Towards Immersion: What Video Games Can Teach Us

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ABSTRACT

This paper explores the areas(process/or remove) of video game design and user interfaces to construct a narrative on ways of improving information visualization.

PROPOSAL

To offer a new perspective on the way researchers present, represent, and think about visualization by extrapolating the methods of visualization used in video games.

MOTIVATION

With each passing day, the amount of data being collected grows exponentially. It seems everyone wants to see the data these days. The facts and figure are increasingly desired to the point that companies are investing large sums of money into research firms whose job it is to gather, analyze, and present their findings. All user design and decision making is grounded in data, so it is always necessary to find the best ways to represent this data. There is a lot of data out there, but much of it is not being utilized. It's being ignored because no one has found out how to give it meaning, or what to do with it.

Finding a way to visually represent data in such a way that is easily understandable by the user is a difficult task to accomplish. There is always a balance to be made between over simplifying the information so that it becomes easily accessible or run the risk of presenting your data in such a way that will only be understood by specialist. Visualization is not about presenting data in an artsy way, it isn't about prettifying your data, but representation and presentation is key. Researchers should be aware of their audience, but a common problem is finding ways to make your data relevant to those who wouldn't care otherwise.

Video games offer a powerful and different perspective into the world of visualization. But what exactly do we mean by visualization? Well, this paper will focus on data visualization that is related to the ways in which video games graphically represent data to establish patterns, trends, and convey meaning. To clarify we are taking data visualization to be the process by which information is represented through images, graphs, and direct manipulation interfaces [3].

There is much to be learned from video games in aspects of data visualization. Many games are largely about making sense of data. Players are expected to make sense of large sets of information, and they are actually pretty good at doing so. Video games can teach us the methods by which to develop an interactive way of viewing data.

RELATED WORK

There are two key aspects to look for in video games as discussed in "Narrative Visualization: Telling Stories with Data" and "Toward Visualization or games: Theory, Design Space, and Patterns", narrative structure and the user interface. As "Narrative Visualization" highlights, successful design visualizations must adhere to a narrative structure typically found in a story with a clear emphasis on the "who/what/where/when/why/how." [4].

1 INTRODUCTION

In the 1940s the idea of a video game

system was thought of by Thomas T. Goldsmith Jr. and Este Ray Mann Thirty. However, it wasn't until the 1970s that a video game arcade system was created by engineers in Stanford. And approximately one year later, video games reached mainstream popularity when they were brought into the living room via consoles that one could purchase at any retailer. From then, video games have come a long way and can almost be found anywhere and played by anyone. And with the invention of the handheld system, the ever growing mobile industry, and web games, video games will continue to grow and become an influential medium. However, the point is not about how pervasive video games have become, but rather what we can learn from them. Specifically, what can video games teach us about visualization? That is, what techniques can we extract from video game visualization and apply to the field of information visualization.

I chose the area of video games because they are a taxing medium that demands attention, executive decision, and planning. Yet despite all these extraneous factors on the user, gamers are able to reach efficient and reasonable solutions by using the user interface because it is designed in such a way that information is displayed in the most optimal way. Without the user interface, many gamers would be unable to analyze the situation and take appropriate action. In this way, the user interface is not only the main source by which data is visually represented, but is fundamental to our development of a framework that may offer new insight into methods of improving visualization.

2 METHODS

In order to suggest some practical methods that would aide in improving how data is represented, it would be necessary to establish high priority elements that users find helpful when it comes to helping them understand a dataset. We would essentially be identifying the design space in a quantitative fashion. Fortunately, Segel and Heer do this for us [figure 7: "Segel and Heer]. Further quantitative techniques including focus group participant statements would be drawn from Erik Fagerholt's and Magnus Lorentzon's paper, "Beyond the Hud" [5].

3 EVALUATION

Again, there is nothing to be proved in this proposal; rather the proposal wishes to inspire researchers to consider new possibilities in how they visualize data. Specifically, this paper aims to inspire others to incorporate the techniques of visualizing used in video games to their own research. Success would be determined on the basis of whether the framework we propose for visualization would be beneficial to researches that are looking for new and exciting ways to present their data.

3.1 Expected Outcomes

At most, researchers will find the information presented interesting, helpful, or at the very least insightful.

4 GAME DESIGN & INFORMATION VISUALIZATION

I feel that one of the most difficult tasks in information visualization is representing your data in such a way that makes it relevant, important, accessible, and understandable to a large audience of varying expertise. If visualization is able to convey its intended meaning to novices and experts, then I feel the visualization is successful. Game design is the process by which enjoyable and memorable user experiences are created in games. In game design, video games teach us that immersion is one of the best ways to draw the viewer in to the data on an emotional level. This emotional level brings the user closer to the data and may inspire the user to feel as if the data is more relevant to

them. In this way, a more positive and meaningful impression is left on the user; the data is able to impact the user with resonance.

Game design also teaches us that immersion is a process enhanced through interactivity, realistic representations of reality, story elements, and direct user manipulation. In essence, we learn that immersion is something important to users because it allows them to relate to the data (or game) in a way that is meaningful to them. In a way, immersion helps solidify the gap between data and audience. If a user is immersed in the data, then they are experiencing the data at its fullest potential; a goal many researchers wish to achieve. As data visualizations are created, the intentions are for our users to tango with the data and fall in love with it. We simply want them to really engage the data, and perhaps learn something new.

Now let's talk about the specific ways in which we will use the game design techniques of interactivity, story, and representation to enhance the power of visualizations. Let's start with the concept of how visualizations should tell a story.

4.1 Visualizations Should Tell a Story

In video games, the narrative, or story being told, usually adheres to a few basic principles of storytelling – this is important because we have to consider what kind of story we are trying to tell through our data; what is the overall theme of our data; what do we want our viewers to get out of viewing our data. Also, in the same way that a story guides a reader from beginning, middle, to end (3), a good representation of data will guide the viewer in the same way. By incorporating a brief introduction about your project that tells us what the big idea is, then showing where problems arose in your research, and finally showing us what your data suggest, users are provided with a natural rhythm in which to view your data.

Following narrative structure would ideally reduce any confusion the viewer might have when looking at complex datasets. Having levels of structure would work to make your data accessible to both novice and expert users. By providing narrative structure the data becomes an experience for the user. Narrative visualization is about structuring the order in which users explore your visualization. Overall, data visualizations should tell a story as a way of interloping viewers into a coherent visually representative learning experience.

Researchers have the data; the problem is finding the best way to represent it. However, narrative visualization provides us with an essential list of elements that visualizations should feature. The following elements list is composed of data gathered by Edward Segel and Jeffrey Heer in "Narrative Visualization: Telling Stories with Data" [figure 7]. It is divided into two categories: visual narrative, and narrative structure.

4.2 Visual Narrative

Within the category of visual narrative, there are three elements that have the potential to improve visualization techniques. The visual narrative is primarily concerned in creating a narrative experience that directs the user's path or attention through the data (2.2). Segel and Heer found that utilizing visual structuring and highlighting provided the most effective ways of creating visual narrative. Visual structuring is concerned with the way your data will be experienced visually, where highlighting is one of the more effective ways at directing a user's attention by creating salience. A set path through your data can be established by visually highlighting the most important or relevant data via color, size, and arrow usage (3.1). For example, by centering an image at the top with a bold title and a downward arrow underneath, you are creating your

establishing shot, a technique used in video games and movies to set up a scene or location. This establishing shot orients the user to your data, and gets them started on a path of exploration. At other times, it will be important to clearly indicate where the viewer is situated within the data, so that the user will know at all times where she is, and where she can go. This can be done by adding a progress bar, which will indicate the current state/location of the system. Lastly, organizing your data semantically and consistently is important for maintaining structure. Consistency in terms of visual layout is important because it establishes credibility and ease of use, and fulfills one of Nielsen's usability heuristics. Semantic consistency reminds us to organize our data through similarity, which makes our data easy to follow. Again, visual structure is the process that attempts to formulate a set path for the way your data should be viewed/experienced via visual indicators and adherence to narrative flow.

4.3 Narrative Structure

Narrative structure emphasizes the need to represent our data in a way typically found in a story with a clear emphasis on the "who/what/where/when/why/how" [2.3]. If a visual representation of data is able to set up this kind of structure, the data is made to be intuitive and simple enough to explore by viewers. Or at the very least, viewers will be able to understand the gist of your data. Narrative structure includes concepts of ordering and interactivity. [figure 7]. Although we are setting up a pre-configured path for our users to explore, we do not wish to pigeon-hole all of our users into having to follow this path. Rather a combination of linear and user-directed path structure is encouraged, as a way of appealing to both newer users and more expert users who already understand the data and wish to explore the data using their own path. In game design, allowing this kind of freedom is called agency. By giving the player agency, you are being conscious of the varying degrees of expertise and how this might influence the ways users experience or expect to experience the data. You want to give your user's agency so as to not fast-track all of your users into experiencing your data in one way. By giving your audience some agency, you are offering them methods of exploration, which will allow for rich and interactive perspectives to be formed, and thus contributed to an overall positive experience. Agency is related to interactivity in the sense that users are able to engage with your visualization in a way of their choosing.

Interactivity concerns itself with the way users are given the power to manipulate the visualizations and mold their own unique experience by choosing their own way to engage the data. Interactivity works at increasing agency, and lets the more advanced users explore the data in a way catered to their experience level and liking. Segel and Heer present two forms of interactivity: author-driven and reader-driven. Reader-driven interactivity provides the most agency (where user has direct user manipulation over data), while author-driven is when you construct the path for the user to take. The field of visualization should learn to use a combination of both, but specifically I wish to highlight the martini-glass structure and the drill-down story approaches.

4.3a Martini-Glass Structure

The martini-glass structure begins with an author-driven approach in order to situate the viewer to the data, but allows for self-exploration later on. This approach is a great way to not over-stimulate users with data and options because it starts off by introducing the big picture (expressed through images, text, annotations), and let's user's move through the data at their own pace. This approach starts with a low learning curve, which is an effective way of teaching newbie users how to interact with

the data.

4.3b Drill-Down Story

This approach presents the user with an overarching theme, and then allows for further exploration into that theme. This style is entirely reader-driver, and is good at representing data related to a singular topic. For example, there might be a visualization that starts off by showing the best colleges in America, and then allows the user to drill-down into a specific school to learn more. This is what they call data-on-demand, and is an important interactive feature to consider having. At the offset, data-on-demand works by not scaring users with too much data and instead letting users manually interact with the visualization when they want more in depth information.

5 Design Space of Visualization

There are two genres in video games that I would like to discuss: first-person shooters and real-time strategy. Each genre constructs the design space of the game, and so the user interface related to each of these genres has to be designed accordingly. This will have important implications for when we consider ways to design our own visualizations.

5.1 First Person Shooter

These games are fast paced, where quick-reflexes and decision making must be supported. Information pertaining to the environment is critical, and success depends on whether or not the user interface displays the appropriate information. For example, the screen might flicker red and show blood splatter to indicate that the player is dying. In addition, the screen might show a hit indicator (an arrow that points in the direction of shooting) to show what direction enemies are shooting from. Users in this arena usually have one goal, survival, and so the way information is visualized is not very interactive or malleable. This is a case of author-driven implementation over user-driven exploration.

5.2 Real Time Strategy

Executive planning, control, and decisive action are the vital elements that the interface must support. Every in-game action made on behalf of the user is based on the data made available through the interface. The most important design element in this game is building an effective interface that is easy to use, and instantly lets the user know what they will learn by exploring the data. The visualization must be robust and interactive enough to support a number of interactions that the player might want to do. This follows the martini-glass approach because the visualization starts by displaying a small overview of data, but lets the user explore and customize the data that they get to see.

5.3 Design Implications

Overall, game genres thought us that interactivity and high user manipulation are some of the most important elements to support in data visualization. Immersion is a by-product of great design. To create some of the newest and effective visualizations, I feel that researchers need to consider the following concepts as discussed in Bowman's research paper.

5.4 Primary Purpose

Researchers should ask themselves: what is the point of my visualization? What exactly are you, as a holder of knowledge, trying to teach or show to your audience? By figuring out what kind of story you want your data to tell, the process of structuring your data will become more cohesive.

5.1 Visual Complexity

Researchers have to be conscious of how much visual literacy is required of their users. For visualizations that require high

visual literacy to navigate and interact with, it might be necessary to start with a tutorial, or adhere to the ten heuristics of interface design. Some of the most applicable heuristics are consistency and freedom, visibility of system status, match between system and the real world, and error prevention. If your visualization method is overly complex, then you have to ensure that the user experience for users who might not readily understand your data is not ruined or made too difficult because users will simply tune out, and overlook your data.

5.1 Target Audience

Lastly, researchers should try to figure out who their visualization is supposed to help. The ideal goal is to make your data interesting to everyone, but most of the time, that will not be the case, and researchers should focus on a target group for which they feel their data would help most. By honing down on one specific group, catering your visualization methods to that group is easier than trying to please a number of groups who might each be looking for a specific thing in your data. However, never forget to consider expertise, which will always vary.

6 Conclusion

Visualization has come a long way from Tufte's time, and will continue to grow towards greater interactivity. Dynamic visualizations are offering novel ways to experience data. Through immersion, visualizations might start having that pull-in effect you get when you read a good book or watch a good film. Immersion helps create a meaningful experience, something all visualizations can use.

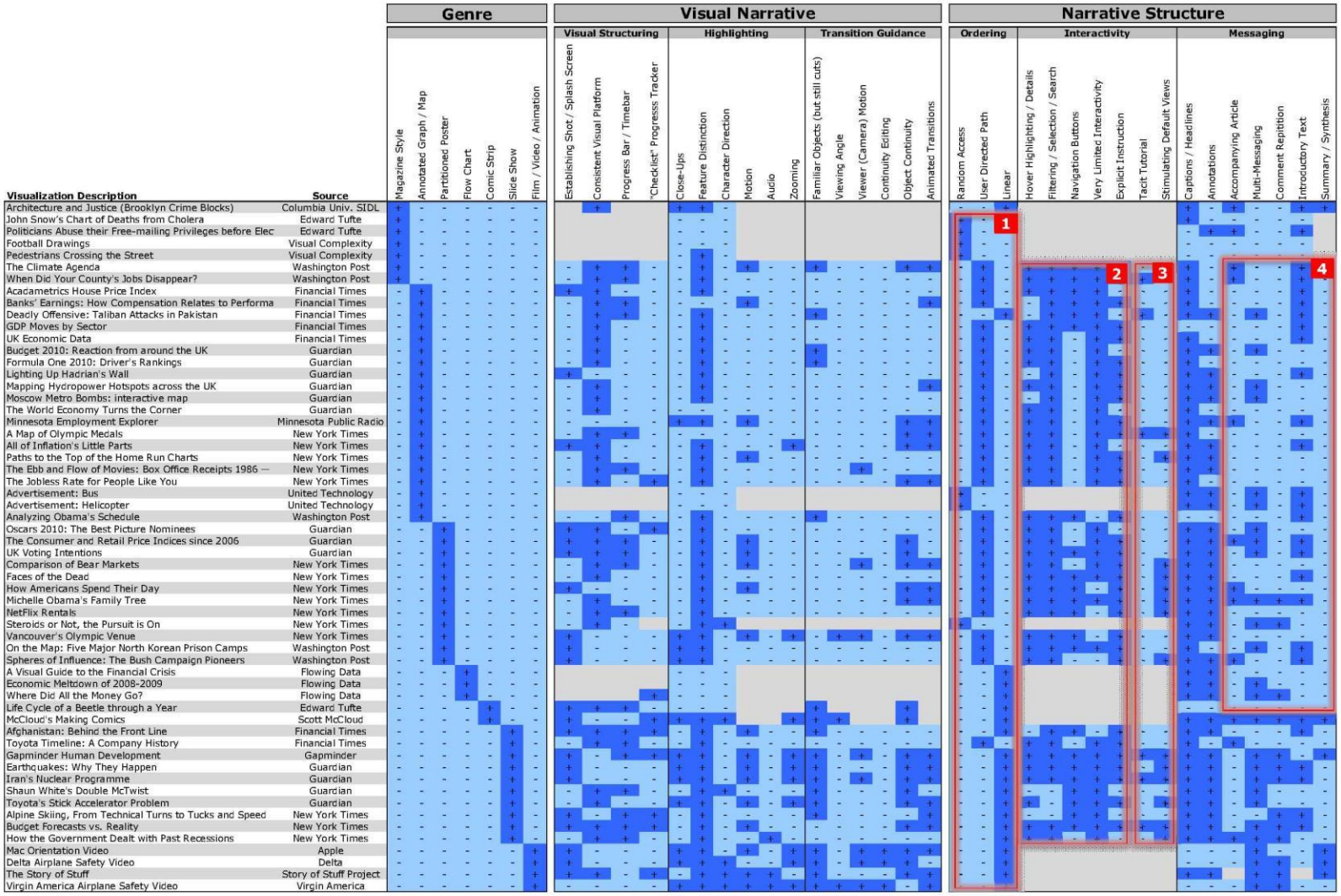

Fig. 7. Design space analysis of narrative visualization. Columns indicate recurring design elements and selected regions highlight patterns in the data. Region (1) shows clusters of ordering strategies that correspond to distinct genres of visual narration. Region (2) highlights the consistency of interactive designs used by visualizations. Region (3) shows the under-utilization of strategies to engage the user in the interactive functionality. Region (4) shows the under-utilization of common storytelling techniques across narrative visualizations.

Citations Page

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