Chapter 7
Computational Intelligence Approaches to Computational Aesthetics

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ABSTRACT

Computational aesthetics is an area of research that attempts to develop computational methods that can perform human-like aesthetic judgements. Aesthetic judgements are often subjective, and as such, the development of computational models of aesthetics is highly challenging. This chapter summarizes the advancements in the area of computational aesthetics and how computational intelligence techniques are applied in art and aesthetics ranging from simple classification problems to more advanced problems such as automatic generation of art artefacts, stories, and simulations. The chapter concludes by summarizing major challenges that need to be addressed, and future directions that need to be undertaken in order to make significant advancements in the area of computational aesthetics and its applications.

INTRODUCTION

Computational aesthetics is an area of research which attempts to develop computational methods that can perform aesthetic judgements in the same way as humans (Hoenig, 2005). It is an area of research which has not developed as a separate discipline till relatively recently. The notion of aesthetics is highly intuitive and often subjective. An aesthetic experience can be negative, positive or more subtly nuanced. Human beings have a strong and deep sense of aesthetics, however rationalising aesthetic decisions is challenging. As such developing computational models to make aesthetic decisions is particularly challenging.

While computational intelligence techniques such as evolutionary algorithms have been able to solve many real world challenges, still such techniques are not widely used to solve problems that involve

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aesthetic decisions. Making an aesthetic decision often requires a human in the loop which in turn creates a barrier between computational intelligence and aesthetics. However recent advancements in computational aesthetics have made computer generated art and aesthetics realisable in several domains (den Heijer & Eiben, 2012; DiPaola & Gabora, 2009).

The purpose of this article is to summarise the advancements in the area of computational aesthetics, challenges involved, computational intelligence approaches to art and aesthetics and possible future directions. The article first summarises early attempts to define aesthetics, through to more contemporary definitions and attempts in developing computational models of aesthetics in various domains. Then, it highlights the challenges associated with bridging the gap between aesthetics and computational intelligence. Thereafter it discusses how computational intelligence techniques are used in art and aesthetics ranging from simple classification problems to more advanced problems such as automatic generation of art artefacts, stories and simulations. The article concludes highlighting the future research directions that need to be undertaken in order to make significant advancements in computational aesthetics and its applications.

BACKGROUND

Aesthetics

The study of aesthetics is chiefly a branch of philosophy with links to other disciplines such as psychology. The term aesthetics was derived from the Greek word aisthanesthai (to perceive (by the senses or by the mind)) and introduced into the philosophical terminology in the eighteenth century (Saw & Osborne, 1960). The definition of aesthetics is a long standing debate. Early definitions of aesthetics are related to art or beauty (Santayana, 1904). Later attempts to define aesthetics discuss that aesthetics mean more than just art and natural beauty (Walton, 2007), (Palmer, Schloss, & Sammartino, 2013). Therefore more contemporary definitions are woven around human mental processes involved in making aesthetic judgements; for example:

- *The study of human minds and emotions in relation to the sense of beauty (Palmer et al., 2013).*
- *Psychological mechanisms that allow humans to experience and appreciate a broad variety of objects and phenomena, including utensils, commodities, designs, other people, or nature, in aesthetic terms (beautiful, attractive, ugly, sublime, picturesque, and so on) (Leder & Nadal, 2014).*

Computational Aesthetics

Computational aesthetics is an area of research which attempts to develop computational methods that can perform aesthetic judgements in the same way as humans (Hoenig, 2005). Classifying something as aesthetically appealing or not appealing might be relatively easy for a human even though it is subjective; however for a computer it is not straight forward to make such determinations. As such, a considerably large amount of literature attempts to define explicit measures of aesthetics that make it possible to distinguish aesthetically appealing objects from objects that are not.

In 1933, Birkhoff defined an aesthetic measure M, which can be explained as the regularity (order) perceived in an aesthetic object for a unit of effort (complexity) (Birkhoff, 1933). This can be defined

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