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***Abstract*—¡Text of the summary of your article¿**

I. Introduction

Evolutionary art blah, blah, blah, ...

The main goal of this paper is ... We show ...

This paper is organized as follows: in Section II, a brief review on Evolutionary Art is presented. The methodology and experiments are presented in Sections III and IV, respectively. Finally, the conclusions and future work can be found in Section V.

II. Evolutionary Art

Computational Aesthetics "is the research of computational methods that can make applicable aesthetics decisions in a similar fashion as humans can" [2]. In the field of computational aesthetics, evolutionary systems can play an important role, enabling the evolution of aesthetically pleasing or innovative structures [1].

A. Art Representation for Evolutive Art

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B. Aesthetic measures for evolutive art

One of the main challenges in Evolutionary Art is how to measure aesthetic value of an piece of evolutive art.

Definition Two modes of aesthetics measures can be defined [3]:

1) "*Aesthetics evaluations are expected to simulate, predict or cater to humans notions of beauty and taste.*" This will be the definition used in this paper.
2) "*Is an aspect of meta-aesthetic exploration and usually involves aesthetic standards created by software agents in artificial worlds.*"

According to Galanter [3], computational aesthetics measures can be classified in the following categories:

- Based on Formulaic and Geometric Theories. The aesthetics of a piece of art are evaluated using a formula o principle (e.g., pythagorean proportions).
- Based in Design Principles. Like the rule of thirds or theory of color (e.g., using opposite colors).
- Based in Neural Networks and Connective Models.
- Complexity Based Models.
- Based in Evolutionary Systems:
  - Interactive Evolutionary Computation. The fitness of the individuals is determined by human agents.
  - Performance based goals. Certain properties of the art piece are evaluated and optimized based in performance measures (e.g., usable surface in a furniture design generator).
  - Error relative to Exemplars. The individual fitness is measured using a real-world example (e.g., a photography).
  - Complexity measures. This type of measures is based in the idea the complexity is directly related to aesthetics and follows the path firstly stablished by Birkhoff [4].
  - Multi-objective. Given the multidimensional nature of aesthetics judgement, multi-objective EAs are a clear option in order to deal with this multidimensionality.
  - Extensions to EA (such as, coevolution, agent swarm behavior, etc.).

A brief classification of the aesthetic measures found in a short review can be fount in Table I.

III. Genetic Operators

In this section we will describe the genetic operators ...

A. Representation

B. Initialization

C. Mutation

D. Crossover

E. Fitness Functions

For this piece of research, we focused on two measures of aesthetics: basic histogram comparison and image matching. The fitness functions are included in the "Error relative to Exemplars" category, using Galanter [3] classification.

1) Histogram comparision: An histogram is a graphical representation of the tonal distribution in an image.

2) Image Matching:

IV. Experimental Results

V. Conclusions and Future Work

This paper introduces a ...

The future work for this research work includes ...

TABLE I. CLASSIFICATION OF THE AESTHETIC MEASURES USED IN A BRIEF REVIEW OF THE LITERATURE ON EVOLUTIVE ART.

Type	Aesthetic Measure
Formulaic and Geometric Theories	Fractal dimension [5], Image order [6], Benford Law [7]
Based in Design Principles	Color contrast (hue) [8], Color ingredient [6], Composition, tonality and color [1].
Interactive Evolutionary Computation	The electric sheep project [9]
Error relative to Exemplars	Resemblance score [1], pixel comparation [10]
Performance based goals	Evolving virtual creatures [11]
Complexity measures	Image complexity [6], Machado and Cardoso aesthetic measure [12]

Aknowledments.:

REFERENCES

[1] S. DiPaola and L. Gabora, "Incorporating characteristics of human creativity into an evolutionary art algorithm," *Genetic Programming and Evolvable Machines*, vol. 10, no. 2, pp. 97–110, 2009.

[2] F. Hoenig, "Defining Computational Aesthetics ," pp. 13–18. [Online]. Available: http://diglib.eg.org/EG/DL/WS/COMPAESTH/COMPAESTH05/013-018.pdf

[3] P. Galanter, "Computational aesthetic evaluation: past and future," in *Computers and Creativity*. Springer, 2012, pp. 255–293.

[4] G. Birkhoff, *Aesthetic Measure 1933*. Harvard University Press, 2003. [Online]. Available: http://books.google.es/books?id=F8A-UF8QgckC

[5] E. Den Heijer and A. Eiben, "Comparing aesthetic measures for evolutionary art," *Applications of Evolutionary Computation*, pp. 311–320, 2010.

[6] Y. Li, C. Hu, M. Chen, and J. Hu, "Investigating aesthetic features to model human preference in evolutionary art," *Evolutionary and Biologically Inspired Music, Sound, Art and Design*, pp. 153–164, 2012.

[7] E. Del Acebo and M. Sbert, "Benford's law for natural and synthetic images," in *Computational Aesthetics in Graphics, Visualization and Imaging*. The Eurographics Association, 2005, pp. 169–176.

[8] E. den Heijer and A. Eiben, "Evolving pop art using scalable vector graphics," *Evolutionary and Biologically Inspired Music, Sound, Art and Design*, pp. 48–59, 2012.

[9] S. Draves, "The electric sheep," *ACM SIGEVOlution*, vol. 1, no. 2, pp. 10–16, 2006.

[10] C. Aguilar and H. Lipson, "A robotic system for interpreting images into painted artwork," in *Proceedings of the 11th Generative Art Conference (GA2008), Politecnico di Milano University, Milan, Italy*, 2008.

[11] K. Sims, "Evolving virtual creatures," in *Proceedings of the 21st annual conference on Computer graphics and interactive techniques*. ACM, 1994, pp. 15–22.

[12] P. Machado and A. Cardoso, "Computing aesthetics," *Advances in Artificial Intelligence*, pp. 105–119, 1998.