo to daily clothing selection to eliminate selection bias without sacrificing the enjoyment of coordination.

3 BingoFit

3.1 Method

In this study, we propose the “BingoFit” system, a clothing presentation system that incorporates elements of bingo, to reduce the bias in the number of times a garment is worn and to expand the range of coordination options of its owner.

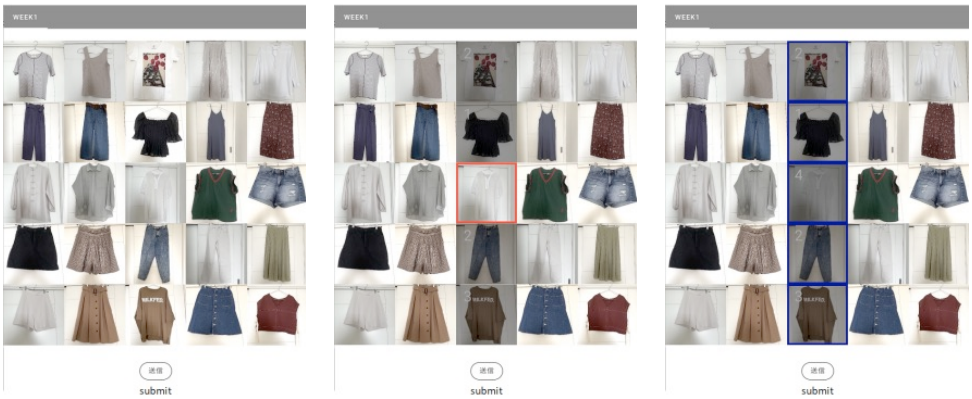
The system presents a bingo card with the user’s clothes arranged in 25 squares (five rows and five columns) (see Fig. 1). The user selects the clothes to wear, referring to the bingo card. If the user wears clothes on the bingo card, the user can fill their squares.

We expect that users will create new combinations of clothes depending on the arrangement of clothes on the bingo card. For example, combining tops and bottoms in vertical, horizontal, and diagonal lines can make a winning bingo line. Moreover, when clothes are worn, the squares on the bingo card are filled, preventing users from wearing the same clothes in a short period and encouraging them to wear clothes they do not usually wear. We also expect that users will make a wearing plan considering the clothes to be worn in the future and select clothing that suits the weather, place, case, and schedule every day by checking the bingo card.

3.2 Implementation & usage

We implemented a prototype system of the BingoFit as a system that can be used on the Web using Vue.js, a JavaScript framework. MySQL was used as the database.

In this system, users first take pictures of their clothes and register them in the database. At the beginning of the week, the system extracts 25 pieces of clothing to be displayed on the bingo card from the user’s clothes registered in the database. The system randomly selects the garments to be presented. The number of each item



(a) Bingo card (b) One more to go (c) Bingo!

Fig. 1. A screen snapshot of the BingoFit system

presented on the bingo card is determined as equal to the ratio of the total number of tops, bottoms, and all-in-ones owned by each user. The number of tops and bottoms was kept the same not to narrow the range of combinations. Next, the 25 extracted clothes are randomly placed in 25 squares and presented to the user (see Fig. 1 (a)). The given clothes and their placement remain unchanged for one week.

When the user clicks on the garment image on the bingo, the system displays a black dotted line around the image. Then the user presses the submit button, and the system records the image in the database as a worn garment. The image is displayed darker than the original image, and the number of days the garment was selected is shown in the upper left corner of the picture. When four squares are selected, either vertically, horizontally, or diagonally, the system displays the red border around the candidate square for bingo (see Fig. 1 (b)). When five squares are selected for bingo, all five squares are surrounded by a blue frame (see Fig. 1 (c)).

4 Experiment

To clarify the usefulness of our system, we conducted an experimental test to ask participants to use our system. Because the type and number of garments worn varied with the season, we conducted the experiment tests in multiple seasons.

4.1 Experiment procedure

As a preparation for the experiment, we asked participants to take pictures of all their clothing for each season. We classified the photos into tops, bottoms, and all-in-ones and registered these pictures in our system.

In the experiment, we explained how to use the system and asked the participants to play bingo by wearing the clothes. We also asked them to look at our system when selecting the clothes they would wear daily for one week.

After the one-week experiment, we asked participants to answer a questionnaire about the clothing worn and the bingo plan.

4.2 Results

We recruited nine participants who owned more than 40 pieces of clothing each season. We asked each participant to participate in the experiment in the season in which they could participate. The duration of the experiment and the number of participants were as follows:

- 2021/09/10 – 2021/09/16 (eight participants)
- 2021/09/20 – 2021/09/26 (nine participants)
- 2022/03/05 – 2022/03/11 (five participants)
- 2022/03/12 – 2022/03/18 (five participants)
- 2022/05/02 – 2022/05/08 (six participants)

Five participants participated in all the experiments. Fig. 2 shows the results of the bingo cards by three participants who participated in all the experiments.

Through the post-experiment questionnaire, we found that during the experimental period, all participants wore clothes that had not been worn for several years or had used new coordinations of garments. One participant commented, “when I first looked at the bingo card, I identified a row where I would be able to bingo and put on the clothes presented in the row.” Thus, some participants commented that they had planned and selected their clothing to reach bingo. On the other hand, some participants commented that it was difficult to bingo in one week, and they had been presented with clothes they could not wear due to the temperature.

Tables 1 and 2 show the average number of squares filled in a week in each season, the probability of “one more to go,” and the probability of getting a winning bingo line. Table 1 is for all participants, and Table 2 is for five participants who participated in all the experiments. These results show that the average number of squares of the bingo card filled in a week and the completion rate were relatively high in September.

Participant A in September Participant B in March Participant E in May

Fig. 2. Examples of the bingo card results.

Table 1. Results for all participants.

	Sep	Mar	May	Avg
Squares filled	7.6	6.8	6.8	7.1
One more to go (%)	47.1	40.0	50.0	44.8
Getting Bingo (%)	23.5	30.0	50.0	31.4

Table 2. Results for five participants who participated in all experiments.

	Sep	Mar	May	Avg
Squares filled	7.3	6.8	5.8	6.8
One more to go (%)	50.0	40.0	40.0	44.0
Getting Bingo (%)	20.0	30.0	40.0	28.0

However, the bingo completion rate in September was the lowest and the highest in May. These results show that achieving more bingos with fewer squares increases depending on our system's usage.

5 Discussion

5.1 Usefulness of the BingoFit system

We found that the BingoFit system creates an opportunity to wear clothes that have not been worn for a long time and helps to eliminate bias in clothing wear. We also found that it could broaden the range coordination range by assisting people in finding new outfits they had not worn before. Based on the above, BingoFit is effective in promoting the utilization of clothing.

On the other hand, some participants commented that winning a bingo line in one week was challenging and presented with clothes they could not wear due to the temperature. To prevent users from being discouraged from filling in the squares, we plan to add a mechanism that allows users to arbitrarily set the clothes presented in the initial stage and the changes to be made.

The experimental results show that more squares can be filled in the high-temperature season than in the low-temperature season. One of the possible reasons for this result is the difference in the degree of freedom in selecting items. In the low-temperature season, the number of items to be worn increases. In addition to tops and bottoms, other garments such as jackets and coats can be worn, and considering combinations of these items becomes more complicated. During warmer temperatures, the number of other items to be considered was relatively small, suggesting the difficulty of selecting clothing on the bingo card was lower.

The results for the participants who participated in all of the experiments showed that they achieved more winning bingo lines with fewer and fewer squares as the experiments progressed. This result may be because the participants learned how to fill in the squares for bingo efficiently and how to coordinate clothing as they used the BingoFit system.

The medium-term experiments found that the BingoFit system was effective for some people but not others. Therefore, we plan to focus our future research on those for whom BingoFit was more effective.

5.2 Relationship between the location of squares and clothing

In a typical bingo card, the probability of achieving a winning bingo line depends on the position of the filled squares. For example, the square in the center of the bingo card overlaps four columns (one vertical, one horizontal, and two diagonal columns). On the other hand, the square in the center of the top row overlaps only two columns (one vertical and one horizontal). Thus, an effective strategy for winning at bingo is to fill the center of the bingo card.

Table 3. Selection rate of squares (%).

Classification of squares	Selection rate
Center square	35.3
Corner squares	27.2
Squares between the center and the four corners	23.5
Other squares	28.7

Table 3 shows the average selection rate for each importance in making a bingo on the cards. The results showed that the selection rate of the square in the center was 35.3%, which was the highest value. The square between the center and the four corners had the lowest selection rate at 23.5%. From these results, we found that participants could choose an effective strategy for winning bingo in the BingoFit system.

To determine whether the clothes in the squares placed close to each other were likely to be combined, the distance between the selected squares on the bingo card was calculated using the Manhattan distance. The expected value of the distance is 3.33, while the average value for all participants in the experiment is 3.15. This result indicates that squares were selected that were close to each other were selected. This result may be because it was easier to imagine how the clothes in the squares placed close to each other would look when combined, and it was easier to consider the coordination of the clothes.

These results suggest that it is possible to guide the selection of clothing. Therefore, placing a garment worn less frequently in the central square of the bingo card or placing a garment that has never been combined with a garment in a nearby square may help eliminate bias in the number of times a garment is worn and may promote the discovery of new combinations. We plan to investigate the possibility of guiding selection by such an arrangement.

6 Conclusion

In this study, we proposed and implemented the BingoFit, a bingo-style clothing presentation system that encouraged the discovery of new clothing coordination patterns. To verify the usefulness of our system, we conducted a mid-term clothing coordination experiment using the BingoFit system. The results suggested that coordination using BingoFit supports new fashion coordination and promotes clothing utilization. We also found that the filled squares varied depending on the season and the number of experiments.

Based on these results, we plan to conduct long-term experiments to investigate the possibility of using the number of times the garment is presented and worn and the location of the squares to induce choice.

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