University of Münster
Department of Information Systems

Title

Seminar Thesis

in the context of the seminar

More than meets the A-eye: Reflecting Human Vision in Artificial Intelligence

submitted by

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2.1 Image Segmentation

Image segmentation is the process of dividing an image into different regions by grouping pixels and assigning each pixel a label. This step is an important part of many computer vision applications, such as detecting tumors in medical images or identifying pedestrians in autonomous driving. According to human visual perception, the identified regions are non-overlapping and meaningful - however, defining what exactly counts as a “meaningful” region can be difficult, as human perception is subjective and object boundaries are not always clear (Yu et al., 2023).

There are three common types of segmentation:

Semantic segmentation assigns every pixel in an image a semantic label, such as “car” or “sky”. *Instance segmentation* separates individual objects within the same class, for example distinguishing several people in one image. *Panoptic segmentation* combines both approaches by providing pixel-wise class labels and also identifying individual object instances.

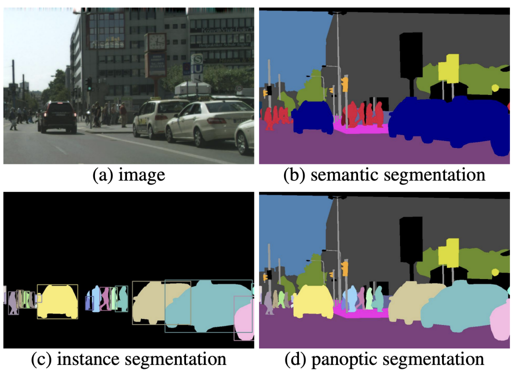


Figure 1 Types of image segmentation by Kirillov et al., 2019

Earlier approaches to image segmentation include algorithms such as k-means-clustering (Dhanachandra et al., 2015). Yet in recent years, deep learning models have significantly improved the segmentation effect and performance, therefore becoming the dominant method for solving segmentation tasks in complex environments (Minaee et al., 2022).

According to Zhou et al., 2024, the above-described image segmentation methods fall into the category of generic image segmentation (GIS). The category of promptable image segmentation (PIS) extends GIS by specifying the target to segment through a prompt. This prompt can have various forms such as text, box or points.

2.2 Salient Object Detection

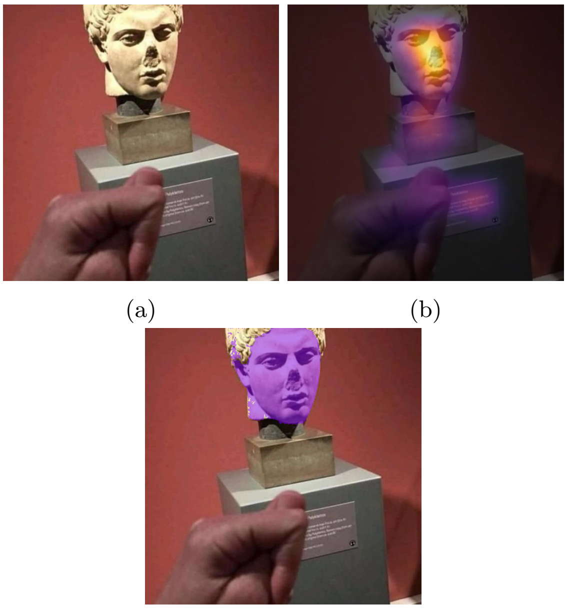
The human visual system pays more attention to certain parts in an image, a property known as saliency. Inspired by this mechanism, *saliency detection* models aim to predict which regions in an image are most likely to attract human visual attention. These models typically provide saliency maps in form of heat maps, in which higher intensity values indicate regions detected to be more important (Ahmadi et al., 2018).

Salient Object Detection (SOD) – also referred to as salient object segmentation (Borji et al., 2019) or saliency segmentation (Kakanopas & Woraratpanya, 2021) – goes one step further by segmenting the most salient object(s) of an image. SOD can be interpreted as a two-stage process: 1) Detection of the most salient object and 2) Accurate segmentation of the region of that object. In contrast to general image segmentation, SOD focuses on segmenting only those objects that are (or that are predicted to be) most salient (Borji et al., 2019; T. Liu et al., 2011). Figure 2 illustrates the difference between saliency detection and salient object detection.

2.3 Image Segmentation Models

Table 1 offers a structured overview of prominent and state-of-the-art image segmentation models, organized according to the segmentation tasks for which they are most suitable.

For our use case, only promptable segmentation models are suitable, as the eye-tracking data provides point inputs that will be used to im-



(a) (b)

(c)

Figure 2 (a) the original image, (b) saliency map (Alexander Kroner, 2025) (c) salient object detection mask generated using SAM3 guided by the eye-tracking data

plement SOD. Among the identified promptable models, SAM and its successors are the only widely adopted models that natively support point-based prompts (Kirillov et al., 2023). In contrast, Grounded-SAM (Ren et al., 2024) and Florence-2 (Xiao et al., 2023) are limited to text prompts, and SEEM, whose last update dates back to 2023, is less actively maintained and less commonly used than SAM (Zou et al., 2023).

The Segment Anything Model (SAM) was developed by Meta AI and first introduced in mid-2023 (Kirillov et al., 2023). SAM performs object segmentation based on prompts, including points and bounding boxes. With more than 15,000 citations, SAM has become one of the de facto standards for domain-specific applications and is already employed in several specialized salient object detection settings, such as camouflage object segmentation and medical image segmentation (Chen et al., 2025), RGB-T SOD (Z. Liu et al., 2025), and text-driven SOD (Yuan et al., 2026). The most recent version, SAM 3, was released on 20 November 2025. Its rapid adoption - reaching over 5.1k GitHub stars within two weeks - indicates strong community interest. Compared to previous versions, SAM 3 introduces the ability to detect and segment instances that match a given text description, and to further refine detections using visual examples (Carion et al., 2025).

2.4 Evaluation of Image Segmentation Models

- Subjective & Objective (Image segmentation evaluation: a survey of methods)

- SAM: IoU (SAM paper itself)

- Metrics in SOD: PR, F-measure, MAE (Salient object detection: A survey)

Generic Image Segmentation			
Instance segmentation	**Semantic segmentation**	**Panoptic segmentation**	**Promptable Image Segmentation**
Mask R-CNN	DeepLabV3	Mask2Former	SAM2, SAM3
YOLOv11-seg	FCN	Panoptic-DeepLab	Grounded-SAM
YOLACT	U-Net	Panoptic FPN	SEEM
Mask2Former	SegFormer	...	Florence-2
Mask DINO	LR-ASPP		...
...	...		

Table 1 Overview of prominent image segmentation models categorized by segmentation task.

3 Methodology

3.1 Experimental Design

3.2 Planned Practical Steps

4 Results

4.1 Model Selection

4.2 Expected Results

A Appendix

TODO: Add result pictures and/or our code here

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