

Issues in Implementing a Virtual Environment based Design Review System

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ABSTRACT

Project design review involves many tasks and is used by the project team as a means to detect and identify discrepancies, errors and inconsistencies in designs. Through interviews and common literatures, we established that the current approaches used are based heavily dependant on 2D paper based drawings and utilizes some form of a checklist to guide the review process. The ability to perform such tasks using a VE-based approach can greatly improve the review process by allowing visualization and modification of 3D representation of the design while providing flexibility for the review team to meet virtually from any remote location. Various implementation issues need to be considered before a VE based design review system can be fully implemented and usable. This research-in-progress investigates several implementation issues; design review process issues, end-user related issues, hardware and software issues, information management issues and collaboration and participation issues.

Keywords: 3D game engine, design review, virtual environment, VE

1.0 INTRODUCTION

In any construction project, a design review process is used by the project team as a means to detect and identify discrepancies, errors and inconsistencies in designs. Designs are usually produced in 2-dimension (2D) paper-based form (either hand-drawn or using CAD software). These drawings are passed from the designers to reviewers and from one design discipline to the other, and vice versa for comments and redesigns until satisfactory designs are accomplished and ready for construction. The process is tedious, time-intensive and there is no effective design review system that can be used to automate the process. Due to these constraints, design review sessions are usually held only a few times during the design phase resulting in the unresolved or undetected errors to crop up in the actual construction. This paper is based on a research-in-progress at Virginia Tech to utilize VE technologies to support the design review process. The research main objective is to develop a framework for a generic design review model that utilizes VE. This paper first discusses the design review process generally employed by design firms and/or consultants. The paper then investigates the issues needed to be considered in the implementation of a VE based design review system.

2.0 THE DESIGN REVIEW PROCESS

Despite the benefits of design review in reducing design conflicts and minimizing costly construction changes, the current process is resource and time intensive, and often results in it being performed at an inappropriate level of effort. According to Nigro (1992), an average project contains five coordination errors per contract drawing and a project of 500 drawings will typically contain 2,500 coordination errors. Most design review is performed by comparing or combining 2D drawings in meetings. Errors or elements that cross or overlap are detected through manual inspection by overlaying the drawings on the 'Light Table', and evaluated for conflicts. If a conflict exists, actions such as corrections and redesigns would take place to avoid further errors, unwanted change orders and unwanted increase in total project costs. Design review is either performed in-house by the designer's firm or by a consultant firm. Based on several (10 in total) interviews conducted with design and construction firms as well as the common literature, we observed there are two main approaches in performing design review; using the pen and paper approach or electronic reviews through the use of a web-based system. A third approach involves the use of a life-sized physical mockups or PMUs. All approaches utilized some form of design review checklist categorized by disciplines or by the CSI Master Format. We observed that the design review process is still lack of automation and based on the aforementioned facts, we are proposing the use of VE.

3.0 THE PROPOSED FRAMEWORK FOR A VE BASED DESIGN REVIEW SYSTEM – DESIGN ISSUES

Our proposed design review system will be VE-based with real-time characteristics (Shiratuddin & Thabet, 2003). 3D virtual representation of the facility can be updated in real-time reflecting user changes and modifications. We see an opportunity where VE can be used successfully in the construction industry, especially during design review. However in order for a VE based design review process for construction to become common, the following issues in implementing the system have to be assessed and resolved. Figure 1 shows some of the major issues that need to be considered in the development of a usable VE based design review system. These issues can be classified into 5 areas: (1) design review processes issues (2) end-user related issues (3) hardware and software issues (4) information management issues and (5) collaboration and participation issues. Each of these main issues is further classified into smaller issues.

3.1 Design Review Processes – Checklist Design Review Issue

The design review checklists breakdown is mainly by discipline or by the CSI Master Format. Our research will look into the viability in creating a checklist that is based on a new format such as assemblies and components, and also to identify the common checklists items that are present in the current systems and techniques used by design and/or consultant firms.

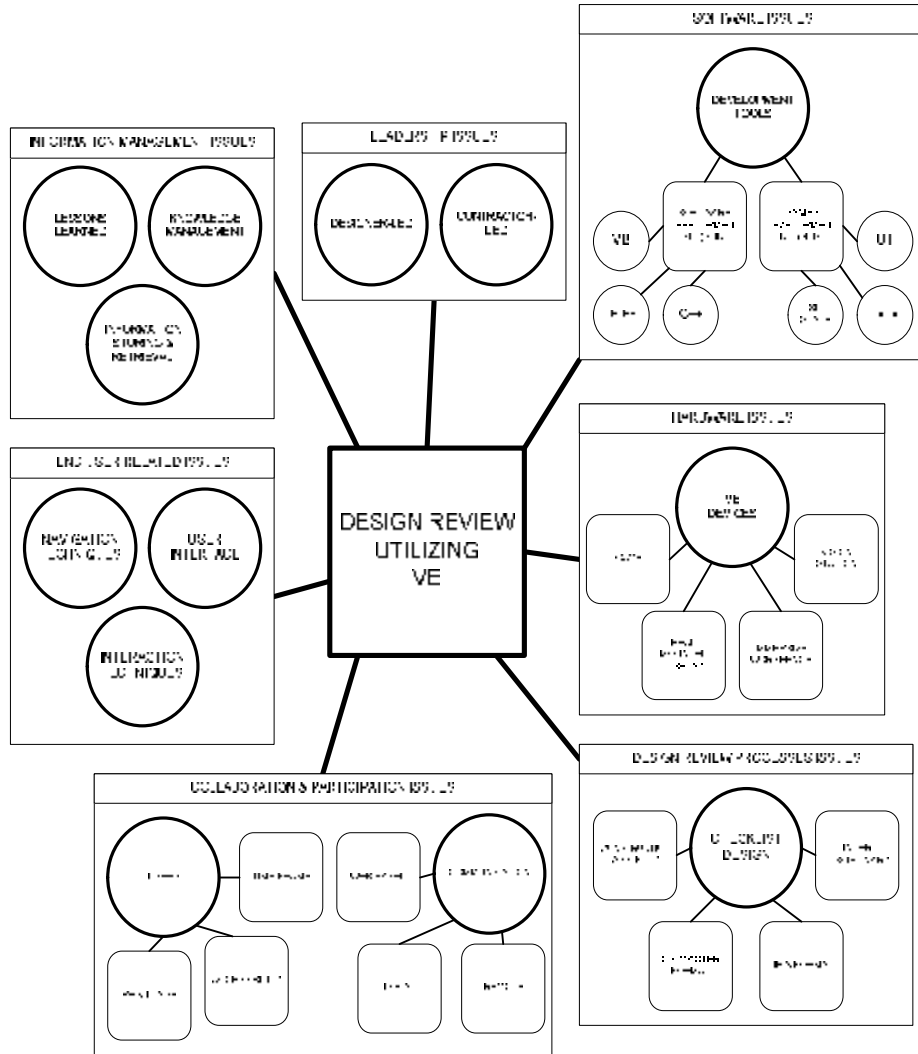


Figure 1: Issues before a VE based design review system can be implemented

3.2 Participation Issues - The Users

Users of the proposed design review system have to be determined so that the functionality of the system could be met. It should also be established whether a participant should participate in the design review session from the very beginning to the end or be involved in partial stages of the process. User's level of accessibility to the system and the ability to make changes to the 3D model should be decided.

3.3 Software Development Issues - The Development Tool

An economical and extensible development tool will be required to develop the design review system. Cost, ease of implementation, future extensibility and maintainability should be the important factors to be considered. To date, we propose to use the 3DState 3D Game Development Kit (GDK) (<http://www.3DState.com>).

3.4 Information Management Issue - Knowledge Management

A method has to be created in order to capture, store, organize and represent the design expert's knowledge and experience from the design review sessions so that a lesson learned database can subsequently be created.

3.5 Leadership Issue

It has to be decided on who should lead and be responsible for the design review effort. The project leader must have the highest level of control over available design review resources and procedures, recruiting other members, leading team meetings, managing and implementing the design review improvements, and able to assign roles of individual team members based on areas of expertise and expected contribution.

4.0 SYSTEM DEVELOPMENT

While the abovementioned implementation issues are being researched and investigated, initial development for the VE based design review system is currently underway. Shiratuddin & Thabet (2003) presented three main modules for the proposed system. They are the (1) design modification module; (2) information manipulation module and (3) the collaboration module (see Figure 2). The 3DState GDK will be used to develop the prototype VE based design review system. The 3DState GDK comprises of more than 500 ready made 3D APIs that can be used to develop 3D related applications. Since 3DState also has support and can be used with standard programming languages such as C++, Visual Basic and Delphi, the extensibility of the proposed system will be more viable. Currently, we are focusing on developing the object manipulation (see Figure 2) feature which is a sub module of the design modification module. 3DState APIs and Visual Basic is used to develop it. Some of the object manipulation features will include the ability for users to move components in the VE from one location to another, moving components in a specified axis and also to rotate, delete and loading new components.

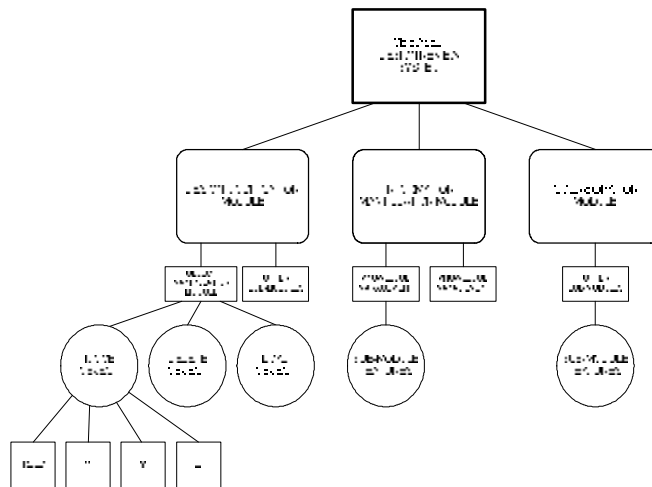


Figure 2: The modules of the proposed VE based design review system

5.0 REFERENCES

DrChecks (2003), <http://www.buildersnet.org/drchecks/>.

Nigro, William. T. (1992), *REDICHECK Interdisciplinary Coordination Booklet*, Third Edition. February 1992.

Redicheck (2003), *REDICHECK construction document review service*.
<http://www.redicheck-review.com/>.

Shiratuddin, M.F. & Thabet, W. (2003), “A Framework for a Digital Design Review System Utilizing 3D Game Development Tool”, *Proceedings of the 20th CIB W78 Conference on Information Technology in Construction*, Waiheke Island, Auckland, New Zealand, 23-25 April 2003.