A Study on the Ubiquitous Computing Service Design System

Jae-Hyung Byun¹, Chang-Soo Kim², Myung-Suk Kim³ Dong-A Univ. ¹, Samsung Advanced Institute of Technology², KAIST³, Korea

Abstract

This study proposes a methodology for Development of Ubiquitous Computing Services Design System under ubiquitous environment focusing on human basic activities and information related to home life. The main feature starts with the analysis of human life and ends with service development. The first step is to draw user's Basic Activities (BA) through analyzing user's everyday home life. Next, designers find the goals of users life and each goal has the set of Basic Activities. UC service will be developed based on these BA sets. This conceptual model defines the context comprised of 'object' and 'information', which is necessary for each activity. Through the analysis of 'object' and 'information', ideas of ubiquitous computing product can be found. Analyzing the connection of objects, information and human activity can be the first step of the new service design methodology in the ubiquitous computing context, and the methodology of UCS in this paper is valuable in this point of view.

Keyword

Ubiquitous computing, Life model, Service design

1. Introduction

The focus of computing has shifted from technology itself to the interaction between human and computer. Moreover, computing environment supporting human life has been the main concern. Ubiquitous technology helps computing resources used for human activity anytime and anyplace, and it will bring big changes in people's way of using computers. The most important matters about ubiquitous computing are how it is coincides with human needs and how it supports human activity. Therefore, 'service design' should be ahead of technology.

Ubiquitous Computing means that computing is provided to people in anyplace, anywhere through anything. Some services via this ubiquitous computing have some preconditions; First of all, all the objects should have the computing ability inside. Second, network is essential to communicate with other object. Finally, the objects should be context-aware for being useful to users.

These conditions can be accomplished with various computing technologies, but many of them are under research. In this circumstance, 'Ubiquitous Computing Service(UCS)' can be a catalyst to build an initial environment of ubiquitous computing and to provide guidelines for user-friendly applications. However, the features and process of UCS have not been defined. Consequently, engineers and planners have troubles in designing services. In this paper, methodology for developing UCS will be discussed.

2. Ubiquitous computing service

There are many discussions about Ubiquitous Computing Service, but the further study of UCS is not the main concern. One of the aims of this paper is to promote the interest of the UCS. People who see 'UCS' first time do not know what it means exactly. And this confusing follows the concept and appearance of UCS. In this Paper, the necessity and the characteristics of UCS development will be discussed.

2.1 Necessity of Ubiquitous Computing Service

UCS is the service aiming user's maximum comfort using ubiquitous computing. UCS helps solve many problems due to current technology; it covers limits of spaces and provide each individual optimized service. And then, what this advanced services will be and how can we develop them? Answering these questions is necessary, because Ubiquitous Computing is at the step of developing, and we cannot know the future of it exactly. Therefore, conceiving UCS will boost engineers' creativity and enthusiasm and give businessmen clear vision.

2.2 Features of Ubiquitous Computing Service

1) Providing Right Information

UCS aims to provide users accurate, proper and immediate information. However, excessive offering of information would be frustrating abusing technology. Also the information by UCS should be appropriate and immediate. That is, users will expect the information which is 'ready-to-use' not 'waiting' in ubiquitous computing age.

2) Providing Natural Interfaces

Users tend to do something in the most natural circumstances. UCS is provided to users through the objects which users want. With familiar everyday things, users can obtain information easily and comfortably.

3) Providing User Benefit

As above, UCS gives appropriate information in the most natural way and maximizes user's convenience. To pursuit this goal of UCS, the service developer should focus on the user's needs. Especially, UBS can offer some needs which was invisible before ubiquitous computing age, and the needs should be more user-centered and efficient.

3. Conceptual model for Ubiquitous Computing Service Design 3.1. Human Home life Conceptual Model

This study aims to develop UCS design systematically supported by ubiquitous technology, which considers human's whole activity as the interaction of information between users and outer objects. For user-centered UCS framework based on the understanding of human activity should be done first. Starting with this framework, methodology for modeling home life, human home life conceptual model, information architecture of real life will be followed.[Fig. 1] Here defines the constituents of human home life conceptual model.

- 1) Human home life is consisted of Basic Activity, which has its own purpose.
- 2) Basic Activity accompanies Information and Object.
- 3) Information and Object are defined as context.
- 4) Basic Activity can be compounded by Sub-goal.
- 5) Sub-goal is to accomplish the goal

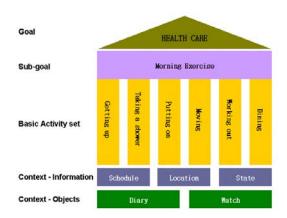


Fig. 1. Human Home Life Conceptual Model

Through the conceptual model describing general human activity at home, the goals and categories of human activity, information and its flow for those activities, states of action including various objects can be figured out. The Conceptual model was made through classifying human home life into several domains and setting process and information of activities in each domain. Analyzing particular process of main activities, extracting common elements, and the correlation between these were done for developing information architecture about real human life.

3.2. UCS Conceptual Model

[Fig. 2] shows the conceptual model of UCS. The main feature of this model is it starts with the analysis of human life and ends with service development. Also in this model, each object and activity connects variously. Therefore, this methodology is different from other product or subject-oriented ones. The first step is to draw user's Basic Activities (BA) through analyzing user's everyday life. Next, designers find the goal of users life and each goal has the set of Basic Activities. UC service will be developed based on these BA sets. This conceptual model defines the context comprised of 'object' and 'information', which is necessary for each activity. Through the analysis of 'object' and 'information', some ideas of ubiquitous computing product can be found.

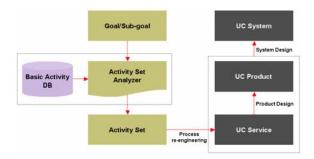


Fig. 2. UCS Conceptual Model

4. UC Service design development process

4.1. Flow Chart Structure

First of all, 56 human basic activities were extracted from home life and described by flow chart.. In this research, human home life was categorized into 7 domains - Self Management, Housework, Caring family members, Safety, Entertainment, Education and Relationship/Communication. Human activities should be matched to one of these domains and the activities range from complex and serial ones to simple contents or motions. Total 56 activities were extracted from psychology literature reviews, user observation and interview. This was named 'Basic Activities'. Therefore, Basic Activities(BAs) can include human home life for various goals. Next, the process of each basic activity was described into detail based on the way of users' searching information. Flow charts explaining human home activity based on the user observation was used to depict each process, and the objects which user need were listed[Fig. 3].

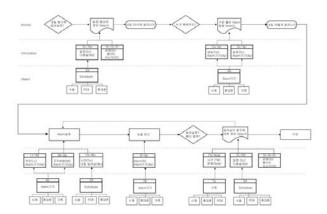


Fig. 3 Activity Sequence Flow Chart

After arranging the process of each BA, some insights were found. - 1) similar patterns in searching and using information. 2) necessity to group related objects according to the purpose of users' action. Based on these findings, to be more consistent, the whole process of each BA was re-designed analyzing 'Man', 'Information' and 'Object'.

Flow Chart describing 'Man' is composed of basic step including 'question', 'searching, 'decision', 'acting'[Fig. 4]. Some steps, which automatically progress, may not have information or only can include only 'decision' phase. And when the various information searching is necessary for one action, this action is placed only after

the final information search. With these standards, re-arranged flowchart can have general question and answer phase patterns. General patterns include some questions - deciding what and whether to do, continuing or stopping actions, deciding tools/methods/services, the existence/state/quality or quantity of objects and how to use objects. Through matching these questions to necessary information group, the relationship of 'Man' level and 'Information' level can be set.

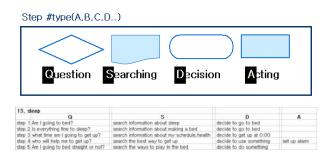


Fig. 4 Man_level Pattern

4.2. Information Classification

Through the flow chart, information and its flow for those activities, states of action including various objects can be figured out. Analyzing the correlation between information and various objects helps to understand the existing human home life. 'Information' is divided from 4 levels - Information Group, Sub Information Group, Information, Object. 'Information Group' consists of 'Objective' and 'Subjective according to the existence of exterior objects for the finding and flow of information. 'Sub Information Group' has several types - State, Time, Quantity and etc. And 'Information' is labeled more specifically than 'Sub Information Group'

Roughly 1500 Home life Information are arranged by analyzing and classifying. [Fig.5] Every Information get code value for the Visualization tool. To be sure, it could be upgraded anytime.

			_	_	_	_
A	В	C	D	E	F	G
1 1단계	▼ 2단계	▼ 3단계	▼ 4단계	5단계 ▼		플로우 ▼
6 왕태/스 11	▲ 조작	Alarm			1	3
51 용변/포실	조작	비데			3	9
5 상점	조작	비데			3 3 5	12
6 상태/의치	조작	비데	공기청향제		3	15
11 전호 // /	분류	설거지			5	2
11 성호 /자도	설거지				5	2
12 상태/약동	설거지				5	5
15 全	화장				5 5 6 7	2
15 英雄	건조 -				7	2
변화 (소년 전 전 전 전 전 전 전 전 전 전 전 전 전 전 전 전 전 전 전	조작	도구/기기			10	3
21 分张	계획	선호			11	1
22 식탄	계획	선호			11	2
22 명봉	계획	선호			11	3
25 夏岸小	✓ 계획	선호			12	1
244 방법	계획	선호			12	2
249 방법					12	3
272 방법	조작	Alarm			13	5
300 방법	요리				14	3
306 방법	구입	원재료			14	賞里学 ▼ 9 12 15 2 2 2 2 3 1 1 2 3 1 2 3 5 5 7 7 7 3 3 5 5 6 7 7 7 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8
310 방법	요리				14	6
313 방법	요리				14	7
337 방법	조작	도구/기기			15	3
362 방법	조작	도구/기기			16	3
270 HFH	조자	E 7 /2121			10	4

Fig. 5 Classified Information

4.3. Object Classification

The final level, 'Object' describes who needs the information. Everything described in 'Object' are categorized into 2 steps. The fist step has 'Information Object' and 'Action Object' according to purposes. And the specific functions are described in the second step. The relationship is obtained by compounding Manlevel step, Information and Object Matrix previously mentioned on [Fig.6]. This is enough valuable to the stage which designer

Object		Information		Insuf	Stee								
Level 1	Level 2	Level 1	Level 2	Lovel 3	Imput	1	2	3		3		7	
제한정보 관리기기	OMBO	ALZY	현대			기상대부걸점	샤트레발급점	식사여부급점	의사에 뉴걸성	倉留与び書位	可能可能要求	베스시간점점	
				짜살		의성사건결장	기 없어 부끌일	사도리얼굴장	식사에 뉴걸장	意智从过渡位	可養的品質品		
	24 Bc)	202	23	0)(0)	유치할 서비	기설시건결정	기압여부괄점	사무레탈급당	식사에 뉴걸장	웃골장	機能人力提供	可是我在事件	臣司書書:
				M.O.	おれ谷 み 婦	베스시간점점							
	건강체크기기 <i>밥</i>	0/18	22	RO	건강축장기	기성시간결성	기상여부글살	식사여부결장	의사에도결정	可見智能益益			
				0991	건강속성기	기상시간결상	가상여부글살	景思以位置	의사예부결정	의사에누결정	可有的可靠效		
	파장관리기기	2/48	18/22	재선	문항 서버	正引用电阻备	100000000000000000000000000000000000000		111111111111111111111111111111111111111				
	경험관리기기	0.0	20	79.55		年が終れ首な							
	0.0000000	n.e.	2.72	조리도구		2.6(6)31							
				불합기기		京都県は/田口							
			8.0	사무준비를		사위준비결결점							
				正科集子		석사에는경장							
				利養中間		食能시간결정							
	蒙赛的电对对	218		준비를	長利服	문비물결정							
가장물론 환리기기	機能が対対		55	천기기구		집안상황점검							
				型付/扩票		ながかを対す							
			8.5	사위를	경험한리기기	整定な記録							
			상품	製製712日		可以使用自然							
		81.71	일함기기			WEST/BB							
		41/4	医钳管		音灯 超 北湖	문비용공장							
	滋养色料为为	um -	- 井平		2.5	発導な							
				再製	9.2	# 결정							
			-	7138	9.0	光装装							
		d'a	*	파설	경험관리기기	변경점							
				0101	경험관리기기	光菱な							
		和和			サロ	옷결상							
		VE	2.57			운반기기	문법하기						_
식생활 한리기기	4재료한의 기기	71-72	7178	化块匠	79.76	正科學医療會							
		8.0	구입	北坡區	2976	三代項目放棄							
		1 pres	2.4	化理算	452					_	_		
			化堆盘	12/各件	883	식사에가결성						_	
			-保持 藍		452	正科學學學習					_		
		275.7	2176	位用権	2576	この対策を必要					_	_	_
	식단점보기기	NT.	841	養柱		日本の名を	2.0(6)7)						
		49	世章	0)40		식사에는걸인							
			이건		스케큐리	대사 에는 경 입							
	-	-	27			식사에는걸장					_	_	_
	날씨잡길기기	0218	AH	2.30	날리장보사비	##500 ##500	727	の無智型基準	문비원경장			_	_
	교통정보기기	71-72	이동수단										
		57108	고통상황	2.9	교통정보서버	機能以び改装	이토방법결정	1					

Fig. 6 The Relationship among Object, Information and Step.

4.4 Methodology for Ubiquitous Computing Service Development

1) Analyzing current user's lifestyle.

develop new service and product.

What people do at home can be categorized into dozens of Basic Activity.(BA) Each BA has several Steps composed of 'Question-Search-Decision-Action'. These steps need some information and the objects which can provide the information. In this phase, Basic Activities are defined and information/objects are added to each steps of BA[Fig. 7].

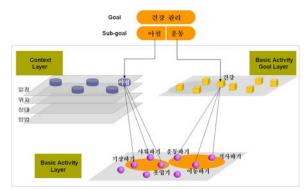


Fig. 7 Analyzing user's lifestyle.

2) Analyzing the connection of BAs

Some BA can have same information and objects. In this phase, BAs with same sets of information/objects are considered as to be connected with each other[Fig. 8].

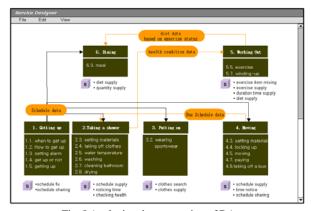


Fig. 8 Analyzing the connection of BAs.

3) Searching new objects

To provide information, objects are necessary. However, in some cases, information does not have appropriate objects in current situations. Also, through the analysis of step level, some steps can be deleted, modified or extended in the UCS context. These two cases, new objects should be defined.[fig. 9]

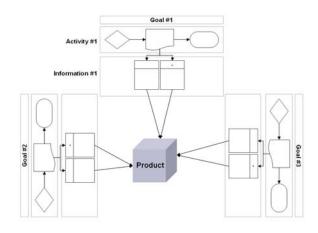


Fig. 9 Searching new objects.

4) Finalizing the new BAs

Current BAs can be modified with the new objects, and these BAs can describe the human life by UCS.

4.5 Visualization Tool Development

Visualization tool is composed of four modules as below. [Fig. 10]

1) Basic Activity Manager

First module serves users in drawing flow chart of new basic activity easily when the ubiquitous computing service area is extended. Basic Activity Manager makes it possible to Reengineering could be carried out in this stage by retouching flow chart. [Fig.11, 12]

2) Activity Set Analyzer

Designer writes out basic scenario. Then related human home life information could be figured out by extracting Basic Activity data source. [Fig.13]

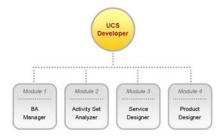


Fig. 10 Ubiquitous Computing Service Developer

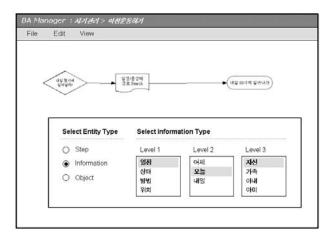


Fig. 11 Basic Activity Manager

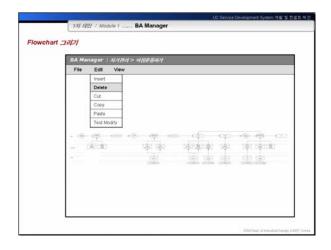


Fig. 12 Basic Activity Manager

3)Service Designer

While designer sees through flow of information with input, output stage, he finds out information of same from activity set. Then he does real design work such as remove, change, addition, or transformation new service and function proposed through process re-engineering. [Fig.14, 15, 16, 17]

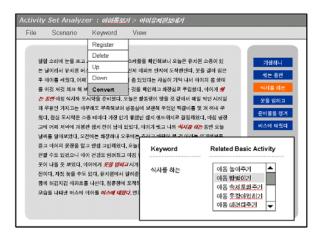


Fig. 13 Activity Set Analyzer

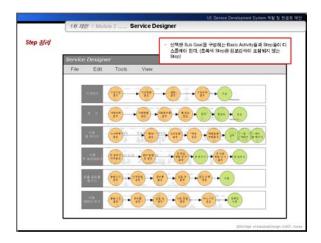


Fig. 14 Service Designer

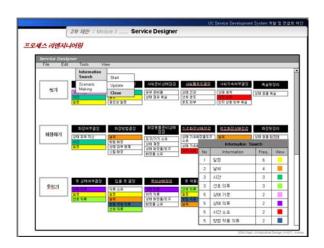


Fig. 15 Service Designer

4)Product Designer

New information can be found from the sub-goal related steps based on each product. And the requirement speculations of each product can be defined through analyzing the flow of service including information. Consequently, to-be scenario can be written beyond current scenario with re-composed map. Also the feature of

notepad is added.[Fig.18]

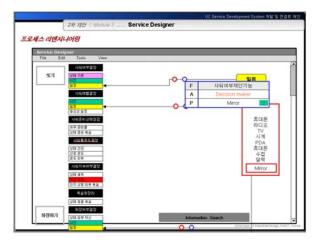


Fig. 16 Service Designer

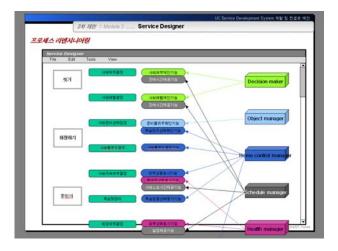


Fig. 17 Service Designer

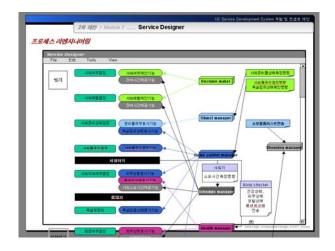


Fig. 18 Product Designer

5. Conclusion

Ubiquitous Computing is an on-going technology not a fixed one. To make this technology come true, the market area for the upcoming technology should be confirmed. And various UCS should be designed to target the markets. UCS cannot be designed perfectly with current service design methodology, because in ubiquitous computing environment, the basic characteristics of objects would be changed. Analyzing the connection of objects and human activity can be the first step of the new design service methodology in the ubiquitous computing context; the methodology of UCS in this paper is valuable in this point of view.

REFERENCES

- Hogun Kim, Hyunggun Yoon, "Design management Stragy," ,
- Mark Weiser, "Some Computer Science Problems in Ubiquitous Computing," *Communication of the ACM*, July, 1993.
- Karl T. Ulrich, Steven D.Eppinger, "Product development theory," *Hanwool*, 2004.
- Anatole Gershman, "Ubiquitous Commerce-Always On Always Aware, Always Pro-active," the 2002 Symposium on Applications and the, 2002.
- A. N. LEONTYEV, Activity and Consciousness, http://www.marxists.org/archive/leontex/works/1977/leon1977.htm, 1997