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A mobile visualization platform for exploring social media data

Yonghong Tong *, Department of Computer & Information Sciences, College of Arts & Sciences, Niagara University, Nigeria.

Muhammet Bakan, Department of Computer & Information Sciences, College of Arts & Sciences, Niagara University, Nigeria.

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Abstract

With the increasing application of using mobile device and social media, large amount of continuous information about human behaviors is available. Data visualization provides an insightful presentation for the large-scale social media datasets. The focus of this paper is on the development of a mobile-device based visualization and analysis platform for social media data for the purpose of retrieving and visualizing visitors' information for a specific region. This developed platform allows users to view the "big picture" of the visitors' locations information. The result shows that the developed platform 1) performs a satisfied data collection and data visualization on a mobile device, 2) assists users to understand the varieties of human behaviors while visiting a place, and 3) offers a feasible role in imaging immediate information from social media and leading to further policy-making in related sectors and areas. Future research opportunities and challenges for social media data visualization are discussed.

Keywords: Social media, data visualization, mobile device

*ADDRESS FOR CORRESPONDENCE: **Yonghong Tong,** Department of Computer & Information Sciences, College of Arts & Sciences, Niagara University, Nigeria. *E-mail address*: ytong@niagara.edu

1. Introduction

Visualization is the concept that provides observers an aggregated representation of an available dataset. It offers a visual system for humans to understand and explore the dataset. Visualization technology, originated from scientific computational visualization that appeared in the 1980s, assists individuals to observe, browse, discriminate, and understand information [13]. Visualization becomes both an art and a science that generate images or/and visual representations from large datasets [10, 3, 13].

Social media, such as Twitter, Facebook, and Instagram, plays an increasingly important role as a social network, which attracts people to share common interests and activities. Social network, such as Instagram, provides a large number of images that contain interesting information for information extractions [11, 12]. As a relatively new form of social network, Instagram can be used to capture photos (or videos) and share with others in a way that provides an instantaneous method for users to capture pictures or videos and share with friends [7]. According to the Instagram statistics [9], till September 2015, there are more than 400 million monthly active users with an average of 80 million photos per day shared on Instagram around the world. Instagram for iOS, Android and Windows are available for users.

A few research studies introduced geo-location based visualizations for social media. Hochman and Schwartz [6] introduced a method to trace cultural visual rhythms by analyzing photos from Instagram. Yin et al. [14] presented a system architecture to extract situation awareness information from Twitter messages generated during various disasters and crises. Some researchers developed systems to analyze social media content using text extraction [15, 14].

The main objective of this study was to develop a mobile-device based visualization and analysis platform to visualize information from social media on a mobile device. When a visitor uses social media at a specific region, the where-and-when information can be collected. In this design, a user server is built for collecting real-time data from the Foursquare server and storing the data in the central database on the server; and a mobile application is developed for retrieving information from the user server and visualizing the information on the mobile device.

Several visualization techniques are applied, including a map view, column chart, and pie chart. The map view could show the location of visitors on a map, which offers a view of the distribution of visitors in a specific area. The column and pie charts are used to present quantitative information. The Mobile Android platform is chosen because of the increasing popularity of Android OS. According the data from International Data Corporation (IDC), Android is the dominated mobile operating system in the smartphone market with a share of 82.8% [8].

This paper will present the process of our project and the result. In section 2, we will introduce the methods we use in this study. The experiments and results will be presented in section 3. In Section 4, the authors discuss the potential opportunities and challenges. Finally, section 5 is conclusion and future work.

2. Methods

The proposed mobile-device based visualization framework is called MobileVis. MobileVis is intended to provide users the visitors' information at a specific region where they visit during a time period with the advantage of mobility at any time and at any place. The conceptual model for this MobileVis framework is shown in Fig.1.

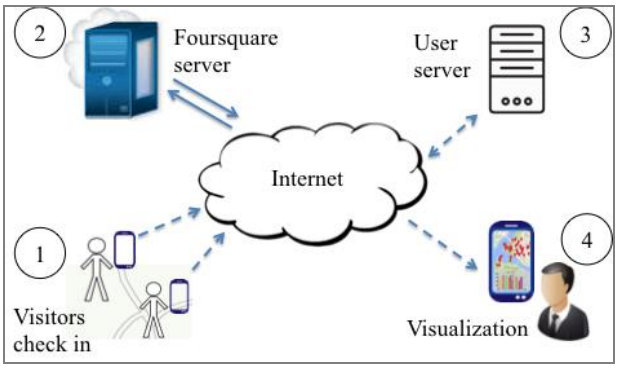

Fig. 1. The diagram of concept of mobile-device based visualization platform
(1) Visitors check in; (2) Foursquare server, (3) User app server, (4) Visualization

This platform consists of four parts: (1) Visitor check-in. At a specific region, when a visitor checks in (upload a photo or text message) via a social media, for example post a photo via Instagram, the information of visitor's location and check-in time will be automatically sent to the Foursquare sever. (2) Foursquare server. Foursquare sever can collect real-time data from the social media, and store the data on the server. (3) User server. User server applications are designed for collecting visitor's information via Foursquare, storing the data on a MySQL database, and distributing the data that will be used by mobile application. (4) Mobile visualization. The application resides in the mobile device can retrieve data from the user server and perform the visualization function. By using the mobile information technology and visualization technology, the visitors' information (location and time) can be collected via the Foursquare server, stored in the user server, distributed in the server, and visualized on the mobile device.

The main approach is to retrieve the data from social media via the Foursquare server, which provides real time check-in (i.e., who is there?) data. The web service for data collecting will run continuously and shouldn't be shut down. A web service in the user server will keep listening and checking if there is new check-in data to store. The web service will go to sleep mode for some time if there is no update. Another service is designed to distribute the data. Four steps are conducted to make this system work (Fig. 2).

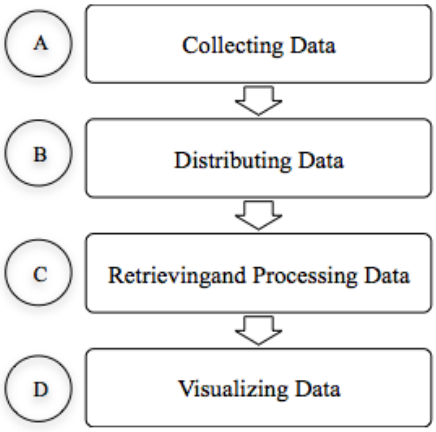

Fig. 2. The information collection and visualization process

2.1. Collecting the Data

The first step in the process is data collection, which is developed to fetch venues of the selected area (i.e., the Niagara Falls tourist area) from the Foursquare server via Venues Service and store the data on a local server computer [4]. The Foursquare server provides this information via Foursquare API (Application Programming Interface) [5]. Once the venues are

collected, the associated web service starts and runs continuously to collect data via the Foursquare API with a designed interval. The collected data will be stored in the database in the user server.

2.2. Distributing the Data

Since the mobile devices have a limited storage and a slow computing speed compared to desktop computers, the collected data should be processed before transferring to a mobile device. To complete this, a service on the use server is designed by using the Java programming language; and this process is called data distribution. The web service receives requests from the network with filters, and responses the collected data set. The importance of the data distribution is to increase the performance for the visualization and big data manipulation on mobile devices. It can also make the mobile application run more smoothly, since big data could exceed memory size of mobile devices and may cause errors.

2.3. Retrieving and Processing the Data

Retrieving and processing the data are handled in both mobile device and the user server. The SOAP-based (Simple Object Access Protocol) web service is implemented for exchanging the information between the user server and the mobile device. When the mobile device sends a request to the server, the server will send an XML file to the mobile device. The deserialization will be applied to convert the XML file into a Java object, which is the data format for mobile application – the visualization application.

2.4. Visualizing the Data

On the mobile device, three types of visualization are applied in this design, including 1) a venue-based visualization in a map; 2) a country-based visualization presented by a pie chart; and 3) a check-in based visualization presented by a column chart. In the venue-based visualization, the collected venues data include the geo-spatial information (latitude and longitude). This information will be used to visualize venues' names and locations on Google Maps. In the country-based visualization, the Android canvas class is used to draw graphics on the screen using lines, rectangles, images, numbers, texts, etc. The pie chart is applied for presenting the comparison of the visitor information distribution among the different regions of interest. For the check-in based visualization, The Android canvas class is also used. There will be a 'monthly' option for the filter to receive the summary of the check-ins for each day of the month from the web service that runs on the user server.

3. Experiments and Results

The Niagara Falls, a world famous tourist attraction, was selected as the region of the study. Java web services and MySQL are applied to implement web services to retrieve data from the Foursquare server. The implementation for mobile visualization was tested on an Android emulator with Google API version 4.4 and API level of 19 (Fig. 3) and a Samsung Galaxy Note II smart phone. The web service works very well for collecting and storing venue data. The communication between Android application and web services is smooth. The visualization application testing on both the emulator and smart phone are well functioned.

Fig. 3. Android Emulator

By using the proposed platform, the visitors' check-in information is visualized by the presentation of a map and column and pie charts. Fig. 4 shows the visualization by using the pie chart. The visualization shows the comparison of the number of visitors between the Niagara Falls region in Canada and the Niagara Falls region in the United States. Four time-period options including the current day, the current month, the current year, and all times are designed for the user to choose to view the associated visualization. Fig. 5 shows the map that visualizes the visitors' location on the map, and the column chart that visualizes the number of the visitors on each day in the current month.

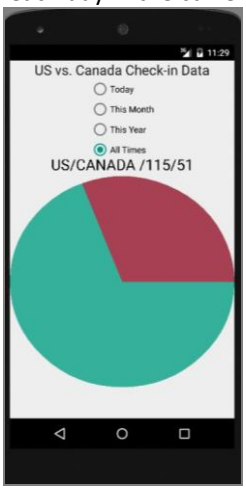

Fig. 4. The Result of Pie Chart Visualization

Fig. 5. The Result of Map and Column Chart Visualization

4. Discussion

The proposed visualization platform offers a clear understanding of the distribution of the visitors at a specific region. With the advance of mobile technology, by using this visualization platform, users can view the visitors' information at anywhere and anytime. There are some other visualization tools that can be used on mobile devices such as Google's visualization API. However, there are several limitations of the Google visualization API for mobile application technology. Among others, one of the limitations is the user's mobile device needs the installation of the library and JavaScript to utilize the features of Google Charts; another weakness is that the visualization data cannot be stored in the local device (offline use) in order to utilize the interactive features of Google Charts [1, 2] Further, data accuracy becomes a concern. Since the data are collected via social media, the information visualized only reflects the visitors who use social media during their visits. The actual number of visitors should be greater than the number visualized, because there are some other visitors who don't use the social media.

One research opportunity for social media data visualization is to create an interactive GIS-based visualization platform. Since this application can extract real-time information about the visitors, it can be applied in other research areas such as the monitoring of the disease outbreak, large public events, or even public security. The main research challenge for social media visualization on mobile device is how to improve the performance with the limitation of hardware resources. Therefore, better algorithms should be developed to improve the performance of the real-time big data process.

5. Conclusions

In this paper, we implemented a mobile-device based visualization platform for visualizing the visitors' information retrieved from the social media. The visualization offers individuals a big picture about how many visitors have visited a specific region during a given period of time. By applying the Google Map API, the map shows the location of visitors on the map.

This study has several policy implications. By extracting, distributing, visualizing the information from social media for a specific region, the administrative or local government can utilize this platform to view and analyze the visitors' interests so that they can develop strategies for further improvements. The visualization and analysis in regarding to this technology offer a great potential to assist the local government to specify a better policy to customize a specific tourist-oriented economy in the region.

This technology can be applied to various geographic locations. The result shows that the proposed platform 1) performs a satisfied data collection and data visualization on a mobile device, 2) assists users to understand the varieties of human behaviors while visiting a place, and 3) offers a feasible role in imaging immediate information from social media and leading to further policy-making in related areas and regions of interests.

It is suggested that future projects add new features to the visualization application such as 3D visualization. A cloud server and advanced visualization technologies are also suggested to the design of future models for retrieving and visualizing social media data.

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