

Information System for the Improvement of Telecommunication Service Quality

Elvis K. de Assis, Emmanuel Tavares, Demóstenes Z. Rodríguez, Renata L. Rosa

Universidade Federal de Lavras

Cid. Universitária, Lavras, MG, Brazil

eassis@sistemas.ufla.br, emmanuelcomp@gmail.com, {renata.rosa, demostenes.zegarra}@dcc.ufla.br

ABSTRACT

This work describes an information system regarding to the telecommunication service with the goal to inform to the telephony service users about the operators signal quality and the users' opinion about the telecommunication operators. The system contains information of cellular base station locations and the results are crossed with sentiment analyses of sentences extracted from a social network, which are related to the telecommunication services. The study aims to detect complaints and dissatisfaction of users about a determined service, helping to make a relation between the users' complains extracted from social network with the number of base stations in the same geographic area of the user's social network. Therefore, the proposed information system can be used by the National Telecommunications Agency of each country for monitoring the quality-of-service of cellular network operators.

CCS Concepts

- Information systems → Database management system engines
- Applied computing → Physical sciences and engineering.

General Terms

Measurement, Experimentation, Human Factors

Keywords

Telecommunication System, Quality of Services, Twitter, Social Networks, Sentiment Analysis.

1. INTRODUCTION

Information systems on telecommunications services are of great utility to the general public for the users of telephony services and also for the telecommunication operators. It is important to establish a relationship between the quality of a communication signal and the quantity and locations of the Base Stations (BS) [1] which are operating in a specific region. However, there are few studies about the quality monitoring of cell phone calls [2]-[4] that are accessible to users.

Currently, complaints about various types of services, not limited

to telecommunication, can be easily found on social networks, and such information serves as evidence of the poor quality that a user may be experiencing in his or her geographic location. Social networks serve as a rich repository of data, where the consumer shares his positive and negative experiences about products and services. Therefore, collecting this information is important for companies to know their strengths and weaknesses according to the consumer's vision.

Positive and negative points, to be extracted from a text, are not a trivial task [5], because it is necessary to analyze slang, icons that express emotions (emoticons) [6] and detect when a user is being ironic or sarcastic. The knowledge of the user's opinion can be done by the sentiment analysis applied in the sentences collected. Thus, one can know if the user is satisfied or dissatisfied about the object in question measuring the user's sentiments about a particular product or service. Monitoring and recommendation systems can make use of the sentiment analysis and can be used in several applications, from health to service communication. In the case of telephony service, current monitoring systems have information of quality indicators, but do not cross these indicators with the users' opinions in a certain geographic region.

Most of the current mobile devices have the Global Positioning System (GPS) application; then, the geographical region in which the user posts a text on social networks can be located at the exact moment of the posting. Certain repositories of quality indicators of telecommunication services indicate the geographical region of BS [7], but do not aggregate the user's opinion on the displayed indicators of the repository. In general, these repositories are administrated and updated by the National Telecommunications Agency of each country that requires the information from all the cellular network operators.

In this context, a system of sentiment analysis was developed to extract the complaints and other negative reports from users and consumers regarding to four telecommunication companies in Brazil, with the objective of filtering the data extracted from social networks. The main objects of each complaint, from the collected data, were selected and the sentences related to a poor signal quality or a bad quality-of-services were stored. Also, the geographic location of the user that posted a complaint was identified and saved. Then, the geographical regions that are related with complain are compared with the number of BSs found in the same geographical region. The sentences, which did not have the user geographical location, were discarded.

The system information which contains the indicators of cellular networks was developed by the National Telecommunications Agency from Brazil (ANATEL) and it contains the number of BS by geographic region, the history of 12 months of quality indicators, as well as the ranking of providers of mobile

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communications services over telecommunication companies. The system can be accessed by any user via a web browser, and it has the potential to be extended to other functionalities. In this work, we improve the information system provided by ANATEL by adding the main complaints according to each area and the companies, which provide communication services based on cellular network.

This paper presents an information system composed by ANATEL data regarding to cellular network parameters, the main users' dissatisfaction about telecommunication services in Brazil considering four cellular operators, and the main topic of each complaint together with the user geographic location extracted from a social network, Twitter. In the proposed work, the main topics of complaints are detected and results are available for the users and for the telecommunication companies and national regulatory agencies. Thus, the main contribution of this work is to develop an information system in which the user can access to the information related to the service quality of the telecommunication operator containing the topics of the main disclaims. Therefore, the proposed system helps users to decide for a determined operator based on its service quality in a specific region.

The remainder of the paper is organized as follows; Section 2 presents the theoretical review. Section 3 shows the methodology for integrating the quality indicators of the main operators in the region of Minas Gerais with social networks data. Section 4 presents the experimental results. Finally, Section 5 presents the final conclusions and future work of this study.

2. THEORETICAL REVIEW

Nowadays, mobile devices have a higher storage capacity than old equipment and they have been used for various purposes. The data stored from various applications on a smartphone cover from audio recordings, videos, texts and other information such as sensor data [7], for example. As cellular mobile devices are currently in widespread use, it is necessary to analyze the level of customer satisfaction with their devices and the telecommunication companies that provide customer services. Data collection work on telecommunication services is still scarce [8] [9], but has a great importance, since social media begin to offer a multitude of opportunities for mobile network operators to improve the quality of their services.

The information available on the Internet is diverse and data mining has become in a very useful tool for the best use of the available data. The sentiment analysis also has helping the task of data mining in the selection of positive, negative or neutral opinions.

Measuring the polarity of sentiments, in texts written by users of a service, is a common practice [10] and nowadays with the advent of social networks, it has become an even more viable practice. According to the sentiment analysis surveys, it is possible to use various techniques to evaluate the intensity of sentiments in a sentence. One of the techniques is by means of a dictionary of words, just like WordNet [10] formed by static words for the sentiment analysis, but it does not consider slang and emoticons. Other static dictionaries are the SentiStrength [11] and the Sentimeter-Br [12] that supports the Portuguese language - Brazil.

The ANATEL Mobile Service Application (App)¹ makes possible to verify the location of the base stations by geographical region; it also provide the information of quality indicators considering the last 12 months. Finally, this application indicates the ranking of providers of mobile communications services. To check if an user complaints could be related to the scarce presence of BS, sentences extracted from the social network that contained the geographic region were related to the information provided of the ANATEL App.

Currently, there are few works [13] that show an user information system containing the relationship between base stations and quality indicators and that still address the main user complaints according to their geographic region. In this work, a study of the quality of communication services in the region of Minas Gerais, Brazil, will be performed.

3. METHODOLOGY FOR INTEGRATING TELECOMMUNICATION SERVICES QUALITY INDICATORS WITH SOCIAL NETWORK DATA

The data provided by ANATEL App consider several indicators, such as, number of BS for operator and network type (2G, 3G and 4G), the rate of call drops for operator, and the information of data connection drops; but with the advent of social media it is possible to improve the system by inserting quality data of services based on the users' opinions extracted from social networks.

In this paper, the data extracted from ANATEL App are correlated with data extracted from a social network whose sentences contained dissatisfaction words, such as "dissatisfied", "horrible", "disrespect", "poor service", among others, and also the name of the Telecommunication Company was added in the search. The names of the four telecommunication companies are represented as X, Y, Z and W.

Figure 1 shows the methodology for integrating ANATEL App data with the social network.

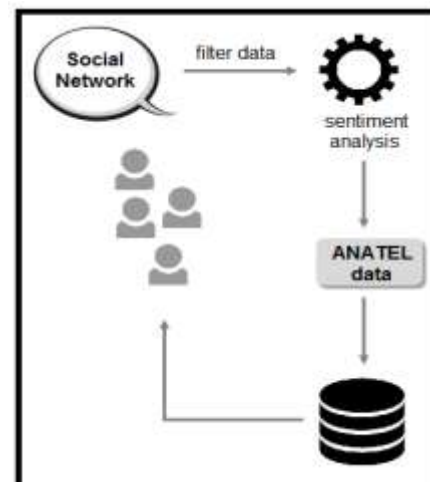


Figure 1. Methodology of data integration, forming the SI available to the user.

¹ ANATEL App. <http://gatewaysiec.anatel.gov.br/mobileanatel>.

The sentences were collected from the Twitter containing negative adjectives and the names of the cellular operators, later the sentences were analyzed by a script of sentiment analysis in order to filter only the negative sentences, and another filter containing the location of the cities of complaints to be searched, in the ANATEL App, to extract the quality indicators.

The data extracted from social network includes the user location, with the city of the states of Brazil, but for simplicity of the tests, it was considered only the cities of the Minas Gerais State. Posteriorly, the city extracted from the social network is searched in the ANATEL App for extraction of the quality indicators for each region. Subsequently, both the data of cellular network parameters and the data of the social networks were analyzed to determine if exist any relation.

4. EXPERIMENTAL RESULTS

It was collected 4,050 phrases from the social network Twitter, with the keywords "problem", "complaint", "horrible", and others, followed by the name of the telecom company. The collected

sentences were analyzed by a script in Python and Hypertext Preprocessor (PHP) language that quantify the final sentiment intensity of the sentences. The parameters extracted from social network are shown in Figure 2.

The sentences with neutral or positive polarity of sentiments were discarded, and considered only the sentences of negative polarity. In this way, the database to be stored was reduced and optimized for the scenario of capture of dissatisfaction and complaints.

Note that in the sentence presented in Figure 3, the user of the social network had a problem with the Internet in the region of Lavras - Minas Gerais (MG), Brazil. We related the results of the social network sentence containing the complaint with the results obtained from the ANATEL application, shown in Figure 3, which shows the base stations of the geographic region of the user, the Lavras city. In the Figure 3 each color of the circles represents a different telecommunication company, the red color represents a specific company, the yellow color represents another, and so on.



Figure 2. Sentence and parameters extracted from the social network.

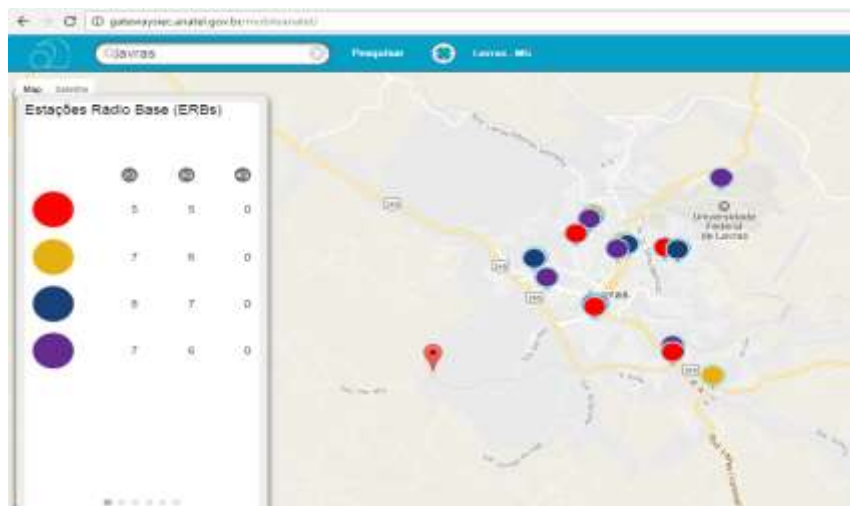


Figure 3. Distribution of Base Stations for each Cellular Operator working in the Lavras city according with the ANATEL App.

Through the ANATEL App results, it is possible to verify that many times when the user of the social network is dissatisfied with the weak signal of cellular is because the company bearing

the signal has few BSs in this region. These data are important to monitor the quality of services offered to users, as well to generate service negotiations [14] for the parameters extracted from the quality system.

Table I show the results related with disclaims about the telecommunication services, the names of the companies are represented by the letters X, Y, Z and W. The results show that disclaims are more related to weak signal, the others represent a lot of advertising messages and costs of call offered by the operator.

Results also showed that 70% of disclaims of social network users, in relation of his or her operator, are related to low quantity of BSs in his/her geographic region.

Table 1. Main disclaims about the telecommunication services offered by the four telecommunication companies

Company	Poor customer service	Weak signal	Others
X	31%	63%	6%
Y	39%	59%	2%
Z	29%	67%	4%
W	26%	70%	4%

5. FINAL CONCLUSIONS AND FUTURE WORKS

The results showed that 70% of the complaints are due to the low existence of BS in the user's region. For best results, it will be necessary to extract the neighborhood in which the user of the social network is situated, but unfortunately the parameter of social network of geographic location only show the city. The Mobile Service App uses the Google Maps location, which resolution is at the street level. It is important to note that ANATEL is providing relevant information for users, helping them to choose the best operator in a determined region.

As future work we intend to generate a message monitoring system that lists the main topics of dissatisfaction, for sending to the companies that offer such services, as well as can be sent to the telecommunication regulatory agency and the end user, notifying the number of BS of your carrier in his or her geographic location. It is also intended, to make a recommendation system for telecommunication service operators to be used by the marketing sector.

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