Design of Service Ecosystem Based on Interactive Design Support in the Case of Job-Hunting Support Services

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Abstract

In past research, we developed a model of service ecosystems involving customers, suppliers, and their communities. The model was constructed using general service loops constituted by the plan-do-check-act (PDCA) cycle and was used to describe service ecosystems. The goal of our research series is to construct a design methodology for service ecosystems. To this end, we need to classify service ecosystems and design a new service ecosystem. Since interactive designs are effective for a loop that indicates adaptive services in a model, we classify service ecosystems from the perspective of interactive design. We devised a new interactive design support system as a job-hunting support service. This system helps users formulate job-hunting plans.

Keywords

Service ecosystem • Open innovation • Interactive design • Job hunting

1 Introduction

1.1 Background

Growing global competition in the provision of services is a major challenge facing several countries. Chesbrough suggested open service innovation as a solution [1]. From the viewpoint of service engineering, the distinctive features of open service innovation are user and supplier participation in service design and openness in interaction among the producer, users, and suppliers. Openness means "having inflows and outflows of knowledge" [2]. Thus, our research has the following general goal: Formulating the design methodology of a service with openness for users as well as suppliers and with the participation of both stakeholders.

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1.2 Past Research

Services of the kind alluded to in Sect. 1.1 can be implemented with the cooperation of a provider, customers, and suppliers. We call such systems "service ecosystems." A framework for such ecosystems (Fig. 1) was proposed [2] and was further developed by Hara et al. [3]. Our model was composed of general service loops (Fig. 2), which we defined based on constructive approach (or synthetic method [4, 5]).

Constructive approach can be explained as, in short, "approach for understanding by construction." It is represented by the plan-do-check-act (PDCA) cycle in production management. Regarding design, "the analytical method must be used as part of the synthetic method" [5]. It means, when constructive approach is introduced, formulating (or improving) a system and analyzing it are repeated for changing specifications (goals). A general service loop involves representation in two axes, actor and action, in order to express cooperation between the stakeholders (or to apply constructive approach with an ecosystem).

Y. Sawatani et al. (eds.), *Serviceology for Smart Service System*, DOI 10.1007/978-4-431-56074-6_2

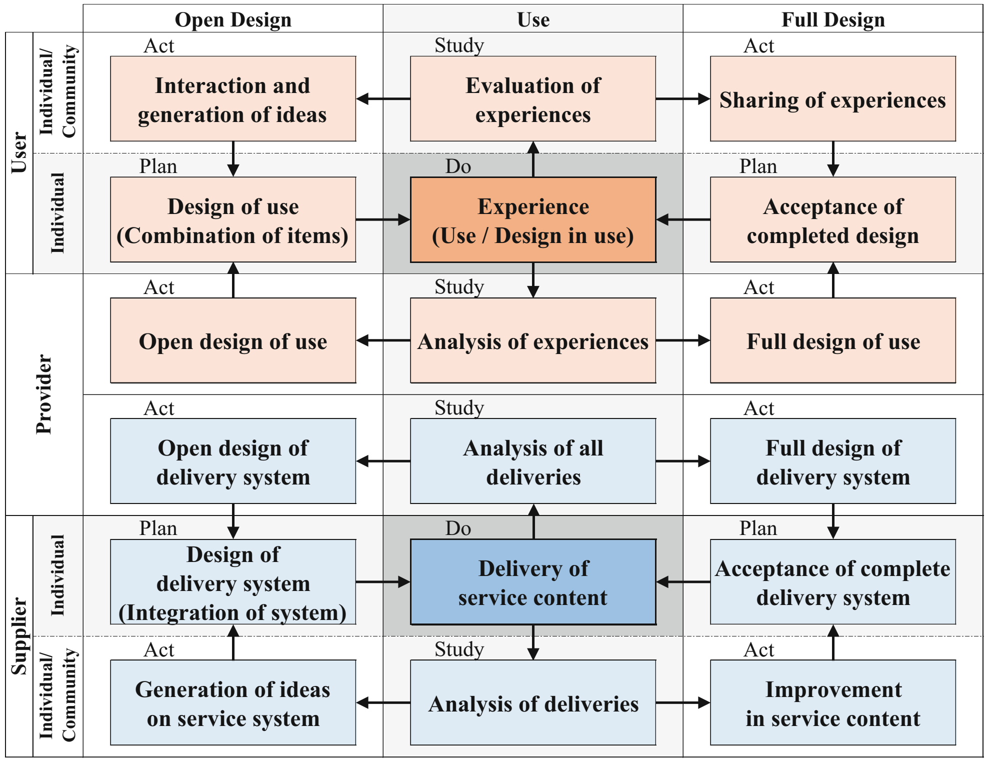

Fig. 1 The framework of service ecosystem

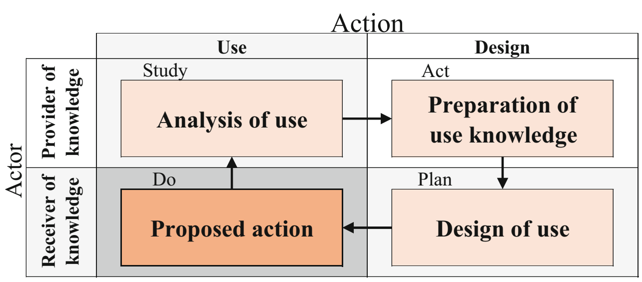

Fig. 2 General service loop

1.3 Objective in This Research

In order to develop a methodology to design service ecosystems based on our model (Fig. 1), we need to observe actual design processes and conduct inductive research.

For the purpose of observation, the center of a service ecosystem is supposed to be automatic and convenient in order to gather data regarding user preferences and behavior. Moreover, since a feature of this model is "design of use," loops in the model can be accelerated with an automatic design support system for users. We then formulate a new design support system.

The process of construction of a design support system in our research is positioned according to the "analysis-by-synthesis" approach explained in [6]. According to Ueda, "The word 'analysis' has the meaning of division methodology as well as the objective of clarification. 'Synthesis' has the meanings of integration methodology and the objective of construction. Therefore, there are four categories: analysis by analysis, analysis by synthesis, synthesis by analysis, and synthesis by synthesis."

Hence, our purpose in this research is implementing a design of service ecosystem to observe and analyze processes of actual design processes on the basis of design support as analysis by synthesis. Note that we just formulated the system, and inspection of the effectiveness and induction for the methodology of designing service ecosystem are going to begin after launching the service with this system.

2 Design Object of This Research

2.1 Operant Resource

One of the foundational premises (FPs) of service-dominant logic is that "service is the fundamental basis of exchange" [7]. This is because the "application of operant resources (knowledge and skills), 'service,' as defined in S-D (service-dominant) logic, is the basis for all exchange." Service is exchanged for service [8]. This means that if users have the requisite knowledge and skills to use a service, they can receive sufficient value from it. The service field (such as a travel service) has a service that might substitute the user's operant resources. When one travels to another country, one might need to learn to speak a few phrases in the local language. In such a case, a book of common phrases in the relevant language would be an adequate substitute for skill. In such services, it is enough for design support system only to change users' behavior, which makes it easier to achieve users' end than otherwise.

At the same time, in some service, operant resources *cannot* be substituted by any service, depending on users' purpose in using the service in question. In case of cars, the skill to drive cannot be substituted unless automatic cars have been manufactured. In such services, users are supposed to be educated to change in attitude, that is, to getting skills or knowledge. The same claim regarding operant resources can be made in the context of a job-hunting service, which is the subject of this research. Hence, in this study, the skills that users should have are part of our proposed interactive design.

2.2 Past Research

An instance of an interactive design support system is the interactive design support system for eyeglasses frames (IDS-GF) proposed by Yanagisawa [9]. Using this system, each customer can design an eyeglasses frame suitable for him/her by repeatedly comparing six processed images of a face with different eyeglasses frame images (Fig. 3).

Another instance is the CT-Planner (Fig. 4) developed by Kurata [10]. This system can suggest a tour plan with sightseeing spots depending on a tourist's preferences. In the CT-Planner, sightseeing spots are modeled as complete graphs, and a tour plan is a node string. The planner generates the node string with the highest sum of utilities by using a genetic algorithm. A user's tour preferences are modeled using a five-dimensional unit vector. Each sightseeing spot has values corresponding to each vector. The utility of each spot is calculated as an inner product.

The CT-Planner contains a combination of other services, such as sightseeing spots, as an answer. However, not only

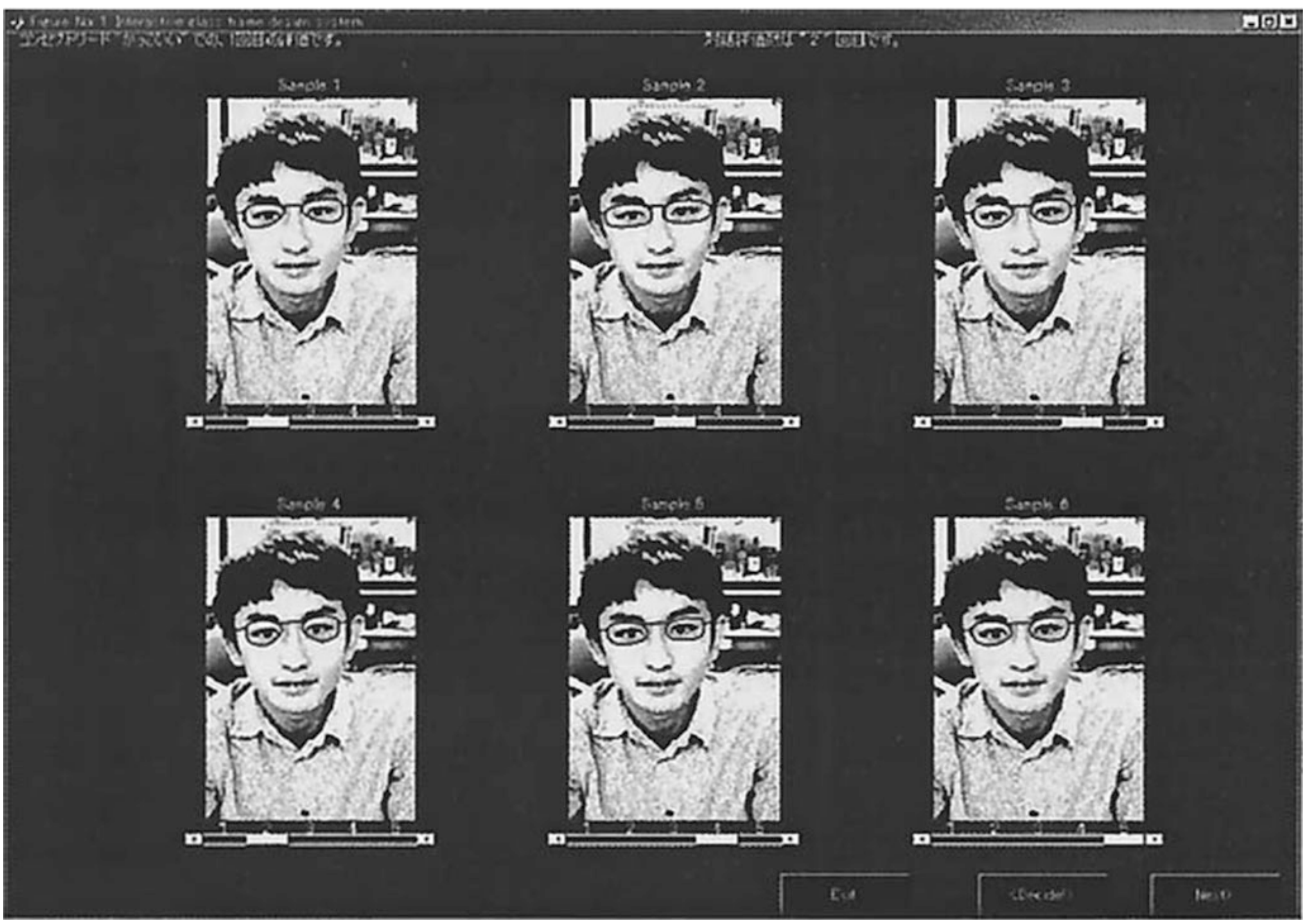

Fig. 3 Design support system for shape of eyeglasses frame [9]

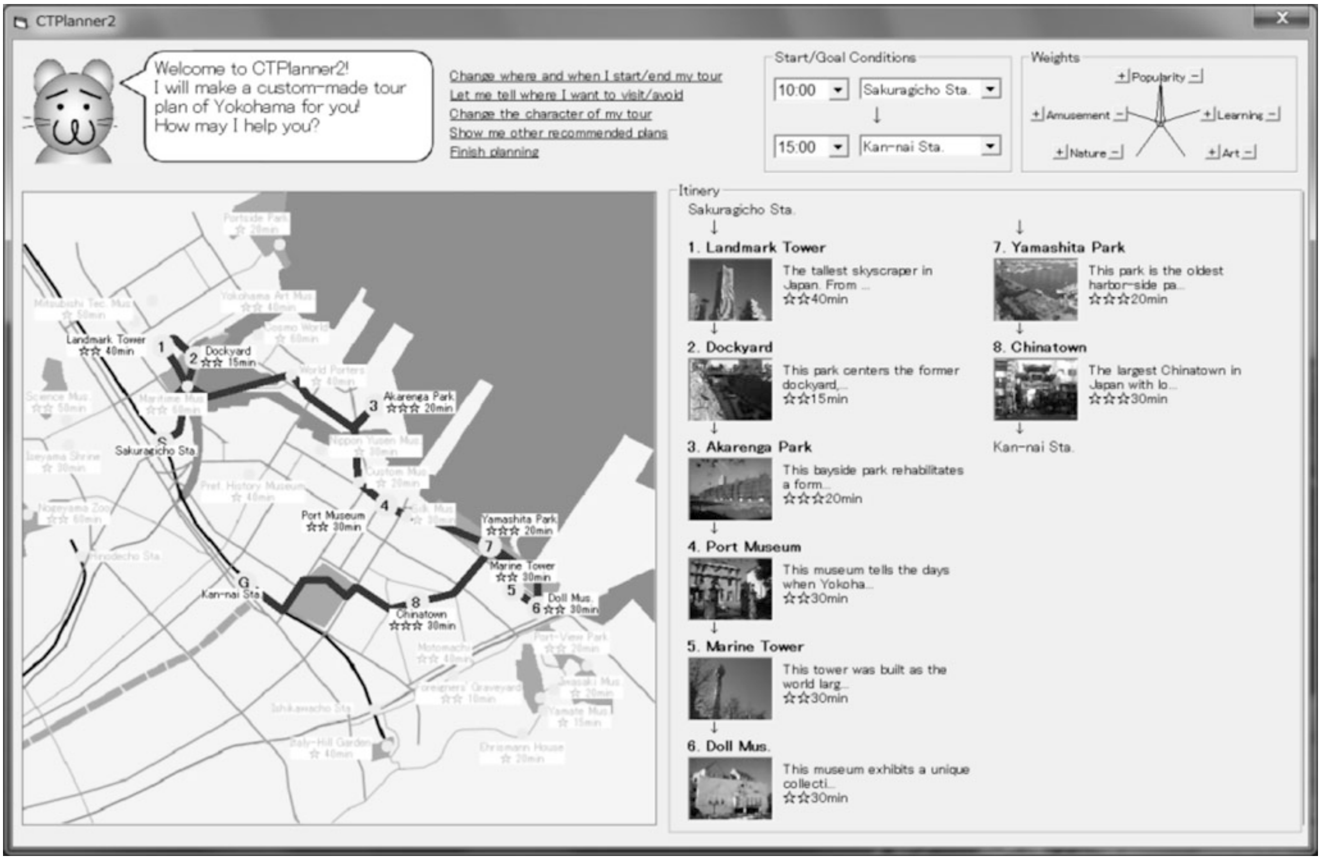

Fig. 4 The main window of CT-Planner 2 [10]

does a sightseeing service contain sightseeing spots, it also contains information regarding transportation, hotels, and so on. This suggests the CT-Planner is not intended solely as a sightseeing service. Moreover, as most operant resources can be substituted by services in the sightseeing service, the skills that users should have are not included in the subject of the CT-Planner.

2.3 Background of Job-Hunting Services in Japan

The design object of our research here is job-hunting support service for university graduates. Job hunting is a new experience for fresh graduates, because of which they might not have the operant resources required for it. In this case, a user's goal in using a job-hunting service as a service field is being offered a job by a company where he/she wants to work, where his/her purpose of using the service is to increase the likelihood of such offers.

In Japan, companies belonging to *Keidanren* (the Japanese Business Federation) start recruiting new graduates at approximately the same time (In the case, for instance, of recruiting students who graduate in March 2016, they begin seeking recruits in March 2015 and make offers in August 2015.) Start-up firms and foreign companies start even earlier. Hence, many prospective graduates begin job hunting or begin using job-hunting services, as early as 2 years before they are set to graduate, be it through internships or signing up for a relevant Web service.

When they start job hunting, few new graduates know how to go about it. Most of them register with a platform service, using which they can search for job openings at many companies and apply for them. Ever more varied types of job-hunting support services are emerging as well. "Agent services" guide new graduates by suggesting prospective employers for them or helping them analyze their own skills as well as the requirements of the companies that interest them. "Scout services" help new graduates apply for jobs. However, these services have not yet become common.

At the same time, the few know where he or she is suitable to work even by him/herself. It depends on their property, such as mind-sets, qualifications, and desire, and companies' specification, such as enterprise, salary, and culture. Agent services help new graduates to know it. As you see, however, they are not commonly known yet, and also their service productivity is still low because advisors meet new graduates face to face and one on one.

2.4 Outline of Proposed Service

Our proposed service provides new graduates, especially those who intend to immediately begin looking for jobs, with two solutions through interactive design:

- A job-hunting schedule (how to go about looking for a job)
- Attributes to improve their chances of employment: e.g., how to interview, English language skills, etc.

From the viewpoint of designing service ecosystems, user data needs to be gathered to track their behavior: information such as how each user executes his/her job-hunting plan and what percentage of these aspirants is offered jobs that they want. Such data can help improve the precision of such a service.

3 Definition and Formalization of the Issue

3.1 Job-Hunting Plan

The duration of object is 2 years, from 2 years before graduation to when students graduate. We chose a month as the unit of length of time ($0 \leq t \leq 24$). Contents (what new graduates could do) are defined by 23 nodes ($0 \leq j \leq 22$), which represent job-hunting support services, such as self-analysis, steps for the Synthetic Personality Inventory (SPI), and actions performed by new graduates on their own, such as studying abroad and gathering news. A job-hunting plan can thus be expressed as a matrix:

$$\mathrm{JP} = \{x_{jt}\} \tag{1}$$

where $x_{jt} = 1$ when the graduate starts j at t; if not, $x_{jt} = 0$.

Each node has an available action term [$a_{j\_\min}$, $a_{j\_\max}$], an actual action term range p_j, and consumed energy E_j. The job-hunting plans are executed only when the following three constraints are satisfied. These constraints are referred to as the resource-constrained project scheduling problem and are as follows:

- Term constraint – Actual action terms exist in each available action term:

$$\forall j, x_{jt} = 0\big(\mathrm{t} < \mathrm{a}_{j\_\min},\ \mathrm{a}_{j\_\max-}p_j + 1 < \mathrm{t}\big) \tag{2}$$

- Energy constraint – At all times, the sum of the energies of ongoing nodes is not greater than the energy limit E_t:

$$\forall t, \Sigma_{j\varepsilon J} E_j \Sigma_{(\text{from s=max}\{t-pj+1,\ \mathrm{a}j\_\text{min}\}\text{to min}\{t,\ \mathrm{a}j\_\text{max}-pj+1\})} x_{js} \leq E_t \tag{3}$$

- Repeat constraint – Each node could be chosen fewer than two times:

$$\forall j,\ x_j = \Sigma_{t\varepsilon T} x_{jt} < 2 \tag{4}$$

3.2 Indices

Our proposed service aims to provide the same functions as human advisors:

- Proposing and deciding upon a proper job-hunting plan by interacting with new graduates
- Suggesting that new graduates obtain operant resources or alter their aims in order to improve their likelihood of employment with companies of their choice

We also need to assess each job-hunting plan using the following two indices:

- Individuality: To what extent does a job-hunting plan suit the preferences of each new graduate?
- Offer rank: How likely is each new graduate to be offered a job by the company/companies for whom he/she would like to work?

3.2.1 Individuality S_I

New graduates who use our service answer 41 questions (a total of 131 choices). Their answers are expressed as ans_i $\varepsilon\{0, 1\}$ $(0 \leq i \leq 1)$. ans $= \{ans_i\}$ is called the "preference of a new graduate." The questions are classified into three categories:

- Questions regarding knowledge: e.g., "How well do you understand each business field?," "How many times have you sought career counseling?," etc.
- Questions regarding skills or experiences: e.g., "Have you ever interned?," "Have you been positive when faced with difficulty?," etc.
- Questions regarding status: e.g., "When do you graduate?" and "What type of school will you graduate from?"

Each node contains a value corresponding to each choice val_i^j. Individuality S_i is estimated as

$$S_i = \Sigma_{j\varepsilon J} \Sigma_{i\varepsilon I}\, val_i^j * ans_i * x_j \tag{5}$$

3.2.2 Offer Rank

Offer rank is the result of the evaluation of offer probability S_N using thresholds. Offer rank is tacit of advisors. Thus, the value of S_N is determined to express it in the system. The rules to calculate S_N are defined in (6a) to (6c) and are nonlinear functions. S_N is calculated and translated into offer ranks S, A, B, C, D, and F using (7):

$$b_i = f_{ans \to \mathrm{b}}(ans_i) \quad (6a)$$

$$b_{iu,\, iv} = f_{ans \to \mathrm{b}}(ans_{iu}, ans_{iv}) \quad (6b)$$

$$b_{iu,\, iv,\, iw} = f_{ans \to \mathrm{b}}(ans_{iu}, ans_{iv}, ans_{iw}) \quad (6c)$$

$$S_N = S_N{}^b * \Pi_{i \varepsilon I} b_i * \Pi_{iu,\, iv \varepsilon I} b_{iu,\, iv} * \Pi_{iu,\, iv,\, iw \varepsilon I} b_{iu,\, iv,\, iw} \quad (7)$$

3.3 Prepared Data

The data were provided by an advisor prior to the construction of our system:

- The value of each node to is separately calculated.
- Rules and function values to calculate offer probability.
- There are a total of 24 samples of new graduates to determine the thresholds of offer ranks (pairs of **ans** and offer rank). (Contents of proposed service)

3.4 Outline

The workflow of our proposed service is shown in Fig. 5, and its outline is as follows:

(A) Showing answers for initial user input
(B) Interactive design of preferences to change (yellow)
(C) Decision regarding job-hunting plan (green)
(D) Making to-do list

In (C), by using new preferences defined in (B), the system suggests a job-hunting plan and finalizes it through interactive design.

3.5 Show Answers for Initial Input

A user (a new graduate) answers a few questions when he/she begins using the service. His/her answers (**ans**) are used as input. Using (6) and (7), the offer probability S_N is calculated from **ans**, and the offer rank is shown to the user.

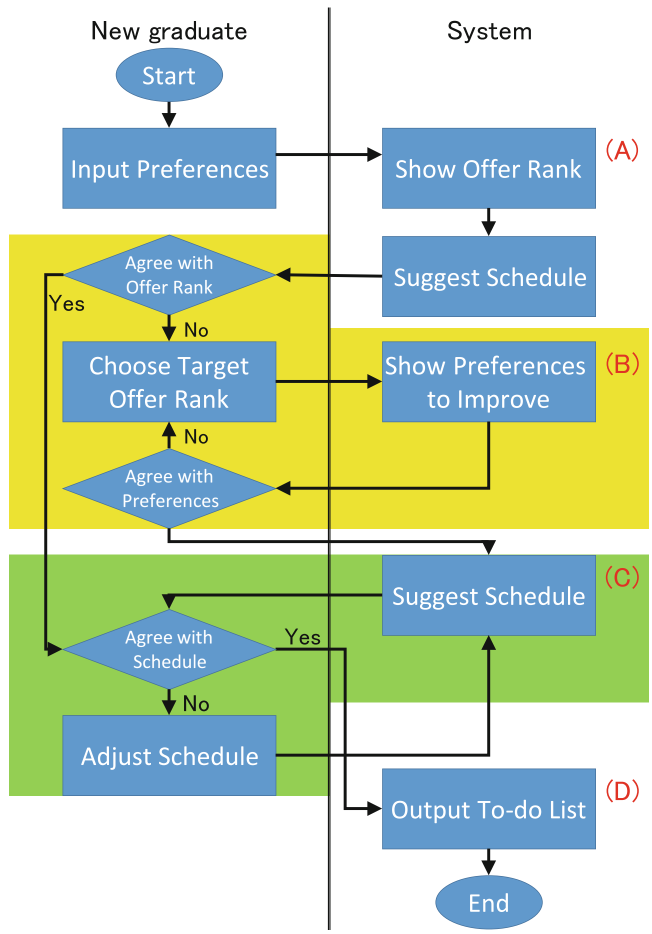

Fig. 5 Workflow of the service

At the same time, a job-hunting plan most likely to suit the user is suggested. Plans are generated using a genetic algorithm, and the one with the best individuality S_I is chosen. The display of the service is shown in Fig. 6.

3.6 Interactive Design of Preferences to Change

If the user cannot be satisfied with his/her offer rank, he/she chooses the target offer rank. The system then shows the user a preference list that he/she can update or change. The relevant interface is shown in Fig. 7.

The preference list generated based on rules applied to user responses to questions is expressed as (6a).

For instance, options as answers to the question "How confident are you with regard to interviews?" are "Very confident" ($i = 69$), "Somewhat confident" ($i = 70$), "Not very confident" ($i = 71$), and "Not at all confident" ($i = 72$). The function values b_i are defined as before:

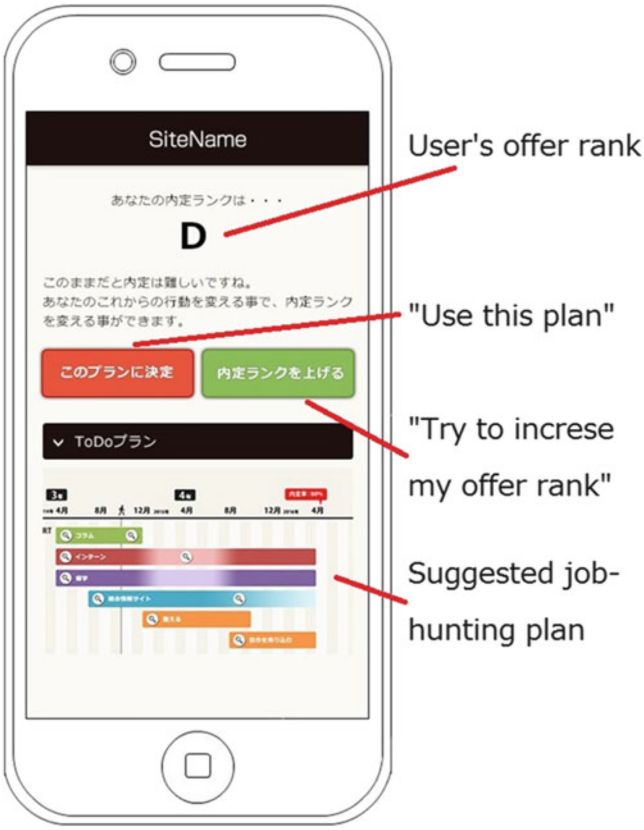

Fig. 6 Display showing answers to input

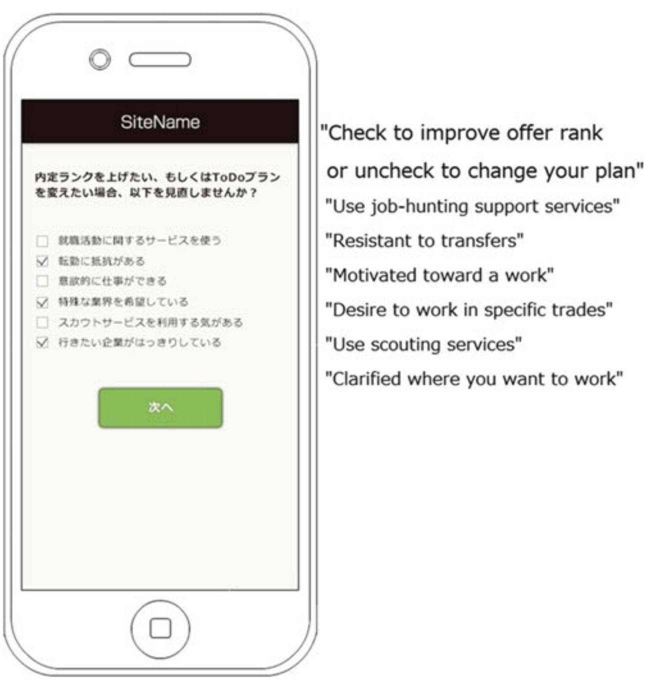

Fig. 7 Display to choose preferences

	Offer Rank: D -> B
✓	Field: Mechanic
✓	Field: HR
✓	Field: Fashion
✓	Practice interview
	Field research
	Agent service

(a) Suggestion by system

→

	Offer Rank: D -> C
×	Field: Mechanic
×	Field: HR
×	Field: Fashion
✓	Practice interview
	Field research
	Agent service

(b) Choices made by user

→

	Offer Rank: D -> C
×	Field: Mechanic
×	Field: HR
×	Field: Fashion
✓	Practice interview
✓	Field research
✓	Agent service

(c) Recalculated by system

Fig. 8 Preferences that can be changed

$$b_{69} = 1.1$$
$$b_{70} = 1.05$$
$$b_{71} = 0.8$$
$$b_{72} = 0.6$$

When ans_{70}, ans_{71}, or ans_{71} is 1, “practice for interview” is listed in the preference list.

Changes in preference are checked against preferences in the list that would have the most significant effect on improving the probability of the relevant user to be offered a job of his/her interest. As a result, a preference list with some check is generated, which is shown in Fig. 8a.

The user unchecks changes in the preferences that he/she does not change or which he/she thinks are difficult to change (Fig. 8b). Following this process, the offer probability is recalculated. When the offer probability is not enough as the target offer rank, the system proposes other preference changes or suggests changes in preference that would have the next most significant positive effect on the user’s likelihood to obtain a job (Fig. 8c).

The new preferences determined thorough these processes are listed in a to-do list. Graduates attempt to meet the goals outlined in their preferences by the time they conclude job hunting and hone their skills to attain their target offer rank. Self-improvement includes obtaining operant resources, skills, and knowledge, such as obtaining information regarding different fields of business. The advantageous feature of this interactive design support system from the perspective of service is not only design of job-hunting plans but also enhancement of users’ self-improvement, that is, getting operant resources.

3.7 Decision Regarding Job-Hunting Plan

Following the finalization of the preferences to change as a result of (B), the system suggests a new job-hunting plan based on the new preferences. The final job-hunting plan is defined by the user through the following actions:

- Choosing nodes which he/she does/does not want to use
- Arranging action terms of each node he/she uses according to his/her actual schedule

The plan determined using these interactions is added to the to-do list.

3.8 Creating To-Do List

The changes in preferences decided in (B) and the job-hunting plan decided in (C) are added to a to-do list. New graduates fill this list and proceed to delete the goals that they have accomplished from the list.

Through this process, users' progress can be checked, and notifications can be sent to users who are falling behind the schedule of completion of objectives on the list. The display for the to-do list is shown in Fig. 9.

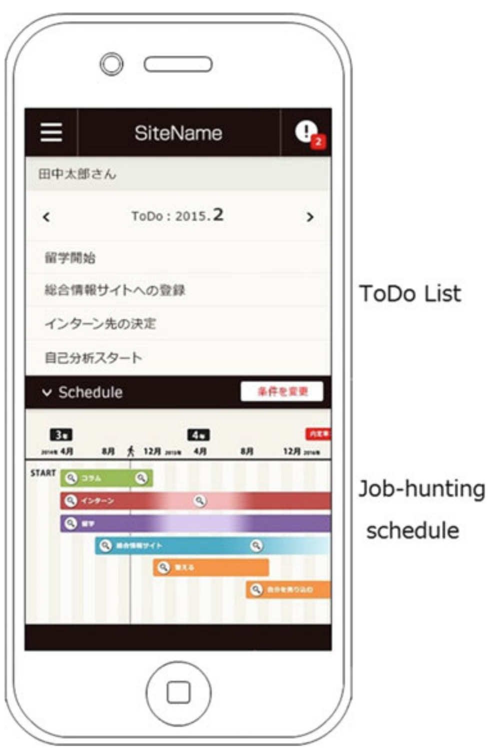

Fig. 9 To-do list and job-hunting schedule

4 Conclusion

In this paper, we proposed an interactive design support system for job hunting in order to implement a methodology for service ecosystem design. At present, the appropriateness of offer rank and the thresholds of offer probabilities can be judged according to the experience of the relevant advisors. The appropriateness of our service, including that of the offer rank, should be determined through its use. Furthermore, the precision of the thresholds, suggestions regarding preferences that can be changed, and the job-hunting plan should be improved based on data gathered during service operation.

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