

Leveraging Bot-Connected User Accounts for Enhanced Twitter (X) Advertising Outcomes

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ABSTRACT

With the expansion of social networks, their utilization in digital advertising has become a key factor in shaping public opinion and driving advertising campaigns coordinated and targeted series of interactions between users on a specific topic. Properly directing these campaigns can focus many individuals on a particular subject, thereby creating effective campaigns. In this research, we introduce a method for developing campaigns suitable for digital advertising on Twitter (X). Users can leverage hashtags, tweets, comments, retweets, and other features of Twitter for a specified topic to build a campaign. This method engages known bot-connected user accounts on Twitter to interact with one another on a topic, generating initial attention and kickstarting the campaign. By then identifying influential users in that area and interacting with them, the campaign is further developed over time. To evaluate the performance of the proposed method, we considered two factors: the number of users involved in the campaign and the relevance of the selected content to the topic. We conducted this experiment with 50 bot-connected user accounts on Twitter. The results revealed that, through 116,594 interactions and receiving 246 responses from non-bot users, the proposed method was able to engage the audience within 5 days. These results demonstrate that our approach succeeded in attracting users and receiving feedback by publishing relevant content, suggesting its potential for realworld success.

Keywords: Digital Advertising, Social Networks, Twitter, Campaign, Bot.

1. Introduction

C ocial networks have emerged as one of the significant D phenomena in the field of information and communication technology, playing a crucial role in shaping human interactions, information exchange, and influencing public opinion. Twitter (X), as one of these widespread social networks, facilitates rapid and extensive dissemination of messages through its structure [1, 2]. With over 450 million active users, many of whom are young individuals and thought leaders, it provides an ideal social network for executing advertising campaigns [3]. Brands can leverage this network as a powerful tool for digital marketing and guiding users toward products and services [4, 5].

Digital advertising encompasses three key issues: advertising content, customization based on individual preferences and habits, and leveraging influential users to amplify the reach and impact of advertisements [6-8]. Effective digital advertising requires a deep understanding of these three key issues. Advertising content must be tailored to the target audience and aligned with the brand's overall messaging and values. Individual preferences and habits must be considered to ensure that advertisements resonate with users and stand out in the increasingly cluttered social media landscape [9]. Influential users, with their large and engaged followings, can serve as powerful amplifiers of brand messaging, driving awareness, engagement, and ultimately, conversions [8, 10].

In the realm of digital advertising, two main approaches exist: one focuses on directly proposing the product to audiences, and the other utilizes campaigns that indirectly advertise by trending related topics [11-13]. In the first approach, companies attempt to attract users by presenting the features and benefits of the product. However, in the second approach, instead of direct proposals, the power of trends is harnessed to create a wave of attention and interaction among users.

Methods based on the first approach primarily focus on widespread dissemination of advertising messages to all audiences without fostering genuine interest or interaction [13, 14]. Research indicates that these methods often lead to advertising messages being ignored and may even cultivate negative feelings toward the brand due to neglecting users' real interests and needs [7, 15]. Moreover, in today's information-saturated environment, users due to content saturation and fatigue from advertisements [15], seeking content they can genuinely connect with. This category of methods has attempted to increase effectiveness by employing targeted advertising and analyzing user behavior [16]. Nonetheless, due to technical complexities and privacy concerns—such as mass private messaging—they have faced limitations [7]. Additionally, many of these methods have failed to generate active interaction and participation among users, focusing more on one-way message delivery [17]. Conversely, utilizing campaigns that trend related topics to create a wave of attention and interaction can be a more effective solution [18, 19]. Study shows that artificial efforts to trend topics may fail and even provoke negative reactions from users [20]. Therefore, a need exists for a method that effectively guides advertising campaigns by leveraging existing facilities in social networks and fostering real interactions.

We propose a method in this paper for trending topics to generate attention and participation among target users. By creating campaigns that trend specific topics, we aim to attract users' attention and encourage interaction and engagement [10]. This is analogous to a situation where an individual chooses a particular product because it has become fashionable and trendy, feeling part of a collective and popular movement [21]. Research has shown that when a topic trends on social networks, users are more inclined to discuss, share, and create content around it [22].

In this research, we present a novel method for creating advertising campaigns on Twitter that combines interactions between known bot-connected user accounts and the identification of influential users to increase attention and participation among target users. Initially, we introduce the advertising topic as a sequence of related keywords. Then, considering the location of the advertisements we select hashtags related to the topic and keywords associated with these hashtags. This approach yields a set of relevant keywords, enhancing the likelihood of selecting appropriate content.

After selecting the topic, the first stage involves generating interactions around the desired topic using several known bot-connected user accounts to garner initial attention on social networks. In the second stage, we identify and interact with influential users in that domain to develop and expand the campaign. Influential individuals are identified by weighing users based on the contents published under related hashtags and the feedback received, with higher weights considered influential. Utilizing existing tools on Twitter—such as posting comments, tagging their IDs in tweets, and following them—we engage with these





users. This approach not only helps create a wave of attention and participation but also increases the likelihood of positive user reactions by providing relevant and engaging content.

The structure of this article is as follows: In Second 2, we review related literature and previous researches. Section 3 details our proposed method. Section 4 presents experimental results and their analysis. Finally, the conclusion is drawn in Section 5.

2. Related Works

In recent years, digital advertising on social networks has become one of the main pillars of marketing strategies. The rapid advancement of digital technologies and the increased use of social networks have provided unprecedented opportunities for brands to communicate directly and interactively with their audiences [23].

One important approach in digital advertising is the use of creative and interactive content. Ashley and Tuten [24], using content analysis, examined the existing creative strategies in the social media content of top brands. Analyzing various social media channels, creative strategies, appeals, and their relationship with consumer engagement, they found that experiential strategies, imagery, and exclusive messages are associated with increased customer engagement. Their method included systematic coding of social media posts and quantifying engagement metrics, confirming the importance of frequent updates and engagement incentives.

In another study, the authors in [25] investigated how to prepare social media content to increase believability. They found that crafting attractive advertising texts significantly leads to increased believability. Their findings were supported by four experimental studies and a critical incident study. Similarly, De Vries *et al.* [26] emphasized that brand content should not only inform but also entertain and be interactive to attract user engagement. They used quantitative methods to analyze the impact of traditional advertising and social messages on brand-building metrics and customer acquisition.

The role of influencers in digital advertising is another approach that has been studied. A study by [27] examined the impact of message value and influencer credibility on consumer trust in brand content on social media using questionnaires and statistical analysis. Their findings showed that influencer credibility has a significant impact on consumer trust and purchase intention. Jin *et al.* [28], focusing on celebrities on Instagram, demonstrated that influencers, despite having large followings, can significantly impact consumer purchasing behavior due to higher engagement rates. Their study used quantitative methods, to assess the impact of influencer characteristics on consumer behavior.

Personalized advertising is another key issue in digital marketing. Chen *et al.* [29], using big data analytics and data mining techniques, analyzed online social interactions and compared the impact of word-of-mouth advertising versus observational learning on consumer behavior. Their method included a natural experiment that provided insights into how personalized content affects purchase decisions.

Additionally, the authors in [8] employed an experimental design with a number of people in Taiwan. This research demonstrated that personalization in advertising affects both attitudes and purchase intentions, with self-esteem as a mediating factor. Consumers with high self-esteem exhibited a more positive reaction to customized advertising, highlighting the importance of psychological factors in advertising effectiveness.

To enhance the effectiveness of product advertising, considering regional differences as a key approach plays a crucial role in shaping consumer responses to digital advertisements. The authors in [30], used a questionnaire to examine the impact of digital advertising on consumer purchasing behavior. The findings revealed that tailoring digital marketing strategies to regional characteristics significantly influences consumer buying behavior. Sharma and Ashfaq [12], on the role of social media in modern advertising, emphasized the necessity of developing strategies that align with the needs and features of different regional markets.

Brite and Logan [15] conducted a study using questionnaires and statistical analyses, demonstrating that excessive and aimless advertising can lead to user fatigue and a decrease in engagement. In this context, utilizing trending topics and leveraging hot subjects can be considered as a novel advertising approach to address these challenges. Zhou and Chen [31] conducted another study employing questionnaires and structural equation modeling to analyze how social media can satisfy human needs and its impact on marketing. Their findings indicate that content related to trending topics can fulfill users' needs for belonging and respect, thereby increasing their engagement.

By reviewing previous research using various methods such as content analysis, questionnaires, experiments, and





economic modeling, we have examined different aspects of digital advertising on social media. These reviews show that while significant progress has been made in understanding creative strategies, influencer marketing, personalization, and technological advancements, there are still areas that need further development. The trending topic method, although promising, presents challenges such as generating initial attention, effectively engaging users, and creating content aligned with brand identity [32]. The present research aims to address these challenges by utilizing topic trending through campaigns in digital advertising.

3. Proposed Method

As mentioned earlier, organizations and companies increasingly use digital advertising on Twitter as an effective tool to promote their products and engage public opinion. In this regard, we have developed a model for digital advertising through campaign creation. This model utilizes bot-connected user accounts to generate attention around a selected topic on Twitter. Synergistic interactions between bots, such as retweeting, tweeting, and utilizing relevant hashtags, generate further discussions and strengthen the advertising campaign. In this method, bot networks are leveraged to trend desired topics on Twitter. The overall framework of the proposed method begins by creating minimal attention using bot-connected user accounts, followed by interactions with influential individuals to expand the campaign. The overall framework is illustrated in



Figure 1.





The overall framework of the proposed method.

The proposed method begins by collecting Twitter data within specified time, regional, and language parameters. The advertisement topic and its related keywords are then received from the advertiser user. By pre-processing the collected data, we extract hashtags-phrases beginning with the # symbol—and identify the n top trended hashtags related to the topic and keywords. Additionally, Regular Expressions can be utilized to extract relevant topics from tweets without explicit hashtags [33]. The extracted hashtags are presented to the system as hot topics. Since these hashtags are extracted from user tweets, they represent trending topics within the community and align with the advertising subject. The system then generates topic-related texts using the LLaMA model [34], storing the generated content in a message repository. Bots collaborate and publish tweets related to the topic using this stored content, creating initial awareness and generating interest around the advertising topic.

Next, the campaign is expanded by interacting with users and gathering feedback. To do this, non-bot users are grouped for each employed hashtags and the feedbacks received by their followers. Then users for each hashtag are scored based on their interaction in the network and their received feedback. Then the top k highest-scored users are designated as the influencer users. Finally, the bots, based on the suggested hashtags, identified influencers, and topicrelated content, engage and interact on Twitter for campaign expansion. The following sections will elaborate on each stage of the proposed method.

3.1. Hashtag Extraction

In this section, we explain the process of extracting hashtags related to the selected topic.





General steps of the hashtag extraction module.

As illustrated in Figure 2, we first collect the Twitter dataset using its API [35]. Afterward, we pre-process the tweets and extract the embedded hashtags. These hashtags are then sorted using a user/time variation graph, which plots the number of users over time for each hashtag. The hashtags used by a significant number of users with increasing popularity are selected and added to the list of rapidly trending topics.

3.2. Influential User Detection

In this section, we explain the method used to select influencer users, for running social media advertisements and forming digital marketing campaigns. We begin by extracting user profiles from the collected Twitter data (see Figure 3). These profiles include information such as the username, published content, a list of hashtags the user has used along with the frequency of each, and the feedback received throughout their activity on Twitter. The extracted hashtags related to the advertising topic are then used to group influencer users. All influencer users employed any of the extracted hashtag are designated in a group. Next, we assign weights to these grouped users based on the feedback they received, and identify the top ninfluential users in each group. This approach assigns a score (W_i) to each influencer (i) considering the number of their followers, likes, retweets, and comments using (1):

 $W_i = \log(F_i + 1) \times [(\alpha \times L_i) + (\beta \times R_i) + (\gamma \times C_i)]$ (1)

where F_i , L_i , R_i , and C_i respectively indicate the number of *followers*, *likes*, *retweets*, *comments* received by user *i*; and α , β , and γ represent a scaler value associated to their significance, ranging between 0 and 1, in computing the score. Note that the summation of α , β , and γ must be equal to 1. Using this equation, we assess users' influence based on multiple factors, calculating a comprehensive weight that incorporates follower count and feedback type. The top *n* users with the highest scores are then identified as key influencers within each group to create campaign.







General steps of the influential user detection module for related hashtags.

3.3. Campaign Creation

In this section, a network of bot-connected user accounts is employed to initiate the campaign. The bots synergize on the chosen topic and generate initial attention on Twitter through mutual interaction together. The stages of this process are illustrated in Figure 4.



Figure 4

General steps of the campaign module.



To interact effectively, the bots require relevant and targeted content aligned with the selected topic. As shown in Figure 4, this content is sourced from pre-stored messages in the message repository. In other words, the bot network accesses the content it needs from the repository, where diverse messages are grouped based on related hashtags.

After creating minimal attention through bot synergistic, these bots engage purposefully with identified influencers to expand the campaign. This interaction includes actions like tweeting, commenting, retweeting, and hashtag sharing. In addition to posting related comments on influencer tweets, bots simultaneously perform other actions, such as liking and retweeting content posted by these influential users. In the following section, we will discuss experiments conducted using this model.

4. Evaluation Results

To evaluate the effectiveness of our proposed method, we created a campaign centered to Imam Reza's martyrdom anniversary, which is widely observed and revered among Muslims, especially in Islamic Republic of Iran. This experiment aimed to highlight the moral virtues of Islam and promote the exemplary lifestyle of Imam Reza, a figure deeply revered by Iranians, coinciding with the anniversary of his martyrdom. We used a dataset collected from Twitter, containing one million Persian-language tweets from 01/•9/2023 to 12/09/2023 in Iran. Dataset features include user IDs, tweet texts, and counts for follower, comments, likes, and retweets. This experiment assesses the model's ability to launch advertising campaigns focused on trending a topic and receiving feedback from non-bot users. The following sections will provide a detailed explanation and evaluation of the steps undertaken in this experiment.

Hashtag Extraction

As outlined in the proposed method, initially the campaign topic, Martyrdom of Imam Reza, and associated keywords are obtained from the advertiser user. Table 1 shows the campaign topic and related keywords

Table 1

Campaign Topic and Related Keywords.

	Persian	English
Topic Keyword 01	Shahadat Emam Reza Emam Reza	Martyrdom of Imam Reza Imam Reza
Keyword 02	Emam Mehrabani	The Imam of Kindness
Keyword 03	Emam Hashtom	The Eighth Imam
Keyword 04	Eshgh o Velayat	Love and Devotion

Table 2

Influential Users Grouping Based on Frequent Hashtags.

		Group 01	Group 02	Group 03	Group 04	Group 05
Hashtags	Persian	Emam_Reza	Hame_Khademo_Rezaeim	Emam_Hassan	Mashhad	Emam_Raouf
	English	Imam_Reza	We are all Khadim al-Reza	Imam Hassan	Mashhad	Imam Raouf
Users ID	User 01	Account 01	Account 01	Account 01	Account 01	Account 01
	User 02	Account 02	Account 02	Account 02	Account 02	Account 02
	User 03	Account 03	Account 03	Account 03	Account 03	Account 03
	User 04	Account 04	Account 04	Account 04	Account 04	Account 04
	User 05	Account 05	Account 05	Account 05	Account 05	Account 05

Using the collected Twitter dataset, the top 10 hashtags related to the topic are extracted based on frequency of use (see Figure 5).





Top 10 Hashtags Related to the Advertising Topic Based on Frequency of Use From 01/09/2023 to 12/09/2023.

To determine the most engaging hashtags, these are then ranked by user engagement rates, with the top 10 hashtags presented in Figure 6.







Ranking of Top 10 Hashtags Based on User Engagement From 01/09/2023 to 12/09/2023.

This analysis allows for a targeted selection of hashtags with high user engagement potential, crucial for increasing campaign relevance and engagement. In this case, the hashtag "Imam_Reza" exhibited the highest level of user engagement within the specified timeframe.

• Influential User Detection

This step aims to identify influential users within the extracted hashtags. Using the collected Twitter dataset, we extracted user account data and published content, grouping users for employing each hashtag usage. In the following, we calculated the weight of these grouped users based on the follower rate, likes, retweets, and comments received. The weight is assigned to each user in the group using (1). Table 2 shows user name of the top 5 influential users for a number of highest frequently usage hashtags relate to the subject of the campaign.

• Campaign Creation

In this step, we created a message repository, which was populated with varied and relevant content to the campaign

Table 3

Language Generated Text Persian امام رضا عليه السلام يكي از بزرگترين شخصيت هاي اسلام است. #امام رضا #عشق و ولايت 1 Imam Reza, peace be upon him, is one of the greatest personalities of Islam. #Imam_Reza #Love_and_state English 2 Persian امام رضا عليه السلام مثالي براي اخلاق و انسانيت است. #اخلاق #امام رضا English Imam Reza is an example of morality and humanity. #Ethics #Imam_Reza 3 Persian زيارت امام رضا عليه السلام دل را به آرامش مي رساند. #زيارت #امام رضا English Visiting Imam Reza brings peace to the heart. #pilgrimage of #Imam_Reza

Sample Messages from the Repository.

As can be observed in the table, the Persian sentences are well-structured with appropriate hashtags, effectively enhancing the content's appeal and attracting user engagement.

• Experimental Results

Finally, we assessed the campaign results created using the proposed method. For this experiment, we deployed a server with 8 CPU cores, 16 GB of RAM, and 80 GB of storage running Ubuntu 22.04, using Python version 3.1. We employed 50 bot-connected user accounts from 12/09/2023 to 16/09/2023 on Twitter. The results show the success of the proposed method in achieving all objectives. Table 4 shows the actions performed by the 50 bot-connected user accounts and received feedbacks on non-bot users during this period.

Table 4

Actions taken by 50 bot-connected user accounts and feedback received from non-bot users.



topic and extracted keywords. This was achieved through prompt engineering, submitting the keywords and topics to the LLaMA language model, and grouping the generated texts by related hashtags. Bots used this organized repository content for publication. Table 3 displays sample messages generated during this experiment.



Hassanpour et al.

	tweet	retweet	like	reply	total
Action from Bot-connected user	5336	55629	14037	41592	116594
Feedback from non-Bot users	-	78	141	27	246

In Table 4, the activity rates for the 50 bot-connected accounts are detailed by action type. Over the model's runtime, the bots performed a total of 116,594 actions. We

also received 246 feedbacks from non-bot users. The trend chart showing the frequency of the #Emam_Reza before and after the experiment is displayed in Figure 7.



Figure 7

Chart of repetition rate of "Emam_Reza" hashtag before and after the test.

As shown in Figure 7, the usage rate of #Emam_Reza ranged between 0 and 3,000 tweets per day (marked in the red box) before the experiment began. Following the experiment, through the synergy of bot-connected user accounts, engagement with influential users, and involvement of non-bot users in the targeted topic, this rate

increased to nearly 40,000 tweets per day. Based on the results, the hashtag received positive user feedback and became the top trend on Twitter during the designated timeframe. Figure 8 illustrates the rankings of Twitter's top four trends before and after the campaign.







Ranking of Twitter's top 4 trends before (a) and after the campaign (b).

According to the figure, #Mahsa_Amini was trending first on Twitter with 4,674 tweets before the campaign, but #Emam_Reza was popped up with 31,726 tweets after the campaign. In addition, #Emam_Raouf, which is related to the topic of the campaign, ranked second on Twitter with 30,325 tweets.

The tweets generated in this campaign received feedback from non-bot users indicating the model's ability to provide engaging content that resonates with Twitter users' preferences.

5. Conclusion

We proposed an innovative digital advertising method leveraging campaign creation on the Twitter social network. We introduced the concept of campaigns for engaging users and generating trends for advertising purposes on Twitter. The proposed method extracts related hashtags associated with the advertising topic and, through the synergy of botconnected accounts, generates initial attention towards the topic. Then influential users within the extracted hashtags are identified and weighed based on their level of influence. Bot-connected user accounts interact with identified influencers to expand the campaign. The synergy and interactions occur through tools such as tweets, retweets, comments, and follows. We evaluated the proposed model using a real-world dataset from Twitter. Real-world testing has demonstrated the effectiveness of the proposed method in achieving the desired objectives. Our proposed method offers a valuable tool for organizations, companies, and individuals aiming to promote products and influence public opinion on Twitter. Its ability to generate trends makes it a powerful instrument for advertising products and achieving targeted goals. For future research, incorporating this method with recommendation systems to enhance user engagement in tweet comments could help attract a larger audience. Moreover, it guides users towards the objectives of the tweets.

Authors' Contributions

All authors equally contributed to this study.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

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Ethical Considerations

Not applicable.

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