

Software Reusability and its Application to Interactive Multimedia Learning System

(Doctoral Consortium Application)

Eng Huat Ng

School of Computing and Mathematical Sciences,

Liverpool John Moores University

Byrom Street, Liverpool L3 3AF, UK.

Email: e.ng@livjm.ac.uk

Expected date of completion: March 1998

Research Problems and Motivations

Although the use of software development methods and tools is increasing and the expenditure on software development is escalating, the production of new software is still falling far behind the demand. Moreover, the achieved quality and maintainability of those software products that are produced is of an inadequate standard. This work proposes that the reuse of existing components will lead to greater productivity, more cost-effective, more reliable, more maintainable and higher quality software products.

Many researchers and suppliers of Object-Oriented Technology promise reusability as one of the key benefits of this approach. However, the established methodologies of object-oriented (OO) analysis and design do not provide an adequate framework to support the concept of reuse and its planned application to the development of OO systems in a specific and formal manner. Besides, these methodologies do not provide system designers guidelines for navigational and user interface design for the development of hypermedia systems on the World-Wide-Web (the Web).

This research aims to tackle these problems by introducing a novel method, the DASBOOM approach which implants domain analysis, scenario-based OO modelling, navigational design and user interface design into the system development life-cycle to improve the reusability, productivity, and quality of software systems.

On the other hand, learning in the traditional class-based environment can be viewed as a tutor assists the students to develop their knowledge of a chosen subject area by presenting them information, such as giving a lecture. However, there are many problems in this type of learning environment: 1. High and increasing student-tutor ratio; 2. Expensive tutors costs; 3. Inconsistent and non-standardised training; 4. High travel costs for international students; 5. The differences in the ability (of perceiving, learning, understanding and knowing) among students.

These problems can be solved partly by using a web-based teaching-aid medium rather than solely in a tradition class-based environment. This work therefore uses the web-based learning system domain as a case study domain. Furthermore, it was chosen as a case study domain in this work for the following reasons:

- Learning Systems form a subclass of software. The production of learning systems should also benefit from reuse. Thus, the basics of software reuse might be applied to the multimedia learning system domain.
- The domain provides many good case studies on software reuse.
- Vast and up-to-date libraries of reusable materials are available via networks.

In short, the motivation of this research is to develop a reuse methodology using OOT in order to improve the reusability, productivity and quality of the learning systems on a distributed hypermedia environment.

Research Questions

Some research questions have to be set before the research aim and objectives being proposed and the research project being carried out.

The main research questions are:

- Does an object-oriented paradigm provide an adequate framework to support the concept of reuse and its planned application to the development of object-oriented systems in a specific and formal manner?
- How are the concepts of software reuse implanted into the development of hypermedia systems such as an interactive multimedia learning systems on the Web?
- Could we achieve better documentation reuse via a planned and systematic approach to a hypermedia systems such as the Web?
- How do we improve the validation process against the users' needs during system development?
- Is OOT translated easily to the practical implementation of hypermedia systems on the Internet?

Research Scopes

In order to answer the research questions above, the research scope can be stated as...

Development of Reuse Method and Assets for Reuse

To develop a reuse method and assets for reuse. The assets refer to building blocks that are acquired or developed for the solution of multiple problems. For example, the asset can be a framework for the learning system, or other reusable components.

Using The Learning System Domain to Test The Reuse Paradigm

To use the learning system domain to test the reuse paradigm. The learning system to be exploited is a distributed hypermedia learning system on the Web. The target user group is the novice user, first year university students. The tools to be exploited are HTML, Javascripts and the Java programming language.

Research Methodology

To answer the research questions, seven main stages have been used to this research(See Figure). These stages are: “set a list of aim and objectives”, “explore theoretical background”, “evaluate current methods”, “identify a theoretical framework”, propose an approach from the theoretical framework”, “develop prototypes to test the approach” and “answer the research questions and justifying the research hypotheses”. This approach provides guidelines for the students without research experiences to carry out their research.

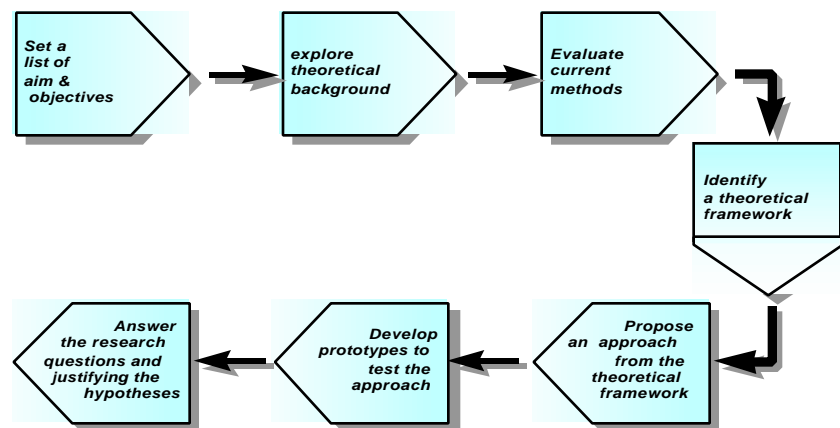


Figure 1: the research methodology.

Research Results and Contributions

A novel method, the DASBOOM approach and a set of Web-enhanced navigational design notations based on OO approach is proposed. Moreover, a novel diagram that depicts the relationships among software reusability, maintainability and related terms within software engineering domain has been proposed while various types of software reuse have been classified into a more organised and easier to understand perception, called "three-layer software reuse". Current problems relating to reusable component retrieval have been identified and a reusable components library on the Web, The Weplib, has been built to

partially address these problems. In addition, The development of an Interactive Multimedia Learning System, or "a Web-based learning system" has demonstrated that both vertical and horizontal reuse can be achieved if the components are planned and developed carefully. Finally, a novel reusable structure for a learning system on the Web for the visually disadvantaged is also proposed as an illustration.

Motivation for participating

The motivation for participating in this consortium are:

- to discuss my work with experienced researcher and educators and receive constructive feedback;
- to discuss strategies for completion of my PhD as well as determine my future research direction;
- to find out the current state of art in computing in USA rather than in Europe only.

Specific topic:

Using Web as a teaching medium