Comfortable Activation of Situation Dependent Services with Objects on the Spot

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Abstract: A variety of services in a ubiquitous environment are activated with a mobile terminal. However, users unfamiliar with the mobile terminal, such as the elderly, can not enjoy services enough because of the difficulty of operation of mobile terminals. In this paper, we propose a system that can activate appropriate services according to a situation of a user without difficult operations. The proposed system is realized in an intelligent environment, the Tagged World. In the Tagged World, user behavior logs are recorded with an RFID system, and user situations are recognized with the logs. Our system provides services appropriate for user situation with selection from many services which are prepared in advance for possible situations. By mapping services dynamically to objects locating around the user, our system gives objects a role of temporal switches for activating the service. By just touching the objects on the spot, the user can easily activate services without the consciousness of computing. We have conducted evaluation experiments. Our system has got a good assessment that the system is useful for users unfamiliar with operations of mobile terminals.

Key–Words: Ubiquitous, Interface, User situation, Intelligent space, RFID

1 Introduction

More and more services come to be available in a ubiquitous environment. Users can enjoy lots of convenient services with a mobile terminal. Therefore, an interface of mobile terminal has been improved to enhance its operability. However, existing interfaces of mobile terminals burden users because the users have to search a service they want by themselves from a lot of services. Users unfamiliar with computer cannot understand terminal operations. There are users who have few chances for use of computer in daily activities, such as the elderly. Since they feel as if they have to operate a complicated computer, they are puzzled by being conscious of computer. Actually, there are many people who cannot enjoy services due to these problems. Users would not have to be conscious of a computer with speech recognition interface [1]. However, existing speech recognition techniques are not practical enough. Users feel stresses because computers cannot recognize natural language.

We propose a system which has an interface that anyone can easily use independently of age or familiarity with computer technologies. The system is realized in an intelligent space ”Tagged World [2]”, where Users can be offered services according to their behavior in homes [3, 4]. In the Tagged World, RFID tags are attached to lots of objects in human life space. A user wears an RFID reader embedded in a small computer. The small computer can detect user behavior such as ”going out” and ”going to bed” from logs

of objects that the user touched. The Tagged World gets states of objects in the area where the user stays through a sensor network. The user situation is recognized with combination of user behavior and states of the objects. The Tagged World offers services depending on the situation. If the user is going out from the entrance without turning off lighting of a living room, the Tagged World recognizes the situation and offers a service for turning off the lighting. With our interface, the user can turn off the lighting on the spot only by touching an object around him, such as a shoe horn. Our system has the following advantages.

- simple operation
- interface without the conscious of computer machinery
- activation of services on the spot

If a user activates an expected service from lots of services with an interface of a mobile terminal, he has to search the service in a menu list by himself. The search forces users unfamiliar with computer to use much time for the activation of services and to waste their energy. Compared with this, our system offers appropriate services selected according to user situation. The users can easily choose services they want and activate the services only by touching objects around them. Any kind of users can enjoy services without difficult operations.

The remaining part of this paper is as follows. Section 2 sorts out the issue of present user interfaces in a ubiquitous environment. Section 3 describes the proposed system and its interface. Section 4 shows implementation of our system. Section 5 evaluates our interface with experiments. Section 6 concludes this paper.

2 User Interface for Activating Service

2.1 Problem of Present User Interface

Many kinds of service are offered in a ubiquitous environment. Users often activate various services with a handy controller which has a GUI interface or lots of buttons. The users have to need to understand difficult operation of the service system with such interfaces, because the users must operate actively by themselves. Users familiar with computer technologies can easily learn how to operate the service system with such interfaces actively. However, there are many users who are not so familiar with computer as to benefit from the services enough. Since the interfaces are complicated for them, they cannot operate the interfaces well. Nichols et al. study an interface for remote control of electrical appliances with a mobile phone [5]. They proposed an interface which provides easier operations for each user, individually optimizing a hierarchical structure of a menu list displayed on a mobile phone. But, the optimization of the structure of a menu list fails to enhance convenience for users who are unfamiliar with computer technologies. They have difficulties in handling a mobile phone itself. Although the interface using a mobile phone can activate services anywhere, the interface has a problem that the interface requires knowledge and experience on operations of a mobile phone. It is difficult for users to search a service they want in the hierarchical structure of a menu list, with understanding of each menu item.

With the increase of ubiquitous services, users consume the time and effort to find an intended service from many services. Riekki et al. proposed an interface for activating service intuitively without wasting time on finding intended services. They utilize RFID tags to activate services for operating electrical appliances on specific spots system [6]. These RFID tags lie under symbols which show service contents. When users wearing an RFID reader touch these symbols, they can activate services corresponding to the symbol. The users can check service contents with the visual symbols. However, the users have to know the correspondence from the symbols to services in advance. If many services are deployed in the same spot, a number of symbol tags bother the users to find services they wants. In addition, because tags are fixed on specific spots, users cannot activate services on spots other than the specific spots.

Tsukada et al. proposed Ubi-Finger with which users operate intuitively information appliances by gestures of fingers [7]. This is an interface which enables intuitive operation by utilizing body action of existing operation metaphor. Therefore, it can reduce complexity for operation of several appliances. However, it has the restriction of user position, because users cannot operate appliances if the appliances do not exist in area that they locate. In addition, it is difficult for users unfamiliar with information appliances to operate intuitively even with existing operation metaphor. Such users need a new interface other than existing operation metaphor.

2.2 Comfortable Interface for User

A ubiquitous environment requires a new interface which enables users unfamiliar with computer technologies to enjoy appropriate services without effort when the users need. We refer to such an interface as a “comfortable interface”. A comfortable interface

must satisfy the following conditions.

simple operation If an operation manner for use of services is difficult, users cannot handle the interface. For example, most users are accustomed with a simple operation such as just pushing button. However few users are familiar with a complicated operation such as a mouse gesture. In addition, it is hard for many users to operate with a combination of plural buttons.

costless operation It is burdensome for users to find a target service from lots of services by their active operation. A few services to be offered should be selected automatically according to user situation. It is preferable for users to avoid learning operations of the interface. Otherwise the users need efforts to understand the manual of operation. However, if the users are inexperienced in computer, they might not even understand the manual.

intuitive operation A service should be offered with an intuitive operation for users who use the service for the first time and who are unwilling to learn the operation manner. It does not necessarily mean the users can use the service with a simple operation such as pushing a button. If there are many buttons, the users cannot operate intuitively and enjoy the service enough.

service provision under unconsciousness of computing Users who are unfamiliar with computers, such as elderly people, are puzzled by using computers or even seeing computers. A ubiquitous environment should provide services so that users can enjoy the services without the consciousness of computer itself.

activation of services on the spot In a ubiquitous environment, users expect to activate services not on predefined spots but on any spot where they stay.

3 Activating Service by Touch to Object

3.1 Tagged World

In this paper, we propose a system which has a comfortable interface with which anyone can easily activate services in a ubiquitous environment. The system is realized in an intelligent space "Tagged World". Fig. 1 shows a concept of the Tagged World. In the Tagged World, short range RFID tags are attached to various objects in human life space. A unique tag-ID

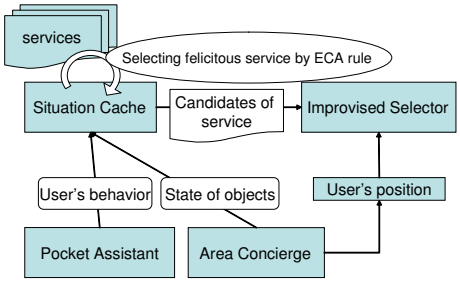

Figure 1: A concept of the Tagged World

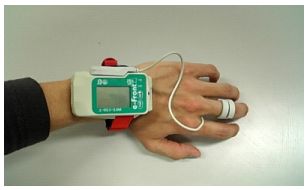

Figure 2: An RFID reader

Figure 3: The Pocket Assistant

which identifies an attached object is recorded in each tag. A user wears an RFID reader embedded in a small computer as shown in Fig. 2 and Fig. 3. The small computer can hold a history of objects that the user touched as behavior logs according to the user behavior, and detects the user behavior by checking kinds of objects and the order of them that he touched [2, 8]. This small computer that detects user behavior is referred to as a "Pocket Assistant". A Pocket Assistant can detect user behavior such as "going out", "coming home", "going to bed", and so on. The Tagged World offers appropriate services for the situation estimated from the user behavior.

The Tagged World uses states of objects in an area around the user as well as his behavior for estimating situation. The states are acquired with a sensor network. For example, a sensor network acquires whether a television is on/off, and whether a door is locked/unlocked. These states are held on a server placed in every area. The server is called an "Area Concierge". The Area Concierge always holds the most recent states.

In the Tagged World, a user situation σ is defined as follows.

$$\sigma = \{b, p, s_1, s_2, ..., s_i, ..., q_1, q_2, ..., q_i, ...\}$$

Where b and p denotes user behavior detected by the Pocket Assistant and user position, respectively. s_i denotes the state of an object held on the Area Concierge. q_i denotes the position of the object. When a user situation is recognized, appropriate services for the situation are selected from services pre-

pared in advance, and offered to the user. For example, when a user goes out, the Tagged World informs him that a window of a bedroom is not locked, and asks him whether to activate the service for locking the window. As another example, when the user leaves something behind in his room, the Tagged World can also offer a service to inform that he may forget something. With our system, the user can easily activate such services, as it is explained in 3.5.

3.2 User Behavior

In a specific scene, people have habitual behavior. For example, when a user is going out, he will generally wear a jacket, pick up a wallet, go to the entrance, put on his shoes, unlock a door, and open the door according to a habitual order. The behavior in a specific scene has individual characteristics on the order of objects which the user touches.

In the Tagged World, we use a short range RFID system to detect user behavior. An RFID reader which a user wears reads the ID of an RFID tag attached to an object he touches according to his behavior. As a result, the history of objects which the user touches is stored on his Pocket Assistant as behavior logs. Using the behavior logs as samples, a behavioral pattern has been constructed from habitual order of touched objects for every behavior such as going out, coming home, and going to bed. A Pocket Assistant matches the current behavior log with the behavioral pattern. At the time, user behavior is detected online by checking the kinds and the order of objects which the user touched.

3.3 State of Object

States of objects around a user are necessary factors for estimating the user situation. For example, a TV is on in the living room, an entrance door is closed, a gas valve is open, and so on. To offer the user appropriate service for user situation, the Tagged World acquires states of objects in area around the user. In the Tagged World, a sensor network gets states of objects in each area. The most recent states of objects are always held by the Area Concierge.

When a Pocket Assistant detects user behavior, the states of objects are used to estimate the user situation. The most recent states of objects enable to estimate the user situation and offer services rapidly.

3.4 Position Information Management

The Area Concierge manages ID of area hierarchically, based on inclusion relations among areas. Each area has an area ID. There are static objects which do not change their location. For example, a refrigerator is fixed in the kitchen. RFID tags attached to static objects are useful to identify area IDs. The Area Concierge links tag-IDs of static objects and area IDs which represent their location. A user wears a Pocket Assistant equipped with an RFID reader. If he touches RFID tags corresponding to area IDs, the Area Concierge can identify his position. Suppose a doorknob corresponding to a hierarchical position represented as “Foo apartment/Block H/201/entrance.” If the user touched the doorknob, his position is identified as the entrance of Room 201. We use the position information of the user to estimate the user situation. By estimating the user situation with position information, meticulous services offering can be considered. For example, when a user is going to go out at the entrance, he should be warned that the lighting of the living room is not off. However, even if the lighting of the entrance is not off, it should not be warned him at that time. By getting the position information of the user, we can improve the timing for offering services.

The Area Concierge can also find objects around the user when his position is identified. For example, when the user touched a shoe horn, it finds that he is at the entrance by the position information of the shoe horn. At that time, the Area Concierge can enumerate “a shoe cupboard”, “an umbrella”, and “an entrance doorknob” as objects around the user.

Figure 4: Improvised selector

3.5 Improvised Selector

In this paper, we propose a system which has an interface to activate services easily for users who can not use conventional interfaces. Our system makes services selected according to a user situation correspond to objects around users. The objects come to ad hoc switches to activate the services. We call the system an “improvised selector”. Fig. 4 illustrates the

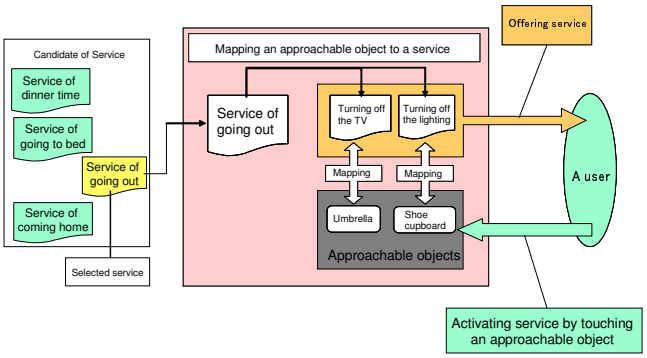

Figure 5: Mapping services to objects

utilization of an improvised selector. Generally, there are a lot of services other than ones suitable for a user situation. It is not easy for the user to choose services he wants quickly by himself from a lot of services. It requires much time and energy. As a solution to this problem, the improvised selector picks up suitable service candidates according to the user situation instead of showing all possible services. Assuming several user situations, the improvised selector prepares many services according to each situation in advance. The improvised selector provides candidates of services by narrowing down the candidates according to the user situation from many holding services. The user can select services which he wants to activate from the candidates of services without searching the services by himself.

The candidates of services are selected with ECA rules. An ECA rule is composed of an event (E), a condition(C), and an action (A). An event corresponds to the occurrence of a specific user behavior, while a condition represents a set of object states. Namely, the combination of an event and a condition corresponds to a situation. An action represents a service to be offered. Suppose a user goes out, which is regarded as an event. Let the situation at that time meet that lighting and a TV are on in the living room, and the user is at the entrance as shown in Fig. 4. A service that turns off the lighting and the TV can be offered as an action. The selection of the services with ECA rules is followed by the calculation of the user position. The position of the user is identified by objects that he touched because the Area Concierge keeps the position information of objects. Beside, objects around the user are also enumerated by the Area Concierge. We refer to objects around the user as "approachable objects". As shown in Fig. 5, the service candidates are mapped to approachable objects. An approachable object comes to a switch to activate one of the service candidates. The mapping from service candidates to approachable objects can be decided on dynamically depending on the user position.

Because RFID tags are attached to approachable objects, the user can easily activate an appropriate service he wants only by touching an approachable object which the service is mapped to. If the user is at the entrance, he can choose the service that turns off the lighting and turns off the TV without going back to the living room only by touching an approachable object such as a shoe cupboard or an umbrella.

The improvised selector has the following advantages.

simple operation A user can activate a service without confusion only by simple operation that is just a touch to an approachable object mapped to the service.

costless operation A user dose not has to search an appropriate service from a lot of possibilities by operating mobile terminal, because unsuitable services are eliminated according to the user situation in advance. He does not need to understand a difficult operation manner to activate services because the operation of the improvised selector is only touching a specific object around him. The user only makes judgments whether candidates of services are helpful for him. He wastes time and energy no more.

recommended services The improvised selector prepares useful services according to several situations. The improvised selector presents to a user candidates of services according to the user situation. Therefore, the user only chooses services which he wants to activate from presented services. Considering position information of the user, the timing to present candidates of services is determined.

service provision under unconsciousness of computing A user has no need to be conscious of computing to activate the intend service. The improvised selector shows him some approachable objects to touch for the activation of services. What he touches is not a computer but an object.

activation of services on the spot Because the improvised selector assigns approachable objects to services, a user can activate offered services on the spot. Suppose a user is going to go out without turning off lighting of the living room, the improvised selector can provide a service for turning off the lighting on the spot, even though the user is not in the living room. Without the improvised selector, if the user is at the entrance,

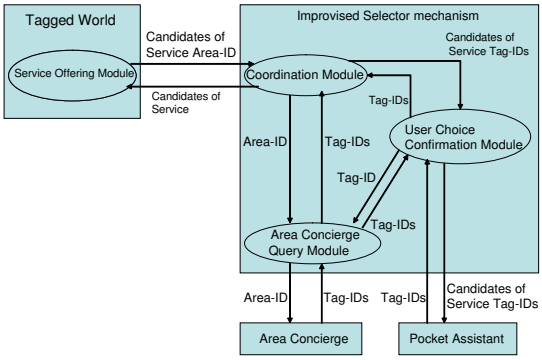

Figure 6: Implementation

he must go back from the entrance to the living room to turn off the lighting. However, the user who uses an improvised selector can turn off the lighting without going back to the living room by activating a service at the entrance with the improvised selector. The improvised selector works as a remote control system.

In a case that position of a user can not be identified or a case that approachable objects can not be pointed out, the improvised selector asks the user to touch something around him. This will pinpoint approachable objects to be assigned possible services. If there is not a switch to activate a service that the user wants on the spot, he is obligated to go where a switch is located. With the improvised selector, the user can activate the service regardless of his position because an object around him becomes a switch to activate on the spot.

By using the real objects as switches to activate the services, the user can activate the services without the conscious of computer. In the future, the RFID reader which the user wears will be miniaturized like a ring or a wristwatch, which can be wore at all times in daily life. Therefore, the usability of the improvised selector will be improved.

4 Implementation of Improvised Selector

We implemented the improvised selector mechanism. It has the following 3 modules as shown in Fig. 6.

- the coordination module
- the user choice confirmation module
- the Area Concierge query module

Here gives a description of each module.

the coordination module The coordination module gets an area-ID which shows the user position and candidates of service depending on the user situation from the service offering module of the Tagged World. The service offering module has already selected appropriate services according to user situation. Through the Area Concierge query module, the coordination module gets tag-IDs of approachable objects as the tag group information. The tag group information and candidates of services are sent to the user choice confirmation module. After the user touches approachable objects, the coordination module gets a service chosen by the user through the user choice confirmation module, and informs the service offering module of the service.

the user choice confirmation module The user choice confirmation module gets tag-IDs of approachable objects and candidates of service from the coordination module, and maps each of the approachable objects to a candidate of the services. After the user choice, which is acquired through the communication with the Pocket Assistant, this module informs the coordination module of a service corresponding to a tag-ID chosen by the user. When the user position is not identified, this module gets a tag-ID which identifies the user position by making him touch an object around him. With the tag-ID, this module asks the Area Concierge query module to know approachable objects.

the Area Concierge query module The Area Concierge query module is sent an area-ID or a tag-ID from the coordination module and the user choice confirmation module. Using the ID, this module gets tag-IDs of approachable objects through the communication with the Area Concierge. The tag-IDs are sent to each module.

5 Evaluation

5.1 Experiment Environment

Two experiments have been conducted to evaluate the improvised selector. The experiments assume an apartment as their environment. As for the layout of the apartment, it is divided into 5 areas: a living room, a bedroom, a kitchen, a toilet, and an entrance. In the experiments, subjects take their own behavior of going out or going to bed. The subjects activate services according to the situation with the improvised selector. The first experiment evaluates utility of the improvised selector. The second experiment compares an

Table 1: Average time to activate services

At the entrance	improvised selector	
	with	without
case1	00:22.855	00:51.068
case2	00:28.515	01:14.948
case3	00:29.531	01:46.240
In a living room	improvised selector	
	with	without
case1	00:22.934	00:41.445
case2	00:23.878	01:02.160
case3	00:13.656	01:22.913
In a bedroom	improvised selector	
	with	without
case1	00:16.246	00:46.505
case2	00:13.057	00:59.792
case3	00:20.993	01:25.988

*A unit of all values is min:sec:milisec.

interface of the improvised selector with an interface of console operation. In each experiment, we measures the time that 6 subjects take to activate services with the improvised selector. We consider the time as one of yardsticks for estimating the simple operation and the costless operation. Of course, we think that the improvised selector can not be evaluated only with the speed. Therefore, we conducted a questionnaire to the subjects after experiments for evaluating the improvised selector.

5.2 Utility of Improvised Selector

The first experiment evaluates the utility of the improvised selector from the aspect of the time length that a subject takes to activate services. This experiment assumes that a subject forgets to make states of some objects proper state for going out or going to bed. With the improvised selector, each of the subjects activates services to set an object state to a proper one according to his situation in the three areas: the entrance, a living room, and a bedroom. The services are activated to realize closing a gas valve, closing a window, turning off lighting, or turning off a TV. In each area, there are about 10 approachable objects which can become switches to activate these services. Randomly, approachable objects are chosen as switches every time in each area. This experiment imposes following two methods to change states of objects in situations that the subject stays in the entrance, in the living room, and in the bedroom.

1. A subject activates services with switches chosen by the improvised selector automatically. (with improvised selector)

2. A subject goes back to room inside and changes states of objects manually without the improvised selector.

Three cases were conducted with different setting of the number of objects to be changed their state. The number of objects where states are changed is in case 1, case 2, and case 3 are 1, 3, and 5, respectively. This experiment was conducted 18 times, combining 3 areas, 2 methods for changing state, and 3 cases per subject. Every time we measured the time for a subject to take until he has changed states of all objects proper states. Table 1 shows the average time of 6 subjects.

Case 1 does not show significant difference of time between 2 methods for changing state in all areas. Case 3 shows noticeable difference of time between the method using the improvised selector and the method without the improvised selector. The time with switches selected by the improvised selector is lower than 30 seconds. Without the improvised selector, the more objects to be changed in their state are, the more time is necessary. The short time in the method of the improvised selector proves that the improvised selector realizes simple and costless operation. In addition, without the improvised selector, subjects must go back to the place where they can change states of objects manually. The subjects waste time and energy. On the contrary, the improvised selector is costless because the subjects can activate services on the spot by using objects around the subjects as switches.

Table 2: Comparison with Console Operation

	improvised selector	console operation
case 1	00:17.65	01:30.37
case 2	00:18.25	01:04.99
case 3	00:36.28	01:44.88

*A unit of all values is sec:milisec.

5.3 Comparing with console operation

The second experiment compares an interface of an improvised selector with the interface of console operation. We assume a console which works as a remote controller to activate service. As a console, let us consider to use a mobile phone, because we can specify a service using its buttons and the display with the mobile phone. With the interface of console operation, a subject must find services he wants from a menu which has a hierarchical structure to activate

services. In this experiment, subjects activates the following services.

- Service to notify of schedule of garbage collection day
- Service to notify of schedule of laundry
- Service to inform of weather forecast
- Service to inform of delay information of train
- Service to call an elevator to the room floor by remote control

There are three cases conducted with different setting of the number of services which a subject activates in the experiment. The number of services in case1, case2, and case3 are 1, 3, and 5, respectively. We measured the time a subject takes until he activates all specified services. The experiment was conducted once with each case per subject. In Table 2, we show average time of 6 subjects.

The result of the experiment with each case shows significant difference between two interfaces. The improvised selector has shown the high utility by the short time. Because it has selected offered services depending on the situation, subjects only have to decide whether they activate each offered service or not. It is not necessary to find services subjects want from lots of services unlike console operation. The interface of console operation needs to understand its operation manner, because subject must operate a console actively by themselves. Subjects waste time and energy to search services they want in a hierarchical menu structure. The improvised selector solves the problem that subjects have to understand a difficult operation manner with an unknown menu structure, because subjects can activate service only by touch to objects around them. The experiment proves that the improvised selector realizes a simpler operation and lower cost for operation than the conventional console operation.

5.4 Questionnaire of the experiments

In this section, we discuss advantages and improvement of the improvised selector with a questionnaire result. In the questionnaire, most of subjects have answered that the improvised selector is simpler to operate than existing interfaces because the improvised selector can activate the service only by touch. They have also answered that the improvised selector can activate a service with less energy, because they do not have to find the service in a hierarchical structure of a menu list. The improvised selector has proved its advantage with simple and costless operation in the questionnaire as well as the quantitative evaluation of average time length for activating services in 5.2 and 5.3. Some subjects commented that if the improvised selector can select objects becoming switches with considering user posture, the shape, the size, and the height of objects, it would promote this advantage. There is another good assessment that subjects could intuitively operate the improvised selector without consciousness of computing. Suppose a situation that they have already put on their shoes at the entrance, leaving a window of the living room open. It is a common answer for all subjects that the improvised selector is a good way for users to close the window automatically by activating a service of remote control on the spot without taking off their shoes to go back to the living room. It means that the improvised selector is convenient, because accessible objects around them in their life space become switches to activate services on the spot.

While there are many users who give a good assessment for the improvised selector, there are a few users who point out improvements on the improvised selector. If there are a lot of objects around them, they would be annoyed with looking for specified objects as switches. In addition, sometimes they cannot understand the correspondence from an offered service to an object. It becomes clear that a user can be puzzled with the position of the approachable objects to become switches and with correspondence between objects and services. In the case that console operation of mobile terminal is used, if the label of a menu is described appropriately, a user can understand correspondence between services and menu items [5]. In the case of an interface using symbol tags, a user can recognize correspondence between services and tags, because symbols describe service contents [6]. However, the improvised selector has no association of image between service contents and approachable objects, because objects in life space become switches. With this problem, it may be said that the improvised selector is more meager than existing interfaces. If the user chooses objects becoming switches, this problem is solved. However it would make him waste time and energy to activate services at the same time.

In the experiment, the improvised selector does not use a terminal display to present information of service contents and to operate for activating service. It aims to make user unconscious of computing. However, in the questionnaire, there was an opinion that a user can easily understand the correspondence between service contents and approachable objects by showing the image of the object on the display. The release of a mobile phone equipping with an interface of a touch screen instead of fixed buttons such

as iPhone [9] may realize a dynamic interface which changes the service menu, according to a user situation. In the future, we would realize a better interface by combining both the advantages of the improvised selector and a display of a mobile terminal.

6 Conclusion

In this paper, we propose the improvised selector as a system which has a comfortable interface that any kind of users can activate services without difficult operations. In an intelligent space "Tagged World", the improvised selector makes approachable objects become switches to activate services by mapping the approachable objects to services according to user situation. A user does not need to understand a difficult operation manner to activate services because he can activate services only by touching a specific object around him. Because approachable objects become switches to activate services, the user can activate offered services on the spot. By the improvised selector, candidates of services to be activated are selected automatically according to user situation. However, the user can decide services which the user activates finally by himself. Therefore, services inappropriate for user expectation can not be automatically activated. Experiments have proved the user can activate services with less energy by using the improvised selector than by using existing interfaces. Subjects have answered that the improvised selector is simpler to operate, and it is easy to use for users who are unfamiliar with computer.

In the future, our system has the following three challenges. First, the system needs a function to cancel activated services which have been chosen once by a user, because the user may mistakenly touch objects which are switches of the activated services, even though the user does not want to activate the services. Second, the system should improve the preciseness to get position information of the user, because the preciseness affects appropriateness of selecting objects which should be used as switches and fineness of the timing to present services to the user. Third, the system needs how to customize ECA rules, which describe definition of a variety of situations, service contents, and the mapping of situations to services. In addition, the customize operation must be very easy so that any user can customize the rules flexibly according to individual habit and individual preference.

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