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Promoting Creative Computing: origin, scope, research and applications

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ABSTRACT

Human creativity needs improvement in contemporary society. Due to the fast development and pervasive utilisation, computing has been a good servant to support creativity. It is not only utilised to facilitate creativity research, but also leveraged to assist creative activities in everyday life. Up to now, people have never stopped exploring the great potentials of computing to facilitate human creativity. Various new concepts of computing are currently emerging, especially creative computing that inspires a novel approach to improving human creativity. This paper presents a comprehensive review of Creative Computing, including its origin, scope, research and applications.

1. Introduction

Human creativity has presented its great capability to improve our living conditions and advance worldwide civilisations (e.g., light bulbs, airplanes, and smartphones). Nowadays, humanity is even defined by creativity in not only artistic fields like literature and music, but also virtually every other domain. Due to its mysterious power, humanity has never stopped pursuing the ultimate answer of creativity. Although an enormous number of valuable results about creativity have been discovered, there is still a long way to go. Especially, in recent years, creativity has been the core competitive advantage [1]. Various kinds of creative products, activities, and services have been the key concerns all over the world [2].

Computing has already been the seemingly perfect tool to support human creativity. In the academic field, it helps researchers to understand human creativity in a truly scientific way. A variety of platforms, systems, and apps are continuously developed to assist creative people. Recently, the Guardian has selected the top 50 apps for creative minds [3]. A project named DevArt (art made with code) is commissioned by Google to push the possibilities of creativity and technology [4]. Various kinds of computing technologies are combined and utilised to create digital art installations. For instances, Wishing Wall enables people to turn their wishes into beautiful butterflies. Colour of World is able to allow people to discover unknown places through the exploration of colours. This kind of new tendency of computing technologies has attracted great attention from both developers and artists all over the world. There is even an exhibition held in London Barbican named the Digital Revolution filled with various creative installations [5].

Other good efforts also have been made to use computing to generate not just simply creative work, but “creativity” itself. The field is known as computational creativity, which aims to generate machine creativity through imitating human creativity [6]. Computational creativity has gone up from the facilitation level into the cooperation level,with respect to supporting human creativity. The computing in computational creativity could work as a “partner” to cooperate with creative people in some kind of creation process, such as music improvisation and dance performance [7]. For now, the relationship between creativity and computing has entered into a new era [8]. Due to the crucial difficulties within creativity, such as uncertainty and vagueness, there are still inevitable limitations within the simulation of human creativity [9]. New or novel approaches to improve human creativity are still urgently demanded.

That is why various new concepts are continuously emerging, especially Creative Computing. Based on the persistent exploration of the possibilities between computing and creativity, computing could finally be deemed as truly creative, rather than appearing to be creative. By doing computing in creative ways, Creative Computing may be able to go further from the cooperation level into

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Tab. 1
Levels of Computing on Creativity.

Levels	*Computing on Creativity*
Facilitation	Creativity Research Technologies
	Creative Tools
	Creative Installations
Cooperation	Creative Installations
	Computational Creativity
Inspiration	Creative Computing

the inspiration level (see in Tab. 1), to stimulate creative ideas for people.

Due to the diversity of human behaviours, there inevitably exist a lot of difficulties. Creative Computing could allow us to think from the perspective of computing. Because of its objectivity, computing could exclude the subjectivity of human, to concentrate on the pure rules governing creativity, in other words, objective rules of creativity. By doing so, Creative Computing might be able to promote human creativity in a more essential way. On the other hand, based on the great power of computing, such as the tremendous computing capability and vast amount of data, it could provide a great space for our creativity to perform. Creative Computing may not try to explain the ultimate nature of creativity but it tries to explore the mechanical rules of creativity and utilise them to improve human creativity.

This paper is organised as follows. Section 2 explains the origin of Creative Computing in details. Then the concrete research topics and initial results are presented in Section 3. Section 4 introduces three example research topics that are currently being studied in the realm of Creative Computing. A small number of application fields, directions, and typical examples are given in Section 5. Finally, a brief summary is presented in Section 5.

2. The origin

In this Section, the origin of Creative Computing will be articulated, including the studies of computing itself, computing for promoting creativity, and the worldwide trend of knowledge combination.

2.1. Latest evolution of computing for inspiring creativity

Due to the fast development and pervasive utilisation of modern technologies, there are not clear boundaries between hardware, software, and web any more. More and more computing tends to or is required to be integrated together, such as the Internet of Things (IoT). Changes have been made to the most basic and indispensable infrastructure by the Internet, which is trying to connect everything in the world [10]. This kind of connection feature has prepared an almost unlimited platform for the future computing to do whatever it wants, such as Creative Computing.

Because of the extreme complexity of social life nowadays, computing, as a loyal servant, has been expected to do more and more work for people. Consequently, computing professionals like Tim Berners-Lee continuously create new technologies like Semantic Web (Web of Data) to meet the urgent requirements. As the inventor of the famous World Wide Web (WWW), Tim is able to foresee the great potential of the Semantic Web. Its core components, such as vocabularies or ontology, RDF data and inference engines, could enable the computer to “think” for people, thereby providing further analysed results that might be more precise and comprehensive [11,12]. In this next step, more terms, like Web OS and Intelligent Webare starting to gain greater attention from around world. This tendency of the growth of “computing intelligence”, to some extent, proves the possibility and probability for the computer to compute in creative ways – Creative Computing.

2.2. Computing for accelerating creativity

There is no doubt that human creativity needs to be heavily improved in modern competition. Because of the highly advanced technologies and infrastructures, human creativity or the flash of creative ideas has been the hot pursuit in recent years. Globally, due to the oversupply of the market, not only the quantity and quality, but also the novelty and uniqueness of products have become the key concerns of contemporary companies and enterprises. In order to seize the great opportunity, many organisations or people dedicate to providing various kinds of services about creativity, such as coaching strategies. One of the most famous is Edward de Bono and his popular lateral thinking techniques and methods [13].

As computing is leveraged almost everywhere, it also starts to present its great potential in the creativity field. In fact, because of the great power, creativity has been studied for a long time and in various domains. As the rise of disciplines like Neuroscience and Cognitive Psychology, scientists eventually start to study creativity scientifically, through utilising computing technologies like fMRI and EEG. Except that the very explanation for creativity still remains a mystery, a lot of valuable results, for example, where and when the creativity occurs in our brains have been investigated. In the meantime, specific studies about how to improve human creativity based on these scientific discoveries is starting to be conducted, such as the utilisation of unexpected experience. Accordingly, totally experiencing a new or even absurd environment could, to some extent, improve human creativity. Technologies of virtual reality have been the perfect tools to facilitate these methods.

Besides the facilitation in creativity research, computing also devotes itself to supporting creativity in daily life, be it for work or entertainment. There are complicated intelligent platforms like Gold fire, which are able to generate comprehensive creative solutions. There are also professional systems or applications like Mind Genius with mind mapping functions to support divergent thinking. Even relatively simple apps also make their own contributions for the creative mind, such as Magic Piano. It could provide a creative way for people to learn how to play music. As can be seen, various kinds of computing have been the concrete foundation for the improvement of human creativity.

However, through zooming out, it can be seen that most of the different forms of computing mentioned above are still concentrating on the virtualisation of tools for creativity. According to the previous analysis of the evolution of computing, we know that computing is becoming more and more“intelligent” over time. Therefore, it is reasonable to believe that computing could be more active and illuminative in the enhancement of human creativity. The key question is how to do it.

The inspirations also come from continuously emerging creative products like the Apple iPhone, which enlightens us to do computing in creative ways. The development of the iPhone has no longer been the common development of the mobile phone. It is more like the creation of some kind of artwork. Even the design of the inner structure of the iPhone is very elegant and beautiful. The great success of the iPhone benefits a lot from this kind of artistic and/or aesthetic designing or developing approach.

Therefore,we finally endeavour to find a new way to improve human creativity that is to compute in creative ways [14], which we called Creative Computing. Through computing creatively, Creative Computing might have more possibilities and