A WORK SERVICE MODEL OF THE UBIQUITOUS OFFICE

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Abstract. In recent years, office environments adopt ubiquitous computing with a focus on collaboration and mobile communication to promote real-time enterprises. Within this context, this study deals with a significant issue on the ubiquitous office environments by understanding human behaviors and works. We propose a ubiquitous office model considering the correlation between ubiquitous computing technologies and work services in the office. Two attributes are focused, collaboration and mobility, as identifier for categorizing the work types. The classic types of work services have variations in the amount of communication and the proportion of working outside of the office. The proposed work service model includes territorial and non-territorial services for the ubiquitous office to enable workers in and out of the office to interact with each other. The findings in this paper would be a theoretical basis for embodying the intelligent office which supports office works efficiently and effectively.

Keywords. Ubiquitous office; work service model; ubiquitous computing; context awareness; collaboration.

1. Introduction

The development of computers and the Internet has changed human life styles as well as societal and economic activities. Recently, for the real-time enterprises, the office environments deal with ubiquitous computing with a focus on collaboration and mobile communication. By understanding human behav-

iors and works, this study proposes a ubiquitous office model through considering the correlations between the ubiquitous computing technologies and work services in the office. We adopted the work context from Alternative Workspace Strategies (AWS) proposed by Gilleard and Rees (1998), which provides a unique context in the ubiquitous office. The ubiquitous office is not what is operated passively by inhabitants but an active information-oriented office that can predict the situation and working patterns of inhabitants. This paper emphasizes the way of making computers understand the situation and the work patterns in an office environment.

This paper consists of three parts: 1) description of the research background with a focus on the concept of the news office and the ubiquitous office; 2) a survey of enabling technologies and their applications in the field of the new office; and 3) the proposition of the service processes of the ubiquitous office in the work service model.

2. Background

2.1. THE NEW OFFICE

The *new office* is defined as all offices which are opposed to the traditional office, and extended to include a shared space which has no time and place limitations. Duffy (1997) described that the traditional office has routine processes which include many individual tasks isolated from the others. On the contrary, the new office supports creative knowledge work which generates interactive workflow. Also, the new office can be distributed and connected for communication through the network. Our daily working time can be expanded to be flexible in mobility. Ubiquitous and mobile technologies empower the creative knowledge work, which ranges from individual to group-oriented.

Gilleard and Rees (1998) described AWS including workplace redesign, on-site/on-premises strategies, and off-site/off-premises strategies as shown in Table 1. Especially, the virtual office reflects the concept of ubiquitous computing (Weiser, 1991). With the development of Mixed Reality (MR), the horizontal and vertical surfaces of the office were augmented for the future visualization (Raskar et al, 1998). The AWS instructs us how to predict and control the work context. Also, the AWS presents similar characteristics to those of the ubiquitous office, mobility for the non-territorial feature and ubiquity for the territorial feature.

Table 1. Alternative workplace strategies (Gilleard and Rees, 1998)

| Workplace redesign	Flexible work schedules	That maximize use of office space
	Modified office standards	To improve productivity and efficiency, and support organizational objectives, such as establishing universal standards.
On-site/ on-premises strategies	Free address	Workspace shared on a first-come, first-served basis usually in a large open space with many workstations.
	Hoteling	Workspace that is reserved on a first call basis and not dedicated to any specific worker beyond a specified occupation time.
	Group address	Designated group or team work space for specified period of time
	Share space	Two or more employees sharing a single, assigned workspace and work tools, either simultaneous or on different shifts/schedules.
	Project team environments	Flexible work areas designed to support work teams as they expand and shrink
	Activity settings	Providing a variety of work settings to fit diverse individual or group activities such as a lounge area, desk work area, conference area, etc.
Off-site/ off-premises strategies	Telecommuting (Home-based)	Combination of home-based and office workspace linked by technology, with employees utilizing their office workspace one or more days a week.
	Satellite officing	Office centers providing technology and administrative support located near employee residences and used full-time by employees living closest to satellite site.
	Remote telecenters	Office centers providing technology and administrative support, located near customers and staffed by employees dedicated to that site or splitting their time between that location and another.
	Virtual officing	Employees have freedom to office anywhere -home, car, hotel, etc. –through the use of portable technology.

2.2. UBIQUITOUS OFFICE

Weiser (1991) described the ubiquitous office as a one room that has hundreds of computers connected to each other through cables and a network. There is a growing interest for the new office space that combines physical and electronic space through the ubiquitous technology.

The ubiquitous office is also defined as an environment where user can utilize computing technologies intuitively without recognizing the computers (Lee and Lee, 2004). In other words, for making the more comfortable working environment within an office, a variety of embedded computers make inferences, interpret and respond to the situation through the perception on the context of workers, which keeps the effective and comfortable environment. Also, the ubiquitous office integrates the mobile environments where mobile devices enable the users to be connected to other devices and col-

leagues distributed at any time (Schilit et al, 1994; Gellersen et al, 2002; Hohl et al, 2002; Henricksen, 2002).

The ubiquitous office contains sensors and devices that adopt various location-aware technologies such as GPS and WPS. The context awareness can be achieved through the use of the devices and sensors, thus producing customized and appropriate work services. The features of the ubiquitous office can be divided into two categories: One is the territorial attribute that provides intelligent services through the understanding of the context of the works and users; the other is the non-territorial attribute that works in the mobile environment. Figure 1 shows the characteristics of the ubiquitous office.
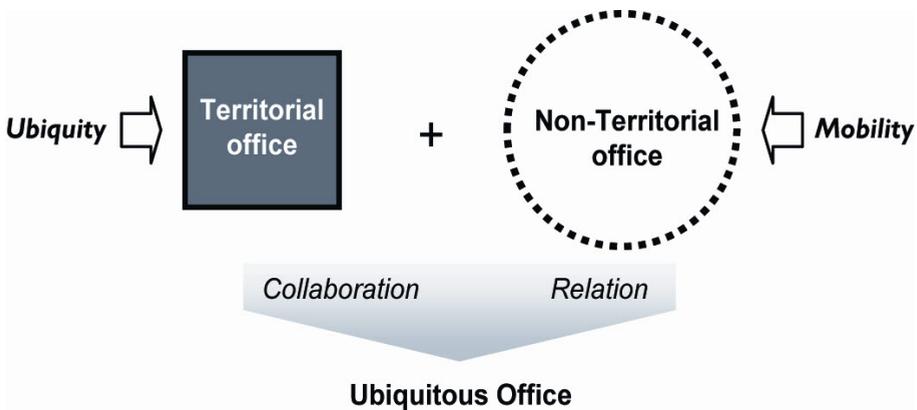
3. Previous relevant work

This section critically reviewed the previous relevant efforts in advancing the new office, although some of them did not deem their cases as new office. The section derives certain important characteristics that the new office should possess.

3.1. ON-SITE/ON-PREMISES STRATEGIES

3.1.1. IBM (UK)

Since 1989, IBM has tried to find out a desirable workplace type for sales staffs and realized that keeping the personal desk is not efficient. More important thing is to provide a workplace where the sales workers can meet customers and access to the technology supports. Well-equipped open breakout spaces

to meet with colleagues are more important than reserving individual private spaces for persons who sometimes drop by (Duffy and Powell, 1997).

3.1.2. ACCENTURE

Accenture has been operating the 'hoteling' strategy for the mobile office. This office accommodates 800 staffs in 168 seats and allots 3-5 consultants to one workspace. Since there is no executive workspace, the concept of the horizontal office is realized. By focusing on public and meeting spaces, the department of supports, each consulting team consisting of 4 persons, assists the work environment in the office (De Long, 2001).

3.1.3. DOWA HOLDINGS

DOWA Holdings is one of the successful cases among companies in Japan which adopt the 'free address' strategy. Contrary to the traditional offices, Yosikawa hirokaz, CEO of DOWA Holdings, broke the physical walls among workers when renovated the headquarters. On the 'free address' strategy adopting wall-breaking, workers should keep their office stuffs in their private cabinets and pick their seats when they start to work. The working pattern enables workers to share their information and interact with each other (Hirokazu, 2007).

3.2. OFF-SITE/OFF-PREMISES STRATEGIES

3.2.1. NTT Group

NTT Group consisting of NTT Data, NTT Communications and NTT software established a home-based working system for their workers, which allows the workers, except sales staffs, to work at home one time in a week. Because of security problems, the group has prohibited the workers from using paper media and made them loan Sun-Client- install PCs from the group. That is, the group limits their employee's works due to the concerns of the information leak (Baek et al, 2009).

3.2.2. Interagency Telecommuting Pilot Project of GSA in USA

GSA (General Service Administration) implemented the pilot project from 1993 to 1996 and advised each administration to execute various types of working systems (telecommuting, telework centers etc.). GSA prescribed to implement the teleworking, outside of office, for more than one day in a month. The teleworking project in GSA established a telework center network

in the areas near Washington in the beginning of 90's (Jeong et al, 2007).

3.2.3. Cisco Mobile Office

Cisco is realizing the mobile office through UC (Unified Communication). UC is a system that integrates various communication means such as telephones, fax, e-mail and cellphones into a single platform, which enables continuous communication without being cut off. Especially, Cisco minimizes employees' the business trips to abroad by installing 'telepresence', one of the technologies of UC, in their branches. Telepresence is an IT system to enable the face-to-face meeting through real-size videos (Cisco Public Information, 2008).

3.2.4. Samsung SDS

For the implementation of the mobile office, employees in Samsung SDS were given smart phones with Mobile desk program. The program that enables the employees to work at any place and time successfully reduces cost and increases productivity. Being connected to the office mail systems and mobile devices through a wireless network, workers can receive and respond to e-mails (Seon and Kim, 2010).

3.2.5. Seoul Metropolitan Rapid Transit Corp (SMRT)

The previous UTIMS (Urban Transit Infrastructure Management System) of SMRT (Seoul Metropolitan Rapid Transit Corp) shared all the information of 5, 6, 7 and 8 line trains with their branches in real-time, but maintained the facilities asynchronously when the repair was available. The mobile support system associated with computer technologies was established and responds to the civil complaints making relieving uncomfortable things at one-stop real-time, which increases the customers' satisfaction on the services (Bae et al, 2010).

4. Work service model

4.1. ENABLING TECHNOLOGIES

Various ubiquitous environments have been implemented by different technologies. Specifically, the technologies have been developed with a focus on the supports of the collaboration in office works. The support can be divided into two types: indoor office collaboration and outdoor office collaboration.

The technologies adopt the territorial attributes and devices of the

ubiquitous office when workers collaborate with team members. Most of tables and walls allow workers to interact with co-workers as shown in Figure 2. Wellner (1993) proposed 'Digital Desk' that provides electronic and actual documents simultaneously using a tablet and pen on a table and projected screen of the computer. iRoom of Stanford university (Borchers et al, 2003) was developed as an open meeting room including interactive walls and tables. The room has cameras, microphones, wireless LAN supports, and a variety of wireless buttons and other interaction devices. Also, Streitz (1999) coined the concept of Roomware and studied on the workplace of the future which was described in i-LAND. The space has Dynawall that can be used by several persons interactively, CommChair, a kind of chair, implemented in a computer and InteracTable is available for the interaction.

Figure 2. iRoom (left)(htp://ldt.stanford.edu) and i-LAND (right)(Johanson et al, 2002)

Telepresence technologies allow workers who are far away from their offices to contact with their colleagues inside the office. The workers can feel like to be present in their offices together with their colleagues and have no difficulties in collaborating with them. Compared to the traditional 2D-based telepresence systems, more realistic 3D mapping techniques have emerged in the area of the collaboration.

The followings are the major technologies adoptable for workers who are working outside their offices. In order to support mobile workers who do their personal and collaborative work with colleagues in indoor offices, the advanced technologies and applications are being developed. The Active Badge Location System (Want et al, 1992) is to provide the location information on the workers who wear the badges through the network sensors. The location-based services have been significantly developed since long time ago. The ubiquitous vision of Victor Poznanski (2004) has the non-territorial attribute and emphasizes the mobility. Therefore, it proposes the nomadic access to the information and services needed for the mobile workers.

4.2. WORK SERVICE MODEL FOR THE UBIQUITOUS ENVIRONMENT

In order to propose a new office model for the future, we developed a work service model of the ubiquitous environment as illustrated in Figure 3. The model describes the processes of the work services. With a focus on the territorial aspects of the offices, we consider two types of attributes of the ubiquitous office for the work service model: one is the territorial office, and the other is the non-territorial office.

The processes of the territorial office are the left part in Figure 3. New values in the context captured by various sensors are perceived by the Office Agent, and then the information is delivered to the Context Interpreter for reasoning the situation through 5W1H. If collaboration is necessary, the Collaboration Provider is then conducted accordingly. If not, the Appliance Controller takes the information and executes the work service using the Office Appliance. On the other hand, those of the non-territorial office start from the location-based context awareness. For example, Location Based Services (LBSs) such as Wikitude and Layar offer the service by interpreting information sensed by GPS. The location information in work context is handled by the Mobile Application. The critical point in the process is the three kinds of relations to the information, thus the mobile process searches for users, objects, and place relations, which is computed by the Relation Provider. Context Awareness is captured by either sensors or mobile devices in the ambient media environment, where the territorial and non-territorial services can be integrated seamlessly in collaboration.
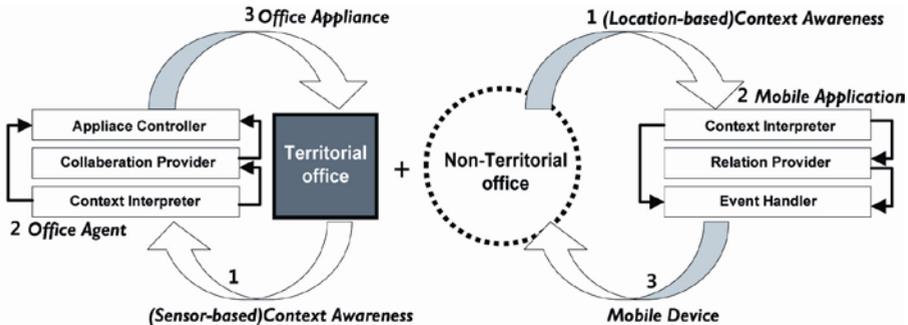

Figure 3. Work service model for the ubiquitous environment.

5. Conclusion

This study argued the ubiquitous office as the new office and investigated into the types of new offices and the background of the ubiquitous office through

the literature review. Also, the ubiquitous office was divided into two features. One is the territorial attribute that understands the context of the works and users and provides intelligent services. The other is the non-territorial attribute that can be applied for the mobile environment. Through the case study, this research identified what actual office works are, what work services are provided according to the degrees of the collaboration and mobility, how the ubiquitous office is adopted and what kinds of technologies are available for ubiquity and mobility.

Ultimately, this study proposed a work service model of the ubiquitous environment and presented the processes for the territorial and non-territorial offices in the ubiquitous environment respectively. More case studies, advanced technologies and investigation are needed for the future study in order to verify the proposed work service model. This study adopted a novel approach to the development of the work service model by integrating two attributes of the ubiquitous office. We plan to do research on the users' experiences and the ways to improve the ubiquitous office in more detail as a next step of the research.

Acknowledgements

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