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Real-time Analysis of Citizens' Reactions to Election Campaign Scenes Using Inverse Order Tree and Smartphone Application

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Abstract. In this era of smart information and communications, the amount of data increases geometrically. Locating and analyzing data and their conditions real-time has emerged as an important factor for prompt data processing. In this study, an inverse order tree structure that inversely generates existing tree structures to help understand the local location and local features of big data was designed, and a mathematical model was completed. An experiment was performed with a smartphone application that analyzes and quantifies emotional data containing citizens' emotional reactions to the campaigning scenes of Gwangju Metropolitan City's mayoral election in Korea. In the experiment, the data collection agents quantified local emotional data for the campaign scenes of two leading mayoral candidates. Using the inverse order tree structure, we collected the data in real time, which were applied to one of the candidates' campaign. This study is very meaningful because for the first time, smartphones were used for analyzing the approval ratings of the candidates during electoral campaigning, and emotional data were quantified and analyzed.

Keywords: inverse order tree, local self-government, big data, real-time analysis, local data analysis, emotional data.

1 Introduction

Big data can generate important values for new economic growth, and the collection of small pieces of information contributes significantly to the creation of new cultural, economic, and social trends. In addition, the data on SNSs can be analyzed to find out how special interest groups spread content, the relationships between such interest groups, and influential figures and related fields within the special interest groups. [1]

As in the case of text mining—extracting a vast amount of information and understanding the relationship between one set of information and another—and opinion mining, by identifying preferences including positive, negative, and neutral, we can group the objects observed on Facebook or Twitter and use them effectively to forecast the future. [2][3][4][5][6]

Therefore, the purpose of this study is to design a real-time search structure eliminating the process of data collection for big data. A data search method collects

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all data, searches for any matches from the first clause to the last clause, and extracts every piece of data that matches. Our inverse order tree structure was designed to construct, in an inverse order, a structure where the highest-level module is based on its lower-level modules. In such a tree, the search time reduces geometrically, and because the sums of the data from the lower modules determine the components of the upper modules, searching real-time in the lower modules is possible using the upper modules

2 Inverse Order Tree

The inverse order ten-digit tree, as shown in Figure 1, has ten components per module. The distance to reach the data in the lowest modules from the highest module is 10 from any direction, which indicates that the distance from the highest module to the lowest module decreases geometrically as the depth increases. For a ten-deep tree structure, the number of the lowest-level modules is 10^{10}; however, the search time elapsing from the highest-level module to the lowest-level module is $\log 10^{10} = 10$, indicating its exponent-dependency.

The movement of the components of each module is expressed as the sums of the components of the lower modules. In Figure 1, the sum of the components of the $\mathbf{x_{30}}$ modules of the lowest-level modules is $\sum_{k=0}^{9} \mathbf{x_{30}}k$, which state-transitions to the first component of $\mathbf{x_{20}}$. Further, the second and the tenth components of the $\mathbf{x_{20}}$ module are state-transitioned to the sums of the $\mathbf{x_{31}}$ and the $\mathbf{x_{39}}$ components, respectively.

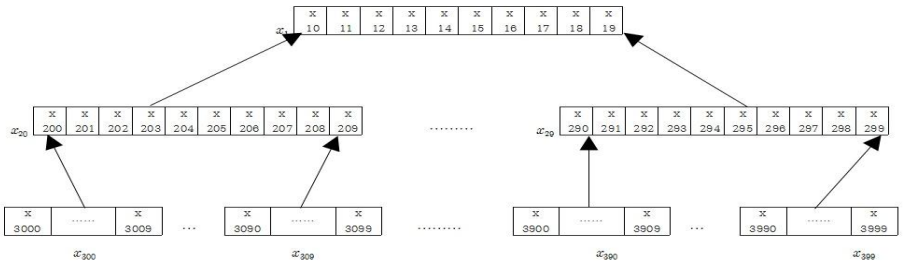

Figure 1. Three-deep ten-digit tree

Then, the sum of $\mathbf{x_{20}}$ is state-transitioned to the first component of $\mathbf{x_1}$. That is, the depth from $\mathbf{x_{30}}$, the lowest-level module, to $\mathbf{x_1}$, the highest module, is 3, and therefore, the distance for searching from the top module to the lowest module was 3.

3 Experiment

A smartphone survey was conducted on citizens' preferences for Gwangju Metropolitan City's mayoral candidates as a part of the National Local Elections of 2014.

On the top nodes of the tree structure are the two most popular and leading mayoral candidates—Kang Wun-Tae and Yun Jang-Hyeon, and the tree was segmented by *gu* and electoral district. The lowest-level nodes contain the areas of their campaigns and the emotional data of these areas.

The tree was a three-deep structure with two additional nodes on the uppermost level. Each sub-structure was given a count of status per sub-electoral district, which was provided by the National Election Commission, and the number of the lowest-level nodes for the data was dependent on a total of eight factors consisting of four minus and four plus factors in order to calculate the approval ratings of the candidates.

The program was Android-based. Hui Company was the appointed developer of the smartphone application (app). The smartphones used in the experiment for the data collection and the survey were Samsung Galaxy S4 and S2, respectively.

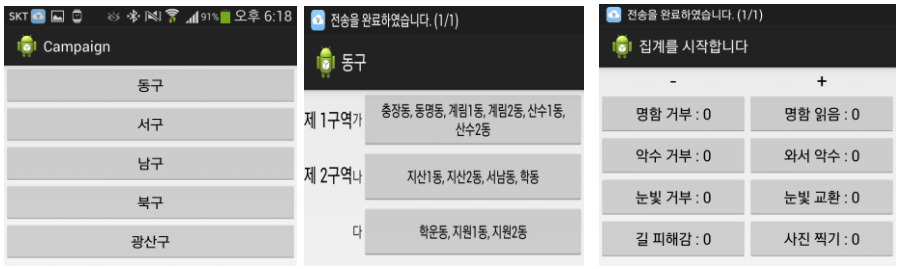

Fig. 2. Application screen for data collection for campaign scenes

As shown in Table 1, the average approval rating excluding the marginal data for Yun Jang-Hyeon was 64.81% and for Kang Wun-Tae was 26.47%. The actual election results dated June 4 were 57.85% for Yun, 31.77% for Kang, and 10.38% for the others.

Table 1. Daily status of the emotional data collection

		May 30		May 31		June 1		June 2		June 3	
		-	+	-	+	-	+	-	+	-	+
Yun Jang-Hyeon		84	149		62	61	343	90	157	480	668
	Approval ratings	63.94%		100%		84.99%		63.56%		58.19%	
Kang Wun-Tae		29	3	135	33	154	80			43	14
	Approval ratings	9.38%		19.64%		34.19%				24.56%	

The collected data were shared real-time with Yun's media team, and the real-time on-site reactions and the opposition candidate's reactions were applied to the media team's campaigning and in part to the campaign plan.

4 Conclusion

As reviewed in Section 3, the reactions that were applied with the emotional factors in the lowest-level nodes were four minus factors [Business card reading, Handshake rejection, Eye-contact avoidance, and Sidestepping] and four plus factors [Business card reading, Handshake, Eye-contact, and Photo-taking]. Each component (factor) occurred real-time and was accumulated to the upper node whenever a data collection agent confirmed it, and a real-time addition to the highest-level node occurred through the inverse order tree structure. The campaign managers utilized the citizens' reactions for decision-making and an immediate execution without collecting and analyzing data. The campaign managers verified a large volume of real-time regional reactions—the sums of the plus and minus factors from the highest-level and the next highest-level modules—and to identify exceptional signs and seek a cooperation, which provided real and real-time information on the election campaign and the citizens' reactions, thereby affecting the election result to a considerable extent.

With the contributions of other researchers and the enhancement of the proposed inverse order tree, it can be applied not only to big data but also to medicine, weather forecast, security, virus breakouts, and many more areas.

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