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## Empirical Studies of Use Contexts for the Mobile Internet

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# Overview

- □ HCI Lab at Yonsei University
- Mobile Internet Market

### Theoretical Frameworks

- Mobile Internet Use Contexts
- Mobile Information Architecture

### Empirical Study Results

- ✓ First Study
- Second Study

### Implications and Related research



# HCI Lab at Yonsei

### □ Where we are?



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### Research Focus

#### To improve the User Experience with Information Appliances

- What are Information Appliances?
  - An extended computer device that can enable a user efficiently to carry out a limited series of activities (Mohageg and Wagner, 2000)
  - ✤ Cellular phones, Interactive TV, PDA, …
- How to improve User Experience?
  - ✤ HCI
  - ♦ A discipline concerned with the <u>analysis</u>, <u>design</u> and <u>evaluation</u> of interactive computing systems for human use (ACM SIGCHI, 1992, p.6)



# **Current Research Projects**

Research Strategies - Learn from PC and Web - Pace with Technology Advance			Mobility	>
		Interactive	Web in PC	Mobile
– Collabo Governn	nent and Industries	IV		Internet
	Analysis	– Adoption and		-Use Context
Ť		post-adoption		-Adoption and Post Adoption
Maturity	Design	– Time Based Navigation	-Emotional Interface	-Color Based Navigation
			-Contextual	– Small Screen
			Navigation	Navigation
Ļ	Evaluation		–– Remote UI Event Capturer	
			<ul> <li>– Architectural</li> <li>Metrics</li> </ul>	



## Sample Research: Remote Usability Evaluation for Web



## Sample Research: Navigation Design for Interactive TV





Time Based Navigation: – Supported by tbiz Consortiu m







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## What is Mobile Internet?



"Mobile Internet is defined as wireless access to the digitized contents of the Internet via Handheld devices"

- Francis, 1997

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# **Rapid Growing Market**

### Mobile Internet subscribers will reach 400 million in 2002

[The Number of Mobile Internet subscribers]



ARC Group (2000)



# **Rapidly Growing Market**

## Mobile Internet users will surpass stationary Internet users in Europe

[Mobile Internet vs. Stationary Internet Market]



Forester Research Report (2000)



# High Optimisms

The number of Mobile internet users in the world will reach 600 million in the world

- ARC group, March, 2001

"The 78 % of Internet users will use Mobile internet within a year"

- Strategic research group, April, 2001

"Subscribers of i-mode service has reached 30 million"

- NTT DoCoMo, December, 2001



## However, Users are realizing...

### Obstacles for spreading the use of Mobile Internet

#### [Mobile Commerce Market Reality]





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## **Characteristics Of Mobile Internet**



# **Research Goal**

### Research Goal

 To identify important Use Contexts and Usability Factors for Mobile Internet from users' perspective

*"Particular Context in which device needs to be considered for the design and development of mobile system"* 

– Alan Dix, 1998

"Mobile Internet will become more successful by overcoming usability problems"

– Creativegood company report, 2000



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# Mobile Use Contexts

- Definition of Mobile Internet Use Context
  - Mobile context is defined as "Any <u>personal</u> and <u>environmental</u> information that may influence the person when he/she is using Mobile Internet"
  - Key considerations
    - Contextual information from the user's perspective
    - Both personal and environmental contexts are included



# **Theoretical Framework (1)**





# **Theoretical Framework (2)**

### Mobile Information Architecture

 Overall structure of the Internet systems for usability (Louis, R. & Peter, M., 1998)





# **Empirical Study Overview**

### The First Study

- Conducted in the first quarter of 2001
  - Early introduction stage for the mobile Internet
- Small scale and broad focus
  - Focus on the use of the mobile Internet itself
  - with heavy users.
- Descriptive
  - What are the key use contexts?
  - What are the critical usability problems?

The Second Study

- Conducted in the second quarter of 2002
  - It becomes Popular, especially among young people
- Large scale and narrowed focus
  - Focus on the use of specific applications
  - with normal users.
- Predictive
  - Which applications in which contexts?
  - Which usability factors for which applications?



## Study 1: Data Collection Method

## Self-reporting

Reporting Period: 2 weeks

Self-reporting Procedures

**Recruiting participants** 

Self-reporting method

Pocket diary for mnemonic cues Web-dairy for detailed use context

Discussion



# Study 1: Self-Reporting Methods

Web-dairy

Listilad Decument - Microsoft Internet Suplayer	
TRACED DOCUMENT - MICrosoft Internet Explorer TRACED - 파진(E) 보기(V) - 즐겨왔기(A) - 도그(T) - 도움망(H)	× 91-
주소(D) @ http://issu.yonsei.ac.kr/ntop/	~ 이동 (연결 *
🚺 🕺 🚺 🚺 🖉	· · · · · · · · · · · · · · · · · · ·
Home   일지작성(보기)   일문   게시판   Help   Log out   Ⅲ 2000년 8월 <sup> </sup> 1 ♥ 일 (오늘은 2000년 11월 04일입니다)	
₩ 사용시간: C 오전 / C 오후 시 분부터	분간
田 사용실함 :	2
	<u></u>
III Q1. 특정 서비스를 이용하기 위하며 접속하셨습니까?( C	Ves/CNo)
때 사용서비스:	
02. 위의 서비스들을 ( C 즐거움 / C 유용함)을 얻기 위	해서 이용하였다.
₩ 03. 미 서비스들을 반드시 미 시간에 사용해마만 의미가 있 마니다 ( ○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6) :	었습니까? 1렇다
▦ Q4. 이 서비스들을 반드시 이 장소에서 사용해야만 의미가 아니다 ( ○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6) :	있었습니까? 1형다
▦ 사용장소	
이직장 이집 이거리 이학교 이화조 이버스 이택시 이승용차 이비행기 이지?	설 C 카페 C 식당 C 극장 철 C 기차 C 기타()
# 순의상태 (C 두순/C 한손)미 이용가능한데,(C # 이동여부 C 주로 걸는 상태/C 정지 상태	) 두손, C 한손)을 사용했다.
표 주비산황	
	🔮 알 수 없는 영역 (혼합)

#### **Pocket diary**





## Study 1: Participants

## Recruiting Procedure

#### **Fist-round Screening**

- Recruiting 40 Mobile Internet Users
- Criteria:

(1) Check Mobile Internet experience for the past 3 months

(2) Phone Interview

#### **Final Recruitment**

• Final Monitoring Participants:

37 (persons)

• Criteria:

Evaluating the ability to report use diaries

## Final Monitoring Participants

Year Gender	15~18	19~22	23 ~ 26	27 ~ 29	0ver 30
Male	3	4	4	4	4
Female	3	4	5	3	3



## Study 1: Measures





## Study 1: Simplified Context Schema

Context Factors		Meaning	
Cool	Hedonic	Used Mobile Internet for pleasure	
GUdi	Utilitarian	Used Mobile Internet for practical purposes	
Emotion	Down	Used Mobile Internet when one feels depressed	
Emotion	Up	Used Mobile Internet when one feels aroused	
Hand	Either	Used Mobile Internet with a right or left hand	
nanu	Both	Used Mobile Internet with two hands	
1.5.5	Stop	Used Mobile Internet when one stopped	
Leg	Move	Used Mobile Internet when one's legs were moving	
Visual Distraction	Low	Used Mobile Internet when there were not much visual stimuli	
VISUAL DISCLACTION	High	Used Mobile Internet when there were lots of visual stimuli	
Auditory	Quiet	Used Mobile Internet where surroundings were quiet	
Distraction	Noisy	Used Mobile Internet where surroundings were noisy	
Co. location	Low	Used Mobile Internet when one was alone	
CO-location	High	Used Mobile Internet when one was surrounded by many people	
Interaction	Low	Used Mobile Internet when one did not communicate with others	
Interaction	High	Used Mobile Internet when one communicated with others	



## Study 1: General Results

### Unit of Analysis

- Use context: 1552 use sessions in total
  - 1502 effective sessions
    - **Excluded 50 sessions for incompleteness (1552 50 = 1502)**
  - About 42 sessions by each participants during the reporting period
- Usability problem: 1505 problems
  - About 41 problems by each participants during the reporting period.

#### Use time

- Average use time: 61 minutes per day
  - Use time ranged from 7 to 132 minutes per day



## Study 1: Frequent Use Contexts

### Not every context is experienced evenly

 People use Mobile Internet heavily in only a few specific contexts

#### [Frequently Experienced Mobile Context]

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## Study 1: Critical Use Contexts

### Experienced Mobile Use Context Ratio

Context Factors		Used at Least Once	Never Used
Coal¥¥	Hedonic	69.5 % (89/128)	30.5 % (39/128)
GOdi	Utilitarian	53.1 % (68/128)	46.9 % (60/128)
Emotion	Low	60.2 % (77/128)	39.8 % (51/128)
Emotion	High	62.5 % (80/128)	37.5 % (48/128)
Uand***	One	76.6 % (98/128)	23.4 % (30/128)
<b>H</b> dllu^^^	Тwo	46.1 % (59/128)	53.9 % (69/128)
	Stop	85.9 % (110/128)	14.1 % (18/128)
Legan	Move	36.7 % (47/128)	63.3 % (81/128)
Visual	Low	57.8 % (74/128)	42.2 % (54/128)
Distraction	High	64.8 % (83/128)	35.2 % (45/128)
Auditory	Low	53.9 % (69/128)	46.1 % (59/128)
<b>Distraction</b> *	High	68.8 % (88/128)	31.2 % (40/128)
Co-location	Low	61.7 % (79/128)	38.3 % (49/128)
	High	60.9 % (78/128)	39.1 % (50/128)
Intoraction	Low	68.0 % (87/128)	32.0 % (41/128)
Interaction	High	62.5 % (80/128)	37.5 % (48/128)



Unit of Analysis: 1502 Use Contexts (\*, p<0.05 ; \*\*, p<0.01 ; \*\*\*, p<0.001 )

## Study 1: Frequent Usability Problems

### Usability Problems of Mobile Internet

Туре	Number of problems	Percent	structure 15%
Content	559	37.2 %	] content
Navigation	431	28.7 %	representation 36%
Representation	298	19.7 %	20%
Structure	217	14.6 %	
Total	1505	100 %	navigation 20%

Content and Navigation Problems amount to 65. 9 %



## Study 1: Usability Problems by Use Contexts

Context Factor		Representation Structure		Navigation	Content
Cool	Hedonic	18.0 %	14.0 %	27.0 %	40.0 %
GOal	Utilitarian	19.0 %	16.0 %	31.0 %	34.0 %
Frankian	Low	19.0 %	15.0 %	26.9 %	38.7 %
Emotion	High	17.9 %	14.6 %	29.5 %	38.0 %
lland	One	17.9 %	16.5 %*	28.5 %	37.3 %
Hanu	Two	20.4 %	7.4 %*	29.6 %	42.6 %
	Stop	17.4 %**	14.8 %	28.6 %	39.3 %*
Leg	Move	35.1 %**	14.9 %	30.4 %	19.6 %*
	Low	16.9 %	14.3 %	30.0 %	38.9 %
VISUAL DISTRACTION	High	19.6 %	15.1 %	28.5 %	38.4 %
Auditory	Low	19.4 %	13.7 %	28.6 %	38.1 %
Distraction	High	17.7 %	15.4 %	28.7 %	38.2 %
	Low	16.6 %	13.5 %	26.5 %	43.6 %**
Co-location	High	20.8 %	16.6 %	31.7 %	30.9 %**
	Low	17.5 %	14.3 %	30.2 %	38.0 %
Interaction	High	21.5 %	16.6 %	22.9 %	39.0 %
Average***		19.7 %	14.6 %	28.7 %	37.2 %

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Unit of Analysis: 1505 Usability Problems

( \*, p<0.05 ; \*\*, p<0.01 ; \*\*\*, p<0.001 )

## Study 1: Conclusion

- Only a few contexts are frequently experienced.
- Significant use-context factors
  - Goal, Number of Hand in Use, Leg Movement and Auditory Distraction
- Most critical usability problem: Content Problems
- Usability Problems by Use Contexts

Туре	Critical Context Factor(s)
Content Problems	Hand(one), Co-location(low)
Navigation Problems	N/A
<b>Representation Problems</b>	Leg(move)
Structure Problems	Hand(one)



# Study 1

## VS.

# Study 2

#### Lack of generality

- Two weeks are too short.
- ✓ Thirty Seven subjects are too few.
- Too much focus on heavy users.

### Lack of validity

- Single method of data collection
- No way to validate users' reports

### Lack of specificity

- Binary coding for use contexts
- No application-specific data

#### Increased generality

- One full month.
- Sixty nine subjects.
- Average normal users.

### Increased validity

- Multiple methods of data collection
- ✓ Validate users' reports

#### Increased specificity

- Detailed coding for use contexts
- Application-specific data





## Study 2: Data Collection for 30 days

### Self reporting

- Two ways to report their usage at the end of their session
  - Mobile Internet System
  - ARS

#### Probing

- Researchers called participants
  - Once in a day at random time
  - All the questions for the self-reporting + how much do you want to use this application in the current contexts?

### Log Data

- From mobile gateway servers
  - Once in a day
  - Validate the self-reported data from participants



## Study 2: Data collection afterwards

## MBTI Test

For standard personality measurement

### Service Quality Test

For subjective evaluation of mobile Internet services

### Post-Experiment

Preliminary Personal Menu System



## Study 2: Participants

## Recruiting Procedure

#### **Fist-round Screening**

- Recruiting 100 Mobile Internet Users
- Criteria:

(1) Check Mobile Internet experience for the past 3 months

(2) Random selection via Tel-cos

#### **Final Recruitment**

- Final Monitoring Participants:
  - 69 (persons)
- Criteria:

Evaluating the ability to report use contexts

## Final Monitoring Participants

Year Gender	15~18	19~22	23 ~ 26	27 ~ 29	0ver 30
Male	4	8	11	8	4
Female	6	7	11	6	4



## Study 2: Detailed Context Schema (1)

#### 





## Study 2: Detailed Context Schema (2)

### **Subjective Time**

- Compiled and Coded into 35 categories
  - In-study, Breakfast, Watching TV, Shopping,....

### Subjective Location

Compiled and Coded into 63 categories

- Living room, bed room, restroom, department store, bar,....
- **Time Pressure**
- Physical Density
- Social Interaction



# Preliminary Results (1)

### Key Usability Factors for Utilitarian Applications

- Searching, Traffic, Travel, Stock Trading...
- Focus on Contents

o	В	Standard Beta	t	Sig
(Constant)	1.34	0	8.06	0.00
System	-0.03	-0.03	-1.05	0.29
Timeliness	0.00	0.00	0.06	0.95
Design	0.05	0.03	1.19	0.23
Contents	0.75	0.69	23.46	0.00



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# Preliminary Results (2)

- Key Usability Factors for Hedonistic Apps.
  - Game, Comic/humor, Entertainment, Special events,

### Focus on

 Contents > Design > Timeliness

o	В	Standard Beta	t	Sig
(Const ant)	0.66	0	4.06	0.00
System	-0.15	-0.16	-5.42	0.10
Time	0.22	0.22	7.55	0.00
Design	0.29	0.23	8.50	0.00
Conten t	0.56	0.49	14.79	0.00



# Possible Implications...

#### Construct a Comprehensive <u>Application Profile</u> for Mobile Internet Applications

- ✓ What kind of people use in which contexts
- ✓ What usability factors should be focused

#### Develop <u>Context-Based Personalization</u> System

- Limited screen size and bandwidth
- Need for personalization system for

#### Focus on <u>Context-specific Usability Problems</u>

- (e.g.) In the development of service that people mostly use while moving, representation problems should be focused
  - Finding a nearby gas station

#### 0 D

. . . . . . . . .

## **Mobile Internet Related Research**

#### Use Contexts

- Experiments for the Effects of Simulating Contexts in Lab Environments for Mobile Internet Services
   Published at Korean Cognitive Science Society Journal.
- Empirical study of the Use Contexts and Usability Problems
  - \* Awarded the best paper at HCISS 35, 2002, Big Island, Hawaii.

#### Navigation Design

- Navigation design for small screen devices
  - Under review for journal publications
- Color navigation system for mobile Internet devices
  - Under review for journal publications

#### Intelligent Mobile Internet Services

- Experiments for the effect and side effect of personalization system in the Mobile Internet
  - Under analysis
- Cognitive modeling for the navigation process of the Mobile Internet
  - Under analysis

#### Mobile Commerce

- Information Quality for Mobile Internet Services
  - \* Electronic Markets, 12 (1), 38–46
- E-business implications of the Mobile Internet
  - \* to be appeared at *Communications of ACM*
- Adoption and Post Adoption of Mobile Internet Business
  - \* Under review for journal article

#### Cross Cultural Studies

- Cultural and Economic Factors on Mobile Internet Usage
   Presented at Tokyo Mobile Roundtable, 2002.
- Cross cultural studies on the value structure of Mobile Internet
  - \* To be appeared at Journal of Electronic Commerce Research



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