

Vorlesung Advanced Topics in HCI (Mensch-Maschine-Interaktion 2)

Ludwig-Maximilians-Universität München
LFE Medieninformatik
Heinrich Hußmann & Albrecht Schmidt
WS2003/2004
<http://www.medien.informatik.uni-muenchen.de/>

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

1

Chapter 3: Mobile HCI

Table of Content

- Input & Output Devices
- Input & Output Techniques
- Guidelines
- System Architectures for Mobile UIs
- Example: Applications for Mobile Phones

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

2

Dynabook Vision



- Handheld,
- wireless connectivity,
- multimedia capabilities
- support for programming

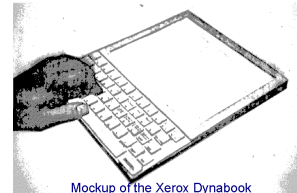
08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

3

Mobile Computing / mobile UIs 1972 Xerox Dynabook

- Alan Kay's group at Xerox PARC
- First description of "mobile computing" with a focus on the UI?
- a portable interactive personal computer, as accessible as a book
- a computer for children (learning aid)
- Big problem: software that facilitates dynamic interactions between the computer and its user



Mockup of the Xerox Dynabook

<http://www.honco.net/os/kay.html>

The Dynabook Revisited - A Conversation with Alan Kay

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

4

Mobile User Interfaces

- "Beyond the laptop..."
- Devices are used while the user is mobile
 - Handhelds & PDAs
 - Phones
 - Wearable Computer
 - Tablet Computers
 - Car Infotainment system

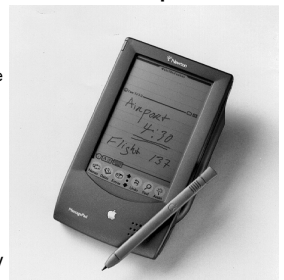
08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

5

Apple Newton Commercial Handheld Computer

- Recognition Architecture
 - Recognizes handwriting--printed, cursive, or a mixture of the two--with the assistance of a 93,000-word, built-in word list
 - Lets you add up to 1,000 words
 - Includes four pop-up keyboards: typewriter, numeric, phone, and time/date
 - Recognizes graphics and symmetrical objects
- 320 by 240 pixels Display
- Sold from 1993



<http://www.oldschool.net/newton/papers/index130.html>

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

6

Itsy Pocket Computer



- Research platform
- Gesture and speech interaction
- *tilt-to-scroll* and *Rock 'n' Scroll* to include the use of gestures to issue commands.

- <http://research.compaq.com/wrl/projects/itsy/itsy.html>
- <http://research.compaq.com/wrl/projects/itsy/movies.html>

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

7

Input to Mobile Devices What to input?

- Commands
- Text
- Drawings/sketches
- Images
- Audio
- Movies

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

8

Input to Mobile Devices How to input?

- Keyboards
 - Full-size
 - Miniature
 - Chord-keyboard
 - On-screen
- Stylus
 - Point and click
 - Handwriting recognition
- hard buttons / wheels
 - Scroll wheels
 - Joypad-style navigation
- Capture
 - Camera
 - microphone
- Future devices
 - Tilt scrolling
 - Virtual workspaces

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

9

Input Technologies for Mobile Devices

- Soft Keyboards
- Screen Keyboards



08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

10

Input Technologies for Mobile Devices

- Keyboards



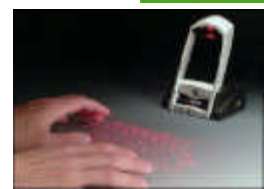
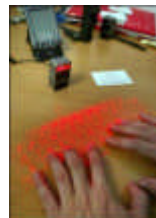
08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

11

Input Technologies for Mobile Devices

- Virtual Keyboards
- Projection Keyboards



<http://www.alpern.org/weblog/stories/2003/01/09/projectionKeyboards.htm>

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

12

Input Technologies for Mobile Devices

- Chord Keyboard
- One-handed Keyboards
- Example Twiddler
 - Combines keyboard and Mouse
 - keypad designed for "chord" keying
This means you press one or more keys at a time. Each key combination generates a unique character or command.
 - 12 finger keys and 6 thumb keys, the twiddler can emulate the 101 keys on the standard keyboard



08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

13

Yoyo Input Device designed for arctic environments

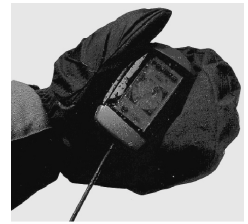


Figure 5. The Yo-Yo user interface.
▪ Smart Clothing for the Arctic Environment by J. Rantanen et al. in proceedings of the int. Symposium on Wearable Computing 2000 (ISWC2000)

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

14

Output What to present?

- Text
- Non-speech Audio
- Music
- Speech
- Images
- Video

- Tactile feedback (e.g. vibra alarm)

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

15

Screens

- Resolution
- Color/Monochrome
- Touch sensitive
- Size

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

16

Head-up Displays

- Images in front of the eye
- Appears free floating
- See through



- <http://www.microopticalcorp.com>

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

17

Haptic feedback Application in Pedestrian guidance



Fig. 1. (a) GentleGuide control unit and wrist devices (b) GentleGuide worn by a participant

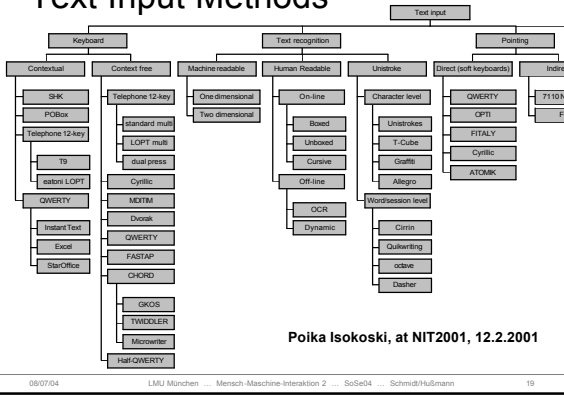
- **GentleGuide: An exploration of haptic output for indoors pedestrian guidance** S.Bosman, B.Groenendaal, J.W.Findlater, T.Visser, M.de Graaf & P.Markopoulos. Mobile HCI 2003. Udine

08/07/04

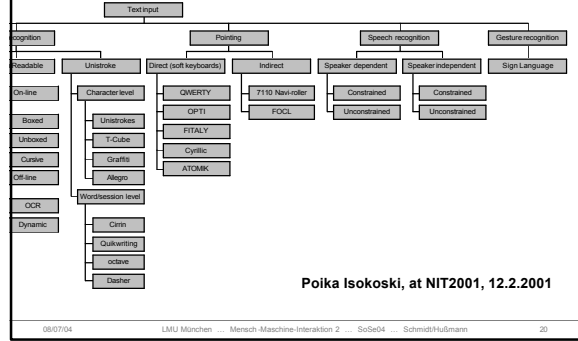
LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

18

Text Input Methods



Text Input Methods



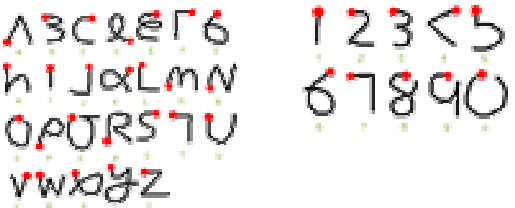
Unistroke



- Explored in the PARCTab Experiment
- Each letter is written in a single stroke
- Lifting the pen indicates a new letter
- Solves the separation problem
- <http://sandbox.parc.com/parctab/csl9501/paper.html>

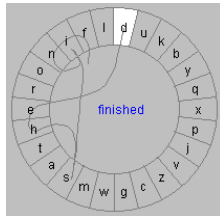
Graffiti

Unistroke used in PalmOS



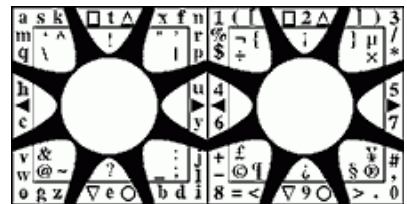
Cirrin - (the CIRcular INput device)

- A word-level unistroke keyboard is a soft keyboard allowing a user to go from any key to any other key without lifting the pen or entering unwanted keys
- Jennifer Mankoff and Gregory D. Abowd. Cirrin: A word-level unistroke keyboard for pen input. In *Proceedings of UIST '98*. Technical note. pp.213-214

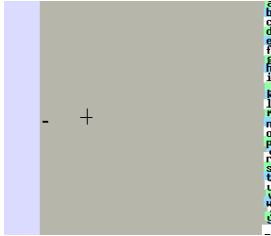


Quikwriting

- <http://mrl.nyu.edu/projects/quikwriting/>
- Authors claim "Quikwriting is significantly faster and less stressful to use than Graffiti"



Dasher



- Dasher is a data entry interface incorporating language modelling and driven by continuous two-dimensional gestures.
- "Tests have shown that, after an hour of practice, novice users reach a writing speed of about 20 words per minute while taking dictation. Experienced users achieve writing speeds of about 34 words per minute, compared with typical ten-finger keyboard typing of 40-60 words per minute."
- <http://www.inference.phy.cam.ac.uk/djw30/dasher/>

Mobile Phone Text Input

- multi-tap
 - A key has more than one letter assigned
 - Pressing the key once gives the first, twice the second, and so on
 - After a period of time or when changing to another button the letter is selected

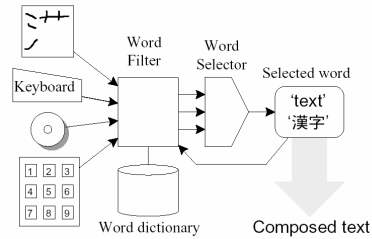


Predictive Text Input

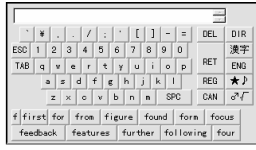
- Example T9
- Input is compared to a dictionary
- Input is matched to existing
- If non-ambiguous a single word is offered
- If multiple words are possible the one with the highest probability is offered and a mechanism to select the others
- Very fast input mechanism for words in the dictionary
- Slow for words that are not in the dictionary

Predictive Input

- Example: POBox - An Efficient Text Input Method for Handheld and Ubiquitous Computers. Toshiyuki Masui. HUC99 <http://www.csl.sony.co.jp/person/masui/papers/HUC99/HUC99.pdf>

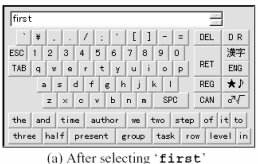


(a) Initial Display

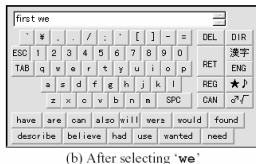


(b) After tapping the "F" key

Fig. 4. Pen-based POBox.



(a) After selecting "first"



(b) After selecting "we"

Fig. 5. After selecting "first" and "we".

References

- Poika Isokoski, at NIT2001, 12.2.2001 http://www.cs.uta.fi/kurssit/Interact/NIT2001_PI.ppt
- The Dynabook Revisited - A Conversation with Alan Kay <http://www.honco.net/os/kay.html>
- Itsy <http://research.compaq.com/wrl/projects/itsy/itsy.html>
- Unistroke <http://sandbox.parc.com/parctab/csl9501/paper.html>
- Quikwriting <http://mrl.nyu.edu/projects/quikwriting/>
- Dasher <http://www.inference.phy.cam.ac.uk/djw30/dasher/>
- POBox - An Efficient Text Input Method for Handheld and Ubiquitous Computers. Toshiyuki Masui. HUC99 <http://www.csl.sony.co.jp/person/masui/papers/HUC99/HUC99.pdf>

Introduction to Java Programming on Mobile Phones

Enrico Rukzio

Enrico.Rukzio@informatik.uni-muenchen.de

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hufmann

31

Developing of Applications for mobile Devices

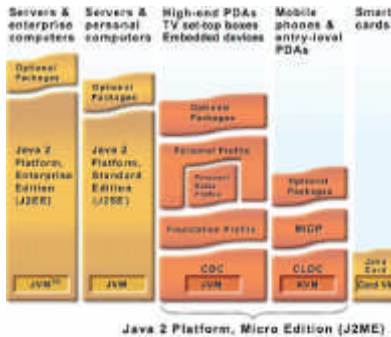
- Devices: Basic Phone, Extended Phone, Smartphone, PDA, Notebook
- Operating Systems (Mobile Phone, Smartphone)
 - Platform specific: Symbian OS (C++, OPL), Palm OS (C++), Pocket PC, Vendor-specific
 - Platform independent: J2ME (Java 2 Platform, Micro Edition)
 - Supported by Motorola, Nokia, Panasonic, Samsung, Sharp, Siemens, Sony Ericsson, Toshiba, etc.

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hufmann

32

The Java universe



08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hufmann

33

J2ME: Basics

- J2ME: Java 2 Platform, Micro Edition
 - “Java for small devices”
- Stack
 - Configuration + profile + optional APIs
- Configuration: specific kind of device
 - Specifies a Java Virtual Machine (JVM)
 - Subset of J2SE (Standard Edition)
 - Additional APIs

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hufmann

34

J2ME: Basics

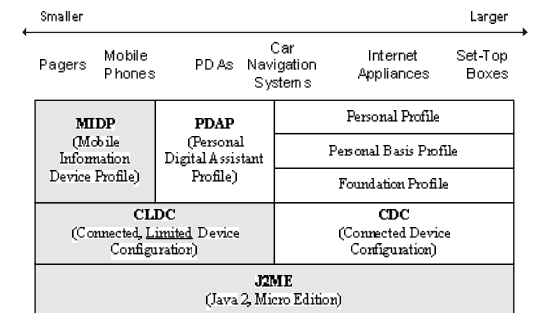
- Profile: more specific than configuration
 - based on a configuration
 - adds APIs for user interface, persistent storage, etc.
- Optional APIs: additional functionality
- Stack for Nokia 6600:
 - Configuration: CLDC 1.0
 - Profile: MIDP 2.0
 - Optional APIs: Nokia UI API, Wireless Messaging API (JSR-120), Mobile Media API (JSR-135), Bluetooth API (JSR-82 no OBEX)

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hufmann

35

The J2ME universe



08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hufmann

36

J2ME: CDC

- Connected Device Configuration
- For set-top boxes, car navigation systems and high end PDAs
- Minimum of 515KB ROM and 256KB RAM
- Full Java Virtual Machine
- Basis for Personal Profile stack (next generation of Personal Java)
- Personal Java is similar to JDK 1.1.8

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmidt/Hußmann

37

J2ME: CLDC

- Connected, Limited Device Configuration
- For small devices (e.g. mobile phone, pager, PDA) with small screen size, limited memory, slow network connection
- For devices with 160 to 512KB (statement is out of date) of memory for Java Platform
- JVM: KVM (“Kilobyte Virtual Machine”)
 - Limitations (no floating point data types)

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmidt/Hußmann

38

J2ME: MIDP

- Mobile Information Device Profile
- Device (such as mobile phones and pagers) characteristics:
 - > 128KB of non-volatile memory
 - > 32KB of volatile memory (runtime heap)
 - 8KB for persistent data
 - Screen: > 94*54 pixel
- Advantages: WORA (Write Once, Run Anywhere), Security (Sandbox KVM)

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmidt/Hußmann

39

J2ME: APIs in CLDC 1.0 + MIDP 2.0

<p>MIDP 2.0</p> <ul style="list-style-type: none"> javax.microedition.lcdi javax.microedition.lcdi.game javax.microedition.media javax.microedition.media.control javax.microedition.midlet javax.microedition.pki javax.microedition.rms 	<p>APIs are restricted when compared with J2SE</p>
<p>CLDC 1.0</p> <ul style="list-style-type: none"> java.lang java.io java.util java.microedition.io 	

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmidt/Hußmann

40

J2ME: Compatibility

MIDP Java Applications	Device-Specific Java Applications	Native Applications (compiled from C, C++, or other languages)
MIDP	Device-Specific APIs	
CLDC		
Device Operating System		

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmidt/Hußmann

41

MIDlet

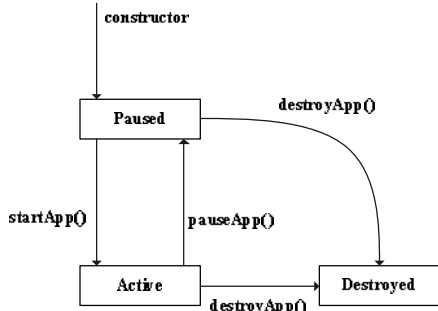
- MIDP applications are called MIDlets
- Every MIDlet is instance of javax.microedition.midlet.MIDlet
 - No argument constructor
 - Implements lifecycle methods
- Conceptually similar to Applets
 - Can be downloaded
 - Executed in host environment

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmidt/Hußmann

42

MIDlet (MIDP Application): Life Cycle



08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

43

MIDlet (MIDP Application): Life Cycle

- Application Manager: controls the installation and execution of MIDlets
- Start of a MIDlet: constructor + startApp (done by Application Manager)
- MIDlet
 - place itself in Paused state (`notifyPaused()`)
 - destroy itself (`notifyDestroyed()`)

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

44

MIDlet (MIDP Application): Life Cycle

- Application Manager
 - `pauseApp()` and `destroyApp()` could be triggered by Application Manager
- 'active' Paused state
 - `resumeRequest()` – MIDlet wants to become Active
- Methods for every state transition

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

45

MIDlet Build Cycle (1/2)

- (1) Edit source code
- (2) Compile (like compiling normal java)
- (3) Preverify
 - Bytecode verification (makes sure it behaves well + won't do nasty things) is split into two steps
 - lightweight second verification on the mobile device (standard verification too memory intensive)
 - special class format (adds 5% to normal class file size)
 - Security problem
 - Normally not visible for the programmer

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

46

MIDlet Build Cycle (2/2)

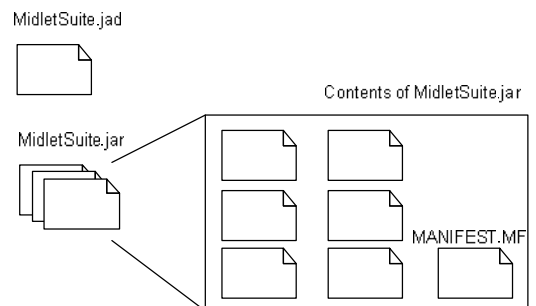
- (4) (Application) Package, MIDlet Suite
 - MIDlets + Classes + Ressources + Manifest Information => Java Archive (JAR)
 - Manifest: describes content of archive (versions of CLDC and MIDP, name, version, vendor)
 - Application Descriptor (*.jad)
 - same information like manifest (+ MIDlet-Jar-Size, MIDlet-Jar-URL), but a external file
 - used for installation
- (5) Test or Deploy

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

47

Anatomy of a MIDlet suite



08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmidt/Hußmann

48

Tool Support / Development Kits

- Sun's MIDP reference Implementation (do not use it!)
- Sun J2ME Wireless Toolkit
- IDE
 - Borland JBuilder MobileSet
 - IBM WebSphere Studio Device Developer
 - Metrowerks Code Warrior Wireless Studio
 - Sun ONE Studio, Mobile Edition
 - Future: Eclipse (Nokia)

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hußmann

49

MIDP: User Interface

- Goal: Write Once, Run Anywhere
- Anywhere?
 - different screen sizes
 - resolution of screen
 - color or grayscale screen
 - different input capabilities (numeric keypad, alphabetical keyboards, soft keys, touch screens, etc.)

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hußmann

50

User Interface: Methodology

- Abstraction (→ Preferred Method)
 - specifying a user interface abstract terms
 - (Not:) "Display the word 'Next' on the screen above the soft button."
 - Rather: "Give me a Next command somewhere in this interface"
- Discovery (→ Games)
 - Application learns about the device + tailors the user interface programmatically
 - Screen size → Scaling

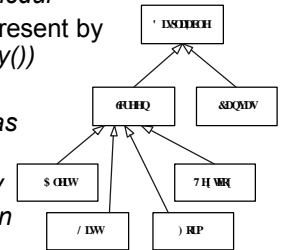
08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

51

User Interface: View from the Top

- User-interface classes *javax.microedition.lcdui*
- Device display represent by *Display (getDisplay())*
- *Display: easel*
- *Displayable: canvas on easel*
- *Canvas: Discovery*
- *Screen: Abstraction*



08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hußmann

52

User Interface: View from the Top

- Changes the contents of the display: passing *Displayable* instances to *Display's setCurrent()*
- Typical Sequence
 - Show a *Displayable*
 - Wait for input
 - Decide what *Displayable* should next
 - Repeat

08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hußmann

53

User Interface: Simple Example

```

public class Commander extends MIDlet {
    public void startApp() {
        Displayable d = new TextBox("TextBox", "Commander", 20, TextField.ANY);
        Command c = new Command("Exit", Command.EXIT, 0);
        d.addCommand(c);
        d.setCommandListener(new CommandListener() {
            public void commandAction(Command c, Displayable s) {
                notifyDestroyed();
            }
        });
        Display.getDisplay(this).setCurrent(d);
    }

    public void pauseApp() {}

    public void destroyApp(boolean unconditional) {}
}

```



08/07/04

LMU München Mensch-Maschine-Interaktion 2 SoSe04 Schmid/Hußmann

54

MIDP: Persistent Storage

- Goal: Write Once, Run Anywhere
- Anywhere?
 - Device with Flash ROM
 - Battery-backed RAM
 - Small Hard Disk
- Abstraction is needed
- Record stores (small databases)
- Min. 8KByte (Nokia 6600: 'the only limitation is the amount of free memory')

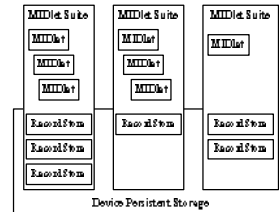
08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

55

Persistent Storage: Records

- *Record store*
 - contains *records* (pieces of data)
 - instance of `javax.microedition.rms.RecordStore`
- Every MIDlet in a MIDlet Suite can access every Record Store
- Since MIDP 2.0: Access across Suite borders possible !!!



08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

56

References

- Jonathan B. Knudsen. *Wireless Java: Developing with J2ME*. Second Edition. ISBN: 1590590775.
- Stephen Neal. *Overview of J2ME and Nokia APIs*. Sun Tech Days.
http://www.nokia.co.jp/forum/publish/documents/Tech_Days_Yokohama_Workshop_Session.pdf
- J2ME datasheet
<http://java.sun.com/j2me/j2me-ds.pdf>

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

57

Set books

- What's in MIDP 2.0: A Guide for Java Developers
<http://www.forum.nokia.com/ndsCookieBuilder?fileParamID=3632>
 - focus on section 3-3.23, without 3.3 (page 15-17)
- MIDP 2.0: An Introduction
<http://www.forum.nokia.com/ndsCookieBuilder?fileParamID=3231>
 - without section 3-7, focus on section 2 (page 4 -19)
- Understanding the Record Management System
<http://developers.sun.com/techtopics/mobility/midp/articles/databaserm/>
 - Record store discovery; Creating + Opening + closing records stores, Adding + reading + updating records, Delete records + record stores

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

58

Perspective: Exercise

- Tutorial 12/07/04, Room A 506, Amalienstraße 17
 - Tools (Edit, Compile, Preverify, Package, Deploy)
 - Storage / User Interface
- Task
 - build a vocable trainer
- Advised exercise 19/07/04
- Infrastructure: Room A 208, 4 PCs, installed developing environment, tutorial examples

08/07/04

LMU München ... Mensch-Maschine-Interaktion 2 ... SoSe04 ... Schmid/Hußmann

59