Information dissemination model for social media with constant updates

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A B S T R A C T

With the development of social media tools and the pervasiveness of smart terminals, social media has become a significant source of information for many individuals. However, false information can spread rapidly, which may result in negative social impacts and serious economic losses. Thus, reducing the unfavorable effects of false information has become an urgent challenge. In this paper, a new competitive model called DMCU is proposed to describe the dissemination of information with constant updates in social media. In the model, we focus on the competitive relationship between the original false information and updated information, and then propose the priority of related information. To more effectively evaluate the effectiveness of the proposed model, data sets containing actual social media activity are utilized in experiments. Simulation results demonstrate that the DMCU model can precisely describe the process of information dissemination with constant updates, and that it can be used to forecast information dissemination trends on social media.

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1. Introduction

The past twenty years have seen the rapid development of social network services (SNSs) [1]. After first-generation SNS tools (e.g., ICQ and MSN) became available, more than one hundred million users were attracted in less than four years. With the pervasiveness of smart terminals and the flourishing development of Web 2.0, social media has developed vigorously, becoming an important part of our daily routines. The freedom, immediacy, and convenience of social media has attracted vast numbers of users. According to recent statistical reports, WeChat attracts 810 million active mobile users per month in China [2], and Facebook attracts 1.57 billion active mobile users per month worldwide [3].

Social media has become a significant information platform for people to obtain and share news [4]. Using services such as Facebook, Twitter, and WeChat, individuals can easily build virtual communities [5] to share news and information with family, friends, and colleagues via smartphones or other smart terminals. With user-generated content [6] becoming a new trend, first-hand accounts of events such as the shootings in Las Vegas and terrorist attacks in EU member states were first reported on social media by ordinary users. A previous survey shows that the majority of individuals (74%) use Twitter for news every day [7].

However, as social media penetrates into real life, the dependence of individuals on social media is increasing, resulting the dissemination of false information brings nonnegligible influence to daily life.

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- First, false information can be released in large quantities on social media, because users of social media generally lack professional knowledge and prefer to make subjective decisions. For example, rumors about food additives are still a constant presence on social media, even though official investigations have repeatedly debunked them.

- Second, sharing among friends not only accelerates the speed of information dissemination, but also greatly strengthens the credibility [8] of false information; this allows the dissemination of false information to bring serious social upheaval and great economic loss to human society. For instance, false reports regarding the RMB exchange rate against the USD caused an acute financial panic in China and disturbed China's financial markets.

- Finally, massive intentional attacks have also occurred as the influence of social media has increased. Recently, the US Central Intelligence Agency (CIA) revealed that organized hacking attacks had affected the results of the 2016 presidential election by discrediting candidates deliberately.

Therefore, reducing the unfavorable effects of false information has become an urgent challenge, because the wanton dissemination of false information not only brings serious damage to people's lives [9], but also jeopardizes national security.

Studies on dissemination of false information and identifying strategies to eliminate it have become significant tasks for researchers. Many diffusion models have been proposed to identify the underlying mechanism of information dissemination and forecast its trends [10]. With researchers investigating the role of mutual influence between related information instances (e.g., rumor and scientific knowledge [11]), many models describing competitive and cooperative relationships between related information instances have been proposed. However, some degree of false information is casually posted on social media by users, which may be updated constantly by the author to restore the event. Relationships between the false information and updates to it cannot be classified solely on the basis of cooperation or competition. On the one hand, because the content of these different diffused versions of information are consecutive and successive, the dissemination of these versions can be perceived as the dissemination of an event, a cooperative relation. On the other hand, they are competitive in dissemination, because any version of the diffusion can be disseminated independently. Thus, information dissemination with constant updates is internally competitive and externally cooperative.

In this paper, a novel competitive model, called DMCU, is proposed to describe the process of information dissemination with constant updates and the competitive relationship between original and updated information in the dissemination process. The main contributions of this paper are as follows:

- *A new competitive model for information with constant updates is proposed.* In DMCU, we focus on competitive relationships among different versions of information (i.e., original information and updated information) and describe the dissemination trends of the different versions. Using data sets collected from real social media, we carry out experiments. Results show that DMCU can describe the renewal process of information in social media very effectively.

- *The mechanism of information update is analyzed.* By modeling the general behaviors of users, we determine the priority of related information. The updated information always has higher priority than the original, because it generally contains more valuable content. Thus, updated information can attract more disseminators than the original and win the competition.

- *The effect of various environmental factors on the process of information dissemination is evaluated.* Results from experiments using real social network data show that environmental factors such as the source information node, dissemination probability of information, the information update time delay, and negative feedback on information can affect the process of information dissemination.

The remainder of this paper is organized as follows. In Section 2, we introduce an information dissemination scenario on social media. We then analyze the information update mechanism in Section 3, and describe the process of constructing our model in Section 4. We describe the process of validating the model and discuss our experimental results in Section 5. We also discuss related work in Section 6. We then discuss our conclusions in Section 7.

2. Dissemination scenario

With the revolution of information technology, social media has developed rapidly, and its function has been constantly enriched. When various types of social media platforms come to the fore, users have more choices to build virtual communities, which means the dissemination of information is cross-platform. Therefore, the network in which information is disseminated is a hybrid network in real life.

As shown in Fig. 1, a portion of special users, who can be called overlapping users, prefer to use multiple social media tools at the same time. Because the existence of overlapping users is undeniable, when an author releases the information, these overlapping users will become the bridge of cross-platform dissemination. Thus, the information dissemination process cannot be completely separated from any platforms.

Moreover, the process of information dissemination within a single platform can become complex because services provided by social platforms are diverse. For example, Twitter cannot only be used to tweet text, pictures, and videos, but also can be used for private communication via Direct Message. Similarly, although instant messaging is the core service of WeChat, it also provides an additional service called Moments for users to post their personal status.