X3D-UML:
3D UML State Machine Diagram

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Modeling, Website Development

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X3D-UML research is Paul McIntosh’s Ph’D Thesis
Outline

• Motivation
• Initial X3D-UML
• Refined X3D-UML
• Limitations
• Applications
Motivation
Fig. 13.
Fig. 15.
Fig. 14.
Motivation

• Hypothesis:
  ➢ Having advantages of separate sub-state diagrams
  ➢ Having the ability to view the state machine diagram as a whole
X3D-UML

- XSLT (eXtensible Stylesheet Language Transforms) to translate source code data into X3D.

- XMI (XML Metadata Interchange) to integrate X3D more easily with UML data—The basis of a UML diagram library for X3D

- 3D Visualization: X3D (eXtensible 3D)—adding a “z” value to the existing Diagram class, to create a depth position.
X3D-UML

- X3D-UML: 3D UML State Machine Diagram

http://www.youtube.com/watch?v=pghZMZJB3MU&feature=related
Cognitive Off-Loading (in Theory)

- Refining implementations, fixing bugs and adding new features

2D Case

3D Case

3D Case with event notation
Initial X3D-UML

Event notation provides a visual summary of where events are handled
Feedback

“Is there measurable benefit in a state machine diagram which makes use of 3D?”

“evaluate the 3D state machine diagram examples given, against the task of refactoring existing state machine diagrams.”

- Layout needs to be improved so 3D diagram is usable.
- Not easy to navigate.
- Need a stronger visual link between substrates and superstates
- Exclude non-relevant state branches would be helpful.
- Event notation lines suggested incorrect relationships
Refined X3D-UML

Event notation summaries were listed at the bottom of diagrams. Transparent connection “cones” visually linked superstates and substates.
Refined X3D-UML

- X3D-UML: 3D UML State Machine Diagram

http://www.youtube.com/watch?v=gcgQajTXVrA&feature=related
More refinements to come...

Paul McIntosh
RMIT PhD Student
Limitations
Complicated Case

- **X3D-UML: 3D UML Visualization of Java3D Source Code**

[YouTube Video Link](http://www.youtube.com/watch?v=aTJvRhbOVUQ)
X3D-UML: 3D UML Visualisation of Java3D Source Code
by internetscooter

```
LwaBackground
  <Class>
  solidBackdrop
  color
  zenithColor
  skyColor
  groundColor
  nadirColor
  backgroundObject
createJava3DObject
getObjectNode
printIVals
```

Replay
Limitations

• Rendering computation in real time
• Not empirically tested on complicated cases.
• No (or rarely) definitive research into the overall benefit of completing critical tasks with UML extended using 3D visualizations.
• No (or rarely) definitive research into the comparison between 2D UML & 3D UML extension.
To Refine further......

Need larger, final empirical user testing
Applications
Augmented Reality

X3D-UML: 3D UML + hardware through ARToolkit

http://www.youtube.com/watch?v=gDb1wN1YAfM
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Visualisation generated through ARToolkit
www.hitl.washington.edu/artoolkit/
Visual Debugging (2010)

• X3D-UML: 3D UML Mechatronic Diagrams

http://www.x3d-uml.org/Publications/2010_ASWEC%3a_X3D-UML%3a_3D_UML_Mechatronic_Diagrams
Student
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Assistance + Supervisor
Paul McIntosh
Summary

• 3D Visualization, one more degree of freedom.

• X3D-UML and its applications
  – Initial model
  – Refined model
  – Limitations

• Augmented Reality
END

(Thank you)
Discussion

• Have you used 3D Modeling Visualization before?
  – Share experience

• Will you use 3D Modeling Visualization in the future?
  – Why and Why not?
Discussion

• Managing models + 3D Visualization?
  – Model merging, slicing, coloring ......
  – Any new problems when we manage models in 3D ?
Sequential Evaluation Methodology

• A methodology for testing 3D user interfaces, which uses a sequence of qualitative and quantitative usability techniques ordered.
  – User Task Analysis
    • (Survey & Implementation)
  – Heuristic Evaluation
    • (Feedback & Response)
  – Formative Evaluation
    • (Refinement)
  – Summative Evaluation
    • (Finalizing & Empirical testing)
Survey, Analyzing requirements

“Is there measurable benefit in a state machine diagram which makes use of 3D?”

• Analyzing actual users’ requirements
  – Users who use IBM Rational Rose RealTime Models (RoseRT)
  – A survey of 1004 state machines, from four independent companies. (33.58%~64.66% of all states existing at substate levels)

• High level tasks
  ➢ pen + paper designs and “in the head” thinking)
  ➢ Translating design into implementation
  ➢ Refining implementations, fixing bugs and adding new features
  ➢ Testing implementation

• [30%~40% of state machines are refactored] per week
2D VS 3D
GMF 3D Editor

http://www.youtube.com/watch?v=lvB8cP7_x34
3D view?
Reference

- X3D-UML http://www.x3d-uml.org/
- 2005 Web3D: X3D-UML: enabling advanced UML visualisation through X3D
- 2008 LED: 3D UML Heuristic Challenge
- 2008 MODELS: X3D-UML: 3D UML State Machine Diagrams
- 2009 Information Visualization: Eclipse GEF3D: Bringing 3D to existing 2D editors
- 2010 ASWEC: X3D-UML: 3D UML Mechatronic Diagrams

- Margaret Hamilton http://goanna.cs.rmit.edu.au/~mh/
- Paul McIntosh http://www.internetscooter.com/

- GMF 3D Editor - Set Domain Model References http://www.youtube.com/watch?v=lvB8cP7_x34