Simon Mikulcik

Stories and Structures

Dr. Gibson, Dr. Kroeg

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Flatland Visualization

In most literary works, visualization is crucial to the overall understanding. Edwin A. Abbott explores this idea in his 1884 novella, *Flatland*,as he describes inhabitants who live inside a two-dimensional plane. With only two dimensions, an inhabitant of Flatland, a Flatlander, would see a one dimensional image – a line – from his perspective. Naturally, from the perspective of someone in a three dimensional world who sees two dimensional images, human readers have a difficult time understanding how someone in Flatland could live day-to-day life. However, Abbott intended for the reader to have some difficulty visualizing the world of Flatland because by understanding the difficulty of visualizing different dimensions, he or she may recognize the possibility of an incomprehensible higher dimension or higher power. Nonetheless, the difficulty of inferring an image of the view of Flatland may prevent several readers from understanding Abbott’s message about higher dimensions.

In response to this problem, the improvements in computer technology and the advances in the field of video games have made visualizing foreign worlds much easier now than it was in 1884. Developers create new worlds which are displayed on a screen that are easily interpreted by the people playing the games. Therefore, a piece of software that makes visualizing Flatland easy would help human readers better understand worlds with dimensions different than their own. This software will widen Abbott’s audience to include those who may have trouble visualizing Flatland merely by reading the text. I have created a demonstration of such a piece of software for this purpose which depicts several aspects of Flatland in an effort to help readers better understand the two dimensional world.

In my demonstration, I primarily tried to recreate the visual world of Flatland. Conveniently, Abbott included a relatively thorough account of life in Flatland from the perspective of a man named A Square which I was able to model in my demonstration without much difficulty. A Square says that all male inhabitants in Flatland are polygons (typically regular polygons, or isosceles triangles) whereas all female inhabitants are straight lines (21). He presents a clear image of the class system in Flatland: the wider a male’s smallest angle is, the higher social class he has, while a woman’s social class is determined by the class of her male family members (21). A Square also mentions many other details about the technicalities of the society in Flatland; however, those details are not emphasized as much as the class and gender differences were.

Abbott emphasized the importance of class distinctions in Flatland. In her introduction to Flatland, Rosemary Jann described the relationship between Flatland and Victorian English society. She claimed that the Flatland society is very similar to the Victorian society because both define their class distinctions with arbitrary nuances (x). On one hand, the Victorians scrutinized nuances in “conduct, speech and appearance … for evidence of one’s relative social standing” (x). On the other hand, Flatlanders distinguish class based on the number of sides one has (note that Flatlanders cannot see a polygon in its entirety at one moment because of the first person perspective). In my demonstration, I illustrate how much of a subtle of a detail one’s side count is to a Flatlander in order to help Abbott show how ridiculous judging people by their appearance and other subtle differences.

The social classes are divided by subtle differences based upon the physical structure of the inhabitants, which is visually apparent, though very subtle. A Square mentions that an inhabitant may ascertain a person’s class by hearing the person’s voice, feeling one of the person’s angles, or by sight recognition (31). A Square describes sight recognition as being the most difficult form of identification that needed “many years of experience” to perfect (39). By including this description of the difficult art of sight recognition, Abbott reminds the readers how much of a nuance one’s number of sides really is, while he also challenges his readers to visualize the world of Flatland and understand how to differentiate angles. In order to help readers realize the difficulty of sight recognition (as well as the feasibility), I strived to make the rendering engine for my demonstration as similar to A Square’s description as was feasible. A Square mentions that the fog present in his part of Flatland was the only way that he could differentiate between different angles by sight (36). The fog helps Flatlanders differentiate shapes because the larger the distance from the observer to a point on the side of a shape, the thicker the fog would appear on the shape. Also, light in Flatland comes “equally at all times and in all places” (19). Thus, we may assume that Flatland is lit by a global illumination model. These passages define the basic lighting model for Flatland. By providing an accurate view of Flatland, I may better help readers relate to the topics described by Abbott.

A Square also describes the specific appearances of the people in Flatland. On page 15, A Square mentions that the inhabitants have “luminous edges,” and on page 38, he describes the appearance of edges closer to an observer as brighter and edges further as shading away into dimness. A Square includes images of the views of a Flatlander to accompany his descriptions. These images are the bars with tick-marks that appear in the observer’s “Eye-glance” that shows what a Flatlander sees when he looks at a polygon (37, 39, 51). These images show a white mark in the center that taper off to blackness on either side. We may infer that the sides of Flatlanders emit light. However, A Square describes the women somewhat differently. He mentions that “the end containing her eye or mouth” is “highly lustrous,” whereas her other end is “sub-lustrous, and, indeed, almost as dim as an inanimate object” (25). Since the calculation of a diffuse shader is simpler than the calculation for an emitter shader, in my demonstration, I have drawn the characters in Flatland as white characters with a diffuse shader which taper into blackness by the fog.

I presented my demonstration in a video game format because it uses immersion to let the readers experience life in Flatland. When people read fiction books, they may become engrossed in the story and feel as if they were actually inside the story. When the reader is in this state, he or she may notice minute facets of the story. When people play video games, a similar phenomenon happens: the reader may feel as if he were actually inside the game. However, reading books may evoke mental images, whereas, playing video games provides the images for the player. The images from the games may be carefully crafted so that the player may visually see the minute details about the game. Recreating the visual world of Flatland alone may be interesting, but viewers may not fully understand the subtle descriptions about Flatland until he has to recognize for himself the number of sides of a polygon by only seeing a Flatlander’s view.

I placed the user in a first person view from A Square’s perspective so that the user may immerse himself into Flatland society better than if he had a top-down perspective. The user sees the one dimensional image that a Flatlander would see on his or her computer screen. The controls are similar to first person shooter games so that a person familiar with those controls would be able to navigate the flat-world without much difficulty. As the user continues to play this game, he or she adjusts to the concept of sight recognition in Flatland, and eventually, will be able to easily visualize it without much difficulty. Thus, this demonstration provides a tool that will help readers to better understand the struggles of life in Flatland.

Earlier, we mentioned that Flatlanders see one dimensional images when they see their world. In a three dimensional world, one dimensional images are infinitesimally thin and infinitesimally thick, yet have length. To a three dimensional eye, the eye cannot see an infinitesimally thin object. This leads to the contradiction: to see the world of Flatland, we must make something which we cannot see at all. A Square reconciles this contradiction in his preface to Flatland because his descriptions of his world are subject to the same contradiction. A Square admits that inhabitants on Flatland indeed do see a thickness to their lines; however, the thickness is equal for everything, which provides no concept of another dimension. In my demonstration, in order to make the Flatland world visible to human eye, I incorporated a universal height of the Flatlander’s view. Looking at my demonstration, one would see varying shades along the horizontal axis, and the same shade along the vertical axis, since the Flatlanders have no concept of a vertical axis.

My demonstration is not a complete product; however, it builds a foundation for further exploration of hard-to-visualize worlds. I implemented the basic framework for rendering a Flatlander’s view as well as the basic structure of a role playing game. My demonstration functions as a tool that is useful for *Flatland*, but the game part of the demonstration could be greatly expanded to enhance the user’s experience with visualizing this world. On a comical note, dissenters of this tool discourage visualization of such worlds. For example, Ladd Ehlinger’s film, *Flatland* explicitly suggests that visualizing Flatland “may injure your brain” (1:19). However, I argue that visualizing what Flatlanders see rather *expands* the brain instead of damaging it. Further extensions of my demonstrations may include a larger world than what I have constructed. It may also extend to help visualize one dimensional worlds, or even four dimensional worlds. Such improvements would further help readers visualize other worlds because it provides a better means of explanation than does written text. Just as the adage goes, “A picture is worth a thousand words,” so would a visual explanation of other worlds be easier to understand than if it were written.

Abbott challenges *Flatland* readers to stretch their minds to imagine worlds unlike their own. Just as the characters in Flatland are presented as having trouble imagining higher dimensions, so do humans in the three dimensional world have trouble visualizing four dimensional worlds. Abbott recognizes the importance of stretching one’s imagination. With my demonstration, I hope to show that by using tools which help stretch one’s imagination, we may broaden our thinking by more fully grasping the world described in Flatland.

Works Cited

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