Designing For Small Screen Mobile Devices

- **Design challenges.**
- **Simple visualizations are possible even on small screens.**
- **Case study: evaluating a small screen device.**
- **Case study: designing a new mobile device.**

Challenges Of Designing For Small Screen Displays

1. **Mobile devices have limited capabilities when compared with desktop computers.**
   - Computational capabilities are weaker
   - Display capabilities are limited
   - Interaction/input may be extremely curtailed or it must be done in a more limited fashion.

General principle: Limit the amount of input required.

General principle: Limit designs to having a limited number of features per screen (e.g., 3 – 5) and use transitions to access additional features.

Challenges Of Designing For Small Screen Displays

2. **The mindset of users change when using a mobile device vs. a desktop system (even if the same task is being performed)**
   - The same task may be performed differently with a mobile device vs. a desktop system.
     - e.g., sending a quick text message response while shopping for groceries
   - Frequent interruptions and distractions may occur during use
   - Typically users focus on actions that can be performed quickly

General principle: interfaces must be glance-able and the user can interact quickly and efficiently with the device.

General principle: Implement an auto save feature that runs periodically

Challenges Of Designing For Small Screen Displays

Overall principle: don't just design a scaled down version of a desktop system. A successful design must consider the usage context.

Menus For Small Screen Displays

- **Representing information: some visualizations and methods of interaction may not be possible.**
- **Less elaborate representations may have to be employed:**
  - Iconic representations
  - Text

Iconic Representations

- **Small icons**
  - It's difficult to design an clearly recognizable icon within a very limited space.
  - Typically requires a text description.
  - Rarely used.
- **Large icons**
  - With increased display space allotted they have been used successfully in certain applications.
  - The mapping of icons to functions may not be immediately self evident but once the mapping is learned then they can be easily recognized (i.e., may be arbitrary – icon design is hard).

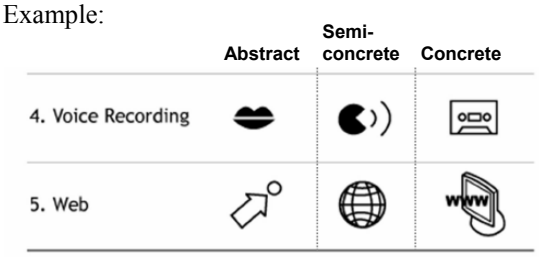
Text

- **Requires concise wording**
  - Sometimes every character counts
  - This must balanced off vs. the need for clarity

One Study Of Icon Design For Mobile Devices[1]

Methodology:

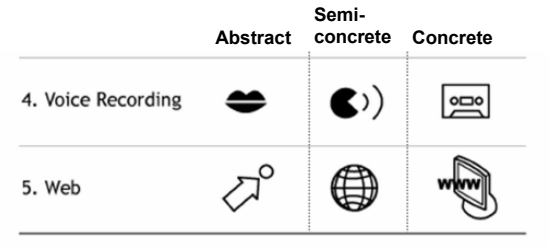
- Employed 20 test participants (10 Korean, 10 American).
- Participants were shown icons that fell into one of three categories: abstract, semi-concrete, concrete.
- Example:



- Icon categories were evaluated by: recognition time, task completion time and participant preferences.

1 Kim, J. H., and Lee, K. P. "**Cultural Difference and Mobile Phone Interface Design: Icon Recognition According To Level Of Abstraction**"

One Study Of Icon Design For Mobile Devices: Recognition



Korean:

- Icon recognition rate higher for the concrete and semi-concrete icons

American:

- Icon recognition rate higher for the abstract icons

Overall:

- Semi-concrete then concrete followed by abstract

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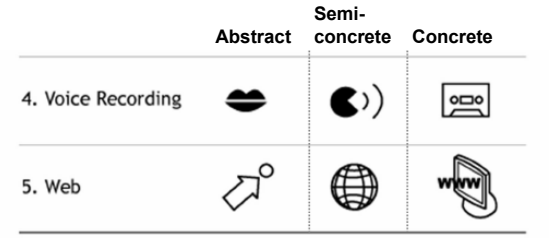
One Study Of Icon Design For Mobile Devices: Task Completion



Korean:

- Faster with the concrete and semi-concrete icons.

American:

- Faster with the abstract icons.

Overall:

- Concrete icons allowed for the fastest task completion.
- Tasks employing semi-concrete and abstract icons took significantly longer.

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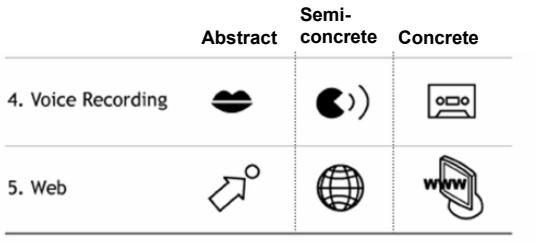
One Study Of Icon Design For Mobile Devices: Preferences



Korean:
- Preferred semi-concrete icons.
- Concrete and abstract icons were tied.

American:
- Preferred semi-concrete icons.
- This was followed by abstract icons and then by concrete icons.

Overall:
- Semi-concrete icons were preferred.
- This was followed by abstract icons and then by concrete icons.

One Study Of Icon Design For Mobile Devices: Remarks

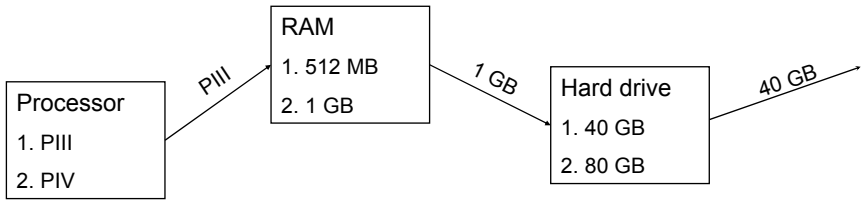
Although it appears that semi-concrete or concrete icons may work better for Korean users and abstract or semi-concrete icons may appear to best suited for American users keep in mind:

- The sample size of participants was relatively small (20)
- The number of icons used was also small (15)
- Icon choice is only one issue in the design of small screen mobile devices
- Also keep in mind that Eastern and Western cultures are far from homogeneous:

Korea ≠ Eastern culture USA ≠ Western culture

The Smaller The Screen The More Temporal Is The Design

- **Example one: a low resolution display only allows for a limited number of options to be displayed.**



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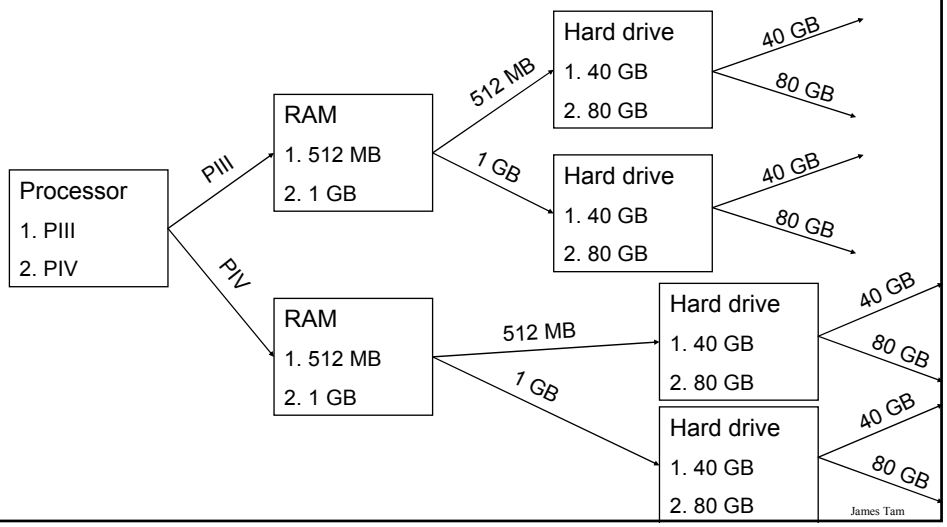
The Smaller The Screen The More Temporal Is The Design

- **Example one: a low resolution display only allows for a limited number of options to be displayed.**



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The Smaller The Screen The More Temporal Is The Design (2)

- **Example two: a higher resolution display with a larger number options available reduces the need to remember previous menu selections.**

Options

1. PIII, 512 MB, 40 GB
2. PIII, 512 MB, 80 GB
3. PIII, 1 GB, 40 GB
4. PIII, 1 GB, 80 GB
5. PIV, 512 MB, 40 GB
6. PIV, 512 MB, 80 GB
7. PIV, 1 GB, 40 GB
8. PIV, 1 GB, 80 GB

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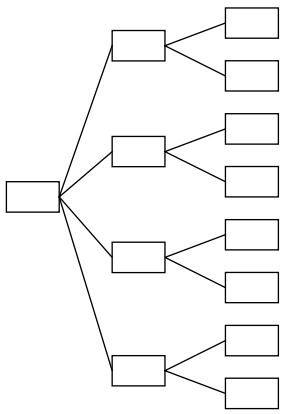
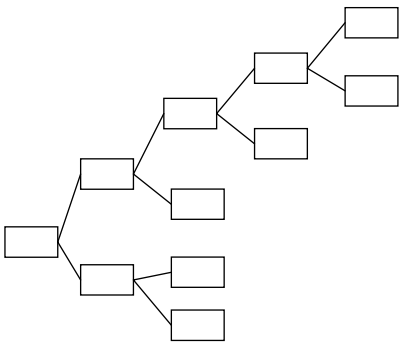
To Avoid Overly Temporal Designs, Consider Broader Rather Than Deeper Hierarchies



Vs.



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Balance Consistency Vs. Navigation

While consistency of menus is important, this should be balanced by the need to distinguish between menu types.

Provide Shortcuts

It's even more essential to do this with mobile devices than with desktop systems (again consider the usage context)

Nokia 3205i: www.nokia.com

Ways Of Creating Shortcuts

- By redesigning lists
- Implement navigational shortcuts
- Implementing data entry shortcuts

Designing Lists Of Functions

- Order lists by frequency over an alphabetical ordering : Can be implemented if a small number of features are invoked the majority of the time.
- Changing the default list that is displayed depending upon the context or reorder lists according to the context

Appointments
(N)ew
(E)dit
(R)emove

Contacts
(F)ind
(E)dit
(N)ew
(R)emove

Provide Shortcuts

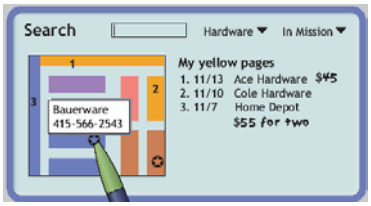
Navigational shortcuts

- To the main menu
- To the previous menu

Provide Shortcuts (2)

Shortcuts for data entry

1. Example one: if a web site that requires data entry has been visited once then previous selections and entries may be saved.
2. Example two: If the device is aware that you will be traveling to another city next week then it may offer you the ability to see information about the city just before your trip.
3. Example three: The device tracks businesses that have been employed and stores information about them in a 'My Yellow pages'

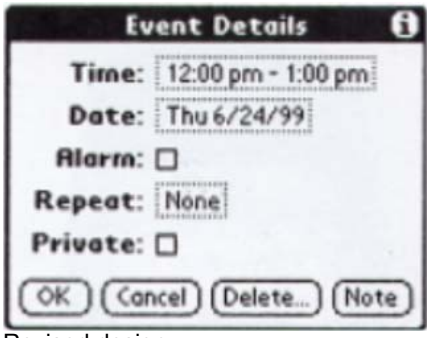


Of course issues like security must be considered as well.

Limit The Number Of Features: Less Can Be More

- **Re-factor the display**
  - Limit features to the most essential
  - 'Bury' less commonly used features in less accessible areas:
    - "Advanced functions"
    - Select "more" features

Original design



Revised design

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Soft Vs. Hard Keys

Hard keys

- Are tied to fixed functions, commonly used and important functions e.g., disconnect, calendar, address book.

Image from "Designing the User Interface" (4th Edition) by Ben Shneiderman and Catherine Plaisant

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Soft Vs. Hard Keys (2)

Soft keys

- Are located near the screen.
- Their exact function changes depending upon the context

Images from "Designing the User Interface" (4th Edition) by Ben Shneiderman and Catherine Plaisant

Limited Display Doesn't Mean That No Visualizations[1] Are Possible

Example:

- Adding 3D effects for visual displays

Previous research:

- People performed better with on a 2D rather than a 3D display (although the difference wasn't significant).
- However, subject measures indicated that people found 3D more natural so it was preferred over 2D displays.
- Displays that used varied amount of 3D (2.5D produced better results than fully 3D systems.

1 Information visualization is one of the sections that will covered sometime in this course

Limited Display Doesn't Mean That No Visualizations Are Possible (2)

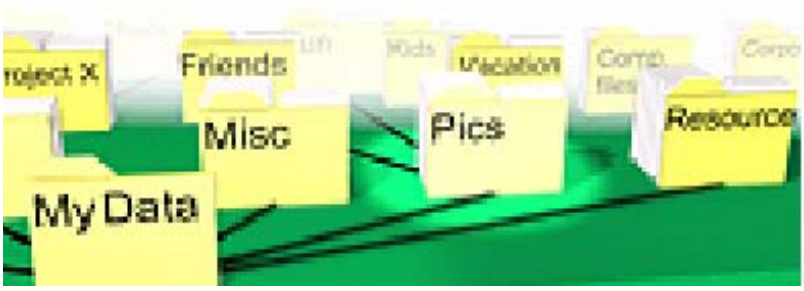
An example study[1] researching the use of 3D and other visualizations on small screen mobile devices:

- The goal was to leverage people's ability to work with partial 3D environments.
- The development platform was on a Nokia phone
  - 4096 color display
  - 176 x 206 resolution (only 176 x 144 was used for displaying content)
- The study focused on document management on a small screen mobile device.

1 Hakala, T., Lehikoinen, J., and Aaltonen A. **Spatial Interactive Visualization on Small Screen**

Limited Display Doesn't Mean That No Visualizations Are Possible (3)

Example one: An experimental "fog-model" version of the Space Manager.

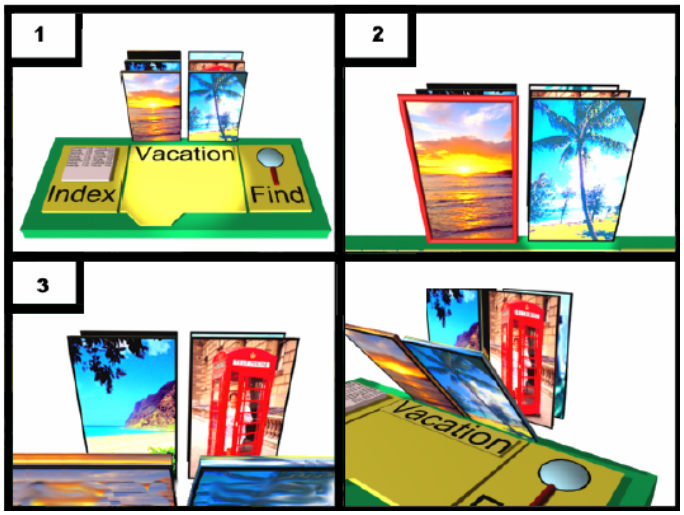


Limited Display Doesn't Mean That No Visualizations Are Possible (4)

Example two: 2.5D plane with a flashlight metaphor

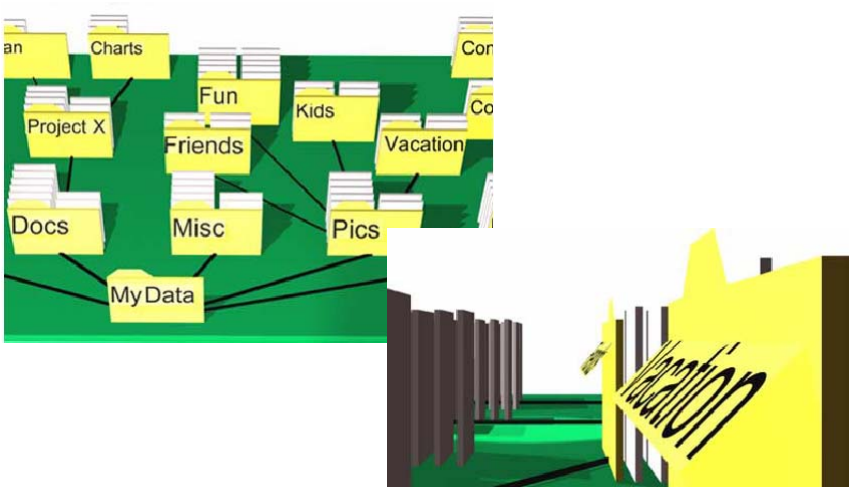
Limited Display Doesn't Mean That No Visualizations Are Possible (5)

Example two: Browsing files



Limited Display Doesn't Mean That No Visualizations Are Possible (6)

Example three: increasing the elevation and manipulating the fonts.



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Case Study No. 1: Evaluating A Small Mobile Device[1]

A usability study was conducted by 'The GIST' (Glasgow Interactive Systems) to evaluate the gestural (touch) and audio based interface for the Windows Media Player running on an Hewlett-Packard iPAQ Pocket PC.

1 From Section 22.2 of **Designing Interactive Systems: People Activities, Contexts, Technologies by Benyon**, D., Turner, P., and Turner S. Addison-Wesley 2005.

James Tam

Study Methodology

To simulate everyday use participants wore the iPAD with either:

1. Media Player
2. The experimental 'TouchPlayer'

They were to complete a series of pre-created tasks asked they walked e.g., "Find the song Wonderwall".

Measures Of Performance

1. **Time to complete a single task**
2. **Time to complete the entire series of tasks**
3. **The number of errors**
4. **Mental workload[1]**
5. **Percentage of normal walking speed**

1 Mental Workload was measure using the TLX (Task Load Index) questionnaire.

Case Study No. 2: The Design Of A Mobile Device[2]

The User-Interface Research and Development department of Samsung Electronics Corporation approached AM+A (Aaron Marcus and Associates) to develop conceptual user-interface designs for future wireless information devices (WIDs) evolving from cell phones.

It was an application of the User-Centered design process to a particular problem domain: mobile devices with small screen displays.

2 From **Designing the PDA of the Future** by Marcus, A., and Chen, E. in Interactions of the ACM January-February 2002

Discovering The Needs Of User

- **Could not be done using focus groups which can be used to gauge reactions towards existing devices but cannot be used in the design of a new device.**
- **The designers observed users in actual usage conditions in order to understand their mobile experience.**
- **The focus of the study was information use:**
  - How were electronic resources (e.g., mobile phones, personal digital assistants) currently employed.
  - How traditional sources of information (e.g., newspapers, sticky notes) used.

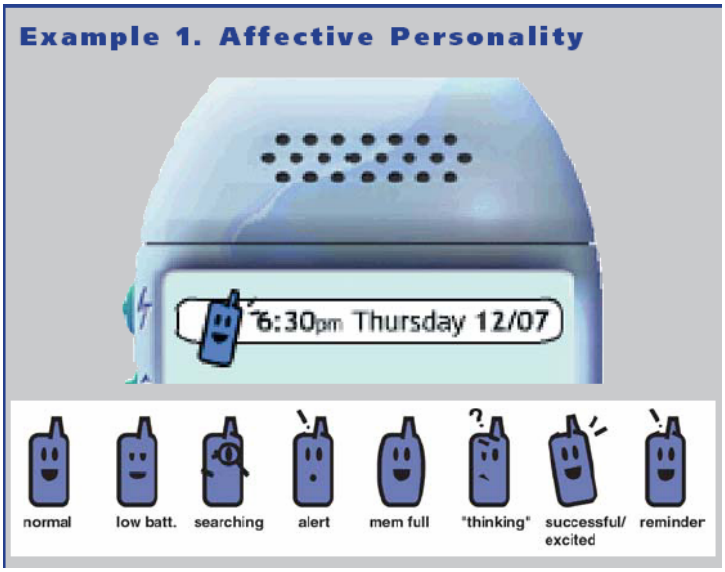
Profiles Of The Participants In The Study

- **A wide range of people were included in the study:**
  - A minister who used many high tech gadgets
  - A male college student
  - A female high school student
  - A commuting professional
  - A Silicon Valley entrepreneur who was a female single parent
  - Etc.

The Process Was Found To Be Highly Personalized

The amount of ornamentation and personalization resulted in a great deal of attachment to possessions such as personal organizers.

Affective Interfaces Were Implemented To Increase Attachment To The Mobile Device



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Customizations To Increase Attachment Towards The Device

- **Actions that support the current activity are automatically invoked while the person is engaged in that activity.**

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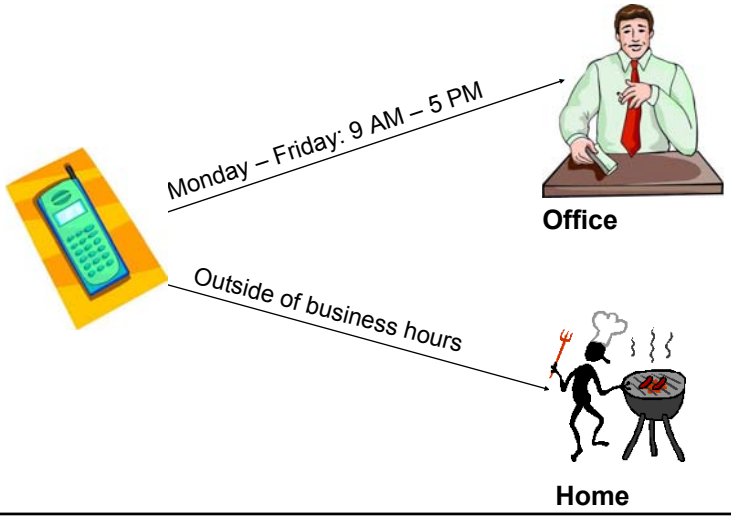
Shortcuts Implemented To Overcome Input And Output Limitations

- **Contextual awareness**
- **Location Awareness**
- **Time-shifting**

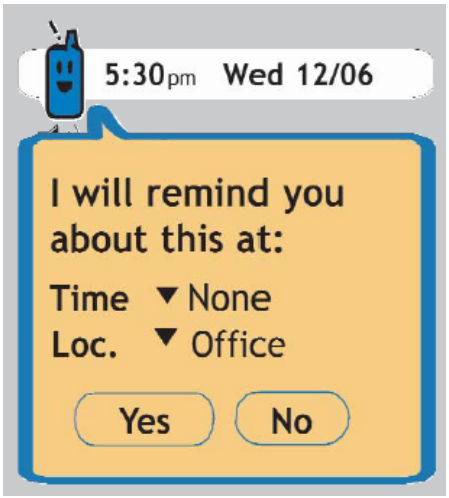
Contextual Awareness

By understanding the user's context the device attempts to assist that person in their current activity as much as possible



Location Awareness

A GPS (Global Positioning System) allows for location based reminders to be created.



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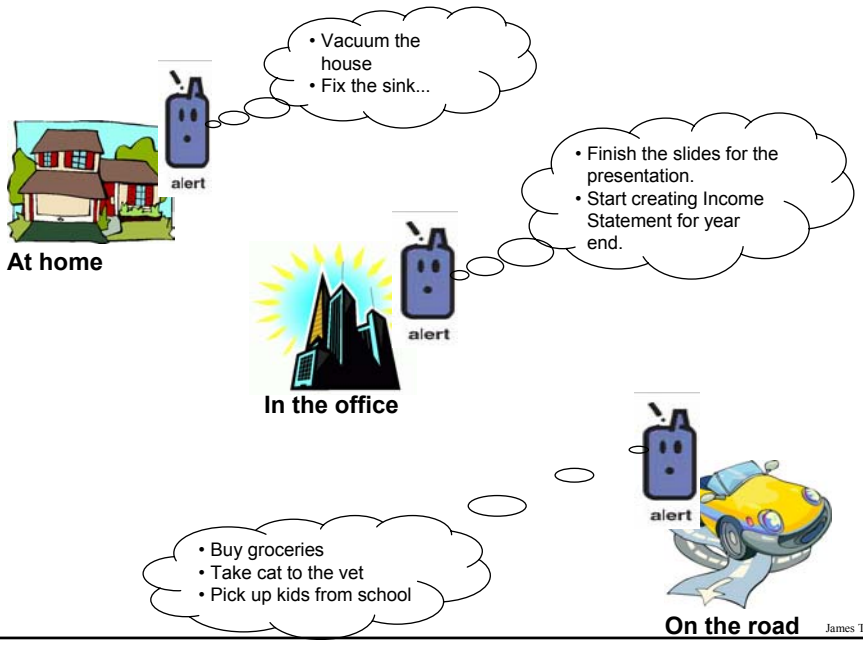
Location Awareness (2)



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Time-Shifting

- **"Start now, finish later"**
- **The user can mark tasks that are received now as something to be completed later.**
- **For example, tagging email.**

You Now Know

- **What are some of the design challenges of small screen displays?**
- **Ways of creating shortcuts to overcome the input and output limitations of mobile devices.**
- **Some visualizations are possible even on small screens.**
- **How to simplify screen design by re-factoring the display.**
- **How and why hard and soft keys are employed in mobile devices.**
- **What are some of the challenges involved in evaluating mobile small screen displays?**
- **One way in which User-Centered Design was used to design a mobile device:**
  - How were affective designs implemented in the device?
  - What shortcuts were used to overcome input and output limitations of the device?