
X3D-UML: 3D UML State Machine Diagram

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@ 2008, ACM/IEEE 11th International Conference on Model Driven Engineering
Languages and Systems

-presented by Luke Liu

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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

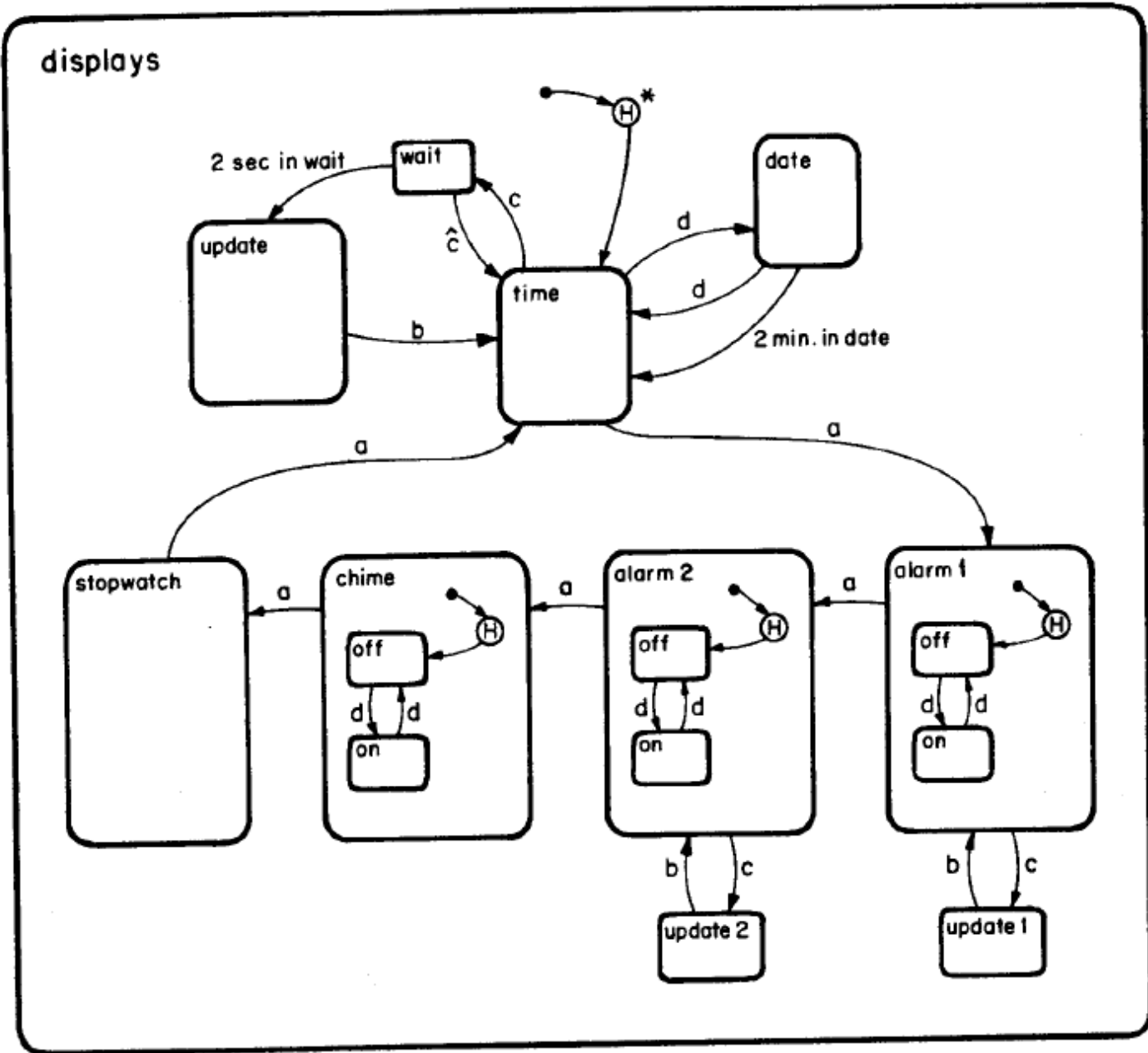


Fig. 13.

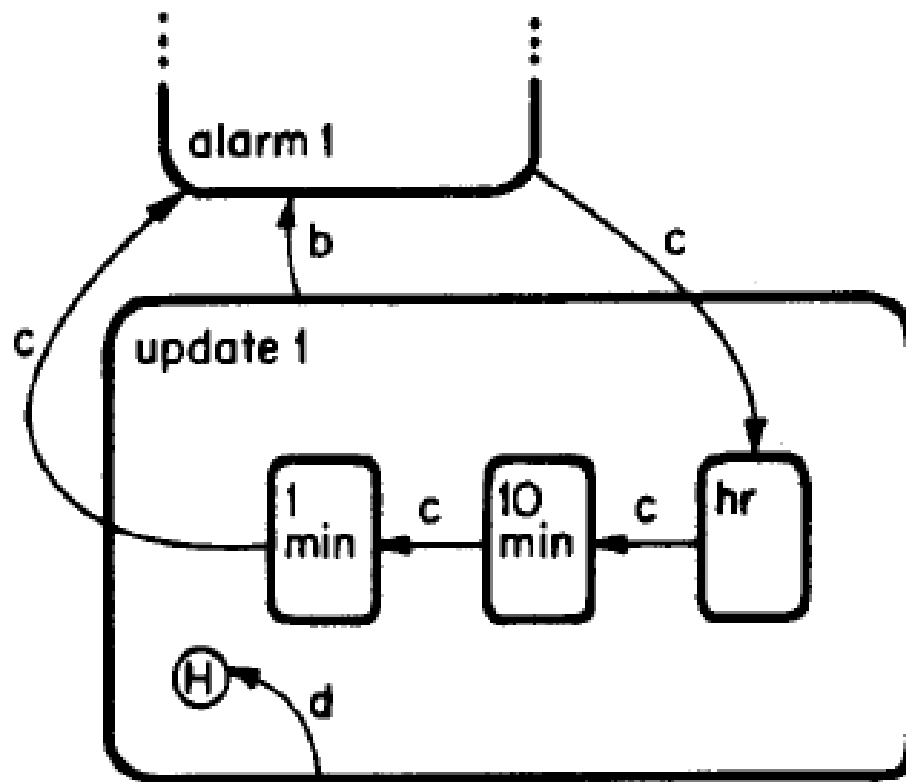


Fig. 15.

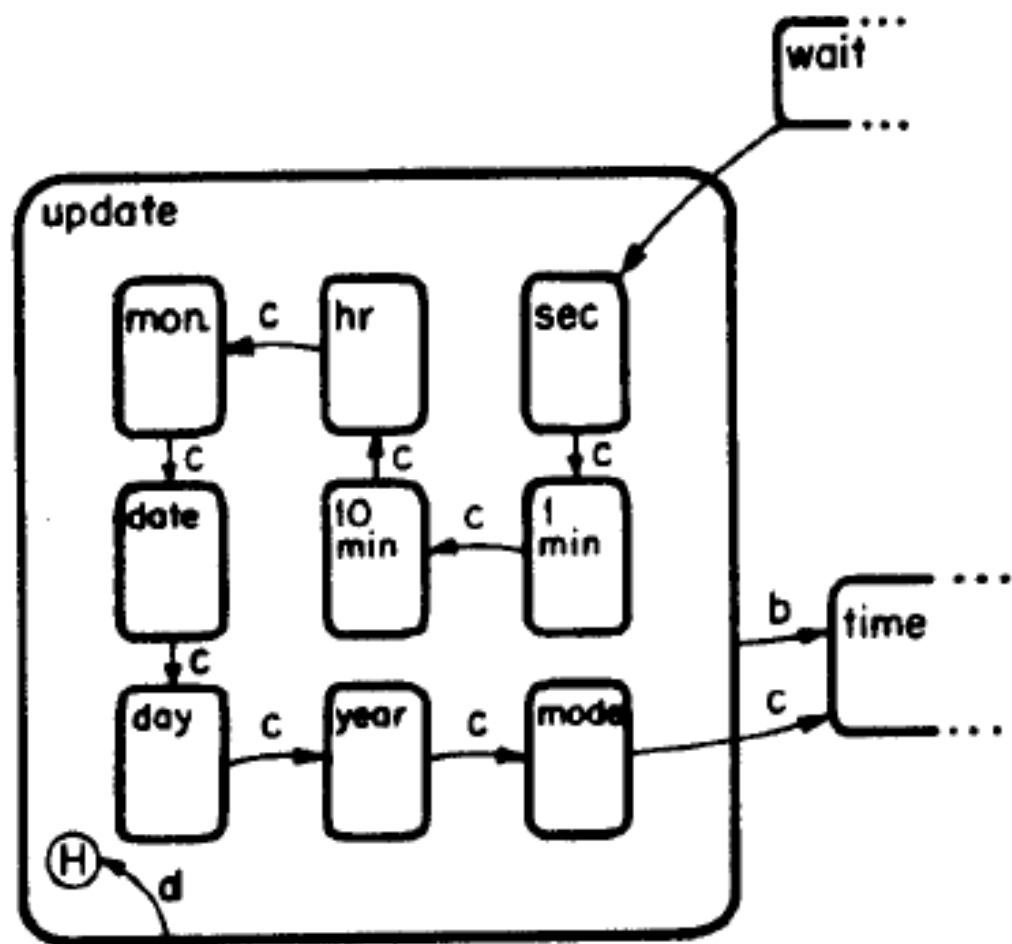
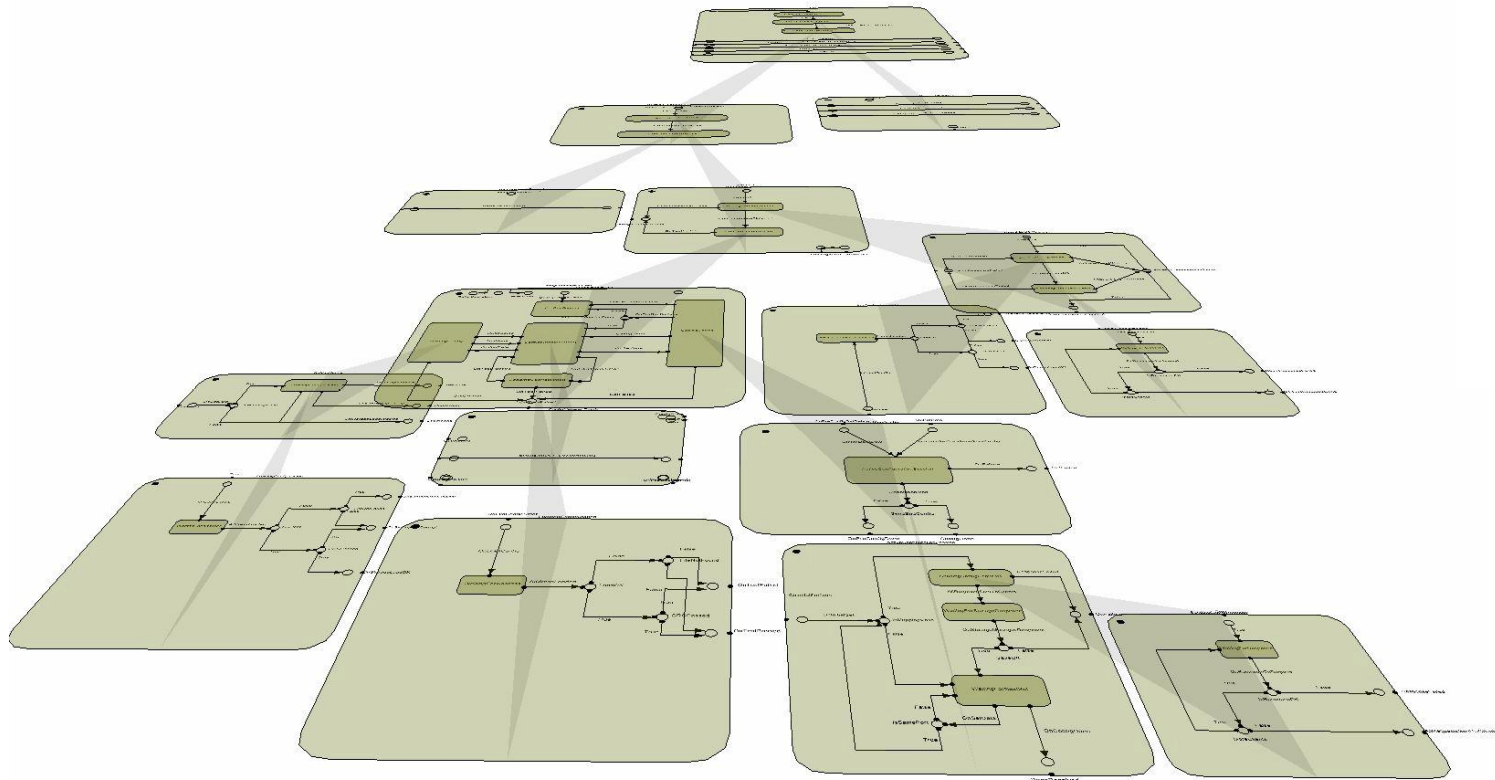


Fig. 14.

Motivation

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

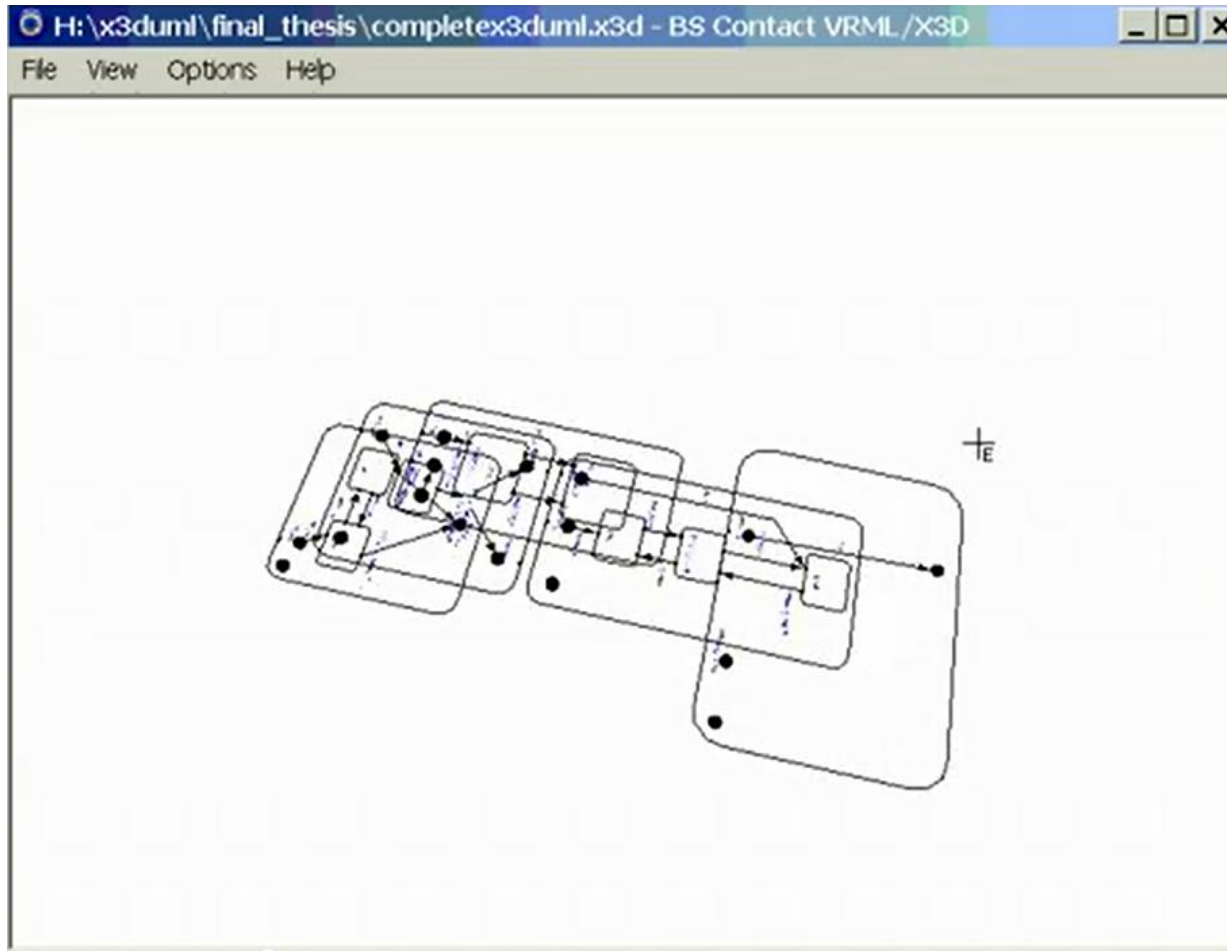


X3D-UML

- 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**

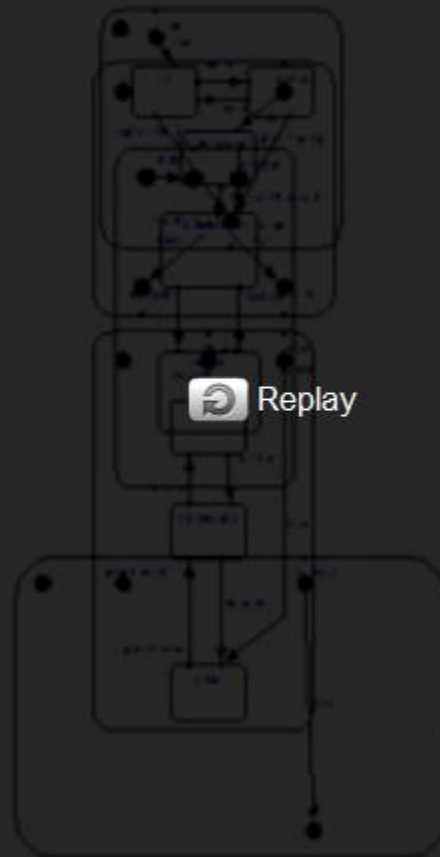


<http://www.youtube.com/watch?v=pghZMZJB3MU&feature=related>

X3D-UML: 3D UML State Machine Diagram

by internetscooter

File View Options Help



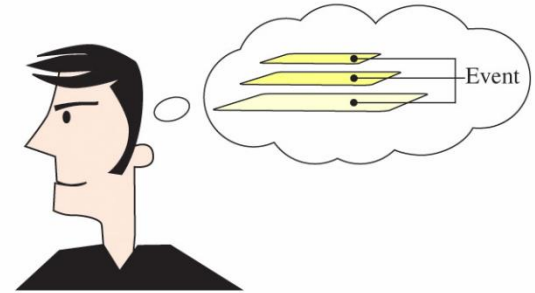
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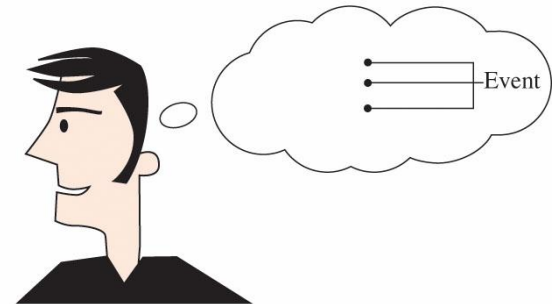
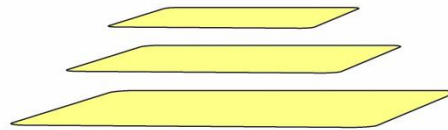
Cognitive Off-Loading (in Theory)

- Refining implementations, fixing bugs and adding new features

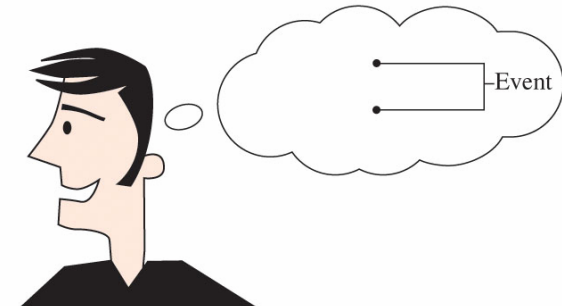
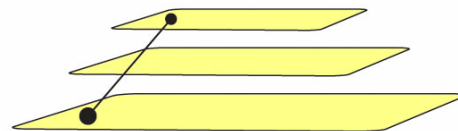
2D Case



3D Case

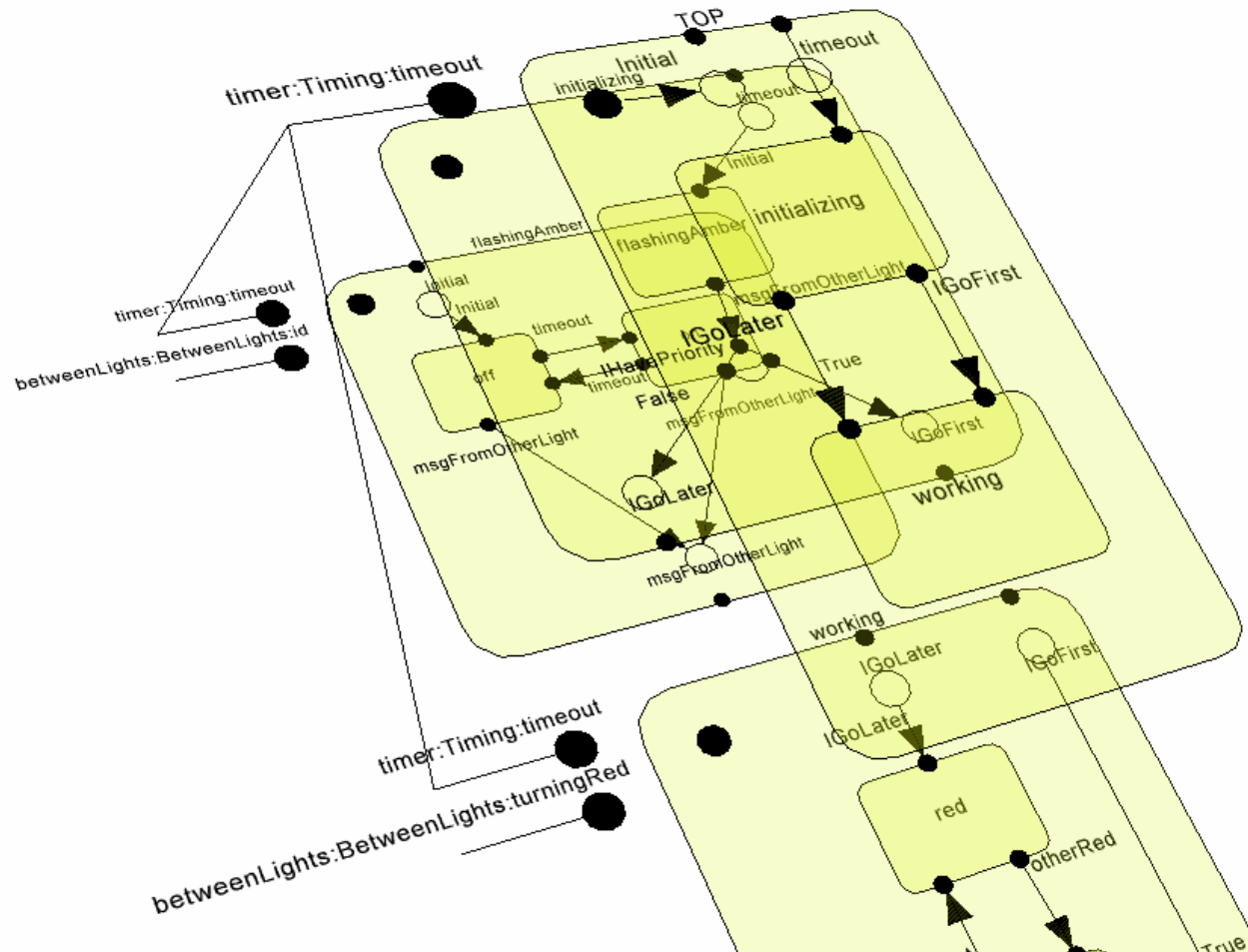


3D Case
with event notation



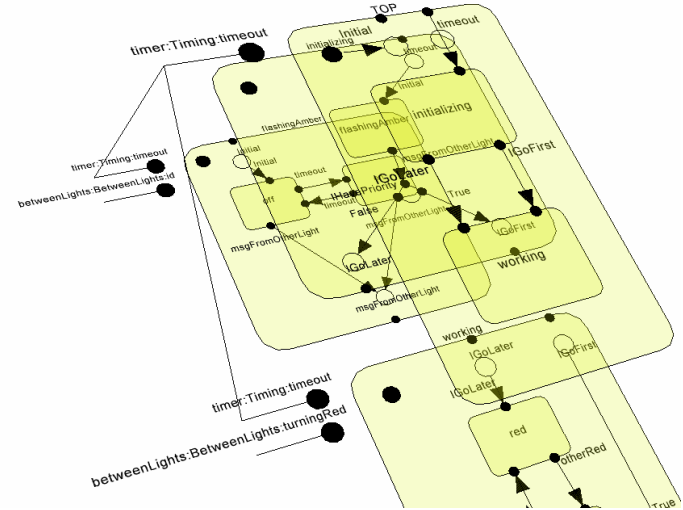
Initial X3D-UML

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?”

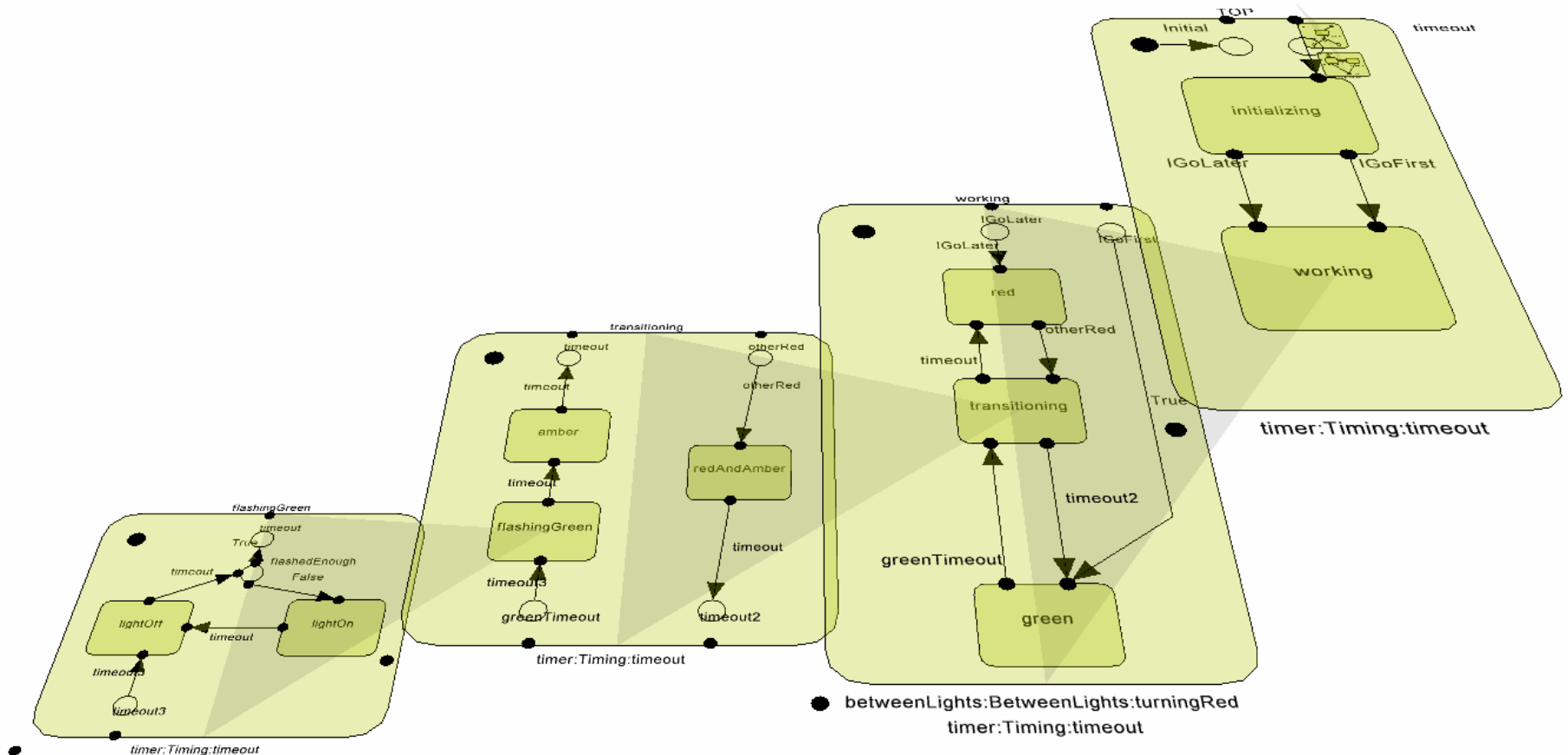


“evaluate the 3D state machine diagram examples given, against the task of refactoring existing state machine diagrams.”

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

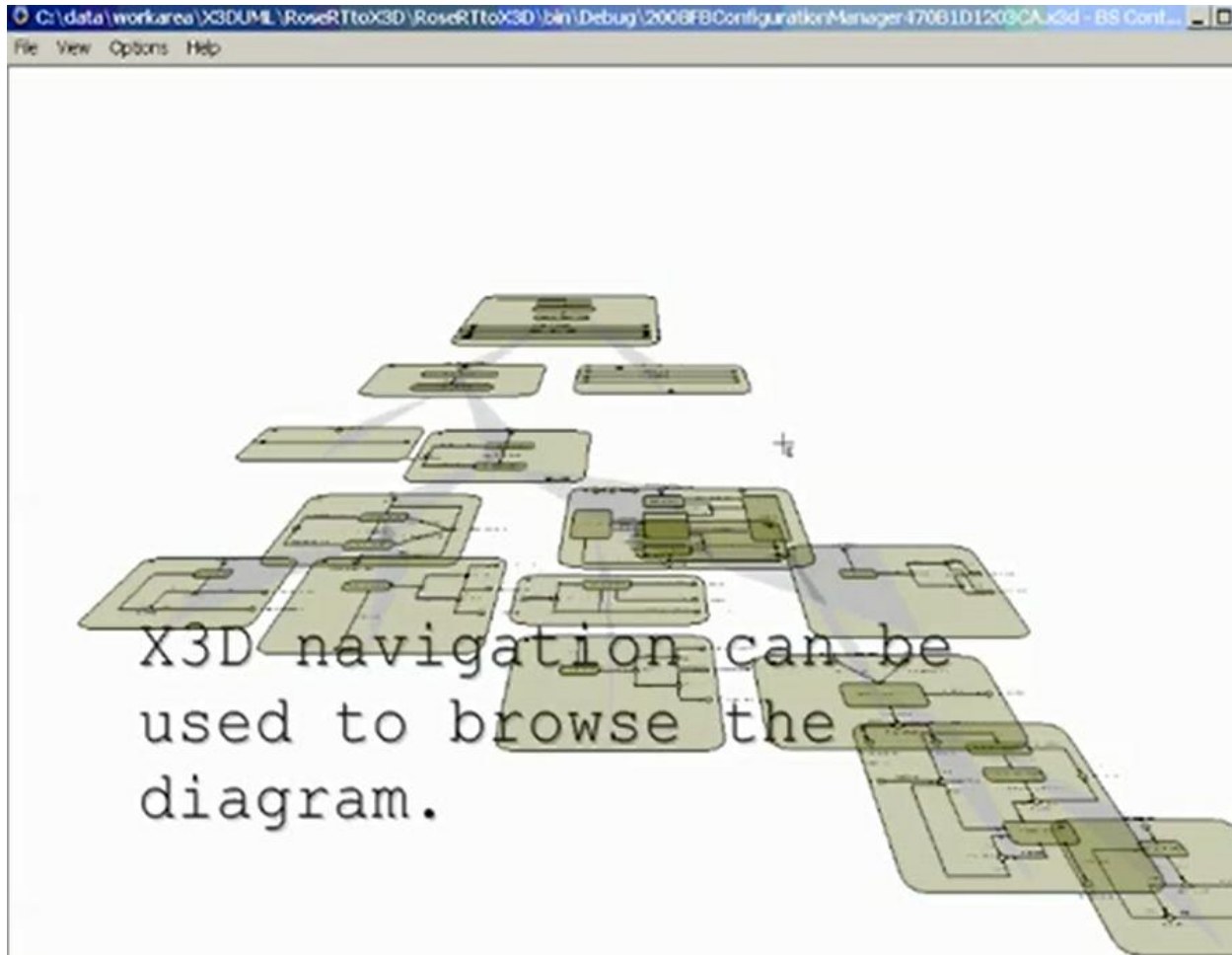
Refined X3D-UML

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

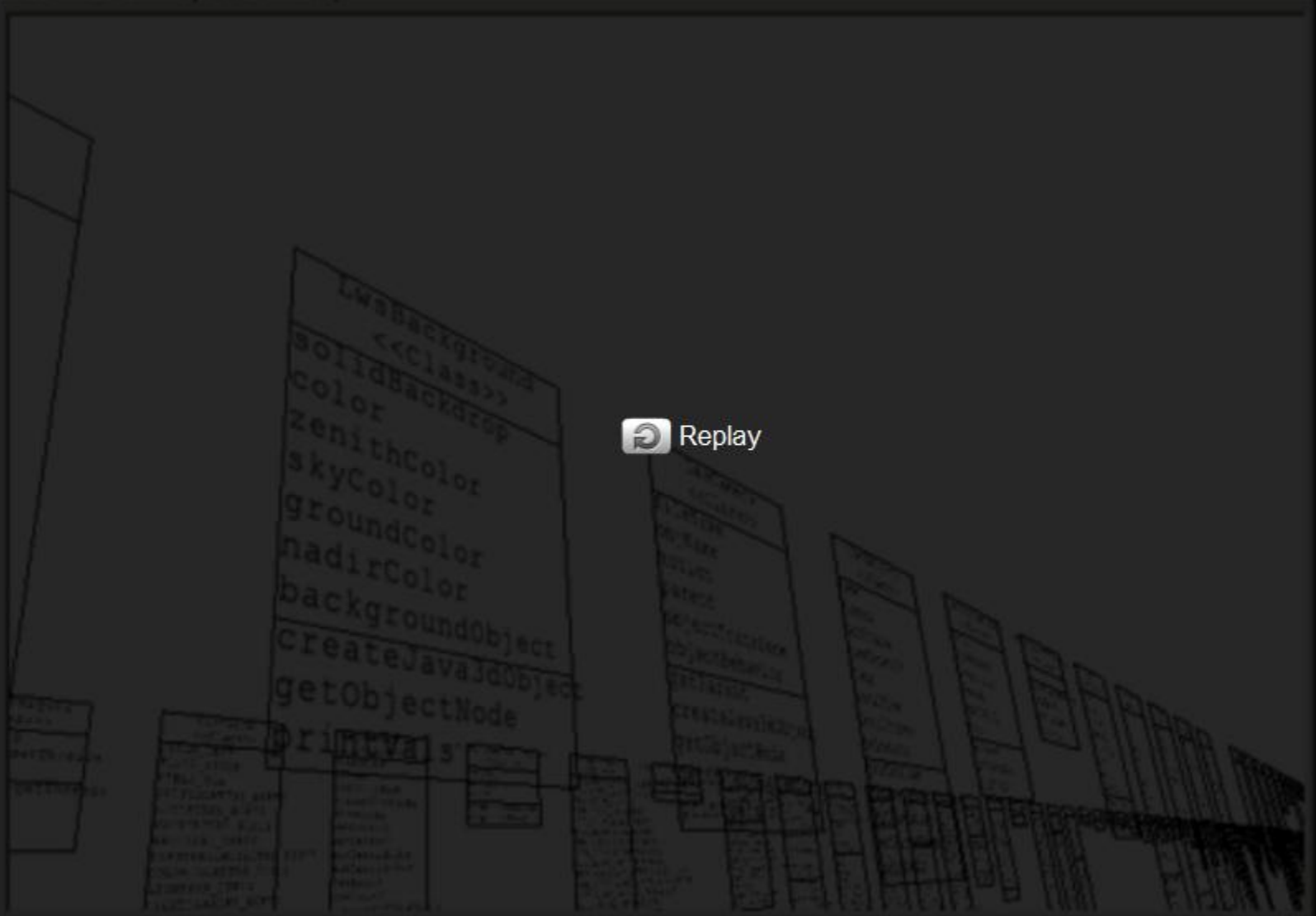



<http://www.youtube.com/watch?v=aTJvRhOVUQ>

X3D-UML: 3D UML Visualisation of Java3D Source Code

by internetscooter

File View Options Help



 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.

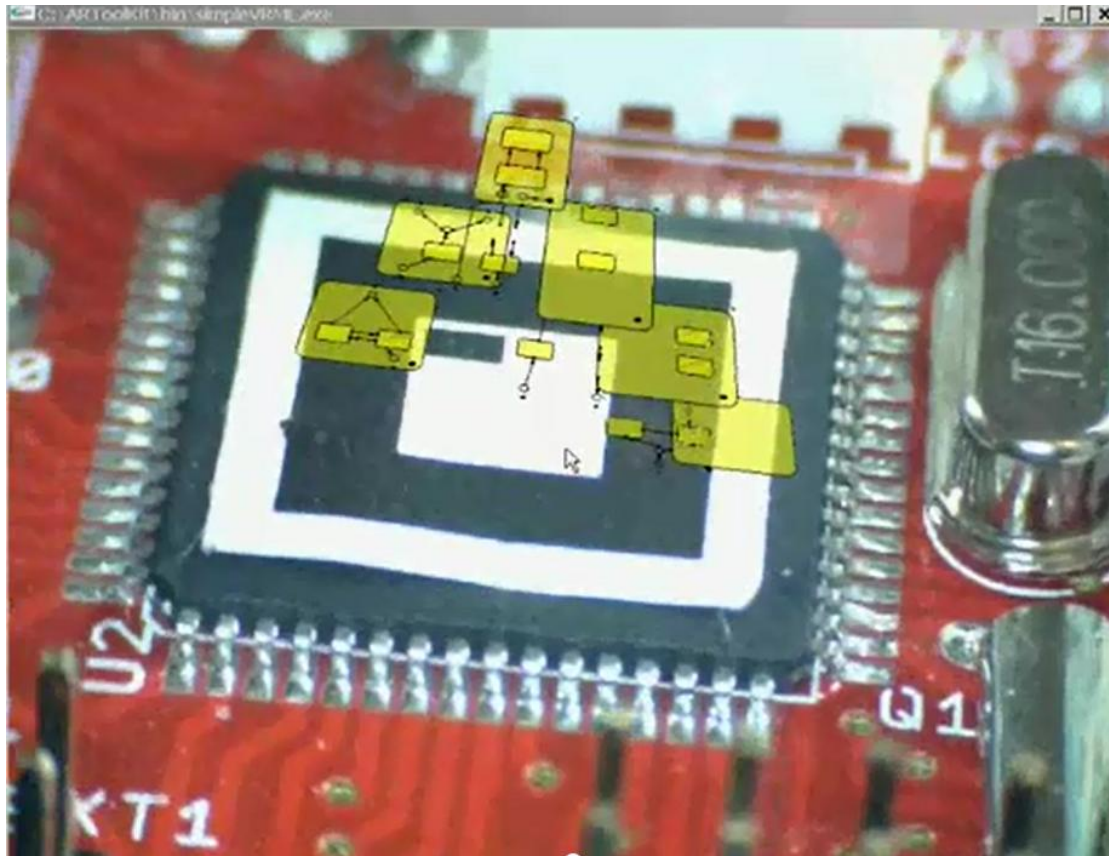
To Refine further.....

Need larger, final empirical user testing

Applications

Augmented Reality

X3D-UML: 3D UML + hardware through ARToolkit



<http://www.youtube.com/watch?v=gDb1wN1YAfM>

Email

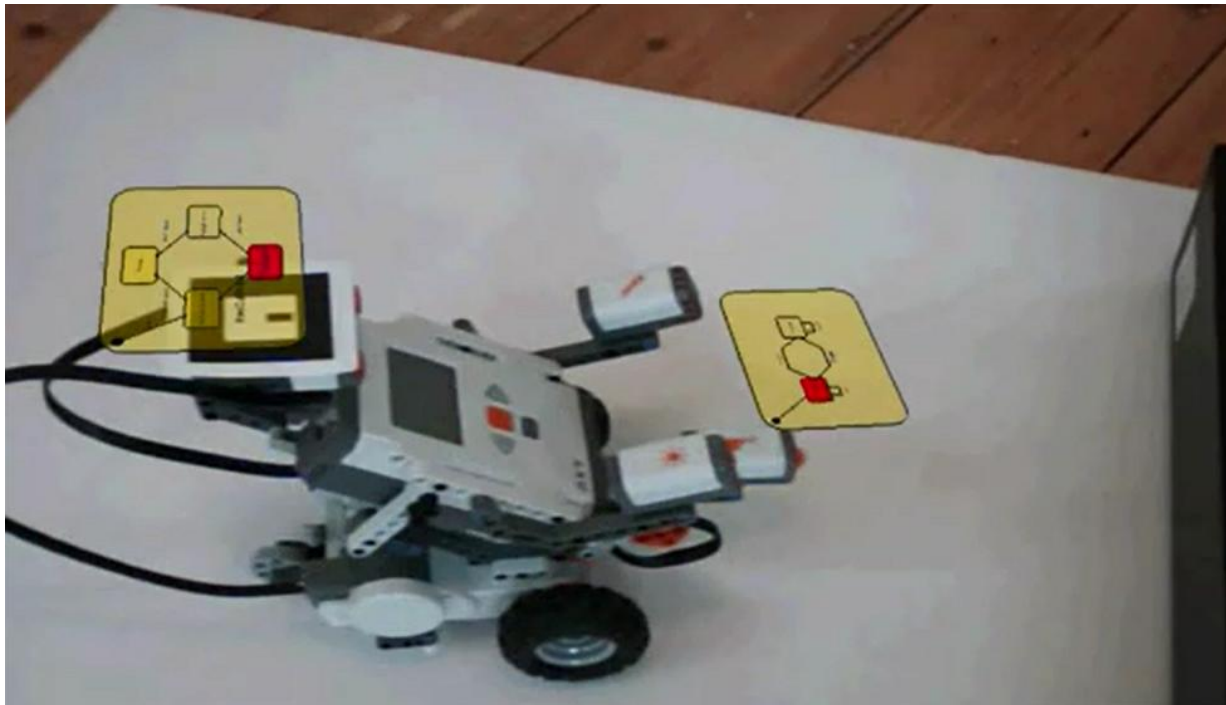
paul.mcintosh
@internetscooter
.com

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

Jin Qian

Assistance + Supervisor

Paul McIntosh

Summary

- 3D Visualization, one more degree of freedom.
- X3D-UML and it's 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 in to implementation
 - Refining implementations, fixing bugs and adding new features
 - Testing implementation
- [30%~40% of state machines are refactored] per week

2D VS 3D

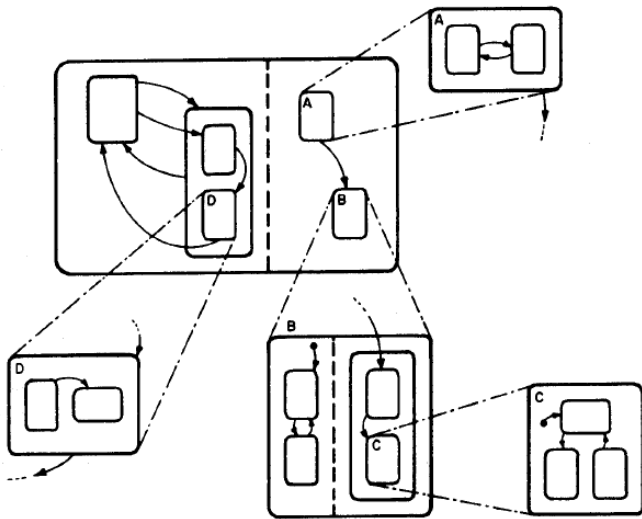
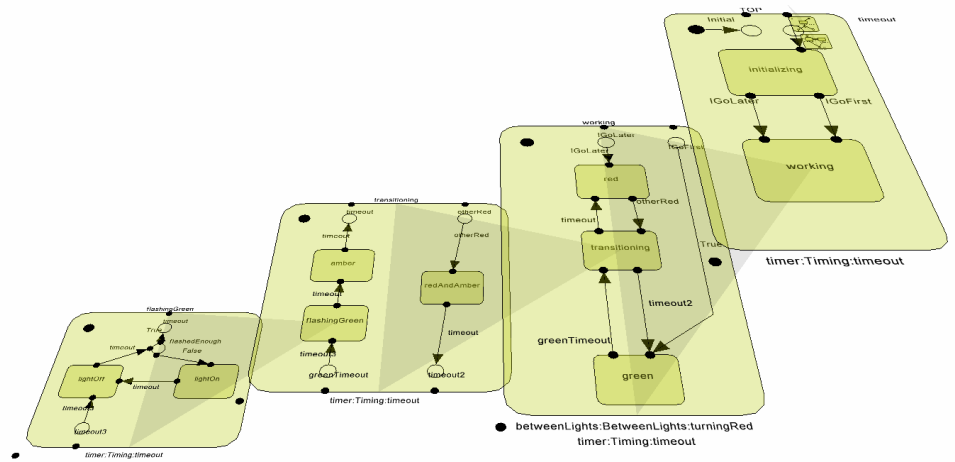
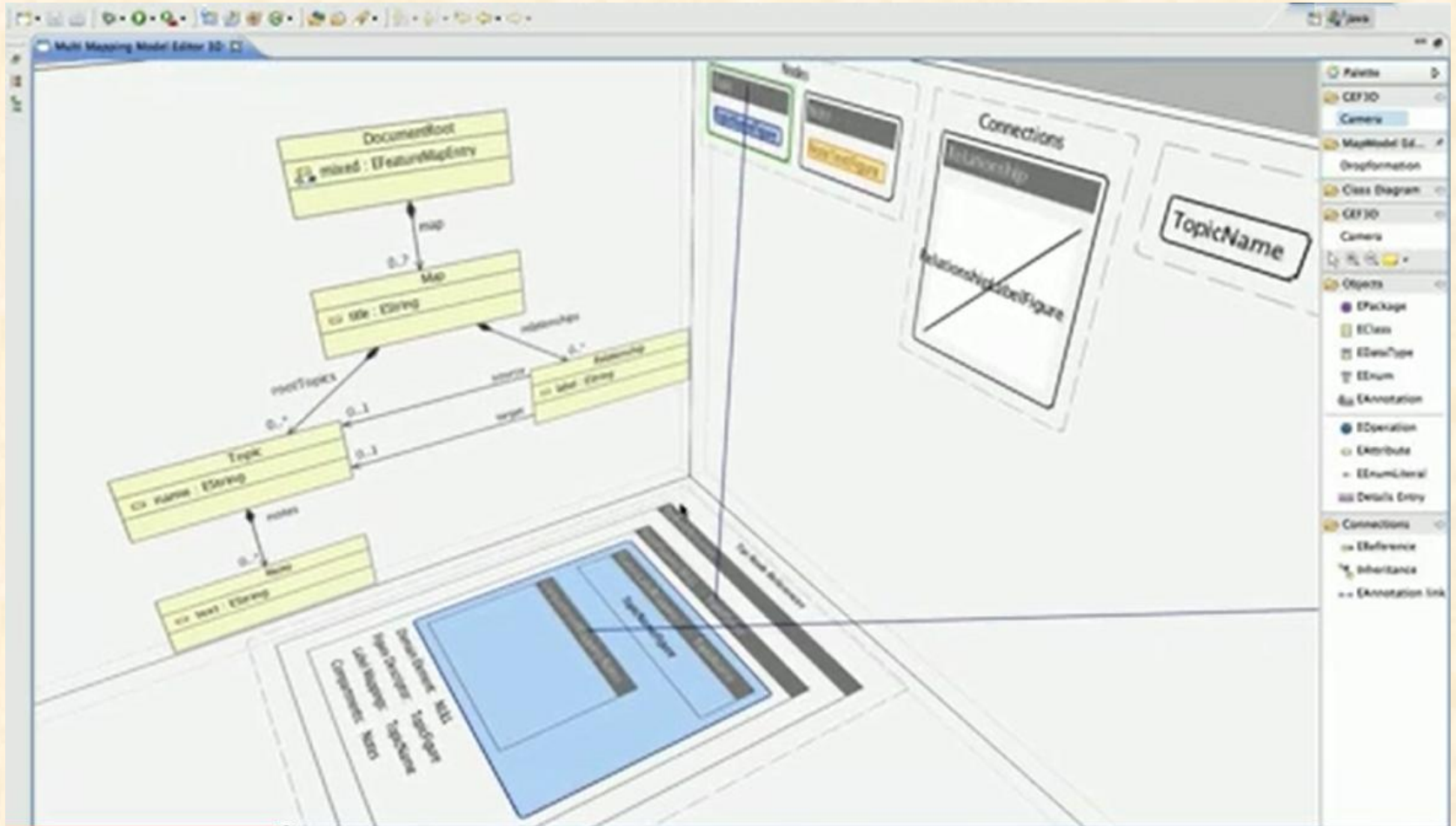


Fig. 36.



GMF 3D Editor



http://www.youtube.com/watch?v=lvB8cP7_x34

GMF 3D Editor - Set Domain Model References

by deraufziehvogel

File Edit View Window Help

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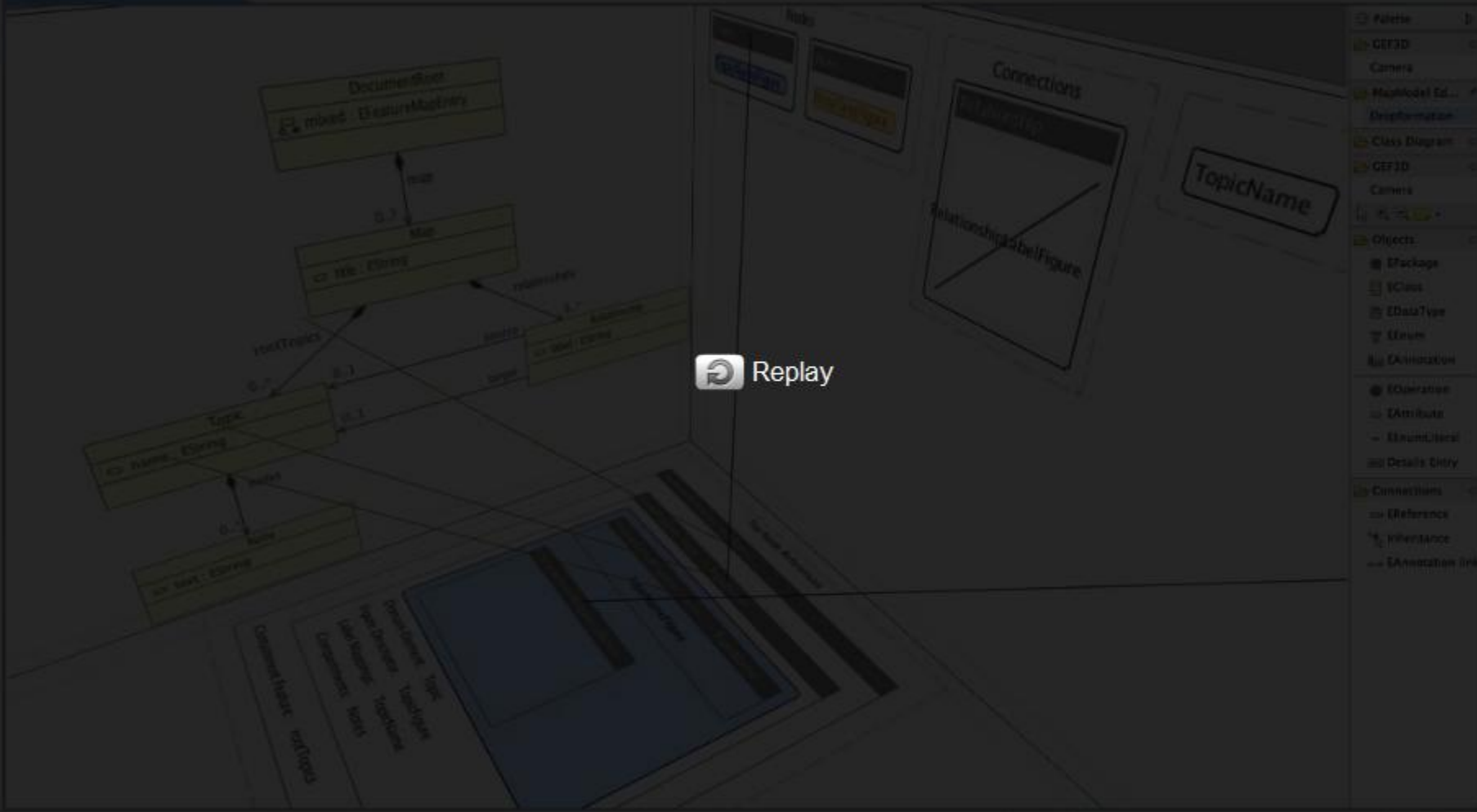
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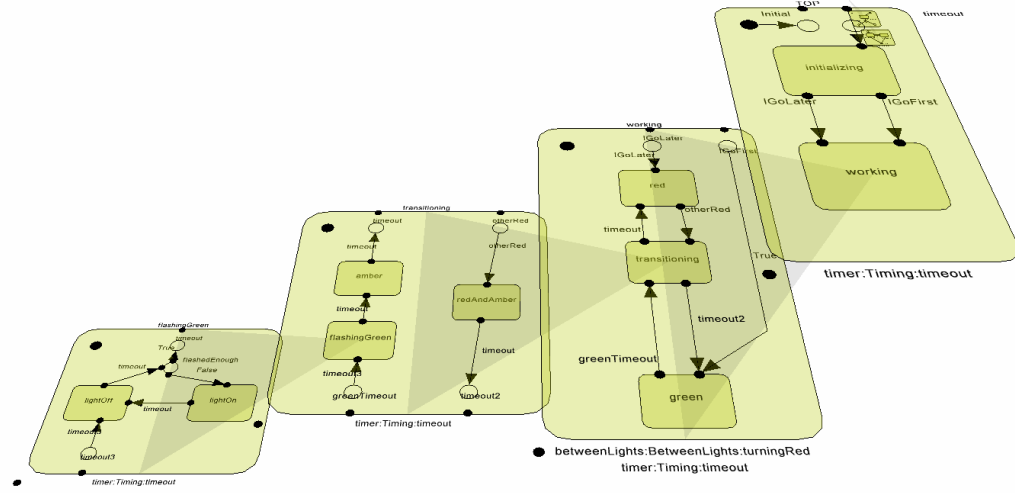
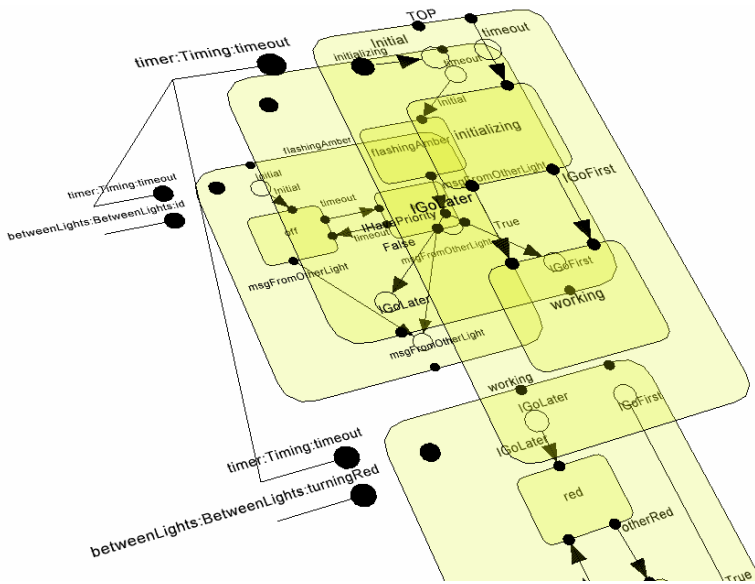
File Edit View Window Help



Replay

- File Edit View Window Help
- GEF3D
- Camera
- FlashModel Ed...
- Deformation
- Class Diagram
- GEF3D
- Camera
- Objects
- EPackage
- EClass
- EDataType
- EEnum
- EAssociation
- EOperation
- EAttribute
- EEnumeration
- EDetailsEntry
- Connections
- EReference
- EInheritance
- EAnnotationLink

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/>
- **Ron van Schyndel** <http://goanna.cs.rmit.edu.au/~ronvs/>

- Harel, D., [Statecharts: A visual formalism for complex systems](#), In *Science of Computer Programming*, 8(3):231-274, (June 1987).
- **GMF 3D Editor - Set Domain Model References** http://www.youtube.com/watch?v=lvB8cP7_x34