OpenDS: An Open Source Implementation of Discriminant Saliency on Center-surround Hypothesis

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***Abstract*—Most existing saliency detection models tend to target color, intensity and orientations. However, it doesn't accurately represent the visual focus of human. The research defines discriminant saliency based on the human attention focus which relies on different psychological factors. The research methodology consists of two stages of detection, involving discriminant saliency detection, and leveraging natural image statistics to finally distinguish the target pop-out. The main difference lies in top-down saliency detector which is optimal in a decision-theoretic sense: "the most salient locations of visual field are those that enable the discrimination between feature responses in center and surround with smallest expected probability of error". The end results stayed consistent with human saliency from visual attention experiments.**

My project scope aims toward Engineering stream, which is to re-implement the detection model in Python, as well as other open-source tools. The first stage is to interpret the research paper and work on static imagery. Since binary file is no longer working, I shall also determine ways to test and evaluate my results to be the same as the research's. Once the first stage is successfully implemented, continue to apply the same model onto dynamic scenes.

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

In computer vision, saliency is defined as standout part(s) of the image with distinct properties that draw eye fixation, which is the attention of the viewers. There are primary 2 saliency cues: bottom-up - fast, stimulus-driven mechanism, and top-down - slower, goal-driven mechanism [1]. Bottom-up saliency is more common in development as people tend to do it naturally without following certain tasks.

Center-surround hypothesis suggests bottom-up saliency as a center-surround process that derives optimal saliency architecture. In this architecture, saliency is detected from discriminating between a neighborhood centered at the area of interest ("the center") and the neighborhood surrounding it ("the surround") [2]. Optimal saliency detectors can serve psychophysics predictions of human saliency such as eye fixation prediction on natural scenes, background subtraction on high dynamic scenes and motion-based saliency in the presence of ego-motion [3]. This project aims to reproduce the discriminant saliency model in Python 2.7 code with the help of open-source libraries such as OpenCV and Numpy.

A project proposal based on "On the plausibility of the discriminant center-surround hypothesis for visual saliency" by Dashan Gao; Vijay Mahadevan and Nuno Vasconcelos in 2008.

II. Methodology and Implementation

The general architecture of image processing mainly follows the Itti-Koch-Niebur (IKN) model [6].

For static imagery, the process consists of 2 main stages. First stage is feature decomposition, using wavelet or Gabor decomposition to process into intensity map, and 4 color channels. The second stage is saliency detection which involves the center-surround classification (with provided formula for calculation) [7]. It also combines with Gabor or wavelet coefficients to reduce complexity of high dimensional image. One concern was to make sure OpenCV is able to handle the RGBY color channels and taken in account for visual angle (pixels/degrees).

III. Results and Validation

The project final step would be to apply the implemented model to a set of input images, which is preferably close to the research's original test set. Previously, the researchers relied on classical experiments in visual attention which were both qualitative and quantitative. For simple target pop-out test, some example images were provided directly in the research paper. And to generate progressive/dependency graph between saliency versus image feature, more static and motion data will be needed.

Due to the lack of test data sources, the project will simulate input images with similar features in such a way that if the model is computed correctly, the outcome should mimic the same behavior as the research results. Essentially it's possible to use previous psychophysics results as a benchmark to evaluate the model. For more reliable online test set on saliency detection, some test input will be retrieved at the Toronto Dataset.

Neil Bruce, John K. Tsotsos. Attention based on information maximization.120 color images of outdoor and indoor scenes (size: 681 x 511px). Observers: 20 undergrads, grads. A large

portion of images here do not contain particular regions of interest. Eye tracker: ERICA workstation including a Hitachi CCD camera with an IR emitting LED.

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The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks . . .”. Instead, try “R. B. G. thanks. . .”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

REFERENCES

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REFERENCES

[1] G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955.

[2] J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[3] I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.

[4] K. Elissa, “Title of paper if known,” unpublished.

[5] R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.

[6] Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].

[7] M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.