# A Comparison Between UI Design in Game Development and CAD Software

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## 1. Introduction

There is no denying that CAD programs are a crucial part of today's architectural framework and pipeline. To sharpen the systems architects use, there is a need to improve on the numerous components that comprise the software. The aim of this paper is to explore ways to improve the intuitiveness of human-computer interaction in computer aided design systems, by focusing on its User Interface. We compare UI elements of the game Sims4 with their counterparts in CAD software Revit.

## 2. Prelude to CAD System value

Architects have expressed varying yet often compatible thoughts when it comes to the importance of software in enriching the design. Durfee, a professor and director of the design education department at the University of Minnesota in Minneapolis argues that CAD programs cannot be used like a drawing board, they are a tool for producing and not for brainstorming. "You fire up the application and three minutes later you're making a rectangle. Twenty minutes later, you're coming up with your first idea," he says, "A good designer could come up with 100 fledgling ideas in that time.".[1]

This may explain why many architect use CAD software only as a visualization tool for their existing ideas. The quality of the final product depends on the talent of the architect, but having a sharper knife makes you a better cook. CAD programs allow veteran architects to advance their designs, and aid them in realizing architecture that could have taken much more time, effort, and budget otherwise.

"Architects make images from ideas" is a concept You can find everywhere from St Thomas aquinas's philosophical quotes About God making the world, to modern key texts about creative cognition[2]. But these fleeting ideas cannot be turned into a creation with the architect remaining inside his head and keeping his eyes closed[3]. there must be a process in which the architect finds a way to pour his thoughts onto a tangible medium he can look at, to edit, test, and improve upon his creations.

If Ng. Edward's (1997) statement "the architects imagination works with its eyes open" is true[3], then the creation process depends on the consistent ping pong motion of thinking of a solution, externalizing it, and visually perceiving it. We would want to help the eyes perceive these depicted ideas as quickly and effortlessly as possible.

This is one reason CAD systems are valuable to architects; it diminishes the need for designers to: 1) rely on their own understanding of the specifications of numerical and mathematical parameters which they need to create designs digitally[4], and 2) visualization and rendering skills acquired by mastering the traditional medium. It does that by providing on-the-spot visual representations of the virtual objects from their ideas, which is much more natural for architects.

Dillon argues that the success of a computer application depends on it providing appropriate facilities for the task at hand in a way that enables users to use and exploit them [5].Qi Su, the founder of Modelo, a 3D modelling tool designed by architects and not software engineers, says that the UI of current CAD programs are strong from the development perspective, but hinder, rather than help, the architect's design flow.[6]
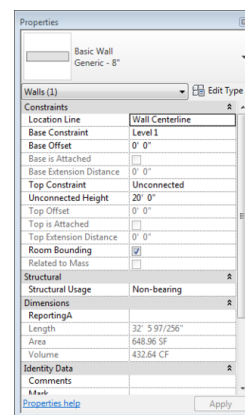


Figure 1. Properties panel in Revit depends on written tables. (Autodesk 2021)

The visual support CAD systems provide to the user does

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not seem to extend to its user interface; an aspect of software that the novice, and even professional architect might find to be hindering to their creative flow. Panels are wordy and disconnected from one another, making you spend time looking for commands even if you have used them before.

Because we know systems can be improved by examining ones that succefully implement solutions, we studied game UI. Game UI designers have pioneered creating user friendly interfaces where players cannot get lost, confused, or keep guessing what to do. What UI elements are used in CAD programs and games, and how do they compare?

## 3. A comparison between games and Architectural software

### 3.1. UI ELEMENTS ORGANIZATION

To understand what the user perceives in a software we will dissect the interface into two prominent sections based on the relative position to one another: the Viewport, and the Tools overlay. Every UI element in the software belongs to one of these two sections[7]:

- **Viewport:** The empty screen/canvas . This is where the creation is viewed and edited.
- **Tools Overlay:** A layer, separated from the workspace, of organized panels that contain the tools you use in that workspace to edit the creation.
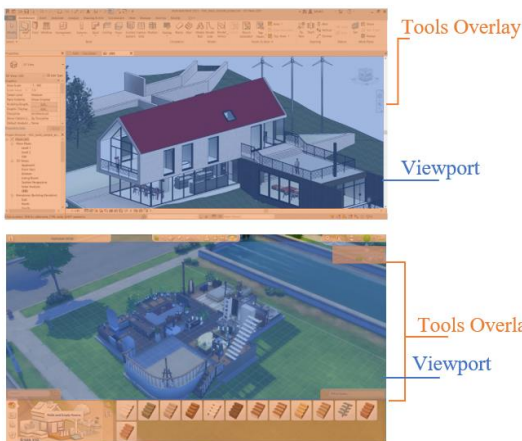


Figure 2. The main User Interface of two programmes: Autodesk Revit (Autodesk2021), Sims4 (ElectronicArts 2014)

To further understand the role of every element in assisting the user navigate, find information, and accomplish goals, a second classification based on the UI elements can be applied after asking two questions:

*Does this element exist inside the viewport?*

*Does a person see this element if they stood in the design?*

The answer to these questions is either yes or no, we can create a flow chart resulting in 4 categories as follows:
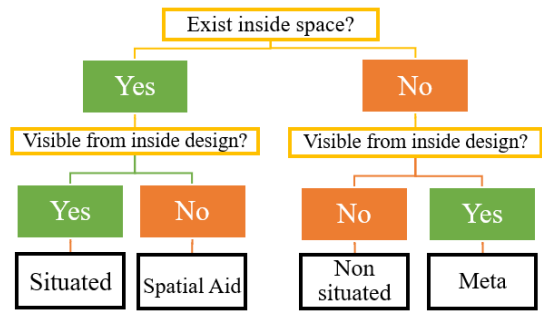


Figure 3. UI elements classification based on their position [7]

### 3.2. SITUATED

Situated UI components that reside inside the viewport and can directly be added and edited by the user.

Table 1. Situated UI used in Revit and in Sims4

| Points | | Simple volumes | |
|---|---|---|---|
| Lines | | Manual 3D meshes | |
| Compound | | Premade 3D blocks | |
| Simple surfaces | | 3D models | |
| 2D blocks | | Human model | |

### 3.3. SPATIAL AIDS

UI components can only be seen from outside the viewport. meaning a hypothetical person inside the viewport cannot see them. They are often added to guide users focus to certain areas in the viewport, and to create visual aid for distinguishing dimensions.

Table 2. The main Spatial aid UI elements used in Revit

| Grid | |
|---|---|
| Annotation | |
| Highlighted selection | |

Games excel in using spatial aid elements to highlight

selections, errors, or important situated elements, giving the player immediate ability to edit and constant feedback while fully being immersed in game play, while spatial UI in CAD is noticeably less than games.
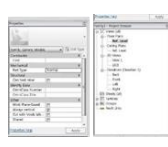
Table 3.　The main Spatial aid UI elements used in Sims4.

| Grid |  | Labels |  |
|---|---|---|---|
| Highlighted selection |  | Editing tool overlay |  |
| Error or flaw |  | Important situated elements |  |

### 3.4. NON-SITUATED

UI components that do not reside inside of the viewport, and are a part of the tools overlay are non situated components. These contain the panels and commands you can use to edit the situated components inside the viewport.
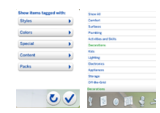
Table 4.　The main Non-situated UI elements used in Revit

| Context menu |  | Properties options and browsers |  |
|---|---|---|---|
| Ribbon Tabs |  | Navigation tools |  |
| Control Status bars |  | Popup windows |  |

Because the main purpose of CAD software is to create, the placement and context of non situated components are dedicated to creation and editing tools. Whereas in games, non situated elements can also provide players with feedback and prompts, for example an assessment of resources or stat meters, as well as keeping track of points, time, inventory, and progress, which aids in deciding the next step of play.

Table 5.　The main Non-situated UI elements used in Sims4

| Tabs |  | Status bars |  |
|---|---|---|---|

| Properties options browsers |  | Popup windows |  |
|---|---|---|---|
| Status |  | Navigation tools |  |
| Ribbons |  | Popup summary |  |
| Search bar |  | Call to action |  |

### 3.5. META

UI components do not reside inside the viewport, but are viewed as conditions that have a direct effect on it and on the design in its extent. Generally, it is possible to control these UI elements, but they are made to mimic real-life physics allowing the user to simulate original conditions.

Table 6.　Meta UI elements in Revit after rendering.

| Sunlight |  | Shadows |  |
|---|---|---|---|

In games, meta UI components can be subtle or dominant[8], but unlike CAD programs which require a rendering command to produce visuals of meta components, games usually operate on a high frame real time rendering basis, and do not require a special command, allowing these components to be visible, and provide real time feedback to the user; for example: the amount of light needed to illuminate a certain room area.

Table 7.　The main Non-situated UI elements used in Sims4

| Sunlight |  | Seasons |  |
|---|---|---|---|
| Shadows |  | Weather |  |
| Time |  | Pollution |  |

## 4. The issue of feedback

When you compare between the two, you find that CAD interface provides a set of menus, buttons, and lists that organize the way you can create, edit, and manipulate your designs. Unlike games, however, this toolkit usually does not give any feedback on the progress or quality of the design. For a novice cook without a recipe, making a tasty dish requires good kitchen ware, a sharp set of skills and a trusty sous chef to taste test the food as he goes. The latter represents external aid that provides real-time feedback, and because of it, you can be sure that your dish is up to quality without having to rely on the final taste test by your costumers.

## 5. UI case study: The Sims4 game

In February 2000, Sims 1 was Developed by Maxis and published by Electronic Arts. The game used dimetric projection and featured open-ended simulation of the daily activities of one or more virtual persons ("Sims") in a suburban area near SimCity.[9] It was successful in allowing anyone to create architecture using readily available building blocks on a computer screen. Sims utilized the intuition and experience players traditionally rely on to solve design problems by offering a simple procedure and user interface.[10]

### 5.1. EXPERIMENT OBJECTIVE

The objective of this experiment is to explore the effect/influence of an intuitive game interface on the process of design and the quality of the final architectural work.

### 5.2. EXPERIMENT PROFILE

A student from Tokyo Institute of Technology participated in a brief experiment for the sake of this study. W.T, a civil engineering student with a brief background in using CAD software SketchUp and no previous background in playing the test game.

The participant was introduced to the game The Sims4, (EA, 2014), and was asked to build their dream house using the game interface and resources within a time frame of 60 minutes. The participant had no information that this research is interested in their interaction with the user interface, they were requested to voice their opinions and thoughts while playing.

### 5.3. OBSERVATIONS

The following are pros and cons that appeared after observation:

- Pro: Spatial aid UI elements like the editing tool overlay help avoid going to non situated UI elements for editing.
- Pro: Meta elements - changing time and season- constantly help to check the design's response to change.

- Pro: Having the icons drawn in one composition helps understand the icon in relation to the others.
- Con: Unnamed icons force the player to hover over them to view information, wasting seconds each time.
- Con: The participant would look for the icon first, and then utilize the search bar, making it difficult to locate if they did not use the correct word.
- Con: Promenant icons are distracting by suggesting priorities to the player.



Figure 4: Progress between the starting build (after 10 minutes) and the final build (after 60 minutes)

## 6. Conclusion

The intuitive interface design of the game and the real-time feedback feature built in game is worth exploring to aid the inexperienced user to become aware the problems in his/her design while creating it, and attempt to find viable solutions, lowering frustration and improving the speed of creating.

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