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Crowd social media computing: Applying crowd computing techniques to social media

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ABSTRACT

Social media producers are currently having a fierce competition worldwide to increase their revenues. To achieve this goal, they are investigating alternative ways to attract more users, generate new user activities, and collect valuable data for personalizing contents and services. One such alternative is crowd computing. Our vision is based on the great potential of a well-coordinated and controlled joint utilization of human intelligence and computer systems that can help solve problems that would be difficult to do with individual capabilities alone. To achieve this vision, which we summarize under our concept of crowd social media computing, we investigate and model the characteristics of the social media ecosystem, we discuss the characteristics of crowd computing, and then we demonstrate how crowd computing can play a pivotal role in emerging social media applications. We also propose a new approach to evaluate the impact of crowd computing on the issue of social media Return of Investment (ROI).

1. Introduction

Social media are basically electronic communication forms through which users can build online communities to share ideas, opinions, information, messages, and other content types in different formats, including text, pictures, and videos [1]. In the last few years, we have been witnessing an explosive growth in information being generated and shared in social media. The speed at which social media has proliferated is unprecedented in the history of technological revolution. A couple of years only have been sufficient, for example, for Facebook, Twitter, LinkedIn, and many others to reach each more than half million users worldwide. These numbers are reflecting an immense acceptance, but are also having a deep impact on customers' behaviors during information seeking or when making purchase decisions [2].

The social media growth, which is mainly being enabled thanks to recent pervasive and mobile computing technologies, has attracted business in all sectors to invest huge amounts of money to create and publish a variety of content types in order to attract consumers. Recent statistics have, indeed, shown that the overwhelming majority of marketers (96%) have indicated that they are participating in social media marketing, among which 92% said that social media is important to their businesses [3]. Statistics from the firm Statistica (2016) have also claimed that the number of active users of social media is expected to reach 2.5 billion by 2018. This projected increase is motivating business media producers to explore various ways to generate long-term lucrative engagements. For instance, they are trying to implement new branding strategies focused on the volunteered contributions of users to improve their future services. The current trend of social media is moving toward the ability to provide the right content on the right platform to the right audience at the right time. In other words, designers and developers are striving to deliver customized content that matches the requirements of each individual user based on his/her device specifications. Indeed, it is essential for social media brands to develop a customer-centric strategy where they offer customers consistent, continuous, and rewarding experiences [49]. To achieve these objectives, we need advanced automated and intelligent solutions that collect, filter, analyse, and take into consideration users' contexts, profiles, and previous experiences when generating the social media content.

Today, the crowd computing paradigm is being considered as a promising option to overcome the limited intelligence of machines. In this emerging paradigm, a group of humans voluntarily use their intelligence, know-how, and computing platforms and work side-by-side with some computing systems to achieve specific tasks exceeding their individual capabilities. This computing model, which actually reinforces computer systems by exploiting humans'

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Table 1
Distinguishing social media and social networks.

	Social Media	Social Networks
Communication style	The social media's owner does all of the talking. Content publishing (e.g., images, videos, eBooks, etc.) aims to generate engagement with fans and followers, while hoping that they interact with this content and/or take actions	In social network, there is a mix of both talking and listening. For instance, users have the opportunities to publish and interact with others
Goals	The ultimate goal is to generate interactions and long-lasting engagements while collecting valuable data for promoting sales	The ultimate goal is to build a network of fans/followers and nurture those relationships, without necessarily expecting a new business opportunity
Content	Content is generated to keep the audience engaged and interested in promoting services, ideas, brands, etc. This content could be similar to the content of social networks, but it needs to be used differently to achieve the expected goals	The content is created to generate extensive informative conversations with people in order to attract new fans or followers and increase the user base of the social network
Time and Effort	Posts could be created and published according to prior schedules. Some tools (e.g., Hootsuite, Sprout Social) could then be used to perform the necessary related analytics and assess the engagements taking place	There is no automated way to truly grow relationships. When many interactions are taking place, each interaction needs a unique focus and attention, which takes a lot of time and effort
Return of Investment (ROI)	The ROI should be identified depending on the envisioned use and goals of the social media	It is easy to measure the ROI from the direct interactions and responses. The number of followers could also be used as an indicator

perceptions and abilities to solve non-algorithmic problems [4], has been confused with some related concepts, including crowd sourcing, crowd-powered systems, social machines, and human computation [5,6]. To further illustrate this point, a crowd computing example could be seen in the scenario of a large-scale search for a missing person whose picture is published on the Internet. In this scenario, in addition to running image recognition processes on some computing systems, people are voluntarily participating to identify that person and find his/her location. The current literature is also reporting the successful use of crowd computing in several other applications, including text translation [7]; affect recognition in text, image and video [8]; evaluation of common sense knowledge [9]; data acquisition, fusion and sharing for hazard monitoring [10]; events photographic coverage [11]; real-time responses to events [12]; as well as in gaming [13].

As crowd computing is demonstrating promising results in dealing with human-related issues in heterogeneous, dynamic, and competitive contexts, there is an increasing interest in adopting and adapting its mechanisms to attract more consumers, generate increased engagements, and collect more valuable data from social media. In this work, we demonstrate the benefits of using crowd computing for the social media sector. We particularly focus on investigating its benefit on the important issue of measuring the Return of Investment (ROI). We summarize our major contributions as follows: (1) We present a new extended conceptual representation of the social media ecosystem; (2) We present a layer-based representation of crowd computing characteristics; (3) We describe a new model where the mapping between crowd computing and social media is emphasized; and (4) We formally evaluate the crowd computing impact on the ROI of social media.

In the remainder of this paper, Section 2 defines and outlines the important features of the social media ecosystem. In Section 3, we study the main characteristics of crowd computing. Section 4 presents some of the benefits of crowd computing when used in the social media context. Section 5 investigates the impact of crowd computing on the ROI of social media. Finally, in Section 6, we highlight some of the challenges and future research directions.

2. Social media ecosystem

Social media are having a very fast penetration usage worldwide. For instance, while it took radio about forty years and the Internet seven years to reach an audience of 50 million, Facebook achieved the same achievement in its third year [2]. This fast acceptance is estimated to exceed 30% worldwide in 2016 [14]. Recent statistics showed that 12 new active mobile social users register every second [15]. The fast acceptance of social media is also reflected in the 2016 statistics which show that the monthly active users of the widely used social media Facebook, Youtube, Google+, Instagram, Twitter, and LinkedIn is estimated to be 1.6 billion, 1 billion, 540 million, 400 million, 320 million, and 100 million respectively [16]. These numbers all together are expected to reach 2.5 billion by 2018 according to the firm Statistica [17].

Compared to social networks, social media could be distinguished based on five characteristics [1]: Communication style, Content, Goals, Time and Effort, and Return of Investment (ROI). We summarize these differences in Table 1.

Several individuals and business actors have identified the large audience of social media users for marketing new products, ideas, and concepts. For instance, 91% of retail brands use two or more social media channels [18]. Much of the investment in social media focuses on visual content such as images/graphics (74%), blog posts (68%), and videos (60%) [19]. Reddit, Storify, and Digg are examples of sites that allow their users to discuss, comment, tag, rate, and share news from various sources [5]. These capabilities have impacted the behavior of social media users who have shifted from passive information consumers to active users, thereby contributing reactively and proactively to enriching contents and services [20]. Recent ubiquitous computing technologies are encouraging additional investments in social media by creating important opportunities for generating and sharing contents that could be adapted to a variety of contexts and profiles. These technologies are also allowing huge amounts of structured and unstructured data to be collected and then processed to ultimately increase users' engagements. In order to reap maximum profit from the data, considerable research and development works are still required to generate and share personalized contents based on the envisioned goals of social media, their audience, and the targeted platforms.

The continuous progress in social media and related technologies and platforms has led to an ecosystem where users with different cultural backgrounds and making use of various devices (e.g., desktops, tablets, laptops, smartphones) on various social platforms (e.g., Facebook, Twitter, Google+) interact with a variety of products, services, and ideas for various functions including publishing (e.g., tumblr, Quora, Wikia), sharing (e.g., YouTube, Instagram, Pinterest), playing (e.g., Zynga, Playfish, Playdom), networking (e.g., LinkedIn, Myspace, Tagged), buying (e.g., tripadvisor, Boosket, hunch), and localization (e.g., Foursquare, yelp, Path) [21]. Corcoran [22] has divided the social media ecosystem into three types: owned media (monitored by the founder/marketer such as a company website or blogs), paid media (purchased by the founder/marketer, such as sponsorships or advertisement),

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