A Three-dimensional Characterization Space of Software Components for Rapidly Developing Multimodal Interfaces

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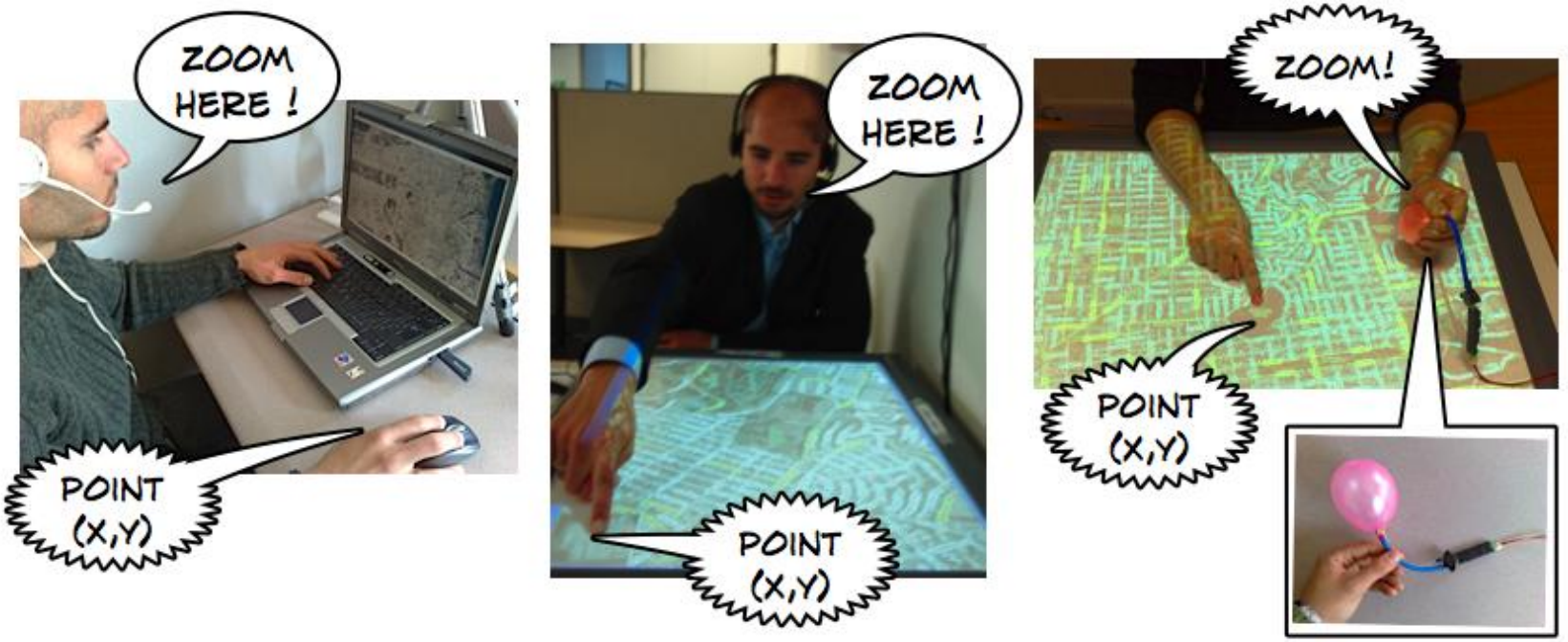
Illustrative example
Multimodal Map Navigator

- Put-that-there ([Bolt 80])



Component-based approach

- Integrate existing code
- Integrate heterogeneous components written in different languages
- Improve reusability
- Rapid modification of component’s assemblies
  - Fast prototyping of multimodal applications
- Graphical assembly of components: non developer users

Key point: component characteristics

- Improve reusability of components
- Ease the creation of component’s assemblies
- Allow people with different background to use a common component-based tool

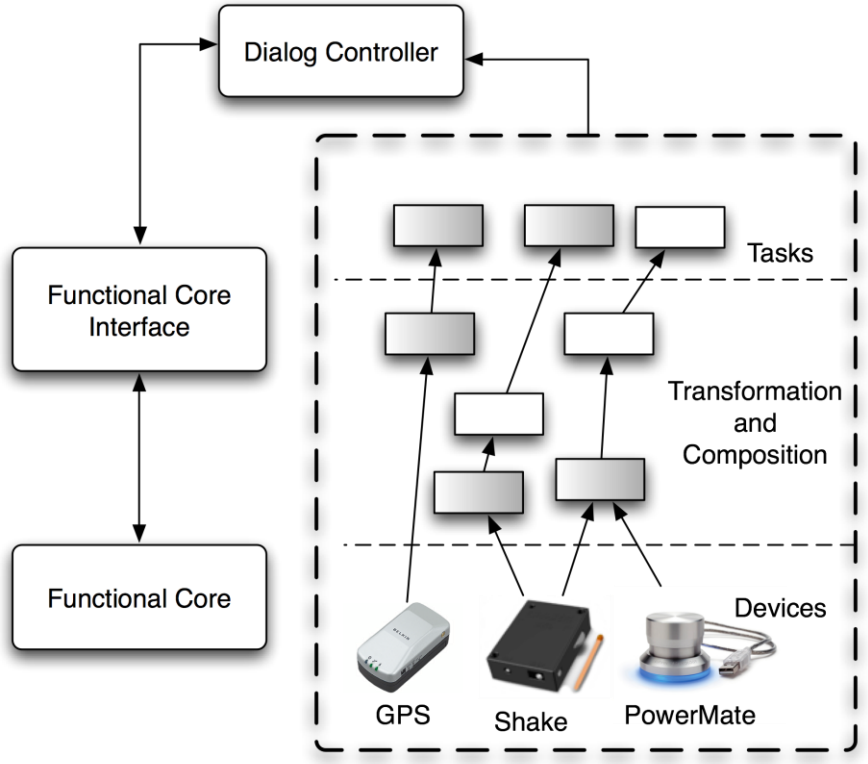
Scope and Overview of the Characterization Space

Overview and Scope of the space Component-based models

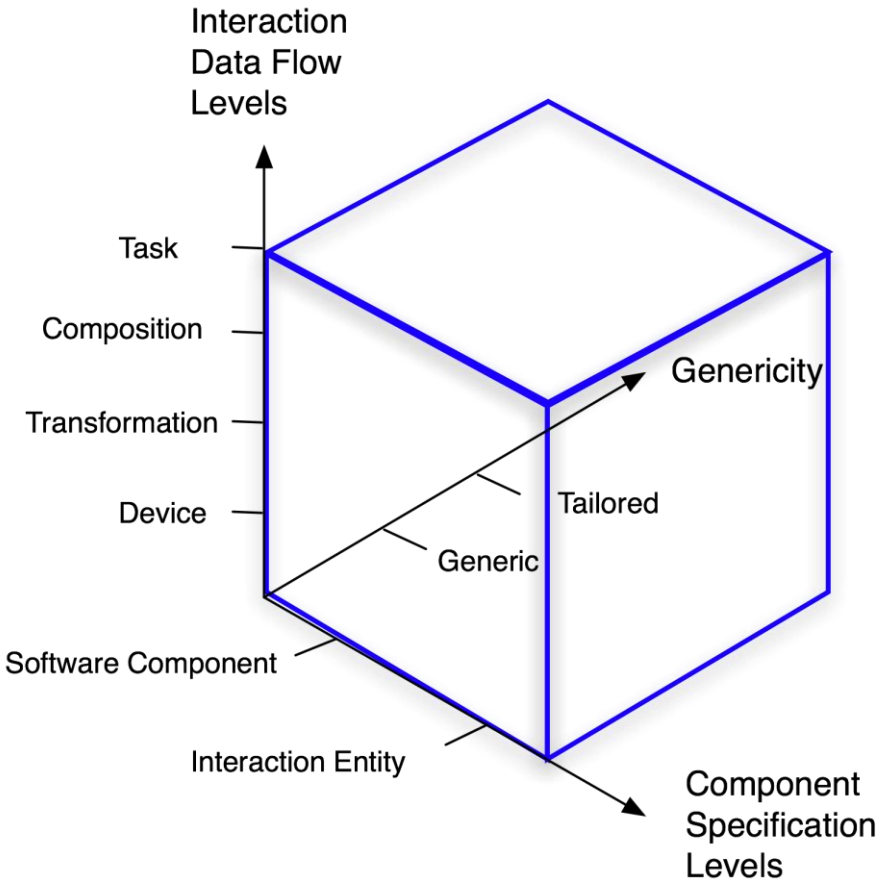
- Space defines set of characteristics of components
- Component: any type of software unit (software component, service)
- DOES NOT define execution behaviour of components
- Define high-level characteristics of components, implemented in any component-based technology
  - Corba Component Model
  - Component Object Model (COM)
  - JavaBeans
  - OSGi

Overview and Scope of the space Interactive System

- Focus on the interactive part of an interactive system in an ARCH software model

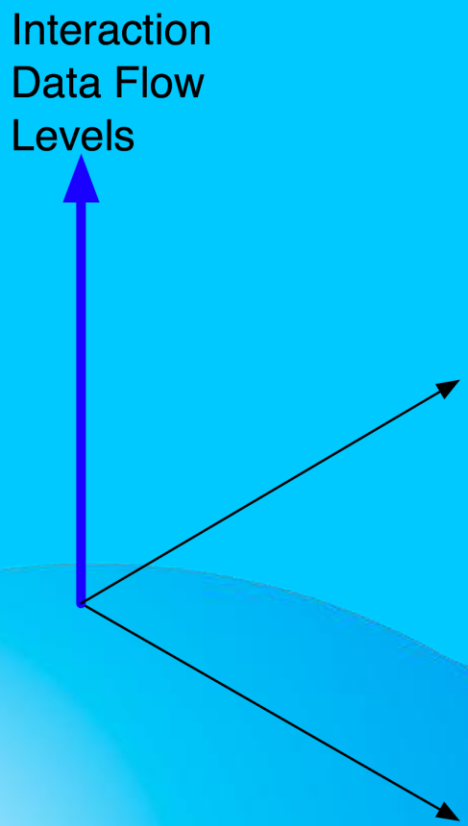


Overview and Scope of the space
Three dimensions

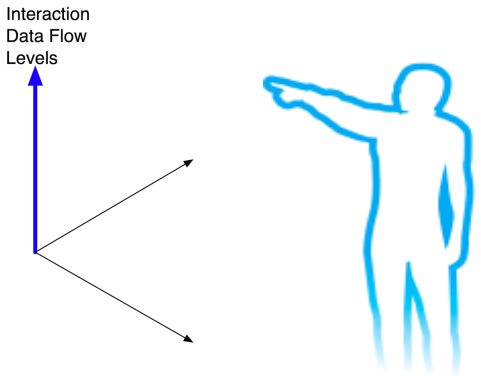


- 3 Dimensions:
  - Data Flow from devices to tasks
  - Specification level
  - Component genericity

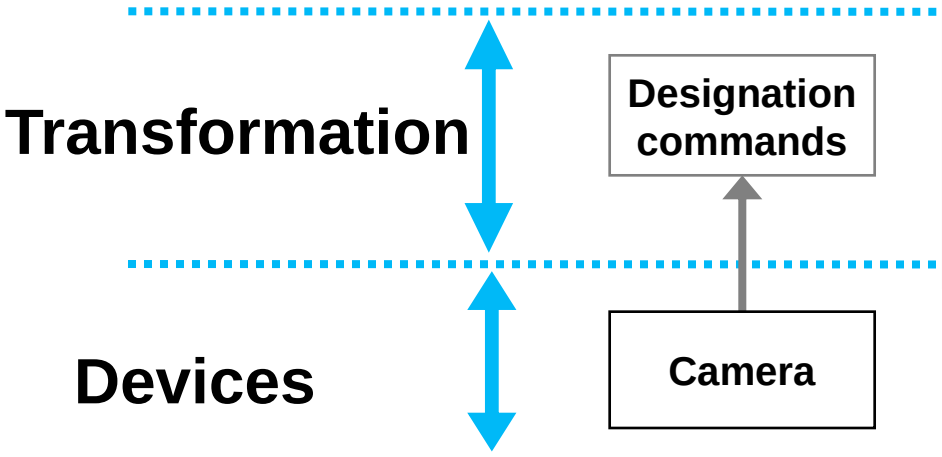
From input devices to tasks



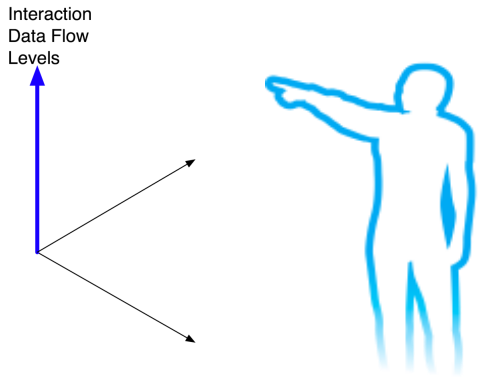
From input devices to tasks



Device + Transformation = Interaction Modality



From input devices to tasks



Tasks

Task:
Center and Zoom Point (x,y)

CARE
Composition

Complementarity

Transformation

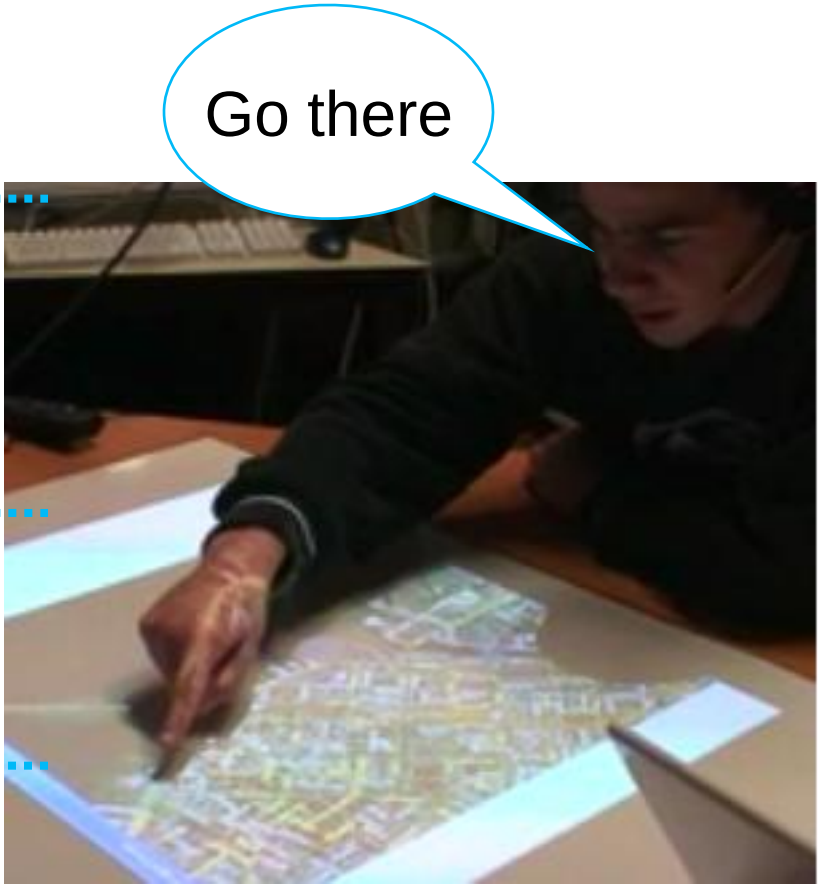
Designation commands

Speech command

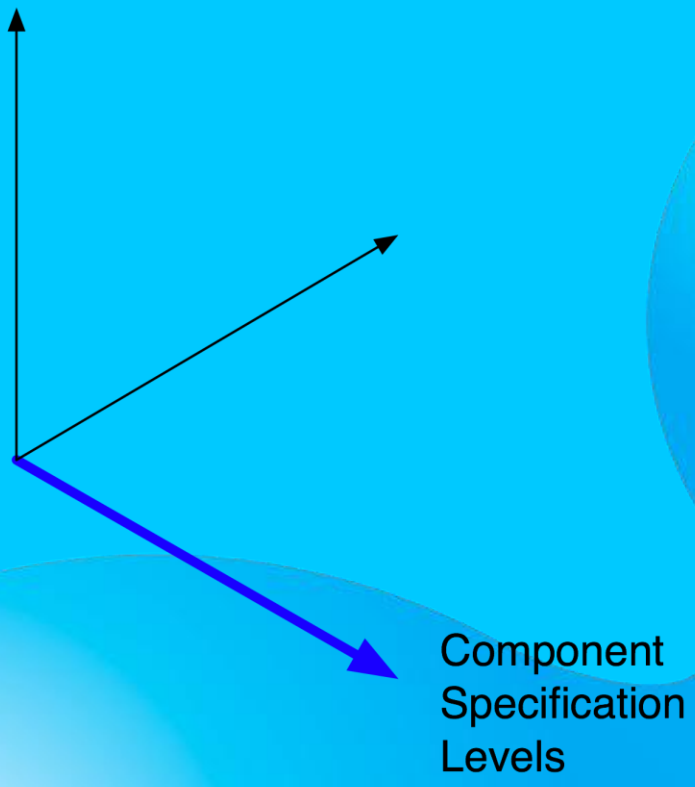
Devices

Camera

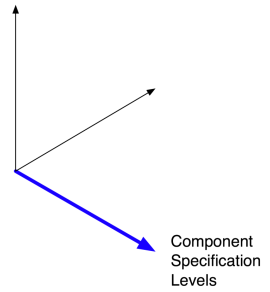
Microphone



Specification Levels



Specification Levels



- Designers should be able to build multimodal applications
- Key point: description level of the components
- Designer interested in
  - Human sense involved
  - Weight of the device
  - Dimensions, etc..
- Developer interested in
  - Driver library
  - Programming language
  - Types of the parameters

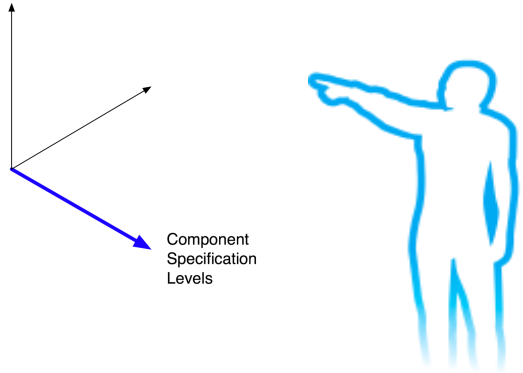
Designer Level

Interaction entities

Developer Level

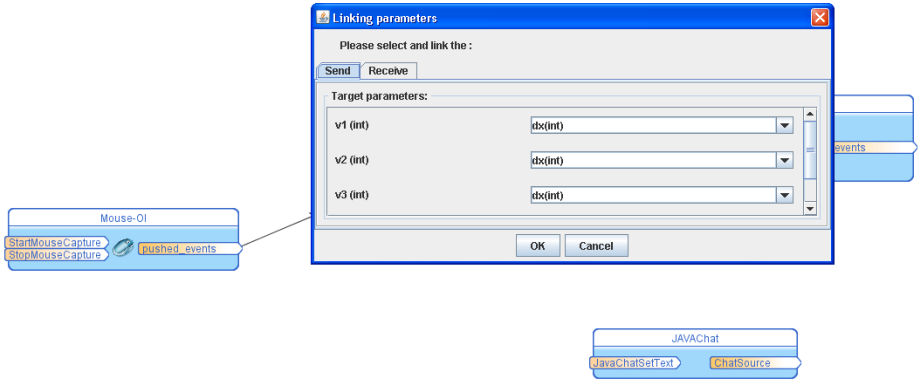
Software components

Specification Levels

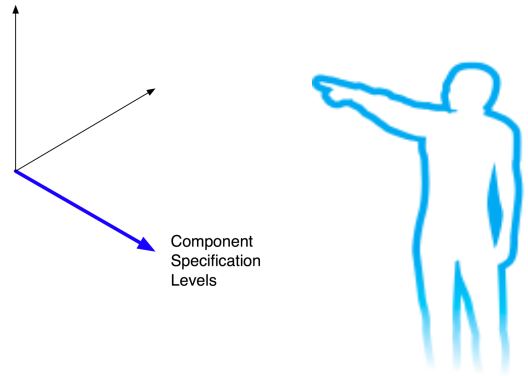


Designer Assembly

Developer Assembly

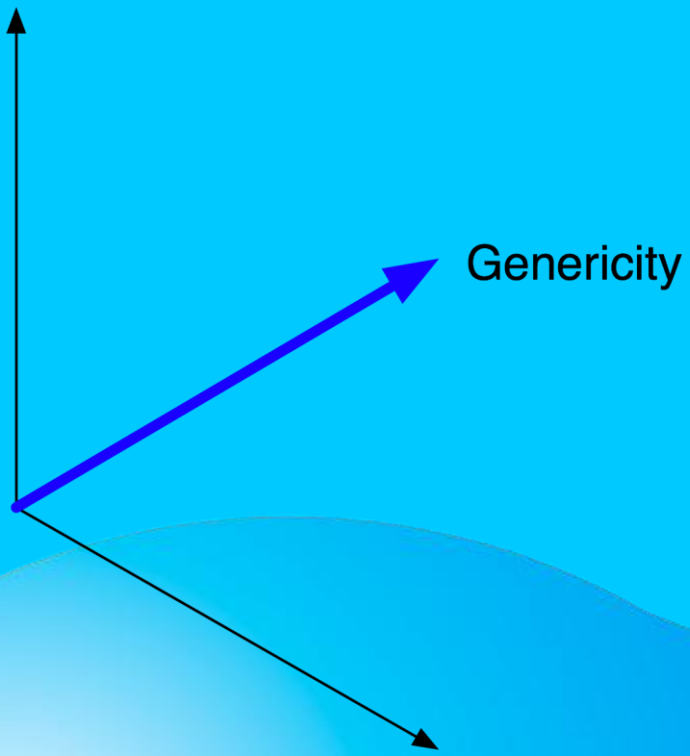


Specification Levels



- Developers
  - Reuse existing components
  - Software engineering criteria
- Application designers
  - Rapid and Easy development of multimodal applications (focus on multimodal interaction)
    - Low threshold (easy to use) while providing a high ceiling (how much can be done with the platform)
  - More iterations as part of an iterative design method for achieving usable multimodal applications

Need for genericity



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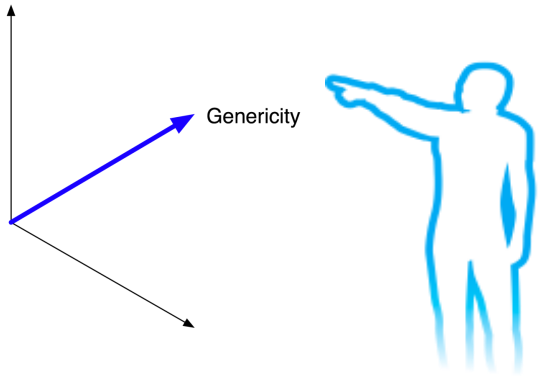
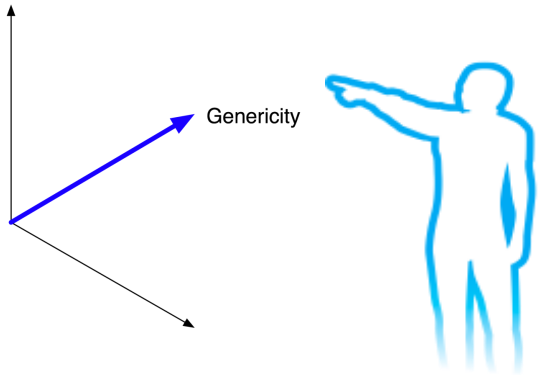


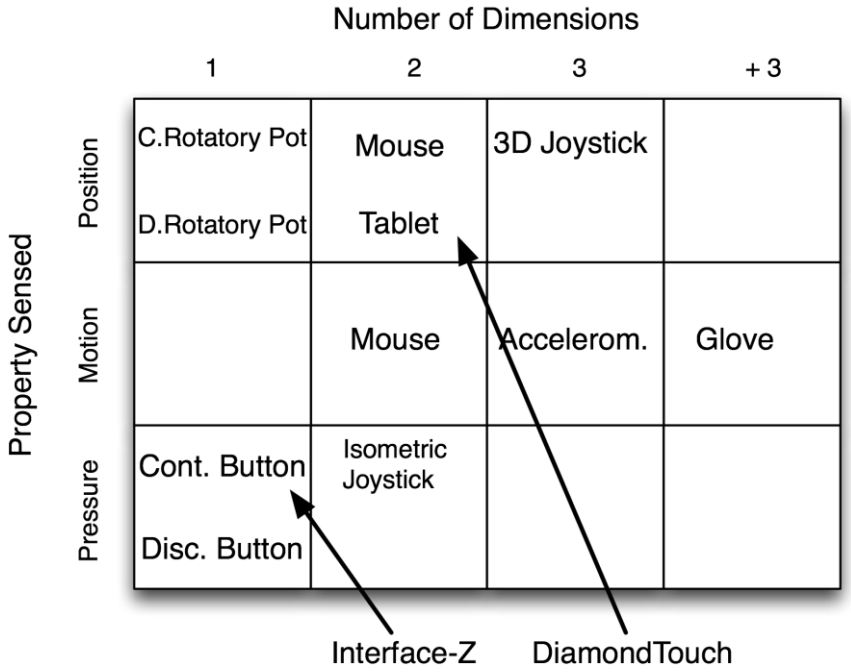
- Tailored components
  - Implemented in ad-hoc ways for the needs of a specific application or interaction
- Generic components
  - Implement generic mechanisms

- Using generic components improve expressive leverage and reusability
  - Expressive leverage: « tool reduces total number of choices a designer must make to express a desired solution » [Olsen 07]

Need for genericity
Generic Devices

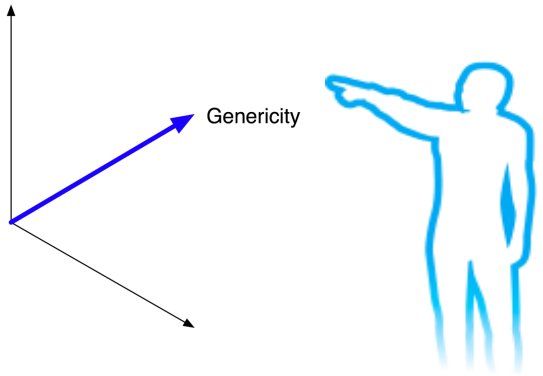


- Buxton's taxonomy [Buxton 83]
  - Hand-controlled input devices



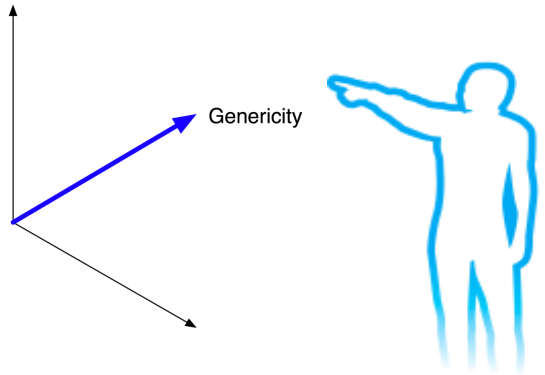
- Speech and Image analysis devices
  - Difficult to classify

Need for genericity



- Generic Transformation
  - Reusable operations usually performed on data from generic devices
- Generic Composition
  - CARE properties [Nigay 97]
  - Complementarity, Assignation, Redundancy and Equivalence
- Generic Tasks
  - Foley’s interactive tasks [Foley 84]

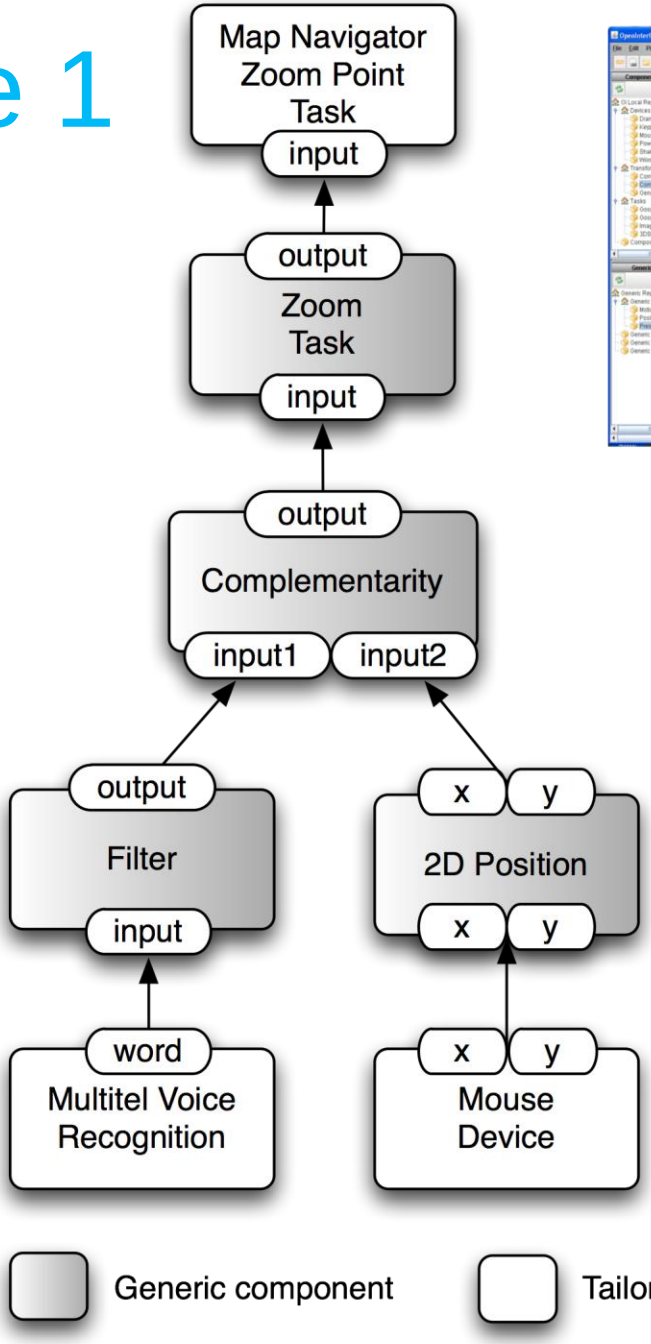
Need for genericity

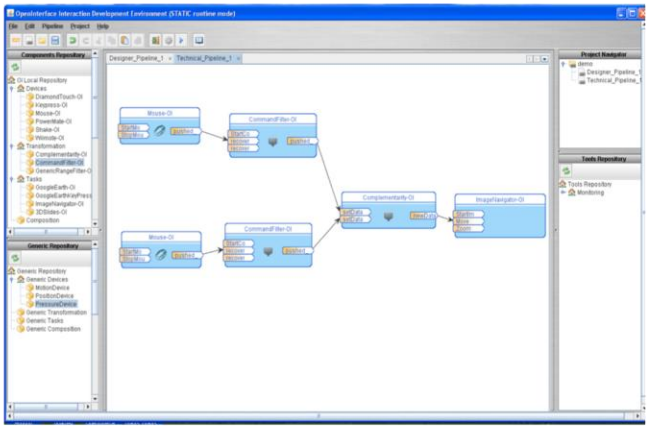


	What ?	How ?
Task	Application independent	Foley's task Configurable generic task
Composition	Modality independent	CARE properties
Transformation	Device and application independent	General Transformations: mathematical, mapping operations
Device	Abstraction of device data in terms of interaction actions, Buxton properties	Buxton's properties

Illustrative Examples

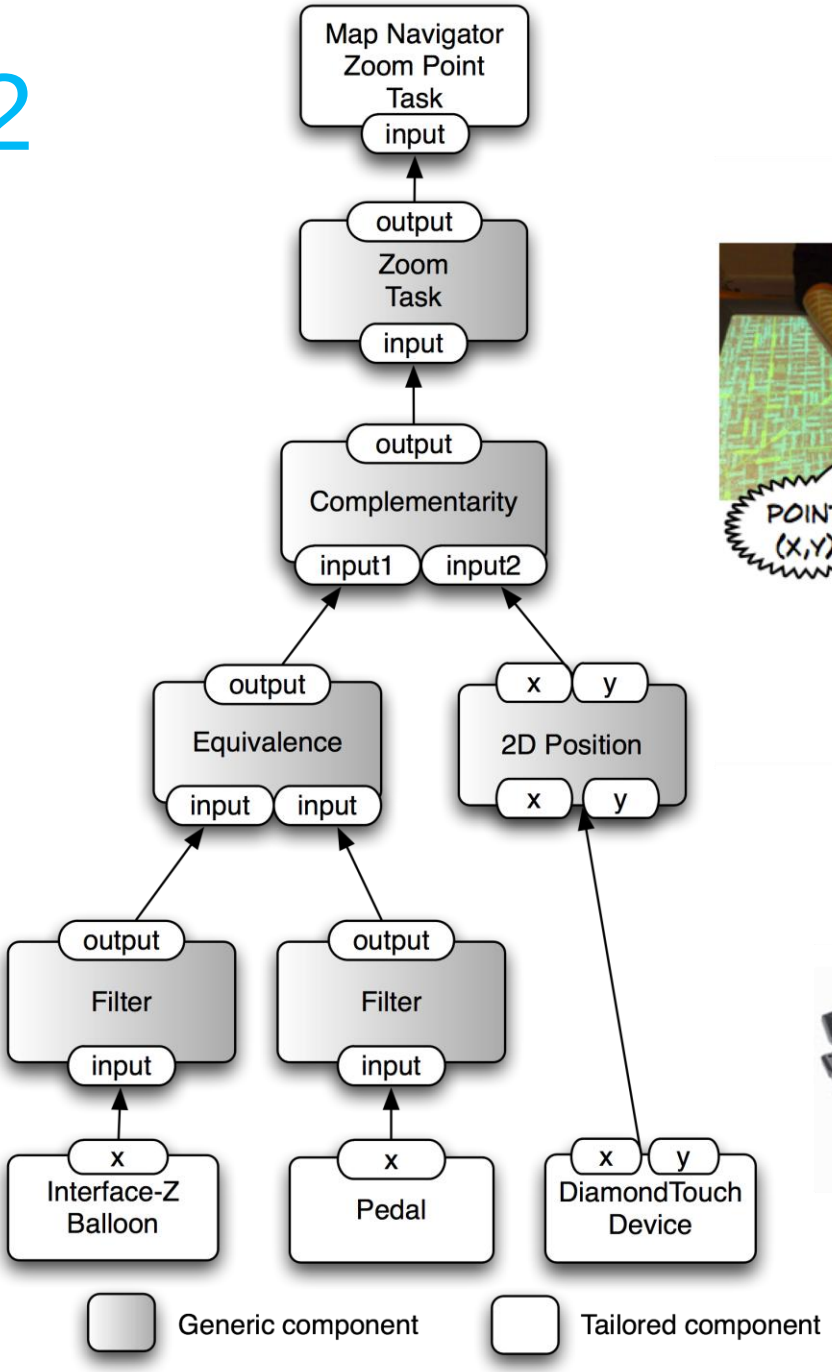
Example 1


Map Navigator
Zoom Point
Task
input
output
Zoom
Task
input
output
Complementarity
input1
input2
output
Filter
input
x
y
2D Position
x
y
word
Multitel Voice
Recognition
x
y
Mouse
Device
Generic component
Tailored component




ZOOM
HERE !
POINT
(X,Y)

Example 2


Map Navigator
Zoom Point
Task
input
output
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input
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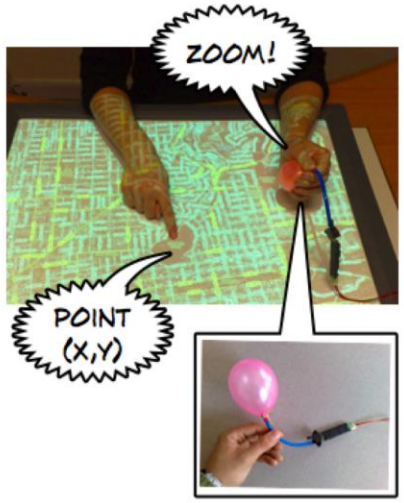
Complementarity
input1
input2
output
Equivalence
input
input
x
y
2D Position
x
y
output
Filter
input
output
Filter
input
x
Interface-Z
Balloon
x
Pedal
x
y
DiamondTouch
Device
Generic component
Tailored component


ZOOM!
POINT
(X,Y)


OR

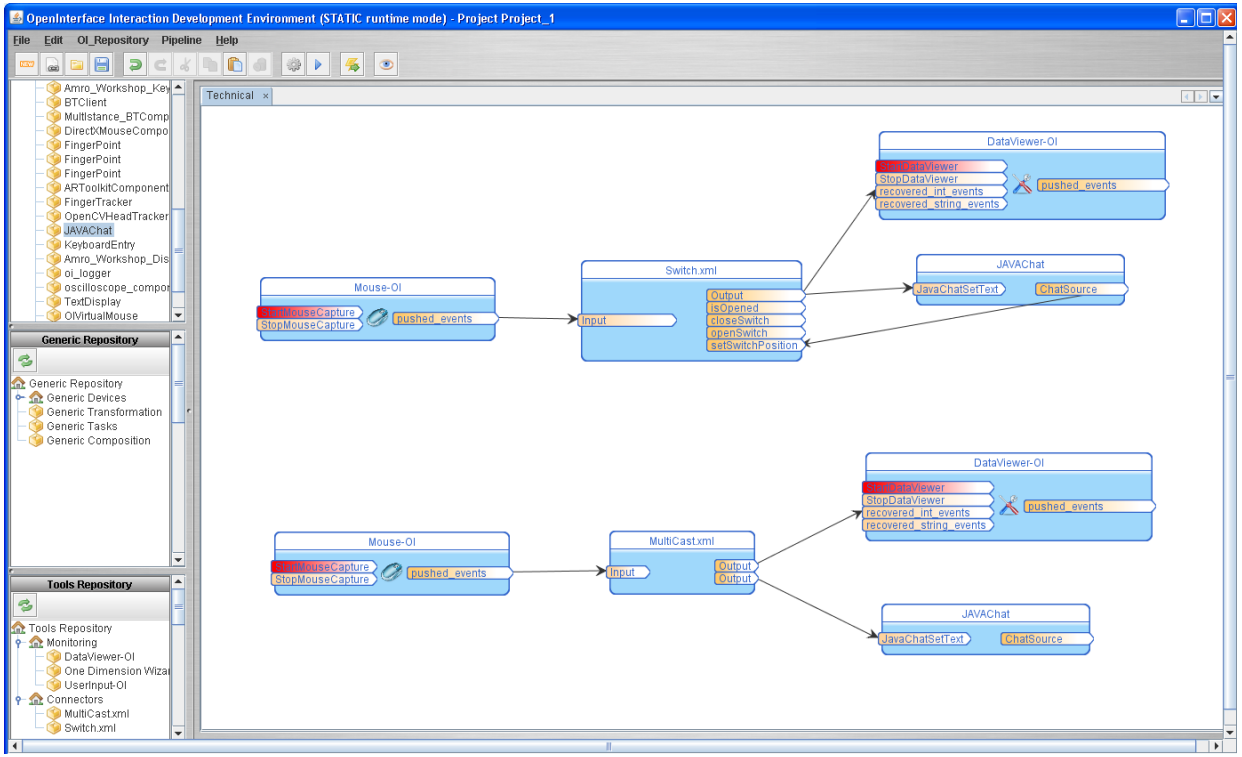
Implementation OpenInterface Framework

OpenInterface Framework
A tool for multimodal interaction

- www.oi-project.org
- The component-based OI framework is made of:
  - 1) Runtime kernel: underlying platform
    - Heterogeneous components:
      Java, C++, Matlab, Python, .NET
  - 2) Repository of interaction modalities
  - 3) OIDE
    OpenInterface Interaction Development Environment
    - Graphical Construction tool
    - Debugging / Logging tool

OpenInterface Framework

- OIDE: Graphical Interface
  - www.oi-project.org



Devices

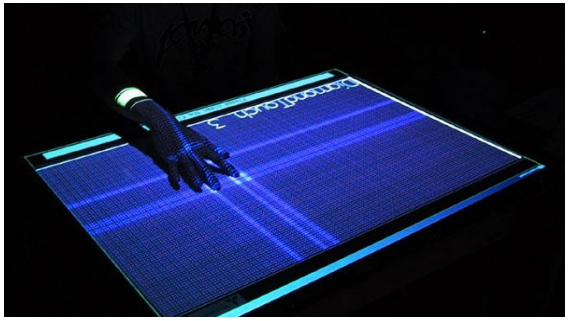
Transformation

Logging and Monitoring

Composition

Interactive Tasks

Implementation: OpenInterface Devices



Diamond Touch

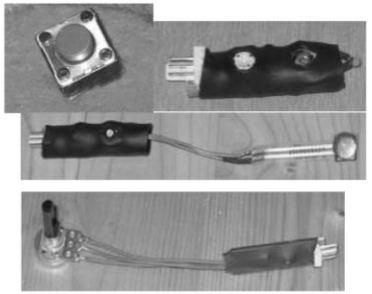
GPS

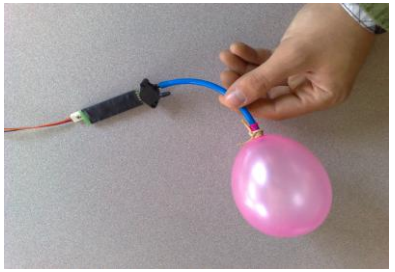
Shake

Wiimote

Track-IR

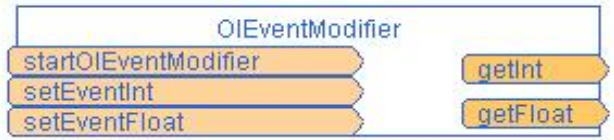
Power Mate



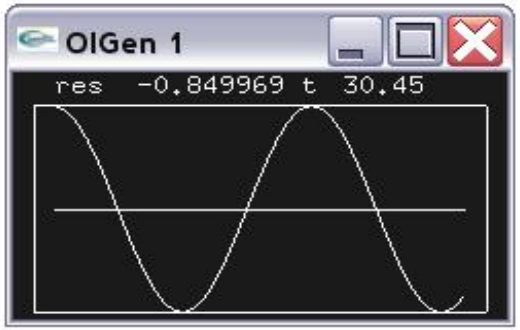


Interface-Z

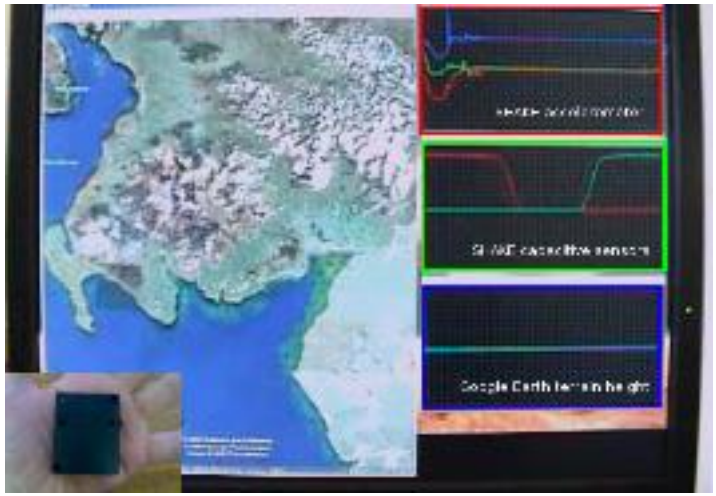
OpenInterface framework Adapters



Event Modifier
Python

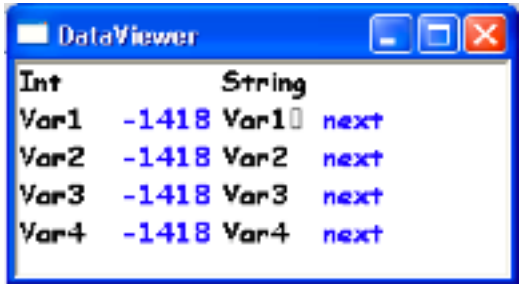


Automatic
Event Generator



Oscilloscope

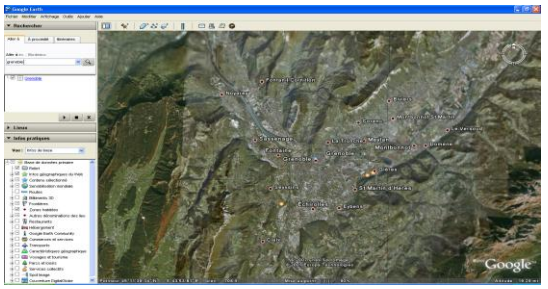
Manual Event
Generator



Data Viewer

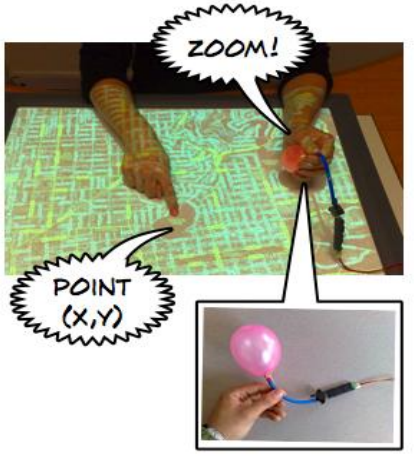
OpenInterface Applications

Game on mobile phone



Google Earth

Game on pc: speedycopter



Multimodal Map Navigator

Conclusion and Future Work

Conclusion

- Characterization Space of Software Components for multimodal interaction
  - Supports generic and tailored components
  - Different levels of abstraction
  - Data flow from input devices to interactive tasks
- Allows users with different technical backgrounds to use a tool implementing these characteristics
- Implemented in the OpenInterface (OI) framework
  - www.oi-project.org
- Several testbeds have been developed:
  - Map-based application
  - Game

Future Work

- Create the designer view in the graphical tool
- Relation between designer assembly and developer assembly
  - Iterative design process for multimodal interaction
- Enrich the framework with new generic components
- Focus on output multimodal response
  - Multiple display set-up
- Links between input and output components

Thank you for your attention

+ OpenInterface demo today

Questions ?