The Construction of Ludic Space

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ABSTRACT
Most modern graphics-based computer games entertain the player in part by presenting him or her with a simulated space, an imaginary two- or three-dimensional region whose visual appearance is mapped onto the two-dimensional surface of the video screen. The player observes this space and sometimes virtually explores or moves through it in the course of playing the game. As an imaginary space, it is necessarily constructed by human beings, and therefore may be thought of as the product of architectural design processes. In this paper I discuss the psychosensory limitations of perceiving ludic space compared with real-world architectural space, and the primary and secondary functions of ludic space. The primary function is to support the gameplay by providing a context for challenges, and I discuss how this occurs; secondarily, the space informs and entertains in its own right by a variety of means: Familiarity, Allusion, Novelty, Atmosphere, and others, which I illustrate by example.

Keywords
Architecture, video games, computer games, game design.

INTRODUCTION

Opinion is divided over the origin of the first computerized game, but the first video game – that is, electronic game played using a graphical video display – is thought to have been *Tennis for Two*, developed in 1958 by William A. Higinbotham, an engineer at Brookhaven National Laboratory, using an oscilloscope and an analog computer.[3] Like its better-known successor *Pong*, Higinbotham's game required the player to pretend that the display screen was a tennis court.

From their earliest days, then, video games have presented simulated spaces to their players. Initially these were abstract spaces, e.g. the chess board, or open spaces as in the 1961 game *Spacewar*.[3] However, games soon began to simulate bounded or indoor spaces as well, usually depicting them via top-down, map-like views of a character moving through a maze or walled area, e.g. *Pac-Man*. As the display capabilities of video hardware improved, so the designers and artists creating the visual environment increased their efforts to present spaces resembling those of the real world, whether natural or artificial.. This paper examines the relationship between ludic spaces and traditional constructed architectural spaces.

I must at this point issue a caveat, however. Neither I, nor indeed most professional game designers, have any formal architectural training. The terms used in this paper refer to architecture in its traditional role of designing constructed edifices and landscapes, rather than in the broader senses in which architecture is sometimes characterized today: cultural, sociological, political, poetic, and so on. My portrayal of the role of architecture is largely conventional.

TWO FUNDAMENTAL PRINCIPLES

Before beginning this examination I must introduce two fundamental principles which underlie my approach: the definition of *gameplay*, and the continuum between *abstract* and *representational* games.

The Definition of Gameplay

Game designers have argued for years over the definition of gameplay. The issue is more complex for video games than for non-computerized games, because video games often include narrative, story-like elements whose contribution to gameplay is still under debate. In our book, *Andrew Rollings and Ernest Adams on Game Design*, Andrew Rollings and I defined gameplay as consisting of the *challenges* that the game presents and the *actions the player may take to overcome them*.[4] In this paper I will treat this definition as axiomatic.

Abstract Versus Representational

Games, whether computerized or not, may be thought of as lying along a continuum between abstract and representational. The more abstract the game, the more it relies on arbitrary rules to define the game world and the gameplay. The more representational it is, the more it relies on similarities between real-world situations familiar to the player, and game-world situations.

Chess may be considered an abstract game. The assignment of such labels as knight or bishop to the pieces is symbolic and unrelated to the actual behavior of real knights or bishops. *Monopoly* is a slightly more representational game, in that the game-world activities of buying, selling, and improving property are simplified models of similar activities in the real world. Driving and flight simulators may be highly representational, seeking to duplicate the experience of driving or flying a particular vehicle with a high degree of accuracy.

HUMAN PERCEPTIONS OF ARCHITECTURE

Let us begin to examine the relationship between ludic and real-world spaces by considering the ways in which those spaces may be perceived, examining each of the senses in turn: vision, sound, touch, smell, and others, leaving out only taste as irrelevant.

Vision

In real-world spaces we may observe that the following conditions apply to visual perception:

- Both eyes operating together have an overlapping horizontal field of view of 120°. The combined area, including monocular regions at the edges is 180-200°.[2]
- Vision is fully stereoscopic.
- The eye is capable of perceiving a light intensity range on the order of 10^{16} levels.[2]
- The viewer can experience total darkness.
- The visual image is perceived to be steady.
- Both eyes together possess ~250 million receptor cells.[2]
- Focus adjusts automatically as the viewer's attention changes.

By comparison, we note the following conditions of visual perception when viewing a monitor screen:

- The visual angle is 40–60°, depending on the size of the monitor screen and the distance from it that the viewer sits[5]. (This assumes a desktop computer monitor at ~50cm. The angle is smaller for television sets viewed from 2m.)
- Vision is not stereoscopic unless VR (virtual reality) goggles are worn.
- The light intensity range of a 24-bit monitor is 255 levels.
- Total darkness is not within the architect's control. The viewer determines the light level of the room in which the monitor is placed.
- The image flickers at a rate of 50Hz for standard European television sets, up to ~100Hz for high-resolution computer monitors.
- An ordinary TV picture contains approximately 250,000 picture elements.[2]
- The focus of the image is fixed.

We can therefore see that the visual perception of spaces via a computer monitor is severely constrained vis-à-vis viewing a space in person. The visual angle, resolution, image quality, and many other viewing circumstances are much more restricted in computer games and virtual environments generally.

Sound

Turning to auditory characteristics, we may again make the following observations concerning real-world spaces:

- Audio perception is fully three-dimensional.
- All observer-created sounds, e.g. footsteps, are audible.
- An infinite number of ambient sounds may be mixed together to create the aural environnment.
- Echoes and other acoustic phenomena are created naturally by the shape of the space and the materials from which it is constructed.
- The perciever can make noise at will to explore the soundscape of the place.
- There is normally no soundtrack imposed by design in ordinary buildings, although there are exceptions (e.g. music in elevators).

By comparison, in ludic spaces we find:

- Audio quality approaches 3D provided that enough speakers are available.

- Player-created sounds (e.g. footsteps) are audible only if supported in software.
- The number of ambient sounds that may be mixed is limited by the number of channels supported by the hardware.
- Echoes and other acoustic phenomena are either absent or simulated inaccurately.
- The player cannot usually interact with the acoustic space by speaking at will.
- The game generally includes a musical soundtrack to enhance its atmosphere.

As with visual perception, auditory perception of ludic spaces is somewhat limited, though not as dramatically.

Touch

We may use our sense of touch to feel a number of things about a building or other constructed space: the texture of materials used in construction, the hardness of the flooring, the ambient air temperature and humidity, radiant heat coming from sunlight and other objects, and air currents, either naturally-occurring or produced by air-conditioning machinery.

In playing a video game, however, none of these perceptions is available. The texture, hardness and weight of the control devices is independent of the content of the game and so cannot be considered a representation of the ludic space. Some control devices, e.g. force feedback joysticks and steering wheels, may be made to offer resistance to the player, and some controllers may also be made to vibrate as part of the experience. However, this tactile feedback is normally associated with game *events*, not with ludic spaces.

Smell

Smell is seldom a primary consideration for architects, but it does play a role in the perception of space: the scent of the wood, concrete or stone used in construction, the scents of plants or earth, and the smells that give cues to the function of a given room, e.g. kitchen, toilet, laboratory, or kennel.

Video games normally do not provide smells. Efforts to create devices which produce smells on demand have not been commercially successful.[1] The game *Leather Goddesses of Phobos* was shipped with a "scratch and sniff" card – cardboard impregnated with scents which the player was to scratch and smell at particular points during the game. This technique was not widely adopted, however.

Other Senses

We may observe the following additional sensory characteristics of video games that distinguish them from the real world:

- Players have no feeling of gravity (or lack of it in a zero-G ludic space) within the ludic space (although they do feel the gravity of real-world space while they play).
- Movement and climbing in ludic spaces is not physically tiring.

- Games can create a limited sense of claustrophobia by restricting the player's movement in the ludic space.
- Games cannot create a sense of agoraphobia because their capacity to create the feeling of open space is too restricted.
- Games can simulate worlds with bizarre physics. In many action games, for example, the player's avatar can change its direction of motion while flying though mid-air, violating Newton's law of the conservation of momentum.

In addition to the above considerations, which deal only with perceptions of space, games also have little capacity to create the feelings of hunger, thirst, pleasure, pain, tiredness and other bodily sensations, although many of them are simulated within the context of the game.

Summary on Perception

From these observations we may conclude that current hardware denies the ludic architect many of the sensory tools available to the conventional architect. The use of virtual reality equipment may improve visual and auditory impressions in the future, but it will be many years before such equipment reproduces the full spectrum of sensations available in the real world. The primary function of ludic architecture is clearly not simply to duplicate the sensory experience of observing real spaces; its role is more subtle.

THE COSTS OF ARCHITECTURE

In designing and constructing a real-world space, we may identify the following cost centers (omitting taxes and other administrative costs): design, construction labor, land, and materials.

By comparison, in a ludic space we can observe that there are no land and materials costs. There are no construction labor costs, because design *is* construction in virtual spaces. Design costs themselves are considerably lower. Game artists are not paid as well as professional architects, and ludic spaces do not require such details as assembly instructions for construction crews.

In games the design of spaces is not limited so much by financial considerations as by the limitations of the display hardware. In 3D games the primary limitation is *detail.* 3D games use a hardware 3D rendering engine to produce the image on the monitor screen, an engine capable of displaying only a certain number of polygons. As a result, 3D spaces in games tend to look rather sparse, with few objects in them. Similarly, such games tend to avoid curved objects, because it takes hundreds of polygons to represent a curved object, but only a few to represent a rectilinear one. In 3D-rendered spaces, curves are expensive, and straight lines are cheap.

In 2D games, in which the space is not modeled for 3D presentation, but displayed like a painting or a photograph, the primary limitation is variety. The amount of detail in any given picture of a space can be quite high, because it is represented only with pixels and not polygons, but the more pictures the game contains, the more it costs to produce. More visual variety requires more artist time to create it. More images require more disk space to store them.

THE RULES OF ARCHITECTURE

In games many of the the fundamental rules of conventional architecture do not apply. We have seen that costs are entirely different. Scale is irrelevant: in a virtual space, an object is as big as the designer says it is, and he can put a palace in a matchbox if he chooses. In addition, the normal engineering considerations do not apply: the architect need not concern herself with issues of mass, materials strength, assembly techniques, and so forth. Similarly, ordinary questions of habitability are irrelevant. It is not necessary in a game to provide fresh air, fire safety, temperature control, electricity and so on. The reason is obvious: a ludic space is not an inhabited space occupied by real human bodies. It is not constructed to be convenient or useful in the usual architectural sense.

It is even possible to construct topologically illogical or physically impossible ludic spaces, which further strengthens the case that ludic architecture is disanalogous from real-world architecture. A room may contain a dollhouse which contains an identical room which contains an identical dollhouse, *ad infinitum*. Games can furnish infinitely long staircases and recursively defined rooms to create a sense of unreality.

THE FUNCTIONS OF REAL BUILDINGS

To continue the examination, I present a short and necessarily incomplete list of the functions of real buildings in the world:

- To protect people, goods, and animals from the weather.
- To offer personal privacy (toilets and private houses).
- To organize collective human activity efficiently (factories, offices, sports arenas).
- To conceal and protect goods and animals from theft (warehouses, barns, shops, storage facilities).
- To protect people from other people (fortifications, military installations, prisons).
- To impress, commemorate or simply decorate (civic monuments and religious buildings).

Let us examine each of these functions in turn with respect to ludic buildings:

- Weather is seldom implemented in most games, and when it is, it is usually cosmetic. Except in “god” games, simulated weather almost never does simulated damage to anything.
- Privacy is normally immaterial. Most players cannot take their clothes off in games, or do anything for which they would want privacy. (This is starting to change as multi-player games begin to allow simulated sexual activity, but it remains the standard at the moment.)
- It is useful to organize collective human activity in games, but buildings are not the most efficient way to do so. There is no need to construct a building called a “shop” in multiplayer online games when the functions of a shop can be provided by an abstract user interface optimized for shopping (e.g. that of Amazon.com). However, the building offers a convenient game-world metaphor for the functions of a shop.

- It may or may not be possible to steal objects in a game. If it is possible, a building provides a metaphor for storage, concealment and protection. The Treasury in the game *Dungeon Keeper* provided a ludic space to store money. If the player did not protect his Treasury, he risked losing it to thieves.
- Military activity does have direct parallel in ludic spaces. Most computer war games make use of constructed edifices as a means of concealment and protection for troops.
- Decoration also has a direct parallel in ludic spaces, and the strongest one. Any game which seeks to create a sense of place uses architecture to define the atmosphere of the place. Even seemingly "natural" spaces (mountains, forests, or caves, for example) must be designed by the ludic architect, because there are no naturally-ocurring ludic spaces. (A few ludic spaces are constructed automatically by algorithmic methods, but these, too, must be defined by humans.)

In short, buildings and other spaces in games mimic the real world *when it is aesthetically desirable or supports the gameplay*, but they frequently diverge for ludic purposes. Chess requires no buildings. The houses in *Monopoly* are not residences but symbolic tokens.

Outdoor Spaces and Natural Objects

As we have seen, games have a problem portraying outdoor spaces. The designer cannot create sweeping vistas or panoramas that feel like the real thing to someone who only sees them on a monitor. Players sitting in a room cannot feel the sensations of being surrounded by vast, open spaces. Even with current VR gear, they cannot feel the sunshine or the wind.

Part of the sensation of being in a large space arises from the length of time required to move through it. An observer standing on the plains of eastern Colorado in the USA will quickly notice that he must walk many, many days to reach the Rocky Mountains on the horizon. The Great Plains are a huge space. But most games allow the player to move quickly, requiring no more than a few minutes to walk from one side of the game world to the other so as to avoid boring him. Thus, the sense of scale is diminished. In addition, many games offer an aerial perspective, which reduces the visual impact of constructed objects. The Great Pyramid does not seem so impressive from 1500 meters in the air.

3D games also have difficulty representing natural objects. Consider an oak leaf: it consists entirely of curves, but as we have seen, curves are expensive and straight lines are cheap. With thousands of leaves per tree and thousands of trees in a forest, it is too expensive to display a detailed forest with 3D rendering methods. As a result, most 3D games avoid natural objects in favor of man-made environments, which makes them feel rather sterile.

THE PRIMARY FUNCTION OF ARCHITECTURE IN GAMES

Having observed that there are significant differences between perception and practical utility of architecture in the real world and in ludic spaces, we must ask ourselves: exactly what *is* the function of architecture in games? Why do games contain simulations of constructed environments?

The essential role of all games is entertainment, specifically entertainment through gameplay (as opposed to entertainment through music or narration, for example). The primary function of architecture in games is thus to *support the gameplay*. Buildings in games are not analogous to buildings in the real world, because most of the time their real-world functions are irrelevant – the real-world activity that the building serves is not meaningful in the context of the game. Rather, buildings in games are somewhat analogous to movie sets. A movie set is an artificial, incomplete structure whose function is to support the purpose of the movie – entertainment through narrative – by creating a context for the story. A ludic space is also an artificial, and usually also an incomplete, structure whose function is to support the purpose of the game, namely, entertainment through gameplay. A ludic space is not exactly analogous to a movie set, however, because its function is not purely visual. Gameplay has different architectural requirements from visual narration.

The Relationship of Architecture to Gameplay

Remember that gameplay was defined as the challenges that the game presents and the actions the player may take to overcome them. Architecture supports the gameplay by helping to define the challenges presented and actions available to the player in four major ways: constraint, concealment, obstacles or tests of skill, and exploration.

Constraint

In abstract board games like chess and checkers, the space is bounded only by the edge of the board. Arbitrary rules governing how the pieces may move create the challenge. In representational games, the player should be able to move his units (whether vehicles or characters) more freely than chess pieces, similarly to the way those units would move in the real world. Architecture, rather than arbitrary rules, establishes boundaries that limit the freedom of movement of units, and therefore makes moving them to a desired location more challenging.

Architecture also establishes constraints on the influence of weapons and other forces. War games make considerable use of buildings or landscape features as a form of protection for troops. In some games these may be destroyed by repeated attacks. In role-playing games, however, as a general rule architectural features are invulnerable: projectiles do not pass through walls (no matter how flimsy) nor do explosions knock them down, nor fires burn through them. A common *non sequitur* found in games such as *Diablo* occurs when the player possesses powerful weapons, but is nevertheless unable to open a simple wooden door without the appropriate key. The walls are impenetrable and the door passable only by means of the key. These architectural elements thus create a challenge: to find the key.

Concealment

Few computer games are games of perfect information, in which the player knows everything there is to know about the state of the game. Architecture is used to conceal many things in games: valuable objects, which the player must find; dangerous enemies or objects, so the player will be surprised when they appear; and of course other players, who may be trying to gain a strategic advantage through stealth.

Thus, walls, buildings, and landscape features offer challenge by requiring the player to detect or discover the concealment. They also offer the player the action of concealing herself from enemies.

Obstacles and Tests of Skill
Chasms to jump across, cliffs to climb, trapdoors to avoid – these are all challenges created by the peculiar landscape architecture of computer games. Some of them can be surmounted by observation and logic, others by hand-eye coordination.

Exploration
Exploration challenges require the player to understand the shape of the space he is moving through, to learn which areas leads to which other areas. If the game does not provide a map, the player may have to rely on memory. Mazes are of course one of the oldest examples of such a challenge.. In recent years designers have started making better use of subtle clues: sunlight coming through a window means that the player is near the outer walls of a building, a differently-shaded patch of wall indicates a hidden door, and so on.

Three Examples

Figure 1 is a sketch by Canadian game designer Peter Lok. It depicts a long ventilation shaft leading from the roof of a building straight down into an equipment room on the ground floor. The sketch includes the following notation:

> Shutters that open and close. Must jump down when open and fan is on. When closed you plummet and shutters are electrified. Have 2 sets of fan/shutter. Must land on ledge above fan. Blades will kill you.
>
> Equipment room with ducts and access doors to labs.

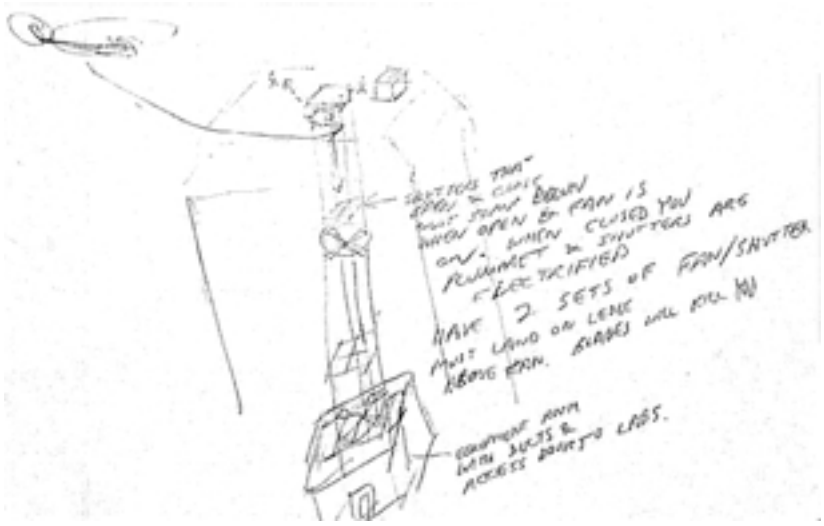

Figure 1. Sketch of a ventilation shaft.

Considered as real-world architecture, this is is not very sensible. The fans apparently blow out rather than in (the updraft prevents you from plummeting if you jump in while they are on). The building might need two fans in order to move a given volume of air, but why would it need two sets of shutters? And why are the shutters electrified? Most importantly, the remainder of the building is undefined. Like a movie set, it is a false front, simply a container for the ventilation shaft and the equipment room below.

As game design, however, the building is perfectly functional. It supplies constraint (the player starts on the roof and must go down the ventilation shaft to get to the equipment room); an obstacle challenge (the fan blades and electrified shutters which, reading between the lines, we can tell must go on and off at intervals); and an exploration challenge (the player does not know what is at the bottom of the shaft until she gets there).

Here is another example of how game design diverges from reasonable architecture. Notice the strange and wasteful design of this building complex from *Quake*. This building is designed to be explored, not used.

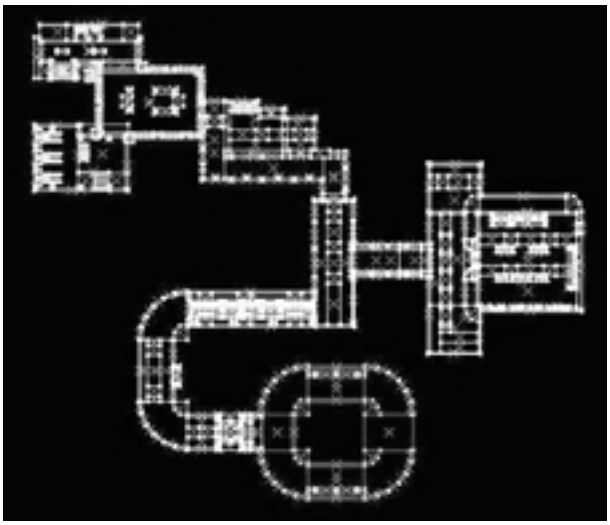

Figure 2. A map of a building in *Quake*.

Or consider this oddly-shaped valley from the Militia level in *Counter-Strike*. The building at the end is fairly rational, but the shape of the valley itself is optimized to create combat challenges through constraint and concealment. It is designed with lots of things to hide behind, allowing small numbers of snipers to cover the whole valley – in both directions.

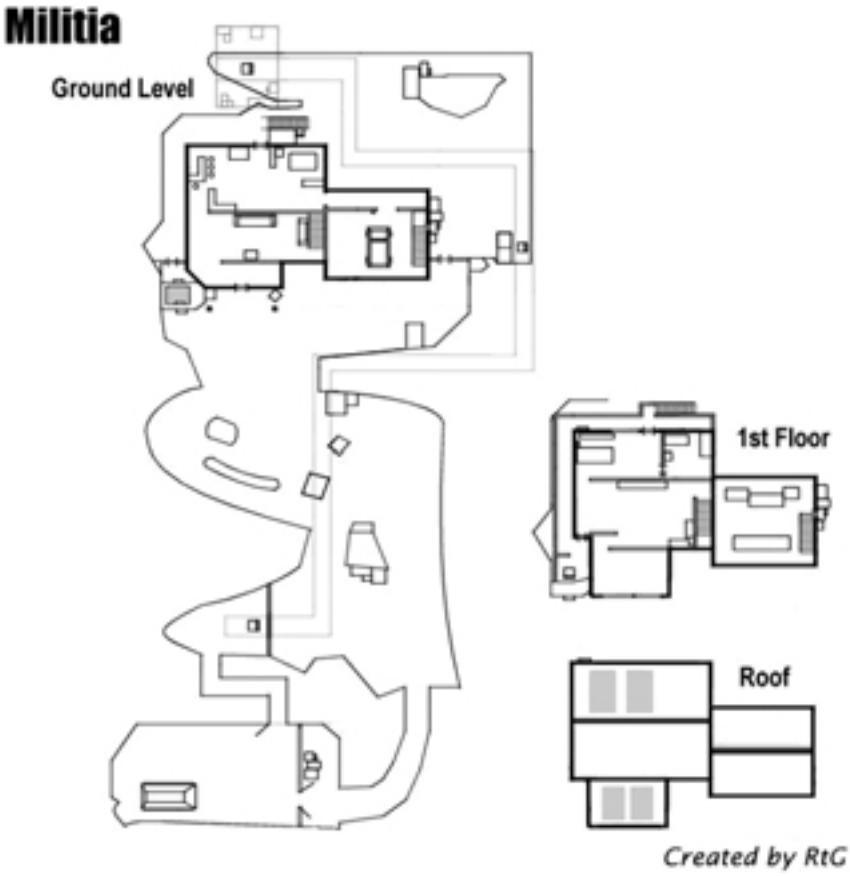

Figure 3. The Militia level in *Counter-Strike*.

All these things are examples of the environment supporting the gameplay, even if they are rather peculiar in real-world terms.

THE SECONDARY FUNCTION OF ARCHITECTURE IN GAMES

If the sole function of ludic architecture was to supporte the gameplay through constraint, concealment and so on, the spaces could all be bare grey walls. But architecture has a secondary, and still highly valuable role to play: *to inform and entertain in its own right*. It does this by a variety of means, which I will illustrate in turn.

Familiarity

Familiar locations offer cues to a place's function and the events that are likely to occur there. If the player sees a kitchen, he does not expect to find a blacksmith making horseshoes. Designers of representational games rely on players to use common sense about the function of certain kinds of familiar spaces, and it is cheating them to violate their legitimate expectations without any explanation. A hotel room, for example, is a highly familiar space. In Figure 4, Gabriel Knight, the player's avatar, is waiting for the maid to finish

cleaning the room so that he can search it. The player's familiarity with hotel rooms informs him that the maid will not stay there indefinitely.

Figure 4. *Gabriel Knight.*

Allusion

Game architecture can make reference to real buildings or architectural styles to take advantage of the ideas or emotions that they suggest. The real world is of course filled with examples, from the ruinous spiritual grandeur of Stonehenge to the gruesome expediency of the gas chamber at San Quentin. *Soul Reaver* is a game about a vampire that eats souls, so a cathedral has powerful connotations.

Figure 5. *Soul Reaver.*

Novelty

New worlds require new architecture. To create a sense of unfamiliarity, games display unfamiliar spaces. This has the disadvantage that it robs the player of a frame of reference, and can create confusion rather than emotional resonance. Figure 6 is a view from *Planescape: Torment.* Note the extreme variety the of buildings and the lack of cues as to their function. To avoid this problem, games often give the buildings explicit names. Among the buildings in Figure 6 is the Brothel for Slaking Intellectual Lusts, a place where the player can pay scholarly prostitutes to talk about philosophy and art.

Figure 6. *Planescape: Torment.*

Surrealism

Surrealism creates a sense of mystery and more importantly, it warns the player that things are not what they seem. A surreal landscape tells him that the game may require extreme lateral thinking or strange leaps of logic.

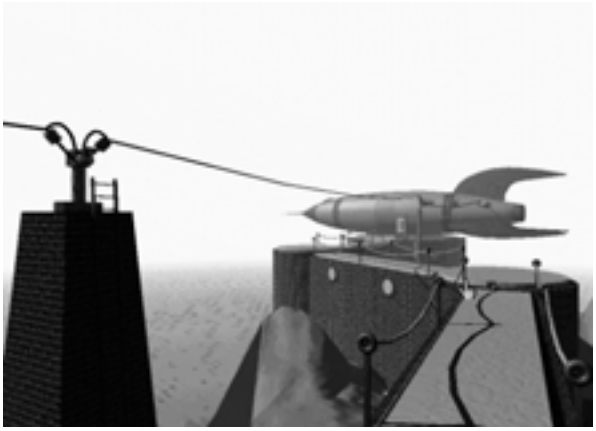

Figure 7. *Myst.*

Atmosphere

To create a game that feels dangerous, it must look dangerous. The city street in *The Longest Journey*, Figure 8, looks like the concrete canyons of Manhattan with their looming high-rises, dim light, and graffiti. The rose window of the cathedral, partially hidden in the background, suggests a place of sanctuary nearby.

Figure 8. The city of Stark, from *The Longest Journey*.

Comedic Effect

Not all game worlds are familiar, dangerous, or strange; some are supposed to be lighthearted and funny. Note the Disneyesque bulging walls and off-kilter windows of Planet Threepwood in Figure 9. This is less a building than an architectural joke.

Figure 9. *Escape from Monkey Island*.

Architectural Clichés

Games, like other forms of popular media, often rely on clichés and stereotypes to set a scene and establish player expectations quickly. This is a variation on the principle of familiarity, without the benefit of being informed by real-life examples. The scene from *Dark Age of Camelot* below includes all the necessary elements to suggest a sort of Lego-land medievalism, complete with dragon, symmetrical castle with banners, and a half-timbered building. The place does not look like any place in the real world, but thanks to Hollywood and earlier games, the player can easily infer what kinds of events might happen here.

Figure 10. *Dark Age of Camelot.*

CONCLUSION

Architecture is what turns the bare space of the chessboard into the living world of the computer game. It tells the player where she is, but more than that, it also tells her what might happen to her there, how she should feel about it, and what she should try to do about it. Ludic architecture is a somewhat peculiar field, disjoint in many ways from conventional architecture because of the many practical differences between them, but both are based in a profound aesthetic instinct: the urge to create dramatic and meaningful spaces.

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