Engineering Applications of Artificial Intelligence 57 (2017) 171–183

Contents lists available at ScienceDirect

Engineering Applications of Artificial Intelligence

journal homepage: www.elsevier.com/locate/engappai

Applying social computing to generate sound clouds

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ARTICLE INFO

Keywords:
Synesthesia
Social Computing
Consonance
Music Generation
Sound Cloud

ABSTRACT

Human beings make decisions on a daily basis according to their social environment. Social information given by such social contexts provides the basis for inferences, planning and coordination of any activity. Social machines aim to incorporate this concept of social nature and make it possible to design digital systems that make information visible to the users. This paper presents a social machine implemented as a VO where humans and machines collaborate in a creative process to transform a picture into a musical sound cloud. The VO is implemented by a MAS, and defines specialized roles for extracting sounds from the color pixels of the image. As a part of the social machine and in order to demonstrate the viability of the system, the prototype built from this model is evaluated by experts who rate the sounds produced following consonance criteria.

1. Introduction

Much of human behavior is explained according to the relationship between humans and their environment. The way of being or responding to any situation is different for everyone, but these attitudes are influenced by the context in which the person was raised; meaning family, friends and life experiences. These factors form the social nature of human beings (Erickson and Kellogg, 2000).

As social creatures, thousands of decisions are made daily based on our social environment. Social information given by such social contexts provides the basis for inferences, planning and coordination of any activity. However, this concept of social nature cannot be translated into digital systems. In the digital world we are socially blind (Erickson and Kellogg, 2000). Thus, the emergence of social machines served to solve this problem and introduce a new concept: social translucence, an approach to design digital systems that makes information visible to the users (Erickson and Kellogg, 2000).

This new paradigm has been applied in various contexts to develop better social software to facilitate interaction and communication among people, to computerize aspects of human society, and to forecast the effects of technologies on social behavior (Wang, 2007).

Consequently, several web services tools have been created to support online communities, fix bugs and collect feedback. Many tools have been developed by Microsoft and IBM, HP, Nokia, NASA and Google (Deng and Tavares, 2013; Wang et al., 2007).

Other authors have computed models of social intelligence based on social and psychological theories. Mission Rehearsal Exercises (Swartout et al., 2006) or Tactical Language Training (Girard et al., 2013; Si et al., 2006) have implemented agents that develop social skills such as leadership, foreign languages and culture in an artificial society. These social models enrich the agent behavior (Gratch et al., 2006; Pynadath and Marsella, 2005). For example, the Sims 2 (Zaphiris and Ozok, 2012) is a popular game that models a virtual world with a social community. We can also consider interactive social robots such Teddy Bear, which was made by MIT Media Lab (Stiehl et al., 2005). This robot monitors various social reactions to human touch.

In the business area, the most widely used applications are recommender systems to suggest products, service and information to potential consumers. Companies such as Amazon or Netflix are adopting these systems (Wang et al., 2007) to improve customer loyalty. One approach is collaborative filtering to predict future sales by using historical sales transactions (Huang et al., 2007). In the public sector, some government applications apply social computing to detect terrorist, criminal or other similar organizations (Ferrara et al., 2014; Snchez Lpez Daniel and Fernando de la Prieta, 2016). Social computing has also been applied to support decision making in health policy or state intervention (Bajo et al., 2015).

With regard to music generation, some form of interaction between humans and machines is quite common. Martin et al. (2011) presented the prototype software Toolkit to enable non-technical users to design artificial and intelligent agents to perform electronic music in collaboration with a human musician. Pachet (2003) developed The Continuator, a system able to interact with users to create a jazz improvisation in real time. Thorogood et al. (2012) also present a system to generate soundscapes based on tweets about recent news

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http://dx.doi.org/10.1016/j.engappai.2016.10.019
Received 21 March 2016; Received in revised form 26 October 2016; Accepted 29 October 2016
0952-1976/

items. Despite these proposed models of person-computer interaction, social machines have not yet been applied to this field.

In this work, we propose a system that supports communication among large groups of people over computer networks. In particular, this article focuses on the upload of images by users to create a musical composition by translating colors into sound, which is called the synesthesia phenomenon. The use of MAS has also been widely applied to creative problems, due to its various inherent features, such as flexibility, scalability, usability and adaptability to the environment (Machado et al., 2001). SC-EUNE (Macedo and Cardoso, 2001) which is a simulated artificial agent that explores uncertain and unknown environments guided by forms of surprise and/or curiosity that permits deliberative reasoning and decision-making. Machado et al. (2001) proposes artificial art critics based on MAS for the domains of music and visual arts, presenting a comprehensive set of experiments in author identification tasks. Macedo and Cardoso (2001) developed a new approach of creative agents, called motivational agents to explore unknown environments. Delgado et al. (2009) built Inmamusys, a music system based on MAS and expert systems. Consequently, a Virtual Organization (VO) based on Multiagent Systems (MAS) is now proposed as the main technology to solve this creativity problem.

This paper aims to design a social machine described as a VO where humans and machines collaborate in a creative process to transform a picture into a musical sound cloud. The VO is implemented by a MAS, and defines specialized roles for extracting sounds from the color pixels of an image. Agents then begin an iterative process based on a swarm algorithm to create sound according to different rules about swarm intelligence and music composition. The prototype built from this model is evaluated by experts who rate the sounds produced by applying novelty and consonance criteria.

The next section briefly explains the concept of social machines and virtual organizations of intelligent agents. A new architecture for creativity scenarios, based on social computing is detailed in Section 3, and the technical description of the workflow of the system is given in Section 4. Section 5 presents the experiment carried out with the preliminary results obtained. Finally, last section discusses the implications of the proposal and future work.

2. Social machines and virtual organizations of agents overview

This section presents fundamental concepts used in the article to model virtual organizations. We begin with a brief explanation about synesthesia as a source of inspiration in creative compositions.

2.1. Social machines

Most societies today have become completely familiar with the concept of social networks. Although the Internet is a young medium of communication, social networks have revolutionized the way we think in less than a decade. It is logical, therefore, that the Internet is incorporating more social features.

In this context, new ways of computation have emerged to deal with these social elements, called social computing, provided by the Internet. This new paradigm is related to social behavior applied to computational systems. Some authors define Social Computing as the computational facilitation of social studies and human social dynamics as well as the design and use of ICT technologies that consider social context (Swartout et al., 2006). For Robertson and Giunchiglia (2013) the power of the Social Computer resides in the programmable combination of contributions from both humans and computers. On the one hand, within organized social computation workflows, humans bring their competences, knowledge and skills, together with their networks of social relationships and their understanding of social structures. On the other hand, ICT can search for and deliver relevant information. Humans can then use this information within their specific context to achieve their goals and, eventually, to improve the overall environment in which they live. Schuler (1994) describes social computing as any type of computing application in which software serves as an intermediary or a focus for a social relation, while Forrester Research (Charron et al., 2006) describes it as a social structure in which technology puts power in individuals and communities, not institutions. Wang et al. (2007) define social computing as the computational facilitation of social studies and human social dynamics as well as the design and use of ICT technologies that consider social context. For (Erickson and Kellogg, 2000) social computing involves systems that support social behavior among people within the system and then make use of that behavior for various purposes. Von Ahn (2009) sees social computing as a kind of human computer interaction that combines humans and computers to solve large scale problems that neither can solve alone. More specifically, this is a technology that supports any sort of social behavior in or through computational systems (e.g. blogs, email, wiki, social networks, etc.). Robertson and Giunchiglia (2013) indicates that the power of the social computer resides in the programmable combination of contributions from both humans and computers.

During recent years, Social Computing has been developed to improve social relationships and behaviors, capturing contextual information and enriching the social model. These features provide tools that allow for cooperation between humans and computers, using the Internet to support the infrastructures of this communication.

This new paradigm of social computing can be integrated with various existing technologies that provide features to regulate patterns and norms within societies. In this sense, Virtual Organizations (VO) are a suitable candidate. A VO is an open system formed by the grouping and collaboration of heterogeneous entities; there is a separation between form and function that requires defining how a behavior will take place (Rodriguez et al., 2011).

Agents are a suitable resource to implement a dynamic VO. Modelling a VO as a Multiagent System (MAS) makes it possible to describe the elements of a specific society, and incorporate norms, functional behaviors or structural compositions. Because a model of social interaction involves many features intrinsic to an open system, a MAS-based VO is especially appropriate for designing a proper architecture, given its ability to incorporate elements of an open society. Such technologies are continuously evolving and it is predicted that they will have a big impact in upcoming years. Some examples are VO and Agent Technology (Camarinha-Matos et al., 2004), WSN (Rodríguez et al., 2015), Information Fusion (IF) (Rodriguez et al., 2014), Indoor Locating Systems (De Paz et al., 2014), or music generation (Navarro et al., 2016).

2.2. Virtual organizations of agents

Agents are a concept that has been widely studied and used in computational research. Agents can exist as a society and cooperate together to achieve the objective of the organization. This entity comprises a specified number of members, who can perform various tasks or functions, and are structured according to a specific communication pattern and topology (Boissier and Gâteau, 2007; Hübner et al., 2010). Thus, Virtual Organization (VO) permits the creation and development of heterogeneous systems such as the one presented in this article.

To develop VOs, the organizational roles, objectives, structure and social norms must be taken into consideration. The roles represent different entities to fulfill the purpose of the organizations activities. The actions of each role must be specified following the organizational objectives. These objectives permit making decisions about how to design the structure of the organization. This structure contains principles that govern the agents behavior and relationships. This is also detailed in the social norms, which contain the members expected behavior and penalties to apply in case of undesirable actions.