UX (Sense-Recognition-Reaction) Based Service Prototype Design Method

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Abstract: In service design, prototype can be regarded as a type of simulation that performs final service inspection through a series of tests before releasing a service. Our service prototype is characterized by a realistic service that reflects user experience (sense-recognition-reaction) as much as possible. The purpose of this research was to review methods for extracting experience data useful for making realistic prototype. As a useful method of data extraction, we tested and evaluated degree of satisfaction (Pleasant-Unpleasant) and performance time (Time Recording) as indices on how satisfactorily the service was performed by participants. Furthermore with consideration on strong influence of unconscious experience on degree of satisfaction and performance time, opinions on conscious service were collected through interviews after completion of the experiment. For comparison of the 3 evaluation indices, satisfaction evaluation was subjectively carried out on qualitative evaluation (interview) and time. Then, the result was reviewed to determine whether it accords with biometric measurement result. As a result, Task 4 and Task 5 respectively showed 69.2% and 73.3% agreement. Based on such results, degree of satisfaction (Pleasant-Unpleasant) and performance time can be reviewed as useful evaluation indices in service prototyping evaluation.

Key words: UX, User Experience, Service Design, Service Prototyping, Healthcare Service

1. Introduction

1.1 Background

Prototype in service design can be considered as a type of simulation that performs final service inspection through a series of tests before releasing a service. Many service prototype methods were carried out in analog way, either by manufacturing on 1:1 scale or using a Lego model to embody service situation identical to reality. [1]

The two analog methods described above have advantages and disadvantages. Manufacturing prototype with actual size offers sense of reality, but it is restricted by time, expense and space. While Lego type provides short time required for manufacture, users have difficulty in empathizing with service experience due to small scale and reduced sense of reality.

This research proposes a UX based service prototype design method that includes sense, recognition and reaction of users while maintaining advantages of analog methods. This method intends to create a realistic prototype by reflecting user experience as much as possible.

Figure1 is a diagram for interaction between service object and user at the service touch point. The diagram describes that user experience is generated from interaction of sense, recognition and reaction at the touch point where service environment with stakeholders (service providers / users).

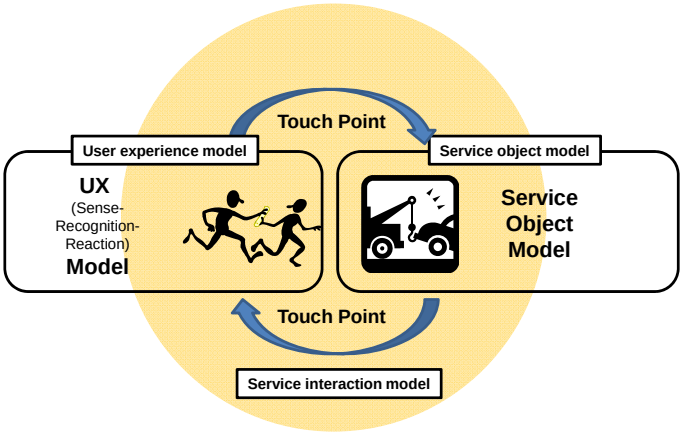


Figure1. Service Interaction Model

Figure 2 shows that the case in which model for user experience at the level of sense, recognition and reaction at the service touch point. This modeling case illustrates the process in which stimuli from service medium are sensed by the user through five senses, process in which situation is judged based on recognition process, and process in which the user shows final reaction.

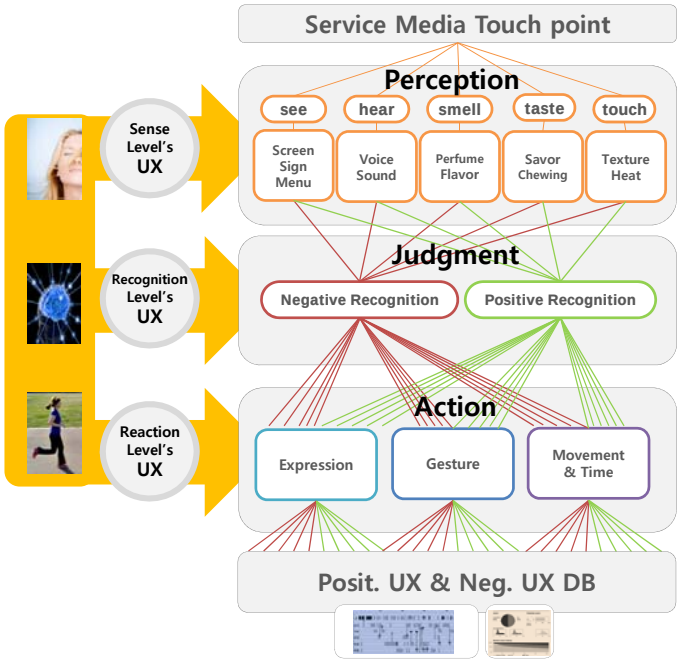


Figure2. Sense-Recognition-Reaction Level's UX Model

In specific, this model represents a natural sense-recognition-reaction of human beings who show appropriate reaction to specific service stimuli based on positive or negative recognition. This means that positive or negative reaction is stored in the database with linked sense-recognition route and remembered in the brain or by an action as positive or negative human experience.

As a result, UX based service prototype design method allows designing and testing of user-oriented service scenario by specifying user experience in 3 perspectives sense, recognition and reaction.

1.2 Objective

The objective of service prototype is to extract user demands through realistic and sympathetic service prototype. This research suggests a UX based service prototype design method focused on user experience.

Figure3 is a diagram that compares existing service prototype design process and our design process. The UX based service prototype design method proposed in this research expands existing service prototype design step (dotted part) into 3 detailed steps as follows.

Step 1: Service test based on sensuous experience, cognitive experience and behavioral experience of participants

Step 2: Evaluation on the results of 3 experience-based tests

Step 3: Manufacture of prototype that reflects user needs based on 3 experiences

The prototype completed through the 3 steps described above then follows existing processes including service test, evaluation and improvement. In the end, the proposed method can create a realistic service that satisfies user needs based on two times of user evaluations.

In this research, steps 1 and 2 will be tested through an experiment and reviewed to determine whether data useful for creating realistic prototype can be extracted.

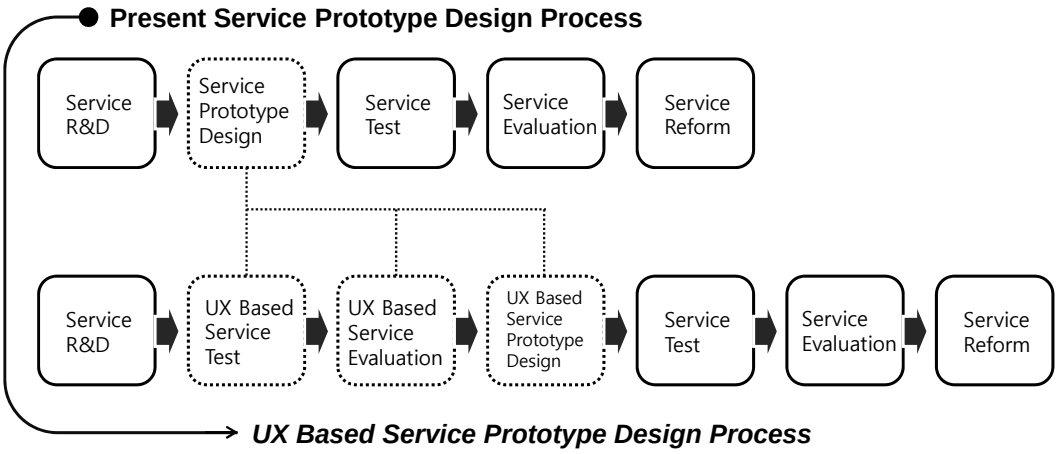


Figure3. UX Based Service Prototype Design Process

In this experiment, while in the “Present Service Prototype Design Process,” the qualitative evaluation through the interview in the service test process is focused, the quantitative evaluation is added for more practical evaluation in the UX based service prototype design process proposed in this study.

Based on the Circumflex Model by Russell (1978,1980) [2] [3], the Emotion Inference Algorism developed in the SMU/Emotion Lab (2013) infers the emotion by mapping PPG, GSR and SKT Signals into two axes (Pleasant" vs. Unpleasant and Relax vs. Arouser) through the signal measuring equipment (Biopac). Figure 4 shows the emotion index based on the Russell's Circumflex Model.

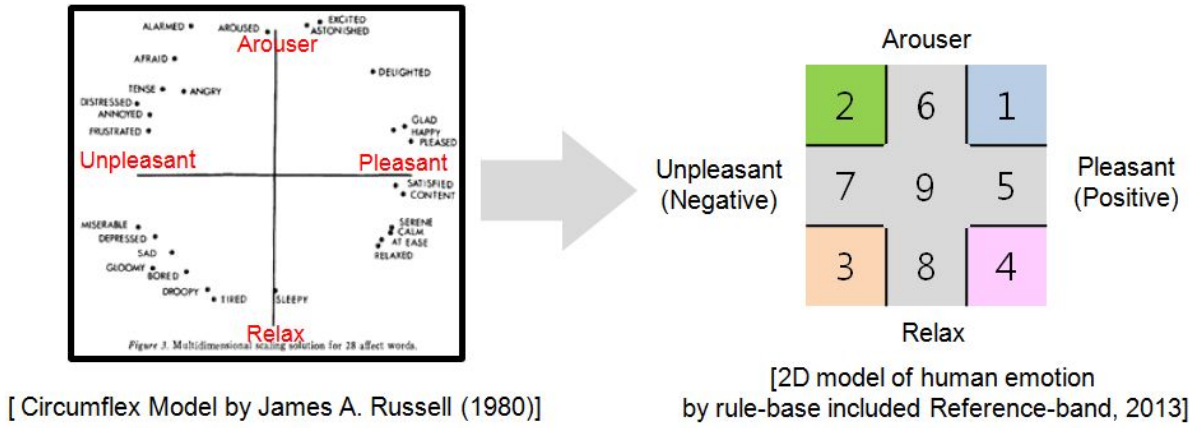


Figure. 4 Emotion Index Based on the Russell's Circumflex Model

In the first quantitative evaluation, the emotion inference system based on the emotion inference algorism is used. Through this system, experience on the service task can be evaluated under the "Pleasant vs. Unpleasant" in real time; this evaluation means that the stronger the "Pleasant" is, the greater the satisfaction about the service is.

Second, the quantitative evaluation is the time evaluation. This is one of the most remarkable methods that can measure the service efficiency when the tasks are performed iteratively. The task performance time is measured by minutes or seconds; this evaluation means that the smaller the average value is, the greater the experience of the effective service is. Although the 'stopwatch' can be used as a manual measuring method, it is more effective when using automatic tools including the Ergo Browser, Data Logger, and Baily's Usability Testing Environment (UTE). [4] Table 1 shows the Index / Method / Value about two types of quantitative evaluation.

Table.1 Quantitative Evaluation Index / Method / Value

Quantitative Evaluation	Evaluation Index	Methods	Evaluation Value
Emotion Evaluation	Pleasant/Unpleasant	Emotion evaluation of PPG, GST and SKT Signal through the Emotion Inference Algorism	Users' emotion can be verified at the moment of the task
Time Evaluation	Minute /Second	Comparison analysis of the average performance time on each task	Time efficiency on the task can be evaluated

As described above, through the Emotion Evaluation method, the emotional condition of the test takers can be verified, and the time evaluation has an advantage that can evaluate time efficiency. Therefore, this study tries to confirm the application value of the emotion (pleasant/unpleasant) and the time on the service task.

2. Method

2.1 Stimuli

For step 1 experiment (service test based on sensuous experience, cognitive experience and behavioral experience of participants) and step 2 experiment (evaluation on the results of 3 experience-based tests) described above, 'Self-Healthcare Service' model that "improve usability of local parks and markets" was developed. The service model is as follows.

2.1.1 Service Scenario

Self-Healthcare Service is composed of 3 steps such as planning of health management, exercise and verification of health results, and adjustment of dietary habits in Figure5. First, the resident visits a local health center before exercising to subscribe to membership for personal health management. The resident devises a plan for health management program with doctors and nurses. After membership subscription is complete, an individual membership card, which contained personalized information, is provided.

The resident goes to a local park and checks today's exercise plan using kiosk already installed at the park and membership card. The resident do the exercise as planned out. When exercise is done, the resident uses kiosk again to check today's exercise result and changed health status. The kiosk provides information about food to be related with day's exercise.

Lastly, the resident receives information about stores in which ingredients for making recommended food can be purchased among stores of nearby traditional market. Store owners can promote vitalization of traditional market based on co-creation with Self-Healthcare Service, and users can buy high quality ingredients more easily.

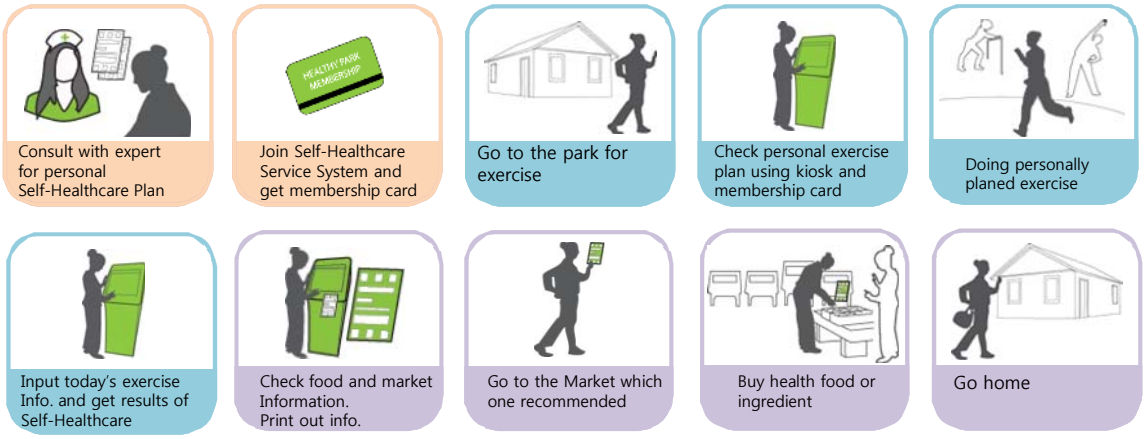


Figure5. New Self-Healthcare Service Scenario

2.1.2 Service Blueprint

Based on the scenario, detailed activities of the final Self-Healthcare Service System concept are shown in Figure6. using service blueprint. Service blueprint is a process analysis methodology proposed by Shostack [5][6]. The proposed blueprint allows for a quantitative description of critical service elements, such as time, logical sequences of actions and processes, also specifying both actions/events that happen in the time and place of the interaction (front office) and actions/events that are out of the line of visibility for the users, but are fundamental for the service.

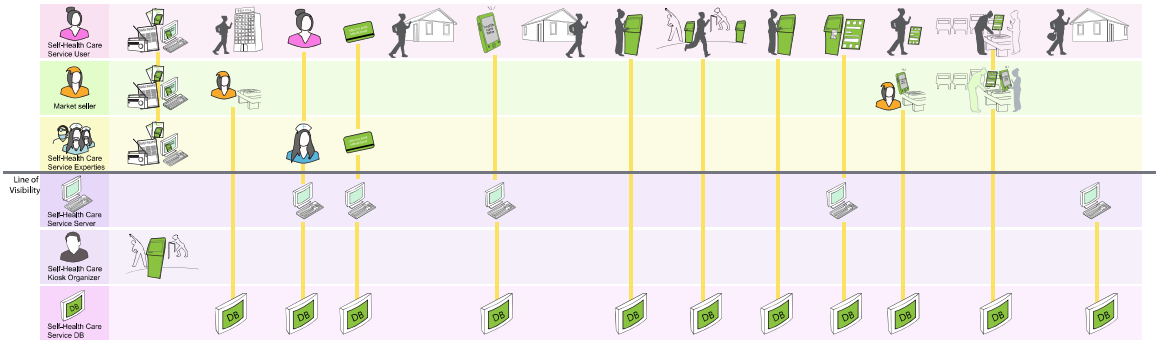


Figure6. Self-Healthcare Service Blueprint

2.2 Experiment

As mentioned in the research, the objective of this case study was to test steps 1 and 2 through experiment and review methods of extracting useful data for realistic prototype. As a useful method of data extraction, we tested and evaluated degree of satisfaction (Pleasant-Unpleasant) and performance time as indices for determining whether participants satisfactorily performed the service. Moreover, the experiment was conducted with consideration on strong influence of unconscious experience on degree of satisfaction and performance time. Opinions were collected through interviews.

As a result, degree of satisfaction, performance time and interview results were comprehensively compared to determine whether data extracted were useful in designing a realistic service prototype.

2.2.1 Kiosk UI Task

Kiosk installed in the park provides exercise information and diet menu service for more professional health management of residents. That is, a resident who receives health diagnosis at a local health center can obtain personal exercise program through kiosk. After exercise, the resident obtains diet menu for health management and acquires short-distance market information for purchase of ingredients. Figure7. is a suggested sample of UI.

Figure7. Sample of UI Test for ‘Self-Healthcare Service’

Such kiosk services and UI are the stimuli of this experiment that compose the ultimate experimental task. Table 2. Illustrated 5 tasks to be checked through this experiment. Task1 and 2 are required behavior of using kiosk before exercise and task 3, 4 and 5 are using after exercise.

Table2. Task of ‘Self-Healthcare Service’ Prototyping

Task	1	2	3	4	5
Content	Recognize the Self-Healthcare Service kiosk and place the membership card next to card reader	Press 'Start' button after listening to voice guideline about today's exercise plan	Recognize the Self-Healthcare Service kiosk and place the membership card next to card reader	Check today's exercise result and dietary information	Check dietary information and find nearby market. Exit the kiosk
	Time check	Time check	Time check	Time check	Time check

2.2.2 Procedure of the Test

As shown in Table 3, this Self-Healthcare Service prototyping was carried out in 5 steps. Before starting the experiment, participants were facilitated for sufficient understanding of Self-Healthcare Service. After completion of facilitate step, 3 different sensors were attached to the body of participants for measurement of bio-signals. Then, reference time of 3 minutes was granted to recognize the status of autonomic nervous system for each individual. After 3 minutes, participants were allowed to use Self-Healthcare kiosk at comfort. Lastly, participants spent time to look for improvements and supplementations to the proposed service through questioning and free talking about the Self-Healthcare Service.

Table 3. Procedure of ‘Self-Healthcare Service’ Prototype

Facilitate Test	Attach Sensor	Reference Time	Test	Interview
				
Explain about 'Self-Healthcare Service' and use of kiosk	Attach sensor to participants for measuring bio-signal while using 'Self-Healthcare Service'	Take a 3 minute relaxing time after attached sensor to collecting reference bio-signal data	Use Self-Healthcare Service kiosk, following sound and screen descriptions	Interviewing 4 questions about usage of kiosk, 1 service and free talking

2.3 Experimental Analysis Methods

2.3.1 Degree of Satisfaction (Pleasant – Unpleasant) Inference and Performance Time

Photo Plethysmo Graphy (PPG), Galvanic Skin Response (GSR) and Skin Temperature (SKT) were measured for using bio-signals, and equipment of Biopac company were used to the experiment. Here, PPG was measured by attaching the sensor on the earlobe. SKT and GSR were measured by attaching sensors on left fingers. Also, LabView2012 of National Instruments was used for signal processing of the measured data.

Participants in the experiment had not cardiovascular problems, and external noise was minimized to concentrate on the experiment. Before executing this kiosk using experiment, individual bio-signals (PPG, GSR and SKT) were measured for 3 minutes for measurement of bio-signal reference status. Then when the experiment

was carried out, bio-signals and performance time were measured until the participants pushed the button after provision of screen for each task in Figure10.

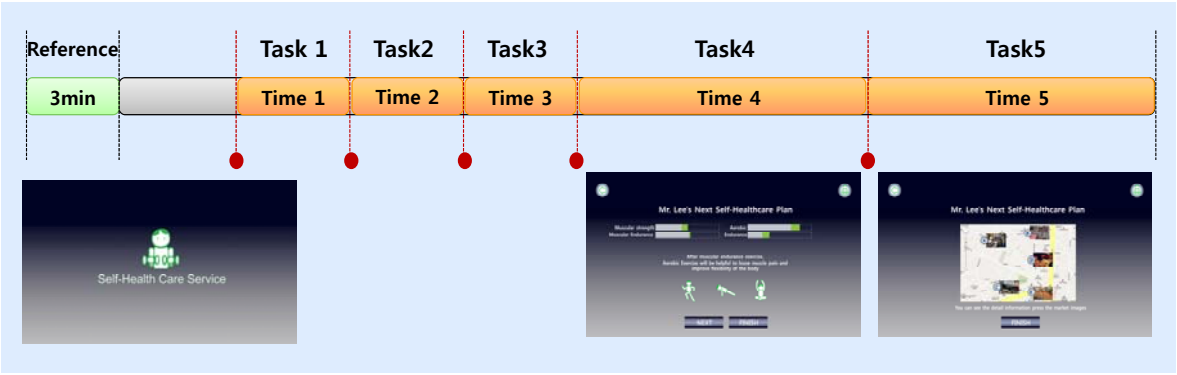


Figure10. Degree of Satisfaction Inference and Performance Time Methods

2.3.2 Interview

Participants were asked 5 questions about the service they experienced immediately after the experiment. As shown in Figure11, questions included 4 questions on functional part of kiosk, collection of free opinions by users on the Self-Healthcare Service, and free talking about services.

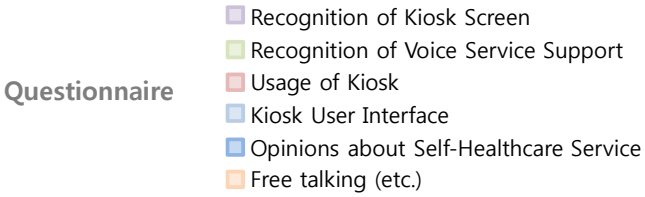


Figure11. Interview & Sample

3. Result

3.1 Participants Profile

Participants of the experiment were 5 males and 15 females (33.7±13.5), and data of 18 participants were used for analysis after excluding data for 2. (Figure12.)

Participants	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18
Age	56	55	53	52	51	46	43	32	31	25	25	24	24	24	23	23	22	21
Gender	M	M	F	F	M	M	F	F	M	F	F	F	F	F	F	F	F	F

Figure.12 Profile of ‘Self-Healthcare Service’ Prototype Participants

3.2 Experiment Analysis

It is important to find unconscious experience of users in order to create a successful service model. This experiment focused on time and emotion as factors of experience. Performance time(T) was evaluated as the method of extracting physical reaction. Change of bio-signal(S) was evaluated as the method of emotional inference [7]. Degree of satisfaction and needs were evaluated through interviews(I).

3.2.1 Quantitative Case Study Result

Data for PPG, GSR and SKT signals were collected at 400Hz, and 4 features including PPG amplitude, PPG frequency, SKT and GSR mean were deduced from the raw data. Moving average was taken on such data with window size of 400 and time interval of 0.25s to minimize signal noise.

In Figure13, After preprocessing was completed, emotion was inferred as 'Pleasant-Unpleasant' axis based on change in status compared to reference state [8].

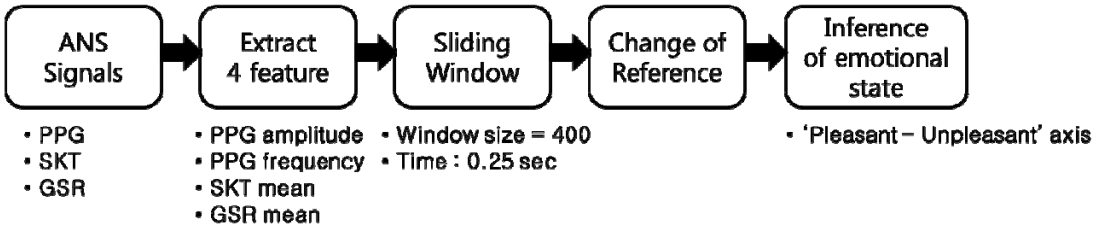


Figure13. Emotional Inference Flowchart

For performance time, there was no significant difference in Tasks 1 and 3 between 2 groups, participants in their 20s and 30s or above. For Tasks 2, 4 and 5, participants in their 20s were found to be definitely faster than others. (Figure14). Accordingly, performance time of users was evaluated in this research after dividing participants into 2 groups, 20s and over 30s (Table4).

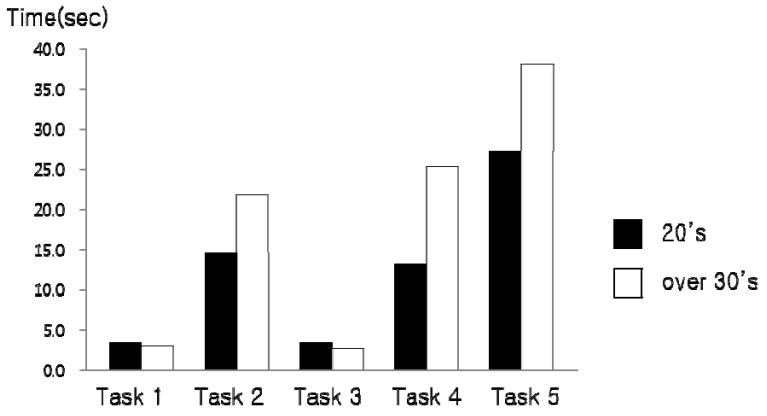


Figure14. Performance Time Result in Each Task of Groups in 20s and over 30s

Table 4. Performance Time Result in Groups in Their 20s and 30s or Above According to Task

	Task 1	Task 2	Task 3	Task 4	Task 5
20's	3.4±1.4	14.7±6.4	3.4±1.4	13.3±7.2	27.2±12.6
over 30's	2.9±1.0	21.8±7.9	2.6±0.8	25.4±7.4	38.1±27.0

3.2.2 Qualitative Case Study Result

Interviews were conducted on the participants. As shown in Figure15, need for sense of touch was mainly shown in terms of functional part of kiosk. Also for overall service, diverse opinions such as inconvenience of visiting health center and desirability of systematic management were deduced.

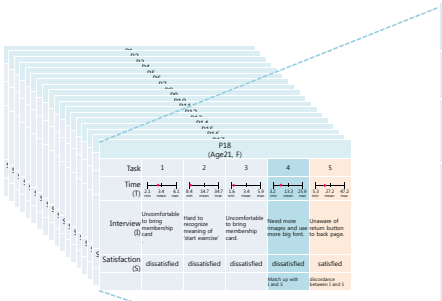
Participants	Age	Recognition of Kiosk Screen	Recognition of Voice Service Support	Usage of Kiosk	Kiosk User Interface	Opinions about Self-Healthcare Service	etc.
P1	56	-	Satisfied	Unclear using steps of membership card	Unaware of detailed market information	Uncomfortable to bring membership card Uncomfortable to visit local healthcare center before use this service. It's gone a better service if it's connoted with local clinic and provide improved information. It's better to connect with park healthcare machine sync with smart phone or some kinds of band to easy to carry	-
P2	55	Little bit hard to recognize m	[illegible]	Hesitate to choose exercise	Unaware of return button to back page. Not clear to understand results ab	Good to provide customized health care information. It's better to provide restaurant information, not just grocery store.	-
P18	21	Satisfied	Satisfied	Need more images and use more big font.	Unaware of return button to back page. Hard to recognize meaning of 'start exercise	[illegible] nected with local clinic and provide improved information. It's better to sync with smart phone or application Review information while doing exercise.	-

Figure15. Qualitative case study

3.3 Results

Quantitative and qualitative data were integrated for analysis (Figure 16). This will be used to determine whether extracted data are useful for developing a realistic service prototype design.

In this experiment, emphasis of analysis was placed on Task 4 (viewing dietary information after seeing today's exercise result) and Task 5 (exiting kiosk after finding viewing dietary information and nearby market) with priority Tasks of all.



P18 (Age21, F)					
Task	1	2	3	4	5
Time (T)	2.1 min 3.4 mean 6.1 max	8.4 min 14.7 mean 34.7 max	1.6 min 3.4 mean 5.9 max	3.2 min 13.3 mean 25.9 max	5.3 min 27.2 mean 47.2 max
Interview (I)	Uncomfortable to bring membership card .	Hard to recognize meaning of 'start exercise'	Uncomfortable to bring membership card.	Need more images and use more big font.	Unaware of return button to back page.
Satisfaction (S)	dissatisfied	dissatisfied	dissatisfied	dissatisfied	satisfied
				Match up with I and S	discordance between I and S

Figure16. Comparative Analysis on Qualitative Evaluation and Quantitative Evaluation

Among 18 participants, 5 in Task 4 and 3 in Task 5 participants who have neutral emotional state were excluded in analysis. In this research, satisfaction ratio was defined as the ratio of cases in which comparison of qualitative evaluation (I), bio-signal measurement (S) and time result (T). That is for comparison of 3 standards, subjective evaluation on degree of satisfaction was performed about qualitative analysis and time. Then, the result was compared with bio-signal measurement result to check for accordance. As a result, Tasks 4 and 5 respectively shows 9 (69.2%) and 11 (73.3%) subjects (Figure 17).

$$\frac{S}{(T-N)} \times 100\,(\%) = \text{satisfaction ratio}\,(\%)$$

T : Total number of participants
N : numbers of Neutral participants
S : numbers of participants Satisfied

Figure17. Measurement of Degree of Satisfaction for the Service

3.4 Discussion

Main users of this case study are expected to be in over 40s. However, participants of the experiment had diverse age distribution between 20 and 50. For this reason, standard of analysis on bio-signal and time data was differentiated between group in 20s and over 30s. Future research must expand its experiment to people in their 40s, who are the main service targets.

In this experiment, degree of satisfaction was evaluated as a quantitative evaluation based on the index of Pleasant-Unpleasant. This was because Pleasant-Unpleasant can be measured using existing technique for measurement of emotional inference. More diverse ways of measuring degree of service satisfaction will become available once other indices are studied with development of standardized measurement techniques.

In this research, UI evaluation on service prototyping was conducted based on 3 standards including interview (I), bio-signal measurement for emotional evaluation (S), and time (T). Here, based on Tasks 4 and 5 with greatest importance, cases that satisfied IS were relatively high. In addition, this is expected to become a useful index for service prototyping evaluation in the future.

4. Conclusions

The objective of this research was to review methods of extracting experience data for creation of realistic prototype. As a useful method of data extraction, we tested and evaluated degree of satisfaction (Pleasant-Unpleasant) and performance time as indices on how satisfied the participants were about the service. Moreover, the experiment was completed with consideration on strong influence of unconscious experience on degree of satisfaction and performance time. Linking memory mechanism with experience, human experience is remembered through learning and either unconsciously or consciously expressed depending on the degree of familiarity in similar conditions. Based on comparison of 3 evaluation indices including interview (I), bio-signal measurement for emotional evaluation (S) and time (T), Task 4 and Task 5 showed 69.2% and 73.3% agreement, respectively. Such result verified that degree of satisfaction and performance time can be useful evaluation indices for service prototype evaluation

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References

[1] Joung, G.H. (2004), *Imbedded System Prototyping Technique*, Korea Information Processing Society, vol.11no.6 , pp86

[2] Russell, J. A.(1978), *"Evidence of convergent validity on the dimensions of affect"*, Journal of Personality and Social Psychology, 36, 1152-1168.

[3] Russell, J. A.(1980), *"A description of the affective quality attributed to environments"*, Journal of Personality and Social Psychology, 38, 2, 311-322.

[4] Tom Tullis /Bill Albert (2009), *Measuring User Experience*, Elsevier Korea L.L.C, 97-106

[5] Shostack, L. G. (1982). *How to Design a Service*, European Journal of Marketing, 16(1), 49-63.

[6] Shostack, L. G. (1984). *Design Services that Deliver,* Harvard Business Review, (84115), 133-139.

[7] Min Cheol Whang et al.(2001). *Effect on Physiological Responses According to Different Arousals,* Korea Society for Emotion and Sensibility, 4(2), 89-93.

[8] Min Cheol Whang et al.(2004). *Research on Emotion Evaluation using Autonomic Response*, Korea Society for Emotion and Sensibility , 7(3), 51-56.