Augmented User Interaction

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Modern Times at Home...

Handling apps with flat finger gestures

Talking with the personal assistant

Playing games with hand or body gestures

… in Industry

Smart glasses in action
for warehouse logistics

Camera-assisted defect inspection at BMW
(courtesy of Michael Voit, WAO 2014)

... but what about us?

Well accepted, but there might be more than that ...

Why we have got used to ...

- ***Mouse click-like interaction:***
  - Very accurate pointing capability
  - Standardized user actions, normally associated with graphical widgets
  - Highly reliable and unambiguous single-user action

    Best suited for complex applications containing a wealth of graphical widgets

  Applies to mice and touch-sensitive displays

Imagine ...

- The "**Third-Hand**" problem
  → Speech recognition
- The "**Rough-and-Dirty-Working-Gloves**" problem
  → Hand or arm gesture recognition
- The "**Missing-Documentation**" problem
  → Wearing a smart glass with head movement recognition capability
- The "**Stiff-Neck**" problem
  → Hand or arm gesture recognition
- The "**Lost-Focus**" problem
  → Hand gesture recognition
- The "**Smart-Phone-Generation**" problem
  → Provide the tools young people have got used to
- ...

Sounds exciting and promising, but ...

A Paradigm Change

- ***Gesture-based (spatial) interaction:***
  - Rough pointing capability
  - User's arm tends to fatigue quickly ("gorilla arm")
  - Head gestures (turning, nodding) might also be considered
  - Very limited number of gesture types, partially standardized, a priori not associated with graphical widgets

    Requires an app-like multi-page application design providing a limited functionality and an unambiguous gesture-to-action mapping at each page
  - Less reliable

    Requires a specific arming / disarming procedure to prevent the user from unwanted interaction
  - Not limited to single-user interaction (depending on gesture recognition device)

Applies to specific recognition devices (with embedded infrared stereo camera, multi-axis gyro sensor, muscle activity sensor)

A Paradigm Change

- ***Speech-based interaction:***
  - No pointing capability at all
  - Huge word pool
  - Context-dependent ambiguity, language-or dialect dependence of vocabulary

    Requires a limited vocabulary set and an unambiguous word-to-action mapping
  - Suffers from ambient noise and the interference of multi-user input

    Requires a specific arming / disarming procedure to prevent the user from unwanted interaction

  Applies to specific speech recognition algorithms

A Practical Example: Web2cHMI

- It's a **real test environment**
  - Web-based and platform-neutral
  - Belongs to the **Web2cToolkit** Web service collection (http://web2ctoolkit.desy.de)
  - Explores the advantages and disadvantages of novel interaction modalities for accelerator control and maintenance applications
- It combines **various input modalities** into a **common human-machine interface (HMI)**
- It defines a set of common user interactions including
  - **Exploring / Launching / Manipulating** of graphical multi-page applications
  - **Navigation** between applications / application pages
  - **Interacting** with application pages / interactive graphical widgets

Supported Modalities

- ***1D/2D flat gestures:***
  - Single-finger actions (**mouse**)
  - Single- and multi-finger gestures (**touch-sensitive display**)
- ***2D/3D spatial gestures:***
  - Hand-gestures (**LEAP Motion controller**)
  - Hand- and arm-gestures (**Myo gesture control armband**)
  - Three-axis (yaw, pitch, roll) head movements (**smart glasses**)
- ***Spoken commands:***
  - English (**Sphinx speech recognition**)

LEAP

Myo

Vuzix M100

Supported Gesture Types

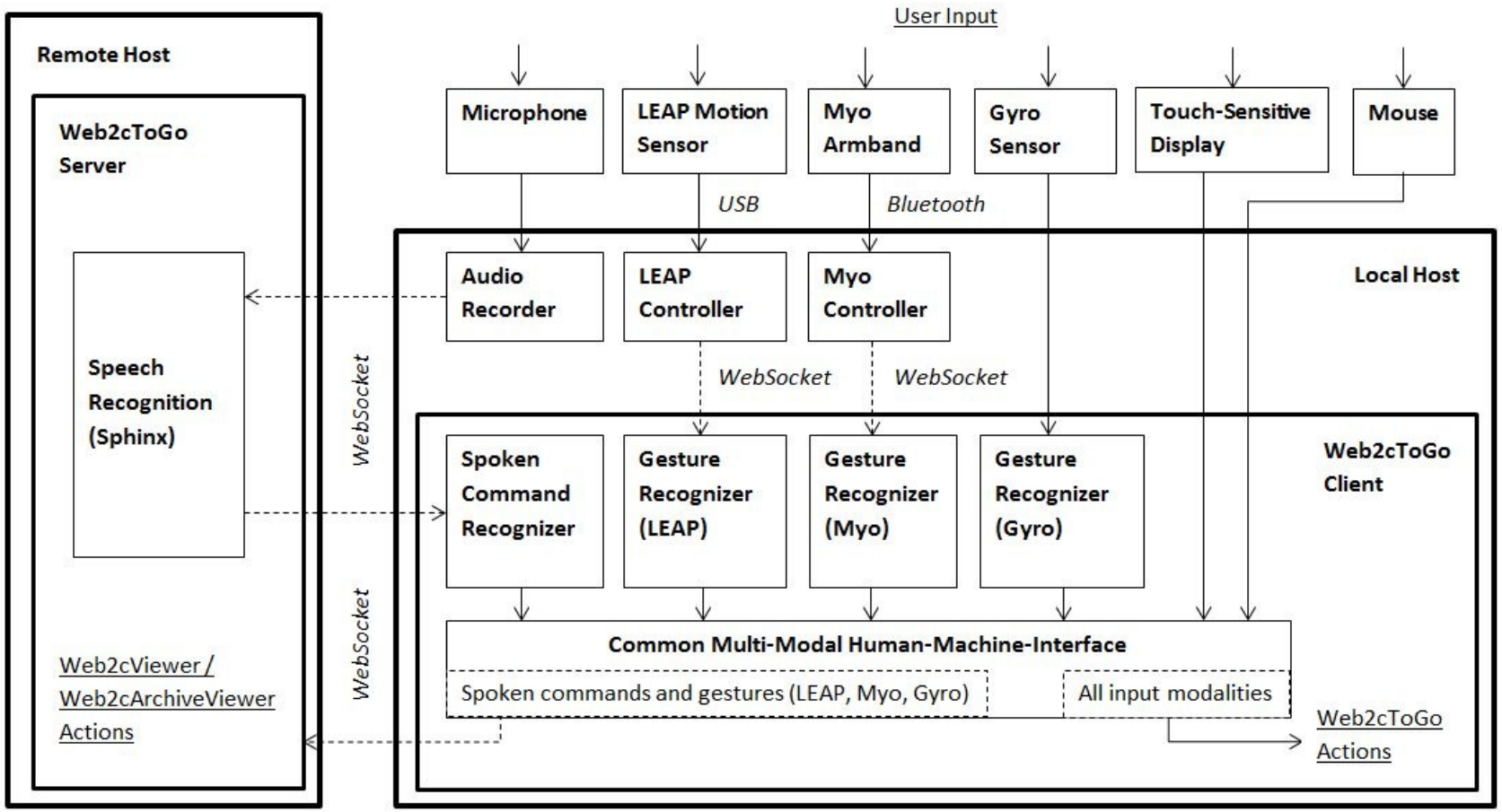
Primitive gestures:

Mouse	Touch-Sensitive Display	LEAP	Myo	Gyro Sensor
Click	Tap	Key-Tap	Double-Tap	Move-Fast / Move-Slow
Move	Move / Swipe	Swipe	Wave-Out / Wave-In	Roll
	Pinch (two fingers)	Open Hand (fingers spread)	Fingers-Spread	
		Grabbing Hand (fist)	Fist	
		Circle		

Enriched gestures: primitive gestures followed by moves or rotations etc.

Virtual Cursor

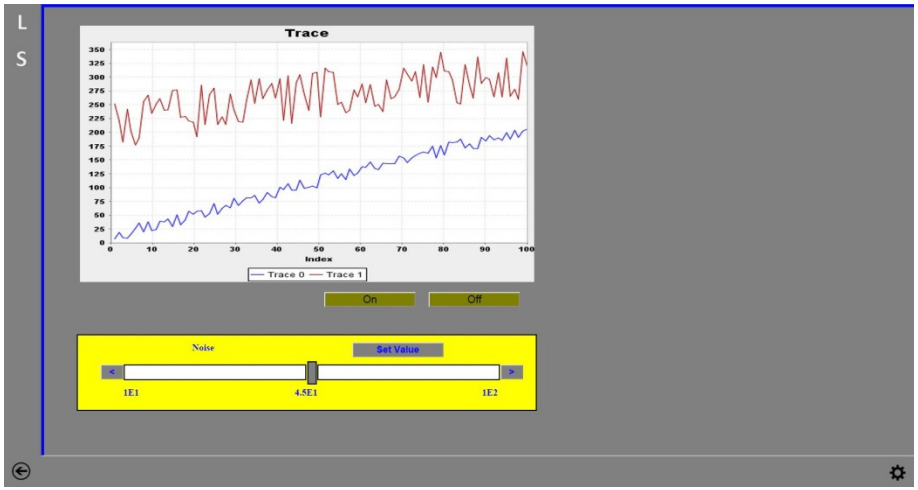
Web2cHMI User Input Data-Flow



Common HMI Example

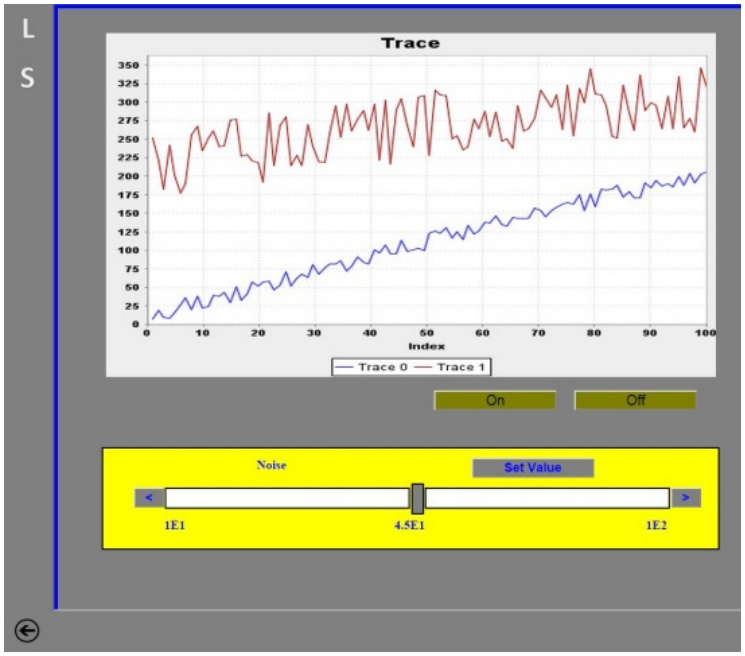
Change Set-Value (small positive step):

Mouse	Touch-Sensitive Display	LEAP	Myo	Speech Recognition	Gyro Sensor
Click (on ">"-Button) **Click** (on Set-Value Button)	**Tap** (on ">"-Button) **Tap** (on Set-Value Button) *(right / left hand)*	*Clockwise* **Circle** *(right / left hand)*	**Fist** & *Clockwise Rotation (right / left arm)*	*"More"*	*Sideward Right* **Move-Slow**



Web2cToGo
(Operation View)

Multi-Page Application Design



Provides a well-confined standard functionality per page being mapped to a specific controls activity (e.g. magnet power supply control)

Example template:

- “On” - action (On-Button)
- “Off” - action (Off-Button)
- “Set Value” - action (Slider)
- “Zoom Data” - action (Chart)

Preserves an unambiguous user-input-to-command mapping (gestures, key-words) for interactive widgets

Open Issues

- It's still an **R&D project**
- Acceptance level of novel interaction modalities will be strongly pushed in the future by **consumer and industrial use cases**

- The **reliability** of the gesture and speech recognition **has to be improved**
- Which gestures / spoken commands are **most intuitive, most common and match best**?
- What is the **best application design concept**?

- Real **field tests** have to be performed to explore the applicability for accelerator controls and maintenance

Open Issues

- Future control room concept?
  - **Camera supervised room:** Collective multi-user attentive environment
  - **Individual augmented reality glasses:** Single-user virtual reality environment
- Next implementation steps?
  - **Intermediate step:** Provide applications suited for touch pads, interactive tables, keep traditional application look-and-feel
  - **Big step:** Omit mouse-click like interaction, skip familiar mouse-centric application design pattern

Ideas and comments are appreciated!

Thank you for your attention!

More HMI Examples ...

Common HMI Example

Launch / Display selected application:

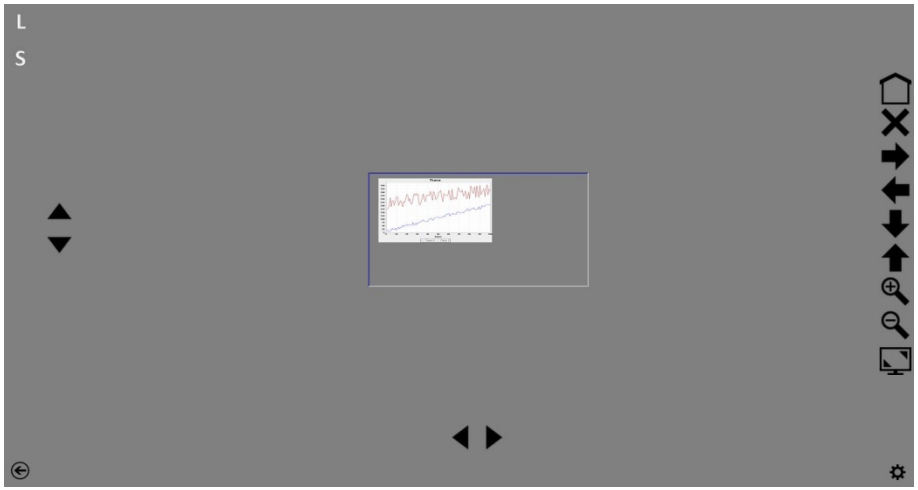
Mouse	Touch-Sensitive Display	LEAP	Myo	Speech Recognition	Gyro Sensor
Click (on application tile)	**Tap** *(right / left hand)* (on application tile)	**Fingers-Spread** *(right / left hand)*	**Fingers-Spread** *(right / left arm)*	*"Display"*	*Downward* **Move-Fast**

Web2cToGo
(Explorer View)

Common HMI Example

Browse to next application page:

Mouse	Touch-Sensitive Display		LEAP	Myo	Speech Recognition	Gyro Sensor
Click ⬆	**Tap** ⬆ *(right / left hand)*	*Upward* **Swipe** *(right / left hand)*	*Upward Long* **Swipe** *(right / left hand)*	**Wave-Out** & *Upward Move (right / left arm)*	*"Browse Up"*	*Upward* **Move-Fast**



Web2cToGo
(Navigation View)

Common HMI Example

Choose item above chosen item:

Mouse	Touch-Sensitive Display	LEAP	Myo	Speech Recognition	Gyro Sensor
Click (on item in list box)	**Tap** *(right / left hand)* (on item in box)	*Upward Long* **Swipe** *(right / left hand)*	**Wave-Out** *& Upward Move (right / left arm)*	*"Browse Up"*	*Upward* **Move-Slow**