



LUDWIG-
MAXIMILIANS-
UNIVERSITÄT
MÜNCHEN

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Physical Computing – Sketching in Software

Medieninformatik Hauptseminar
Wintersemester 2009/2010
„Prototyping“





Overview

Introducing Physical Computing

Toolkits

Outlook



Physical Computing

- Building interactive physical systems with software and hardware that can integrate digital information with everyday physical objects.

- **Tangible Interfaces**

Adding sensor technologies to electronic devices – the physical input can control graphical or audio output.

- **Ubiquitous Computing**

Integrating computer elements into analog devices, to enter our everyday objects.



Prototyping

- Prototyping decreases:
 - Development cost
 - Development time
 - Reduces errors
 - Helps improve and evaluate the design & usability

Hardware toolkits

- Are connected to the software.
- Usually consist of sensors, actuators and displaying technologies.
- Popular toolkits – Arduino, Phidgets, Lego Mindstorms, Smart Its, Calder toolkit, ...



User Groups

- Sketching software is interesting to different user groups, which have different goals, and therefor need different toolkits.
 - Programmers
 - Designers
 - Domain experts
 - Non programmers
 - Children
- Visually programming is a good way to enable the users, with a low technical understanding.



Papier Mâché

- Developed by university of Stanford, Berkeley, and Washington since 2004
- Free and runs on Java, Phidgets for RFID, and is supported by Eclipse
- No hardware or connection knowledge required - ease everybody to use Papier Mâché.
- Abstracts input, which is tracked by a camera, tagged with barcodes, or RFID tags.
- Mapping the input into application behavior for tangible user interfaces.
- Once an Object is detected, it will behave in the way it was authored.



Papier Mâché

Current Phobs

- RFIDReaders
 - RFID Reader: ...
 - RFID Reader: 1027
- VisionPhobGenerators
 - VisionPhobGenerator: (Video Camera)
 - Bounds[227, 64, 255, 89]; Size[334]; Hue[173], Sat[77]
 - Bounds[148, 7, 219, 124]; Size[1753]; Hue[196], Sat[94]
 - Bounds[242, 85, 275, 107]; Size[323]; Hue[160], Sat[65]
 - Bounds[50, 148, 263, 238]; Size[4751]; Hue[80], Sat[56]
 - Bounds[22, 50, 63, 128]; Size[331]; Hue[121], Sat[135]
- BarcodePhobGenerators
 - BarcodePhobGenerator: (Video Camera)
 - PhobTag: 04777675130

Vision input (Video Camera)

00:00:46.65

Vision Processing

Edge Detection Thresholds

0 255 0 255 0 255

Update this VisionPhob Remove this VisionPhob

Classifier Map

TagPhob	AudioClip
VisionPhobGenerator: (Video Camera)	Visual Analogues (JPanel) for JPanel

New classifier Remove classifier

Association Map

Bounds[22, 48, 63, 127]; Size[335]; Hue[119], S...	JPanel
Bounds[22, 48, 63, 127]; Size[336]; Hue[119], S...	JPanel
0411330679	Message0.wav Length: 3.75 Positi...
Bounds[22, 52, 63, 127]; Size[320]; Hue[119], S...	JPanel
Bounds[22, 41, 68, 128]; Size[352]; Hue[122], S...	JPanel
Bounds[22, 33, 81, 127]; Size[383]; Hue[121], S...	JPanel
Bounds[50, 148, 263, 238]; Size[4712]; Hue[81],...	JPanel
Bounds[242, 85, 275, 107]; Size[321]; Hue[158],...	JPanel
Bounds[147, 7, 219, 124]; Size[1763]; Hue[199],...	JPanel
Bounds[227, 64, 255, 89]; Size[333]; Hue[173], ...	JPanel

Barcode Display

Decoded Value = 04777675130

Message0.wav Length: 3.75 Position: 0.0

Audio Clip: Message0.wav Length: 3.75 Position: 0.0

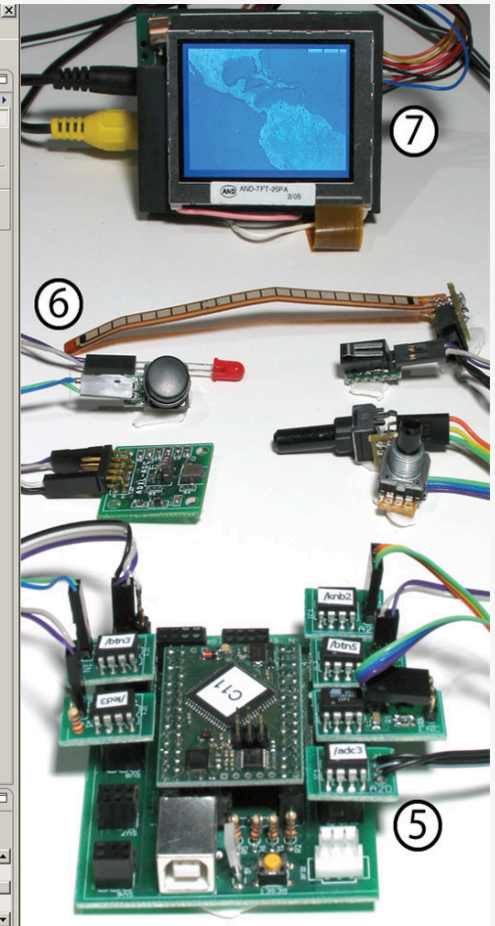
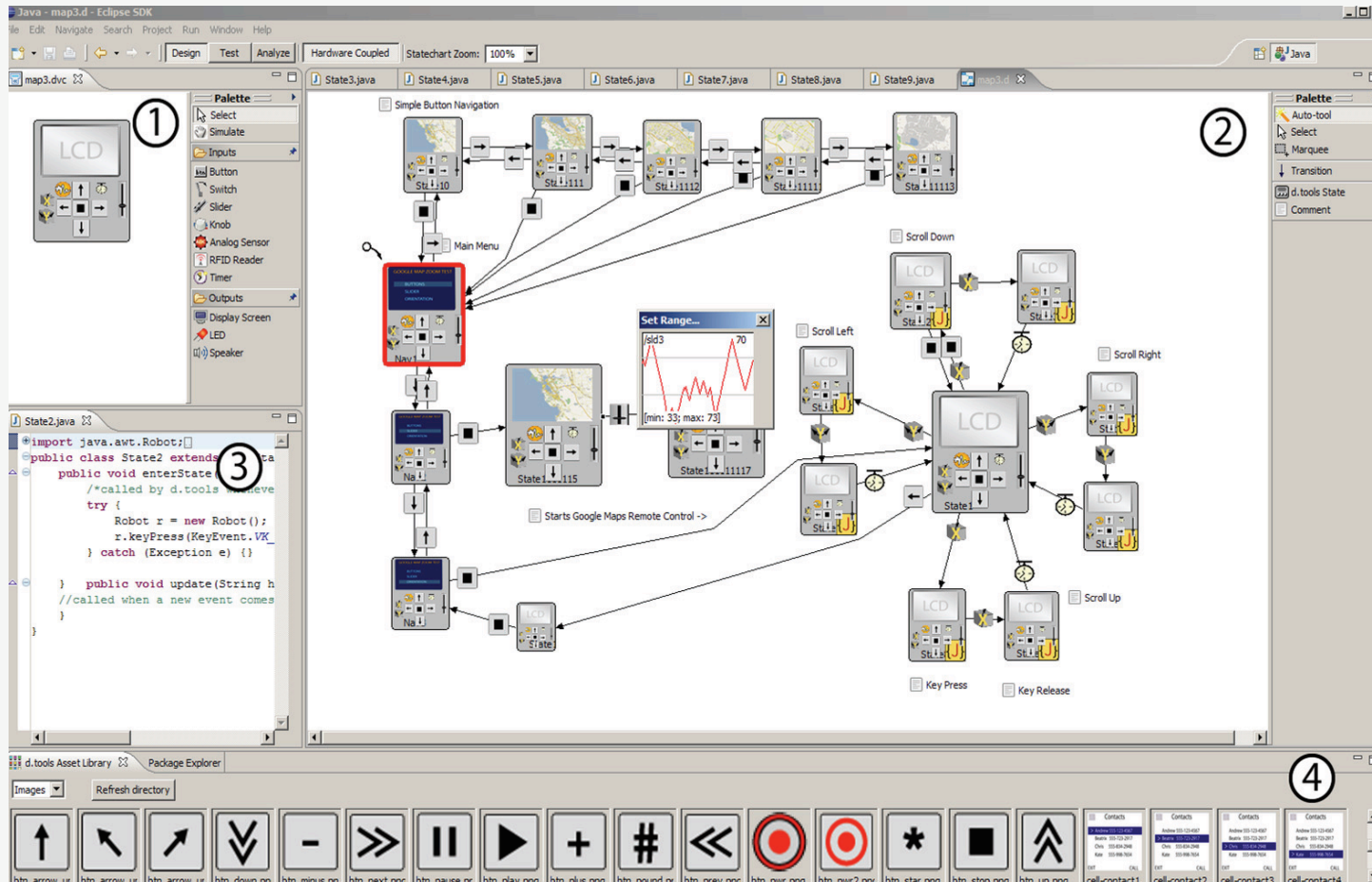
Source: Klemmer et al. (2004)



d.tools

- Developed by the Stanford university since 2006
- Free, editor as a Eclipse plugin, own hardware but Wiring and Arduino board can be connected and the Phidgets interfaceKit.
- Prototype digital cameras, MP3-players, and mobile phones.
- Workbench connected to hardware setup, which builds the device.
- The devices behavior is authored in the workbench.
- Offers Design-Test-Analyse mode for the prototype.

d.tools



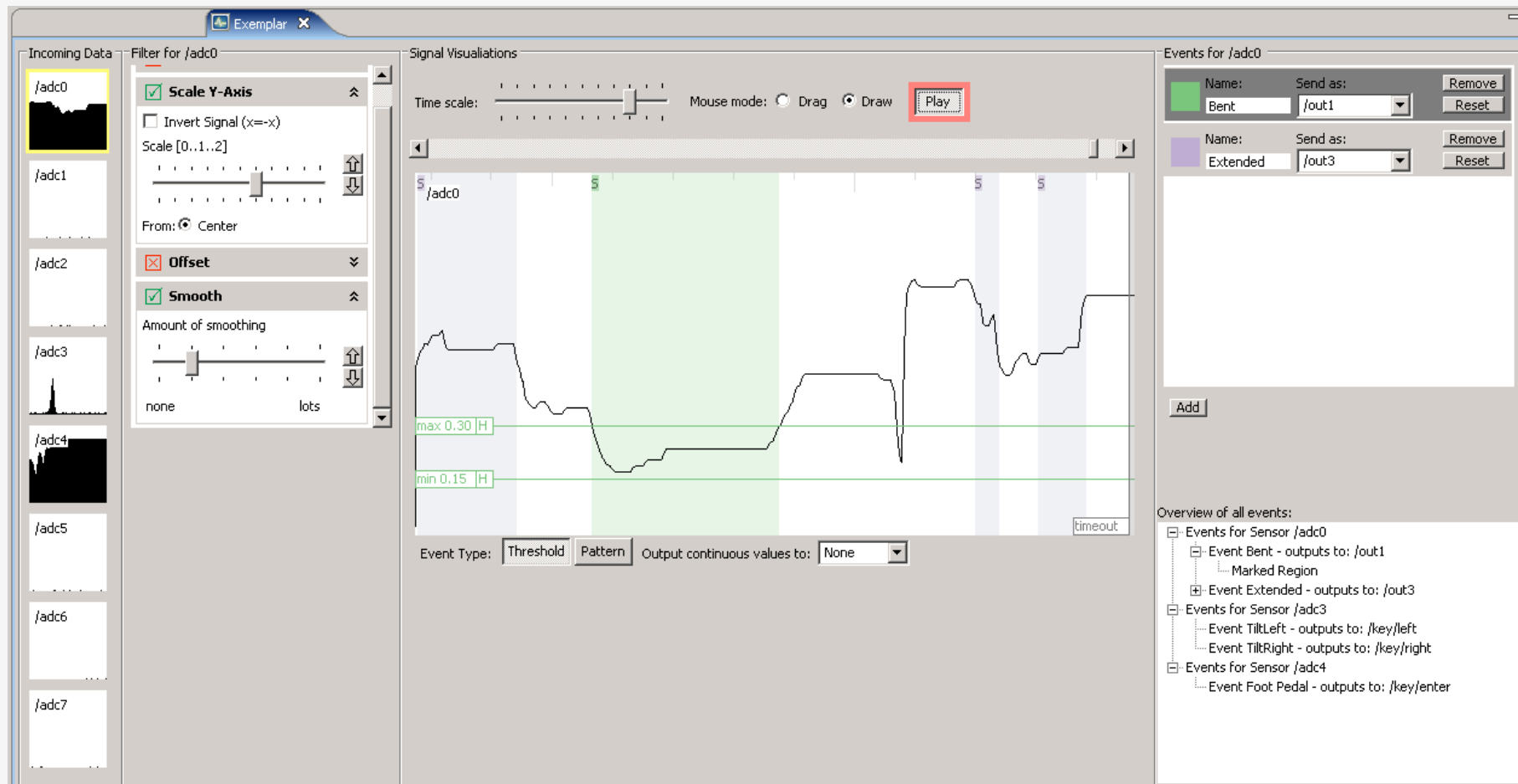
Source: Hartmann et al. (2007)



Exemplar

- Developed by the university of Stanford in 2006
- Corresponds to d.tools hardware interface.
- Free and works as a Eclipse plugin.
- Shows the sensor data from the hardware interface in a window.
- The data can be filtered and used for other applications, or the data can be turned into discrete events.

Exemplar



The screenshot displays the Exemplar software interface, which is used for signal processing and event detection. The interface is divided into several sections:

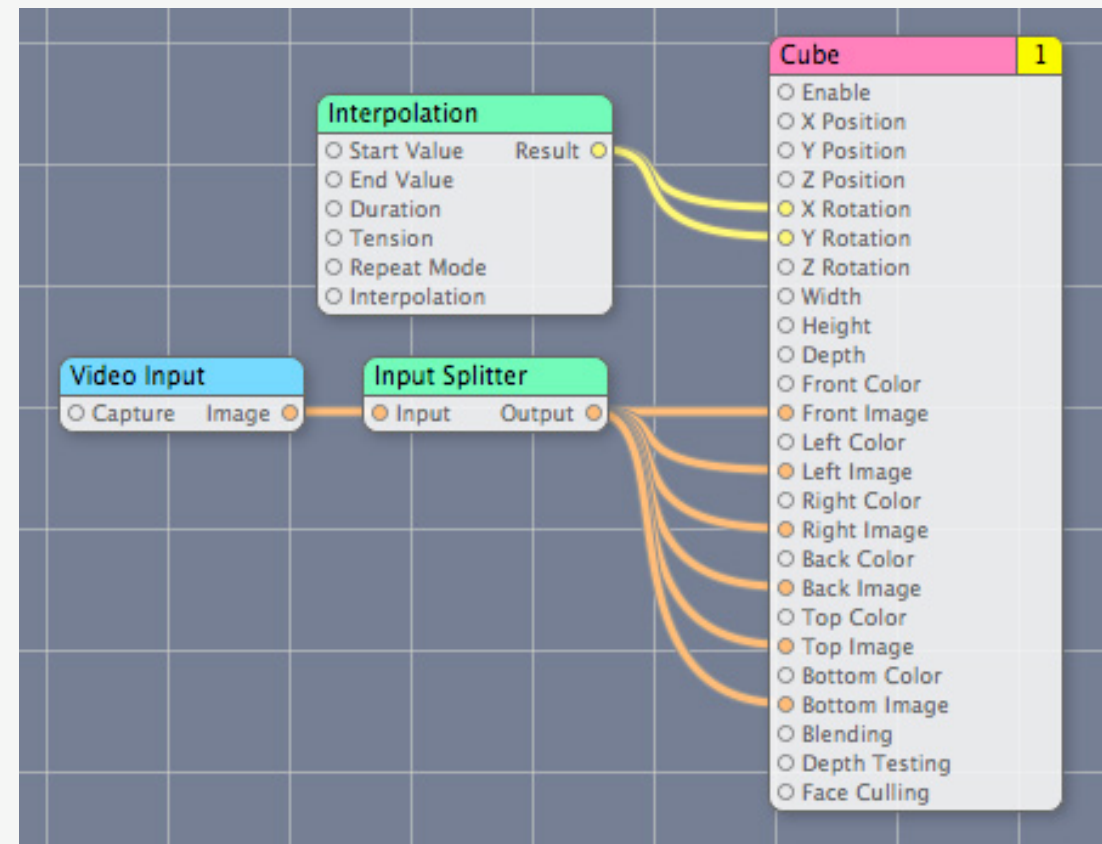
- Incoming Data:** A list of sensors from /adc0 to /adc7. /adc0 is selected and highlighted in yellow.
- Filter for /adc0:** A panel with various processing options:
 - Scale Y-Axis**: Includes an "Invert Signal (x=-x)" checkbox and a "Scale [0..1..2]" slider.
 - Smooth**: Includes an "Amount of smoothing" slider ranging from "none" to "lots".
 - Offset**: A checkbox for offsetting the signal.
 - From:** Set to "Center".
- Signal Visualizations:** A central plot area showing a signal waveform for /adc0. A green shaded region highlights a specific part of the signal. A "Play" button is visible in the top right of this section.
- Events for /adc0:** A panel on the right showing detected events:
 - Event Name: Bent, Send as: /out1, with "Remove" and "Reset" buttons.
 - Event Name: Extended, Send as: /out3, with "Remove" and "Reset" buttons.
 - An "Add" button is located below the event list.
- Overview of all events:** A tree view at the bottom right showing a summary of events for all sensors:
 - Events for Sensor /adc0: Bent (outputs to: /out1), Extended (outputs to: /out3).
 - Events for Sensor /adc3: TiltLeft (outputs to: /key/left), TiltRight (outputs to: /key/right).
 - Events for Sensor /adc4: Foot Pedal (outputs to: /key/enter).

Source: <http://hci.stanford.edu/research/exemplar/> (10.01.2010)



Quartz Composer

- Developed by Apple, since Mac OS X v10.4 „Tiger“, Xcode-development environment as visual programming tool for processing and displaying information.
- Programming environment for 3D and animation graphics.
- Patches are base processing units, that produce and execute results.



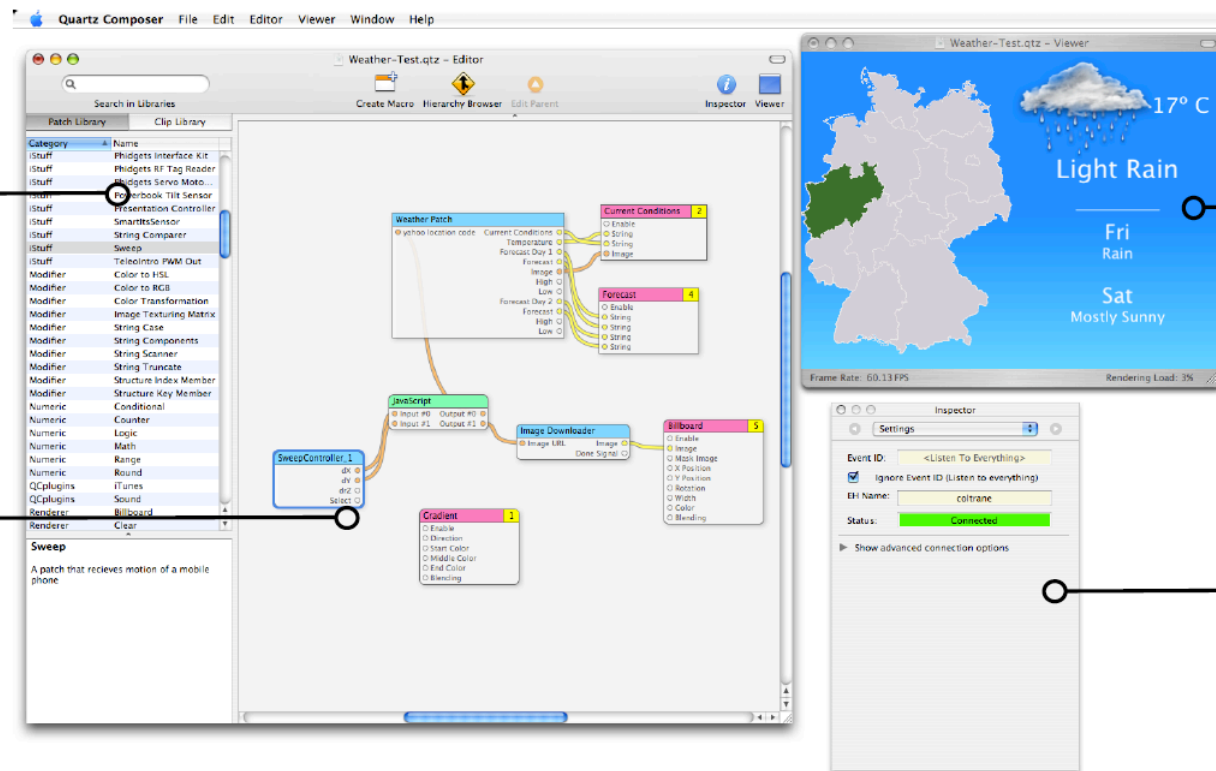
Source: <http://developer.apple.com/graphicsimaging/quartz/quartzcomposerfordashboard.html> (10.01.2010)



iStuff Mobile

- Developed by the RWTH Aachen in 2007
- Works with Smart-Its sensors.
- Enables to build new mobile phone applications and interactions.
- Communicates with visual programming environment – using a reversion of the Quartz Composer.
- Build new sensor based interfaces with existing mobile phones, by adding new hardware.

iStuff Mobile



The library is used to select which components are used in the composition.

The workspace is where components are linked together to form a composition.

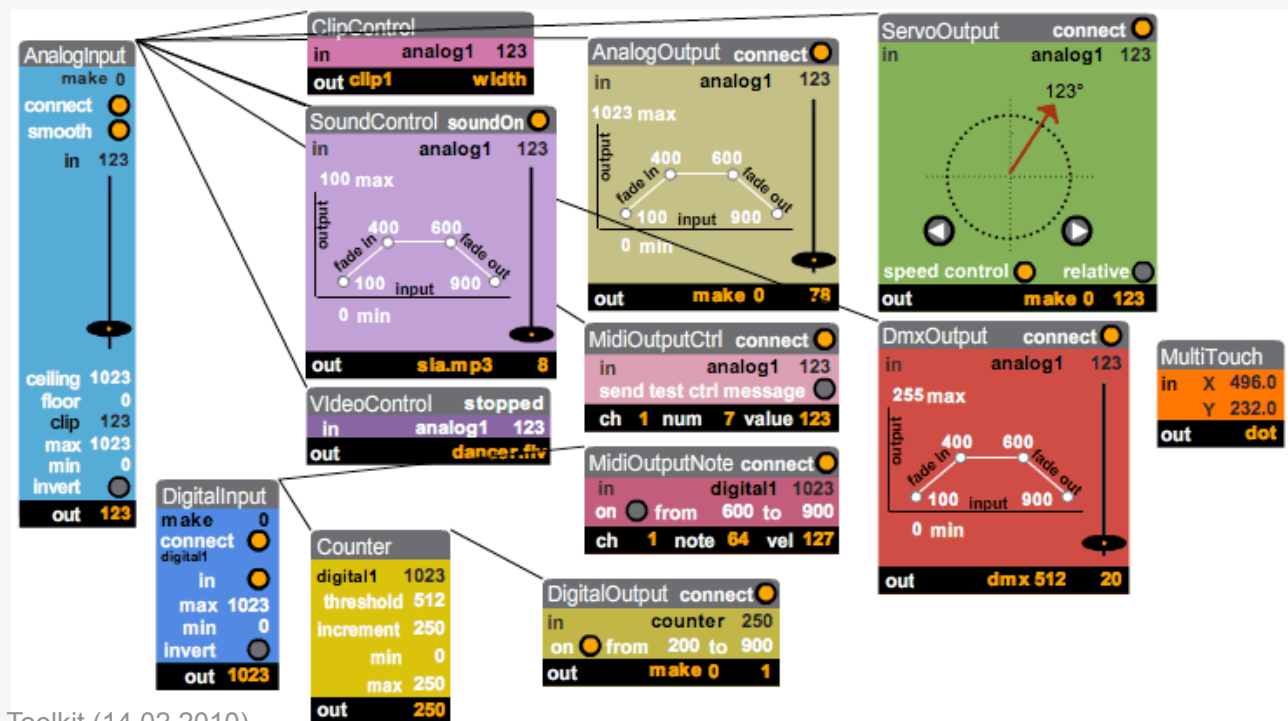
The preview window is live. The 3D animation immediately shows the impact of the designer's changes.

The inspector window allows the designer to adjust parameters and settings of the different library components used in the composition.

NETLab toolkit

- Developed by the college for design in Pasadena in 2007.
- Free and based on Flash, uses Arduino

- Made for designers and students
- Control motors or video projections with sensors, slides, etc.



Source: http://newecologyofthings.wik.is/NETLab_Toolkit (14,02,2010)

EduWear

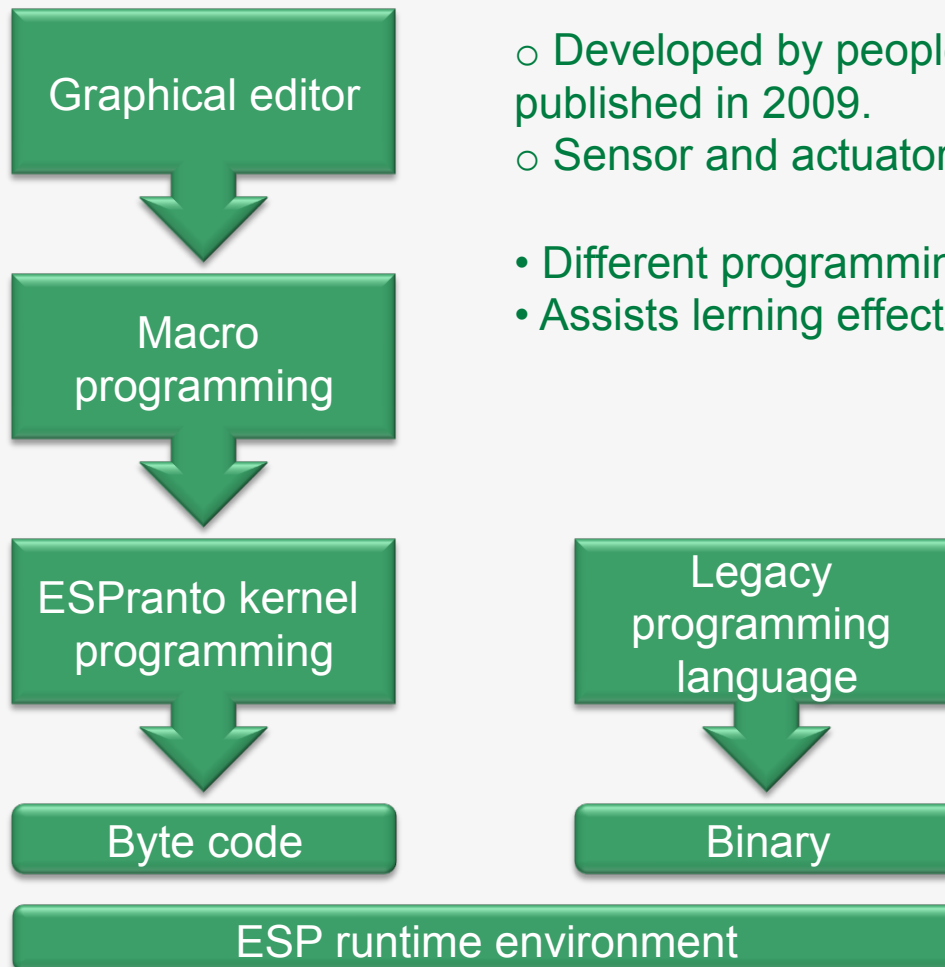
- Developed by the university of Bremen in 2007.
- Uses Arduino for Switches, LED's and actuators, and textile technologies
- For children
- Adding functionality to cloth.
- Programming visually with „Amici“



Source: Reichel (2007)



EsprantoSDK



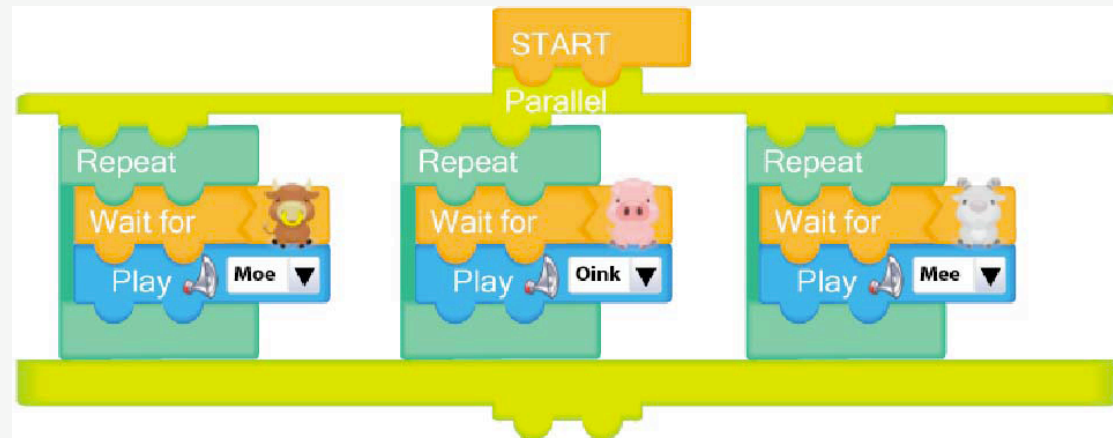
- Developed by people from Philips and SeriousToys, published in 2009.
- Sensor and actuator based application.

- Different programming layers for different user-groups.
- Assists learning effects to rise in programming layer.



EsprantoSDK

- Graphical layer with puzzle pices.
- Translated into macro code.



```
repeat (waitFor Cow;  
        play Moo)  
|  
repeat (waitFor Pig;  
        play Oink)  
|  
repeat (waitFor Sheep;  
        play Mee)
```



Outlook

- Becoming more portable to other architectures.
- Visual programming enables a larger user group.
- No „universal“ toolkit.
- Sketching software is becoming more important.



? ? ? Questions ? ? ?