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# A Comparative Analysis of Facebook and Twitter Bots

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# A COMPARATIVE ANALYSIS OF FACEBOOK AND TWITTER BOTS

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## ABSTRACT

The increasing level of sophistication in the field of machine learning and artificial intelligence has engendered the creation of automated programs called “bots”. Bots are created for varied reasons, and it has become imperative to evaluate the impact of bots on the social media ecosystem and consequently on our daily lives. However, despite the ubiquity of bots, very little research has been conducted to compare their trends and impacts on the social media ecosystem. To address this gap in bot research, we perform a comparative analysis of Facebook and Twitter bots, in terms of their popularity and impact on the society. This paper sets the foundation to allow for subsequent, more detailed studies into this subject area. Analyzing trends of these emerging technologies can provide insight into identifying their importance and roles in our everyday life. We provide a brief background of the subject, such as types of social bots and their utility, bot detection techniques, and the impact they have had on society. We then utilize the IBM Watson cognitive search and content analytics engine to examine the public perception of these bots. We also use the Google query volumes to investigate the trends of search terms related to Facebook and Twitter bots. Our findings suggest that there is a slightly higher public acceptance of Facebook bots as compared to Twitter bots. Furthermore, the utilization of bots on Online Social Networks (OSNs) is on the rise. Originally, bots were developed as a tool for driving user engagements on social media platforms. However, today bots are increasingly being used to convey mis/disinformation and political propaganda.

## Keywords

Qualitative comparison; Bots; Chatbots; Facebook; Twitter; Social media data analytics; Information Science

## INTRODUCTION

The term “bot”, inspired by the emergence of the Internet Relay Chat (IRC), was first coined in the computing industry to describe an automated program that maintains chat sessions when users are not active (Dunham and Melnick, 2008). A bot (also known as a software robot) is defined as an automated or semi-automated program that can interact with users or other computers in intrinsically repetitive ways. Over the years, the influence of bots became prominent in search engines. These search engines use an algorithmic approach, i.e., first, an automated script is used to search for a website to crawl, then the crawling frequency is determined, and, finally, updates are made to the web content. While these kinds of bots are an example of “good” bots, which try to crawl websites for aggregation, Search Engine Optimization (SEO), etc., “bad” bots, in contrast, try to hack the site (Thelwall and Stuart, 2006). In addition to a web crawler bot, a “chatbot” also known as “chatterbot”, is increasingly used in the modern information technology environment. A chatbot is a piece of computer program that simulates a conversation in either textual or audio form with a human user (Mauldin, 1994). According to Ferrara et al. (2016), these kinds of bots are mostly used on social media platforms to promote certain ideas by generating messages (or content). Chatbots are also used for entertainment purposes. For example, CogniToys<sup>1</sup> was developed by IBM Watson as a question-answering computer system to help children in their education. Distinguishing between a bot and a human is quite challenging. During a conversation, a normal human can sway from one topic to another-this makes it naturally difficult for bots to pass the criterion for intelligence as proposed by Alan Turing in 1950 (Machinery, 1950). However, the current advancements in the field of Artificial Intelligence (AI) and the increasing level of sophistication of machine learning algorithms has led to an improvement in the range of tasks that these bots can perform, thereby, making it more difficult to separate a bot from a human. The utilization of these bots have become increasingly impactful on today’s social media ecosystem, creating the need for academic discourse.

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<sup>1</sup> <https://cognitoys.com>

The rest of this paper is organized as follows. In the next section, we provide a brief background regarding social bots. Subsequently, we discuss our methodology including a trend analysis and an impact analysis. In the final section, we discuss our conclusions and ideas for future work.

## BACKGROUND

While several researchers have explored the impacts of bots on the Twitter platform (Sakaki and Matsuo, 2010; Ferrara et al., 2016; Agarwal et al, 2017), others have investigated means of detecting bot activities (Davis et al., 2016; Varol et al., 2017). One of the most pervasive bot detection techniques is Botometer (formerly known as BotOrNot), which is a Twitter bot detection tool (Davis et al. 2016). This service leverages several features to assign a score on how likely a Twitter account is to be a bot. Botcheck.me<sup>2</sup> is a relatively new web service that was developed to detect and track political propaganda bots on Twitter using metrics such as frequency of tweet activity, endorsement and sharing of political propaganda, and number of accrued followers within a short time span.

Lately, there have been reports of the negative impact of bots on cyber as well as physical spaces, i.e., "cybernetic space" (Alkhateeb and Agarwal, 2015). Bots can be used to steal personal information such as credit card numbers. Likewise, spambots can be used to steal email from an Internet account. A group of bots working together called "botnets" can cause DDoS (distributed denial of service) attacks and bring an entire system down (Agarwal et al, 2017). A study by Newberg in 2017 showed that 9% to 15% of Twitter accounts are bots. This implies that approximately 48 million Twitter accounts are bots. In another report by Sheehan (2018), it was shown that there are more than 100,000 bots on the Messenger platform. It also was reported by Sheehan (2018), however, that Facebook admits that approximately 270 million accounts are fake. We can speculate that a large proportion of these accounts are bots since we are not aware of any publicly available data to corroborate or dispute this claim.

Some journalists claim that social media bots on Twitter played a crucial role in the United States 2016 Presidential election (Agarwal et al. 2017; Ratkiewicz et al. 2011; Ferrara et al. 2016). Bots can be used to create propaganda to promote a favorable or unfavorable image of a public figure/person, increase the followers of a social media account, or strategically repost text created by users (Ferrara et al. 2016). There is also a dearth of research that has been carried out to analyze bots on Facebook due to its stringent data collection policies (Rieder, 2013).

Due to the broad utility and potential impact of these social media bots, we next present a comparative analysis of Facebook and Twitter bots. We use the Google query volumes to investigate the popularity of search terms related to Facebook and Twitter bots. We further leverage the IBM Watson cognitive search and content analytics engine to examine the public perception of these bots using IBM Discovery News Dataset.

## METHODOLOGY

In this section, we describe how we used the Google trends dataset to understand the popularity of "Facebook bot" and "Twitter bot" (trend analysis). In the subsequent subsection, we describe how we used the IBM Watson Discovery News service to explore the sentiments, entities and topics affiliated with "Facebook bot" and "Twitter bot" (impact analysis).

### Trend Analysis

Although social media data is growing at a fast pace, one of the major challenges of bot research, especially on Facebook, is the lack of publicly available datasets. This limitation is probably due to the stringent data collection policies on some of these social media platforms. To bridge this gap and get an insight into the socio-cultural interest of these emerging technologies, we utilized the Google query volume data to analyze the popularity for the search terms "Facebook bot" and "Twitter bot" between January 1, 2014 and December 20, 2018. We chose this range because it is the maximum interval allowed by the Google query volume tool.

#### *Interest Over Time Comparison Analysis*

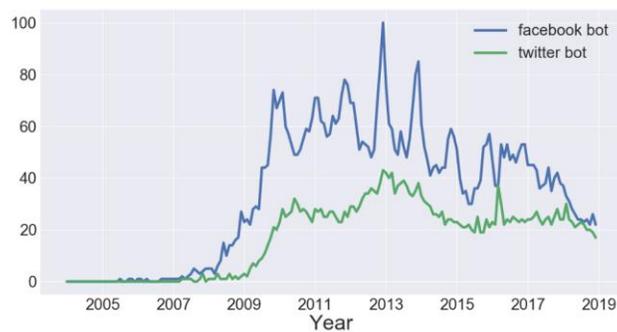
Here we describe the search interest of "Facebook bot" and "Twitter bot" over time. We understand that these values are relative and not absolute, i.e., search interest is obtained by taking all the interest data for the specified keywords and dividing it by the highest point of interest for that timespan. To further clarify this concept, if we obtained an interest index of 100 in the United States and an index of 20 in Mexico, the implication of this is that the concentration of Americans searching for the keyword "Facebook bot" are higher than the concentration of Mexicans searching for that keyword. There are a couple of reasons why this may happen. For instance, it could mean that Mexicans are less interested in "Facebook bot", or they may just frequently

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<sup>2</sup> <https://botcheck.me/>

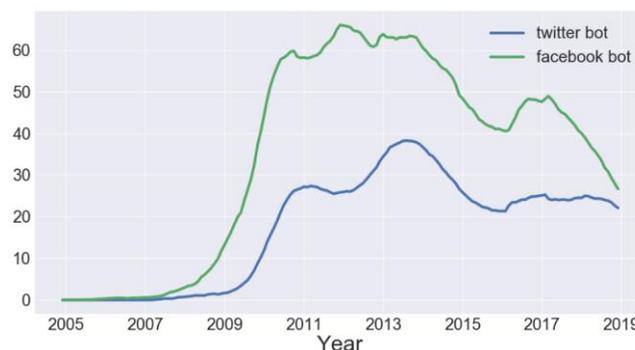
search for many other keywords. This value does not take into consideration the size of Internet populations and volume of queries per user.

A side-by-side comparison of search term popularity of “Facebook bot” versus “Twitter bot” reveals that both keywords received a popularity score of zero for the first eighteen (18) weeks of our selected data range, January 1 to February 2, 2013. Although interest in “Facebook bot” and “Twitter bot” appeared to be beginning to rise after the initial flat lines, by the end of the date range, January 14 to January 20, 2018, the popularity scores of these two keywords has fallen to 35 and 26, respectively (see figure 1). Peak popularity (a score of 100) for the search term “Facebook bot” and “Twitter bot” occurred during the week of December 8 to 14 of 2012. The search term “Facebook bot” experienced another spike in popularity (with a score of 85) between December 27, 2013 and January 2, 2014. Furthermore, our analysis shows that the keyword “Facebook bot” had sixty-three (63) percent of the total search interest while the keyword “Twitter bot” had a search interest of thirty-seven (37) percent. The implication of this observation is that there is generally a higher search interest for Facebook bot than Twitter bot. This finding is important because it highlights the general preference of bot creators and operators to place bots on the Facebook platform as opposed to on the Twitter platform, and the fluctuation of this preference over time, which can be seen as coinciding with significant world events such as elections.



**Figure 1. Comparison of popularity of search terms “Facebook bot” and “Twitter bot” over time. The y-axis represents the search interest; the x-axis shows the timespan of our analysis. The green line depicts “Twitter bot” while the blue line represents “Facebook bot”.**

We observe some forms of seasonality in Figure 1. For instance, the interest for “Facebook bot” has a leap from 2010 to 2011, declines briefly in 2012, and increases again from 2013 to 2014 after which a sharp decline was observed in 2015. This pattern of seasonality motivated us to conduct a time-series analysis in order to observe the presence of any temporal pattern in the interest in these keywords over time. We used a standard approach of computing the rolling average, which involves taking an average of data points on either side. This approach is useful for smoothening the noise and identifying the trend. We also set our rolling window to 12 months since we’re focusing on yearly seasonality as shown in figure 2.



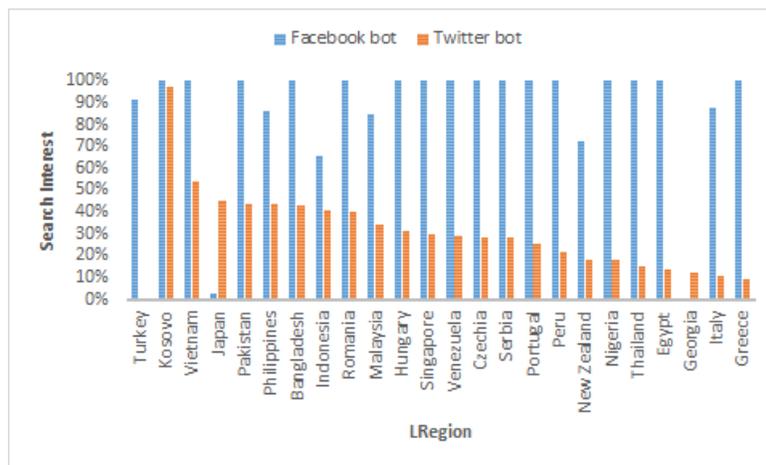
**Figure 2. Trends and seasonality in the usage of the keyword “Facebook bot” and “Twitter bot”**

To explore our suspicion of the presence of a trend in the dataset, we computed a first order differencing as highlighted by Kwiatkowski et al., in 1992. Indeed, we observed a temporal pattern. For instance, the popularity of these bots increased in the

first five months in each year and declined sharply in the remaining months (figure remove due to space limitation). This finding suggests that the interest of people in these bots fluctuates based on the period of the year. There could be several socio-cultural factors responsible for this trend, such as the timing surrounding significant events and elections.

*Interest by Region*

Location is important in understanding how these bots are perceived. To understand how the interest in these bots vary based on geolocations, we used the Google trend dataset to examine region specific interest in “twitter bot” and “Facebook bot”. We observe a noticeable interest in both types of bots in Kosovo. Turkey, on the other hand, seems to only be interested in “Facebook bot” throughout our selected timeframe. This could be explained by highlighting some details about social media use in general within Turkey. For example, Turkey has a high usage of social media, which is used to disseminate information regarding important cultural and political information throughout the region. However, in 2015, Turkey had around 9 million Twitter users as opposed to having around 27.19 million Facebook users. Creators and operators of social bots, therefore, would be more successful in getting their messages out (in terms of reach) if they focused on placement on the Facebook platform. Further, we see a high interest in “Facebook bot” in most of the other regions (see figure 3). The contrary was observed for the interest in “Twitter bot”; although, there is a higher interest in Twitter bots as compared to Facebook bots in Japan. It is hard to determine what makes these specific types of bots more pervasive in Japan than everywhere else. A report by Pandorabots<sup>3</sup> suggests that the Japanese bot service hosts as many as 300,000 bots. Perhaps, the success of these kinds of bots on Twitter can be attributed to its loose culture and the ability to use it to communicate freely during natural disasters (Sakaki and Matsuo, 2010).



**Figure 3. Interest of “Facebook bot” and “Twitter bot” by region.**

**Impact Analysis**

A growing number of researchers have begun to investigate the logical incentives and insecurities that come with the usage of bots on social media, such as the psychological effect that may result when related users are gaining more followers than others (Newberg, 2017). To evaluate the general perception of bots, we used the IBM Watson cognitive search and content analytics engine on the Watson Discovery News dataset<sup>4</sup>. This dataset is pre-enriched with cognitive insights such as: keyword extraction, entity extraction, semantic role extraction, sentiment analysis, relations, and category classification. It contains news sources that are updated continuously, with approximately 300,000 new articles and blogs added daily. Some of the use cases of this dataset include: determining trending topics in the news, event detection and news alerting.

Figure 4 illustrates the opinions expressed in a piece of text available in the above-mentioned dataset. Figure 4 a, b shows the entities and topics that are mentioned alongside the term “Twitter bot”, respectively. Similarly, figure 4 c, d shows the entities and topics affiliated with the term “Facebook bot”. Our analysis shows that the entities affiliated with “Facebook bot” are more

<sup>3</sup> <https://www.crunchbase.com/organization/pandorabots-inc#section-overview>

<sup>4</sup> <https://www.ibm.com/watson/services/discovery-news/>

inclined towards social media engagement. For instance, the prominent entity is “Billy Darr”, who runs a viral traffic machine. Similarly, other prominent entities include “Katy Perry” and “Grant Langston”, who are a musician and a professional motocross racer, respectively. On the contrary, the entities related to “Twitter bot” are political figures. For instance, one of the most prominent entities is “Sam Woolley”, who, according to a quick search on Google, and based on their twitter bio, is a director of the DigIntel Lab, and is involved in Automation, politics and propaganda. The next two prominent entities are “Hillary Clinton” and “Donald Trump”, who are renowned political figures. A similar pattern was observed for the prominent topics. While the topics affiliated with “Facebook bot” are more social media inclined, topics affiliated with “twitter bot” are more politically inclined. This diametric distinction between the entities and topics affiliated with these bots motivated us to conduct a sentiment analysis using the discovery news dataset.

Sentiment analysis can be used to perceive users’ attitudes towards/about events, products, or entities. We observed that the term “Facebook bot” had a significantly higher positive sentiment than the term “Twitter bot” for our selected timespan (figure remove due to space limitation). This implies that the emotional tone used for “Facebook bot” is more positive than for “Twitter bot”. The high negative sentiment of “Twitter bot” could be due to the perception of a Twitter bot as a potential source of misrepresentation and disinformation (Agarwal et al, 2017). This result is also consistent with our earlier intuition that since Twitter bots are more affiliated with political figures, they are more likely to be more polarized; whereas, entities for the term “Facebook bot” are primarily related to social media and bot development.

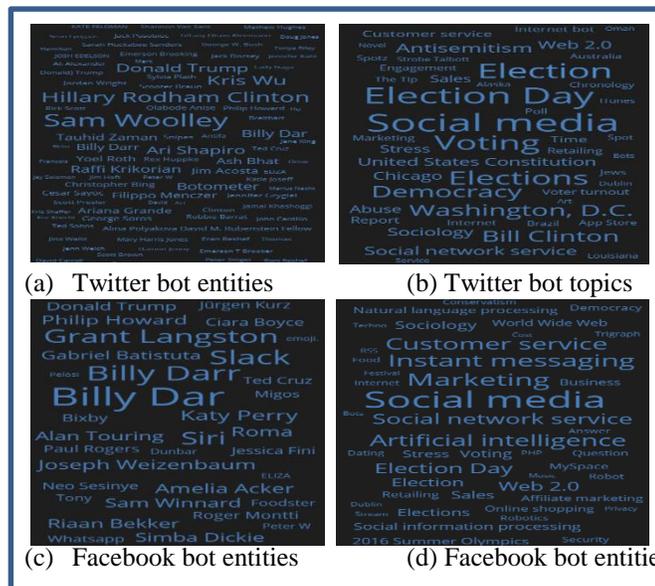


Figure 4. Entities and topics affiliated with Facebook and Twitter bots

**CONCLUSIONS AND FUTURE WORK**

The utility and impact of both Facebook bots and Twitter bots is on the rise. A growing number of companies are embracing the utilization of bots to either boost their products or connect with their customers to improve customer engagement and to promote their products. Additionally, celebrities and politicians use social bots to maintain a favorable image and to influence public opinion. In this paper, we performed a basic qualitative comparison between Facebook bots and Twitter bots. We discovered that Facebook bots have, so far, been more conversational and geared more towards social media engagement; whereas, Twitter bots have been more political in nature. We also observed that the term “Facebook bot” generally had a higher search interest across all regions (with the exception of in Japan), but especially in Turkey. The term “Twitter bot”, on the other hand, generally had a lower search interest across all regions, except for in Japan, which had a preferred search interest in “Twitter bot” over “Facebook bot”. Gaining an understanding of the overall social media usage information for a given region can provide insights into why one type of bot is predominant over the other. We further observed that the general perception of the term “Facebook bot” was more positive than that of the search term “Twitter bot” based on our sentiment analysis.

The use of AI-based social bots could be applied to many areas in addition to product marketing and political discourse. Numerous health-related areas, for example, could benefit from the use of bots to address such issues as autism, smoking

cessation, post-traumatic stress disorder (PTSD), anxiety, depression, and suicide prevention. This paper sets the stage for further research into the utility and impact of social bots. In the future, we intend to look at the contexts in which social bots influence the information environment. We intend to further examine bots and their coordination behaviors. Subsequently, we intend to develop predictive behavioral models to detect social bot activity and to identify bot coordination strategies.

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