Leveraging Gaze Data for Segmentation and Effects on Comics

Ishwarya Thirunarayanan,* Sanjeev Koppal, John Shea and Eakta Jain

University of Florida

(a) Original comic frame (b) Gaze clusters allow segment extraction (c) Comic effects such as defocusing, recoloring and stereoscopy

Figure 1: *Eyetracking comics viewers allows us to extract the regions that are important to the story, thus enabling us to apply effects to the objects of interest.*

Abstract

In this work, we present a semi-automatic method based on gaze data to identify the objects in comic images on which digital effects will look best. Our key contribution is a robust technique to cluster the noisy gaze data without having to specify the number of clusters as input. We also present an approach to segment the identified object of interest.

Keywords: clustering, segmentation, eyetracking, comics, effects

Concepts: •**Information systems** → **Clustering;** •**Computing methodologies** → **Computer vision; Image segmentation;**

1 Introduction

It has been shown in [Jain et al. 2012] that comic artists influence viewer gaze towards regions important to the narrative. Therefore, gaze data from multiple viewers can be a natural substitute to manual user input for identifying the effects-worthy objects in a comic panel. The challenge is that gaze data is noisy and difficult to process. In order to achieve meaningful clustering of this data into semantic regions, we use *relative eigen quality* (REQ) in a normalized cut framework to automatically predict the number of clusters for the spatial locations of gaze data [Shea and Macker 2013]. REQ achieves all the three ideal eyetracking clustering characteristics outlined in [Santella and DeCarlo 2004].

2 Method

To cluster gaze data points from multiple viewers, we obtain the generalized eigen vectors and eigen values for a weighted adjacency graph that treats each gaze data point as a vertex. The cost between two vertices is proportional to the Euclidean distance between them. Bi-partitioning the second smallest eigen vector gives us the first two clusters [Shi and Malik 2000]. We then calculate REQ for each eigen value as in [Shea and Macker 2013]. The number of eigen values whose REQ is greater than a selected threshold is the correct number of clusters for the given data. Already obtained clusters are further partitioned based on subsequent larger eigen vectors until the required number of clusters are obtained. We do not sub-divide a cluster where the standard deviation of the eigen vector elements is less than 0.01. We then oversegment the input comic image into superpixels using SLIC[Achanta et al. 2010]. Finally, we assemble the superpixels to create semantic objects. For each cluster on a given panel, we first perform outlier removal and then compute the number of points that lie within a superpixel. If this count is greater than a user defined gaze density, then that superpixel is marked as a fragment of an important object. All such superpixels are combined to create a final segment or object. An example of such extracted segments for an image obtained from [Archive 2015], and some of the potential effects on them are shown in Figure 1 (b) and (c).

*e-mail:iiyengarthir@ufl.edu

SAP '16, July 22-23, 2016, Anaheim, CA, USA
ISBN: 978-1-4503-4383-1/16/07
DOI: http://dx.doi.org/10.1145/2931002.2947703

References

ACHANTA, R., SHAJI, A., SMITH, K., LUCCHI, A., FUA, P., AND SÜSSTRUNK, S. 2010. Slic superpixels. Tech. rep.

ARCHIVE, 2015. Internet archive. http://comicbookplus.com/?dlid=20927.

JAIN, E., SHEIKH, Y., AND HODGINS, J. 2012. Inferring artistic intention in comic art through viewer gaze. In *Proceedings of the ACM Symposium on Applied Perception*, ACM, 55–62.

SANTELLA, A., AND DECARLO, D. 2004. Robust clustering of eye movement recordings for quantification of visual interest. In *Proceedings of the 2004 symposium on Eye tracking research & applications*, ACM, 27–34.

SHEA, J. M., AND MACKER, J. P. 2013. Automatic selection of number of clusters in networks using relative eigenvalue quality. In *Military Communications Conference, MILCOM 2013-2013 IEEE*, IEEE, 131–136.

SHI, J., AND MALIK, J. 2000. Normalized cuts and image segmentation. *Pattern Analysis and Machine Intelligence, IEEE Transactions on 22*, 8, 888–905.