Glyphs in Matrix Representation of Graphs for Displaying Soccer Games Results

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Abstract—Soccer is a popular game in many countries. Aiming at showing information about soccer teams performance along competitions several sites publish match statistics. Although those sites gather a lot of informtion, they in general present them in a table format, with little usage of graphics, making analysis harder for users. This work has a twofold goal: to propose an alternative for the visualization of varied attributes associated to the edges of a graph that represents a soccer competition and, also in such alternative, to provide an overview of the teams' results in all matches. The paper presents the proposed visualization technique with details regarding glyphs design and usage. Examples with data from a large competition is used to show preliminary results.

Index Terms—Information visualization, sports visualization, glyphs, soccer.

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INTRODUCTION

Soccer is a popular game in many countries. Important competitions like "Copa Libertadores da América" and "Euro Cup" bring together the main international clubs. Some countries, like Brazil, Spain and England, among others, hold competitions that involve a significant amount of clubs distributed in varied divisions. With the aim of showing information about clubs performance at competitions, numerous sites publish matches statistics. Sport Stats [21], a site that conveys statistics about sports in general, has a section dedicated to soccer. Another site called Soccer STATS [22] exhibits statistics of varied championships around the world. Although those sites gather a lot of information about teams' performance, they in general present them in a table format with little usage of graphics, making harder the analysis by users.

In Brazil, where soccer is considered a national passion, a big space in media is dedicated to that sports news. People interested in soccer and, specially, sports journalists utilize that information to base their commentaries and debates. The globosport.com site [23] publishes stats about matches of the main Brazilian championships, presenting part of the information using graphics. The graphics are based on bar and line plots that show clubs and players performance. But those graphics only show individual performance without providing an overview of information about past matches.

Information visualization aims at presenting abstract data in graphical format so the user can use his visual perception to assess them [5]. An interactive graphical representation offers to the user the skill of not only getting a clear and understandable presentation but also to modify it, in order to allow the highlighting of interesting aspects. Information visualization systems must provide the user with interaction mechanisms with at least zooming and filtering, allowing getting details on demand from an overview of a big amount of data [17].

A soccer championship can be modeled as a graph in which the nodes represent teams and edges represent matches. Championships where teams play one against another as locals and visitors generate dense graphs that can be represented properly by means of adjacencies matrixes [7].

This work has a twofold objective: to propose an alternative for the visualization of varied attributes associated to the edges of a graph that represents a soccer competition and, also in such alternative, to provide an overview of the results obtained by the teams in all the matches.

For achieving such objectives, we adopted a matrix representation in which glyphs [3], located in each cell, map the various matches' attributes.

The paper is organized as follows. Section 1 presents a brief review of related work on information visualization of sportive events. Section 2 describes the proposed technique implemented in an application named Soccer Matches. Finally, some conclusions and future works are drawn in the last section.

1 RELATED WORK

Although numerous information visualization systems have been applied to several areas, little research has been made in sports data visualization. However, specific types of sportive competitions have attracted some visualization designers and developer in the last years. Some systems as Table Lens [14] show stats data having sports as a case study. Techniques as TreeMaps [11] also have been applied for the visualization of some sports. Turo [20], for example, utilizes it to exhibit stats about basketball players of NBA. Tennis Viewer [9][10], an application built specifically for information visualization of sports, utilizes Tree-Maps to display the hierarchy of points in tennis matches. It adopts the MagicLens [2] technique to allow the exploration of lower layers of the structure and animation so that users can visualize the modifications that occur in data along the match. It also utilizes an iconic representation of the tennis court, in which the drawing of an arrow is used to map the ball traces. SportsVis [6], a system developed for data visualization related to baseball games, also utilizes a TreeMap. It has been used to display the efficiency of each player taking into account the time of participation in matches. The system has also a baseline bar display for representing several data about the matches as, for example, result (win, defeat), place (home, away) and scoreboard, which are mapped to visual attributes as color and length.

In MatchPad [12], a glyph-based visualization is used to aid the notational analysis process. Events recorded along a Rugby match and represented in the form of glyphs are associated to a video for later analysis of the players and team performance. AdaptiviTree [19] was created as an alternative form for the visualization of tournaments' results, in which competitors or teams that are defeated are eliminated, and only winners go to the next phase until only the champion is left. It uses a more compact representation than the traditional approach, making it possible to show the same information in half of the space.

CourtVision [8] was created with the aim of quantifying and communicating the performance of the basketball players' shots. The application displays part of the court around the basket and utilizes rectangles allotted to the shots position in order to represent attempts. The size of each rectangle maps the amount of attempts and the color

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the obtained points. Being so, it is possible to visualize positions with more frequent shots and position efficacy. SnapShot [13] presents a technique called Radial Heat Map, with a similar approach as used in CourtVision in order to exhibit information about goal shots in ice hockey. The shoots distances are visualized through a series of colored concentric rings drawn around the goal framework. The shoots frequencies in each ring are indicated by the use of a color scale.

1.1 Soccer Visualization

Some applications dedicated to data visualization related to soccer have also been proposed. The Attribute Explorer [18] system was extended to allow the analysis of events in soccer matches [1]. It shows histograms in multiple coordinated views allowing that restrictions applied to the data displayed in a diagram could reflect in others. It also has a visualization of events that aggregates information about localization, for example, a pass execution. Small circles are displayed in a representation of a soccer field to mark the player position at the moment of the pass.

Soccer Scoop [15] is a system designed to display stats about soccer matches. One of its visualizations (Field Viewer) shows graphic information about players' performance in an area resembling a soccer field. Among the information shown, there are shots accuracy and other attributes as speed, easiness, coordination and fluency. A second visualization (Player Viewer) allows comparing the performance of two players. In order to map the attributes, it employs a graphical representation of a player with specific parts filled in with a color that encode the performance. For example, the head represents head balls and legs represent shoots. In another work, Rusu et al. [16] extends Soccer Scoop to include a specific representation for comparing goalkeepers' performance.

2 SOCCER MATCHES

Soccer Matches is an application designed to offer to a general audience a view of the many attributes associated to the matches occurred in a soccer championship. In this first version we choose two sets of attributes to be visualized. The first set is composed of matches' results (win, loss, draw), amount of goals of each team, and the difference of goals pro the winner team. The second set is formed by several statistics generated for each team, as for an example: amount of faults, attempts, offside, among others. Next, we will present the main characteristics of the application using as an example data from the 2013 Brazilian league series A.

2.1 Brazilian league series A

The Brazilian league series A is formed by 20 teams with home and away matches. With 38 matches for each team, the total number of matches is 380. There are 38 rounds with 10 matches each. Points are scored in each match (3 for winning, 1 for a tied match, 0 for loosing), the champion being the team that sums up the most of points. Besides the champion title, the competition gives a prize to the three top teams: participation in a championship with the best teams of Latin America, called "Libertadores da América". The fourth team gets an opportunity of taking part in the qualifying phase of that competition. The last four teams are punished by "falling" to the B division in the following year.

2.2 Visual representation

The proposed visualization uses adjacency matrix representation to display the data related to the matches. It adopts a similar approach used by Brades and Nick [4], which exhibits a glyph in each cell to show evolution in time of edges associated data. In SoccerMatches the glyphs are used to map matches attributes. The system is composed by a main area that exhibits an overview of the matches results in a championship (Figure 1a) and two others that display a stacked bar chart with results stats of each round (Figure 1b) and the frequency of each result (Figure 1c).
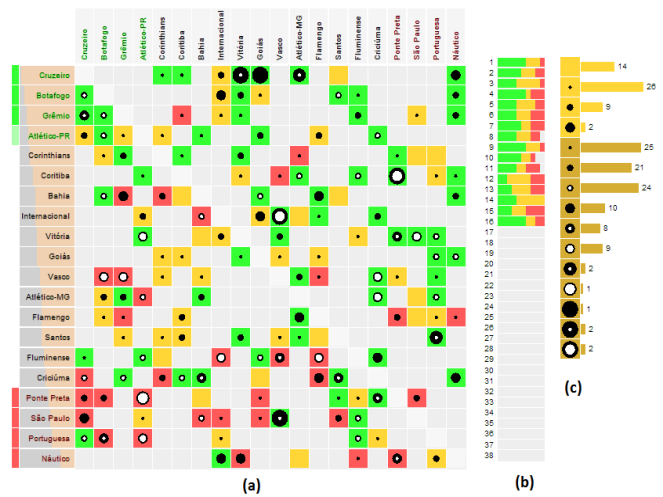

Fig. 1. SoccerMatches components

In the overview area (Figure 1a) the team names are in the rows and columns of the matrix. The names in the rows, displayed in horizontal direction, refer to the *home* teams, i.e., in whose stadium the matches occurred. The names in columns, displayed in the vertical direction, refer to *away* teams that played in the adversary stadium. At the left of the home teams small rectangles indicate the status of the team in relation to the "Libertadores da América" competition and also in relation to the passage to the lower division. The three green rectangles indicate the guarantee of participation in that championship and the lighter green ones the dispute of qualify. Light red rectangles mean that the team is a current candidate to go to a lower division.

Those names can be sorted by varied criteria selected by the user as for an example descendent order of points and amount of goals among others. A bar chart displayed over the team names shows the relationship between the attributes values used as sorting criteria. When user changes the sorting criteria, the transition in the representation is performed with animation in order to minimize user disorientation.

The background color used in each cell represents a not-occurred match or its result. The gray color represents a not-occurred match and the green, yellow and red represents respectively win, draw, loss. The team to which the presented result is referred depends on user selection (home or away), indicated by a dark grey background in the teams names. In Figure 1, for example, the home teams were selected (teams names in dark grey rows). Thus, results must be read in the horizontal direction. Figure 2 exemplifies the two situations.
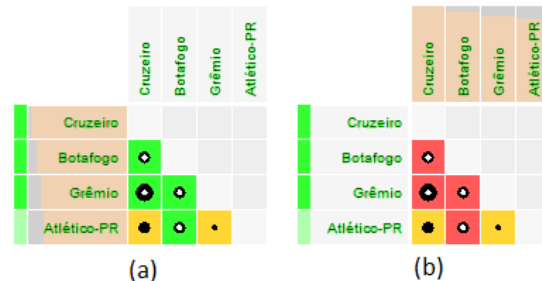

Fig. 2. Home (a) and away (b) teams

Considering the selection of home teams (Figure 2a) one can detect that Grêmio has defeated at home both Botafogo and Cruzeiro. But when away teams are selected (Figure 2b), reading in vertical direction, it can be noted that Grêmio as away team has drawn with Atlético-PR, and Botafogo and Cruzeiro were beaten by Grêmio as an away team.

The glyphs presented in Figure 2 are used to map three pieces of information: (1) amount of goals by winner teams, (2) amount of goals by loser teams and (3) difference between the amount of goals scored by both teams. The glyph is formed of two concentric circles. The outer circle, drawn in black, represents the amount of scored goals by winner teams and the inner one drawn in white color represents the amount of goals of the loser teams. A ring inside the two circles indicates the goals difference. The diameter of each circle is proportional to the amount of goals that it represents and its length is normalized taking into account all the goals scored along all the championship. When the amount of goals is zero, the circle is not drawn.

Figure 3 illustrates this proposal with some examples. From left to right many matches results are represented: 0x0, 2x2, 2x0, 1x2 and 5x3. It can be noted that for results like 2x0 and 2x2 the same glyphs are used, with the display of only one circle, taking into account that the absence of goals are not marked and equal amounts of goals generate circles with the same diameter. In that case, the background color of each rectangle (win, loss, draw) is used to differentiate the two results.

Fig. 3. Results codification

The area shown in Figure 1b exhibits stats about the results distributed by rounds. We use several stacked bar charts drawn in the horizontal direction representing each round. Numbers positioned at the left of each plot identify each round. The colors, similarly to the cells of the matrix, indicate win (green), draw (yellow) or defeat (red) taking into account the type of team selected (home or away). In Figure 1b, for example, one can perceive that in round 14 no home team was defeated. The areas in grey indicate rounds still not occurred (16 to 38) or postponed matches (rounds 8, 10 and 11). The length of bars that form each stacked bar chart are proportional to the amount of matches that end up with each one of the possible results (win, defeat or draw).

As mentioned before, Figure 1c shows the frequency of each score obtained taking into account the matches played in the championship. The yellow rectangles represent draws and the light brown ones represent results with a win regardless of being home or away team. Each result is identified by the appropriate glyph and the respective numeric value can be obtained by the activation of the correspondent tooltip (Figure 4). The frequency is represented by means of a horizontal bar with length proportional to the frequency of each result. Figure 4 shows an example where scores 5x1 and 5x3 occurred two times each.

Fig. 4. Results Tooltip

In Figure 5, the glyphs representing the amount of goals scored in each match were replaced by others, which map a larger number of attributes. Each bar is constituted by two segments that represent the value of a specific attribute for each team taking part in the match. The black segment (left) refers to the attribute of the home team and the white one (right), of the away team. The length of each bar is proportional to the value of the attribute that it represents. The user can choose which attributes to visualize. In Figure 5, the following attributes were represented: wrong passes, faults, and offsides.
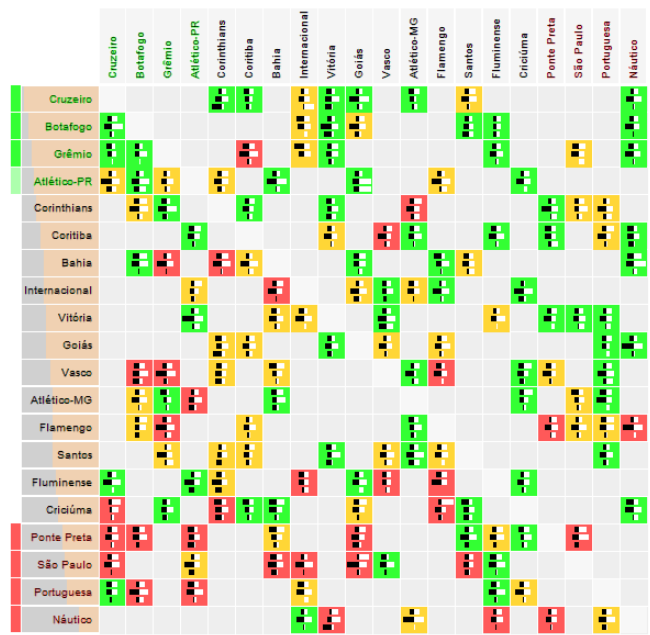

Fig. 5. Representing stats data for the two teams in their matches.

2.3 Interaction

Beyond allowing for sorting the teams by several criteria as mentioned in section 2.2, the application provides the user with a function for highlighting specific glyphs by selecting the rounds stats bar or in the results frequency. When a round is selected, the cells that exhibit data of matches that do not belong to it are displayed with a background filled with 7% of opacity in order to highlight the other ones (Figure 6).
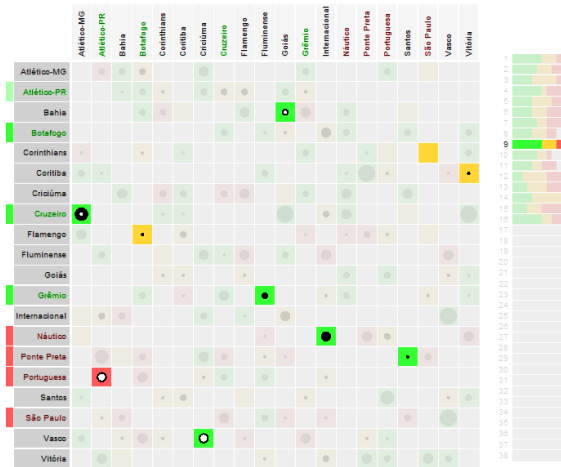

Fig. 6. Teams in alphabetical order with the selection of round 9

Tooltips that show the round number; match result; names and symbols of the teams are also included (Figure 7).

Fig. 7. Tooltip showing details about a soccer match.

3 CONCLUSION AND FUTURE WORK

In this work we presented a technique for the visualization of data associated to edges of dense graphs that represent attributes of matches already played in a soccer championship. We adopted a matrix representation, in which glyphs located in each cell map several attributes. That strategy provides users with an overview of the results, from which they can start a phase of exploration of the whole data set. The examples shown herein were obtained with data collected from the first 16 rounds of the Brazilian league series A, 2013 edition. In soccer there is the hypothesis that the home team has an advantage over the adversary. That hypothesis can be confirmed through the analysis of the overview presented in Figure 1, in which it is easily perceived that most part of the home teams were not defeated in the games. Due to this is an on going work we have not performed yet evaluation with users, which is the next step for validating our proposal.

In the next phases of this work we intend to explore the temporal aspects related to the teams and their players, as for example, the players and teams performance evolution along the championship phases. The visualization of the events in each match, for example, goals, cards, substitutions, among others, will also be investigated.

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