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A Study on the Direction of Smart Furniture by Changes in Ubiquitous Technology-Based Residential Environment

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ABSTRACT

This study is intended to forecast changes in Ubiquitous technology-based residential environment since the digital revolution so as to suggest the direction of furniture design in the near future. Among Ubiquitous technologies, the intelligent digital technology applied to a residential environment is defined as "Smart Digital Technology." Ministry of Commerce, Industry and Energy named the residential environment where such technology is applied "Smart Home." Smart Home is strategically creating intelligent residential environment where interactivity is made between human, furniture and residential environment, based on home automation, home network and intelligent sensor technology. Smart furniture is based on strategic characteristics of smart home. Its convergence with IT equipments is being made. Largely, smart furniture has three characteristics as below:

First, smart furniture provides users with information on home management, health management, education and fashion, not just functioning as storage space. Second, smart furniture that is a new lifestyle pattern will suggest a new aesthetic standard based on unsettled shapes and innovative structure. Finally, it gives convenience to users intelligently. Namely, smart furniture, "intelligent informative furniture", will be suggested as a new paradigm.

Key words: Ubiquitous, smart home, smart furniture design, interaction.

INTRODUCTION

Fig.1. Mark Weiser (1952-1999).

Background & Purpose of Study

Since Mark Weiser had made Ubiquitous (literally derived from Latin and mean 'existing everywhere at the same time', but 'natural resources existing everywhere like water, air' in cultural science and 'God exists everywhere space and time have no meaning' in religion) public at PARC, a wide variety of the technologies for a new residential environment being close to prototype has been developed. Such digital (Fig. 1) Mark Weiser technology is predicting that our life style will change so-called (1952-1999) revolutionary, from a trivial daily life on.

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Ubiquitous computing environment will sink into anywhere of our daily life and become naturally a part of that and therefore will not be distinguished from intentional usage of computer. In other words, in the phase of generalization of "Computer Network" environment computer will disappear and instead "user-centric environment", namely "Smart World", where users do not recognize their action of use, will be developing.

Among Ubiquitous technologies, the intelligent digital technology applied to a residential environment is defined as "Smart Digital Technology" and Ministry of Commerce, Industry and Energy named this residential environment where such technology is applied "Smart Home." (defined by MOCIE as a space inside of house focusing on intellectualization of residential environment, environment-friendly life and high standard of life.) In residential environment already, especially in information technology sector regarding Smart Home or Smart Space, Home Automation & Home Network are ongoing and are changing into intelligent residential environment resulted from mutual networking between computer, human & space and exchanging of each information as to form of residential environment and human's senses. Studies regarding Smart Home are recently on the way by not only domestic, also international enterprises and transference of residential environment into "Convergence" of digital technology, namely where space, object and human converge one another, is forecasted. In addition, furniture inside of residential environment will be developing into a converged form related with digital technology and informative house appliance, too. Despite of the beginning step as Smart Furniture, kitchen furniture, wardrobe, bed, frame and mirror etc. have been diversely applied abroad and have provided user with intelligent service and interface function.

This study hereupon is intended to forecast changes in Ubiquitous technology-based Smart Home and /or Smart Space and furthermore to suggest the direction of Smart Furniture design as functional objects in digital period. (Smart Furniture: defined in this study as "intelligent informative furniture" related with the characteristics of Smart Home based on ubiquitous technology).

Scope and Method of Study

This study is focusing on suggesting a direction of development for Smart Furniture as "intelligent informative furniture" by analyzing several examples inside & outside of Korea regarding Smart Home based on ubiquitous technology available to apply to residential environment. The residential environment and furniture based on the ubiquitous technology are underway to be studied now, and therefore the typical characteristics of the shape are not developing yet. So, in this study the represent experimental examples inside & outside of Korea have been taken for analyzing and the technical & typical changes of furniture according to ubiquitous technology are forecasted.

Scope and method of study in detail are as follows:

First of all, material and objects of the study result from general theories with regard to ubiquitous technology, the technical theories available to apply to residential environment & furniture and bibliographies & case studies accordingly. Then the main concepts, characteristics and applications have been analyzed.

1) Theoretical consideration of ubiquitous computing and residential environment & the applicable smart digital technology accordingly

2) Consideration of concept & changing factors of residential environment in paradigm point of residential environment and seeking a new paradigm after so-called Digital Revolution

3) Analysis of concept & related technologies & possibility of advance of Smart Home in terms of good examples inside & outside of Korea / and find-out of strategic characteristics

4) Consideration of functional & formative changing of Smart Furniture on the basis of the analysis & result of Smart Home study / and study of the availability of technical match
5) Suggestion of a direction for development of Smart Furniture through analyzing examples according to different life style inside and outside of Korea

STRATEGIC CHARACTERISTICS OF UBIQUITOUS TECHNOLOGY-BASED RESIDENTIAL ENVIRONMENT

Change of paradigm per technology

Residential environment prior to the Industrial Revolution was manually made by craftsmen and piety, virtuosity and symbol of status etc. were expressed in that. Communication and transportation begun in the 19th century had brought the transference of paradigm into the linear & simple module of design-style based on Euclidean geometry, under the industrial aim of mass scale for mass consumption. The question of the standardized coessentiality, however, was raised. In the 1970s and 1980s post-modernism and post-structuralism with USA & France respectively as a center developed beyond the standardized coessentiality as like simplification, rationalization and functionalization etc. and developed further in case of USA into historicism & cultural pluralism, in case of Europe into deconstruction esthetics like complexity and antagonism around Peter Eisenmann. Also the usage of computer as a supplementary appliance for helping human has been increasing among designers and divers program has developed. Improvement of digital technology thanks to computer incurred the information-revolution, and a new concept in residential environment as digital technology expressing cultural diversity was presented. Also in expression way of design after Digital Revolution in the 1990s, non-linear & systematic design breaking from the past mechanized mass production has appeared. In ubiquitous based residential environment especially mental needs of customer & participation of user are getting important and intangible design focusing on customer's satisfaction, one for one concept are becoming meaningful. Epidermal of objects as well are changing into digital epidermal united by physical & electronic space based on ubiquitous-technology, and Augmented Reality as new format taking William Mitchell's Bits is forecasted (William Mitchell 1999).

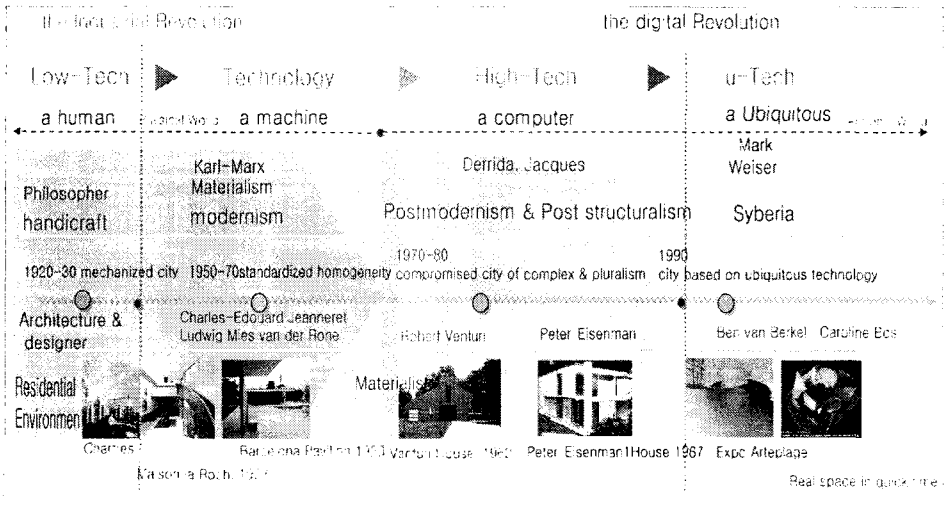


Fig.2. Paradigm-changing of residential environment.

Current status of Smart Home-development inside & outside of Korea

Ubiquitous technology presents us a fully new and infinite opportunity that was not available in existing traditional analog space. The starting of this change is focusing on E-medicine, home-working (telecommuting) and on-line shopping over the internet etc. according to user's life style. Home automation & home network especially will reform the concept of residential environment, and in center of this change there is Smart digital technology. (Space Design Society 2005)

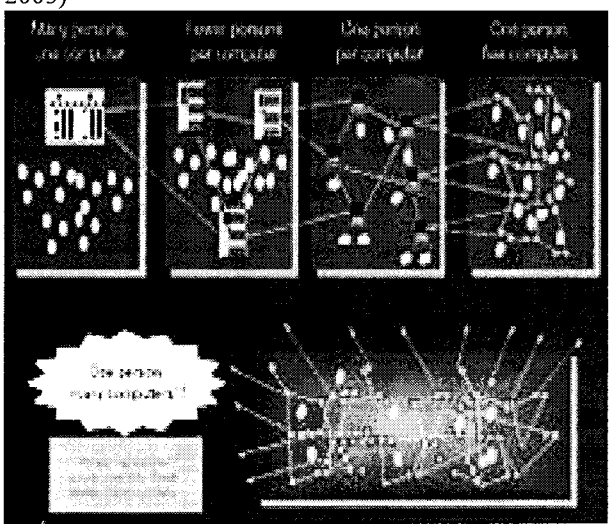


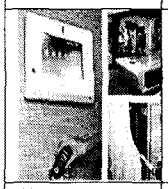
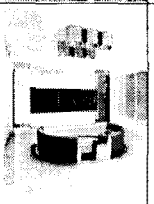
Fig.3. Ubiquitous Computing System.

In case of USA, in the 1940s such studies had been carried out and in the middle of 1990s Home Automation & Home Network system developed and in result they have been applied to McNeil House, House-N, Bill Gate's House, Oatfield Estate etc. Besides this Smart Home in Sweden and Welfare-Techno House in Japan are examples suggesting a direction of residential environment in near future, and furthermore Smart Home for the handicapped and seniors is in progress. (MOCIE 2005)

Even though Smart Home, future of apartment has been presenting by several big construction companies in Korea since IT-infra has been organized from the late of 1990s on, but it is still the beginning phase and due to lack of the understanding about the related technology and trial & error in application diverse studies are insufficient.

Table 1. Projects of the ubiquitous based residential environment inside & outside Korea

Picture	Project	Nation / Company	Main Concept	Characteristic	Application
	Smart Home	Sweden	6 detached houses/ ICT technology/ Comfortable & safety/ High standard of life	Water service/Electricity stove Invasion sensor Ventilation Socket adjustment/. Automatic blind(Woogmo Lee , 2005)	Electrical Key / Whether Forecasting
	Wel-fare - Techno House	Japan	Handicapped- & seniorperson-oriented design / self-supporting available	Adjust-available stairs / Door handles in different height/ Motor-operated devices	Adjust-available diverse furniture & appliance

	House-N	USA / MIT Construc-tion Engineer	MIT media lab / Picture reflect Child's motion fully Hint of big change of play & learning	Sequence- Community- Play & learning- Architect design- Visual simulation Environment	Customized module wall
	Bill Gate House	USA / Microsoft	High-tech equipment at home supportsentertainment software. heating. light. temp. & humid. security as well.	Electric pin attached to close makes mobile lighting, music and news etc. possible	Electron pin network
	U-DREAM	Korea / 6 Telecom companies	3D image tube. U-Home. U-business where user experience future life style.	Cleaning robot. use of internet & newspaper by voice-recognition. ordering by high-tech intelligent frame for dinner. (www.udquitousdream.or.kr)	Voice-recog nition. magic mirror. refrigerator connected with computer
	Ramian U-Style	Korea / Samsung	Cultural life style. Human-centered environment touching sensibility	Interactive relation of all devices. adjustment of interior environment. household affair. health & culture (Smart Home 2006)	Home network service. Magic mirror
	Bloomin g U-City & Dream House	Korea / Byuksan	Probable future life in entry hall & kitchen. bedroom. bathroom can be experienced. Zoning +ubiquitous: realistic	Upon opening of entrance door PDP senses all motions and offers information. In the kitchen high & low of sink is available. Helper for cook. (Smart World 2006)	Magic mirror. lighting curtain. LCD light. Digital garden

Strategic Characteristics of Smart Home

In result of case studies of Smart Home inside & outside of Korea, the technical conditions for Smart Home lie in Home Automation where intelligent sensor is aware of any situation with user and computers automatically, and furthermore in Self Growing System leaning and growing by itself. The following shows the applicable devices based on such basic technologies.

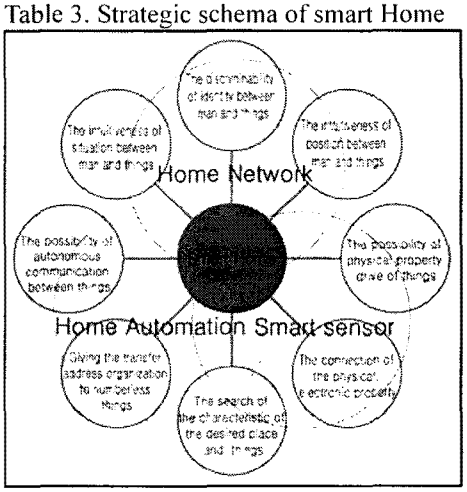
Table 2. Digital technical conditions for Smart Home (Heejung Cho, 2005)

Division	Applied Technology	Applied Device
Home Automation	Automatic control	Management of energy, remote inspection, inner remote control, voice recognition, outside remote control, timer control

Home Network	Network	Telemedicine, U-Learning, U-Community
	Security control	Anti-entry & thief system, Fire & gas detector, emergency, safety during going out, unified key, entrance & exit system, elevator security, DVR recording system
Smart sensor	Smart-Display	Smart wall, smart table, intelligent floor-display, Magic mirror, smart mirror
	Environment Adjustment system	Interior temperature, brightness, automatic ventilation & turn-on & off, water temperature, automatic collecting of trash

Smart digital technology will make home-networking not only for residential environment, also for the to outside extended purpose possible, and Home Automation and Smart Sensor etc. will be applied to interior of residential space. Thanks to such various technologies intellectualization of residential environment will be realized and user can continually follow & understand environment, change of objects and information-flow accordingly, and updated information sharing will finally become active. Based on this intellectualized residential space also intellectualization of life environment, environment-friendly life and high standard of life will be pursued.

Table 3. Strategic schema of smart Home



The hereupon based strategic characteristics of Smart Home are:
First, intellectualization of devices inside of house and house itself (carry out of human life & activity and space installed with intelligence-based environment),
Secondly, human centered 'comfort' thanks to the high standard of life (security, disaster prevention and safe management of personal information), and 'pleasure' (dual-active D-TV, VOD, online game etc.), and 'convenience' (e-learning, e-medicine, e-inspection, remote-control etc.)

Smart Home is a space connecting information, furniture necessary for residence with electronic devices including communication equipments one other and at the same time it freely matches information with objects. Also it plays a role as a vehicle of intellectual space where inter-face of human & objects as well as human & computer is enriched, and it connects all devices with objects in electrical- and physical space. Information, human and object respectively have will be mixed and intelligent residential environment of interactivity is strategically created.

STRATEGIC CHARACTERISTICS OF SMART FURNITURE

Functionality of the ubiquitous technology-based Smart Furniture

Rapid changes of industrial structure in modern times has demanded mass production and according to the furniture-production way and development of material businesses, furniture being diverse in material, function and design has been offered in residential environment in 1970s and

1980s. The advanced technology of machinery though industrialization had changed a cupboard carried out just traditional function of furniture into a new furniture form of life style, namely refrigerator of which function had matched with new needs of user to keep material fresher. Since that furniture & house appliances placed independently in space have been combined in 'Built-in" and "Plugged" form, according to each construction, purpose of residential environment and life style. The combination-formed Smart Furniture is proceeding as new study case of standard & tradition, and it needs to intend to the systemized form among innovative object concept and components of residential environment, way of usage and unsettled purpose of furniture.

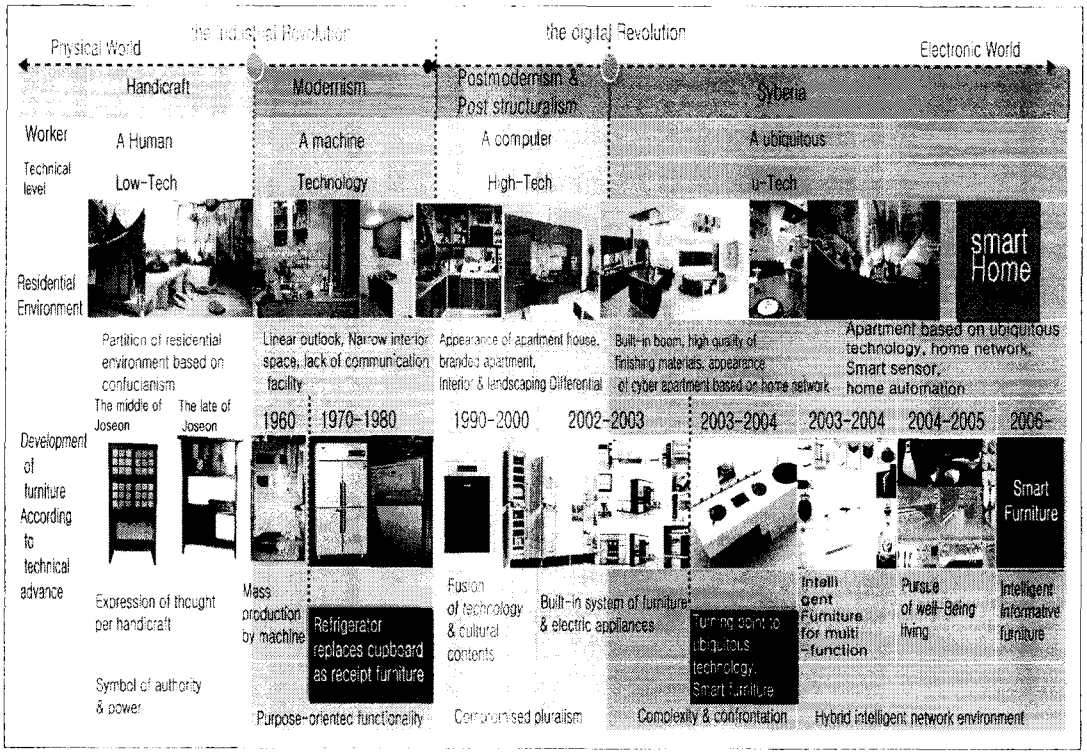


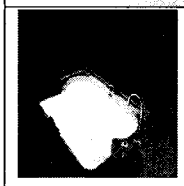
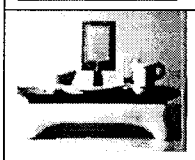
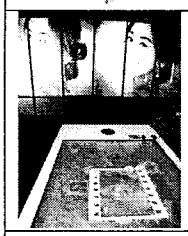
Fig.4. Change of furniture in terms of development of technology.

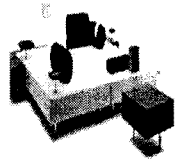
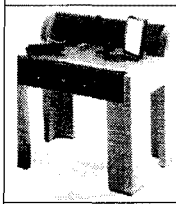
Residential environment after Digital Revolution was connected sequently with the development of Home Automation, Home Network, Smart Sensor based on smart digital technology, and made diverse-formed service for user available, and Convergence phenomenon among house appliances inside of residential environment, communication equipments and furniture has been speeded up. Such tendency is forecasting a new paradigm of interactivity among human-residential environment-furniture for intellectual function, over the existing traditional period of furniture.

Case study of Smart Furniture according to life style

On the basis of the preceding study life style was classified in sleeping, healthy care, home management, cook & dinner, communication, carry out of work, hobby & rest, education, fashion etc. and component according to purpose was analyzed.

Table 4. Case study of Smart Furniture according to lift style

Picture	Life style	Company	Main Concept	Characteristic	Application
	sleeping	Philips LETTO ZZZ	Digital technology applied in bedroom & personal taste can be experienced from going bed to wake up.	Bed equipped with LCD projector DVD & fixed space in head area.	LCD projector DVD, sound case
	Health care	Ramian/ Bath & basin	Washing & shower are preparation and recovery of the day / intelligent system support rest & leisure.	Magic mirror of basin checks up bloodless health & information	Intelligent whirlpool bath, magic mirror
	Cook & dinner	Philips Breakfast Tray	Leisurely breakfast on the bed / internet / information of schedule	Magnetism inside of tray prevents sliding of cup & dish/ monitor offers diverse information.	Internet network / LCD Monitor
	House managem ent	Ramian Magic mirror	Overall management of home network based on ubiquitous technology / Minimizing of the time for daily household chores	Usually used as mirror / in case of home network system used home as home management	Smart mirror / Magic mirror
	Commun -ication	Philips Interactive	Helpful not to disturb the life-style of other family members have schedules in each different time	Ordinary frame plays a role as communication device and a controller of home network	Internet network LCD monitor
	Working	Ramian Digital desk	Residential & office environment overlapped through home-working / business regardless of time & space	Multi media fiction for home office (display,keyboard, speaker, CD player) in each module	Multimedia/ netwirk
	Hobby	Philips Plugged Furniture	Audio & digital existed respectively are proposed as one new furniture form	Shelf as case goods + audio make a visually meaningful object (www.philips. design.com)	Audio / Speaker

	Multimedia	Philips Q4 Plugged	Function as sofa in living room. but changeable to module. Multifunction as rest & fellowship. business & play	Divers audio. media according to each tastes can be replaced and installed	Display internet network system
	Education	Philips Home desk	Assistant device for leaning in residential environment / developed by that computer. fax came into residence	Office-ware composed of vertical screen. printer & speaker. digital pen / inter-active with user	IR receiver/ RF receiver/ Health check-up bathroom panel
	Fashion	Ramian Gallery Smart closet	Convergence of closet and magic mirror shows outfit without direct wearing of cloth / information of shoes and accessory matched with the selected outfit	Information of weather & schedule / function as wash-machine removing stink and dust	Magic mirror internet network system

The a.m. case study of Smart Furniture shows roughly 4 directions as below.

First, exchange of information between user & home becomes available thanks to the new life-style based furniture and convergence of furniture & communication devices.

Secondly, in accordance with it's intellectualization, furniture can be applicable to the entertainment factor offering user visual satisfaction and interest.

Thirdly, smart digital technology applied to furniture creates new purposes and material-development that was not in the existing furniture and it meets synergy effects, and a new formative construction could be realized accordingly.

Finally, smart furniture is likely connected with Smart Home on the bases of communication-technology, and users can be provided with information outside as well as inside of house and they can control their residential environment.

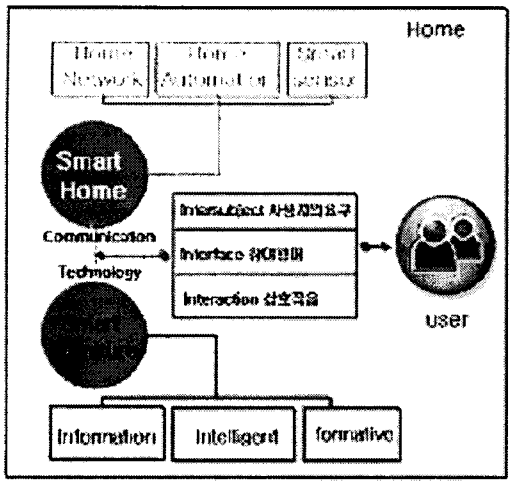
CONCLUSIONS

The main thesis of this study lies in suggesting a direction of Smart Furniture by changes in ubiquitous technology-based residential environment. For that the changes of residential environment in terms of smart-technology inside & outside of Korea and the strategic characteristics accordingly has been here considered and also functions & special quality of Smart Furniture presented, and through the case study according to life style the following trends/directions are learned.

1) The ubiquitous technology-based residential environment is changing into intelligent environment communicating with user and recognizing it's reaction.

2) The case study of Smart Furniture inside & outside of Korea indicates that intelligent interactivity between user & furniture based on Home Network, Home Automation and Smart Sensor is being strategically created.

Table 5. Strategic characteristic of smart furniture



3) Smart Furniture based on the conditions & characteristic of Smart Home is rapidly converged on house appliances and recently interactive phenomenon among human-residential environment-furniture is intellectually developing.

4) The strategic characteristics of Smart Furniture show that Smart Home is closely associated with furniture, and show a tendency to informatization, intellectualization and formalization.

- Informatization: Furniture provides user with information for house management, health care, education and fashion etc., over simple function as case goods.

- Intellectualization: Furniture as communication technology with user is intellectualized by Inter subject, Interface and Interaction.

- Formalization: Digital epidermal as a new type of etiquette and tradition will present a new esthetic standard composed of type of unsettled from and innovative object and bits.

5) In Smart Home diverse services are available thanks to Home Automation, Home Network and Smart Sensor based on the ubiquitous technology, and also Smart Furniture inside of residential environment is a suggestion of new paradigm making interactive communication : Intelligent + Information & Communication Technology + formative + furniture = Smart Furniture

6) 2 domestic house appliance suppliers have recently concluded an agreement with furniture industry and studied convergence between furniture and electric appliances, and abroad Philip is suggesting a direction of Smart Furniture in detail. Such trends are foretelling new changes in furniture industry in near future, out of the traditional production line, and they will make a wide variety of product ranges. Namely, "Revolution comes into the traditional furniture industry."

For the future from now comfortable & pleasant functions of Smart Furniture and also esthetic taste as to form & shape need to be studied. Especially prototype modeling by a new design process has to be presented.

REFERENCES

Bill Gates 1997. The Road Ahead, Samsung: p 23-45

Heejung Cho 2005. Case study of future residence in Sweden and Netherlands, Residential Environment department at Graduate School Yonsei University: p 36

Kyungran Choi 2006. Ubiquitous space & Object design: 23-39.

MOCIE, Ministry of Commerce, Industry and Energy 2005, p 5-9. A study of the future design paradigm under ubiquitous technology based condition

Space Design Division 2005. Inter Space Design Biennale, Smart Space 2K+U, Korean Institute of Spatial Design: p 2-17

Smart Communication May Edition 2006. monthly Ubiquitous magazine

Smart World Journal Feb. Edition 2006. monthly magazine

William Mitchell 1999. City of Bits, MIT Press: p 89-110.
Woogmo Lee. 2005. Study of furniture design based on Home Network system,
Master's thesis HongiK University: 67.
Younsook Lee. 2005. Coming Future / Reacting world house, Yonsei University Press: 34-71.
Younsook Lee. 2005. Life of Korean and House of future, Yonsei University Press: 58.
www.bulthaup.com
www.ernestomeda.it
www.philip.design.com
www.samsungdesign.net
www.ubquitousdream.or.kr
www.udquitousdream.or.kr

Membership Admissions Fee Information

This society is managed based on the admission fee of our members. Please send us the 2008 admission fee to below address. Furniture Society Membership Admission Fee Information

President	200,000 won/ year
Vice President/ Library Member / Company President	100,000 won / year
Executive Director / General Director	50,000 won / year
Standard Member	10,000 won / year
Joining Admission Fee	10,000 won / year
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