Towards a Metaphor of Immersive Data Filmmaking

Abstract
With this research plan, I propose the metaphor of immersive data filmmaking to analogize the immersive data storytelling to data filmmaking. Through the exploration of the exact characteristics of an immersive story, the main components of an effective immersive visualization, and the ways a user interacts with the immersive data story, I hope to generate a set of design guidelines that bridge the gap between AR/VR technologies and the end user.

Introduction
As an emerging interdisciplinary research field, immersive analytics has drawn attention from researchers, practitioners in the data visualization community, as well as in virtual and mixed reality, and human-computer interaction. Recent advances have been made on displays and interaction technologies that enable the more fully engaged human senses [1], identification of potential design space of the embedded visualizations for augmented reality [2], specifications of a high-level interactive grammar that provides visual encoding rules and a composition algebra for layered and multi-view displays [3], taxonomy on basic immersive analytic tasks and narrative patterns that facilitate the exploratory task implementation [4], etc. However, a human-computer interface and a set of design guidelines that support effective immersive visual analysis are missing [4], leaving a large gap between the users and their data in the immersive settings. While narrative visualization and its immersive nature serve as a good solution, the exact characteristics of an immersive data story and the immersion experiences it would compass remain elusive [5]. In this case, I propose this research plan to further explore the possibilities and principles of immersive data storytelling and its role in engaging and involving users to have active data exploration. My research aims to provide a solid understanding of storytelling as a technique while enlighten its use for designing immersive human-data communication. I hope to fill the knowledge gap in visual encoding rules for immersive analytics and enable it to reach a larger audience by allowing the interactions between users and multisensory visual stories.

Methodology
With this proposed research plan, I intend to address three main research questions through the analogy between immersive data storytelling and filmmaking in both concept and practice. To address these questions, the study will be broken down into three phases.
<u>Research Questions</u>
1. What makes an immersive story?
2. What makes an effective immersive visualization?
3. How should the user interact with the immersive data story?

<u>Phase 1: Characteristics that Make an Immersive Story</u>
The concept of immersion could be interpreted from either the physiological or the psychological perspective. While there is no clear definition of immersion experience in the domain of visualization, it has been described as a sense of absorption or transportation in game and cinema [5]. Particularly in filmmaking, the immersive experience in a story have two different conditions: one refers to the involvement and engagement of the audience to absorb the story (Fig.1), the other refers to the construction and formation of a fictional universe encompassing

the audience (Fig.2). Both conditions require active participation of the audience with different requirements on their abilities of sensation and perception.

Fig.1 The Audience Absorbs the Story (

Fig.2 The Story Encompasses the Audience

To figure out the exact characteristics of an immersive story which may cause one or both of these two immersion experience, I plan to conduct a qualitative comparative study in this phase.

- Data Collection (Case Studies)
  Immersive stories within the filmmaking context mainly exist in the form of multidimensional (3D/4D/5D) and recently VR/AR films. Increasing attention has been paid on their design strategies and production pipelines, which gave birth to several high-quality works. I'll use the case study method to have deep analysis into two or more of these immersive films about the immersion experience they bring about.
- Data Analysis
  The collected data, i.e. the films will be compared in a parallel manner, with their narrative strategies, technology usage, media-sense interaction, etc being displayed respectively. General characteristics of these immersive films will be logged and summarized as a report.

Phase 2: Components of an Effective Immersive Visualization
The effectiveness of visualization and related guidelines have been deeply grounded in empirical studies and decades of observation and practice [8]. These measurements usually take place through a quantitative reasoning process which happens either in a lab controlled experiment or a crowdsourcing environment. Compared with 2D visualizations, 3D visualizations can be misleading in three aspects: occlusion, projection, and perceptual ambiguity [6]. Oftentimes, 3D visualizations can easily lead to distortion of certain visual cues like angle, shape, size (Fig.3) and finally cause data misinterpretation.
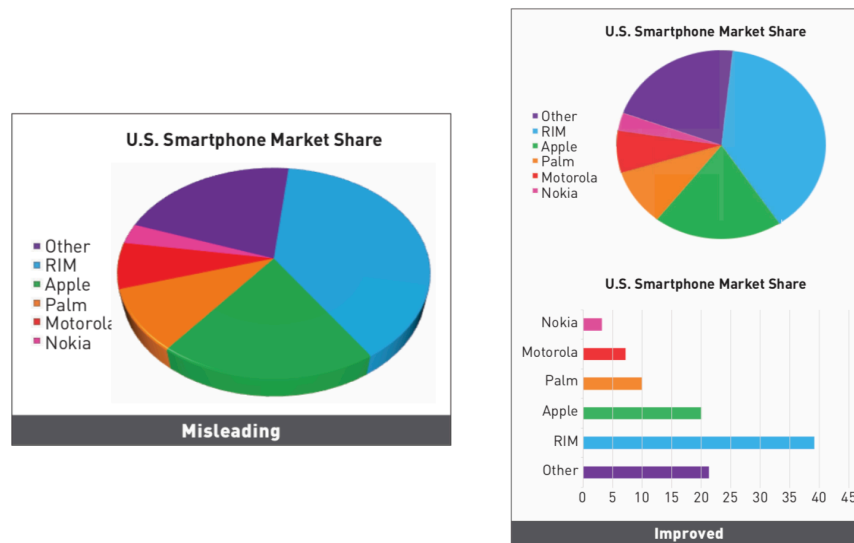

Fig.3 Distortion due to projection in the 3D pie chart causes the green wedge to represent far larger market share than the data supports. (Figure courtesy Danielle Szafir)

To ascertain the components that make up an effective 3D visualization, especially those inherent in the immersive space, I'll follow the empirical practice using quantitative method in this phase.

- Experimental Design
  Research Question - How do people interpret data in an immersive setting differently than in a traditional setting?
  Method - Quantitative research with a Lab Controlled Experiment
  Population - Proficient & Non-Proficient Immersive Technology Users
  Hypothesis - People will generally have better performance in 2D data interpretation than in 3D whereas with some exceptions.
  IV - a. Visualization Types b. Data Types c. Static / Dynamic
  DV - a. Response Time b. Response Accuracy c. User Experience
- Experiment Analysis
  The experiment results will be analyzed statistically to confirm the above hypothesis. Roles of visualization types, data types, static or dynamic presentation in data interpretation will be examined. User experience is a unique DV in this case.

Phase 3: Interaction Techniques for Immersive Human-Data Communication

As an important storytelling technique, animation has been demonstrated as a fun and engaging way to represent and analyze data changes across time [7]. Besides, studies also suggest that the desirable outcomes of human-computer interaction like engagement and memorability relate to aesthetics in visualization [8]. Efforts have been made in the field of retailing, entertainment, and journalism and so forth to make applications based on mobile/tablet, web platforms, wearable displays (Fig.4). However, these efforts are sort of scattered and are short of a uniform standard of design rules to follow.

Fig.4 Examples of the immersive interaction on different platforms (Figure Courtesy IKEA Place app, BBC Hans Rosling: 200 Years in 4 Minutes, Steven Spielberg: Ready Player One)

To generate a set of practicable and repeatable guidelines for immersive user interface and experience design, I intend to frame this phase as a user centered design problem.

- Field Study
  In this early development, information about user needs and requirements will be gathered through methods like observation, survey, interview. I hope to get insights about what functions potential users would like to see in an immersive app and what interactions they would find most useful and engaging when using it for visual analysis.
- Prototyping
  After initial data collection and analysis, I'll design and develop a narrative immersive app for a specific user group's data. With their feedback, I'll iterate on the UI and storyline to fit it for different platforms including mobile devices, web, and HoloLens.
- Usability Testing & Evaluation
  This proof-of-concept product will be tested and evaluated carefully to first meet the minimum viable product (MVP) requirement and then get improved into a minimum marketable product (MMP).
- Product Launch
  Finally, this product will be thrown into the market and get real-world feedback, followed with a detailed set of guidelines for immersive visualization UI/UX design.

Conclusions

Immersive technology is evolving rapidly, while suffering the lack of efficient human-computer interface and design guidelines. With the three aggregated research phases proposed in my plan, visualization designers will be empowered with good immersive storytelling strategy, embodied data encoding skills, and immersion experience design guidelines. The contribution of my work will allow for more effective visual encoding and data communication in the immersive space.

References

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