4 Fundamental Issues in Multimedia Programming

4.1 Multimedia Programming in Context

Looking Back: Central Issues & Alternative Approaches

The Purpose of All This?

4.2 History of Multimedia Programming

4.3 A Radically Alternative Approach: Squeak

4.4 Trends and Visions
Looking Back

• Example technology Flash & ActionScript
  – Extremely powerful for creating pseudo-realistic 2D animations
  – Smooth integration of various media into one consistent user experience
    » Information retrieved and computed from various sources
    » Images, still and in motion
    » Sound, including spatial sound effects
  – Much more efficient than plain programming
  – Still painful coding for complex tasks

• Managing multimedia projects
  – Much more activities than in traditional programming-only projects
    » Production of creative idea, storyboard, graphics, sound
  – Requirements often become clear in parallel to evolution of the system
    » Employ iterative/evolutionary process models (e.g. XP)
Key Issue: Code vs. Pictures

Graphically Oriented Authoring:
- Drawing pictures
- Using graphical metaphors (e.g. timeline)

Text-Oriented Programming:
- Writing code
- Using general-purpose or specialized language

How to mix code and pictures? Three types of programs:

**Type C:** Code only, no pictures, no metaphors:
- Suitable only for logic-intensive programs with very simple graphics

**Type CP:** Large share of code and pictures, limited use of metaphors:
- Suitable for most highly interactive programs like games
- Timeline was used sparsely in game examples

**Type P:** Small share of code, large share of pictures, use of metaphors:
- Suitable for mostly fixed interaction like product presentation
- Timeline main tool for defining control flow
Programming Language Issues

• General-purpose language (like Java) or specialized language (like ActionScript) ?

• General-purpose language:
  – Pure text languages like Java, C++ etc:
    » Difficult to integrate with graphical authoring tool
    » Can be complemented with multimedia frameworks (e.g. Java Media Framework)
  – Highly interactive language built for graphical development environment
    » See below (Example Smalltalk/Squeak)

• Specialized multimedia language:
  – Typically scripting language with immediate execution (interpreted)
  – Additional training effort for developers
  – Additional development effort for tool/language designers

• Compromise taken e.g. by Macromedia with ActionScript:
  – Specialized language which is mostly identical to a standard language (ECMAScript)
Authoring Tool Paradigms

Screen-based authoring
– Examples: Apple HyperCard, Asymetrix ToolBook
– Time dimension only indirectly described

Timeline-based authoring
– Example: Macromedia Director
– Time dimension main principle of design

Flowchart-based authoring
– Example: Macromedia Authorware
– Media objects as nodes in a flow graph
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Literature:


Why Multimedia Programming?

• What, in the first place, was the motivation for all this?
  – Creating an immersive experience for users of computer systems
    » Not a real answer, but a circumscription
  – Giving people fun in using computer applications?

• Why should we want to give people fun in using computers?
  – Destructive answer: To attract customers to specific products
    » Neil Postman’s criticism: Culture replaced by shallow attractions
  – Constructive answer: To improve efficiency of working
    » Justifies only limited amount of multimedia interaction
  – Neutral answer: Fun is not the central aspect, multimedia is just the natural way of communicating
  – Humanistic answer: To empower those people to use computers, which do not want/can use the un-natural forms of interaction of most man-machine interfaces
    » E.g. children!

• Where does the idea of multimedia programs come from?
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Literature:
Mark Guzdial: History of Squeak
Lecture notes at http://coweb.cc.gatech.edu/cs2340/3608

http://minnow.cc.gatech.edu/squeak/3139
Ivan Sutherland’s Sketchpad, 1963

First object-oriented drawing program
Master and instance drawings
Rubber bands
Simple animations
Alan C. Kay

• U. Utah PhD student in 1966
  – Read Sketchpad, Ported Simula
• Saw “objects” as the future of computer science
• His dissertation:
  Flex, an object-oriented *personal* computer
  – A *personal* computer was a radical idea then
  – How radical?

"There is no reason anyone would want a computer in their home."
(Ken Olsen, Digital Equipment Corp, 1977)

Further stations of Alan Kay’s life:
– Stanford Artificial Intelligence Laboratory
– **Xerox PARC**
– Apple, Atari
– Disney Interactive
– Viewpoints Research Institute
– Hewlett-Packard

from M. Guzdial
The FLEX Machine

• “A personal computer for children of all ages”
• Includes pointing device
The Dynabook Vision

- Small, handheld, wireless(!) device – a new *medium*
- Can be used creatively by everybody, in particular children, for learning
- Xerox PARC Learning Research Group, early 70s

Tablet PC, 2004
Xerox PARC Learning Research Group: Smalltalk-72

- Object-oriented programming system
  - Mouse
  - Windows
  - Icons
  - Pop-up menus
- Uses simple object-oriented language “Smalltalk”
- Idea of user interface: Make computers easy to use for everybody
- Idea of language: make programming both more simple and more powerful (e.g. include multimedia: sound)
The Alto

- The machine the prototype of which impressed Steve Jobs so much that he decided to produce the Lisa/Macintosh kind of computers for the mass market (1979)
  - Graphical user interface
  - Networked via Ethernet
  - Programming language Smalltalk
Smalltalk and Learning

• Original intention of Smalltalk:
  – Make the programming system so intuitive that children can use it
  – In fact a first multimedia authoring system
  – Children projects at Xerox PARC

• What happened to Smalltalk?
  – Becomes commercially targeted programming language
  – ParcPlace
  – Smalltalk-80

• Smalltalk is still the environment in which most programming inventions appear:
  – Design patterns
  – Extreme programming

(We will have a look at Smalltalk syntax and environment later on.)
Back to the Future: Squeak

• 1995: Alan Kay, Dan Ingalls, Ted Kaehler at Apple
  – Still want "A development environment in which to build educational software that could be used—and even programmed—by non-technical people and by children"
  – Build on Open Source Software strengths
    » Use the distributed power of Internet-based programmers
  – Available Smalltalk versions had lost many media capabilities

• Later on, the Squeak team moves to Disney
  – “its all about media”

• Multimedia in Squeak:
  – 16 voice music synthesis
  – 3-D graphics, MIDI, Flash, sound recording
  – Network: Web, POP/SMTMP, zip compression/decompress
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Literature:
www.squeakland.org
Electronic Toys: EToys

Alan Kay, EToys and Simstories in Squeak

• “EToys are computer environments that help people learn ideas by building and playing around with them. They help an “omniuser” - usually a child - create a satisfying and enjoyable computer model of the idea and give hints for how the idea can be expanded. SimStories are longer versions of Etoys that - like essays - string several ideas together to help the learner produce a deeper and more concerted project. A good motto for Etoys and SimStories is: We make not just to have but to know. Another motto that applies here is: Doing with images makes symbols. That is, the progression of learning moved from kinaesthetic interactions with dynamic images to a symbolic expression of the idea.”
Etoys: Example “Car Race” (1)

• Step 0: Create a new empty project
• Step 1: Draw the things with which we want to play
  – Very simplistic bitmap-oriented painting tool
• Step 2: “Keep” the drawing
  – We get a Squeak object
    » Free form, not square
  – Can be moved around
“Halo” of a Squeak Object

- The “halo” is a circular graphic menu which can be invoked on any object by a mouse click (depending on playfield configuration often just by mouse over, always with Ctrl-click).
Squeak Viewers

• Step 3: Create a viewer (e.g. via the object’s halo)

• A viewer shows categories of properties and commands for objects
  – Many different categories
  – Origin: Object is derived from a subclass in a complex class hierarchy

• Commands can be immediately executed (exclamation mark button)

• A viewer always creates its own flap for quickly showing and hiding the viewer

• A viewer can show many different categories in parallel
Squeak Scripts

- A *script* is a simple sequence of commands which can be executed under user control or automatically through a timer ("ticking").
- Scripts are represented by graphical windows, segmented into tiles, and are created in a full drag-and-drop style.
- Step 4: Create a script by dragging the "empty script" onto surface.
- Step 5: Add the forward command by dragging it from the Car viewer.
- Adjust the parameter(s)
Running a Script

- Step 6: To control all scripts, use a new script control object.
  - To be found under the “Widgets” flap, like many other helpful tools
- All scripts of the project are simultaneously started and stopped through one button
  - Again just one drag operation to instantiate the object
- Example: Now car can be “driven” forward (till the border of the screen)
Object Interaction in Scripts

- Parameters of script commands can be computed from other objects’ properties (by dragging the property onto the parameter location)
- Local adjustments can be added at the end (factor, offset etc.)
User Control through Graphical Objects

- Graphical manipulations can be used to control other objects
- Example:
  - Steering wheel graphics
    - Drawn by hand
    - Viewer attached
  - Rotated by user (e.g. through halo operations)
  - Heading of wheel is transferred to car
  - A “servo steering” i.e. a less sensitive transfer is recommendable
Watcher

• The values of object properties can be easily shown on the screen
  – Updated regularly and automatically
• Technically, this is an “Observer” mechanism
  – Hidden behind simple drag&drop interface
• Watcher:
  – Simple watcher (value), Detailed watcher (value plus label)
  – Can be obtained from menu left of property (in viewer)
  – Can be placed anywhere on screen
Sensors for Environment

- Squeak objects can easily observe where they are currently located
  - Through coordinates
  - Simpler: through colours
- Sensors:
  - Realizable as special parts of the graphics with a unique colour
  - “color x sees color y” test: Which colour is below the sensor?
- Example:
  - Grey road, car with two sensors
  - Alert lamp shall go red when one of the sensors is not on road
Example: Alert Lamp

Test tile
Test on left sensor
Alert lamp
Test on right sensor
Assignment
(dragging the green-on-purple arrow right of properties)
Example: Auto-Steering

- Interaction among objects can be designed in communication loops

- Example:
  - Car automatically moves forward
  - Sensor detects border of road
  - Car automatically steers to stay on the road

- Enables complex interactive learning experiences (setting up feedback loops)

Wheel control better removed at this stage?