VENOM

A Visual Exploratory Notation for Object-based Multimedia

Introduction

Multimedia development can be very time consuming and potentially frustrating for beginners. Similarly, the object orientated (OO) paradigm can be very hard to grasp, particularly for those used to the procedural programming paradigm. Learning to develop using Macromedia Flash combines all of these complexities. Flash is both procedural and OO in nature.

This project was born out of the experiences gained by one researcher while employed part-time at Victoria University of Wellington to teach Macromedia Flash to undergraduate students. These were students studying introductory level Electronic Commerce and Multimedia. Many of the students were having significant difficulty performing workshop tasks where animation was required within an object hierarchy (for example, an animated roll-over button). Students would often seep to loose their way within the object hierarchy of their Flash files, and end up editing the wrong symbols/objects by mistake. Initial attempts to address these issues involved ad-hoc whiteboard diagrams combined with oral explanations. This approach was helpful for many of the students. Students were observed looking back at the whiteboard while they worked to help them when they got stuck with a task.

Clearly, some qualities of this approach were assisting students' learning. Since our aim was to scaffold student learning, we decided to try to identify and improve on the aspects of our teaching that seemed most effective.

Literature Review

Existing notations (either static or interactive) were considered to see if any existed that could be suitable for the research problem. The Blue Environment (Kolling, 1999a), a tool used to teach OO programming to undergraduate programming students, was considered and rejected as not having a good fit with the Macromedia Flash development environment or the task. UML was considered and rejected as not having a good fit and being too complex for the task. Likewise, STRPN, a Petri-net based notation, was also too complex. Interestingly, however, STRPN is a general tool for spatio-temporal modeling (Hsu et el, 2003) and as such, confronts many of the issues facing some expert Flash animators and developers.

While these existing notations may not have been suitable as solutions for our research problem, we were able to adopt some of the underlying concepts to inform the research process. For example, one of the key benefits of the Blue Environment is that it keeps the programmer informed as to where they are working in the within their object hierarchy - an outcome that would clearly benefit our Flash beginners.

Other key areas of literature that helped to form the theoretical foundations of this research project were:

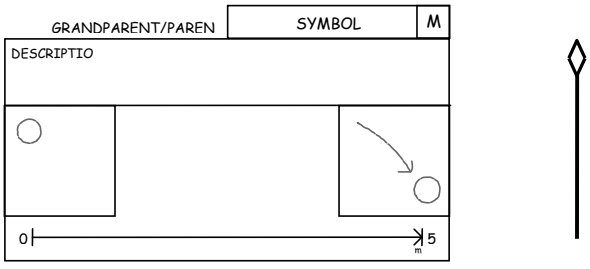
- Visual Language Theory, more specifically the explanation of visual languages and their component parts, as outlined by Narayanan & Hubscher (1997). This article was very informative for developing the first iteration of the VENOM notation.
- The Cognitive Dimensions of Notations Framework, for instance, Green and Blackwell's CD tutorial (1998) informed the method selected for testing VENOM.
- Cognitive Science, more specifically material on mental models and how diagrams work, as summarized by Price in her masters thesis literature review in 2001/2.
- Multimedia development theory, for instance, the different types of development methodology discussed by Phillips (1997).
- The study of Semiotics.

Key findings from this literature were considered along side: the constraints of the Macromedia Flash interface (itself an interactive notation); common object-orientated metaphors; existing OO diagramming conventions; and the unique requirements of novice multimedia developers. These were all considered whilst developing the VENOM methodology.

Development of the Methodology

Developing the VENOM methodology began by identifying which key skills and tasks required scaffolding. These were:

- Identification, creation, and appropriate reuse of graphical symbols in Flash
- Design, successful creation, and usage of an effective symbol/object hierarchy in Flash.



The next stage was to develop the visual primitives that would make up the notation, for instance, the basic container notation (illustrated above left), which has specific spaces for secondary textual notations. This was influence by the popular OO container metaphor, discussed by Benyon and Imaz (1999). Illustrated above right, is the aggregation symbol from VENOM, taken from UML. Aggregation is the main type of relationship used in Flash.

Testing the Methodology

In order to fit its purpose VENOM needed to be simple to learn. A key goal was to reduce, rather than increase, cognitive load. A heavy-weight methodology, such as UML, requires a considerable cognitive effort to learn. Scaffolding students' learning required a very close and highly intuitive fit between the exploratory methodology and the tasks we were attempting to teach in the target domain. If learning failed to occur, this could be because the VENOM notation was not in fact a good cognitive fit with the application domain, rather than because an exploratory notation was not an effective method of teaching the desired skills. The Cognitive Dimensions of Notations framework is especially suitable for evaluating fit between a notation and an application domain, so we selected this framework to perform our evaluation. Once we could be confident of a good fit between our exploratory notation and the Flash development environment, we could then proceed to evaluate whether an exploratory notation was effective for the goal of scaffolding students' learning.

In brief summary, our research methodology was as follows.

1. Recruited participants from subject matter experts in the areas of: multimedia education, systems design and development, multimedia development, graphic design, modeling languages, and object-orientation.
2. Reviewed key concepts of the Flash development environment (such as using symbols in Flash)
3. Taught participants VENOM
4. Performed some structured development tasks in Flash following an exploratory design created by the participants using VENOM
5. Individual heuristic analysis (Nielson, c.1996) of VENOM using a questionnaire based on the CD framework; version 5.1 of *A Cognitive Dimensions Questionnaire* (A. Blackwell & T. Green, 2000)
6. Filmed focus group discussion of experiences encountered while using VENOM, and reflections that had surfaced while participants were filling out the questionnaire.

Results

Overall, the results of the evaluation session provided:

1. Information about the CDs and effectiveness of VENOM
2. A list of improvements that can be made to VENOM
3. Information about how better to teach VENOM

The first of the above set of findings is explained further in the following paragraph.

VENOM performed well in the Cognitive Dimensions of: visibility, diffuseness, closeness of mapping, role-expressiveness, provisionality, and consistency. These results are very encouraging. Of particular importance is the good result for provisionality. This indicates that VENOM would likely be an effective exploratory notation. The closeness of mapping and the role-expressiveness results indicate that VENOM would potentially make a good tool for scaffolding novice developer understanding of object-based Flash (and quite likely a better understanding the Flash application itself). Poorer results for error-proneness and hard mental operations reinforce some of the comments made by participants about how to improve VENOM.

Future Research

In the immediate future, having established the fit between VENOM and the Flash application domain, we can now proceed to answer our original research question: *Can we use a visual notation method to improve the technical quality of the multimedia artifacts produced by novice developers, making it easier for them to develop in an object-orientated way?* This is to be accomplished by a quantitative study, incorporating an experimental design and qualitative analysis. A major goal of attending the present workshop is to obtain feedback on our research so far, and to inform the experimental design of the next phase of the research.

Our current intention is that participants will be divided into two groups (experimental and control) and asked to perform the same two object-orientated animation tasks using Macromedia Flash. Before they begin the first task, both groups will be given a mini-tutorial revising basic Flash concepts, and explaining what object-orientated animation is and why it is useful. Prior to starting the first task, the experimental group will also be taught VENOM and asked to use this method when attempting both tasks. The control group will be taught VENOM after they have completed the first task. The control group will be asked to use the visual notation method to complete the second task. The table below summarises this proposed method:

Control Group	Experimental Group
1. Introductory mini-tutorial	1. Introductory mini-tutorial
2. Animation task 1	2. Taught visual notation
3. Survey 1	3. Animation task 1 (completed using notation)
4. Taught visual notation	4. Survey 1
5. Animation task 2 (completed using notation)	5. Animation task 2 (completed using notation)
6. Survey 2	6. Survey 2

In the longer term, the VENOM project has implications for research into how people learn and form mental models of hyper-structures, such as software and websites.

Key References

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