Saliency Maps of Images of Facial Disfigurements from Head and Neck Cancer

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Introduction: Head and neck cancer (HNC) and its treatment can result in facial disfigurement and functional defects in speech, swallowing, and vision that persist after reconstructive surgery. Body image concerns are pervasive among HNC patients, and a large portion of these concerns stem from worries about social interaction. Our overarching goal is to develop normative interventions to inform HNC patients about how others will respond to the changes in their facial appearance. In this study, we investigated saliency map algorithms for highlighting regions of interest on a clinically disfigured face that are expected to draw an observer's eye based on color, intensity, etc.

Materials and Methods: A bottom-up graph-based visual saliency algorithm [1] was utilized for the scope of this project. Using heat maps derived from the experimental fixation data as our evaluative baseline, results from the saliency algorithm were qualitatively compared for agreement. Gaze data and self-reported disfigurement ratings, using a valid and reliable scale, were collected from twenty lay observers as they examined 144 images of 35 HNC patients at various time points. Four of these images were practice slides. The EyeMMV toolbox for MATLAB [2] was used to classify fixations and generate heat maps that visualized the frequency of these fixations at a certain location from the observer gaze data.

Results and Discussion: The saliency maps agreed well with the heat maps of the observer gaze data only for stimuli images with high contrast disfigurements, like external tubes and bright red scarring (Figure 1 A, B, C). Conversely, there were very obvious disfigurements that observers fixated on but which were not recognized as salient by the algorithm because of the lack of color contrast (Figure 1 D, E, F).

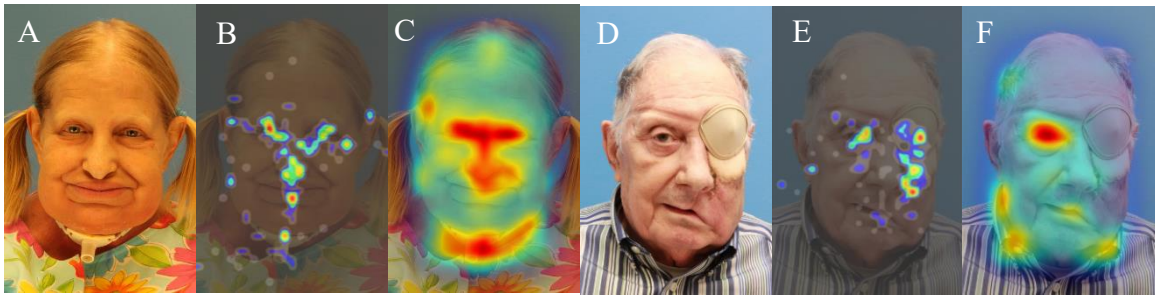

Figure 1. A) The original stimuli image of a HNC patient with high contrast facial disfigurement. **B)** Heat map using the averaged frequencies of eye tracking data between all observers. **C)** Results from the bottom-up saliency map algorithm, highlighting breathing tube. **D)** The original stimuli image of a HNC patient with low contrast, but obvious, facial disfigurement. **E)** Heat map using the averaged frequencies of eye tracking data between all observers. **F)** Results from the bottom-up saliency map algorithm, failing to highlight the disfigurement.

Conclusions: This bottoms-up saliency algorithm investigated in this study was insufficient for modeling fixation patterns on clinically disfigured faces. Saliency map algorithms that incorporate top-down features of faces should be considered, with an emphasis on facial symmetry, which is often disrupted for HNC patients.

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References:

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