Abstract—The Internet has spawned many different information exchange systems ranging from file sharing to online social networking. Online social networks (OSNs) have gained significant popularity and are considered to be some of the most visited sites. OSN users can interact with friends through various features such as connecting with friends, establishing new friendships, sharing photos and videos, and commenting on each other’s posts. As digital interactions supersede over physical interactions, it is important to understand how users interact over such digital platforms. Moreover, understanding OSN traffic patterns is valuable when designing new OSN platforms and managing content distribution networks. In this study, we provide analysis of online activities that happen around a user, i.e. circles. To better understand activities in a user’s friend circle, we developed a Facebook application that monitored the walls of several Facebook users. In particular, we obtained statistics of every post shared with the user by their friends, circles, for 16 volunteers that provided continuous measurements for 15 days.

I. INTRODUCTION

The Internet has spawned many different types of information sharing systems. Recently, online social networks (OSN) have gained significant popularity and are considered to be some of the most popular sites. Online interactions have become an integral part of our daily activity and digital interactions have surpassed physical interactions for younger generations. People are interacting with other users to share various life events and opinions using OSN platforms. The emergence of OSNs has altered both the information spread in the Internet landscape and human’s interactions. A powerful aspect of OSNs is the customization of the user’s experience with influx of information shared by friends.

More than two-thirds of the global online population visit and participate in OSNs and blogs. In fact, social networking and blogging account for nearly 10% of all time spent on the Internet. These statistics suggest that OSNs have become a fundamental part of the global online experience.

An OSN consists of a representation of each user (often a profile), his or her social links, and a variety of additional services. Social network sites are typically web-based services that allow individuals to create a public profile, a list of friends with whom to share content, and view content posted by other users. The basic structure of an OSN, a user profile is divided into two categories called relations and resources. Relations can be friends, family etc., while resources can be private information, private messages, wall status, pictures etc. The social network is composed of user accounts and links between users. Each user has a unique set of friends, and we refer to this set of friends as the user’s circle. The friends in a the circle all have at least one social connection with the user. Some sites allow users to link to any other user, without consent from the link target (e.g., Twitter). Other sites require consent from both the creator and target before a link is created between these users (e.g. Facebook).

As social networks have changed the medium through which people interact with, it is important to understand the characteristics of these networks. Amongst OSNs, Facebook, has more than 1.39 billion users with 745 million of them accessing the Facebook via a mobile devices [1]. A good understanding of this network provides better insights in new OSN designs and applications.

Understanding how users interact using an OSN is important. Studies of user behaviors allow the performance of existing systems to be evaluated. OSN traffic has also important effect on reshaping Internet traffic. While designing next generation social networking platforms, the analysis of the workload of social network traffic would be valuable.

With the increase usage of social networks, privacy concerns with different OSN platform designs are proposed by different studies. OSNs can be categorized either as centralized or decentralized OSNs. In centralized OSNs all personal content is stored, at a single location. It requires a provider to distribute the resources and maintain this service. In decentralized OSNs, there is no central authority that controls the user data [2]. The data is distributed among multiple locations. The main focus in this study is to understand the activity characteristics of users of Facebook, the most popular social network currently in use, and use the insights to develop a new decentralized OSN [3].

In this study, we focus on the events occurred around users’ ‘circles’. For this, we need to get different vantage points to get a good understanding of Facebook usage around an individual. To better understand how data is being generated and disseminated in OSNs, we developed a Facebook application to monitor the activities of users and their circles (i.e., posts shared by their friends). We have recorded number of friends, number of friendlists (and number of friends in each group), number of posts made within an hour and their length, number of likes and comments for each post, number of messages sent thorough chat and online duration of the friends of the users. No personal information, like the names or any content was saved during the collection period. We did not even record who volunteered for the measurements as we used random identities for users and their friends.

On average, the number of friends is 220 (146 of whom used a smart device) and the number of groups is 9. Similarly, per day, the average number of text posts in the users’ circle is

An Analysis of Friend Circles of Facebook Users

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53, links is 37, pictures is 51, videos is 7, and chat messages is 85. The monitored users themselves uploaded just a total of 25 pictures and 2 videos over the same period. We observed that the majority of the posted photos are less than 100KB and none of the posted photos is greater than 1MB. This is likely due to Facebook compressing the photos as the user uploads them. The majority of videos are less than 10MB, but exceptionally there are videos larger than 100MB. Online timing patterns of circles are also analyzed.

The rest of the paper is organized as follows, Section II provides a brief description of the Facebook application implementation, Section III presents the measurement results of the 16 Facebook user’s circles, Section IV discusses the related work, and Section V concludes the paper.

II. Facebook Application

The application that collected the friend circle information for each volunteer was directly implemented into Facebook as an application. The volunteers need to visit webpage www.cse.unr.edu/ eerdin/facebook and login their Facebook account via the link provided in the page. Each volunteer was required to add the data collection application to their Facebook account and accept all the permissions. The application uses the Facebook Graph API to directly interact with the Facebook platform. The API allows for the creation of HTTP requests to query any data about the user and their friends. In our study, the identifiers for the specific friend was generated so no real IDs were stored, maintaining privacy. The application was set to collect the volunteer user’s wall information (status updates, photo/video posts, link shares) every hour and collect which friends were online every minute. These time intervals were chosen so the application would not exceed the maximum number of queries the application could do per day. The results from the data queries were sent and stored on a server at our university. After the data was collected for 15 days, all of the data was analyzed using a separate Java application to parse the data and calculate different statistics about the data.

III. Analysis

In this section, we present the measurement results from 16 volunteers that installed our measurement in May 2014. We asked a group of users to voluntarily participate in our study and 18 of them accepted to participate in. Using the developed

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Fig. 1. Picture posting pattern of the circles of users (log-scale)

Fig. 2. Video posting pattern of the circles of users (log-scale)
app, we obtained measurements of activities of 18 Facebook users and their circles (i.e., posts shared by their friends) for 15 days with explicit permission from the users. Two of the users almost had no activities, since they had a low number of friends (less than five friends), hence we dropped them and did not include the activities of these users in results.

A. Posting Patterns

Tables I and II show the total number of posts shared by the users and their circles over the 15 day period. On average, the number of friends is 220 (146 of whom used a smart device) and the number of groups the user is 9. Similarly, per day, the average number of text posts in the users’ circle is 53, links is 37, pictures is 51, videos is 7, and chat messages is 85. The monitored users themselves uploaded just a total of 25 pictures and 2 videos over the same period.

Figures 1 and 2 show how multimedia (pictures and videos) posts are generated by circles of each user. We observed that the majority of the posted photos are less than 100KB and none of the posted photos is greater than 1MB. This is likely due to Facebook compressing the photos as the user uploads them. The majority of videos are less than 10MB, but exceptionally there are videos larger than 100MB.

Since the activities of users and their circles are periodically recorded, we analyzed how active the friend circle was when posting to Facebook. Figure 3 shows the hourly posting pattern of circles of the user with most number of friends, specifically for photo, video, link and status update. Figure 4 and 5 present...
the average number of multimedia and non-multimedia posts shared by the circles of all the users. As expected, link and status updates are the ones shared most. In the multimedia postings, number of photos posted is always larger than the number of videos shared. This is expected as it is easier to take and share photos compared to videos.

B. Mobile Device Usage

The Facebook application also allows to see whether the friends of users are connecting Facebook through mobile device or desktop. Figure 6 presents the average number of friends using mobile device to connect Facebook is shown for 16 users. As expected, mobile usage to connect to the OSN is higher than traditional desktop usage since the number of mobile devices has soared in the recent years.

C. Online Pattern

Facebook allows a user to send instant messaging chat messages to the user’s friends. Through this service it can be detected whether one is online or offline at a time. By using this feature, the online timings of friends of the users can easily be saved with one minute intervals. Note that, users that mark themselves to be shown offline cannot be detected. Figure 7 presents online timing pattern of 16 users’ circles. The figure shows how many friends were online and for how long, each line representing the information of each user. The x-axis shows the percentage of total time (15 days) and the y-axis shows the percentage of friends who are online at a time. From the figure, we can say at most 40% of the friends are online at a time for only one user. An important thing to note is, these friends are not necessarily the same each time. For most of the users, at most 25% of their friends are online at a time. The lines which has higher duration percentages are for the users with less number of friends. As the number of friends increase we see less percentage of friends are online. For example, when a user has only 10 friends, seeing 5 of the friends online for a long time is not a surprising result, but in contrast seeing 250 friends online for most of the time for a user who has 500 friends would not be expected with a high probability. Figure 8 shows the online timing pattern of circles of the users in minute intervals. It starts from the time we started collecting data, and ends at the end of 15th day. It specifically shows at what time how many unique friends (in percentage) were online. In other words, we calculated how many friends of the users are online at each minute. The bold line is the average of all users. On average, we can always see around 10% of the friends of the users are available, and the user may contact these friends.

Another piece of useful information that can be acquired from online timings of the circles is the chance whether a user will see his/her friend online when he/she logs in Facebook. In other words, we calculated the possibility of a specific friend being online at a time and presented in Figure 9. The difference of this figure from Figure 7 is that, the unique friends online duration is calculated for this figure. Each line represents the percentage of duration of different friends of 16 users. As can be seen, none of the friends was always online during whole 15 days of observation. Figure 9 includes only the friends who are observed at least once as online. Almost on average 25% percentage of friends were never recorded online during the observation, which means they are mostly passive users of Facebook or hide themselves (with selection of being invisible) although the are logged in. Less than half of the number of friends have the possibility to be seen online with a possibility higher than 0.1 which again shows most of the friends are less active users.

Based on online time intervals we calculated how much
Fig. 7. Number of online friends at a time

Fig. 8. Number of online friends (in %) of users (minutely)
data need to be looked up by user while his/her friends are online. One issue is to determine when to take a snapshot of online activity. To mimic real user activity, we assumed the user became online one minute before one of her/his friends actually became online. Hence, we obtain a much larger number of data points than an individual's online pattern. Figure 10 presents the amount of multimedia data a user would need to download when s/he became online. As the time between logins increases, the amount of data the user might download from her/his friends increases. In extreme cases, we observe there is about 1GB of data when the user has not logged in for about a day and friends have posted large videos.

IV. RELATED WORK

There are a vast number of studies that analyze the online social networks. Many of the studies focus on graph theoretical analysis of OSNs, while others focus on actual user interactions. A few studies have tried to explore the differences and commonalities between different OSNs. For example, Kumar et al. explore how path properties of social networks change over the time for Flickr and Yahoo360! [4]. Mislove et al. explore the degree and cluster coefficient of the embedded networks for Flickr, LiveJournal, Youtube and Orkut [5]. CyWorld, MySpace, Orkut have been profiled by Ahn et al. [6]. In addition to comparative analysis, there are studies whose main goal is to discover properties of an individual OSN, including Facebook [7], [8], Twitter [9], [10], [11], and Google+[12], [13]. All these studies confirm that OSNs have power-law degree distribution along with small-world network characteristics.

User interactions have gained interest in research community as the trends in utilizing user's social network for various services has become popular. Wilson et al. study user interactions in the Facebook to see whether social links are valid indicators of real user interactions [14]. Viswanath et al. shows evolution of activity between users in Facebook OSN [15]. Schneider et al. characterizes user interactions within Facebook, LinkedIn, Hi5, and StudiVZ [16]. Chun et al. analyzes communication patterns among the users Cyworld [17]. Benvenuto et al. presents insights into how users interact with friends in Orkut, MySpace, Hi5 and LinkedIn [18]. Jiang et al. measures the user interaction in Renren [19]. Finally,
Cristofaro et al. look into how liking fraud on Facebook is typically done bot farms to promote Facebook pages with honeypots [20].

All the studies mentioned above, either focus on OSN analysis from graph theoretical approach, or on user interactions in OSNs. Our study presents the posting pattern of the circles of Facebook users, specifically for photo, video, link and status update. We evaluated the traffic being transmitted within the friends of a user. Moreover, we presented how active the circles of the users are including the online timing patterns which have not been presented previously.

V. CONCLUSION

Recently, online social networks (OSN) have gained significant popularity and are among the most popular sites. These networks have changed the medium through which people interact. It is expected the integration of social networks in the digital world will keep increasing. Hence, understanding how users interact in OSNs is valuable. Measurements of user interactions allow understanding the existing systems and provide better insights in future designs. Additionally, understanding of OSN traffic would allow better content distribution.

In this study, we presented some preliminary analysis of friend circles by developing an application to monitor and collect data on the activities of 16 Facebook users and their circles (i.e., posts shared by their friends) for 15 days. We have recorded number of friends, number of friend lists (and number of friends in each group), number of posts made within an hour and their length, number of likes and comments for each post, number of messages sent thorough chat and online duration of the friends of the users. The application and measurements allow us to get a foundation for a better understanding of activities that happen around a user.

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REFERENCES


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