V Evolving Ambiguous Images

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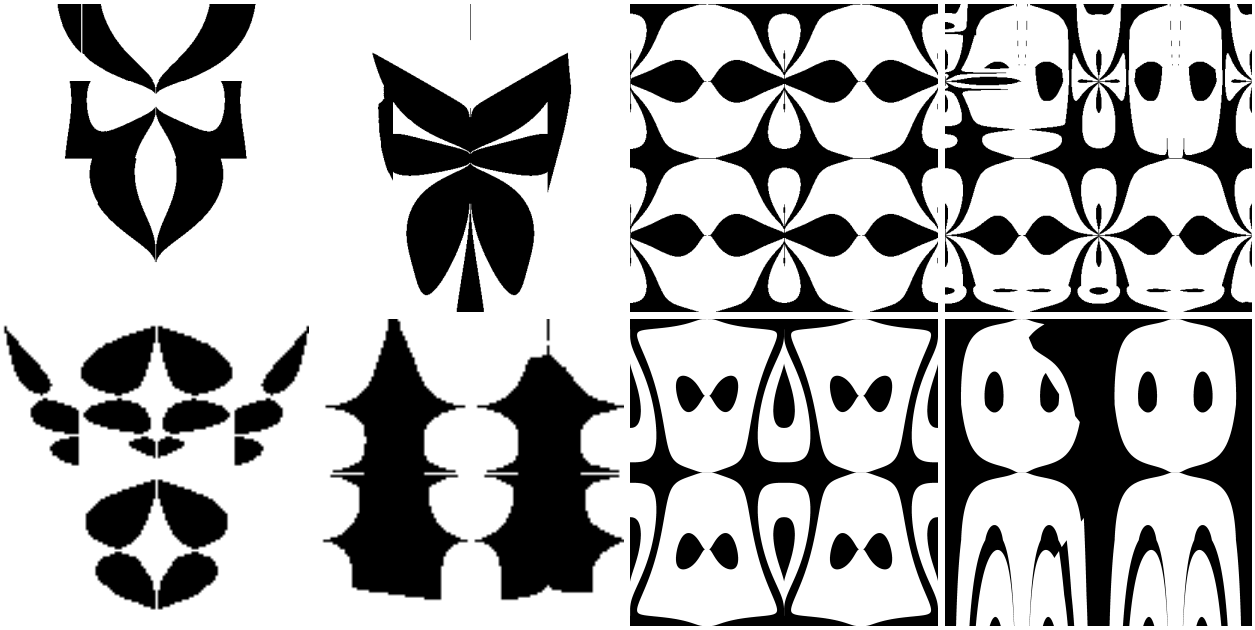

This figure results from our efforts to automatically create ambiguous images—i.e., images that may induce multistable perception, a phenomenon that occurs when the brain (or computer) is confronted with an image that can be interpreted in multiple ways.

First, using an expression-based Genetic Programming approach, we evolve images containing a single object. Following Machado et al. (2012) and Correia et al. (2013), we use object detectors based on cascade classifiers to guide evolution, assigning fitness based on the internal values of the object detection process. Then, we focus on the evolution of ambiguous images, which is achieved by evolving images containing at least two distinct objects in the same region of the image.

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The results obtained when evolving images of single objects confirm previous work in this field. In all runs and for all classifiers, evolution was able to produce images where the object was detected. However, in most runs, the object was not visible to a human observer, which indicates the tendency of the evolutionary engine to converge to false positives (Machado et al., 2012; Correia et al., 2013).

The results regarding the evolution of ambiguous images show that the task becomes significantly harder. As previously, in most cases the system converged to images that are computationally ambiguous, but that are not ambiguous to the human eye. Nevertheless, in some cases, such as the ones depicted in the figure, the system was able to evolve images that are ambiguous from both perspectives.

The figure above presents examples of am-

biguous images containing faces and flowers that were evolved by our system. The two leftmost columns were evolved in runs where the minimum size of the detection window for each object was set to 80% of the image area. This restriction enforces a high degree of overlap among objects, making the task particularly hard. The two rightmost columns were evolved in runs where the minimum size of the detection window was 25%. Reducing the minimum window size relaxes the overlap restrictions and allows more flexibility. As it can be observed, this resulted in the evolution of images that are more susceptible to induce multistable perception. Interestingly, some of the evolved images explore the same type of optical illusion that can be found in human-created ambiguous images such as Rubin's vase.

Overall, the experimental results highlight the ability of the system to evolve ambiguous images and the differences between computational and human ambiguity. Further details can be found in Machado et al. (2015) and on http://cdv.dei.uc.pt/ambiguousimages/.

References

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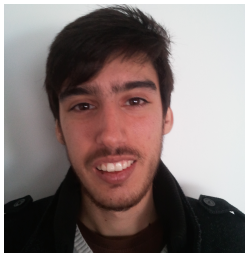

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