



An efficient method of content-targeted online video advertising[☆]

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ABSTRACT

With the rapid development of Internet, the views of the online video have increased dramatically. Meanwhile, the corresponding online video advertising market showed a momentum of rapid and sustained development. In order to attract more potential purchasers and reduce the interference on the ordinary video browsers, many researchers and enterprises have conducted the research of video online advertising. At present, the insertion methods of most video advertising are always position-fixed, mandatory timing, quantitative, and the relevance of advertisement content and the video content is usually ignored. These methods will inevitably reduce the advertising effect because of browsers' dissatisfaction and resistance. In order to overcome the shortages of the existing methods of video advertisement insertion, this paper proposed an effective content-targeted method for online video advertising. The insertion of advertisement is determined by comparing the content of the videos and the advertisements. At the same time, the characteristics of the scene switching in the video are taken into account to select the appropriate position of the advertisement insertion. Experimental results show that our method can provide a better user experience than existing methods, and its attractiveness and comfortableness is greatly improved.

1. Introduction

In recent years, network videos have become widely popular with the development of Internet. More and more people choose to watch movies and TV shows on Internet. And the corresponding online video advertising market presents a rapid and sustained development momentum. Online video advertising possesses huge business opportunities. However, if the inserted advertisement is inappropriate, it can easily arouse the browsers' displeasure and affect the user's experience, thus reducing the visits to network videos. How to insert advertisements into videos has become an important issue for the content providers.

The purpose of online video advertising is to attract more potential purchasers. To this end, many researchers and enterprises have conducted the research on video online advertising. Some online multimedia advertising systems have been developed already, such as Google's AdSense, YouTube's implantable video advertisements and so on. At present, most insertion method of video advertising are position-fixed on timing and quantitative, which inevitably leads to a poor advertising effect because the inserted advertisements often interrupt the viewing process of the browsers.

It's a common sense that if the inserted advertisement is highly

related with the video content, and the advertisements are inserted at the end point of the plots, the advertisement insertion will not lead to unpleasant experience. In this paper, an online video advertising method based on video content analysis is proposed to improve the advertising effect. In our method, advertisement is inserted at scene switching point which is detected by scene segmentation method. Furthermore, the content similarity between the advertisements and videos is fully measured, the advertisement that has the highest matching degree with the video content will be selected to insert. This method has a higher flexibility and matching accuracy than the existing methods. The advertisement can be selected adaptively according to the video content and inserted, which can effectively reduce the negative effect of advertising on the browsers' experience.

The rest of this paper is organized as follows. In Section 2, related research work is summarized and analyzed. The proposed advertisement insertion method based on video content analysis is introduced in Section 3. Experimental results and analysis are given in Section 4. The conclusions are drawn in the final part.

2. Related work

In recent years, some research works have been carried out on the

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methods of online video advertising. These methods can be classified into three categories: text based methods, users' behavior based methods and content analysis based methods. The following section is a specific introduction of the research advances.

2.1. Advertisement insertion method based on text correlation

Advertisement insertion method based on text correlation is also called content oriented advertising method. Chatterjee et al. [1] pointed out that the higher correlation degree between the inserted advertisement and the video content is, the more effective the advertisement can be played. On the contrary, the insertion of content independent advertisement could have a negative impact on the browsers' viewing experience. On the whole, the most popular way to insert advertisements is text based method, such as AdSense and Adword. AdSense inserts advertisements by matching the text content of the video web pages and the keywords of advertisements. While Adword inserts advertisements by matching the user's search keywords with the keywords of advertisements.

Text based video advertisement insertion systems relies on the matching results between the text content of the web pages/videos and the keywords of advertisements. Therefore, the matching strategy has a direct impact on the performance of the online video advertising. Ribeiro-Neto et al. [2] proposed about ten kinds of matching strategies of advertisement text and web page text. These strategies apply the spatial vector model [3] to measure the similarity between the advertisements and web pages. In order to improve the matching degree, Ribeiro-Neto et al. [4] introduced an idea of genetic programming, and defined a function which can describe the matching degree of web pages and advertisements [5].

In general, some of the text content in the webs is not exactly related to the theme of the videos. In order to avoid the negative impact on the final advertising effects, Yih et al. [6] proposed a keyword extraction algorithm for web content. This method determines the content related keywords based on the length of the words and the positions of the words in the web pages. Experimental results showed that this method can effectively improve the matching degree.

Although the text-based advertisement insertion method has been widely used in many websites, it still has limitations. Nevertheless, whether the text information is automatically extracted from the web pages or manually annotated by the managers of content providers, both the two ways are unable to avoid the negative impact of the personal subjectivity or mislabeling. The effectiveness of text based advertisement insertion method is greatly constrained by the low correlation between advertisement keywords and video content.

2.2. Advertisement insertion method based on users' behavior

The main idea of advertisement insertion method based on users' behavior is to analyze the behavior of users' searching, browsing and clicking on the Internet and finding out their personal interests to insert the most relevant advertisements [7]. First, it is required to set up the personalized user model to describe the users' behavior characteristics as accurately as possible. In Ref. [8], the users' interests and preferences are inferred from the viewing history of the individual users. Finally, the advertisements with similar preferences will be pushed to the users.

Wang et al. [9] pointed out that advertising according to the users' interest can effectively improve the quality of the users' experience, and can significantly improve the click rate of the advertisements. In addition, Yan and Malheiros et al. [10,11] also showed that the method based on the users' behavior has a positive effect on the effectiveness of the advertisements.

2.3. Advertisement insertion method based on video content analysis

Most current video playback systems adopt the fixed-point

advertisement insertion method, which inserts advertisements at the beginning, pause or end of the video. However, this method is likely to insert advertisements at an inappropriate time, which will seriously affect the user's mood and reduce the quality of user's experience [12]. Therefore, some researchers have tried to determine the optimal insertion position of the advertisements based on video content analysis, and have made a lot of efforts.

AdOn system [13] determines the advertisement insertion time by calculating the duration of the shot and the intensity of video motion. VideoSense [14] calculates the contrast between the adjacent frames of the video to determine whether insert the advertisement or not. The purpose of vAdeo system [15] is to detect the switching points of the video scenes and insert the advertisements at this time, regardless of the content relevance of the advertisements and the videos. In addition, some researchers analyzed the amount of information in the video frames, and then insert the advertisements at the position where the amount of information is lowest. In Ref. [16], in order to maximize the revenue of advertisements, Liao et al. [17] pointed out that the publishing bid of the insertion of video advertisements should be considered. Compared with other methods, the video content based advertisement insertion method has less interference to the users.

The above-mentioned advertisement insertion methods based on video content mainly focus on the motion degree of the videos or the analysis of the scene switching points. Besides, the relevance of advertisement content and the video content is usually ignored. In order to solve this problem, this paper proposes an advertisement insertion method based on video content analysis. The advertisement with the highest correlation degree of video content will be selected for insertion.

3. The proposed advertisement insertion method based on video content analysis

In order to improve the perception of video advertisement insertion, this paper proposes a new method based on video content analysis. The purpose of the proposed method includes two aspects: the first is to determine the most appropriate position of the advertisement insertion, taking the characteristics of the video scene switching into account. The second is to select the most suitable advertisement to insert by comparing the content similarity between the video and advertisements. Specific idea is shown in Fig. 1. For the video, shot segmentation is performed first. Based on the segmented shots, scene boundaries will be detected as the candidate positions of the advertisement insertion. The key frames and their visual features will be extracted from the video and the advertisement respectively. The similarity between them will be measured. Finally, the most suitable advertisements and the position to insert can be determined.

In this paper, taken the computational complexity and accuracy into account, video shot segmentation based on sliding window is adopted and a shot is treated as a basic processing unit. To solve the problem of over segmentation, the motion property of the shot is also analyzed to strengthen the measurement of the videos of chasing, fighting and so on.

Each part of this method is described in details as follows.

3.1. Shot segmentation method based on block histogram

Histogram is one of the most widely used methods of shot segmentation, which has been applied in many video content analysis methods. In this paper, blocked based HSV color histogram is used to segment the shots. The reason for choosing HSV color space is that the HSV color space is closer to human perception. In this method, the image is divided into r blocks. Then the corresponding blocks of adjacent frames are compared. Similarity is defined as follows.

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