Utilizing Gaze Information from Labelers: Can Bridging the Gap Between What Humans and Machines Fixate On Improve Model Performance and Explainability?

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BACKGROUND:

- **Limited Data:** Very limited data may require expert knowledge to analyze and annotate.
- **Model Explainability**: Explainability and trust are crucial for users making decisions.
- **Manual Annotations**: Hand-labeled annotations of salient areas in an input image may not reflect the brain's full decision-making process.

METHODS:

- Dataset from [Ehinger 2009] contains ~1000 images with target-present (human) and target-absent (no humans) labels
- Dataset includes gaze fixation information for 14 labelers for each image
- [Boyd et al. 2022] suggests blurring non-salient regions of input images may increase performance
- [Boyd et al. 2023] suggests implementing a CAM loss to encourage the machine to focus on salient regions

RESULTS:

- An an increase in classification accuracy was observed after the implementation of CAM loss derived from dataset labeler gaze.
- An improvement to model explainability was also identified through a decrease in CAM loss, suggesting the neural network is more closely aligned with the human labelers in regards to the regions it focuses on.

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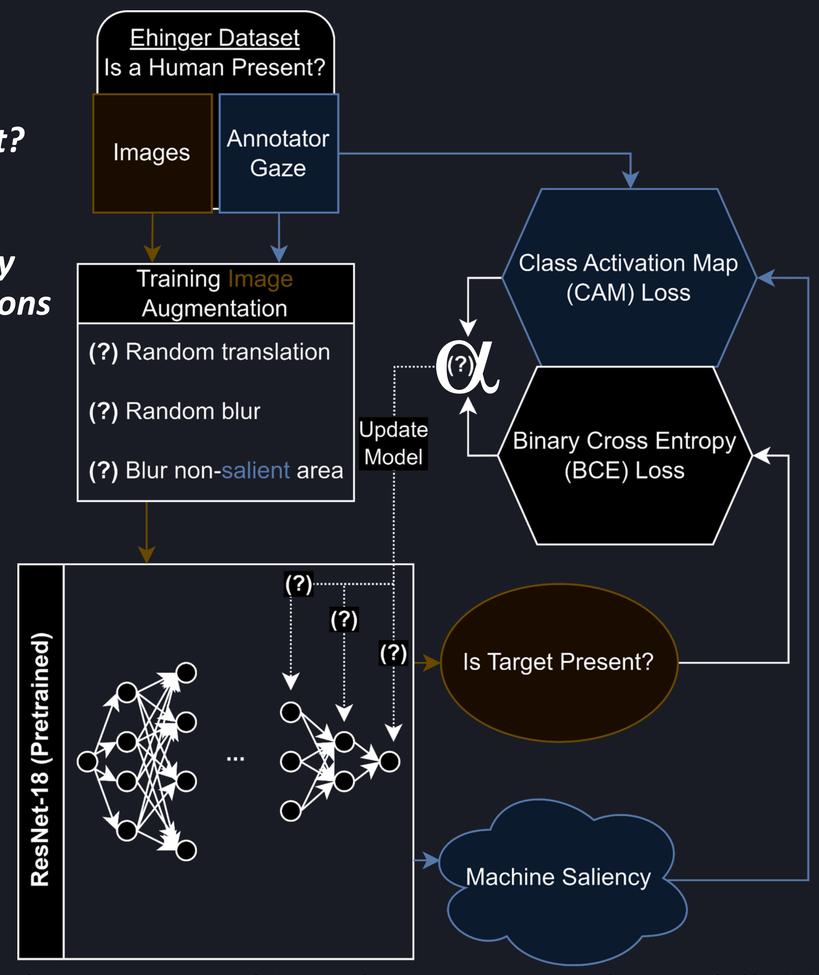
Hand-labeled saliency maps produced by dataset labelers have been shown to improve the quality of neural networks.

Can saliency information extracted from eye-tracking data provide the same benefit?

Can the resulting networks reliably demonstrate that they are focusing on the same regions as the human labelers?



Dataset: [Ehinger et al. 2009]
- "Human" search task
- Strongly guided search
  - [Mack & Palmeri 2011]
- Fixations from 14 labelers

(?) Will blurring the areas of a training image people gazed more infrequently at improve the model's performance?

(?) Will balancing the loss from human-to-machine classification with the loss from human-to-machine saliency improve the model's performance and explainability? [A/Alpha Parameter]

(?) How much of a pre-trained model should be unfrozen for the best performance?

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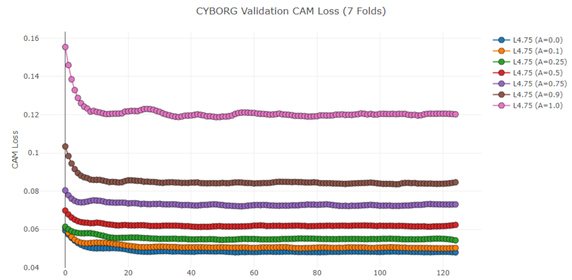
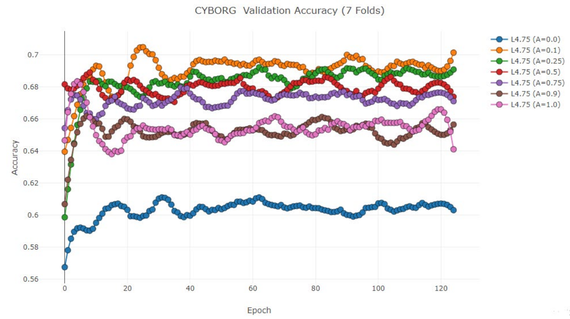
Possible Training Augmentations:
- Random cropping/translation
- **Fixation-based blurring** (gaussian blurring regions labelers did not fixate on)

Possible Alpha values (balance between the machine fixation--based CAM loss and the classification task-based BCE loss):
- 1.0, 0.9, 0.75, 0.5, 0.25, 0.1, 0.0

Possible pre-trained layers to unfreeze:
- Layer 4 (all or part)
- Layers 4 & 3 & 2

Top Left: A target-present input image.
Top Right: A target-present input image with non-fixated areas blurred.
Bottom Left: A target-absent input image with non-fixated areas blurred.





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